Session 2

DISCRETIONARY POLICY AND FISCAL IMPACT

REAL-TIME DETERMINANTS OF FISCAL POLICIES IN THE EURO AREA: FISCAL RULES, CYCLICAL CONDITIONS AND ELECTIONS

Roberto Golinelli[*] *and Sandro Momigliano*[**]

*We examine the impact of four factors on the fiscal policies of the euro-area countries over the last two decades: the state of public finances, the European fiscal rules, cyclical conditions and general elections. We rely on information actually available to policy-makers at the time of budgeting in constructing our explanatory variables. Our estimates indicate that policies have reacted to the state of public finances in a stabilizing manner. The European rules have significantly affected the behaviour of countries with excessive deficits. Apart from these cases, the rules appear to have reaffirmed existing preferences. We find a relatively large symmetrical counter-cyclical reaction of fiscal policy and strong evidence of a political budget cycle. The electoral manipulation of fiscal policy, however, occurs only if the macroeconomic context is favourable. The estimates are robust to alternative measures of the dependent variable and of the regressors. Many of our results do not carry over when we use the latest available (*ex post*) information for our regressors or when we apply the same model to a group of 8 OECD countries outside the area.*

1. Introduction[1]

Over the last decade, a large body of literature has analysed the characteristics of fiscal policies in the OECD countries (e.g. Bohn, 1998; Melitz, 2000; European Commission, 2001; Ballabriga and Martinez-Mongay, 2002; Buti, 2002 and IMF, 2004). In this paper we contribute to this area of research in three respects.

First, we use the same model to analyse the role of the following four factors: (i) the initial state of public finances, (ii) the European fiscal rules, (iii) cyclical conditions and (iv) the political budget cycle. Previous studies have often focused on one specific factor, adding a number of control variables that are often not fully discussed. By including all four factors and by carefully specifying them, we hope to avoid the risk of biased estimates arising from omitted variables. Moreover, we explicitly derive our model from a very general one, checking the restrictions that we impose on it.

---

[*] University of Bologna, Department of Economics.

[**] Bank of Italy, Economic Research Department.

[1] The paper greatly benefited from the hospitality of the Burch Center, UCA Berkeley, extended to one of the authors and the many conversations he had with Alan Auerbach. A preliminary version of the paper was presented at the 8th Banca d'Italia Workshop on Public Finance (Perugia, 30 March-1 April 2006). We wish to thank Matthias Mohr for helping us in the application of the statistical filter proposed in Mohr (2005 and 2006), Riccardo Rovelli and the participants in the Workshop, in particular Cláudia Braz, for very useful comments. The opinions expressed do not necessarily reflect those of Banca d'Italia.

Second, we focus on the euro-area countries, whereas many studies include all OECD countries for which data are available. We show that the fiscal policies in the euro area are relatively homogeneous, while this is not true for our full sample of OECD countries.

Finally, unlike most studies, this one explains fiscal policies largely on the basis of the information actually available at the time budgetary decisions were taken and not on the basis of the latest available (*ex post*) data. A few recent papers have taken the same direction, controlling for errors in forecasting when assessing the response of fiscal policy to cyclical conditions and elections (Larch and Salto, 2003; Buti and Vand den Noord, 2003 and 2004; Mink and De Haan, 2005). However, cyclical conditions are still measured on the basis of *ex post* data. Forni and Momigliano (2004) assess the budgetary reaction to cyclical conditions over the last decade in the euro area and in the OECD countries on the basis of both real-time and *ex post* estimates of output gaps. They show that the use of *ex post* data may significantly bias the estimates. Here, we also use real-time data for the general government balance, given that in some countries (in particular, Greece) significant revisions have occurred in the sample period. Furthermore, we include election dummies among the regressors and extend the period of analysis to the years before Maastricht, which allows us to discuss the role played by the European rules.

The rest of the paper is structured as follows. In Section 2 we discuss the specification of the fiscal rule we estimate. In Section 3 we describe the data set used in our analysis, focusing largely on the construction of the real-time estimates of cyclical conditions. In Section 4 we analyse our main results and present some robustness exercises. In Sections 5-7, respectively, we discuss in detail the impact on fiscal policies of the state of public finances and the European fiscal rules, the cyclical conditions and the position in the electoral cycle. In Section 8 we examine how our estimates change if we use *ex post* instead of real-time data. Section 9 concludes. In Appendix 1 we show how we derive our base model, which implies the estimation of 25 parameters (of which 19 are time dummies), from a general specification with 91 parameters. In Appendix 2 we present additional tests of the robustness of our results.

2. Model specification and statistical validation

As in a number of studies (e.g. European Commission, 2001; Auerbach, 2002; Cohen and Follette, 2003; Galí and Perotti, 2003; Taylor, 2000),[2] we estimate a fiscal rule in which the discretionary fiscal action, measured by the change in the

[2] Some authors, among which Galí and Perotti (2003), use as dependent variable the level of the CAPB, instead of its change. In principle, if we had included, as those authors do, the lagged level of the dependent variable among the regressors, the two specifications would be equivalent (giving the same estimates for all coefficients except for that of the lagged dependent variable, for which our estimates would be equal to those of the other specification plus 1). In fact, we use among the regressors the primary balance not adjusted for the cycle, so that there is not a strict correspondence between the two specifications.

cyclically-adjusted primary balance,[3] is explained by the cyclical conditions (measured by the output gap) and the state of public finances (measured by the primary balance and the debt of the general government). In addition, we include two explanatory variables meant to capture the electoral cycle and one meant to capture the impact of the European fiscal rules on the behaviour of countries that were in an excessive deficit position.

As for the latter regressor, we basically follow Forni and Momigliano (2004) in introducing a regressor, m_{it} (also referred to as the Maastricht variable) which defines a *benchmark* correction of the primary balance which is a function of the excessive deficit, the number of years in which the latter needs to be eliminated and the expected contribution from interest payments (see Box 1).[4]

Box 1

Modelling the European fiscal rules

When modelling the European fiscal rules, as defined by the Maastricht Treaty and the Stability and Growth Pact, we focus only on the requirement to correct the deficit when it exceeds the 3 per cent of GDP threshold. In particular, we do not include an explicit rule for the medium-term target of a "close to balance or in surplus budgetary position" (introduced by the Stability Pact in 1997) for two reasons. First, meeting the target is not supported by any formal sanction and it rests largely on the country's willingness to comply. Second, the rule is not fully defined (and the same applies to the "medium-term targets" differentiated across countries in the new version of the Pact introduced in 2005).(1) As a matter of fact, the reactions to the initial conditions that we find in operation, at least since 1988, are broadly consistent with meeting the medium-term targets.

The Maastricht variable m_{it} is set equal to zero in the years before 1992 or if the deficit is below the 3 per cent threshold. For the years 1992-96, m_{it} is equal to the difference between the deficit and 3 per cent of GDP, divided by the number of years leading up to 1997(2) and then reduced by the expected change in interest expenditure in the following year.

---

3 We are aware that the change in CAPB gauges with some error the discretionary actions taken by the fiscal authorities but, in our opinion, there is no alternative proposed in the literature that is clearly preferable.

4 We differ from the proposal in Forni and Momigliano (2004) essentially in two respects. First, when computing the needed correction of the primary deficit, we subtract the expected change in interest payments. We do so because, especially for the years 1992-96, for some countries the contribution to the consolidation coming from the fall in interest rates was large and could be forecast with a significant precision. Second, as a result of specific tests (see Appendix 1), when the Maastricht variable is different from zero, we exclude all the other explanatory variables from the fiscal rule.

Formally:

$$m_{it} = [\ (ob_{it} - (-3\%)) \ /\ [1998 - (t{+}1)]\ ] - \Delta\, in_{it+1}$$

where Δ is the first-difference operator, all variables are defined as a ratio to GDP; ob is the overall balance (a negative value corresponds to a deficit) and in is the interest payment, subscripts i and t refer, respectively, to the individual countries and to the year. The formula implies a reduction of the excessive deficit (*i.e.* above the 3 per cent threshold) inversely proportional to the number of years leading up to 1997 and net of the contribution expected from interest payments. After 1996, the provisions of the Stability and Growth Pact (in principle, also of its 2005 version) require countries to correct an excessive deficit in the year after its official recognition, which usually occurs with a one-year lag. Therefore, in the first year that an excessive deficit occurs, we substitute in the denominator of the formula the constant 2 to the expression [1998 – (t + 1)]. If the excessive deficit persists, m_{it} equals the full difference with respect to the threshold, net of the expected contribution from interest payments.

Throughout the period 1992-2006, if the expected reduction in interest expenditure is larger than the correction required in $t + 1$ for the overall balance, m_{it} is set to zero. Therefore m_{it} takes either a negative sign or is equal to zero.

---

(1) The reform of the Growth and Stability Pact, endorsed by Ecofin in April 2005, is based on two new European Council Regulations: Council Regulation 1055/2005, amending Council Regulation 1466/97, and Council Regulation 1056/2005, amending Council Regulation 1467/97.

(2) Participation in the Monetary Union required achieving a deficit smaller than 3 per cent of GDP in 1997. For Greece, the reference period is extended up to 1998, the year in which the country qualified for entering the Union.

Our base fiscal rule (hereinafter, base model) is the result of a process of reduction from a very general specification, in which it is nested. In the process, all the restrictions that we impose are validated by statistical tests, which indicate that the restricted model does not entail a loss of relevant information (the procedure followed and the test results are reported in Appendix 1).

The general unrestricted model (GUM), in addition to the six policy parameters mentioned above, allows for: (i) fixed country and time effects, (ii) different parameters for the Maastricht variable for the period 1993-97 and for the period 1998-2006, and (iii) five dummy variables for Germany for the years 1990-94, meant to control for the unification process. Moreover, the GUM allows for different values for the set of parameters (including country and time effects) depending on whether a country is or is not in a situation of excessive deficit (more precisely, on whether our Maastricht variable is negative or equal to zero) and on whether the output gap is positive or negative. In principle, this specification requires the estimation of four sets of parameters, depending on the sign of the output gap and of the Maastricht variable. However, when the latter differs from zero output gaps are always negative and this reduces the number of sets to three. The absence of observations for other intersections of states further reduces the number of country and time effects parameters to be estimated. Overall, the GUM has 91 parameters, including 31 individual effects and 38 time effects.

The base model resulting from the above-mentioned process of reduction from the GUM includes 25 parameters, 19 of which are time dummies. A particularly noteworthy result is represented by the elimination of the fixed effects, *i.e.* the systematic effects related to individual countries. Contrary to previous studies, we find that they are not statistically significant, indicating that fiscal policies in the euro area tend to be relatively homogeneous, once their main determinants are taken into account.[5]

The base model is represented by two equations, which apply depending on whether the Maastricht variable is negative or equal to zero.

If the Maastricht variable is equal to zero (*i.e.*, either the year preceeds 1992 or the deficit does not exceed the threshold or the required correction in $t+1$ of the overall balance is less than the expected contribution from interest expenditure) the specification of the fiscal rule is:

$$\Delta capb_{it} = \phi_{pb} pb_{it-1} + \phi_d d_{it-1} + \phi_x x_{it-1} + \phi^p{}_{e1} e^p_{it} + \phi^p{}_{e2} e^p_{it+1} + u_{it} \qquad \text{(1a)}$$

where all the variables except the dummies for elections are defined as a ratio to GDP, $capb$ is the cyclically-adjusted primary budget balance (a negative sign indicates a deficit), pb is the primary balance, d is the debt level, x is the output gap, e^p is a dummy variable equal to 1 in the year of regular elections (defined as those held at the end of a full term) if the output gap is positive when budgetary decisions are taken, and subscripts i and t refer, respectively, to the individual countries and to the year. Finally, the error-term u embodies time effect λ_t and random ε_{it} unobservable components.

The coefficients ϕ_{pb} and ϕ_d gauge the impact on fiscal policies of the state of public finances at the time budgetary decisions are taken ($t-1$): a negative value of ϕ_{pb} and a positive value of ϕ_d indicate that the higher the initial levels of debt and deficit, the greater the tightening of fiscal policy.

The coefficient ϕ_x (positive if policies are countercyclical) captures the response of budgetary actions to *current* cyclical conditions, *i.e.* the cyclical conditions of the year in which budgetary decisions are taken (t–1). The variable x_{t-1} is a plausible alternative to x_t, as Galí and Perotti (2003) also recognize, given the inertia and

[5] A full proof of this claim, obviously, would require formally testing for poolability with respect to individual countries. This is not possible, as the number of observations is too limited.

complexity of the decision-making process. Moreover, the values of output gaps are highly persistent, so that the two choices lead to similar results, as shown in Forni and Momigliano (2004).[6] We have also estimated our base model with x_t instead of x_{t-1} (Appendix 2) without significant differences in the results. The two parameters $\phi^p{}_{e1}$ and $\phi^p{}_{e2}$ measure the effects of regular general elections, provided that the output gap is positive, in the year in which they are held and in the previous year, respectively. If the sign of these parameters is negative, it implies that, *ceteris paribus*, the fiscal stance loosens in the presence of elections. In the tests performed on the general unrestricted model, of all the parameters only the reactions to elections is found to be statistically different depending on the output gap being positive or negative. As the value of the election parameters in case of adverse economic conditions is not significantly different from zero (Tables 3 and 8), we exclude the corresponding regressors from our base model. In Section 7 we explore some alternative specifications for the electoral variables which take into account the month, or the quarter, in which elections are held.

As for the distinction between the countries having and not having an excessive deficit, the tests performed on the general unrestricted model indicate a significant difference in all the relevant policy parameters (Table 8). If the Maastricht variable differs from zero (*i.e.* if it is necessary to correct the primary balance in order to eliminate the excessive overall deficit), all the other explanatory variables in our model are not statistically significant and can be excluded from the model without loss of relevant information.[7] Therefore, if m_{it} differs from zero our base specification of the fiscal rule is:

$$\Delta capb_{it} = \phi_m m_{it-1} + \varepsilon_{it} \tag{1b}$$

A value of -1 for ϕ_m would suggest that policymakers strictly followed the proportional correction formula shown in Box 1.

Throughout the paper we usually report results for both our base model and a specification in which equation (1a) is applied to all the observations (hereinafter, Eq. (1a) model). In our view, the base model has the advantage of avoiding possible misspecification problems, as the data indicate that countries with an excessive deficit significantly modified their policies. On the other hand, the Eq. (1a) model does not have the shortcoming of including a somewhat *ad hoc* regressor, such as the Maastrich variable. In all cases, the two models give the same indications.

---

6 We prefer using $xt-1$ instead of xt largely for statistical reasons. First, the latter requires the recourse to instrumental variables, as the output gap is affected by fiscal policy, which opens up to a number of equally acceptable alternatives, with a potential indeterminacy on the results. Second, our estimates of the output gap in real time are less subject to a possible end-point bias in the case of $xt-1$ rather than in the case of xt (see Section 3).

7 These results confirm and extend those of van den Noord (2002), who finds that the euro-area countries that needed to consolidate their public finances tended to neglect the stabilization function.

3. The data

The full sample covers 19 OECD countries, including 11 countries of the euro area (only Luxembourg is excluded for lack of data), 3 other European countries (the United Kingdom, Sweden and Denmark) and 5 non-European countries (the United States, Japan, Canada, Australia and New Zealand).[8] All the economic variables are from OECD publications (except in some of the exercises which test for robustness). The data set on elections (reported in Table 6) is constructed using the data base of the International Institute for Democracy and Electoral Assistance (IDEA) and the information available in www.electionguide.org, integrated and checked with Routledge (2005).

Our dependent variable ($\Delta capb$) is, for each country, the currently available estimate published by the OECD (from the OECD December 2005 Economic Outlook, hereinafter EO). We use the latest vintage of data because they represent, by definition, the most precise assessment of the variable throughout the period. For robustness, we also use the latest available estimates of the International Monetary Fund, from the March 2006 WEO, and of the European Commission, from the Autumn 2005 Forecast (see Table 1, Section 4).

As for the explanatory variables, we use real-time estimates to compute the Maastricht variable, for the primary balance (or, in alternative specifications, for the overall balance, see Section 5) and for the cyclical conditions. We do so because all these variables are subject to large revisions over time. We use the latest available information on the general government debt, as the OECD did not publish comparable data on the debt until recently. The use of *ex post* data for the debt should not lead to significant distortions, as over the last years the revisions to the initial estimates have been a small fraction of the debt level and it is likely that this holds true also for the years for which we do not have this information.

Budget documents are, in principle, the most direct source of the real-time information available to policy-makers, but they often do not report the data we need and, more generally, the estimates included may be distorted for political reasons (connected with the possibility of "announcement effects") or not comparable, reflecting differences in risk aversion (see, for a discussion on these aspects, Forni and Momigliano, 2004). For this reason, we rely for all countries on the estimates included in the December EOs published by the OECD.

In the countries that we examine, the budget for year $t + 1$ is usually finalised at the end of year *t.* Therefore, the December EO*s* are based on an information set which is temporally aligned to that available to national policymakers when taking budgetary decisions for the following year. Considering also that OECD estimates and forecasts for fiscal variables and for GDP are

---

[8] The current information on our dependent variable (Annex Table 30 of the December 2005 EO) refers to 24 OECD countries. However, 5 countries were included only very recently.

extensively discussed with national experts, it seems reasonable to assume they should be close to those on which budgetary decisions are based.[9]

From the various issues of December EOs, starting from 1989, we directly use the real-time estimates of the general government primary and overall balance and interest payments. For the years 1987 and 1988, for which real-time budgetary data data are not available, we rely on the information available in 1989. The use of the 1989-information set for budgetary data should not lead to significant distortions, as it is temporally close to the real-time information set and, in our knowledge, large revisions of the initial estimates have been registered only in more recent years.

As for cyclical conditions, the OECD started to publish estimates of the output gap only in the EO of December 1995.[10] To overcome this limitation we compute the output gaps on the basis of the series of GDP growth, published in the December EO since 1987. Therefore, we can calculate implicitly-available estimates for output gaps for the years 1987-2005, which bear on policy actions for the years 1988-2006. To compute the gap we employ the filter proposed in Mohr (2005). The filter, which represents an extension of the widely used Hodrick-Prescott filter, avoids the bias in end-of-sample estimates which characterises the latter. This is very important, as we need to estimate the cyclical component of year t with a series ending in $t + 2$.[11] In Appendix 2 we present results based on the more traditional Hodrick-Prescott filter.

We consider among explanatory variables the regular national elections (*i.e.* those held at the end of a full term)[12] as they could be expected by policymakers when budgeting, both for the year in which they were held and for the previous year. We consider only parliamentary elections, the only exception being the U.S., where we regard the presidential elections as more relevant. In Section 5, for comparability with other studies where all elections were considered (e.g. Mink and De Haan, 2005), we present the results of a model which includes an additional regressor for early elections.[13]

---

9 The EOs are made available to the general public at the beginning of December, but a preliminary version of the Report is discussed with national delegates (usually from the Finance Ministries) between the end of October and the beginning of November.

10 In Forni and Momigliano (2004), the estimates of the output gaps implicit in the 1993 and 1994 EOs are approximately computed on the basis of the estimates of the cyclical component of the budget.

11 To avoid the end-of-sample bias of the Hodrick-Prescott (HP) filter, series are usually extended further, at least to $t + 4$. Using the filter proposed by Mohr (2005) in place of the HP filter, we achieve the same objective without introducing an element of arbitrariness in our procedure. For a number of years and countries, the OECD publishes, in addition to the growth in year $t + 2$, an estimate for the growth in its last semester or quarter. In these cases, we use the latter estimates as proxies for expected growth in $t + 3$.

12 We consider an election being "regular" if it takes place in the year in which the term ends or if the anticipation with respect to the end-of-term date does not exceed 6 months.

13 While it is true that in many cases these early elections could not have been expected when budgeting for the year in which they were held, they could be regarded as a lagged proxy of the political difficulties that led to them.

Our analysis covers three distinctly different periods: (i) the years 1988-92, preceding the Maastricht Treaty (which was signed in February 1992 and went into force in 1993); (ii) the years 1993-97, when participation in the Monetary Union required achieving, in 1997, a deficit below the 3 per cent of GDP; and (iii) the years 1998-2006, during which fiscal policies have been conducted within the framework established by the Stability and Growth Pact (signed in 1997).

In terms of cyclical developments, we are able to fully encompass at least two full business cycles. The period includes, in particular, two almost generalised downturns: at the beginning of the nineties and at the turn of the century. The sample is almost evenly split between positive and negative output gaps. For the euro area we have, respectively, 101 and 108 observations (69 and 83, respectively, for the other 8 countries).

Our GDP-growth-based estimates of output gaps are generally close to those published by the OECD, for the years for which this comparison is possible (including the years 1993-94 for which indirect estimates of the OECD data are available). The standard deviation of the two sets of data, for the euro area, is similar: 1.4 and 1.8 respectively; their coefficient of correlation is 0.7. There is a slight difference in the average value, equal to –0.4 in our estimates and to –1.0 in those of the OECD. The number of positive and negative gaps is more balanced in our estimates. In Table 9 of Appendix 2 we compare our estimates for the period 1994-2006 with those obtained using, in our base model, the estimates of output gaps published by the OECD. The results are qualitatively similar.

4. Main results

In this section we discuss the main results of our model for the euro area and the indications gathered from some exercises meant to test robustness (additional exercises are presented in Appendix 2). We also examine how the same model fares if applied to the 8 countries outside the area included in our sample.

Our base model (column "Base" of Table 1), applied to the euro-area countries, explains approximately 38 per cent of the variability of budgetary actions between countries and over time. The model satisfies the standard misspecification tests (see Table 7 in Appendix 1); furthermore, the Chow test for parameter constancy over the three sub-periods 1988-92, 1993-97 and 1998-2006 does not identify any structural breaks (with a *p*-value of 57.0 per cent). All the estimated parameters have the expected sign. They are also highly significant, except those capturing the 1-year-before effect of elections. However, the two election parameters are jointly significant, with a *p*-value of 0.02 per cent.

The estimates of the coefficients of the primary balance and the debt indicate that fiscal policies react to the initial state of public finances in a stabilizing manner. Given the absence of individual fixed effects, fiscal policies aim in the long run at reducing to zero the level of both variables and, implicitly, of the overall balance. As for the reaction to the primary balance, the coefficient (–0.19) indicates that, *ceteris*

Table 1

Main Results and Robustness(1)

Parameters \ Models	11 Countries of the Euro Area: BASE	Eq. (1a)(2)	BASE-sy(3)	BASE-IMF	BASE-EC	Other Samples: 8 OECD	19 OECD
ϕ_{pb}	–0.192	–0.222	–0.188	–0.169	–0.172	–0.141	–0.173
	–4.39	*–5.72*	*–4.21*	*–3.65*	*–3.83*	*–3.63*	*–6.53*
ϕ_{d}	0.011	0.012	0.011	0.008	0.007	0.005	0.008
	3.03	*3.93*	*3.00*	*2.19*	*1.91*	*1.26*	*3.00*
ϕ_{m}	–0.619		–0.619	–0.621	–0.543		–0.619
	–6.09		*–5.99*	*–5.79*	*–5.16*		*–6.06*
ϕ_{x}	0.427	0.302	0.345	0.320	0.426	0.086	0.309
	3.82	*3.43*	*3.13*	*2.72*	*3.75*	*0.94*	*4.72*
$\phi^{(p)}_{e1}$	–1.366	–1.283		–1.349	–1.419	–0.311	–0.797
	–4.16	*–3.96*		*–3.89*	*–4.23*	*–0.87*	*–3.32*
$\phi^{(p)}_{e2}$	–0.551	–0.482		–0.444	–0.606	–0.274	–0.321
	–1.77	*–1.59*		*–1.36*	*–1.91*	*–0.75*	*–1.38*
ϕ_{e1}			–0.953				
			–3.37				
ϕ_{e2}			–0.342				
			–1.39				
N. of obs.(4)	209	209	209	209	196	152	361
RMSE(5)	1.118	1.141	1.137	1.179	1.128	1.087	1.124
R^2	0.381	0.352	0.360	0.345	0.358	0.396	0.326
R^2 adjusted	0.297	0.268	0.273	0.256	0.265	0.277	0.265

(1) *T*-statistics are reported below the estimates. The estimates of 19 time-dummies are not reported.
(2) Eq. (1a) is applied to all observations.
(3) Base model but election parameters independent of the sign of the output gap (p-value of the restrictions = 5.1%).
(4) 13 observations are missing in the data from the European Commission (EC).
(5) Root Mean Squared Error.

paribus, one fifth of the imbalance is corrected in the following year. The reaction to the debt is equal to 1 per cent of the outstanding stock.

For a cost of the debt (5.5 per cent) close to the average value in our sample (5.1 per cent) the estimate of the parameter for the debt implies a reaction to interest payments equal to that estimated for the primary balance. This suggests the need for explicitly comparing this specification with a more parsimonious one, including only the overall balance. This analysis is conducted in Section 5.

The Maastricht variable estimate (–0.62) would suggest that Governments have chosen a more back-loaded strategy than our proportional benchmark, though the result may also be partly due to approximations in our formula.[14]

The coefficient for the output gap is positive, pointing to a counter-cyclical reaction of fiscal policy to economic conditions, as assessed at the time budgetary decisions were taken. The reaction is sizeable, as the estimated coefficient implies that a 1 per cent negative output gap induces, *ceteris paribus*, a discretionary expansion amounting to 0.43 per cent of GDP.

Finally, we find a large impact of regular elections, conditional on cyclical conditions being assessed as being favourable when budgetary decisions are taken: they induce a loosening of the fiscal stance equal to 1.4 per cent of GDP in the year in which they are held and of 0.6 per cent in the year before (the latter estimate is only 10 per cent significant).

In columns 2-4 of Table 1 we check the robustness of our estimates to, respectively, (i) the exclusion of the Maastricht variable ("Eq. (1a)" column), (ii) the imposition that the effects of elections be constant across good and bad times ("BASE-sy" column) and (iii) the use of alternative estimates of the dependent variable.

The exclusion of the Maastricht variable, *i.e.* allowing Eq. (1a) to be applied to all observations, induces a slight worsening in the explanatory power of our model, but leaves the estimates of the other parameters and their levels of significance largely unaffected. There is only a slight reduction in the point estimate of the reaction to the output gap and a slight increase in those to the initial state of the public finances. Analogously to what we found for the base model, the Chow test for parameter constancy over the three sub-periods specified above does not identify any structural breaks (with a *p*-value of 44.6 per cent).

Assuming that the effects of elections are constant across good and bad times alike has negligeable effects on the values of the other parameters (in particular, it does not significantly modify the estimate of the coefficient for the output gap) but, obviously, lowers the estimated impact of elections.

[14] For simplicity, we do not take into account the expected contribution of the cycle in the following years. Moreover, when defining the Maastricht variable we assume that policymakers expect that the contribution from interest payments in year $t+1$ to the overall correction remains unchanged in the following years.

Finally, the results do not change significantly if the latest available OECD estimates of our dependent variable are substituted with those of the International Monetary Fund (from the March 2006 WEO, "IMF" column) and the European Commission (Autumn 2005 Forecast, "EC" column).

In column 5 ("8 OECD") of Table 1 we follow the same estimation procedure outlined in Section 2 – *i.e.*, from a general model to a restricted one – to assess the determinants of the fiscal policies of the 8 countries of our sample outside the euro area.[15] The estimates of the restricted model (which includes an individual effect for Japan) suggest the absence of systematic reactions to cyclical conditions and of an electoral budget cycle. The responses to the initial state of public finances are slightly smaller and, especially in the case of the debt, less precisely estimated.[16]

Finally, in column 6 ("19 OECD") we assess the determinants of the fiscal policies of our full sample of 19 OECD countries, following once more the procedure outlined in Section 2. The results, based on a model which includes individual effects for the 5 non-European countries of the sample, are broadly in line with those for the euro area, masking the substantial heterogeneity of the two groups of countries (as shown by the comparison between columns 1 and 5). Clearly, the good performance of the model for the sample of 19 OECD countries is explained exclusively by the information included in the euro-area data. This result shows the potential risks of pooling groups of countries with different characteristics without checking for parameter constancy between them.

5. The reactions to the state of public finances and the role of Maastricht

As shown in the previous section, our estimates indicate that fiscal policy reacts to primary balance and debt levels in a stabilizing manner. These results are robust to the changes examined in Table 1 (Section 4). Moreover, if we allow for different values of ϕ_p and ϕ_d, depending on whether cyclical conditions are favourable or adverse, the two sets of parameters do not significantly differ (see Table 3 in Section 6).

In Table 2, we split our sample period in the three sub-periods 1988-92, 1993-97 and 1998-2006, presenting for robustness the estimates both for the base model and for the model in which Eq. (1a) is applied to all observations.

Focusing on the reactions to the primary balance and the debt, the estimates tend to remain, even in the sub-periods, significant. The point estimates of the initial and last sub-periods, both for variables and models, are also relatively close. A larger stabilizing reaction to the state of public finances can be detected, for the

15 We cannot reject the hypothesis of parameters poolability of the 3 non-EMU European countries with the 5 non-European OECD countries (the *p*-value of the relevant test is equal to 41.2 per cent). The 3 countries are considerably less poolable with the 11 euro area countries (the *p*-value of the test is 8.9 per cent).

16 The difficulty of applying our fiscal rule to the 3 non-euro-area countries may be due to the fact that for two of them the budget is influenced by revenues from oil production.

Table 2

Estimation Results over Sub-periods[1]

PARAMETER	BASE MODEL					Eq. (1a) MODEL[2]			
	1988-2006 [3]	**1988-92**	**1993-97**	**Obs.**[5]	**1998-06**	**1988-2006** [3]	**1993-97**	**Obs.**[4]	**1998-06**
ϕ_{pb}	–0.192	–0.165	–0.756	(13)	–0.208	–0.222	–0.330	(55)	–0.239
	–4.39	*–2.41*	*–2.73*		*–2.82*	*–5.72*	*–3.55*		*–3.86*
ϕ_d	0.011	0.011	0.078	(13)	0.009	0.012	0.024	(55)	0.010
	3.03	*1.93*	*3.01*		*1.64*	*3.93*	*3.49*		*2.15*
ϕ_m	–0.619		–0.603	(42)	–0.821				
	–6.09		*–6.14*		*–2.45*				
ϕ_x	0.427	0.378	0.098	(13)	0.445	0.302	0.109	(55)	0.452
	3.82	*1.66*	*0.22*		*3.21*	*3.43*	*0.72*		*3.58*
$\phi^{(p)}_{e1}$	–1.366	–1.790	1.834	(1)	–1.290	–1.283	0.183	(1)	–1.265
	–4.16	*–2.59*	*1.27*		*–3.33*	*–3.96*	*0.15*		*–3.41*
$\phi^{(p)}_{e2}$	–0.551	–0.196	–0.069	(3)	–0.822	–0.482	–0.046	(3)	–0.830
	–1.77	*–0.34*	*–0.05*		*–2.03*	*–1.59*	*–0.06*		*–2.06*
No. of obs.	209	55	55		99	209	55		99
RMSE [5]	1.118	1.360	1.038		1.011	1.141	1.123		1.009
R^2	0.381	0.345	0.545		0.388	0.352	0.455		0.383
R^2 adjusted	0.297	0.200	0.432		0.279	0.268	0.334		0.281

(1) *t*-statistics are reported below the estimates. The estimates for the time-dummies are not reported.
(2) Eq. (1a) is estimated over the whole euro-area countries sample. For the 1988-92 column see the corresponding "Base" column.
(3) The *p*-values of test for parameters constancy over time (Chow test) are, respectively, 45.7 per cent for the base model, and 35.9 per cent for Eq. (1a)) model.
(4) Number of non-zero observations for the corresponding regressor in the sub-period 1993-1997.
(5) Root Mean Squared Error.

period 1993-97, both in the case of the base model (where, however, the estimates of these parameters are based on thirteen observations only) and in the specification Eq. (1a). The larger reaction to imbalances, and the simultaneous loss of significance for the effects of cyclical conditions and elections, is consistent with the political climate of that period, particularly favourable to the pursuit of sustainable public finances.

It is still highly controversial whether the Maastricht Treaty simply reaffirmed pre-existing preferences or, instead, it created its own political dynamics inducing governments to undertake consolidations they would not have effected otherwise. Von Hagen *et al.* (2002), on the basis of the comparison of the estimates of a fiscal rule for the year 1972-89 and for the years 1990-98, argue that the Treaty had an impact on fiscal policies as they find a positive shift in the intercept term between the two periods in the direction of surpluses. Our results, though not strictly comparable (we examine only five years of policies preceding Maastricht and, on the other hand, we include eight years beyond 1998), are less univocal, but tend to support the opposite view.

In favour of a "Maastricht effect" there is the strengthening of the stabilizing reaction to imbalances (both in terms of primary balance and of debt) in the 1993-97 period, compared to the previous period. However, the tightening is only temporary and there is no clear evidence of a structural break.[17] We also find that throughout the period 1993-2006 the behaviour of the countries with excessive deficits is more accurately captured by a specifically constructed regressor (the Maastricht variable), defined on the basis of the European rules. However, the exclusion of the Maastricht variable leaves the explanatory power of the model and the estimates of the reactions to cyclical conditions broadly unchanged, as indicated by the results of the Eq. (1a) model. Overall, we conclude that the European fiscal rules only reaffirmed preferences that can already be detected in the years immediately preceding the Treaty of Maastricht. It is possible, however, that those preferences would have not remained stable without the Treaty.

The use of the primary balance and the debt to account for the initial conditions of public finances is relatively standard in the literature, but it is also plausible that fiscal policy would react, instead, to the overall balance. To assess this alternative fiscal rule, we have estimated a model substituting the primary balance and the debt with the overall balance, once more following the procedure from general to specific outlined in Section 2. The estimate obtained for the parameter of the overall balance (0.40) is not significantly different from that of the base model for the primary balance (0.43), while that for all the other parameters is virtually identical.[18] However, the explanatory power of the model with the overall balance is slightly worse than that of our base model, suggesting a greater role for both primary deficit and debt in influencing policy decisions. Formal tests point in the same direction.[19] Moreover, focusing on the debt (as in the base model) instead of its cost (implied by a fiscal rule based on the overall balance) is, in principle, a better rule,

---

[17] As mentioned in Section 4, the tests for parameter constancy do not identify any structural breaks over the three different sub-periods, for both the base and the Eq. (1a) models.

[18] This result is not surprising, as we found that the parameter for the debt, on the base of the average cost of the debt in the sample, was broadly consistent with a value of a parameter on interest payments equal to that estimated for the primary balance (see Section 4).

[19] In a model which includes all three variables, the *p*-value of the null hypothesis that the overall balance has no additional impact on the dependent variable is 94.8 per cent, while the *p*-value of the null hypothesis that the primary balance and the debt have no additional impact is only 11.9 per cent.

as it avoids unnecessary reactions to temporary fluctuations in the level of interest rates. This implies, for example, that the role currently assigned to the debt is proportionally larger than its actual cost, as in recent years interest rates have been particularly low.

We also tried to further understand the impact of the 3 per cent rule on the behaviour of fiscal policies in countries violating the threshold. In order to do so, we added the Maastricht variable to the Eq. (1a) model. In this context, the estimate of the parameter of the Maastricht variable falls to 0.5 but it remains highly significant (with a *t*-statistics of 3.2), suggesting that this variable contributes to better understanding the behaviour of countries in excessive deficit. Finally, we explored the possibility that the policies of the countries in excessive deficit changed between the period 1993-97 (ϕ_m 1993-97) and the following years (ϕ_m > 1997), in view of the widespread idea that after 1998 the impact of the fiscal rules weakened significantly. The point estimates, as well as more formal tests, do not suggest any differences in behaviour.[20]

6. The reactions to cyclical conditions

As seen in Table 1 of Section 4, controlling for other factors we find a sizable stabilizing reaction of fiscal policies of the euro-area countries to cyclical conditions, as assessed at the time budgetary decisions were taken. A 1 per cent negative output gap in year t induces a budgetary loosening in year $t + 1$ amounting to 0.4 per cent of GDP. We get a similar reaction if, in our model, we substitute the estimate of the output gap of year t with that of year $t + 1$ (see Table 9).

These results are in line with those of Momigliano and Forni (2004) and, partly, with those of Buti and van den Noord (2004),[21] while differ from the findings of various studies that, on the base of *ex post* data and generally referring to periods starting in the early seventies and ending in the late Nineties, indicate that discretionary policies (in the euro area or in the EU) have been either a-cyclical or pro-cyclical (e.g. Buti and Sapir, 1998; Wyplosz, 1999; Buti, 2002; European Commission, 2001; Brunila and Martinez-Mongay, 2002; Melitz, 2002; Galí and Perotti, 2003 and the studies referred to in European Commission, 2006). The results of these studies have been generally taken as relevant for assessing the *behaviour* of fiscal authorities *facing* cyclical imbalances. However, as it is shown in Section 8, the use of *ex post* data may largely explains these findings, at least for the last two decades.

---

[20] If, starting from the base model, we split the Maastricht variable into two regressors, referring to the two sub-periods, their point estimates are, respectively, –0,6 and –0,82, with *t*-statistics equal to 5.7 and 2.2. When we impose the same value to the two parameters, the restriction is not rejected, with a *p*-value of 57.2 per cent.

[21] Buti and van den Noord (2004), examining the years 2000-2003 and controlling for errors in forecasting, find that fiscal policy is counter-cyclical in the absence of elections.

The sign of the reaction does not change across sub-periods (Table 2). The reaction is less strong in the 1993-97 period, but it is also not precisely estimated. As in Galí and Perotti (2003), we find evidence neither of the pro-cyclical bias that could stem from the Stability Pact being "all sticks and no carrots" (Bean, 1998) nor of the "overall improvement in cyclical stabilization" with respect to the pre-Maastricht era, detected by Buti and Pench (2004).

A number of recent papers have found an asymmetrical reaction of fiscal policy to cyclical conditions, depending on whether the latter are favourable or unfavourable (OECD, 2003; Forni and Momigliano, 2004 and Balassone and Francese, 2004). These analyses have generally been based on models including two parameters (respectively, for the positive and negative output gaps) for the reaction of fiscal policy to cyclical conditions. Here we consider a more general asymmetric behaviour, as we allow all parameters of our model to have two values, depending on whether the output gap is positive or negative.[22]

In Appendix 1 we show that the restrictions imposing symmetry (with respect to the sign of the gap) in country and time fixed-effects are largely not rejected by data and that country effects can be altogether excluded by the model. Therefore, in this section we focus on two intermediate specifications (IM-BASE and IM-Eq. (1a)) which differ from our base and Eq. (1a) models, respectively, only because they allow the values of the other parameters (which measure the reactions to, respectively, the primary balance, the debt, the cyclical conditions and the elections) to be different, depending on the sign of the output gaps.

The parameter estimates of these intermediate models and their level of significance are shown in Table 3. The reaction to cyclical conditions ϕ_x is always stabilizing, independently of the model or of the sign of the gap. In the base model, the size of the reaction is almost identical in the two cyclical contexts (0.39 when gaps are positive and 0.42 when they are negative) and the null hypothesis of symmetry cannot be rejected (with a *p*-value of 91.4 per cent). In the Eq. (1a) model, the difference in the point estimates is sizeable but it is also not significant (the *p*-value for the hypothesis of symmetry is 34.3 per cent). Furthermore, the counter-cyclical reaction is stronger in good times, while previous studies found the opposite result, indicating that in favourable economic conditions policies tended to be either pro-cyclical or a-cyclical.[23]

---

22 For a non-parametric approach to this issue, see Manasse (2006).

23 As an additional check on this issue we also examined two alternative approaches. The first involves estimating the base model (and the Eq. (1a) model) over two sub-samples, which include, respectively, only positive and only negative output gaps. Then a Chow test for parameter constancy is performed. The second approach, which is in line with previous analyses, involves a model with two parameters ϕ_x (p) and ϕ_x (n) (respectively, for the positive and negative output gaps) estimated over the full sample and a coefficient-equality test. In both cases, the null hypothesis of symmetry is largely not rejected.

Table 3

Testing the Simmetry, with Respect to the Sign of the Output Gap, of the Policy Parameters

	IM BASE MODEL			IM Eq. (1a) MODEL		
	estimated parameters(1)		symmetry tests(2)	estimated parameters(1)		symmetry tests(2)
	if gap > 0	if gap < 0		if gap > 0	if gap < 0	
ϕ_{pb}	–0.187 ***	–0.215 **	77.8%	–0.196 ***	–0.261 ***	38.6%
ϕ_{d}	0.011 ***	0.009 *	65.7%	0.014 ***	0.013 ***	86.6%
ϕ_{x}	0.393 **	0.422 **	91.4%	0.427 **	0.224 *	34.3%
ϕ_{e1}	–1.404 ***	0.128	1.7%	–1.381 ***	–0.045	0.6%
ϕ_{e2}	–0.592 *	0.078	19.1%	–0.555 *	–0.089	30.3%
$\phi_{e1\ and}\ \phi_{e2}$			4.1%			1.9%
ϕ_{m}	–0.619 *			–		
- No.of parameters	30			29		
- No.of observations	209			209		
- RMSE	1.132			1.147		
- R^2	0.383			0.362		
- R^2 adjusted	0.280			0.260		

(1) The estimates of 19 time-dummies are not reported.
The notations *, **, and *** indicate that parameters are, respectively, 10%, 5% and 1% significant.

(2) *p*-values of the tests of parameter equality.

The difference in our results with respect to those of Forni and Momigliano (2004), which are directly comparable as they are also based on real-time information on cyclical conditions but point to a significant asymmetry in the reaction of fiscal policy, depends on three factors: (i) the different data used for the estimates of the output gap,[24] (ii) the inclusion among regressors, in our model, of the (asymmetric) effects of elections, and (iii) the use of real time information, again in our fiscal rule, on budget balances. In fact, if we estimate our base model over their sample period (1994-2004), we still tend to largely accept the hypothesis of

24 This result is not surprising. Orphanides and van Norden (2002) show that different methods to compute the output gap lead to significant differences in the results, especially when cyclical conditions are assessed in real time. Forni and Momigliano (2004) use, for the years 1995-2003, the estimates of output gaps published in the OECD EOs and, for the years 1993 and 1994, the estimates of the output gaps implicit in the EOs, approximately computed on the basis of the estimates of the cyclical component of the budget. In the period 1993-2003 the number of positive output gaps in these estimates is limited (27 observations out of 121), which suggests caution in interpreting empirical inferences.

symmetry in the reactions to cyclical conditions, with a *p*-value of the test of 93.4 per cent. If we substitute our real time estimates of the output gap and of the budget balances with those used by the authors and exclude elections from the regressors, symmetry is rejected, with a *p*-value of 3.3 per cent.

7. The role of the political budget cycle

We find that regular elections (*i.e.*, those held at the end of a full term) have a large impact on fiscal policies, provided that budgetary decisions are taken in a cyclical context assessed as favourable (*i.e.* the output gap is positive). Estimates based on our base model (Table 1, Section 4) indicate that, in this case, regular elections lead to a loosening of the fiscal stance of 1.4 per cent of GDP in the year in which they are held and of 0.6 per cent in the year before. These effects are relatively large, clearly on the high side of the empirical evidence (for a survey of the literature on political budget cycles see Drazen, 2001). The two election parameters are jointly highly significant, with a *p*-value of 0.2 per cent for the null hypothesis.

In contrast, regular elections have no significant effects on fiscal policies if the budgetary decisions are taken when the output gap is negative (see Table 3, Section 6). In particular, in the test of joint significance, the *p*-value of the hypothesis of no effects exceeds 95 per cent (row IM4, Table 8).

Other studies have provided evidence of electoral manipulation of fiscal policy in EU countries (Hallerberg and Strauch, 2002; Buti, 2002; von Hagen, 2002 and Buti and van den Noord, 2003). Evidence that the cyclical context has an impact on the extent of these manipulations for the euro area can already be found in Buti and van den Noord (2004). This previous evidence, however, refers only to four years (2000-03) and to pre- or early election years. Here we broadly confirm and substantially extend those results, as we find a preminent role of the cyclical context over almost two decades in determining fiscal policies both in pre- and in election years.

The importance of the cyclical conditions has, in our opinion, a plausible explanation, in line with the models of political budget cycles which emphasize temporary information asymmetries (e.g. Rogoff and Sibert, 1988). In good times, policymakers can provide additional public goods to the electorate while signalling, with a relatively low (unadjusted) deficit, that they are good administrators. This behaviour is not possible in adverse economic conditions, as the automatic stabilizers and the counter-cyclical action already raise the deficit and leave no room for providing additional public goods. If correct, this explanation implies that, at least in the euro area, improving information on cyclical conditions and on their impact on budget balances would help to reduce electoral manipulations of fiscal policy.

As the euro-area countries are essentially established democracies, our results contrast with those of Brender and Drazen (2004), who find that electoral budget cycles are confined to new democracies.[25]

When we split the sample into sub-periods (Table 2), a general pattern emerges. The estimates of the two parameters for the sub-periods 1988-92 and 1998-2006 are always negative (*i.e.*, the effects are deficit-increasing), relatively stable across periods and, in the case of $\phi_{e1}{}^{p}$, always highly significant. In the period 1993-97 there are so few elections that the results cannot be considered reliable.

On the issue of measuring the electoral variables, other authors have proposed more complex alternatives to the yearly dummies we use. In Table 4 we compare our results with those obtained with two of these alternatives. As benchmark, for comparability with other studies, we show the estimates of a slight variant of our base model (BASE-early), which also includes a parameter for early elections ($\phi^{p}{}_{e3}$).

Franzese (2000) defines an electoral variable equal, in the year t (that of the election), to the number of the month in which the election is held divided by 12 and, in the year before elections, to its complement to 1. In the column "Month" of Table 4 we present the estimates of a specification which, compared to our base model, excludes our regular elections dummies (with the corresponding parameters $\phi^{p}{}_{e1}$ and $\phi^{p}{}_{e2}$) and includes the corresponding variables proposed by the author (parameters $\phi^{p}{}_{e1}$ *with month* and $\phi^{p}{}_{e2}$ *with month*). As with our model, we set to zero the variable if budgetary decisions are taken in bad times (the results of the comparison are not modified if we allow the effects of elections to be symmetric in all the models). The estimates for the parameters of the latter variables (for both sides of the table) are in line with our results, taking into account that the mean and the median of the ratio between the election month and 12 in our sample is slightly above 0.5, but do not seem to add relevant information. More formally, there is no evidence of any of the two models being superior to the other, as both are valid reductions from a general model in which they are nested.[26]

Mink and de Haan (2005) split the electoral variable for the year t into four variables dependent on the quarter in which the election is held, to capture a non-monotonic relationship. In the column "Quarter" we present the parameter estimates using this specification.[27] The evidence of statistical differences between

---

[25] In our sample only the elections in 1989 in Spain refer, in Brender and Drazen terminology, to "new democracies". Excluding that episode (an early election), does not significantly modify our results.

[26] In a model which includes all four variables, the *p*-value of the null hypothesis that our two dummies have no additional impact on the dependent variable is 56.2 per cent, while the *p*-value of the null hypothesis that Franzese variable has no additional impact is 58.2 per cent.

[27] Here, to facilitate the interpretation of the values of the coefficients and comparability with our results, we present estimates where the yearly dummy is split into four quarterly parameters, while Mink and de Haan (2005) start, in fact, from Franzese electoral variable. Results for the model based on their original

(continues)

Table 4

Results of Alternative Specifications of the Electoral Variables[1]

Parameter	Base-early	Month	Quarter
ϕ_{pb}	–0.190	–0.191	–0.218
	–4.33	*–4.35*	*–4.84*
ϕ_{d}	0.010	0.011	0.011
	2.95	*3.01*	*3.10*
ϕ_{m}	–0.619	–0.619	–0.619
	–6.09	*–6.08*	*–6.14*
ϕ_{x}	0.422	0.392	0.428
	3.78	*3.55*	*3.79*
$\phi^{(p)}{}_{e1}$	–1.413		
	–4.27		
$\phi^{(p)}{}_{e2}$	–0.594		–0.577
	–1.90		*–1.86*
$\phi^{(p)}{}_{e1}$ *month*		–2.536	
		–4.05	
$\phi^{(p)}{}_{e2}$ *month*		–0.954	
		–1.98	
$\phi^{(p)}{}_{e1}$ *for Q1*			–1.464
			–2.67
$\phi^{(p)}{}_{e1}$ *for Q2*			–0.963
			–2.00
$\phi^{(p)}{}_{e1}$ *for Q3*			–4.142
			–3.43
$\phi^{(p)}{}_{e1}$ *for Q4*			–1.219
			–1.73
$\phi^{(p)}{}_{e3}$	–0.423	–0.402	–0.455
	–1.18	*–1.12*	*–1.28*
No. of observations	209	209	209
Root Mean Squared Error	1.117	1.120	1.108
R^2	0.385	0.382	0.405
R^2 adjusted	0.298	0.294	0.310

[1] *t*-statistics are reported below the estimates. The estimates for the time-dummies are not reported.

specification for the quarterly variables are close to those presented here. In particular, the overall explanatory power is similar and the estimates of the four parameters are, approximately, proportional to the product of those shown in column "Quarter" and the ratio between 12 and the middle month of each quarter. The *t*-statistics of the parameter of the electoral variable for the year before the elections increases slightly and becomes 5 per cent significant.

their values and that of the yearly parameter $\phi^{(p)}_{e1}$ is mixed, as the *p*-value of the joint hypothesis of no differences is 11.4 per cent. Examining individual quarters, only the effects of elections held in the third quarter are significantly different (larger) than those in the other quarters. This time pattern is broadly consistent with that found by Mink and de Haan (2005), who detect a peak in the effect for the elections held in the middle of the year.

Overall, we tend to conclude that, in the euro-area context, there isn't any mechanical correlation between the magnitude of the budgetary effects and the month in which the election is held, but there is some evidence that elections held in the third quarter do exert a larger expansionary impact on the deficit than those carried out in the other quarters.[28]

Finally, the choice of electoral variables does not affect the estimates of the other parameters.

8. The effects on estimates of using *ex post* data

As mentioned in the Introduction, most empirical estimates of fiscal rules have used *ex post* (latest available) data. If the estimated parameters are interpreted as identifying the behaviour of policy-makers, the use of data which could not possibly have been used by the latter entails the risk of a biased assessment.

It should be noted that even if only one explanatory variable is measured with error (depending on the use of *ex post* – revised – data in models where real-time information matters), *all* parameter estimates are biased. If there are more variables measured with error (as in our case, where all explanatory variables would have to be measured on the basis of real-time data) the expressions of the biases get very complicated. The direction of the bias on the coefficients is determined by: (i) the model parameters, (ii) the correlations between the variables (measured without error, *i.e.* real-time) and (iii) the ratios of the revisions' variances to the respective variances of the true (*i.e.* real time) variables, see e.g. Levi (1973).

The risks of biased estimates could be limited if the revisions were small. However, it is well known that the initial assessment of the cyclical conditions is subject to large revisions over time. This is, in part, due to the error in assessing growth in the current year but, more importantly, depends on the fact that the estimate of the output gap for a given year is crucially tied to the growth of GDP in the following periods, which is usually forecasted with large errors. In the case of fiscal data, the initial assessment for some countries has been also significantly modified in recent years, as the application of some methodological criteria has been

[28] This result seems to require a different explanation from that proposed by Mink and de Haan (2005), based on information lags concerning the public sector borrowing, as that is inconsistent with the presence of a not-irrelevant impact of elections on fiscal policies in the year before the one in which they are held.

clarified by Eurostat and/or corrected by National Statistical Institutions and new information has become available.[29]

In order to quantitatively assess the extent to which the use of *ex post* data can modify the estimates, at least in our sample, Table 5 shows the comparison between our results and those obtained using the latest available information (from the OECD December 2005 Economic Outlook). Overall, it indicates that the type of information set used has a large impact on estimates.

The first column of the table shows the OLS estimates based on real-time data for a slight variant of our base model, in which we allow elections to exert different effects in the positive and in the negative cyclical phases.[30] In addition, since *ex post* data embody revisions that may not average to zero within countries over time, we start with a model with both country and time effects. As in our base model, individual effects are not significant (and are therefore excluded by the model on which the reported estimates are based), while time effects are, and election effects are significant only during the positive cyclical phases. Point estimates and significance levels of all other parameters are almost identical to those of the base model.

In the second column we report the OLS estimates of the same model but using *ex post* data for the output gaps. Results are generally broadly similar to those of the first column but without the asymmetry in the effects of elections dependent on the sign of the output gap. Furthermore, the counter-cyclical reaction is significantly smaller and is only 10 per cent significant. Finally, the overall explanatory power of the model is reduced.

In the third and fourth columns of Table 5 we report OLS and GMM estimates of the same model using *ex post* data not only for the output gaps but also for the budget balances. We also use GMM (following the proposal of Arellano and Bond, 1991) as, in this case, country effects are statistically significant and, therefore, they are included in the specification on which the reported estimates are based. Not being significant, time effects were excluded. While the results in the third and fourth column are broadly similar (except for the parameter of the Maastricht variable), almost all estimates are significantly different from those based on real-time data and the explanatory power of the models drops further.

9. Conclusions

This paper examines the impact of four major factors on the fiscal policies of the euro-area countries over the last two decades. We rely on information actually

29 From 1998 to 2005, public deficits of the euro-area countries were above the Maastricht Treaty limit (3 per cent of GDP) 12 times with real-time data and 24 times on the basis of the latest available information.

30 Given that measuring the output gap with ex post data may alter the identification of positive and negative cyclical phases, it is not granted *a priori* that elections play an asymmetric role with ex post data too. For this reason, we prefer to start from a more general framework.

Table 5

Comparing Results with Real-time and *Ex Post* Data[1] [2]

	Real-time Data	***Ex Post* Data for Cyclical Conditions**	***Ex Post* Data for Cyclical Conditions and Primary Balance**	
	OLS [3]	***OLS*** [3]	***OLS*** [4]	***GMM*** [4], [5]
ϕ_{pb}	–0.193	–0.181	–0.348	–0.318
	–4.36	*–3.98*	*–6.81*	*–7.62*
ϕ_d	0.011	0.011	0.023	0.012
	3.02	*2.96*	*3.55*	*3.92*
ϕ_m	–0.619	–0.619	–0.634	–1.154
	–6.05	*–5.89*	*–5.55*	*–6.61*
ϕ_x	0.426	0.197	0.098	0.114
	3.69	*1.83*	*1.41*	*1.87*
$\phi^{(p)}_{e1}$	–1.367	–0.976	–0.563	–0.615
	–4.13	*–2.62*	*–1.56*	*–1.80*
$\phi^{(n)}_{e1}$	0.030	–0.790	–0.289	–0.408
	0.06	*–1.84*	*–0.73*	*–1.21*
$\phi^{(p)}_{e2}$	–0.551	–0.181	–0.125	–0.253
	–1.76	*–0.57*	*–0.36*	*–0.78*
$\phi^{(n)}_{e1}$	–0.024	–0.651	–0.190	–0.195
	–0.07	*–1.62*	*–0.52*	*–0.58*
Joint significance (p-values)				
Individual effects	41.4%	43.4%	0.7%	-
Time effects	2.2%	6.2%	76.5%	26.6%
Elections effects	0.2%	2.3%	56.0%	30.2%
Main diagnostics:				
N. of observations	209	209	209	209
RMSE[6]	1.124	1.156	1.150	1.215
R^2	0.381	0.345	0.323[7]	0.241
R^2 adjusted	0.289	0.248	0.256[7]	0.214
Hansen J[8]	-	-	-	15.1%
Autocorrelation[9]	12.4%	7.9%	96.2%	62.3%

(1) *t*-statistics are reported below the estimates. The estimates of the individual and time-dummies are not reported.

(2) Base model plus generalised (*i.e.* positive and negative) election parameters. Deterministic components are estimated when significant (see notes below).

(3) As a result of parameter tests, the model allows for time effects and does not include country fixed effects.

(4) As a result of parameter tests, the model allows for country fixed effects and does not include time effects.

(5) Arellano and Bond (1991) GMM-diff estimator.

(6) Root Mean Squared Error.

(7) Based on the squared coefficient of correlation between actual and fitted values.

(8) Hansen (1982) overidentification test.

(9) First-order residual autocorrelation for OLS, second order for GMM.

available to policy-makers at the time of budgeting in constructing our explanatory variables. A parsimonious model, which does not include fixed effects for individual countries, is able to explain almost 40 per cent of the variability of budgetary actions between countries and over time. The tests for parameter constancy over the three sub-periods 1988-92, 1993-97, 1998-2006 do not identify any structural breaks. Our estimates indicate that:

- Fiscal policies reacted to the levels of the primary balance and of the debt in a stabilizing manner: the coefficient of the primary balance indicates that, *ceteris paribus*, one fifth of the imbalance is corrected in the following year, while the reaction to the debt is equal to 1 per cent of the outstanding stock.
- European fiscal rules play a somewhat limited role in our model. The point estimates of the reactions to primary balance and debt levels are higher for the sub-period 1993-97, but this increase is not statistically significant and it is temporary: the estimates for the following period (1998-2006) are in line with those for the pre-Maastricht years (1988-92). We also find that the behaviour of the countries with excessive deficits is more accurately captured throughout the period 1993-2006 by a specifically constructed regressor, defined on the basis of the European rules. However, the exclusion of this variable leaves the overall explanatory power of the model and the parameter estimates broadly unchanged. Overall, we conclude that the European fiscal rules only reaffirmed preferences that can already be detected in the years immediately preceding the Treaty of Maastricht. It is possible, however, that those preferences would have not remained stable without the Treaty.
- The reaction of the fiscal authorities to cyclical conditions has generally been stabilizing and not negligeable: a 1 per cent negative output gap leads to a budgetary loosening of 0.4 per cent of GDP. This result differs from the findings of most empirical analyses, which find on the basis of *ex post* data and referring to periods including earlier years that the normal response of euro-area fiscal policies to cyclical developments has been either a-cyclical or pro-cyclical. The type of information set used seems a crucial element in explaining the different results. If we replicate our analysis using the latest available (*ex post*) information for our regressors, the estimated reaction becomes smaller and not significant.
- The results for the response to cyclical conditions have some implications for the current debate on fiscal rules and policies. First, as well as Galí and Perotti (2003), we do not observe the pro-cyclical bias that could stem from the Stability Pact (Bean, 1998). Second, taking into account that the counter-cyclical reaction comes on top of the working of the automatic stabilizers, there is probably little need to modify fiscal rules in order to induce governments to seek greater stabilization as suggested, for example, in Bruck and Zwiener (2006). Finally, the results based on *ex post* information suggest that actual stabilization carried out by the governments (which is particularly important for the euro area, not only because of the centralization of monetary and exchange policies, but also owing to the limited geographical mobility of labour and to wage flexibility;

cfr. Feldstein, 2005) would be enhanced by improving the real-time assessment of cyclical conditions.

- When we distinguish between favourable and adverse cyclical conditions there is no evidence of the asymmetry in the policy response that some recent studies found.
- We find strong evidence for the existence of a political budget cycle, but the fiscal loosening associated with elections (1.4 per cent of GDP in the year in which they are held and 0.6 per cent in the year before) is present only if cyclical conditions are assessed as favourable when the relevant budgetary decisions are taken. The tentative explanation we offer for this pattern implies that improving information on cyclical conditions and on their impact on budget balances would help to reduce electoral manipulations of fiscal policy. It is noteworthy that the evidence of a political budget cycle tends to disappear when we use the latest available (*ex post*) information for our regressors.
- The results are robust to alternative measures of the dependent variable and of the regressors, and to the exclusion of any country, in turn, from the sample. In particular, the estimate of the response of fiscal policies to cyclical developments is almost unaffected by the imposition that the effects of elections be constant across good and bad times.
- Many of our results do not carry over when we apply the same model to a group of 8 OECD countries outside the area.

Table 6

Election database (from 1987 to 2007): Year (Month) R=regular, E=early

United States of America: 1988(11)R, 1992(11)R, 1996(11)R, 2000(11)R, 2004(11)R

Japan: 1990(2)R, 1993(7)E, 1996(10)E, 2000(6)R, 2003(11)E, 2005(9)E

Germany: 1987(1)R, 1990(12)E, 1994(10)R, 1998(9)R, 2002(9)R, 2005(9)E

France: 1988(6)E, 1993(3)R, 1997(5)E, 2002(4)R, 2007(4)R

Italy: 1987(4)E, 1992(4)R, 1994(3)E, 1996(4)E, 2001(5)R, 2006(4)R

United Kingdom: 1987(6)R, 1992(4)R, 1997(5)R, 2001(6)R, 2005(5)R

Canada: 1988(10)E, 1993(10)R, 1997(6)E, 2000(11)E, 2004(6)E

Australia: 1987(7)E, 1990(3)E, 1993(3)R, 1996(3)R, 1998(10)E, 2001(11)R, 2004(10)R, 2007(11)R

Austria: 1990(1)R, 1994(1)R, 1995(12)E, 1999(10)E, 2002(11)E, 2006(11)E

Belgium: 1987(12)E, 1991(11)R, 1995(5)R, 1999(6)R, 2003(5)R, 2007(5)R

Denmark: 1987(9)R, 1988(5)E, 1990(12)E, 1994(9)R, 1998(3)R, 2001(11)R, 2005(2)R

Finland: 1987(3)R, 1991(3)R, 1995(3)R, 1999(3)R, 2003(3)R, 2007(3)R

Greece: 1989(9)R, 1993(10)R, 1996(9)E, 2000(4)R, 2004(3)R

Ireland: 1987(2)R, 1989(6)E, 1992(11)E, 1997(6)R, 2002(5)R, 2007(6)R

Netherlands: 1989(9)E, 1994(5)R, 1998(5)R, 2002(5)R, 2003(1)E, 2007(5)R

New Zealand: 1987(7)R, 1990(7)R, 1993(11)R, 1996(10)R, 1999(11)R, 2002(7)R, 2005(7)R

Portugal: 1987(7)E, 1991(10)R, 1995(10)R, 1999(10)R, 2002(3)E, 2005(2)E

Spain: 1989(10)E, 1993(6)R, 1996(3)E, 2000(3)R, 2004(3)R

Sweden: 1988(9)E, 1991(9)E, 1994(9)E, 1998(9)R, 2002(9)R, 2006(9)R

APPENDIX 1
FROM THE GENERAL TO THE BASE MODEL

In this Appendix we provide a detailed description of the process of reduction from a general unrestricted model (GUM) to our base model and from a general model which does not include the Maastricht variable (GUM-Eq. (1a)) to the Eq. (1a) model.

Preliminarily, we perform on the GUMs (GUM and GUM-Eq. (1a)) a number of specification tests. Results are shown in Table 7. In detail, the upper half of the table shows the results of a few specification tests to the GMM estimates of the GUMs and of the comparison between the latter and the estimates based on OLS. In the lower part we analyse the statistical properties of the residuals obtained with OLS.

Then we assess the restrictions which enable us to move from the general unrestricted model to, respectively, the base and the Eq. (1a) models. This analysis performed for all restrictions at once and, for greater transparency, also for homogeneous groups of restrictions (Table 8). In particular, we assess the sets of restrictions which enable us to move to two intermediate models, IM-BASE and IM-Eq. (1a), which differ from the final ones (base and Eq. (1a) model) only for the fact that they allow the values of policy parameters to vary depending on the sign of the output gaps. The estimates for these intermediate models are shown in the main text in Table 3.

Validation of the GUMs

In order to decrease the impact on parameter estimates of biases due to possible model specification errors in the GUMs, we allow for country and time effects. The country effects should account for the influence of almost time-invariant omitted variables, and the time effects should allow for a degree of dependency across individuals due to common factors (individual-invariant omitted variables). It is widely acknowledged that the presence of individual effects in dynamic panel models implies that the lagged dependent variable is correlated to the equation error. In this context, the approach proposed by Arellano and Bond (1991), involving the GMM applied to differenced data, delivers consistent parameter estimates. Nevertheless, we prefer to use OLS estimators, especially for the restricted models, for a number of reasons.

First, in our analysis two factors should limit the risk of biases of the OLS estimator. The different nature of data – cyclically-adjusted *ex post* data for the dependent variable $\Delta capb_{it}$ and unadjusted real-time data for the explanatory primary balance pb_{it-1} – should weaken the endogeneity problem of the regressor. Moreover, the size of the bias should be limited, as it is inversely proportional to the time dimension of the sample, which in our case is relatively large (19 years). In this context, the OLS bias may be more than offset by its greater precision compared to

Table 7

Gum and Base Models Misspecification Tests and Diagnostics

	Equations (1a)–(1b)			Equation (1a)		
Residual and specification tests of GMM estimates						
GMM AR1 *p*-values	0.8%			2%		
GMM AR2 *p*-values	8.8%			24.5%		
Hansen *J* *p*-values	1.5%			8.0%		
Hausman statistic, χ^2	48.3			60.3		
- degrees of freedom[(1)]	61			45		
- *p*-values	88.1%			6.4%		
Analisis of GUM, IM and base model OLS estimates						
Residual tests:	GUM	IM	BASE	GUM(1a)	IM(1a)	Eq. (1a)
- White *p*-values	46.7%	70.7%	31.0%	44.7%	93.1%	56.6%
- Breusch-Pagan *p*-values	65.4%	93.6%	97.9%	81.5%	90.6%	99.0%
- Ramsey RESET *p*-values	0.1%	49.8%	46.7%	7.4%	7.1%	6.6%
- Bhargava *et al.* Durbin-Watson	2.38	2.25	2.24	2.51	2.25	2.25
- Wooldridge, AR1 *p*-values	5.6%	5.1%	10.9%	0.8%	2.7%	2.9%
- Arellano-Bond, AR2 *p*-values	35.5%	13.9%	17.5%	47.1%	13.1%	12.3%
- Godfrey LM, AR1 *p*-values		5.4%	6.4%		5.7%	5.7%
- Godfrey LM, AR2 *p*-values		14.9%	16.6%		16.4%	16.3%
Other diagnostics:						
- Number of parameters	91	30	25	66	29	24
- Number of observations	209	209	209	209	209	209
- RMSE	1.118	1.132	1.118	1.162	1.147	1.141
- R^2	0.603	0.383	0.381	0.480	0.362	0.352
- R^2 adjusted	0.297	0.280	0.297	0.240	0.260	0.268

(1) Number of parameters in GUMs (see below), excluding the individual effects.

GMM estimator (see Nickell, 1981; Judson and Owen, 1999; and Attanasio *et al*., 2000).

Second, estimates of OLS over GMM can be formally compared with the Hausman (1978) test. As the test does not rejects the null, suggesting OLS and GMM (in differences) estimates are equivalent, OLS estimates are advisable, being more efficient.

Finally, it should be pointed out that the country effects, though on the basis of OLS estimates, can be restricted to zero (see the following section of this Appendix) and in this context the OLS method delivers consistent parameter estimates.

As a check preliminary to performing the Hausman (1978) test, we assess the estimates of the GUMs with the GMM-differences approach proposed by Arellano and Bond (1991). The main diagnostics are laid out in the upper panel of Table 7. The absence of second-order residual autocorrelation suggests well behaved residuals, while the presence of first-order autocorrelation is simply due to data transformation in first-differences. Hansen (1982) J-test does not reject, at lest at the 1 per cent level, the over-identification restrictions (*i.e.* the choice of the instruments).

The lower part of Table 7 reports the main tests on residuals with OLS, namely: White (1980) and Breusch and Pagan (1980) tests for heteroskedasticity, Ramsey (1969) specification error test, Bhargava *et al.* (1982) Durbin-Watson-type, Wooldridge (2002, pp. 282-83) and Arellano and Bond (1991) tests for first- and second-order autocorrelation. In addition, Godfrey (1988) LM-type tests for first- and second-order autocorrelation are reported for OLS estimates without fixed individual effects (*i.e.*, only for base and intermediate models). The residual diagnostics are reported not just for the GUMs but also for the intermediate models (IMs) and for the final models. In general, the models performance is in line with the hypothesis of well-behaved residuals; hence, parameter inferences can be drawn on the basis of OLS estimator statistical distributions.

Validation of the restrictions

Table 8 presents the results of the tests on the restrictions which allow to move from the GUMs to our intermediate models (IM-BASE and IM-Eq. (1a)) and to our final specifications (base and Eq. (1a)) discussed in the main text.

The upper part of Table 8 (rows 1-10) is devoted to test restrictions that imply a switch from equation (1a) to equation (1b) when the Maastricht variable m_{it-1} is negative (see Section 2). This dichotomic representation requires that all parameter estimates of equation (1a) be not significantly different from zero when m_{it-1} is negative. The tests of these 25 restrictions are shown in row 8 of Table 8. Since the GUM allows for different ϕ_m parameters for the run-up to Maastricht (1993-97)

Table 8

From General to Restricted Models, Tests on Coefficient Restrictions
(p-values of the tests)

	From GUM	
Tests of irrelevance of other factors if $m_{it} < 0$		
(1) no country effects	44.2%	
(2) no time effects	85.1%	
(3) no country and time effects = (1+2)	*73.2%*	
(4) no output gap effects	74.6%	
(5) no primary balance and debt effects	98.6%	
(6) no election effects	57.0%	
(7) no (4 + 5+ 6) effects	*91.7%*	
(8) no country, time and policy effects = (3+7)	*83.0%*	
(9) ϕ_m constancy	70.1%	
(10) All restrictions above	85.0%	
		From GUM-Eq. (1a)
Test of irrelevance of German unification dummies[(1)]		
(11) no effects of German unification dummies[(1)]	84.4%	52.7%
Tests of symmetry w.r.t. the sign of the output gap[(1)]		
(12) symmetry in country effects[(1)]	26.3%	40.4%
(13) symmetry in time effects[(1)]	85.0%	69.7%
(14) All the restrictions above[(1)]	37.1%	56.1%
(15) no (symmetric) country effects[(1)]	31.8%	54.1%
(16) no (symmetric) time effects[(1)]	46.1%	13.2%
(17) Test of restrictions from GUMs to the Intermediate models: restrictions (14+15) [(2)]	37.7%	67.3%
(18) Restrictions (14) and no time effects (16)	11.8%	12.4%
(19) Test of restrictions imposed on Final models: restrictions (17+IM2)[(3)]	46.3%	66.0%
	From IM-BASE	**From IM-Eq. (1a)**
Further tests, starting from Intermediate Models		
(IM1) no time effects	1.7%	2.2%
(IM2) symmetry (w.r.t. the sign of the output gap) in output gap, primary balance and debt effects	89.9%	45.5%
(IM3) symmetry (w.r.t. the sign of the output gap) in election effects	4.1%	1.9%
(IM4) no effects of elections if the output gap <0	96.0%	95.9%

(1) The following tests include, for the first column, all the restrictions in row 10.
(2) The null hypothesis of these restrictions identifies in the first and in the second column, respectively, the IM-BASE and the IM-Eq. (1a) model; their parameter estimates are reported in Table 3.
(3) The null hypothesis of these restrictions identifies in the first and in the second column, respectively, the BASE and the Eq. (1a) models; their parameter estimates are reported in Table 1.

and for the post-1998 period, we also test the restriction that the two parameters are equal (row 9).

On the basis of the large *p*-value reported in row (10), the 26 restrictions that allow to simplify the GUM into the dichotomic representation:

$$(1a)\text{–}(1b)\ (\textit{i.e.}\ m_{it-1} < 0)$$

cannot be rejected.

In row 11, we present the results of the test on whether it is admissible to restrict to zero the effects of the German unification, a captured by dummies for the years 1990-94. The GUMs allow the possibility of asymmetry, depending on the sign of the output gap, both in country and time fixed-effects and in explicit policy parameters (which measure the reactions to, respectively, the output gap, the initial conditions of public finances and the coming elections). Rows 12 and 13 of Table 8 show the results of tests examining the restrictions which impose symmetry in the country and time effects, respectively. The overall test of row 14, for both the GUM and the GUM-Eq. (1a), suggests that the null hypothesis of no German unification effects and of symmetry in country and time effects cannot be rejected. Therefore, the German unification dummies can be excluded from the specifications and the two sets of, respectively, country and time effects can be unified.

In lines 15 and 16 we test the relevance of (symmetric) country and time effects. Individual effects are largely not significant, while the overall relevance of time dummies is relatively less clear. To assess the latter, we prefer referring to the *p*-values in row (IM1), where only 19 restrictions are tested (against the intermediate specifications IM-BASE and IM-Eq. (1a)), and to reject the null hypothesis of zero time effects.

Therefore, on the basis of the finding just mentioned, we are able to simplify the starting GUMs by imposing the 63 and 37 non-rejected restrictions in row (17) to, respectively, the GUM and the GUM-Eq. (1a). On the basis of the resulting intermediate models (IM and IM-Eq. (1a)) in Section 6 (Table 3) we examine the issue of asymmetry/symmetry in policy actions, depending on whether the output gaps are favourable or adverse.

Here, summarizing the results of Section 6, we show that the joint test on the symmetry of policy reactions to output gaps, primary balance and debt effects (row IM2) are largely not rejected, while that on the symmetry of the policy reactions to elections is clearly rejected. Moreover, in the case of elections, their effects when the gaps are negative are not significant and can be excluded (row IM4). Overall, the reduction from GUMs to the corresponding specifications, base and Eq. (1a) model, respectively implies 67 and 44 largely non-rejected restrictions, with *p*-values equal to 46.3 per cent and 66.0 per cent.

APPENDIX 2
OTHER ROBUSTNESS EXERCISES

In this section we test the robustness of our estimates to the timing and measurement of the output gap and to the exclusion of any single country of our sample. In the main text, additional evidence of robustness has been provided: in Table 1 for alternative samples of countries (outside the euro area), in Table 2 for different periods of time, and in Table 4 using alternative elections' indicators.

Robustness to the timing and measurement of the output gap

Given the relevance of the role played by the output gap in our modelling strategy (it is both a regressor of the base model and the variable governing the cyclical phases), it is important to assess the robustness of our results with respect to alternatives involving this variable. As far as timing is concerned, in our base model we assume that policymakers react to the *current* cyclical conditions (x_{t-1}), *i.e.* existing at time the policy is set, but they may plausibly react to the conditions *expected* for the following year (x_t). In this case, because of the simultaneity of the explanatory output gap, the base model parameters must be estimated with instrumental variables (IV) rather than using OLS. As for alternative output gap measures, we use: that obtained by filtering GDP real time data with the traditional Holdrick-Prescott approach instead of Mohr's, and that reported in the OECD EO. A drawback with the EO measure is the reduced number of observations available (only since 1993, see Section 3).

Estimation results of all the robustness exercises about the output gap described above are reported in Table 9. In particular, in the first column (BASE(x_{t-1})) we report the benchmark estimates of the base model over the period 1988-2006. In the second column (IV) the instrumental-variable estimate of the base model is reported. The (simultaneous) output gap at time t is instrumented with its lagged values.

It is well known that the performance of estimators exploiting instrumental information crucially depends on the relevance of the instruments in question, that is, on the correlation between the instruments and the endogenous explanatory variables. In finite samples, low instrument relevance ("weak instruments") can lead both to biased estimators and to the departure of their distribution from the asymptotic normal. In order to check for instrument relevance, we performed the Stock, Wright and Yogo (2002) *F*-statistic to test the null hypothesis that the lagged output gap is weak. The first-stage F-statistic in our case (27.9) is well above the 5 per cent critical value (8.96, see Stock, Wright and Yogo, 2002, Table 1, p. 522), and leads to the rejection of the null.

In the third column (HP) the output gap is measured by the traditional Hodrick-Prescott-filtered GDP. In the case presented here, we set to 100 the

Table 9

Robustness to Alternative Estimates of Cyclical Conditions(1)

	1988-2006			1994-2006	
Model / Parameter	**BASE (x_{t-1})**	**IV (x_t)**	**HP (x_{t-1})**	**BASE(x_{t-1})**	**OECD(x_{t-1})**
ϕ_{pb}	–0.192	–0.180	–0.223	–0.189	–0.223
	–4.39	*–4.11*	*–4.66*	*–2.59*	*–2.76*
ϕ_d	0.011	0.009	0.014	0.008	0.009
	3.03	*2.46*	*3.57*	*1.50*	*1.34*
ϕ_m	–0.619	–0.619	–0.619	–0.653	–0.653
	–6.09	*–6.05*	*–5.97*	*–6.21*	*–6.12*
ϕ_x	0.427	0.553	0.489	0.421	0.203
	3.82	*3.29*	*3.61*	*3.16*	*2.16*
$\phi^{(p)}_{e1}$	–1.366	–1.258	–1.153	–1.153	–1.094
	–4.16	*–3.42*	*–3.14*	*–3.09*	*–2.50*
$\phi^{(p)}_{e2}$	–0.551	–0.728	–0.139	–0.791	–1.339
	–1.77	*–2.21*	*–0.47*	*–1.94*	*–2.41*
N. of obs.	209	209	209	143	143
RMSE (2)	1.118	1.126	1.140	1.021	1.037
R^2	0.381	0.355(3)	0.356	0.410	0.391
R^2 adjusted	0.297	0.267(3)	0.269	0.319	0.298

(1) The *t*-statistics are reported below the estimates. The estimates of the time-dummies are not reported.
(2) Root Mean Squared Error.
(3) Generalised R^2, see Pesaran and Smith (1994).

smoothing parameter, but the use of alternative values of the parameter would not significantly alter our results.

In order to ease comparisons, columns four and five of Table 9 report alternative estimates of the base model over the common sample 1994-2006, given the limited availability of OECD's output gap data. The fourth column reports estimates based on our data set, while the fifth column shows results based on the estimates of the output gap of the OECD (OECD).

These robustness experiments confirm our base model findings, pointing to the asymmetry of the election effects and to significant, and symmetric, counter-cyclical policies. Across the first three columns, the expansionary effect of elections in the same year they are held is quantitatively similar, while there is some variability for the effect of the elections held in the previous year.

In the last two columns of Table 9, notwithstanding the reduced dimension of the sample, our results generally confirm the estimation results of the base model. However, in the last column the reaction to cyclical conditions is lower (but still significant) and the effect of the elections in the year before that in which they are held is higher.

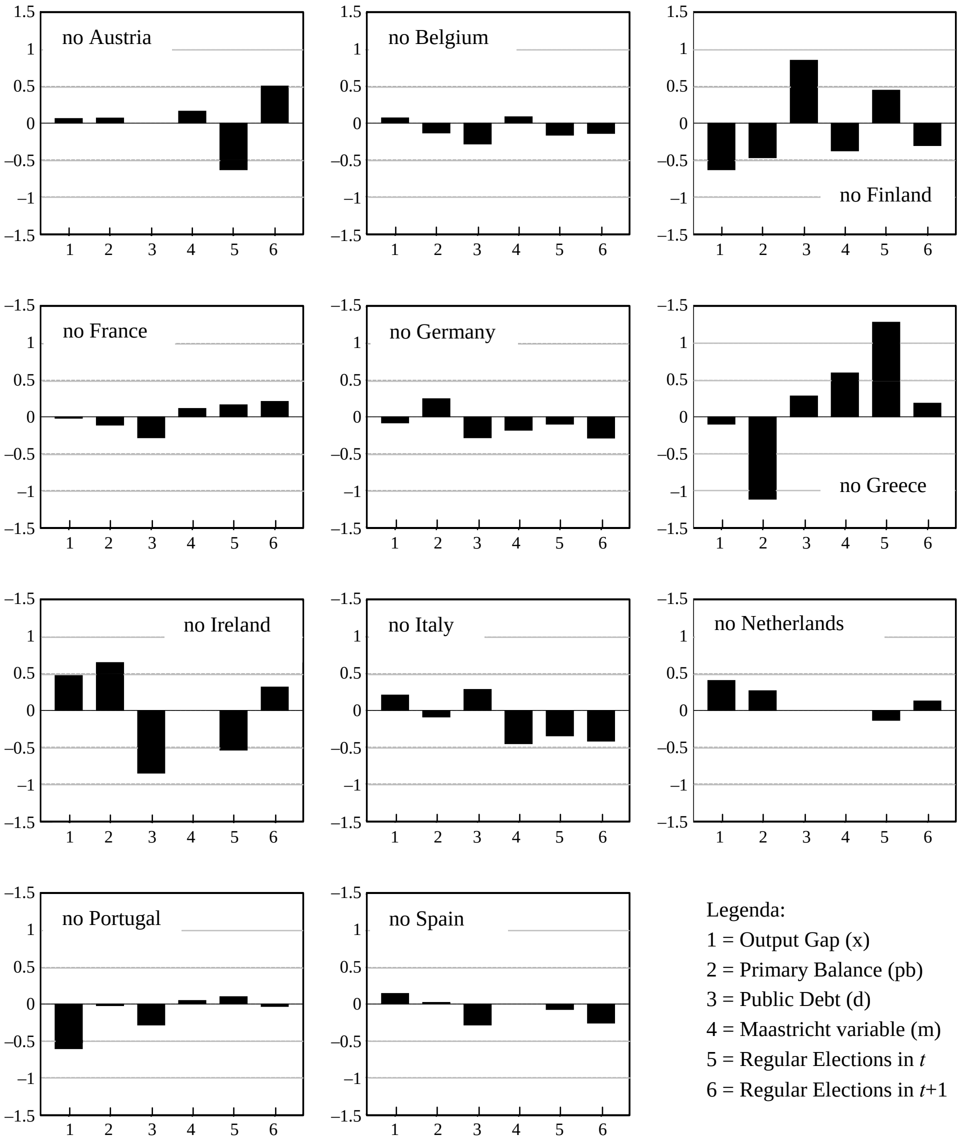
Robustness in euro-area sub-samples

We estimated our base model on the basis of eleven alternative samples obtained by excluding one country at a time (the number of observations in each sub-sample is 190 against 209 in the full sample). Results are shown in Figure 1, where each plot represents one particular sample (e.g. the "no Austria" plot reports estimation results for the euro-area sample without Austria).

In order to ease the comparison between the results for each of the 11 sub-samples and for the base model estimates, we report for each parameter (here represented by a histogram bar) the difference of its sub-sample estimate against the corresponding result in the base model, divided by the standard error. The results indicate that sub-sample estimates never fall outside the corresponding 95 per cent confidence intervals (two standard errors) of the base model estimates. In fact, even the larger discrepancies (such as those involved by excluding Greece, Finland or Ireland) rarely fall outside the ±1 range.

Figure 1

Normalised Differences with Respect to the Base Model Estimates Obtained by Excluding, in Turn, One Country from the Euro-area Panel[(1)]



[(1)] Each parameter estimate (along the horizontal axis) is measured as the difference with respect to the corresponding estimate of the base model in terms of its standard error. In this way, bins bigger than two in absolute value suggest that the corresponding estimates (obtained excluding that country from the sample) lay outside the 95 per cent confidence interval of the base model estimates.

REFERENCES

Arellano, M and S. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies*, Vol. 57, No. 2.

Auerbach, A.J. (2002), "Is There a Role for Discretionary Fiscal Policy?", paper presented at the Conference sponsored by the Federal Reserve Bank of Kansas City "Rethinking Stabilization Policy", Jackson Hole, August.

Balassone, F. and M. Francese (2004), "Cyclical Asymmetry in Fiscal Policy, Debt Accumulation and the Treaty of Maastricht", Bank of Italy, Temi di Discussione, No. 531.

Ballabriga, F. and C. Martinez-Mongay (2002), "Has EMU shifted policy?", *Economic Papers of the European Commission*, Directorate-General for Economic and Financial Affairs, No. 166.

Bean, C.R. (1998), "Discussion", *Economc Policy*, No. 26, pp. 104-07.

Bohn, H. (1998), "The Behavior of U.S. Public Debt and Deficits", *Quarterly Journal of Economics*, Vol. 113, No. 3, pp. 949-63.

Brender, A. and A. Drazen (2004), "Political Budget Cycles in New versus Established Democracies", NBER, Working Paper, No. 10539.

Bruck, T. and R. Zwiener (2006), "Fiscal Policy Rules for Stabilisation and Growth: A Simulation Analysis of Deficit and Expenditure Targets in a Monetary Union", *Journal of Policy Modeling*, Vol. 28.

Brunila, A. and C. Martinez-Mongay (2002), "Fiscal Policy in the Early Years of EMU", in M. Buti and A. Sapir (eds.), *EMU and Economic Policy in Europe*, Edward Elgar, UK and USA.

Buti, M. and A. Sapir (eds.) (1998), *Economic Policy in EMU*, Oxford, Clarendon Press.

Buti, M. (2002), "Public Finances in the Early Years of EMU: Adjusting to the New Policy Regime", paper presented at a workshop organized by the Fundación por la Modernización de España, Madrid, October.

Buti, M. and L.R. Pench (2004), "Why Do Large Countries Flout the Stability Pact? And What Can Be Done About It?", *Journal of Common Market Studies*, Vol. 42, No. 5, pp. 1025-32, December, Blackwell Publishing.

Buti, M. and P. van den Noord (2003), "Discretionary Fiscal Policy and Elections: the Experience of the Early Years of EMU", OECD, Economic Department, Working Paper, No. 351.

————— (2004), "Fiscal Discretion and Elections in the Early Years of EMU", *Journal of Common Market Studies*, Vol. 42, No. 4, pp. 737-56.

Cohen, D. and G. Follette (2003), "Forecasting Exogenous Fiscal Variables in the United States", paper presented at the Public Finance Workshop in Seville, Spain, October.

Drazen, A. (2001), "The Political Business Cycle after 25 Years", *NBER Macroeconomics Annual 2000*, Cambridge (MA), MIT Press.

European Commission (2001), "Public Finance in EMU – 2001", *European Economy*, Reports and Studies, No. 3.

―――――― (2006), "Public Finance in EMU – 2006 – Part IV, Fiscal Policy in Good Times", *European Economy*, Reports and Studies, No. 3.

Feldstein, M. (2005), "The Euro and the Stability Pact", *Journal of Policy Modeling*, Vol. 27, No. 4.

Forni, L. and S. Momigliano (2004), "Cyclical Sensitivity of Fiscal Policies Based on Real-Time Data", *Applied Economics Quarterly*, Volume 50, No. 3.

Franzese, R.J. (2000), "Electoral and Partisan Manipulation of Public Debt in Developed Democracies", in R. Strauch and J. von Hagen (eds.), *Institutions, Politics and Fiscal Policy,* Kluwer Academic Publishers.

Galí, J. and R. Perotti (2003), "Fiscal Policy and Monetary Integration in Europe", *Economic Policy*, No. 37, October.

Hallerberg, M. and R. Strauch (2002), "On the Cyclicality of Public Finances in Europe", *Empirica*, Vol. 29, No. 3, pp. 183-207.

Hansen, L. (1982), "Large Sample Properties of Generalized Method of Moments Estimators", *Econometrica*, Vol. 50, No. 3.

IMF (2004), *World Economic Outlook*, No. 74, September.

Larch, M. and M. Salto (2003), "Fiscal Rules, Inertia and Discretionary Fiscal Policy", *European Economy*, Economic Papers, monographic issue, No. 194, October.

Levi, M.D. (1973), "Errors in Variables Bias in the Presence of Correctly Measured Variables", *Econometrica,* Vol. 41, No. 5.

Manasse, P. (2006), "Pro-cyclical Fiscal Policy: Shocks, Rules, and Institutions – A View from MARS", IMF, Working Paper, January.

Mélitz, J. (2000), "Some Cross-country Evidence About Fiscal Policy Behaviour and Consequences for EMU", *European Economy*, No. 2.

―――――― (2002), "Debt, Deficits and the Behaviour of Monetary and Fiscal Authorities", in M. Buti, C. Martinez-Mongay and J. von Hagen (eds.), *The Behavior of Fiscal Authorities – Stabilization, Growth and Institutions*, Palgrave.

Mink, M. and J. de Haan, "Has the Stability and Growth Pact Impeded Political Budget Cycles in the European Union?", CESifo Working Paper, No. 1532, September.

Mohr, M. (2005), "A Trend-Cycle(-Season) Filter", European Central Bank, Working Paper, No. 499, July.

OECD (2003), *Economic Outlook*, No. 74, December.

Orphanides, A. (1998), "Monetary Policy Evaluation with Noisy Information", Federal Reserve Board Finance and Economics Discussion Series, No. 1998/50.

———— (2001), "Monetary Policy Rules Based on Real-time Data", *American Economic Review*, Vol. 91, No. 4, September.

Orphanides, A. and S. van Norden (2002), "The Unreliability of Output-gap Estimates in Real-time", *The Review of Economics and Statistics*, Vol. 84, No. 4.

Rogoff, K. and A. Siebert (1988), "Elections and Macroeconomic Policy Cycles", *Review of Economic Studies*, Vol. LV, pp. 1-16.

Routledge (2005), *The Europa World Year Book 2005*, 46th edition, London and New York, Routledge.

Taylor, J.B. (2000), "Reassessing Discretionary Fiscal Policy", *Journal of Economic Perspectives*, Vol. 14, No. 3.

van den Noord, P. (2002), "Automatic Stabilizers in the 1990s and Beyond", in M. Buti, C. Martinez-Mongay and J. von Hagen (eds.), *The Behavior of Fiscal Authorities – Stabilization, Growth and Institutions*, Palgrave.

von Hagen, J. (2002), "More Growth for Stability – Reflections on Fiscal Policy in Euroland", ZEI Policy Paper, June.

von Hagen, J., A.H. Hallett and R. Strauch (2002), "Quality and Success of Budgetary Consolidation", in M. Buti, C. Martinez-Mongay and J. von Hagen (eds.), *The Behavior of Fiscal Authorities – Stabilization, Growth and Institutions*, Palgrave.

Wyplosz, C. (1999), "Economic Policy Coordination in EMU: Strategies and Institutions", ZEI Policy Paper, No. B11.

STRUCTURAL BALANCE AND "STRUCTURAL EFFORT"

Dan Lévy and Jean-François Ouvrard[*]

Introduction

The evolution in the public balance reflects both fiscal policy decisions and the impact of cyclical evolutions. In attempting to characterise the orientation of fiscal policy, it is *a priori* natural to adjust for the impact of the economic cycle on the public finances. This exercise is important as much for the management of public finances as for the conduct of macroeconomic policy.

There seems to be no dispute regarding either the utility of the calculation or its methodological base. The method used, which is broadly common to all the international organisations, consists of evaluating the cyclical component of the general government balance on the basis of measurement of the economy's position in the cycle (captured by taking the output gap). The so-called "structural" balance is then obtained by deducting this cyclical component from the observed balance.

In practice, however, measurement of the structural balance raises a certain number of difficulties. In the first place, it turns out to be sensitive to the measurement of the economy's position in the cycle, which may be differently assessed by different institutions. These differences in the diagnosis of the cyclical situation then have an impact on the construction of the absolute level of the structural balance. In addition, the calculation method is based on a set of assumptions that are more or less open to question. In particular, it assumes that "spontaneous" tax revenue evolves in line with activity. While this property seems to be verified econometrically over the long term, it constitutes a very strong conventional assumption for the short term and one that is not verified in practice.

This latter difficulty has an important consequence, namely that it substantially blurs the interpretation of the structural balance when attempts are made to identify the portion of the evolution in the public balance that is attributable to discretionary decisions on the part of the authorities. This means that the concept of structural balance is a very imperfect measure for characterising the orientation of fiscal policy. It is in fact conceived as the "residual" between the observed balance and its cyclical component, the result being that any factor that does not explicitly appear in the cyclical balance is, by construction, of a structural nature. This is true in particular for the interpretation of short-term fluctuations in the elasticity of revenue: the calculation conventions used in the method lead to interpreting these fluctuations entirely as part of the variations in the structural balance, whereas in fact, by their very nature, they lie outside the control of the fiscal authorities and therefore are not subject to discretionary decision.

[*] Public Finance Outlook Division, Treasury and Economic Policy Directorate General, French Ministry of Finance. E-mail: jean-francois.ouvrard@dgtpe.fr

What is probably a more satisfactory measure of the discretionary component of public finances has been proposed in the "Economic, Social and Financial Report" annexed to the 2004 Budget Bill, using the notion of "structural effort". This "structural effort" singles out two factors: the gap between the growth in public expenditure and potential growth, which may be called the "structural expenditure effort" and the new measures relating to compulsory levies collected by the whole of general government. In fact, the structural effort in any case merely identifies a part of the factors relating to the evolution in the structural balance and an accounting breakdown makes it possible to move from one concept to the other by means of certain adjustments: elasticity effect, timelag between "chargeable event" and collection of certain taxes (personal income tax and corporation tax), and the evolution in revenue excluding compulsory levies.

An approach of this kind is still open to improvement. The simplest would be to adjust the discretionary expenditure effort to allow for that part of spending that can be regarded as "automatic", in particular interest charges and unemployment-related expenditure. This adjustment marginally modifies the calculation.

At a more fundamental level, however, the method remains asymmetrical in its treatment of expenditure and revenue. On the revenue side, the structural effort does indeed single out the new measures taken by public decision-makers – in the legal sense. On the other hand, for lack of an evaluation of the "new measures" on the expenditure side, reasoning of a statistical nature is adopted by comparing growth in expenditure with potential growth. However, the reference to potential growth as the yardstick for distinguishing discretionary expenditure from non-discretionary expenditure seems to be highly conventional.

1. The public balance fluctuates with the economy's position in the cycle

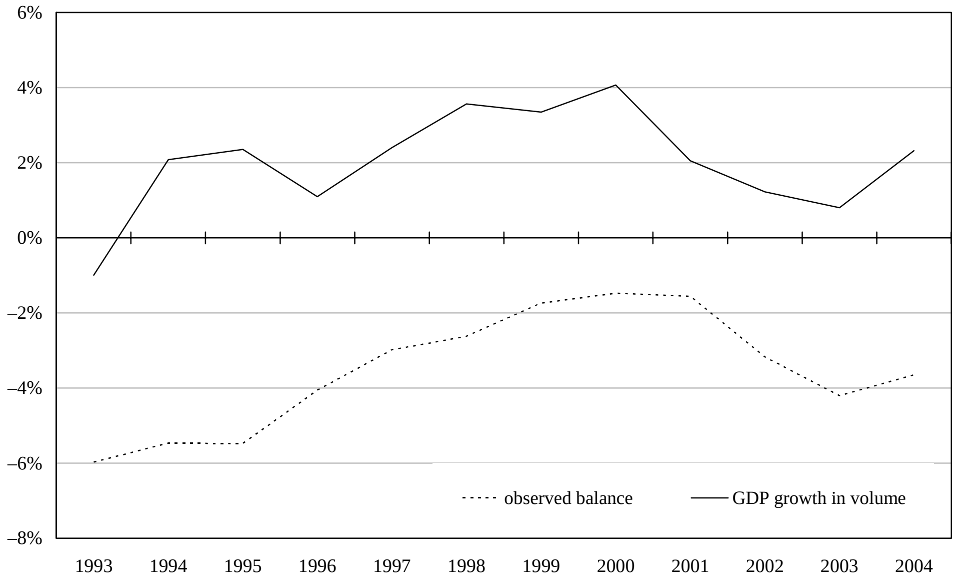
The evolution in the general government balance in part reflects cyclical fluctuations in the economy. In the trough of the cycle, there is a shortfall of revenue and a surplus of expenditure, while in more favourable periods, the public deficit is improved as a result of higher tax revenue and a decline in certain social welfare benefits.

A large part of public expenditure is fairly inert and turns out to be independent of the economy's position in the cycle (for example, civil service remuneration, pensions, health care, infrastructure). Major exceptions to this rule, however, are unemployment benefits and income support for jobseekers, such as the French "revenu minimum d'insertion".

Revenue, on the other hand, turns out to be sensitive to cyclical evolutions in the respective taxable bases. For example, VAT revenue (assessed on household consumption and corporate investment), corporation tax, personal income tax and social security contributions (assessed on the total wage bill and hence sensitive to

Figure 1

Public Balance and Cyclical Fluctuations



the productivity cycle and the situation on the labour market) fluctuate in response to shocks affecting the economy.

2. The structural balance: the public balance adjusted for cyclical fluctuations

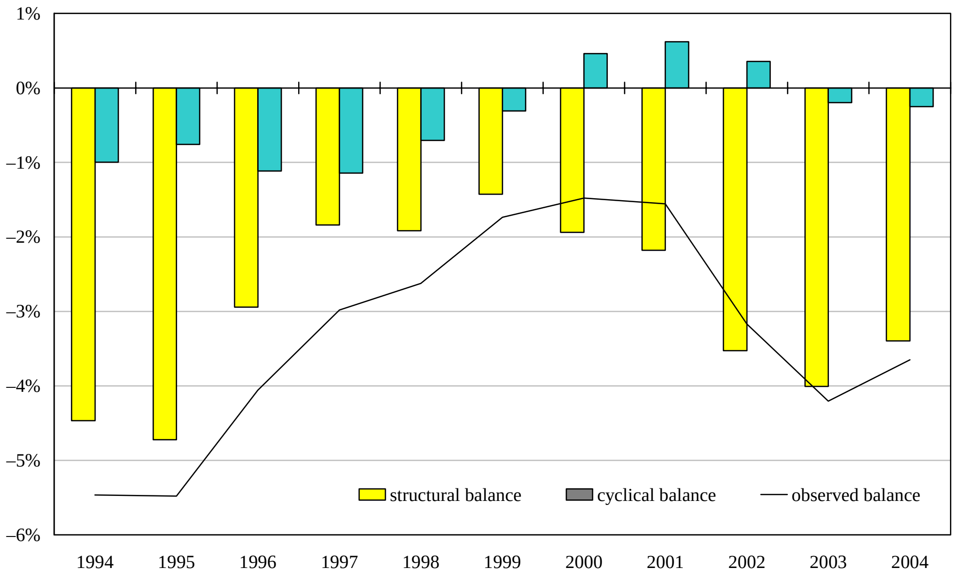
In seeking to characterise the orientation of fiscal policy, it is desirable to adjust the evolution in public finances for the effects of cyclical fluctuations. The method used consists of evaluating the cyclical component of the general government balance on the basis of measurement of the economy's position in the cycle (captured by taking the output gap). The so-called "structural" balance is then obtained by deducting this cyclical component from the observed balance.

2.1 A measure of the economy's position in the cycle: the output gap

The economy's position in the cycle is generally assessed by means of the "output gap", defined as the difference between observed GDP and its potential level, *i.e.* the level that is sustainable without either inflationary or deflationary tensions. Potential GDP is itself calculated on the basis of a production function linking value added to the factors of production (labour and capital) and to total

Figure 2

Structural and Observed General Government Balance



factor productivity – or technical progress. In periods of demand shortfall the output gap is negative; in periods of excess demand, positive.

2.2 *The structural balance: the public balance adjusted for cyclical fluctuations*

There seems to be no dispute regarding the methodological underpinnings of the calculation, which are common to all the international organisations. Cyclical revenue is obtained by adjusting actual revenue on the basis of the elasticities of the principal taxes to the output gap.[1] To be more precise, for a given tax T, we have:

$$T_c = T^* \,(Y - Y^*/Y^*)^{\alpha}$$

where T_c denotes the cyclical portion of the revenue from tax T and α the elasticity of the tax to the output gap $Y - Y^*/Y^*$.

Certain organisations introduce a refinement into the method in order to take account of the timelag between the "chargeable event" (evolution in the taxable base) and the actual collection of certain taxes that are paid following a one-year timelag (personal income tax or corporation tax). For these taxes, the output gap taken as reference is not the contemporaneous gap but that of the previous year.

[1] The elasticity of a given tax to the output gap is a measure of the sensitivity of the evolution in the tax to variations in activity.

Box 1
The calculation of the structural balance

This box gives a somewhat more formal presentation of the calculation of the structural balance. Let S denote the public balance, R the revenue and D the expenditure. Subscript c identifies cyclical values and subscript s structural values. Finally, Y represents observed GDP, Y^* potential GDP and $(Y - Y^*)/Y^*$ the output gap.

Cyclical adjustment, revenue side

For each revenue item R, we have:

$$R_c = R\left(\frac{Y - Y^*}{Y^*}\right)^{\alpha}$$

where α represents the elasticity of revenue item R to the output gap.

Certain organisations introduce a refinement into the method in order to take account of the timelag between the evolution in the taxable base – which constitutes the "chargeable event" – and the actual collection of the tax. This is the case in France for personal income tax and corporation tax, for which the output gap taken as reference is not the contemporaneous gap but that of the previous year. For taxes of this kind, the previous relationship becomes:

$$R_c = R\left(\frac{Y_{-1} - Y_{-1}^{\ *}}{Y_{-1}^{\ *}}\right)^{\alpha}$$

Cyclical correction, expenditure side

Most public expenditure is not directly affected by cyclical fluctuations. Unemployment benefits and income support for jobseekers like the French RMI are exceptions to this rule, however. These are captured by applying a method based on Okun's Law:

$$D_c = D\left(\frac{U - U^*}{U^*}\right)^{\eta}$$

where η is the elasticity of expenditure on unemployment benefits and jobseekers' income support to the gap between observed unemployment U and structural unemployment U^*, *i.e.* $(U - U^*/U^*)$.

The cyclical balance can then be derived as:

$$S_c = R_c - D_c$$

as can the structural balance:

$$S_s = S - S_c$$

On simple assumptions (no allowance for the income and corporation tax timelag, unit elasticity of total revenue to the output gap, no impact of the cycle on expenditure), the evolution in the structural balance is then easily deduced from the evolution in the output gap:

$$\Delta\left(\frac{S_c}{Y}\right) = \delta * \Delta(\text{output gap})$$

where δ denotes revenue as a share of GDP (slightly below 0.5 in the case of France). The evolution in the structural balance can then be written:

$$\Delta\left(\frac{S_S}{Y^*}\right) = \Delta\left(\frac{S}{Y}\right) - \delta * \Delta(\text{output gap})$$

Expenditure is in large part insensitive to cyclical fluctuations and is therefore considered as structural, with the exception of unemployment compensation and spending on income support measures for jobseekers such as the French "revenu minimum d'insertion", which are treated similarly to revenue using an Okun's Law method. To be more precise, if IC denotes unemployment benefits, IC^* the structural portion of these benefits, U^* the equilibrium unemployment rate, U the observed unemployment and η the elasticity of unemployment benefits to variations in unemployment (of the order of 0.4), we have:

$$IC^* = IC\ (U^*/U)\eta$$

2.3 The limitations of the cyclical adjustment

In practice, the measurement of the structural balance poses two major difficulties. In the first place, it is sensitive to the measurement of the economy's position in the cycle, which may be differently assessed as between one institution and another (there are in fact numerous methods for estimating the output gap: production function, log-linear trend, statistical method using a filter). Divergences in the diagnosis of the cyclical situation are then passed on into the construction of the structural balance in absolute terms.

In the second place, the structural balance is calculated as a "residual" between the observed balance and the cyclical portion of the public balance, meaning that all factors that do not explicitly appear in the cyclical balance are, by construction, regarded as structural in nature. This is particularly true of fluctuations in the elasticity of revenue to the level of activity. In fact, the calculation of the cyclical balance is based on a conventional assumption regarding the elasticity of revenue, so that any gap between the observed elasticity and this conventional elasticity automatically affects the structural balance. In this respect, the method poses two problems:

(i) Relating the sensitivity of revenue directly to the output gap rather than to the respective specific taxable bases contains a strong assumption, being in fact tantamount to assuming that all the taxable bases move on average directly in line with GDP. In practice, however, the impact of a macroeconomic shock on the public balance depends on the structure of demand. For example, an external shock (from world demand, for example) is propagated to activity via a decline in exports and hence has no direct impact on the public balance. The usual timelags for adjustment in employment and wages delay the impact on household income, which itself takes time to bring about a decline in consumption (and hence in VAT revenue). By contrast, the impact on the public balance of an internal shock on activity of the same magnitude (fall in the household saving ratio, for example) is not the same, inasmuch as its impact on VAT revenue is immediate. It will therefore be seen that evaluating the impact of the cyclical situation on the public balance using as sole indicator the output gap constitutes a substantial approximation.

(ii) The specific features of the tax system produce a divergence between the evolution in "spontaneous" revenue (revenue in the absence of new measures) and the evolution in taxable bases: the progressive nature of personal income tax and the timelag between the taxable base applied (the "chargeable event") and the actual collection of the tax (income and corporation tax) introduce divergences between the evolution of the taxable base and of the corresponding revenue.

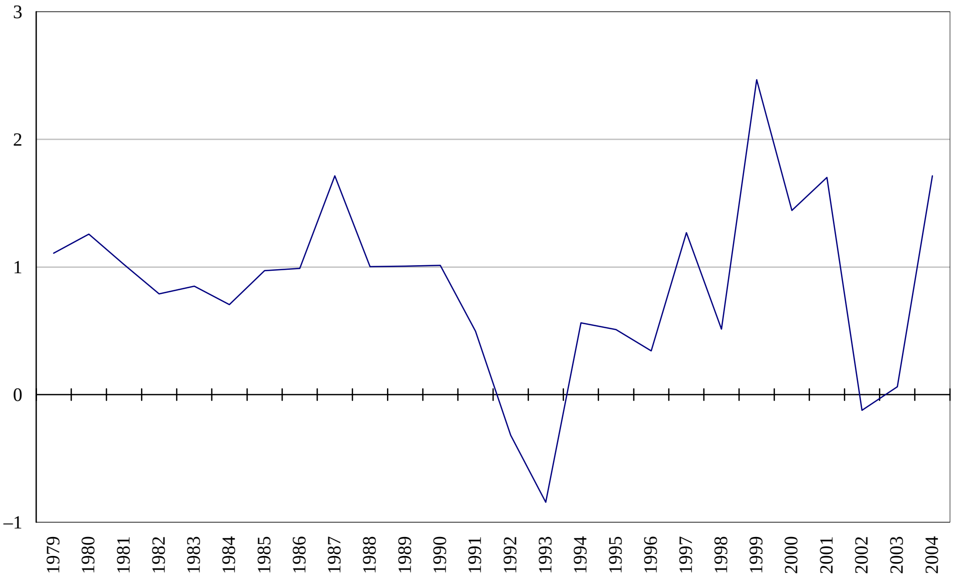
3. A proposed measure of the discretionary component of public finances

3.1 The structural balance is not a measure of the discretionary component of public finances

The adoption of a conventional elasticity has one major consequence: it considerably blurs the interpretation of the structural balance when an attempt is made to identify the portion of the evolution in the public balance that is attributable to discretionary decisions on the part of the authorities. This means that the concept of structural balance is a highly imperfect measure for characterising the orientation of fiscal policy, notably because of short-term fluctuations in revenue elasticities, which, because of the calculation conventions used, are classified entirely as variations in the structural balance, whereas, by their nature, these evolutions lie

Figure 3

Elasticity of Central Government Tax Revenue



outside the control of the fiscal authorities and therefore can in no way be regarded as discretionary.

Moreover, revenue items other than compulsory levies (non-tax revenue of central government, for example) are by their nature not regarded as being cyclical and therefore are implicitly included in the structural balance, although treating them as being entirely discretionary is debatable.

3.2 A first measure of the discretionary component: the "discretionary effort"

One measure of the discretionary component of public finances that is probably more satisfactory than the structural balance has been proposed in the "Economic, Social and Financial Report" annexed to the 2004 Budget Bill, based on the notion of "structural effort". This "structural effort" singles out two factors: the gap between the rise in public expenditure and potential growth, which can be called the "structural expenditure effort" and the new measures relating to the compulsory levies collected by all parts of general government. This means the exclusion of revenue other than compulsory levies as well as variations in the structural balance due to movements in revenue elasticities.

De facto, the structural portion of the public deficit is indeed related to the structural expenditure margin and to the new measures relating to compulsory levies. The "structural effort" merely isolates a part of the factors relating to the evolution in the structural balance and an accounting breakdown makes it possible to move from one concept to the other by means of certain adjustments, as shown in Table 1:

- the elasticity effect: between 1999 and 2001, the apparent elasticity of revenue was temporarily higher than unity, a fact which contributed to the improvement in the structural balance, but without this improvement stemming from discretionary decisions. Conversely, when revenue elasticity is below unity (as has been the case in 2002 and 2003), the result is to widen the structural balance;
- the timelag in the case of certain taxes between the evolution in the taxable base and actual collection (income and corporation tax), which tends to worsen the structural balance in times of cyclical slowdown;
- the evolution in revenue other than compulsory levies;
- expenditure adjustment related to unemployment compensation.

Table 1

Breakdown of the Structural Balance

	1998	1999	2000	2001	2002	2003	2004
Observed balance	**–2.6**	**–1.7**	**–1.5**	**–1.6**	**–3.2**	**–4.2**	**–3.6**
Structural balance : absolute level	–1.9	–1.4	–2.0	–2.2	–3.6	–4.0	–3.4
Structural balance: year to year change	**–0.1**	**0.5**	**–0.5**	**–0.2**	**–1.3**	**–0.4**	**0.6**
Discretionary variation in the structural balance	**0.8**	**–0.6**	**–1.2**	**–1.0**	**–1.1**	**–0.1**	**0.2**
New measures relating to compulsory levies	*0.3*	*–0.2*	*–1.2*	*–1.0*	*–0.4*	*0.2*	*0.1*
Gains due to the divergences between growth in expenditure and in GDP	*0.5*	*–0.4*	*0.0*	*0.1*	*–0.7*	*–0.3*	*0.1*
Non-discretionary component	**–0.8**	**1.1**	**0.6**	**0.7**	**–0.2**	**–0.4**	**0.4**
Revenue other than compulsory levies	*–0.3*	*–0.1*	*0.3*	*0.2*	*0.0*	*–0.2*	*–0.1*
Income and corporation tax timelag	*0.1*	*0.0*	*0.1*	*–0.2*	*–0.1*	*0.0*	*0.1*
Unemployment adjustement	*0.0*	*0.0*	*–0.1*	*0.0*	*0.0*	*0.1*	*0.0*
Effect of spontaneous elasticity of compulsory levies	*–0.5*	*1.3*	*0.3*	*0.7*	*–0.2*	*–0.2*	*0.3*

Box 2
Structural effort and breakdown of the structural balance

This box proposes a formal linkage between the structural balance and the structural effort calculated in the "Economic, Social and Financial Report", distinguishing the structural expenditure effort and the structural revenue effort.

Breakdown, expenditure side

We have, using the same notation conventions as in Box 1:

$$Ds = D - Dc$$

The adjustment related to spending on unemployment compensation and *RMI*, D^{unem}, can be written:

$$D_c = D^{cho}\left(\frac{U - U^*}{U^*}\right)^{\eta}$$

hence:

$$\Delta\left(\frac{\mathrm{D_c}}{\mathrm{Y^*}}\right) = \eta\frac{D^{cho}}{Y^*}\Delta UG$$

where UG represents the relative divergence between observed unemployment and structural unemployment.

The evolution of the share of expenditure in potential GDP can be written:

$$\Delta\left(\frac{\mathrm{D}}{\mathrm{Y^*}}\right) = \frac{\mathrm{D_t}}{\mathrm{Y^*_t}} - \frac{\mathrm{D_{t-1}}}{\mathrm{Y^*_{t-1}}} = \frac{\mathrm{D_{t-1}}}{\mathrm{Y^*_{t-1}}}\left(\frac{D_t}{Y^*_t}\frac{Y^*_{t-1}}{D_{t-1}} - 1\right) = \frac{\mathrm{D_{t-1}}}{\mathrm{Y^*_{t-1}}}\left((d+1)(1-y*)-1\right)$$

where d is the nominal growth in public expenditure and y^* the nominal growth in potential GDP. The evolution in the share of the structural expenditure in potential GDP (corresponding to the contribution of expenditure to the evolution in the structural balance) can then be written:

$$\Delta\left(\frac{\mathrm{D_s}}{\mathrm{Y^*}}\right) = \Delta\left(\frac{D}{Y^*}\right) - \Delta\left(\frac{D_c}{Y^*}\right) = \frac{\mathrm{D_{t-1}}}{\mathrm{Y^*_{t-1}}}(d - y*) - \eta\frac{D^{cho}}{Y^*}\Delta UG$$

where d is the nominal growth in public expenditure and y^* the nominal growth in potential GDP.

The first term is regarded as discretionary and is taken as forming part of the structural effort. This is not true of the second term, which represents the cyclical expenditure adjustment related to unemployment compensation.

Breakdown, revenue side

Let ε denote the observed elasticity of tax revenue to activity. In what follows, the conventional reference elasticity used in the calculation of the cyclical balance α (see Box 1) is assumed to be unity. *MN* denotes the new measures. The elasticity ε verifies the following relationship:

$$\varepsilon \frac{dY}{Y} = \frac{\Delta R - MN}{R}$$

The variation in structural revenue can be written:

$$\Delta R_S = \Delta R - \Delta R_c = \left(MN + \varepsilon \frac{dY}{Y} R \right) - \left(R - R^{ret} \right) \Delta (OG) - R^{ret} \Delta (OG)_{-1}$$

where R^{ret} denotes the "retarded" revenue (in practice, income and corporation tax) and OG the output gap. We then have:

$$\Delta \left(\frac{R_S}{Y^*} \right) = \frac{R_S}{Y^*} - \frac{R_S}{Y^*} \Bigg)_{t-1} = - \frac{R_S}{Y^*} \Bigg)_{t-1} y* + \frac{\Delta R_S}{Y^*}$$

The contribution of revenue to the evolution in the structural balance can then be written, ignoring second-order magnitudes, as follows:

$$\Delta \left(\frac{R_S}{Y^*} \right) = \frac{MN}{Y^*} + (\varepsilon - 1) \frac{R}{Y^*} \frac{dY}{Y} + \frac{R^{ret}}{Y^*} \Delta\Delta OG$$

The first term, which represents the contribution of new measures relating to compulsory levies to the evolution in the structural balance, is discretionary by nature. On the other hand, the second and third terms, representing respectively the contribution of variations in revenue elasticity to the evolution in the structural balance and the impact of the income and corporation tax timelag are not discretionary by nature.

3.3 The "discretionary effort" is still nevertheless an imperfect measure of the discretionary component: some possible lines for improvement

The proposed calculation of the structural effort represents an appreciable improvement in the treatment of the revenue side in the measurement of the discretionary component of the public balance. The approach is nevertheless open to improvement. One simple improvement consists of adjusting the discretionary expenditure effort for a portion of expenditure that can be considered as "automatic" and, as such, unrelated to any discretionary decision. Such a portion would be, for example, the expenditure related to unemployment compensation and to interest charges on the debt. Taking these two adjustments into account would reduce the structural effort by around 1/10 of a point of GDP per year between 2000 and 2004.

At a more fundamental level, however, the method remains asymmetrical in its treatment of expenditure and revenue. On the revenue side, the structural effort does indeed single out the new measures corresponding to discretionary decisions in the legal sense of the term. On the other hand, for lack of an evaluation of the "new measures" on the expenditure side, the discretionary effort in this case is evaluated by reference to potential growth. This dividing line is essentially conventional. For certain items, potential growth does not in fact appear to be the most relevant basis for isolating the discretionary component of public expenditure: this is true, for example, in the case of public-sector wages and salaries.

This convention leads, moreover, to asymmetrical treatment of new measures on the revenue and expenditure sides. For example, the substantial (6.4 per cent) rise in 2003 in the ONDAM (official healthcare expenditure target) was greater than potential growth and therefore contributed to diminish the structural effort even though the new measures influencing the target were exclusively cost-cutting in nature (reduced or zero reimbursement of certain medicines, for example). Conversely, adjustments on the revenue side (higher taxes on tobacco) led to an improvement in the discretionary component of the public balance. An alignment of the two methods would result in contributions that were both positive.

WHICH FIGURES TO LOOK: CONFUSION OVER VARIOUS FISCAL INDICATORS

Masato Miyazaki[*]

Introduction

There can be many ways through which one tries to judge an economy's fiscal sustainability. Some may prefer focusing on the size of each year's fiscal deficit, e.g. in comparison with the economy's tax revenue, GDP, current and/or trade surplus, and the like. Others may emphasise the size of national debts, again in comparison with various parameters. Still others may think it more apt to look at the government's balance sheet (B/S) as a whole.

One caveat, however, is that the definitions of fiscal deficit, debt, and B/S can vary. One needs to take such differences into account when judging an economy's fiscal conditions, because different definitions could lead to different interpretations and to different conclusions.

This short note aims at discussing these differences and their consequences, relying on Japanese examples.

1. Fiscal deficit

The simplest definition of fiscal deficit is a balance between the given fiscal year's revenues and expenditures.[1] If the economy in question has access to capital markets, this balance usually corresponds with the new issuance of government bonds. In some cases, however, the gap may be closed by aid, borrowings from international organizations such as the IMF and the World Bank, credit from the central bank and so on.

1.1 General account

In Japan's case, the headline fiscal deficit for FY 2006 (April 2006 to March 2007) is JPY 30 trillion, which is the balance between the tax and other revenues (JPY 50 trillion) and the expenditures (JPY 80 trillion) in the so-called general account.[2] Of course, the gap is financed from the market solely by government bonds (JGBs) (Table 1).

---

* Budget Examiner at the Budget Bureau, Ministry of Finance of Japan. The views expressed in this note are, however, personal.

1 Although there often are multi-year spending authorizations in a budget, future spending should be counted against the revenue of the year in which such spending is made for the purpose of fiscal analysis.

2 General account is the main body of the Japanese government budget.

Table 1

General Account Budget Deficit
(in JPY billions)

	FY2006
Tax and Other Revenues (a)	49,713
Expenditures (b)	79,686
Balance (a)–(b)	–29,973
Balance to GDP *(percent)*	5.8

1.2 General and special accounts

In the budget systems around the world, there are often expenditures that are made outside the main body of the budget. Off-budget expenditures in the United States are but one example. In Japan, there are 31 special accounts outside the general account. Each of these special accounts is assigned with specific task, ranging from providing health insurance, and running motor vehicle inspection and registration services, to managing foreign currency reserves. Each account has its own revenues, such as insurance premia, charges, taxes, and transfers from the general and other accounts. Each account also has its own expenditures, which include insurance payments and transfers to other accounts.

If expenditures of the general account and all 31 special accounts are to be added up, the total is JPY 540 trillion, and revenues amount to JPY 572 trillion. However, the balance between these two figures does not have any relevance to judging Japan's fiscal health, since they include transfers among accounts. It is therefore more appropriate to "net out" these revenues and expenditures, which brings about the net expenditure of JPY 367 trillion and the net revenue of JPY 398 trillion (Table 2).

These figures may be meaningful in looking at the size of the funds that go through the national coffer. Still, information that implies the Japanese government has a fiscal surplus as large as JPY 31 trillion (!) will be grossly misleading.

The confusion stems from the fact that these figures are the result of adding up items that are quite different in nature. First, revenues include not just taxes and premium, but also funds raised by the issuance of bonds and bills. Likewise, expenditures include the repayment of principal and interests of bonds and bills, which makes both revenue and expenditure figures widely inflated. Second, unlike, e.g., building an airport or paying salaries for patent officers, insurance and re-insurance schemes operated through special accounts do not necessarily intend to

Table 2

General and Special Accounts Budget Balance
(in JPY billions)

	FY2006
Revenues	
General Account	79,686
31 Special Accounts	492,796
Gross Total	572,482
Overlaps + Transfers	174,769
Net Total (a)	397,713
Expenditures	
General Account	79,686
31 Special Accounts	460,386
Gross Total	540,072
Overlaps + Transfers	173,114
Net Total (b)	366,957
Balance (a)–(b)	30,756
Balance to GDP *(percent)*	6.0

balance the revenue and expenditure in each fiscal year in the first place.[3] Still, they are simply aggregated.

1.3 Central and local governments

Because the size of the local governments naturally differs across economies,[4] just comparing the size of the central governments' budgets may not be a good way for looking at an economy's fiscal conditions. There is no doubt, therefore, that

[3] It is usual the case for long-term insurance schemes that reserves are created to provide investment proceeds and thereby set the premium lower than actuarially required, and to save extra resources for the future when insurance payments may prove to exceed expectation.

[4] Local governments in federal economies such as the United States and Germany probably weigh much more than in centripetal economies such as France.

examining the “consolidated” budget balance of central and local governments is meaningful.

Japan, though no federation, has “big” local governments, because the central government entrusts local governments for implementing many of the government programmes and measures. Funds for those are paid out in the form of subsidies[5] and/or transfers from the central government to local governments, which expand the size of the latter.

There is a serious drawback, however. A “consolidated” budget balance of central and local governments cannot be produced timely, because this has to be done by collecting budget data from approximately 2,000 local governments of every level. In fact, the tally is published retrospectively two years after the end of the fiscal year in question, when accounts are settled.[6] Moreover, since the published figures are based on the general account (central government) and ordinary accounts (local governments), which leave out special accounts (central) and public corporations (local), it cannot be denied that these figures fail to show the whole fiscal picture (Table 3).

1.4 General government (System of National Accounts (SNA) basis)

When one wants to judge fiscal conditions of an economy as a whole, therefore, a good place to start is to look at the General Government figure that captures central government, local governments and social security funds. Even better, because it is a common method, figures based on it are suitable for international comparison. In fact, the OECD semi-annually publishes its members’ fiscal conditions on this basis (Table 7),[7] and the IMF encourages governments to produce SNA figures as part of the drive towards fiscal transparency.

On its part, the Japanese government publishes its General Government fiscal balance on the SNA basis when a budget is submitted to Diet (Parliament) in

---

5 The central government usually funds one-third to one-half of the programme.

6 It is true that an estimated aggregate local government budget (Local Public Finance Programme, or LPFP) is formulated at the same time as the central government budget, in order to calculate the financing gap of the aggregate local governments that are to be filled up by the central government’s expenditure through Local Allocation Tax Grants (LATG) and other transfers. So, on the LPFP basis, a prospective consolidated balance is available before a fiscal year starts.

The LPFP has fatal flaws, however. First, some important social security programmes, e.g. health and long-term care, carried out by local governments with the financial assistance from the central government are not included. Second, and even more seriously, the LPFP, which is assembled by the interior ministry of the central government, is merely a forecast and does not regulate in any way the actual budgets of the local governments that are adopted by local parliaments. In fact, the aggregate expenditures of the local governments frequently turn out to be much larger than that foreseen by the LPFP. The contents of the expenditures also differ greatly from that predicted in the LPFP.

It is therefore not very meaningful to discuss local government’s fiscal situation in the coming fiscal year, based on the LPFP figures.

7 While the OECD figure is created by the OECD to show the balance on a calendar year basis, the Japanese government figure is on a fiscal year basis.

Table 3

Fiscal Balance of Central and Local Governments
(in JPY billions)

	FY 2003
Revenue	
Local Govt. Total Revenue (a)	94,887
o/w Transfers from Central Govt. (b)	31,130
Local Govt. Own Revenue (c)=(a)–(b)	63,757
Central Government Revenue (d)	50,278
Total Revenue (e)=(c)+(d)	114,035
Expenditures	
Local Govt. Total Expenditure (f)	92,582
Central Govt. Total Expenditure (g)	88,792
Overlaps and Transfers (h)	34,222
Total Expenditure (i)=(f)+(g)–(h)	147,152
Balance (e)–(i)	–33,117
Balance to GDP *(percent)*	6.6

January. Because of the above-mentioned limitation, however, local governments' fiscal balance has to be an estimate at the time of the publication, which is calculated using an econometric model. In other words, it is not a fact, and not even a manifestation of local governments' intentions (Table 4).

1.5 Central and local governments (SNA basis)

Because the General Government figure includes social security funds, which may not necessarily be designed to achieve annual balance, it may be sometimes misleading if annual fiscal analyses are made based on the General Government figures. For this reason, the proclaimed goal of the Japanese government, *i.e.* achieving a primary surplus by early 2010s, is targeted to the fiscal balance of General Government less social security funds (Table 5).

Table 4

Financial Balance of General Government on the SNA Basis
(in JPY billions)

	FY 2004	FY 2005 (E)	FY 2006 (E)
Central Government	–26,946	–25,195	–23,126
Local Governments	–2,719	–2,016	–1,028
Social Security Funds	2,035	0	–1,028
Total	–27,631	–27,211	–25,695
Balance to GDP *(percent)*	5.6	5.4	5.0

Table 5

Financial Balance of Central and Local Governments on the SNA Basis
(in JPY billions)

	FY 2004	FY 2005 (E)	FY 2006 (E)
Central Government	–26,946	–25,195	–23,126
Local Governments	–2,719	–2,016	–1,028
Total	–29,665	–27,211	–24,154
Balance to GDP *(percent)*	5.8	5.4	4.7

Table 6

Primary Balance of Japan on the SNA Basis
(in JPY billions)

	FY 2004	FY 2005 (E)	FY 2006 (E)
Central Government	–20,810	–18,644	–16,445
Local Governments	1,226	1,512	2,056
Total	–19,584	–16,629	–14,389
Balance to GDP *(percent)*	3.9	3.3	2.8

Source for the tables in this page: Cabinet Office.
Note: The published estimates for FY 2005 and 2006 contain only the proportion to GDP. The balance figures shown here are calculated with the proportion number and the GDP estimates.

1.6 Primary balance

As a global trend, more attention has been paid recently to the primary balance when considering an economy's fiscal soundness. Primary balance is a measure that looks at how far revenues other than borrowing can, or cannot, cover expenditures other than debt services. If the primary balance is neither in deficit nor in surplus, the economy in question is in a position to finance all policy expenses by funds that need not be repaid, such as tax. In other words, the economy's debt outstanding increases by the exact amount of its interest payments. If the interest rate is the same as the nominal GDP growth rate, the economy's debt-to-GDP ratio will stay the same. In this sense, looking at the primary balance of the economy is a simple but useful method to judge whether its fiscal path is heading for an increasing debt-to-GDP ratio and ultimately unsustainable fiscal conditions[8] (Table 6).

2. Debt

Debt level is as important a yardstick, if not more, as deficit level, in analysing an economy's fiscal sustainability. It is usually discussed in comparison with GDP or export earnings (when overseas borrowing is high), but there is no established threshold beyond which an economy's fiscal sustainability comes into question. To cite one example, although Japan's debt outstanding, measured on the JGB (Japanese Government Bonds) basis, is more than 100 per cent of GDP, the market so far remains calm about it and demands little premium, while Argentine defaulted when her public debt was a "mere" 60 per cent of GDP in 2001. This is not to say that economies can sit back and be relaxed about their debt-to-GDP ratio: on the contrary, they need to be vigilant even when the ratio is relatively low, since the market may pull the carpet from under their feet at any moment if investors get scared by developments in other conditions and indicators.

Discussion becomes more complicated, however, because definition of debt can vary across economies. Moreover, even within one economy, debt may mean many things.

2.1 What is debt: in Japan's case

2.1.1 JGB outstanding

Most narrowly, "debt" means JGB outstanding. This includes not only bonds that have been issued to finance each year's revenue shortfall, but also those that

---

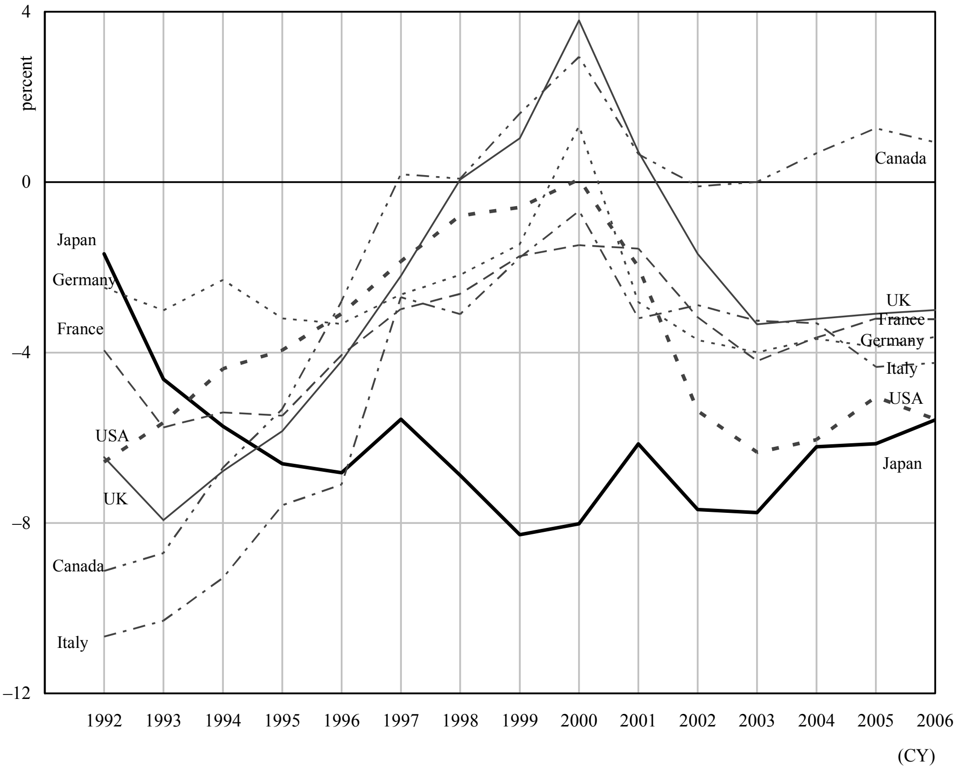
8 Needless to say, even when the debt-to-GDP ratio is stable, if the ratio itself is regarded by the market as too high, it will still leave an economy in a vulnerable position. In this sense, it is important to note that a primary balance is but an interim target: the ultimate goal is to achieve a primary surplus, so that the actual debt level can be reduced.

Table 7

General Government Financial Balances – International Comparison
(percent of GDP)

(CY)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Japan	–1.7	–4.6	–5.7	–6.6	–6.8	–5.6	–6.9	–8.3	–8.0	–6.1	–7.7	–7.8	–6.2	–6.1	–5.6
United States	–6.6	–5.6	–4.4	–3.9	–3.1	–1.9	–0.8	–0.6	0.1	–2.0	–5.4	–6.3	–6.0	–5.0	–5.6
United Kingdom	–6.5	–7.9	–6.8	–5.8	–4.2	–2.2	0.1	1.0	3.8	0.7	–1.7	–3.3	–3.2	–3.1	–3.0
Germany	–2.5	–3.0	–2.3	–3.2	–3.3	–2.6	–2.2	–1.5	1.3	–2.8	–3.7	–4.0	–3.7	–3.9	–3.6
France	–3.9	–5.8	–5.4	–5.5	–4.1	–3.0	–2.6	–1.7	–1.5	–1.6	–3.2	–4.2	–3.6	–3.2	–3.2
Italy	–10.7	–10.3	–9.3	–7.6	–7.1	–2.7	–3.1	–1.8	–0.7	–3.2	–2.9	–3.3	–3.3	–4.3	–4.2
Canada	–9.1	–8.7	–6.7	–5.3	–2.8	0.2	0.1	1.6	2.9	0.7	–0.1	0.0	0.7	1.3	0.9

Source: OECD Economic Outlook 78 (December 2005). Figures are calculated on an SNA basis.
Japan and United States: General government financial balance excluding social security.



have been issued to finance repayments of old debts.[9] As at end-FY 2006, debt according to this definition is forecast to reach JPY 542 trillion, or 105 per cent of GDP.

2.1.2 Central government borrowing

Apart from issuing JGBs, Japan's central government borrows directly from private banks and the FILP.[10] Such borrowing is expected to be around JPY 60 trillion, or 12 per cent of GDP, at end-FY 2006, most of which (about JPY 53 trillion) is for funding transfers from the central government to local governments.

2.1.3 Local government borrowing

Local governments also issue bonds and/or borrow from the private sector as well as from the FILP. Local government bonds are not guaranteed by the central government, though some of the borrowing from the market through a government-affiliated institution is indirectly guaranteed. Debt outstanding for local governments is estimated to be around JPY 204 trillion, or 40 per cent of GDP at end-FY 2006. Of this amount, approximately JPY 34 trillion, or 7 per cent of GDP, is in fact borrowed by the central government (to fund transfers to the local governments) but required to be repaid by the local governments.

2.1.4 FLF bonds

The central government issues the so-called Fiscal Loan Fund bonds (FLF bonds), which amounts to approximately JPY 141 trillion, or 27 per cent of GDP, at end-FY 2006. These bonds aim at financing the FILP, and not the budget expenditure. They are serviced and repaid by repayment from borrowing institutions, though it is not separately managed from JGBs. FLF bonds, therefore, are treated exactly the same as JGBs by the market. In other words, FLF bonds are outside the budget and their repayment do not rely on tax revenues, but still they are often seen as part of the government's debt.

2.1.5 FBs

The central government issues financing bills (FBs) for the purpose of efficient cash management. FBs are issued to fill the time gap of tax receipt and expenditure payment. Some FBs are also for financing the purchases of rice crops

---

9 To be very precise, there are special kinds of bonds other than JGBs, the purposes of which are not necessarily gap-financing. For instance, there are bonds given to families of the war dead, and promissory notes to international organisations. The outstanding amount of these bonds is about JPY 3 trillion.

10 The Fiscal Investment and Loan Programme (FILP) is a government-run scheme that raises funds cheaply from the market and recycle the money to worthwhile infrastructure and other programmes.

(that are sold in the markets at a later date), oil (that forms strategic reserves for a rainy day and will be sold in the market when it rains) and foreign currencies (that forms foreign reserves which may be sold in the market when currency interventions are made). The maturity of FBs is 13 weeks and usually repaid within the fiscal year, though FBs to finance purchases of above items may be rolled over across the fiscal years. For instance, at the end of FY 2006, maximum of JPY 142 trillion, or 28 per cent of GDP, worth of FBs may remain outstanding.

2.1.6 Contingency liability

The government guarantees debts of some government-affiliated institutions, including the Deposit Insurance Corporation that borrowed cheaply from the market to enhance the capital base of private banks following the banking crisis of 1997-98. These guarantees amount to approximately JPY 60 trillion, or 12 per cent of GDP, at end-FY 2006. Since they are contingent liability, it is unlikely that the government will have to assume the burden of repaying all JPY 60 trillion.

2.2 How much is Japan's debt?

The question arises, then, as to how large is Japan's debt after all. The answer may depend on who asks the question as well as the definition of "Japan" (Table 8).

JGB holders may primarily be interested in the debt servicing capacity of the central government, so that they may focus on the size of JGBs outstanding (JPY 542 trillion).

Because there is no practical distinction between them, investors may want to monitor the outstanding of all bonds that are issued by the central government by adding FLF bonds and other bonds to JGBs, reaching JPY 686 trillion (542+141+3), or 133 per cent of GDP.

If they want to focus on the capacity to repay debts through tax revenues, they may want to look at JGBs, other bonds and government borrowings, but take out FLF bonds, because there have hardly the cases when borrowing institutions were not able to repay their debts to the FILP. Such calculation makes the debt level of the Japanese government around JPY 605 trillion (542+3+60), or 118 per cent of GDP.

Furthermore, the capacity of the economy as a whole to raise taxes may be examined, because, for instance, if local governments impose a very heavy tax burden, room for raising more tax to repay the debts of the central government may be seen to be limited. If the market takes such a view, fewer people will remain willing to hold JGBs and lend to the government. In other words, outstanding bonds and borrowings of the public sector as a whole may be seen as more important than simply looking at the central government's. As such, aggregate debts of the central government and the local governments, JPY 775 trillion (605+170), or 151 per cent

Table 8

Selected Definitions of Debts
(in JPY trillions)

	Amount	Central government borrowings	Central government long-term bonds	Central government total bonds and bills	Public sector total bonds and bills (net)	Central government's actual and	Public sector's total actual and contingency debts
JGBs and other bonds	545	○	○	○	○	○	○
Central government borrowings	60	○	-	-	-	○	○
FLF bonds	141	-	○	○	○	○	○
FBs	142	-	-	○	○	○	○
Central government guarantees	60	-	-	-	-	○	○
Local governments bonds and borrowings	204	-	-	-	○	-	○
Total		605	686	828	998	948	1,118

Source: Ministry of Finance.
Note: When debts of the central and local governments are added up, a double-counted borrowing (JPY 34 trillion) needs to be deducted.

of GDP, may be seen as representing the yardstick for repayment capacity of Japan as a nation.

Alternatively, again looking at the central government, FBs outstanding may be added, because, in a very formal sense, FBs are a (temporary) transfer of funds from the private- to the public-sector, which the government promises to repay.[11] By including this amount, the indebtedness of the Japanese government will reach JPY 747 trillion (605+142), or 145 per cent of GDP.

Then, one may want to aggregate all bonds, bills and borrowings by the central government, including FLF bonds, which amounts to JPY 888 trillion (747+141), or 173 per cent of GDP.

Likewise, one may also want to aggregate all bonds, bills and borrowings by the public sector as a whole, which reaches JPY 1,058 trillion, or 206 per cent of GDP.

[11] By selling the rice, oil or foreign currencies in the markets, the government may finance much of the funds necessary to repay FBs.

Finally, pessimists may also want to take into account the government's contingency liabilities by adding up the government guarantees, though it will exaggerate the government's indebtedness. Such exercise will produce JPY 1,118 trillion, or 218 per cent of GDP.

No doubt there can be other combinations that will shed light on Japan's fiscal conditions from specific viewpoints. Cynics may say that various definitions do not make much difference, because they all are bad.

2.3 International comparison

Japan's debt levels, as shown above, cannot be compared directly with other economies', because budget systems vary widely across economies. For this reason, the OECD publishes international comparison of debt levels of the general government according to the SNA (Table 9 and Table 10).

Amongst the G7 economies, only Canada shows a constant decline in indebtedness since the mid-1990s: all others show modest increases in indebtedness since around 2000, after declining for a previous few years. Japan is the only economy that shows a constant, and steep, rise in indebtedness. It started the 1990s with relatively sound fiscal conditions, but by 2000 she had overtaken all others to win the gold medal of fiscal indebtedness, the speed not even seen on the piste of Turin.

According to the OECD Economic Outlook, Japan's gross General Government debts are forecast to reach 161 per cent of GDP in 2006 (Calendar Year).[12] On the other hand, in the net General Government debt league table, which the OECD also publishes, Japan's situation still appears bad, but not as bad as in the previous table. In fact, on this basis, Italy is the worst case among the G7.

It is not entirely clear what constitutes the difference between the gross figures and the net figures, but it is easy to imagine that assets of social security funds are among the largest assets that are subtracted from the gross debts to make the net figures.

This poses two issues.

Firstly, the net debt figure becomes much smaller than the gross figure, if an economy has a public pension system that has large reserves/provisions for future pension liabilities. Japan is an example of such economies.[13] On the contrary, if an

[12] This figure includes debts of local governments and some government-affiliated corporations, but not FLF bonds.

[13] Japan's system is domestically called "derivative pay-as-you-go system". Because the dependency ratio was low when the system was initially set up, it was felt fiscally sound to create a system, where the premium was set higher than necessary to finance a year's total pay-outs, and thus build up reserves which would be withdrawn when the dependency ratio gets higher so that the premium level can stay as low as possible. Needless to say, when the "raid" on the reserves starts, the economy's net General Government indebtedness will have to deteriorate.

Table 9

General Government Gross Debt – International Comparison

(percent of GDP)

(CY)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Japan	68.6	74.7	79.7	87.0	93.8	100.3	112.1	125.7	134.0	142.3	149.4	154.0	156.3	158.9	160.5
United States	73.7	75.4	74.6	74.2	73.4	70.9	67.7	64.1	58.1	58.0	60.3	63.4	64.0	63.8	64.6
United Kingdom	39.8	49.6	47.8	52.7	52.5	53.2	53.7	48.7	45.7	41.1	41.3	41.9	44.2	46.8	49.1
Germany	41.0	46.3	46.7	55.8	58.9	60.4	62.2	60.8	59.9	59.3	61.6	64.6	67.9	69.9	71.4
France	43.9	51.0	60.2	62.6	66.3	68.4	69.9	66.5	65.2	63.8	66.6	71.7	74.7	76.7	77.5
Italy	-	-	-	125.5	131.3	133.3	135.0	129.5	124.9	124.5	123.5	121.4	123.0	125.4	126.8
Canada	89.9	96.9	98.2	100.8	100.3	96.2	93.9	91.2	82.7	82.9	80.5	75.7	72.2	69.3	64.6

Source: OECD Economic Outlook 78 (December 2005). Figures are calculated on an SNA basis.

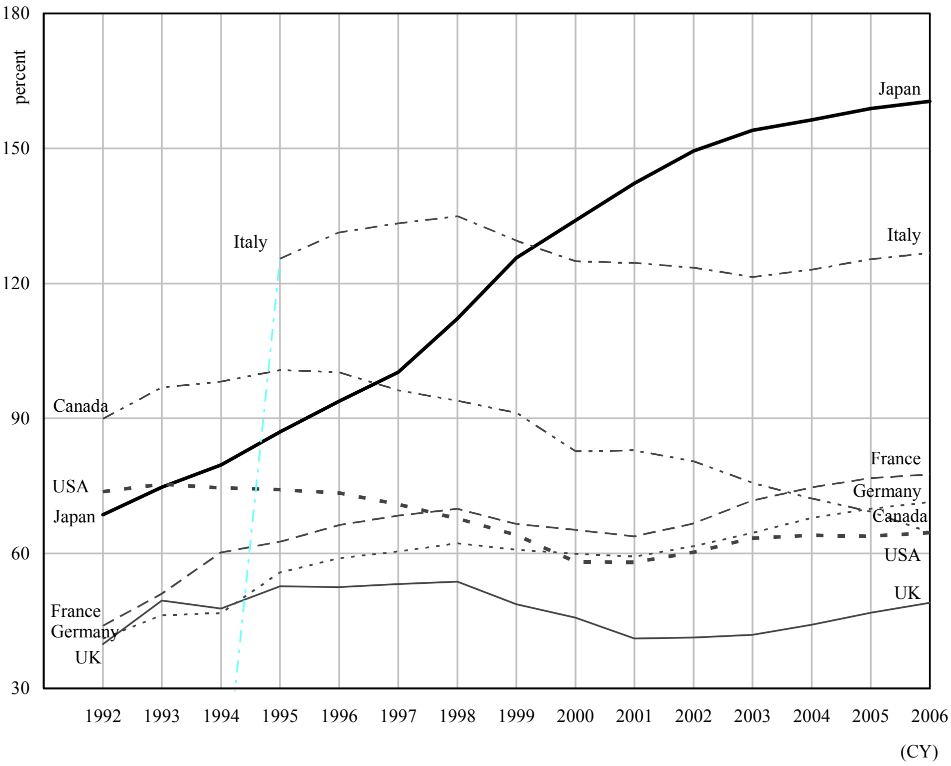


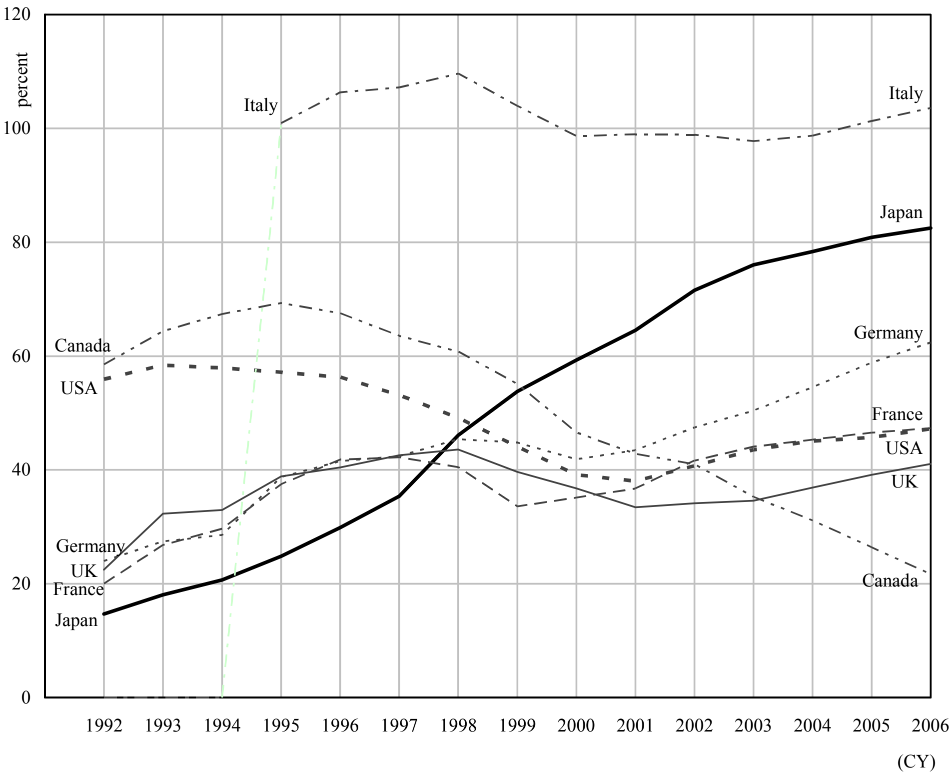
Table 10

General Government Net Debt – International Comparison

(percent of GDP)

(CY)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Japan	14.7	18.1	20.7	24.8	29.9	35.4	46.1	53.8	59.3	64.5	71.5	76.0	78.3	80.9	82.5
United States	55.9	58.4	57.9	57.2	56.3	53.1	49.1	44.1	39.2	38.0	40.7	43.5	45.1	45.7	47.2
United Kingdom	22.5	32.3	33.0	38.9	40.4	42.6	43.6	39.7	36.8	33.4	34.1	34.6	36.9	39.1	41.1
Germany	24.0	27.4	28.6	38.7	41.6	42.4	45.4	44.8	41.9	43.4	47.5	50.4	54.5	58.8	62.4
France	20.0	26.8	29.7	37.5	41.8	42.2	40.5	33.6	35.1	36.7	41.7	44.1	45.3	46.5	47.4
Italy	-	-	-	100.9	106.3	107.2	109.6	104.0	98.6	99.0	98.9	97.8	98.7	101.3	103.6
Canada	58.5	64.4	67.4	69.3	67.5	63.5	60.8	55.1	46.6	42.8	41.0	35.3	31.1	26.4	21.7

Source: OECD Economic Outlook 78 (December 2005). Figures are calculated on an SNA basis.



economy's pension system is closer to a pure pay-as-you-go system, in which there is little need for keeping large reserves, the General Government assets will be smaller than otherwise, and thereby the difference between net and gross debts will not be so large.

As long as actuarially sustainable, adopting any pension systems should not affect the government's fiscal sustainability. But, in practice, two economies with exactly the same gross debt positions will show quite different net debt pictures, simply because of a difference in the mechanics of their pension systems. This can be rather misleading.

Secondly, the purpose of showing net figures should be, in the first place, to disclose the final amount that the economy needs to repay by taxes. It implies that the assets will have been sold up by that time. In other words, it is a kind of (negative) liquidation value of an economy.

But, this is only theoretical. It is fanciful to assume that an economy can wind up its public pension system and sell all the assets that belong to it. Even if it were possible, not all assets can be sold to agents outside the public sector, particularly at the book value. Non-financial assets will be even harder to sell.

For these reasons, Japan, for one, has argued at the OECD to minimise influence of social security funds, when discussing member economies' fiscal conditions, and to emphasise the gross, rather than net, indebtedness.

3. Balance sheet

Like some economies,[14] the Government of Japan has been publishing a national B/S, which explains assets and liabilities on a stock basis, following closely, where appropriate, the private sector's accounting rules. As at end-FY 2003, liabilities are shown to exceed assets by approximately JPY 245 trillion. Simply put, this difference will need to be filled up by the future generation. In this sense, the national B/S is a powerful tool with which one judges an economy's fiscal conditions.

That said, there are a number of issues surrounding the B/S, which are still under discussion, so that the B/S approach must take into account various limitations.

For example, first, although the national B/S shows consolidated figures between the general and special accounts, local governments are not consolidated. This is because only about 60 per cent of the total local governments currently

---

14 The United States began publishing a B/S of the Federal Government in 1995, Britain started in FY 2001 and plans to issue a consolidated B/S (with local governments) from FY 2006, France initiated a trial in 1988, Australia started in FY 1996 and New Zealand began in 1991.

produce their B/S. Thus, at the moment, the national B/S shows only the B/S of the central government.[15]

Second, some assets of the central government may be valued in one way or another, but cannot be sold. For instance, it is difficult, if not impossible, to pin the market value to assets such as national parks, river banks, highways, and military bases.[16] Even if that were done, they are often not intended for sale. In this sense, recognising them as assets on the B/S may only be academic, since they will not help "repay" liabilities. In other words, the difference between assets and liabilities (JPY 245 trillion) is in truth much larger.

Third, there are debates about unrealised shortfall in the pension assets. There is a school that argues Japan's employee's pension insurance, the main pillar of the public pension system, lacks JPY 450 trillion in reserve that is needed to honour the pension liabilities corresponding to the past period. In fact, the first trial at the national B/S in 2000 listed various possibilities as to how to treat the pension liability, which includes an option to recognize JPY 450 trillion as if it were a realised liability. Subsequently, this approach was abandoned, though the decision has been criticized in some circle.

It is unfortunate that the debates on this matter are somewhat confused. In the first place, the idea of unrealised shortfall implicitly presupposes a fully-funded personal account pension system. Under this system, the aggregate funds in all personal accounts must be sufficient to finance all (discounted) future pension requirements that are expected from those who have held accounts, and have paid in premia, to date. If Japan's employee's pension system is run as such, clearly the total reserves fall short. That shortage is about JPY 450 trillion. In other words, JPY 450 trillion is needed, if the employee's pension system is "privatised" today and going to be operated without government supports for ever.[17]

However, like many public pension systems around the world, it is a pay-as-you-go system: requirements for pension payments in one future year will be funded by tax and insurance premium collected in that same year, plus investment proceeds and withdrawal from reserves when appropriate. Thus, as long as the current system is maintained, there will be no need to retrospectively fully-fund the pension reserves. In this sense, the government panel has reached the conclusion that

---

15 A second B/S that consolidates the central government and government-affiliated organisations including the postal saving is also published.

16 In the Japanese government's B/S, tangible assets for which there are no meaningful markets are valued by aggregating investment amounts hitherto, and then subtracting depreciation.

17 In some countries, including the United States, a shift from a pay-as-you-go system towards a fully-funded system is being proposed. The common problem in such a shift is how to resolve the so-called double burden of the current workforce: they have to finance the pension payments for the retired generation while at the same time spare funds for their own accounts. The idea of unrealised shortfall is to put the first burden on the shoulder of the government. In Japan, this corresponds to approximately JPY 450 trillion.

Table 11

Japanese Government Balance Sheet

(in JPY trillions)

Line items	end-FY2002	end-FY2003	Change	Line items	end-FY2002	end-FY2003	Change
Assets				**Liabilities**			
Cash and deposit	24,938	42,489	17,550	Accounts payable	9,958	9,546	–412
Securities	55,169	70,563	15,394	Reserve for bonus payment	233	332	98
Accounts receivable	18,295	17,224	–1,071	Short-term government securities held by the public	46,850	70,639	23,789
Loans	307,939	289,912	–18,027	Government bonds held by the public	450,281	508,218	57,936
Money in trust	35,278	54,203	18,925	Borrowings	17,567	20,173	2,606
Allowance for doubtful accounts	–2,359	–2,408	–48	Deposits received for the FLIP	185,352	162,620	–22,732
Tangible assets	178,016	182,164	4,148	Insurance reserves	9,086	9,277	190
Intangible assets	222	222	0	Deposits received of public pensions	161,649	143,131	–18,518
Investments	35,169	36,051	881	Reserves for retirment benefits	16,803	15,677	–1,125
Others	4,792	5,499	707	Others	1,601	1,464	–137
Total assets	657,462	695,923	38,460	Total liabilities	899,385	941,081	41,696
				Difference between assets and liabilities			
				Difference	–241,922	–245,158	–3,236

Source: Ministry of Finance.
Note: General and special accounts of the central government.

the unrealised shortfall should not be recorded as the liability on the B/S: instead, only the current reserves (deposits) are listed amongst the liability items.[18]

4. Net or gross: that is the question

4.1 There is no definitive definition

Information about an economy's fiscal soundness is very important not only for investors and academics but also for ordinary taxpayers. Without it, informed expectation, a cornerstone of market-based democracy, cannot be formed.

Needless to say, such information should be accurate, timely, and easy to understand, while at the same time in-depth analyses must be made possible if so desired. The fiscal transparency manual prepared by the IMF set a parameter, but not a definitive definition of what constitutes deficit and debt.

In fact, there does not seem to be a perfect definition that fits all economies of different government systems. Even in one economy, it is hard to think of one definition that can answer every question from everyone.

In the case of Japan, all necessary information is included in the budget documents that are submitted to Diet for discussion, but the media and market participants almost solely focus on the headline deficit figure, *i.e.* revenue shortfall (new issuance of JGBs), of the general account. This is a rather narrow definition, as discussed above, but there are certainly merits in emphasising this figure. Most of all, this is easiest for ordinary people to understand, by analogy to a household account: they can instantly grasp how much money needs to be saved, either by cutting spending or increasing revenues (taxes, etc.).

As a logical extension, attention is usually paid to JGBs outstanding and/or the central government long-term debts (bonds and borrowings) when discussing the magnitude of Japan's indebtedness. The perpetual quest for fiscal consolidation, therefore, aims at reducing the size of annual JGB issuance and that of JGBs outstanding.

4.2 What is happy news?

Because there is no definitive definition, it is always possible to produce a plausible fiscal figure by picking and choosing suitable components.

In their paper[19] in September 2004, Broda and Weinstein made a radical claim: they argued that Japan's debt position is not too bad and in fact comparable to

---

[18] In the United States, because pension assets are invested in unmarketable Treasury bonds, they are not listed in the assets of the national B/S.

[19] Christian Broda and David E. Weinstein, "Happy News from the Dismal Science: Reassessing Japanese Fiscal Policy and Sustainability", September 2004.

some European economies, if Japanese debts are netted out by social security funds, postal savings, BOJ's JGB holdings and the like. Starting from this notion, they estimated that, even with the rapid ageing, current "generous" levels of pay-outs to the elderly can be maintained for a foreseeable future and fiscal conditions would remain sustainable, if the tax rates are raised to the current European levels.

Their paper was received enthusiastically in some circles in Japan, while others thought it inappropriate and irrelevant. The debate was somewhat surreal, because it was stuck in the definition of debt: neither of the two camps could convince the other what should be regarded as debt.

It is true that part of the outstanding JGBs is held by various arms of the government sector and the BOJ as assets. In this sense, as they say, thinking of the outstanding JGB figure only as cost may be misleading: some of the debt service expenditure forms revenue of the government sector.[20]

While agreeing to the observation, the majority does not think that it enables the government to count out the government-held portion of the JGBs from the total government indebtedness, because such JGBs will also have to be repaid. If the government nullifies such JGBs, the government bodies will not be able to honour their responsibility to pay out pensions, savings etc. In such a case, the government will have to pay out in their place, which makes little difference from repaying JGBs held by them in the first place.

In particular, nullifying JGBs held by the BOJ will affect its financial strength, raise doubt about its independence from the government, and in any case lead to a reduction of signorage that the government receives from the BOJ every year as part of non-tax revenues.

If the argument of Broda and Weinstein were to be taken to the extreme, the Japanese government would have few debts. Because almost all JGBs are held domestically, it could be argued that they are both asset and liability of the Japanese population, which cancels each other out. But, such thinking is unorthodox, to say the least.

If the outstanding JGBs cannot be netted out, estimates for their second claim should appear differently. But, even if the first claim were accepted, still it would be difficult to agree to their optimism.

Tax and social welfare (health, pension, long-term care etc.) burdens in Japan are calculated as about 36 per cent of national income (FY 2005).[21] On the other hand, it is widely believed that the benefit levels in Japan are less generous than in northern European economies. Japan's fiscal sustainability may indeed be assured,

---

[20] Indeed one of the reasons why the Japanese government began producing a B/S is to clarify this point. Of course, difference between assets and liabilities is not affected by the fact that some government arms hold JGBs as assets.

[21] The same ratio is 33 per cent in the United States (2002), 48 per cent in Britain (2002), 54 per cent in Germany (2002), 64 per cent in France (2002) and 71 per cent in Sweden (2002).

even if she maintains the current levels of social benefits, provided that tax rates reach the European levels, with less-than-the European level benefits. But, this is something the Japanese government and taxpayers alike want to avoid. Of course tax rates must be raised, but the government's goal is to contain the tax increase as far as possible by rationalising social security and other programmes, so that the balance between costs (tax etc.) and benefits (services) will be restored.

5. Conclusion

In the era of absolute monarchy, banks and merchants who lent to kings and governments thought they knew how much repayments they could expect. Repeatedly they were proven wrong. Only kings and governments knew how much they owed, because it was they who decided how much they would repay, regardless of the numbers on the I.O.U.

In the modern era, banks and pension funds who lent to governments are convinced that they will be repaid in full, and usually their expectation is fulfilled. Still, taxpayers do not necessarily know how much their government owes them after all, not because it is an arbitrary decision of the government, but because deficit and debt has become a rather complicated concept, as the government's activity has expanded.

Needless to say, the government must eschew from intentionally misleading taxpayers by selectively using the kind of definitions that suits the government's purposes in specific circumstances. It should use, as far as possible, the simplest concept and keeps producing the number according to that definition.

Perhaps the most difficult question is how far the government should use fiscal figures that are based on econometric projections, for ordinary taxpayers tend to confuse these with hard facts.[22] Moreover, figures may differ, if the model used is tweaked. Therefore, it may be more "democratic" to use such figures with clear caveat.

In this light, if an economy wants to set a "democratic" kind of fiscal target, that of the euro economies appears a good model.[23] Needless to say, however, whether such a target will be achieved and kept has nothing to do with the beauty of the target itself.

---

22 SNA figures are not the only example of econometric projection. Structural and cyclical deficits are also based on mathematical calculation, and hence the product differs somewhat according to who (the IMF, OECD or others) creates the model.

23 The Maastricht Treaty states that, in order to join the EMU, an economy's budget deficit may not exceed 3 per cent of GDP and the public cumulative debt may not exceed 60 per cent of GDP. The Stability and Growth Pact inherits the basic idea. However, as is well known, this simple formula did not stop a number of arguments about what is allowed and what not under this accounting framework.

PUBLIC FINANCE, EMPLOYMENT AND GROWTH IN THE EU8

Leszek Kasek, Thomas Laursen and Emilia Skrok[*]

In this paper we review the theory and international evidence on the links between public finances and growth, including through the link between taxation, employment, and investment, and look at the evidence on these relationships in the EU8 countries over the past decade – both at the aggregate and disaggregate fiscal levels. Our econometric analysis reveals a strong negative impact of "distortive" taxation on employment and growth while we find a less robust positive relationship between "productive" expenditures and growth. These findings suggest that reducing labor and other highly distortionary taxes while searching for efficiency gains in various areas of public expenditure should be a high priority for EU governments. These findings are consistent with recent research of Afonso, Schuknecht and Tanzi (2006) who find that emerging market countries with public expenditure ratios around 30 per cent of GDP – well below most EU8 countries – tend to be the most efficient.

1. Introduction

Fiscal trends in recent years have varied considerably among the EU8 countries. Two groups of countries emerge within the EU8 on the fiscal scene: those with relatively strong fiscal positions, modest debt, and small governments (the Baltic countries, and to some extent Slovakia); and those with relatively weak fiscal positions, sizeable debt, and large governments (Hungary, Poland, and the Czech Republic). Slovenia is a special case, with strong public finances but a large government (Annex, Figures 9, 10 and 11). Of the EU8 countries, only the Baltic States and Slovenia clearly satisfy the fiscal criteria for euro adoption.

In recent years, some EU8 countries pursued fiscal consolidation strategies while others allowed deficits to remain high or even widen further. In particular, the Baltic countries, Slovenia, and Slovakia all undertook a sustained adjustment effort, with general government deficits now around or below the critical Maastricht level of three percent of GDP. Debt levels are low in the Baltic countries, moderate in Slovenia, and reaching comfortable levels in Slovakia.[1] Fiscal policy has been more erratic in the other Visegrad countries.[2] The Czech Republic managed to reverse a sharp widening of the fiscal deficit in 2001-02, but new pressures are building fast.

---

[*] World Bank, Warsaw.

[1] Debt developments have generally been influenced favorably by strong output growth, lower interest rates, and currency appreciation.

[2] Fiscal outcomes in the Visegrad countries have generally fallen well short of targets agreed with the EU in the context of pre-accession economic programs and in some countries post-accession convergence programs.

Poland pursued an expansionary fiscal policy in the period 2001-04, especially in the most recent years where output growth recovered strongly, although there was some consolidation in 2005. Hungary has to a large extent lost control over its fiscal policy, with deficits exceeding 6 percent of GDP and debt levels hovering around the critical 60 percent of GDP limit.

Fiscal consolidation efforts have been supported by strong output growth and in some countries expenditure reform and/or discipline while tax reforms have tended to lower revenues (Annex, Figure 10). Several countries have been pursuing tax reforms aimed at lowering the overall tax burden, and in most EU8 countries general government revenues as a share of GDP are now significantly lower than in the EU15. Slovakia has been a frontrunner in these efforts, however starting from a relatively high level. Cuts in corporate and personal income taxes have tended to lower the share of direct to total taxes, while the reliance on social security contributions and indirect taxes has increased.[3] Overall, labor taxes remain relatively high in most EU8 countries, constituting a large part of tax wedges in these countries.

There are large divergences in public expenditure to GDP ratios ranging from 34.6 per cent in Lithuania to 51.3 per cent of GDP in Hungary in 2004 (Annex, Figure 11).[4] The Baltic States spend much less than the Central European countries which resemble the EU15 (47.9 per cent of GDP in 2004). The higher the level of public expenditures, the higher the tax burden, especially labor taxes, which are usually earmarked to finance social protection expenditures.

Slovakia has been the only EU8 country to undertake a comprehensive restructuring of its social spending programs, with more piecemeal reforms in other countries that have tended to rely on various administrative measures (notably Hungary). A planned reduction of benefit rates and tightening of eligibility criteria (the so-called *Hausner Plan*) met strong political resistance in Poland. While the more indebted EU8 countries have benefited from a decline in global interest rates and spreads, on the whole the structure of spending has not changed much over the past five years.[5] Social benefits and social transfers in kind constitute one-half or more of total spending and their levels have remained stable in the Visegrad countries, Slovenia and Estonia, while Latvia and Lithuania cut these programs from already low levels. Spending on public consumption amounts to around 10 per cent of GDP in the Visegrad countries, Slovenia and Latvia, but is somewhat lower in Estonia and Lithuania. Public investment is particularly low in Latvia.

Higher government spending, including on social protection, appears to be negatively related to output growth in the region (Figure 1, Figure 2). This lends

---

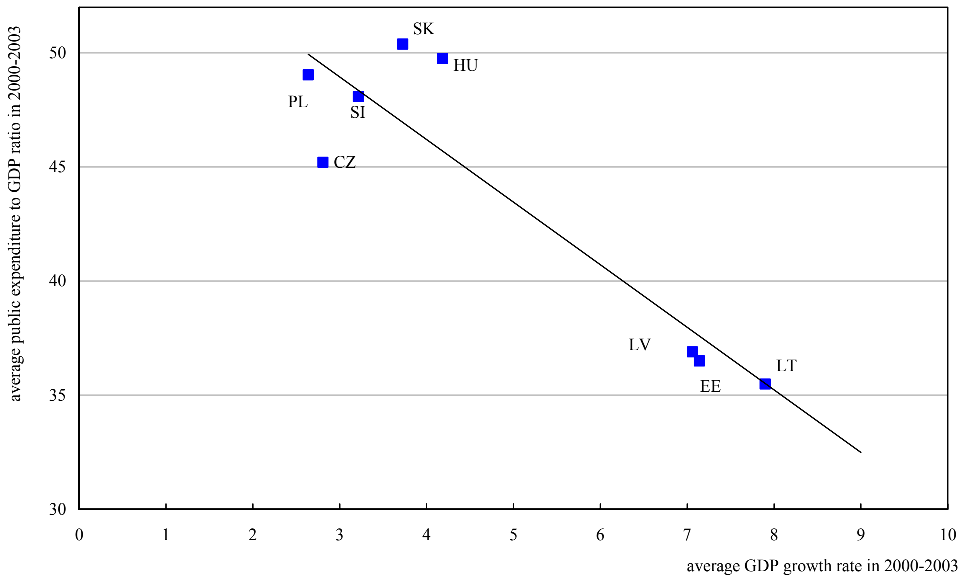
3 More recently, changes in indirect taxes have been influenced by EU accession.

4 The cross-country comparisons refer to direct public expenditures. The net public expenditure, *i.e.* gross expenditure corrected by i.a. differences in the reliance on tax expenditures, taxation of social benefits or introduction of private insurance schemes, could not be calculated because of data availability constraints.

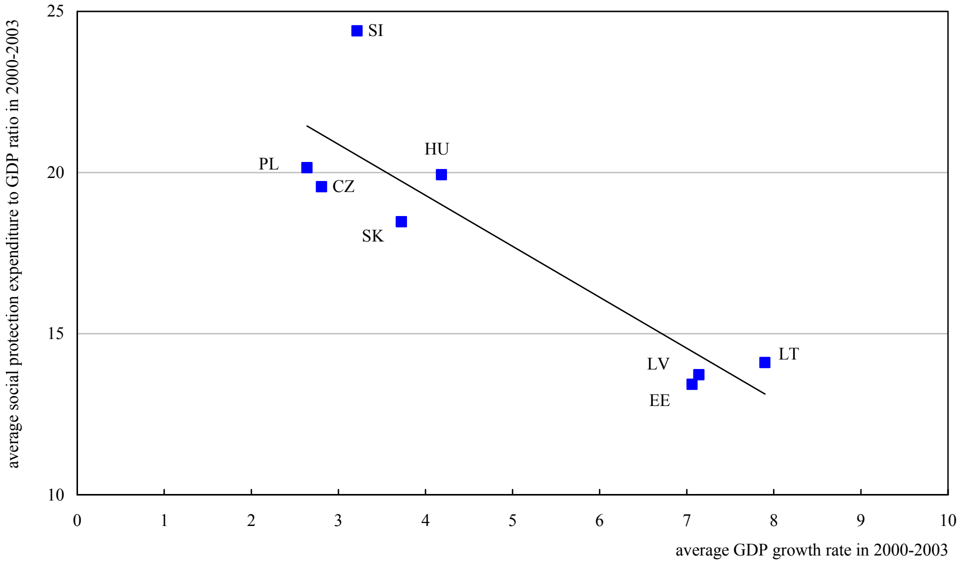
5 Several EU8 countries, including The Czech and Slovak Republics as well as Latvia, faced large fiscal costs related to bank restructuring in the second half of the 1990s.

Figure 1

Public Expenditure and Average GDP Growth Rates in 2000-03
Total Expenditure
(percent)



Social Protection Expenditure
(percent)



Source: Eurostat. Data for social protection expenditure based on ESSPROS methodology.

support to Kornai's view (1992) on "premature welfare states" in Central and East European countries. At the same time, it is clear that there is important variation among countries. Slovakia and Hungary grew faster than suggested by their spending levels (based on the simple correlation line below), despite roughly average spending on social protection. A similar picture would emerge if we looked at total revenues and social security contributions.

The purpose of this paper is to examine these relationships in the EU8 more carefully, in particular through looking at the impact of the structure of both spending and financing on growth – including how taxes affect employment and investment in the region. The rest of the paper is structured as follows: in Section 2, we examine the theoretical arguments and international empirical evidence relating public finances to output growth, and proceed to undertake an econometric analysis of the link between public spending, taxation, and output growth in the EU8 during the period 1995-2004; in Section 3 we examine theory and evidence relating labor taxes to employment; in Section 4 we look at corporate taxes and investment; and in Section 5 we conclude.

2. Fiscal policy and medium-long-term growth

2.1 Theoretical considerations and empirical evidence

The relationship between government spending, taxation, and economic growth has been one of the most studied issues in economics. However, while it was apparent that public finances could affect output growth in both the short and longer term, the theoretical link was not clearly established in the standard neoclassical growth theory (notably Solow and Swan, 1956). According to these, the only source of long-run growth was exogenous technical change with the production function featuring decreasing marginal returns to both capital and labor. Policy changes could affect the level of output but not its steady-state growth rate.

More recent endogenous growth models such as Romer (1986), Lucas (1988) and Barro (1990) have been based on perpetual, endogenously determined increases in the productivity of human and physical capital thus implying that the marginal product of physical capital would not tend to zero when the amount of capital per worker increases and allowing for long-run per capita growth. Growth can be permanently raised by increasing aggregate savings, by accumulating inputs (labor, human, and physical capital), and by higher efficiency in the production process (including through public support to research and development).

The main ways in which fiscal policy affects growth in the endogenous models are the following:[6]

---

[6] European Commission (2000).

- *production externalities*: public investment may boost production of the private sector through complementarities between public infrastructure and private investment;
- *productivity growth and differences*: fiscal policy may influence innovation and R&D while differences between public and private sector efficiency may provide growth-enhancing opportunities;
- *effects on factor accumulation*: physical/human capital; and
- *crowding out effect*: unproductive public expenditure versus productive private expenditure.

Endogenous growth theory has generated a number of models linking fiscal policy and long-term growth and demonstrating various conditions under which relations are robust (see Barro and Sala-i-Martín, 1995; Jones, Manuelli and Rossi, 1993; Devereux and Love, 1994; and Stokey and Rebelo, 1995). These models highlight the distinction between productive and non-productive expenditures and between distortionary and non-distortionary taxes.

Distortionary taxes in this context are those which affect the investment decisions (with respect to physical and/or human capital) and create tax wedges on labor. Government expenditures are differentiated according to whether they are included as arguments in the private production function or not. For example, if there are externalities from investment in physical or human capital, government intervention to increase school enrolment or capital formation may boost growth. These models envisage that shifting taxation from distortionary towards non-distortionary forms has a growth-enhancing effect, whereas switching expenditure from productive towards unproductive forms is growth-hindering. Non-distortionary tax-financed increases in productive expenditures are expected to have a positive impact on economic growth, while financing of non-productive expenditure would not have any impact. Finally, non-productive (productive) expenditures financed by distortionary taxes would have an unambiguously (ambiguously) negative growth effect.

As theoretical notions do not translate easily into operational rules, the empirical literature offers different measures of "productive" public expenditure and "distortionary" taxation. For example, Kneller, Bleaney and Gemmell (1999) treat income and property taxes as "distortionary" and consumption (expenditure-based) taxes as "non-distortionary" on the grounds that the latter do not reduce the returns to investment even though they may affect the labor/education/leisure choice (Annex, Table 6).[7]

Generally, expenditures with a substantial (physical or human) capital component are treated as "productive", but it may apply to only a narrow range of expenditures such as subsidies to R&D, education and transport (Romero De Avila and Strauch, 2003). Allocation of expenditure to productive/non-productive

---

7 Mendoza, Milesi-Ferretti and Asea (1997) note that this choice may indirectly affect investment and growth.

categories may also differ between rich and poor countries. The conditions under which a change in the composition of expenditure leads to a higher steady-state growth rate of the economy depend not only on the physical productivity of the different components of public expenditure but also on their initial shares. The various programs that have been hypothesized in the theoretical literature to have positive growth effects typically amount to less than one-fifth of public expenditure in OECD countries but more than one-half of public spending in less developed countries (Fölster and Henrekson, 1997).

Finally, the fiscal deficit should be interpreted as a means to finance additional government expenditures and in this way it may indirectly effect economic growth. While in a Ricardian world there should be no difference between tax and deficit financing of government expenditures unless the tax structure would be different in the future than today (Ludvigson, 1996), in other cases (e.g., due to overlapping generations or credit imperfections) public debt can change the private incentives to invest and thus influence the rate of growth in the economy (Zagler and Durnecker, 1999).

A variety of empirical studies have examined the effect of fiscal policy on economic growth. Many have used an aggregate approach, looking at the impact of total government revenue or expenditure (in percent of GDP) on growth. Some studies have found no significant relationship between the level of spending and the rate of growth (Mendoza, Milesi-Ferretti and Asea, 1997; Tanzi and Zee, 1997), while others found either a significant positive (Holmes and Hutton, 1990; Sala-i-Martín, 1992) or negative (Barro, 1991; Weede, 1991; Hansson and Henrekson, 1994) relation between the variables. The results may also depend on the level of development (e.g., Fölster and Henrekson, 2001 point to a robust negative relationship between government expenditure and growth in rich countries). Similarly, using the aggregate tax-to-GDP ratio, many studies found a significant negative relation to growth although the size of the effect differs considerably (Engen and Skinner, 1996; Cashin, 1995; Fölster and Henrekson, 2001) (Annex, Table 7). Other studies found no significant effect.

The above results suggest that the relation between growth and "government size" is likely to be non-linear. Devarajan, Swaroop and Zou (1996) suggest that expenditures, which would normally be considered productive, become unproductive in excessive amounts. Similarly, while taxes may reduce growth by being too high, they might also constrain growth by being too low (insufficient to finance essential government services). Evidence of a "Laffer" curve has been found in several countries.

The studies mentioned above generally fail to identify channels through which fiscal policy have an effect on growth and how the composition of revenue or expenditure matters in this regard. However, other studies have picked up where these left off. For example, Kneller (1999) found that both the structure of taxation and expenditure composition influenced the rate of growth.

Consumption and social security spending are mostly found to have no or negative effect on growth (Aschauer,1989; Barro, 1990 and 1991; Grier and Tullock, 1989) although some like Cashin (1995) found a positive growth impact from welfare spending. In contrast government, regarding investment expenditure, Aschauer (1989) found that "core infrastructure" (streets, highways, airports, mass transits, etc.) had a positive relationship with private sector productivity. Many other studies have found plausible growth effects of government investment expenditure (Nourzad and Vrieze, 1995; Sánchez-Robles, 1998; Kamps, 2004), with some evidence that the law of diminishing returns holds (De la Fuente, 1997). Further, a large number of studies present evidence that public investment can be productive if it is spent on infrastructure that serves as inputs to private investment (Devarajan, Swaroop and Zou, 1996). The empirical literature on the growth-enhancing effect of expenditure on human capital is almost unequivocal (Guellec and van Pottelsbergh, 1999; Diamond, 1999; De la Fuente and Doménech, 2000; Heitger, 2001). Some studies, however, found that this required that public spending (*i.e.* on R&D) complemented rather than crowded out private spending (David, Hall and Toole, 2000). Weak links between education, health and growth, where such existed, was ascribed to poor targeting or allocation of expenditures. For other categories of public spending, the evidence is less conclusive.

Regarding tax structure and economic growth, Widmalm (2001), using a panel data set for 23 OECD countries, found that different taxes had different growth effects and that tax progressivity was bad for growth (especially personal income taxes). The harmful effects of a progressive income tax structure (compared to a flat tax) were also noted by Koester and Kormendi (1989), Cassou and Lansing (2000), Cauccutt (2003), and Padovano and Galli (2001). Daveri and Tabellini (1997) and Heitger (2001) reached similar conclusions regarding the negative impact of personal income taxes. Further, Mendoza, Milesi-Ferretti, and Asea (1997) found that changes in labor income taxes had stronger effects on growth than changes in capital income taxes. Consistent with these findings, several studies (Jones, Manuelli and Rossi, 1993; Pecorino, 1993; Devereux and Love, 1994; Stokey and Rebelo, 1995) found that consumption taxation induced fewer distortions than the taxation of factor incomes.[8] A comprehensive discussion of the growth effects of consumption taxes compared with income taxes can be found in Krusell, Quadrini and Rios-Rull (1996).

2.2 *Empirical strategy*

2.2.1 *Specification of the model*

Our empirical model is based on the specification used in two of the most influential papers in the growth literature: Barro and Sala-i-Martín (1992) and Barro (1996); and similar to the specification proposed by Bleaney, Gemmell and

[8] On the other hand, Leibfritz, Thorton and Bibbee (1999) and Xu (1999) found that capital taxes were more detrimental to growth in the long term than taxes on wage taxes or consumption.

Box 1
Analytical Problems in Testing Relation Between Fiscal Variables and Growth

Empirical studies of the relation between fiscal variables and growth faces several difficulties:

First, omitting important country-specific features of revenue/expenditure policies (expenditure/revenue design, linkages with other policy instrument, *i.e.* between benefits and entitlements, specific aims of spending programs) may distort the quantitative importance of taxes and expenditures for growth. This is closely related to the fundamental issue of efficiency.

Second, failure to adequately specify the government budget constraint may introduce a bias to the growth regressions (Mofidi and Stone, 1990; Miller and Russek, 1993; De la Fuente, 1997; and Kocherlakota and Yi, 1997). According to Kneller (1999), the non-robustness of results arises also from a “widespread tendency to add fiscal variables to regressions in a relatively *ad hoc* manner without paying attention to the linear restriction implied by the government budget constraint”.[(1)] Thus, Miller and Russek found that the growth effect of a change in expenditure depended crucially on the way in which the change in expenditure was financed, while Kocherlakota and Yi showed that tax measures affected growth only if public capital expenditures were included in regressions.

Third, correlations between economic growth and its proposed determinants are often sensitive to the inclusion of other potential growth variables. Levine and Renelt (1992) point out that over 50 different variables have been reported significantly correlated with economic growth in empirical studies, but that only two of these survive a systematic sensitivity analysis (the share of investment in GDP and the initial level of income – conditional-convergence hypothesis).

Finally, the issue of potential endogenity is, as often the case, an important concern. For example, countries tend to spend more on public services as incomes grow (Wagner’s law).

(1) Source: Kneller, Bleaney and Gemmell (1999).

Kneller (2001). Following this, we assume that growth, g_{it} , in country i at time t is a function of base (non-fiscal) variables, Y_{it} , and a vector of fiscal variables, X_{jt}.

For the first set of variables, we assume a standard human capital augmented growth model where the real per capita growth rate in country i and year t (g_{it})

depends on the accumulation of physical (gross investment as a share of GDP; *INVit*) and human capital (measured as the higher education enrolment rate; *EDUhit*) as well as the population growth rate (the latter occurred to be insignificant and we subsequently excluded it from our base regression). Given the overwhelming support for (conditional) convergence in the empirical growth literature (Barro and Sala-i-Martín, 1995), we also included initial income (Y_0) as an explanatory variable.

The models noted above distinguish between "distortionary" and non-"distortionary" forms of taxation and between "productive" and "unproductive" expenditures. Further, they acknowledge the existence of the government's budget constraint. We thus include these categories of taxes and expenditures along with the budget balance in the set of fiscal variables. Given that the sum of revenues, expenditures, and the budget balance equals zero, one element must be omitted in the estimation in order to exclude perfect collinearity. The omitted variable serves as is the compensating element within the government's budget constraint (*i.e.* if we omit non-distortionary taxation, we assume that any change in expenditure will be financed by a change in non-distortionary taxes).

To put our basic growth equation formally:

$$g_{it} = \alpha + \sum_{i=1}^{k} \beta_i Y_{it} + \sum_{j=1}^{m} \gamma_j X_{jt} + u_{it}$$

Since $\sum_{j=1}^{m} X_{jt} = 0$, one of its element must be omitted from the estimation:

$$g_{it} = \alpha + \sum_{i=1}^{k} \beta_i Y_{it} + \sum_{j=1}^{m-1} (\gamma_j - \underbrace{\gamma_m}_{\text{omitted element of the budget}}) X_{jt} + u_t$$

Productive government expenditures are expected to have a positive impact on growth while distortionary taxes should have a negative impact. Unproductive consumption and non-distortionary taxes are expected to have no growth impact and therefore might be excluded from the estimation. To test this, we estimated two equations, each time with one of these variables omitted, and then checked for the significance of the remaining one. In both cases the test supported the hypothesis that the coefficient of the growth-neutral variable was zero. Omitting both irrelevant variables yielded more precise estimates.

The empirical growth literature suggests that correlations between economic growth and included regressors are sensitive to the inclusion of other potential growth determinants (Levine and Renelt, 1992). We performed sensitivity analysis using "conditioning" regressors, including monetary policy indicators (average level of inflation, standard deviation of inflation), proxies for country openness to international trade (such imports and exports as a share of GDP), terms of trade,

Box 2
EBA Methodology[(1)]

Extreme-bounds analysis involves the following steps (see, e.g., Leamer, 1983 and 1985).

Imagine that there is a pool of variables (I and Z) that previously have been identified to be related to growth and one is interested in examining whether the inclusion of a particular variable M is robust. Thus, one would estimate an equation of the form:

$$Y = \alpha + \beta_m M + \beta_i I + \beta_z Z + \beta_d D + \varepsilon$$

where Y is per capita GDP growth, I is a set of variables always included in the regression (e.g., the initial level of income, the investment rate, the higher education enrolment rate, and the rate of population growth – following Levine and Renelt, 1992), Z is subset of variables identified by past studies as potentially important explanatory variables of growth (usually up to three variables are taken from a pool of n variables available) and M is the variable of interest.

Extreme-bounds testing involves varying the subset of Z-variables included in the regression to find the highest and lowest values for the coefficient on the variable of interest, (β_m), that standard hypothesis test do not reject (at the 0.05 or 0.1 significance level). Thus, the extreme upper bound is defined by the group of Z-variables that produce the maximum value of β_m plus two standard deviations ($\beta_m + 2\sigma_m$). A result is “robust” if β_m remains significant and of the same sign at the extreme bounds. In contrast, if one finds a single regression for which the sign of the coefficient changes or becomes insignificant, the result is “fragile.” Thus, alteration in the conditioning information set may change the statistical inferences regarding the relationship between Y and M.

(1) It should be noted that the EBA method has been criticized for “reverse data mining” (Sala-i-Martín, 1997) and multi-colinearity.

unemployement, and a deterministic trend (similar to Folster and Henrekson, 1998). The point of departure for our robustness tests was Leamer’s (1983) extreme bounds analysis (EBA), and Levine and Renelt's (1992) empirical application of this.

2.2.2 Data

We use a cross-sectional data set for the EU8 countries for the period 1995-2004. All data, with a few exceptions, are taken from Eurostat. Data on the

Table 1

Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
GDP per capita g	80	4.81	2.6	–1.63	11.97
Initial GDP	80	7606.43	2157.54	4876.28	13012.56
Higher Education	80	42.88	16.15	18.24	80.44
Openness	77	90.88	26.07	37.37	138.62
Investments	80	25.82	4.16	14.31	34.75
Budget surplus	76	–3.0	2.31	–10.00	3.22
Unproductive exp.	79	19.97	3.15	14.41	26.8
Productive exp.	79	17.22	2.09	11.86	21.97
Other expenditure	79	4.083	2.66	1.59	12.79
Distortionary taxes	80	19.94	3.92	15.48	23.9
Non-distortionary	80	11.70	2.57	9.85	15.52
Other taxes	80	5.57	3.61	0.73	16.26

(gross) school enrollment rate and fiscal variables (based on GFS methodology) come from the World Bank Databases, Government Financial Statistics Yearbooks (IMF) or Ministries of Finance in the respective countries.[9] The data are consolidated and cover all levels of government. All fiscal variables are expressed as percentages of GDP. Fiscal variables were classified into types proposed by Bleaney, Gemmell and Kneller (Annex, Table 6). We thus assume that income taxes (personal income tax, corporate income tax, and social security contributions) and property taxes are "distortionary" and that expenditures with an important (physical or human) capital component are "productive" (*i.e.*, with a functional classification, general public services expenditure, educational expenditure, health expenditure, and housing expenditure).[10]

Data on the main variables are presented in Table 1. Among the fiscal variables, our "distortionary" tax category yields about twice as much revenue (20 per cent of GDP on average) as "non-distortionary" taxes, while the two main expenditure categories each account for about 20 per cent of GDP.

---

9 In the sample, data on expenditure in Estonia and Slovenia comes from different sources, but represents the same methodology.

10 Our classification differs from that of Bleaney, Gemmel, and Kneller with regard to "Transport and Communication" expenditure. In our classification, this category belongs to non-productive expenditure as we were unable to exclude it from "Economic Affairs". For those countries where data are available, this category represents 0.3-2 per cent of GDP on average in the last ten years.

2.2.3 Estimation results

Table 2 summarizes the key results. In the first column, we regress the real per capita growth rate on the non-fiscal variables (Y_0, *INV*, *EDU*) and all budget elements except unproductive expenditure (we treat this variable as the implicit financing element). Then we change the implicit financing element from unproductive expenditure to non-distortionary taxation (second column, EQ2). Next, we test the hypothesis that the neutral budget elements (unproductive consumption and non-distortionary taxes) can be omitted from our growth equation. As the hypothesis of a common coefficient was not rejected by the data, the next column omits both non-productive and non-distortionary variables, imposing a common coefficient for these two elements of the budget constraint. Finally, our base regression (EQ4) omits "neutral" and non-significant fiscal variables.

The base regression results point to a negative relationship between distortionary taxation and the growth rate of GDP per capita for EU8 countries in the period 1995-2004. The size of the estimated coefficients implies that an increase of the revenue ratio by 1pp is associated with a decrease in the growth rate in the order of 0.4pps. This number is very similar to results obtained by Kneller (1999) for a sample of 22 developed countries in the period 1970-95. At the same time, the coefficient for the level of government productive expenditure is positive and statistically significant, *i.e.*, an increase of 1pp of GDP in the ratio of productive expenditure-to-GDP boosts the growth rate per capita by about 0.3pps. We also find a large and positive relationship between the budget balance and growth[11] in line with several other studies.[12]

We proceeded to test whether the choice of implicit financing element alters the correlation between fiscal variables and growth. Instead of using "growth neutral" financing elements, we experimented with all others. We found that the choice of implicit financing element imparts the expected bias to the coefficients in

---

11 While it might have been preferable on theoretical grounds to link growth to the structural budget balance, the incorporation of the government budget constraint and difficulties in estimating structural budget balances in the EU8 countries argued for using the actual budget balance. Furthermore, budget balances in the EU8 are generally believed to be largely structural (see, e.g., Convergence Programs), so our findings are not likely to be sensitive to the choice of fiscal balance indicator.

12 These results are in line with previous findings for the EU8 countries by the authors (World Bank, 2005) despite differences in specification of the growth model and estimation methodology. We previously found that:

a) the total tax burden was negatively related to growth, although not robustly;

b) there was a negative and robust relation between the share of direct taxes and social security contributions (presumably more distortionary taxes) and economic growth, with an increase in the share of these taxes by one pp associated with 0.3 pp lower growth; and

c) indirect (presumably less distortionary) taxes had a positive and robust correlation with economic growth.

At the same time, none of the variables reflecting expenditure structure were robustly correlated with growth, although two of these – gross fixed capital formation and social benefits other than social transfers in kind – were robust in some combination of conditional variables. In these cases, gross fixed capital formation had a positive impact on growth while social benefits other than social transfers in kind were associated with lower growth.

Table 2

Estimation Results

Estimation technique: Linear regression,
heteroskedastic panels corrected standard errors (Prais Winsten standard errors)
(dependent variable: growth GDP per capita)

	Static	**Static**	**Static**	**Static**	**Static**	**Static**	**Dyna-amic**
Variables	**EQ1**	**EQ2**	**EQ3**	**EQ4 - Base**	**EQ5 - Sensi-tivity**	**EQ6-Sensitivity**	**EQ7 – Endog-eneity**
Initial GDP per capita (Yo)	–0.0004* (0.0002)	–0.0003* (0.0002)	– 0.0003*	–0.0003* (0.0001)	–0.0004* (0.0001)	–0.0004* (0.0001)	–0.0006* (0.0004)
Investments (INV)	0.15* (0.06)	0.17* (0.06)	0.13* (0.05)	0.14* (0.05)	0.10** (0.06)	0.10** (0.06)	0.18*** (0.11)
Higher education (Eduh)	0.07* (0.02)	0.07* (0.02)	0.08* (0.02)	0.08* (0.02)	0.09* (0.03)	0.09* (0.02)	0.13* (0.05)
Budget balance (Surp)	0.53* (0.13)	0.84* (0.19)	0.58* (0.12)	0.53* (0.11)	0.51* (0.13)	0.52* (0.10)	0.55* (0.17)
Productive Expenditure (PEXP)	0.39* (0.18)	0.69* (0.22)	0.47* (0.15)	0.36* (0.16)	0.29* (0.16)	0.28* (0.16)	0.65* (0.13)
Unproductive Expenditure (UEXP)	-	0.37** (0.2)	-	-	-	-	-
Other expenditure (OEXP)	0.02 (0.13)	0.31* (0.15)	0.12 (0.11)	-	-	-	-
Taxes Distortionary (DTAX)	–0.51* (0.15)	–0.87* (0.22)	–0.47* (0.15)	–0.4* (0.12)	–0.43* (0.13)	–0.36* (0.13)	–0.78* (0.12)
Taxes Non-Distortionary (NTAX)	0.28 (0.15)	-	-	-	-	-	-
Taxes Other (OTR)	–0.04 (0.1)	–0.33* (0.17)	0.12 (0.11)	-	-	-	-
Const	2.53 (2.36)	1.79 (2.34)	3.63 (2.32)	3.8** (2.35)	3.382 (2.35)	4.7 (2.27)	-
Openness (OPE)					0.05* (0.02)	0.03* (0.02)	0.03* (0.02)
Regulations (REG)					0.86* (0.51)		
Trend					–0.17 (0.13)		–0.21 (0.23)
N	76	76	76	76	73	75	55
R^2	0.57	0.58	0.56	0.55	0.59	0.59	0.59

In parentheses the standard errors are reported.
Coefficients from EQ5 present total effects: current first difference coefficients plus lagged.
* Variables significant at 5 percent level.
** Variables significant at 10 percent level.
*** Variables significant at 15 percent level.

Table 3

Robustness Test for the EU8 Sample with Three Conditioning Variables

	Distortionary Taxes					
	Three Conditioning Variables			Three Conditioning Variables, plus Omitting Initial GDP		
	Coefficient	"*Z*" variables	Robust	Coefficient	"*Z*" variables	Robust
EBA lower bound	–0.47	Ope, CPI_dev Trend, Reg	Yes, at the 5% level	–0.59	Ope, CPI_dev Trend, Reg	Yes, at the 5% level
EBA base	–0.4	-		–0.49	-	
EBA upper bound	–0.36	Ope		–0.48	Ope	
	Productive Expenditure					
	Three conditioning variables			Five conditioning variables		
EBA lower bound	0.27	Ope, Trend	Yes, at the 10% level	0.24	Ope, Trend	No
EBA base	0.35	-		0.28	-	
EBA upper bound	0.39	CPI_dev Trend, Reg		0.36	CPI_dev Trend, Reg	

case of unproductive expenditure and changed the statistical significance in case of productive expenditure (correlation becomes insignificant). Unproductive expenditure, when financed by an increase in distortionary taxation or a widening of the budget deficit (we do not show this in the table), was significantly and negatively correlated with growth, while financing through non-distortionary taxation resulted in a positive (albeit weak) correlation with growth (EQ2). In case of distortionary taxation, the estimated negative coefficient did not seem to be sensitive to the choice of the omitted variable (choice of the compensating element within the government's budget constraint).

2.2.4 Sensitivity analysis

The regression specification in column four of Table 2 is next subjected to robustness tests. Applying the EBA methodology in our context implies the estimation of regressions of the form where I is a vector of the base variables that always appear in the regressions (Yo, INV, Eduh, Surp, PEXP (or DTAX), M denotes the variable of interest (DTAX or PEXP) and Z is a vector of four variables (openness, regulation index, standard deviation of inflation, and trend) taken from the pool of additional plausible control variables. However the more formal test was based on EBA methodology. We test whether our results are sensitive to i) the inclusion of four "conditional variables;" and ii) exclusion of initial GDP (see, e.g., Easterly and Rebelo, 1993). The results from the EBA performed on the base variables are displayed in Table 3.

The inclusion of the conditional variables did not change our results. Both tested variables were robustly correlated with growth, with the taxation coefficient generally more robust than the expenditure coefficient. Additionally, the coefficients of the fiscal variables resulting from different specifications of the growth equation remained fairly close to those in the base estimation. In Table 2 (EQ5, EQ6) we show two examples of the change in the specification of our growth equation. In contrast, excluding initial GDP from the base regression, the PEXP coefficient became fragile. Since initial GDP was a significant regressor in our base equation, this was not surprising. However, it may suggest simultaneity in our regression caused by Wagner's law (increases in per capita incomes lead to higher government spending).

There is no clear explanation of our results (less robust correlation for the expenditure than for the tax variables; small coefficient bias when we change the implicit financing element) but they may arise from:

1) the linear specification of our model while the relation between expenditure and growth is likely to be nonlinear; and
2) our model does not capture properly the efficiency of public spending.

2.2.5 Endogeneity

Potential endogeneity of regressors (investments, openness and fiscal variables) may lead to biased and inefficient coefficient estimates and misleading results. We experimented with various variables as instruments for the potentially endogenous variables, but did not find any instruments that improved our estimates (small sample size is problematic since the instrumental variables estimator is an asymptotic estimator that requires a large samples to be consist). Thus, we specified a dynamic panel model, which was estimated using the Arellano and Bond (1991) Generalized Method of Moments (GMM) technique (which uses lags of the endogenous variables as instruments). While this should yield consistent estimates of the coefficients, our small sample size might still bias estimates (downwards). EQ7 in Table 2 shows the result from the dynamic model estimation (budget

Box 3
Quantitative measures of public sector efficiency in the EU8

In recent years, a number of attempts have been made at measuring the efficiency of public sectors. The techniques developed include parametric and non-parametric methods. The parametric approach assumes a specific functional form for the relationship between inputs and outputs of government spending. It is based on econometric methods and includes the Public Sector Performance indicator (PSP) and the Public Sector Efficiency indicator (PSE). The non-parametric approach calculates the frontier from the data without imposing any specific functional restrictions. Techniques developed within this approach include Free Disposal Hull (FDH) and Data Envelopment Analysis (DEA), using mathematical programming techniques.

Afonso, Schuknecht and Tanzi (2006) conducted a pioneer quantitative analysis of public sector efficiency for the ten new Member States that acceded to the EU in May 2004. While calculating the PSP and PSE measures, the authors take into account two broad groups of indicators: process (opportunity) and traditional (Musgravian) indicators. The first group includes administrative, education, and health, each of which contains several sub-indicators (e.g., health includes the infant survival rate and life expectancy). The second group includes income distribution (measured by the Gini coefficient), economic stability (measured by the average inflation rate and the variation of GDP growth in the most recent 10 years), and economic performance (measured by the average unemployment rate and GDP growth in the most recent 10 years). All indicators are given equal weight and their values are normalized with the average set equal to one. To derive PSE values, PSP figures were weighted by the relevant category of public expenditure. Also, public spending was normalized across countries, taking the average value of one for each of the six categories.

The authors show that expenditure efficiency across the new EU Member States was diverse, especially compared to the best performing emerging markets in Asia (Annex, Table 8). Within the EU8 group PSP was better among high spenders (Slovenia and Hungary), while PSE – taking into account resources used – was better in countries with smaller governments (the Baltic States). All EU8 countries performed well below the average of the selected comparator group of countries. However, the differences between the EU8 countries was not as large as the difference between these and the much better performing non-European emerging markets like Chile, Mexico, Korea, or Thailand. At the sub-indicator level, the efficiency scores on economic performance were much better for the Baltic States than for the remaining EU8 countries, while efficiency measures in the education were near average (Poland) or even above average (remaining three Visegrad countries).

surplus, investments, productive expenditure and distortionary taxation were assumed to be endogenous in this estimation). Comparing the results of the dynamic model with the static model (our base regression) we see that coefficient signs are unchanged but of much higher magnitude in the dynamic specification.

3. Labor taxation and employment

3.1 Trends in GDP growth, employment growth and tax wedge in the EU8

Output and employment growth rates have fluctuated significantly in the EU8 during the period 1996-2003, with some tendency for the two to follow the same pattern (Figure 2). Tax wedges have, as expected, been much more stable. The largest change occurred in Hungary, which had the highest tax wedge rate in EU8 group at the outset of the period.

While the limited variations in the tax wedge within individual countries does not allow one to discern any relationship with employment, there does seem to be a negative relationship between the two across countries, albeit with significant variation (Figure 3).

3.2 Theoretical considerations

Consider a simple theoretical framework of labor demand and labor supply (Figure 4). In this framework, an increase in the tax wedge can be represented by a downward shift in the labor demand curve.[13] The more elastic is the labor supply curve (and/or demand curve), the more harmful is the tax wedge for employment. In the case of a vertical labor supply curve (demand curve), an increase in the tax wedge is fully accommodated by a decrease in the net wage (increase in total labor cost) without any employment effect meaning that workers (employers) accept the full financial burden of the higher tax. In the case of a horizontal labor supply curve, workers would not accept any net wage decrease – the tax incidence is fully on employers and they reduce employment accordingly.

Most theoretical and empirical analyses concerning the influence of the tax wedge on employment attempt to uncover the shapes of the labor demand and supply curves and the micro- and macroeconomic factors that influence these in various countries and situations. Our goal is not to examine the exact shape of labor demand and supply curves in the EU8, but rather to examine how their interrelations might affect employment in the region.

[13] In our framework, a change in the tax wedge is represented by a shift in the labor demand curve because wages are expressed in net terms (see also OECD, 2003b; Bell *et al.*, 2002, and other sources).

Figure 2

GDP, Employment and Tax Wedge Trends in EU8 Countries in 1996-2003

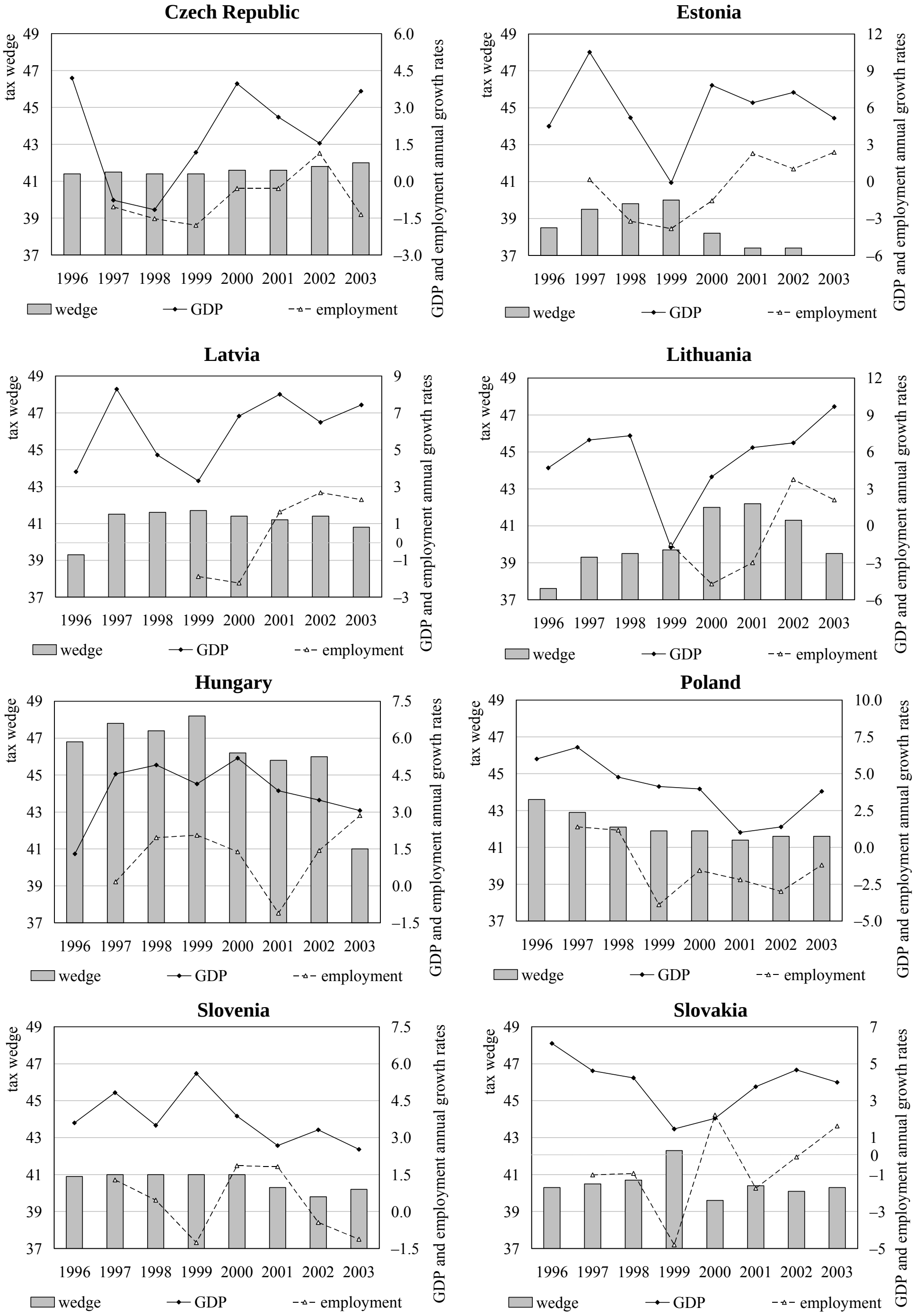
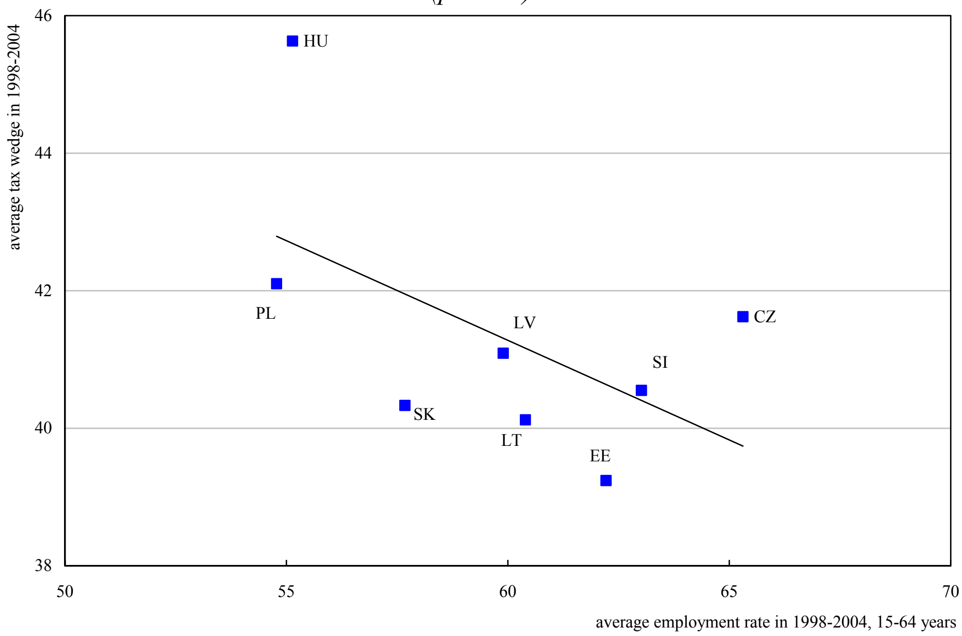


Figure 3

Average Tax Wedge and Average Employment Rate in EU8 in 1998-2004
(percent)



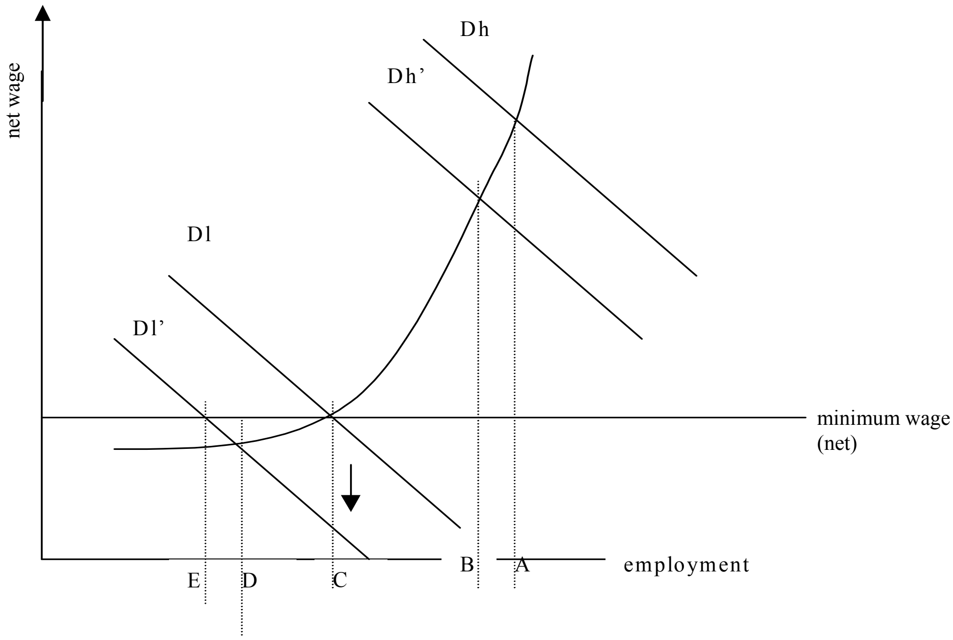
Note: the tax wedge is defined with respect to an earner of 67 per cent of the average production wage in manufacturing (APW). The tax wedge is the ratio of total labor taxes to total labor costs.
Source: Staff calculations based on EUROSTAT data.

3.2.1 The role of skills, reservation wage and non-employment benefits

The simple analysis in Figure 4 implies that in the case of standard convex aggregate labor supply (and demand) curves, a change in the tax wedge affects employment more for relatively low-wage earners (generally low-skill workers). This is confirmed in several empirical studies (OECD 2003a and b; EC 2003a; Kugler and Kugler, 2003). The elasticity of labor supply at the lower end of the income distribution, and thus the impact on low-skill employment of changes in the tax wedge, may be increased (the curve becomes flatter) by the presence of any kind of wage-floor, be it a statutory minimum wage or a reservation wage driven by the existence of alternative work-income sources (shadow economy or non-employment benefits). While minimum wages in the EU8 are not particularly generous, non-employment benefits (especially various early retirement and disability pensions) have been relatively generous potentially creating unemployment traps (see, e.g., Polish Ministry of Economy and Labor, 2005). Similar to the relationship between labor taxes and employment, we observe a negative correlation between pension expenditures and employment in the EU8 (Figure 5, Figure 6).

Figure 4

Labor Market – Theoretical Analysis



Dh: demand for skilled labour
Dh': demand for skilled labour after tax wedge
D1: demand for unskilled labour
D1': demand for unskilled labour after tax wedge
AB: employment reduction among skilled workers due to tax wedge
CD: employment reduction among unskilled workers due to tax wedge without bindind minimum wage
CE: employment reduction among unskilled workers due to tax wedge with binding minimum wage

Source: authors.

3.2.2 Employee versus employer taxes and wage rigidity

Even in the simple competitive framework from Figure 1, the negative employment effect of the tax wedge differs depending on which side of the market is being taxed when one introduces minimum wage regulations and/or alternative income sources. In the minimum wage case, an increase in the payroll tax (paid by employers) results in a downward shift in the labor demand curve and thus lower employment (move from point "C" to point "E"). On the other hand, an increase in income taxes can be represented as an equal downward shift of the (net) wage floor and labor demand. In this case there is both a net wage and an employment effect but there is no involuntary unemployment (move from point "C" to point "D").

The employment effect of an increase in income taxes also depends on the relative taxation of work- and alternative income. In the framework from Figure 1,

Figure 5

Pension Expenditure *(percent of GDP)*
and Employment Rates *(percent)* **in the EU8**

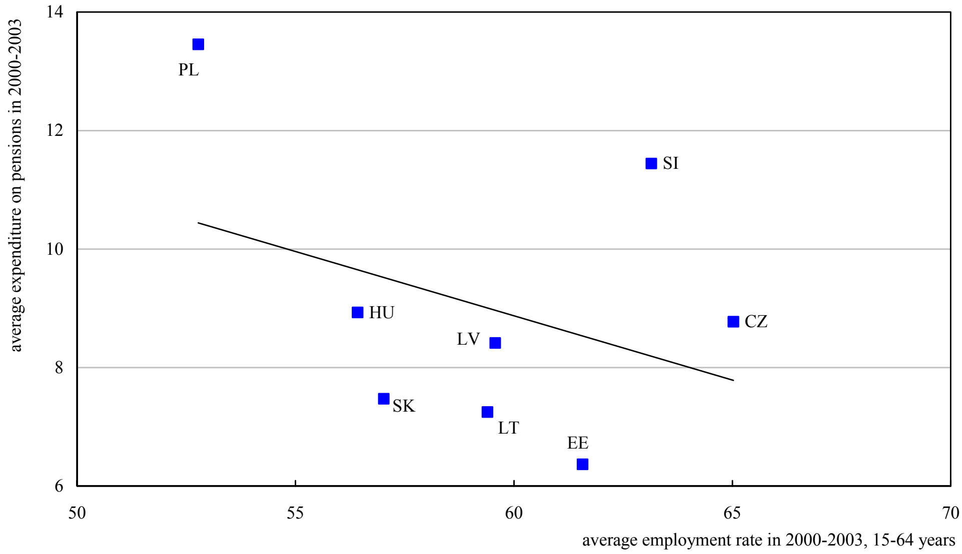
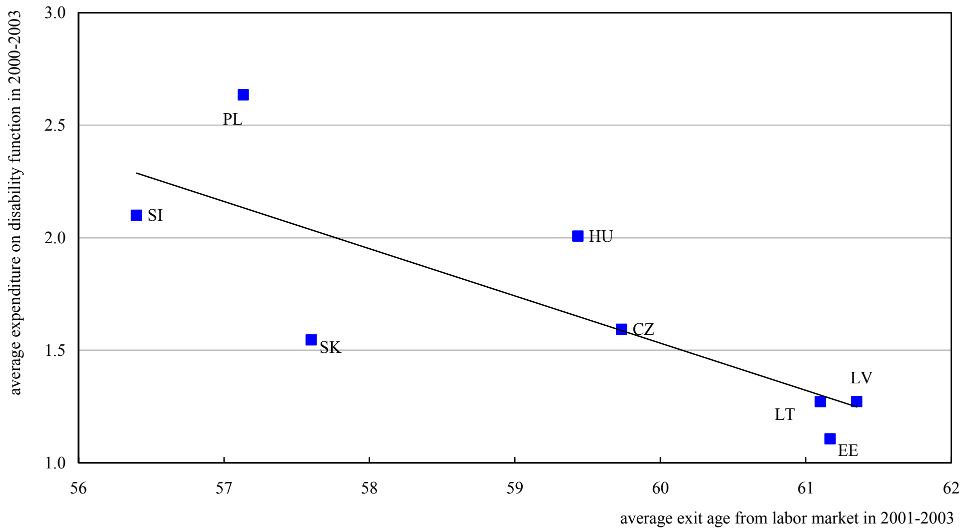


Figure 6

Disability Expenditure *(percent of GDP)*
and Exit Age from Labor Market in the EU8



Source: Eurostat data based on ESSPROS methodology.

one can replace the net wage with the difference between the net wage and alternative net income. If both are taxed with the same rates, the increase of the income tax does not shift either of the curves – there is no impact on net wages and employment. On the other hand, if non-employment benefits are tax-free or taxed at a lower rate, the increase in the tax rate on wages leads to a downward shift of the labor demand curve (as perceived by employees) and lowers employment accordingly.

As soon as one replaces our simple framework with more sophisticated theoretical models, the employment effect of income tax changes becomes lower than for payroll tax changes even without statutory minimum wages and alternative income sources. These models suggest that a shift of the tax burden from employers to employees may result in lower total wage costs and higher employment. Several studies have confirmed this applying various theoretical structures of the labor market (e.g., Goerke, 1999 and 2001; Koskela, 2001; and Nickell, 2003).

Further, both theoretical models and empirical research suggest that the overall tax-employment elasticity may depend on the direction of change in the tax-wedge as a result of real wage rigidity. Wages are often more rigid downwards than upwards and more rigid for blue-collar than for white-collar workers. Also, the existence of any kind of wage floor naturally increases wage rigidity.

3.3 Empirical analysis

3.3.1 Specification of the model

The general structure of empirical models designed to assess the relationship between tax wedges and employment is the following (see, for example, Daveri and Tabellini, 2000; Nickell, 1997; and Alesina and Perotti, 1997):

$$EMPL_{j,\,t} = \beta_0 + \beta_1 LABTAX_{j,\,t} + \beta_2 CONTROL_{j,\,t} + e_{j,\,t}$$

where: *EMPL* = employment measure, *LABTAX* = tax wedge measure, *CONTROL* = set of control variables, *j* = country, *t* = year and *e* = error term.

In our study of the EU8, the model has been modified slightly both due to the small size of the sample and to important structural features of the analyzed economies. We have used employment growth instead of the employment level on the left hand side of the estimated equation and GDP growth as the only explicit control variable.[14] While other variables are likely to affect employment growth (for example economic structure, trade links, the institutional setting, and various exogenous and endogenous shocks hitting individual countries), or limited sample and data do not allow the inclusion of a broader set of control variables.[15] Thus, in

[14] We also tried a specification with the employment rate (and output) in levels (for the period 1996-2004), but in this case output was not significant and the tax wedge coefficient only around 0.3.

[15] In any case, several of these factors are likely to be correlated with output growth, and this specification therefore allows us to at least partially tackle the problem of omitted variables.

our estimation, the tax wedge is treated as a factor negatively influencing the responsiveness of employment to a change in output/labor demand.

The following equation has been estimated on the pool of annual data from all EU8 countries for the period 1996-2003:

$$EMPG_{j,t} = \beta_{0,j} + \beta_1 WEDGE_{j,t} + \beta_2 GDPG_{j,t} + e_{j,t}$$

where *EMPG* = employment growth, *WEDGE* = tax wedge for low wage (50 per cent and 67 per cent of APW) earners, *GDPG* = real GDP growth, j = country, t = year and e = error term.

Data

Data for tax wedges for 67 per cent APW earners come from EUROSTAT, while tax wedge data for 50 per cent APW earners are own calculations using EUROSTAT data and applying the same methodology. Estimations have been performed for both balanced and imbalanced samples (Table 4).[16]

Ideally, the tax wedge variable should correspond to the employment variable used, but attempts to ensure this are complicated by lack of data. In some cases, the 50 or 67 per cent may be more or less in line with median salaries or weighted average income (e.g., in Poland), whereas in other cases it may not (e.g., Slovenia, where about three-fourths of workers receive close to the APW). One could also argue that it would be more appropriate to use changes in the tax wedge (since other variables are in changes), but the case for this is not clear and test results anyway not materially different.

Estimation results

We used fixed effects estimation in order to allow for structural features of individual country labor markets that are not necessarily correlated with GDP growth (e.g., output structure, labor force structure and labor market institutions). These factors are expected to be relatively time invariant. To the extent they are not, but positively correlated with one or the other of the included variables, their effect may be partly captured by the relevant variable (and including them in the analysis would present its own set of econometric problems). Finally, if they are not correlated with any of the explanatory variables, the bias depends on the direction of change in the omitted variable relative to the direction of change in the included explanatory variables and the dependent variable.

[16] Data on the tax wedge for 67 per cent APW earners in Estonia ended in 2002; it has been assumed that the tax wedge did not change between 2002 and 2003 (estimations were also performed without assuming a tax wedge number for 67 per cent APW earners in Estonia for 2003, but results were similar). Data on the tax wedge for 50 per cent APW earners for Estonia ended in 2001 (no data have been assumed for subsequent years in this case).

Table 4

Estimation Results

Coefficients	Dependent Variable: Employment Growth (EMPG)			
	Tax Wedge for 67 per cent APW Earner		Tax Wedge for 50 per cent APW Earner	
	Balanced Sample	Unbalanced Sample	Balanced Sample	Unbalanced Sample
Wedge	–0.55 (–1.93)	–0.51 (–2.10)	–0.80 (–2.05)	–0.50 (–2.50)
GDPG	0.36 (2.26)	0.39 (3.13)	0.11 (0.57)	0.40 (3.30)
R^2	0.39	0.36	0.51	0.41
Sample used	1999-2003	1997-2003	1999-2001	1997-2003
No. of observations	40	52	20	50

t-values in parentheses.
Source: staff calculations.

The results of the panel regressions indicate that, for a given GDP growth rate, each percentage point increase in the tax wedge is associated with a decline in employment growth by 0.5-0.8 percentage points. These results thus suggest a strong and significant negative relationship between the tax wedge and employment in the EU8 countries. While the magnitude of this effect seems to be on the high side of the range estimated for other countries, and data limitations, the small sample size, and the small number of variables and related possibility of omitted variables could have biased the results, the direction and the strength of the employment effect seem plausible.

4. Corporate income taxation and FDI

FDI has been found in many studies to be a significant determinant of growth in middle-income countries. FDI not only increases the domestic capital stock, but also tends to enhance productivity through technology and knowledge transfers. Studying the determinants of FDI is therefore important.

The undertaking of FDI by multinational firms involves complex strategic decisions, based on considerations about ownership, location, and internalization. While taxes may impact on all aspects of the decision process, several studies have shown that other factors are likely to be more important. These include agglomeration economies, proximity to key markets, an attractive investment climate (political, social, and macroeconomic stability, rule of law, low levels of corruption, good infrastructure, etc.), and other production costs (including notably labor). Taxes are more likely to matter at the margin.[17]

Nevertheless, following EU enlargement in May 2004, a heated debate ensued about "tax competition." Some incumbent EU countries argued that several new Member States had lowered tax rates to a level that represented an unfair competitive advantage and there were even suggestions to reduce EU regional aid to those countries. On their side, new Member States argued that they suffered from other competitive disadvantages, needed to stimulate investment (both foreign and domestic) in order to support growth and income convergence, and that corporate income taxes in any case was not the main reason why foreign investors were interested in these new markets. In the following we look at the relative size of corporate taxes in the enlarged EU and examine the role of these in attracting FDI.

4.1 Comparison of corporate taxes in the EU

The new Member States of the EU generally have lower tax-to-GDP ratios than the old members. The average ratio in the EU8 countries was 33.8 per cent in 2004 compared to 41.9 per cent in the EU15 (all new Member States were below the average of the old Member States). The share of corporate taxation in total tax revenues varies among the EU countries, but is relatively small and on average smaller in the EU8 than in the EU15 (Figure 7) Also, effective tax rates, calculated as the ratio of corporate tax payments to gross operating profits of corporations, is much lower in the EU8 than in the EU15 on average (Figure 8).[18] From the mid-1990s, effective corporate tax rates were growing in the EU15, but falling in the EU8 countries. Since then, both trends appear to have reversed and some convergence taking place.

4.2 Econometric analysis of the role of corporate taxes in determining FDI in the EU8

Our econometric analysis for the EU8 was based on a panel covering seven of the new EU Member States (EU8 except Slovenia, for which comparable data was not available) for the period 1995-2002. The dependent variable was net inflows of FDI measured in dollars per capita (based on UNCTAD World Investment Reports). The explanatory variables included the effective corporate income tax rate (*ETR*),

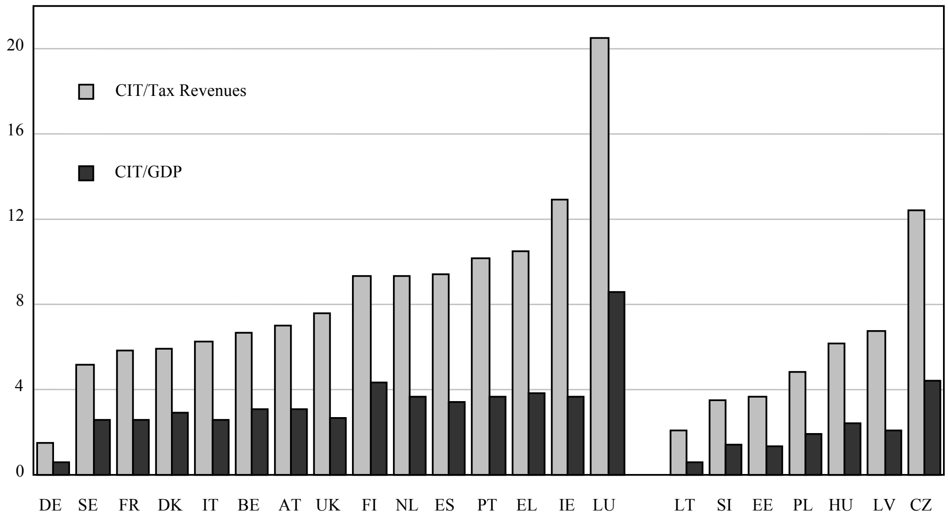
---

17 There are only a few studies on FDI determinants in transition countries as the time series are short and data problems significant, and tax issues have not been the focus of these studies (Kinoshita *et al.*, 2004; Garibaldi *et al.*, 2001).

18 The data on corporate tax payments were extracted from an EC database (EC, 2004b), while gross operating profits of corporations comes from the AMECO database. The gross operating surplus measures profits before depreciation, thus eliminating the distortion from differences in depreciation rules. The same concerns interest, and consequently the method of financing is irrelevant for the results. Unincorporated companies often fall under the PIT regulations and tax receipts can e reduced by loss carry-forwards which may lead to a downward bias in the estimates of effective tax rates.

Figure 7

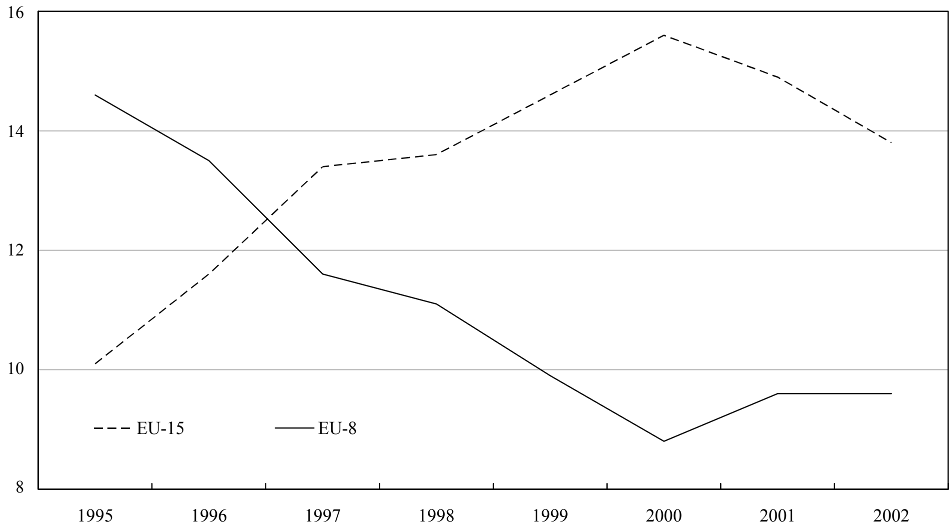
The Role of Corporate Taxation, 2002



Source: EC, 2004b.

Figure 8

Effective Tax Rates in Old and New EU Member States
(percent)



Note: Simple averages.
Source: authors' calculations.

Table 5

Regression Results for FDI Flows
(Dependent Variable: FDI)
Method: Seemingly Unrelated Regression
Total Panel (Unbalanced) Observations: 36

ETR	–11.35
	(–2.31)
NW	–1.43
	(–7.63)
TI	554.37
	–5.73
XM	3.55
	–9.57
Fixed Effects	
_CZ – C	–1,288.051
_EE – C	–1,555.104
_LT – C	–1,545.056
_LV – C	–1,450.462
_HU – C	–1,735.904
_PL – C	–1,187.758
_SK – C	–1,520.787
R^2: 0.55	
Durbin-Watson stat: 2.1	

ETR: effective tax rate.
NW: average nominal wage in USD.
TI: transition index (EBRD).
XM: share of export and import in GDP.

average nominal wages in US dollars as a proxy for labor cost (*NW*), openness of the economy measured by the share of foreign trade (exports and imports) in GDP (*XM*), and the EBRD transition index (*TI*) as a proxy for reform progress. The data set is unbalanced as certain observations for the key variables are missing. While this list of explanatory variables is hardly complete, it includes most of the main determinants of FDI identified in the literature. We estimated a fixed-effects model for the pooled sample in order to capture country specific (but time-invariant) characteristics. Such differences between countries can be represented by differences in intercepts, while we assumed that the coefficients for the explanatory variables did not differ among the included countries. The results of our estimation are presented in Table 5.

All the variables examined were found to be statistically significant and have the expected sign, although the precision of the estimation as measured by R^2 was not impressive. The results indicate that more open and advanced economic reformers attract more FDI flows. At the same time, higher labor costs and taxes hamper FDI inflows. The relative importance for FDI of the effective tax rate versus labor cost, reform progress and the openness of the economy were calculated as 1 : 2.5 : 3.2 : 1.7, respectively.

5. Conclusions and policy implications

The level and structure of taxation and expenditure appears to matter for employment, investment, and growth in the EU8. Our econometric panel data analysis covering the period 1996-2004 found a negative and robust relationship between distortionary taxation (primarily income taxes and social security contributions) and growth. Also, there appeared to be a positive relationship between productive expenditure and growth, but this was sensitive to the implicit financing element as well as to inclusion of the initial income level (supporting Wagner's law). Further, a strong fiscal position appeared to be supportive of growth. This evidence was supported by our analysis of labor taxation which revealed a relatively strong negative relationship between the size of the tax wedge and the employment rate in EU8 countries. We also found some evidence that higher corporate income tax rates are associated with lower FDI, although other factors seemed to matter more.

These findings suggest further public finance reforms in the EU8 are critical to support higher employment and growth rates. There is a need to shift taxation away from reliance on distortionary income taxes (not least high social security contributions) and find fiscal space for additional productive expenditure, not least on infrastructure and human capital development. Some countries (notably the Visegrad countries) also need to pursue further fiscal consolidation to enhance macroeconomic stability and crowd-in additional private investment. There is significant scope for enhancing the efficiency of public finances on both the revenue and expenditure sides – in some countries (Poland, Hungary, the Czech Republic, and Slovenia) through reducing the overall size of the public sector, and in all countries through broadening tax bases, introducing or increasing less distortionary taxes (notably on property), and ensuring that spending in various areas is better aligned with desired outcomes.

ANNEX TABLES AND FIGURES

Table 6

Theoretical Aggregation of Taxation and Expenditure

Theoretical aggregation	Functional classifications
Distortionary taxation	Taxation on income and profit Social security contributions Taxation on payroll and manpower Taxation on property
Non-distortionary taxation	Taxation on domestic goods and services
Other revenues	Taxation on international trade Non-tax revenues Other tax revenues
Productive expenditures	General public services expenditure Defense expenditure* Educational expenditure Health expenditure Housing expenditure Transport and communication expenditure
Unproductive expenditures	Social security and welfare expenditure Expenditure on recreation Expenditure on economic services
Other expenditures	Other expenditure (unclassified)

* Barro (1990, 1991) finds that current expenditures less education and defense expenditure is associated with lower per capita growth.

Source: Kneller, Bleaney and Gemmell (1999), "Fiscal Policy and Growth: Evidence from OECD Countries", *Journal of Public Economics*, No. 74, pp. 171-90.

Table 7

Selected Analyses of the Impact of Taxes on Economic Growth on the Example of OECD Countries

Study	Research Area	Impact of Taxation on Growth	Extent of Impact
Cashin (1995)	23 OECD countries 1971-88	negative	1pp of GDP increase in taxes/GDP ratio lowers production per employee by 2 per cent
Engen and Skinner (1996)	USA, sample from OECD countries	negative	2.5pp increase in taxes/GDP ratio reduces economic growth by 0.2-0.3 per cent
OECD - Leibfritz, Thornton, Bibbee (1997)	OECD countries 1965-95	negative	10pp increase in taxes/GDP ratio lowers GDP growth by 0.5-1 per cent
OECD (1997), European Commission	Model Quest	negative	1 per cent GDP increase of personal income tax lowers GDP growth by 2.4 per cent compared to base scenario
Bleaney, Gemmell and Kneller (1999)	17 OECD countries 1970-94	negative	1 per cent of GDP increase of distorting* tax revenues/GDP lowers GDP growth per capita by 0.4pp
Fölster and Henrekson (2001)	Sample of most affluent countries of OECD and outside OECD 1970-95	negative	10pp increase of taxes/GDP lowers GDP growth by about 1 per cent
Bassanini and Scarpetta (2001)	21 OECD countries 1971-98	negative	1pp increase in taxes/GDP lowers GDP growth/per capita by about 0.3-0.6 per cent
Price Waterhouse Coopers (2003)	18 OECD countries 1970-99	negative	1pp GDP increase of in direct taxation/GDP lowers GDP growth by 0.2-0.4 per cent

* distorting tax revenue = revenue from taxes on income and profit, social security contribution, tax on payroll, tax on property.

Source: Leach, G. (2003), *The Negative Impact of Taxation on Economic Growth*, new edition, Reform.

Table 8

Public Sector Efficiency (PSE) Indicators, 2001-03[1]

	Oppurtunity Indicators			"Musgravian" Indicators			Total Public Sector Efficiency (Equal Weights) (2)
Country	Administration	Human Capital	Health	Distribution	Stability	Economic Performance	
Brazil	0.78	0.81	1.15	0.48	0.33	0.59	0.69
Bulgaria	0.79	1.49	1.00	1.01	0.06	0.29	0.77
Chile	1.53	1.04	1.70	1.15	1.37	1.51	1.38
Cyprus		0.92	1.66		1.44	1.39	1.08
Czech Rep.	0.76	1.31	0.66	1.04	0.66	0.66	0.85
Estonia	1.09	0.83	0.91	1.21	0.57	0.87	0.91
Greece	0.97	1.32	0.83	0.83	1.23	0.56	0.96
Hungary	0.83	1.12	0.75	1.05	0.70	0.63	0.85
Ireland	1.36	1.18	0.84	1.44	1.79	1.61	1.37
Korea	1.40	1.31	1.72		1.47	2.36	1.65
Latvia	0.82	0.79	1.14	1.11	0.75	0.87	0.91
Lithuania	0.83	0.88	0.90	1.27	0.40	0.90	0.86
Malta	0.92	0.99	0.68		1.16	0.90	0.78
Mauritius	1.21	1.04	1.91		2.04	1.58	1.56
Mexico	1.18	0.72	1.52	1.90	0.55	2.01	1.31
Poland	0.89	0.98	0.97	0.80	0.69	0.68	0.83
Portugal	0.92	0.71	0.66	0.90	1.01	0.71	0.82
Romania	0.69	1.53	1.03	1.05	0.20	0.68	0.86
Singapore	2.09		2.90	1.38	5.05	2.94	2.39
Slovakia	0.82	1.23	0.77	1.18	0.90	0.64	0.92
Slovenia	0.91		0.68	0.81	1.15	0.84	0.88
South Africa	0.93	0.54	0.89		1.69	0.68	0.95
Thailand	1.58	0.86	1.68		1.91	3.11	1.83
Turkey	0.96	0.99	0.98		0.15	0.69	0.63
Average (3)	1.06	1.03	1.16	1.03	1.14	1.15	1.09
Max	2.09	1.53	2.90	1.90	5.05	3.11	2.39
Min	0.69	0.54	0.66	0.48	0.06	0.29	0.63

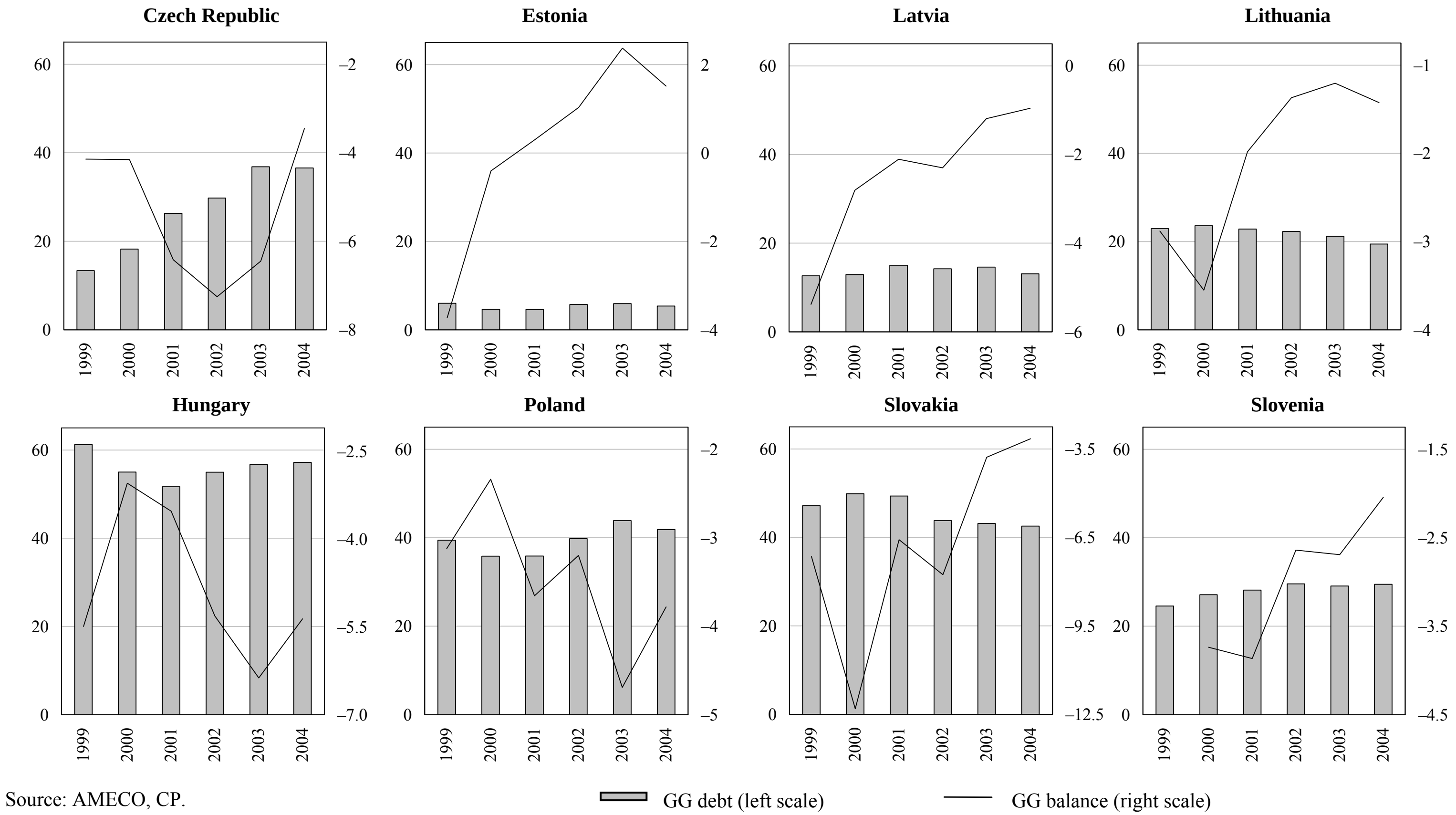
(1) These Indicators are the expenditure weighted.
(2) Each sub-indicator contributes equally to the total PSE indicator.
(3) Simple averages.

Source: Afonso, Schuknecht and Tanzi (2006), p. 33.

Figure 9

General Government Balance and Debt, 1999-2004

(percent of GDP)

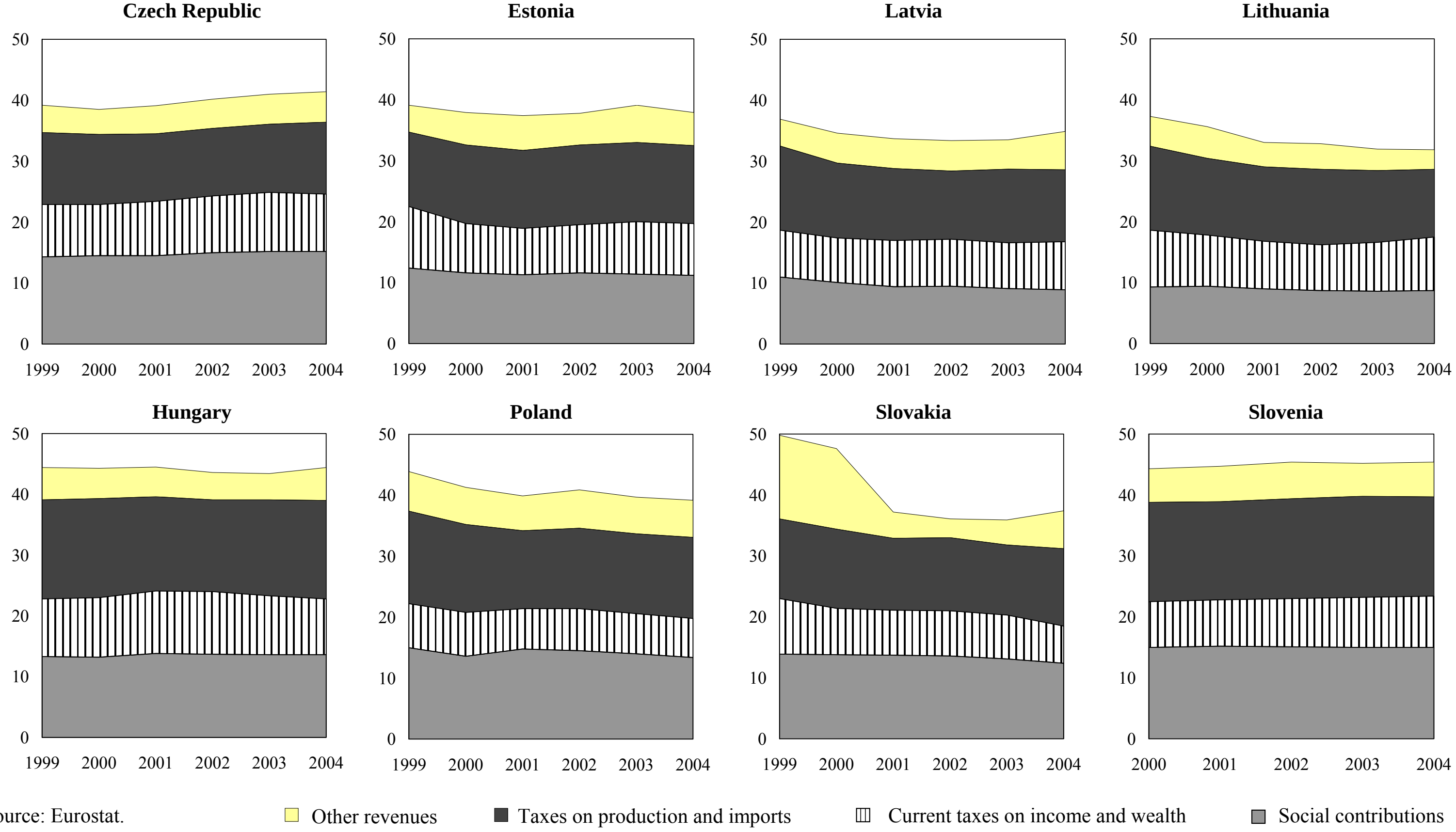


Source: AMECO, CP.

Figure 10

General Government Revenues, 1999-2004

(percent of GDP)

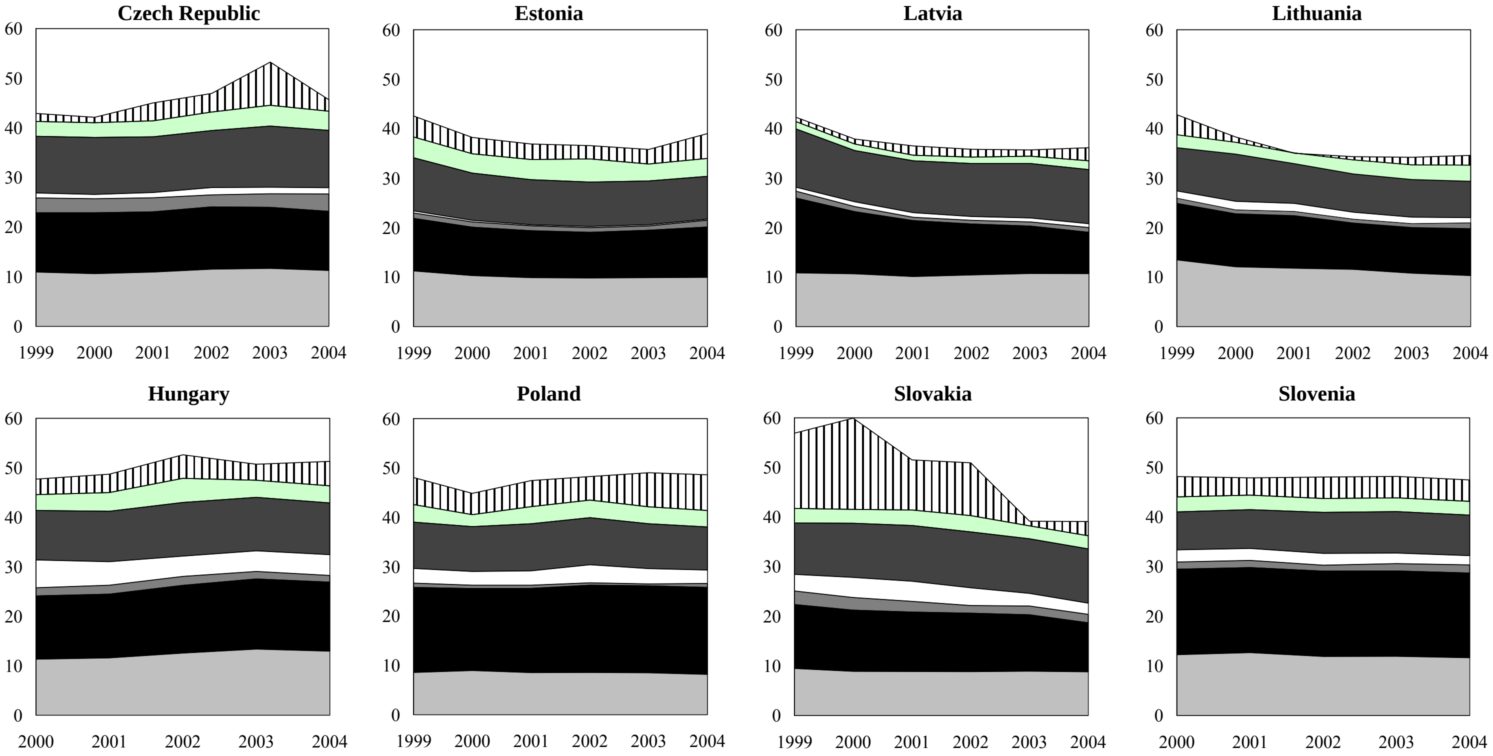


Source: Eurostat.

Figure 11

Economic Classification of General Government Expenditure, 1999-2004

(percent of GDP)



Source: AMECO.

Other; Gross Fixed Capital Formation; Collective Consumption Expenditure; Interest; Subsidies; Social Benefits Other Than Social Transfers in Kind; Social Transfers in Kind

REFERENCES

Afonso, A., L. Schuknecht and V. Tanzi (2003), “Public Sector Efficiency: An International Comparison”, European Central Bank, Working Paper, No. 242.

―――――― (2006), “Public Sector Efficiency: Evidence for New EU Member States and Emerging Markets”, European Central Bank, Working Paper, No. 581, January.

Alesina, A. and R. Perotti (1997), “The Welfare State and Competitiveness”, *American Economic Review*, Vol. 87, No. 5, pp. 921-39.

Arellano, M. and S. Bond (1991), “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations”, *Review of Economic Studies*, Vol. 58, pp. 277-97.

Aschauer, D. (1989), “Is Government Spending Productive?”, *Journal of Monetary Economics*, No. 23, pp. 177-200.

Barro, R.J. (1990), “Government Spending in a Simple Model of Endogenous Growth”, *Journal of Political Economy*, No. 98, pp. S103-S125.

―――――― (1991), “Economic Growth in a Cross-section of Countries”, *Quarterly Journal of Economics*, Vol. 106, No. 2, pp. 407-43.

Barro, R.J. and X. Sala-i-Martín (1995), *Economic Growth*, New York, McGraw-Hill.

Bassanini, A. and S. Scarpetta (2001), “Does Human Capital Matter for Growth in OECD Countries? Evidence from Pooled Mean-group Estimates”, OECD, Economics Department, Working Paper, No. 282, Paris.

Bell, B., J. Jones and J. Thomas (2002), “Estimating the Impact of Change in Employers’ National Insurance Contributions on Wages, Prices and Employment”, Bank of England, Quarterly Bulletin, Winter.

Bleaney, M.F., N. Gemmell and R. Kneller (2001), “Testing the Endogenous Growth Model: Public Expenditure, Taxation and Growth over the Long-run”, *Canadian Journal of Economics*, Vol. 34, No. 1, pp. 36-57.

Cashin, P. (1995), “Government Spending, Taxes, and Economic Growth”, IMF, Staff Papers, Vol. 42, No. 2, pp. 237-69, Washington (D.C.), International Monetary Fund.

Cassou, S.P. and K.J. Lansing (2000), “Growth Effects of a Flat Tax”, Working Paper, Kansas State University, August 23.

Caucutt, E.M., S. İmrohoroğlu and K.B. Kumar (2003), “Growth and Welfare Analysis of Tax Progressivity in a Heterogenous-Agent Model”, *Review of Economic Dynamics*, Vol. 6, No. 3, pp. 546-77.

Daveri, F. and G. Tabellini (1997), "Unemployment, Growth and Taxation in Industrial Countries", IMF, Seminar Series, No. 97/28, pp. 1-49, Washington (D.C.), International Monetary Fund.

David, A., B. Hall and A. Toole (2000), "Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence", *Research Policy*, Vol. 29, No. 4-5, pp. 497-529.

De la Fuente, A. (1997), "Fiscal Policy and Growth in the OECD", CEPR, Discussion Paper, No. 1755, London.

De la Fuente, A. and R. Doménech (2000), "Human Capital in Growth Regressions: How Much Difference Does Data Quality Make?", OECD, Economics Department, Working Paper, No. 262, Paris.

Devarajan, S., V. Swaroop and H. Zou (1996), "The Composition of Public Expenditure and Economic Growth", *Journal of Monetary Economics*, No. 37, pp. 313-44.

Devereux, M. and D. Love (1994), "The Effects of Factor Taxation in a Two-sector Model of Economic Growth", *Canadian Journal of Economics*, No. 27, pp. 509-36.

Diamond, A.M. (1999), "Does Federal Funding 'Crowd In' Private Funding of Science?", *Contemporary Economic Policy*, Vol. 17, No. 4, pp. 423-31.

Durnecker, B.G. and M. Zagler (2003), "Fiscal Policy and Economic Growth", *Journal of Economic Surveys*, Vol. 17, No. 3.

Easterly, W. and S. Rebelo (1993), "Fiscal Policy and Economic Growth", *Journal of Monetary Economics*, No. 32, pp. 417-58.

Engen, E.M. and J. Skinner (1996), "Taxation and Economic Growth", NBER, Working Paper, No. 5826, National Bureau of Economic Research.

European Commission (2000), "Public Finances in EMU – 2000", European Economy, No. 3.

—————— (2003a), "Employment in Europe 2003", DG Employment, Brussels.

—————— (2004a), "A Common Consolidated EU Corporate Tax Base", Commission Non-Paper to informal Ecofin Council, 10 and 11 September, 7 July.

—————— (2004b), "Structures of the Taxation Systems in the European Union", Data 1995-2002, European Communities.

Fölster, S. and M. Henrekson (1997), "Growth and the Public Sector: A Critique of the Critics", IUI, Working Paper, No. 492.

—————— (2001), "Growth Effects of Government Expenditure and Taxation in Rich Countries", *European Economic Review*, Vol. 45, No. 8, pp. 1501-20.

Garibaldi, P., N. Mora, R. Sahay and J. Zettelmeyer (2001), "What Moves Capital to Transition Economies?", IMF, Staff Papers, Vol. 48, Special Issue.

Goerke, L. (1999), "The Wedge", IZA, Discussion Paper, No. 71, Bonn.

Grier, K. and G. Tullock (1989), "An Empirical Analysis of Cross-national Economic Growth 1950-1980", *Journal of Monetary Economics*, Vol. 24, No. 1, pp. 259-76.

Guellec, D. and B. van Pottelsberghe de la Potterie (1999), "Does Government Support Stimulate Private R&D?", OECD, Economic Studies, No. 29, 1997/II, pp. 95-122.

Hansson, P. and M. Henrekson (1994), "A New Framework for Testing the Effect of Government Spending on Growth and Productivity", *Public Choice*, No. 81, pp. 381-401.

Heitger, B. (2001), "The Scope of Government and Its Impact on Economic Growth in OECD Countries", Kiel Working Paper, No. 1034.

Holmes, J.M. and P.A. Hutton (1990), "On the Causal Relationship Between Government Expenditures and National Income", *Review of Economics and Statistics*, No. 72, pp. 87-95.

Jones, L.E., R.E. Manuelli and P.E. Rossi (1993), "Optimal Taxation in Models of Endogenous Growth", *Journal of Political Economy*, Vol. 101, No. 3, pp. 485-517.

Kamps, C. (2004), "New Estimates of Government Net Capital Stocks for 22 OECD Countries 1960-2001", IMF, Working Paper, No. 04/67, Washington (D.C.), International Monetary Fund.

Kinoshita, Y. and N.F. Campos (2004), "Estimating the Determinants of Foreign Direct Investment Inflows: How important are Sampling and Omitted Variable Biases?", BOFIT, Discussion Papers, No. 10.

Kneller, R., M.F. Bleaney and N. Gemmell (1999), "Fiscal Policy and Growth: Evidence from OECD Countries", *Journal of Public Economics*, No. 74, pp. 171-90.

Kocherlakota, N. and K.M. Yi (1997), "Is There Endogenous Long-run Growth? Evidence from the US and the UK", *Journal of Money Credit and Banking*, Vol. 29, No. 2, pp. 235-62.

Köster, R.B. and R.C. Kormendi (1989), "Taxation, Aggregate Activity and Economic Growth: Cross-country Evidence on Some Supply-side Hypotheses", *Economic Inquiry*, No. 27, pp. 367-86.

Kornai, J. (1992), "The Socialist System: The Political Economy of Communism", Princeton University Press.

Koskela, E. (2001), "Labor Taxation and Employment in Trade Union Models: A Partial Survey", Bank of Finland, Discussion Paper, No. 19, September.

Krusell, P., V. Quadrini and J.V. Rios-Rull (1996), "Are Consumption Taxes Really Better than Income Taxes?", *Journal of Monetary Economics*, No. 37, pp. 475-503.

Kugler, A. and M. Kugler (2003), "The Labor Market Effects of Payroll Taxes in a Middle-Income Country: Evidence from Colombia", IZA, Discussion Paper, No. 852, Bonn, August.

Leach, G. (2003), "The Negative Impact of Taxation on Economic Growth", new edition, Reform.

Leamer, E.E. (1983), "Let's Take the Con out of Econometrics", *American Economic Review*, Vol. 73, No. 1, pp. 31-43.

—————— (1985), "Sensitivity Analyses Would Help", *American Economic Review*, Vol. 75, No. 3, pp. 308-13.

Leibfritz, W., J. Thornton and A. Bibbee (1997), "Taxation and Economic Performance", OECD, Economics Department, Working Paper, No. 176, Paris.

Levine, R. and D. Renelt (1992), "A Sensitivity Analysis of Cross-country Growth Regressions", *American Economic Review*, Vol. 82, No. 4, pp. 942-63.

Lucas, R.E., Jr. (1988), "On the Mechanics of Economic Development", *Journal of Monetary Economics*, No. 22, pp. 3-42.

Ludvigson, S. (1996), "The Macroeconomic Effects of Government Debt in a Stochastic Growth Model", *Journal of Monetary Economics*, No. 38, pp. 25-45.

Mendoza, E., G. Milesi-Ferretti and P. Asea (1997), "On the Effectiveness of Tax Policy in Altering Long-run Growth: Harberger's Superneutrality Conjecture", *Journal of Public Economics*, Vol. 66, No. 1, pp. 99-126.

Miller, S. and F. Russek (1993), "Fiscal Structures and Economic Growth: International Evidence", mimeo, University of Connecticut.

Ministry of Economy and Labor (2005), "Employment in Poland 2005", Warsaw.

Mofidi, A. and J. Stone (1990), "Do State and Local Taxes Affect Economic Growth?", *Review of Economics and Statistics*, Vol. 72, No. 4, pp. 686-91.

Nickell, S. (1997), "Unemployment and Labour Market Rigidities: Europe versus North America", *Journal of Economic Perspectives*, No. 11, pp. 55-74.

—————— (2003), "Employment and Taxes", CESifo, Working Paper, No. 1109, Center for Economic Studies and the Ifo Institute.

Nourzad, F. and M. Vrieze (1995), "Public Capital Formation and Productivity Growth: Some International Evidence", *Journal of Productivity Analysis*, No. 6, pp. 283-95.

OECD (2003a), *OECD Employment Outlook 2003*, Paris.

————— (2003b), *OECD Economic Surveys: Belgium*, Paris.

Padovano, F. and E. Galli (2001), "Tax Rates and Economic Growth in the OECD Countries (1950-1990)", *Economic Inquiry*, Vol. 39, No. 1, pp. 44-57.

Pecorino, P. (1993), "Tax Structure and Growth in a Model with Human Capital", *Journal of Public Economics*, No. 52, pp. 251-71.

PriceWaterhouseCoopers (2004), *CEE-CIS Tax Notes*, Issue No. 4.

Romer, P.M. (1986), "Increasing Returns and Long-run Growth", *Journal of Political Economy*, Vol. 94, No. 5.

Romero de Avila Torrijos, D. and R. Strauch (2003), "Public Finances and Long-term Growth in Europe: Evidence from a Panel Data Analysis", European Central Bank, Working Paper, No. 246.

Sala-i-Martín, X. (1992), "Transfers", NBER, Working Paper, No. 4186, National Bureau of Economic Research.

————— (1997), "I Just Ran Four Million Regressions", NBER, Working Paper, No. 6252, National Bureau of Economic Research.

Sánchez-Robles, B. (1998), "Infrastructure Investment and Growth: Some Empirical Evidence", *Contemporary Economic Policy*, No. 16, pp. 98-108.

Solow, R.M. (1956), "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, Vol. 71, No. 1, pp. 65-94.

Stokey, N.L. and S. Rebelo (1995), "Growth Effects of Flat-rate Taxes", *Journal of Political Economy*, Vol. 103, pp. 519-50.

Swan, T.W. (1956), "Economic Growth and Capital Accumulation", *Economic Record*, Vol. 32. No. 3, pp. 334-61.

Tanzi, V. and H.H. Zee (1997), "Fiscal Policy and Long-run Growth", IMF, Working Paper, No. 97/1, Washington (D.C.), International Monetary Fund.

World Bank (2004), "EU-8 Quarterly Economic Report, Special Topic: Corporate Income Taxation and FDI in the EU-8", World Bank, Warsaw, October.

————— (2005), "EU-8 Quarterly Economic Report, Special Topic: Labor Taxes and Employment in the EU-8", World Bank, Warsaw, April.

Weede, E. (1991), "The Impact of State Power on Economic Growth Rates in OECD Countries", *Quality & Quantity*, No. 25, pp. 421-38.

Widmalm, F. (2001), "Tax Structure and Growth: Are Some Taxes Better Than Others?", *Public Choice*, Vol. 107, No. 3-4, pp. 199-219.

Xu, J. (1999), "Taxation and Economic Performance: A Cross-country Comparison and Model Sensitivity Analysis", Department of Finance – Canada, Working Paper.

ESTIMATING THE IMPACT OF PUBLIC INVESTMENT FOR THE UNITED KINGDOM: HAS THE GOLDEN RULE OF PUBLIC FINANCE MADE A DIFFERENCE?

Jérôme Creel, Paola Monperrus-Veroni and Francesco Saraceno[*]

This paper uses a SVAR methodology to investigate the effects of public investment on growth, and more specifically, the effects of the introduction of a golden rule. We extend the existing literature by estimating a model of the British economy that takes into account long run factors. This seems necessary when dealing with a multi annual variable like public investment, and its long term effects on public finances through debt accumulation. We find that in such a long run framework investment has significant and permanent positive effects on GDP growth; this result runs counter to most recent literature on the topic, that was limited to a short run specification. We further find, by comparing different subsamples, that the introduction of the golden rule in 1997 strengthened this positive effect of public investment.

1. Introduction

This paper develops a comparative method to analyze the regime change experienced in the UK with the introduction of the "golden rule" in 1997. We build on the increasingly popular literature on structural VAR that originally developed in the field of monetary theory, and has been applied to fiscal policy since the seminal paper of Blanchard and Perotti (2002).

The golden rule remains a controversial subject; its adoption in the UK stirred a debate, not settled yet, on whether the fiscal framework for the Euro area should somehow be amended to take into account the particularity of public investment. This debate has proceeded on the double track of whether public investment is beneficial for economic growth, and of whether the golden rule would be able to ensure a sufficient level of public investment without hampering the sustainability of public finances.

On both accounts the theoretical literature is quite inconclusive, as the results depend on the relative weight of contrasting factors as crowding out, externalities, strategic interaction with monetary policy and so on. The empirical literature does not help in disentangling the issue, as its results are mixed.

---

[*] Observatoire Français des Conjonctures Economiques (OFCE).

Corresponding author: OFCE, Research Department, 69, quai d'Orsay, 75340 Paris cedex 07, France. Tel. ++33-1-44185456, Fax ++33-1-44185478. E-mail: jerome.creel@sciences-po.fr

We are grateful to Gwenaëlle Poilon for skillful research assistance. The usual disclaimer applies.

Our exercise uses as a benchmark the specification by Blanchard and Perotti (2002), and we use constraints on elasticities in order to endogenize or exogenize public investment (the latter case being the typical setting of the golden rule). Interestingly enough, this benchmark gives no relationship between investment and growth, a result consistent with recent work (e.g. by Perotti, 2004).

Our paper adds to the existing literature in that we extend the model in order to take into account a longer time horizon. This seems a natural and necessary extension when discussing a typically long run phenomenon like investment. In a longer time horizon debt has to be explicitly accounted for when dealing with public finances, so that we find it convenient to borrow the framework we developed for different purposes in Creel, Monperrus-Veroni and Saraceno (2005). The change in the results, with respect to the benchmark, is quite dramatic, with a positive and persistent effect of investment on growth that emerges in new specification. We further find that this effect became more robust since the introduction of the golden rule in 1997, thus giving arguments in favor of a positive role of such a framework.

The paper is structured as follows: Section 2 briefly reviews the debate on the golden rule sketching the arguments in favor and against it; we also give a short summary of the recent literature on the effects of public investment on growth. Then, Section 3 details the SVAR model we build, describing our identification procedure in the benchmark and in the long run models. We also map the different identification procedures to the different institutional settings. Section 4 gives the results of our estimations, showing how the effect of investment emerges when we shift from the benchmark to the long run model. Finally, Section 5 concludes.

2. The "golden rule of public finances"

Since 1997 the United Kingdom has adopted a double budget approach, according to which the budget is split into a balanced current account and a deficit-financed capital account. More explicitly, the golden rule states that, over the cycle, government borrowing should not exceed net government capital formation; hence, current expenditures should be financed by current receipts. Indeed, the UK budget incorporates a medium-run target for the net-of-public investment deficit, where the medium-run corresponds to a cycle. Over this cycle, this deficit should be balanced. The ensuing "golden rule" is associated with a "sustainable investment rule" (HM Treasury, 2002)[1] in order to prevent any overstatement for public investment and to limit net public debt below 40 per cent of GDP.

The distinction between current and capital spending aims at removing the bias against capital spending thus shifting attention from a mere quantitative target (one of the most controversial characteristics of the Stability and Growth Pact) to the quality of public finance (recent contributions include Fitoussi and Creel, 2002; Le Cacheux, 2002; Blanchard and Giavazzi, 2003).

---

1 See also Buiter (2001).

A number of reasons may be given in favor of the golden rule. First, it allows countries to spread the cost of durables over all the financial years in which they will be in use, and the burden of capital formation over the generations of taxpayers benefiting from it.[2] Further reasons derive from the current fiscal setup of the European Union. In fact, as documented in Balassone and Franco (2000),[3] there has been a close relationship between fiscal consolidation and cuts in capital spending in Europe during the eighties and nineties, and the strong constraints on public finances imposed by the Maastricht and Amsterdam Treaties have certainly played a role in this consolidation. The example of Portugal, that reduced investment substantially after breaching the Pact in 2001, shows that the problem is still present Adopting a golden rule would put an end to this negative bias. Moreover the golden rule implies debt-to-GDP convergence to the ratio of public capital to GDP, rather than to the unwarranted level of zero implied by the Stability Pact.

Two additional advantages of a golden rule should be mentioned. First, as European countries aim at "creating the most innovative area in the world" (Lisbon summit recommendation), there should be budgetary scope for improving infrastructures and human capital for which *public* capital (considered quite widely and loosely) may play an important role through two channels: first, public investment provides public goods like transport infrastructures which benefit users and directly or indirectly improve total factor productivity; second, public investment also raises overall welfare when it participates in the protection of environment or enhance the fairness in resource distribution.

On the other hand, many critical arguments against the golden rule are advanced in the literature. The main one is that such a rule would risk to hamper public finance sustainability. As discussed in EC (2003, part III), a golden rule of public finance in the EU would stop the reduction in public debts. Part of the rationale for slowing down public debt to GDP ratios in the euro area has been related to monetary policy. High public debts are seen as a threat to price stability and to the independence of the ECB. Though the latter is prevented by statute to monetize public debts, high debts might increase the risk of default which would require ECB intervention as the lender of last resort, and hence cause inflation. In a previous paper (Creel, Monperrus-Veroni and Saraceno, 2005) we discussed the strategic interaction of monetary and fiscal authorities. This tendency of debt to explode could be easily contrasted though, by adopting a debt ceiling as done by the UK. In fact, it may be proven that this is not even necessary, as two intrinsic features of the golden rule, endogenously limit the debt explosion. The first is that under the golden rule the debt ratio converges to the ratio of public capital to GDP (Blanchard

---

2 Though the welfare benefits of boosting public investment may be unevenly distributed across generations – public investment should increase private capital formation and wages, but the latter rise only gradually whereas the former is in the hands of the "elderly" –, Heijdra and Meijdam (2002) show that financing some part of public investment with public bonds increases equality across generations. A golden rule is thus theoretically welfare-improving.

3 See also EC (2003) and notably, table III.3 which shows that fiscal consolidation induced by high debt levels and the need to satisfy the Maastricht criteria coincided with relatively larger cuts in public investment.

and Giavazzi, 2003). We already argued that this seems more coherent than a zero debt ratio as implied by the SGP. Second, the rule contains built-in mechanisms that prevent endless growth of investment and deficit. Creel (2003) shows how the interest payment expansion generated by public capital accumulation and debt would impose a constraint to current expenditure growth, and hence at a certain point prevent further capital accumulation. We can conclude from these counter arguments that the fear of debt explosion is overemphasized, and that the "Debt arm" of the UK golden rule may be considered as redundant.

The endogenous limit to public investment incorporated in the golden rule also answers the concerns raised by Buti, Eijffinger and Franco (2003) that "the possibility of borrowing without strict limits in order to finance investments can lower the attention paid when evaluating the costs and benefits of each project". (p. 18). In fact one may argue that as the growth in public investment is limited by the necessity to pay interests on public debt, it is in the interest of government to implement investments whose cost/benefits ratio is the lowest.

Besides public debt's growth or the cost/benefits analysis, other criticisms to the adoption of a "golden rule" in the euro area are worth mentioning. Balassone and Franco (2000) consider that the "golden rule", as it is promoting public investment, will result in a bias in favor of physical assets, at the expense of health and education expenditures. Hence, the definition of "public investment" in national account statistics includes transactions that lead to changes in the stock of physical capital (like the construction of infrastructures or the purchase of computer hardware), but excludes large amounts of expenditures related to the accumulation of human capital, like training or R&D. More in general, the vagueness of the concept of "public investment" may lead to dangerous practices of creative accounting, aimed at covering lack of fiscal discipline. This is a serious argument, and an eventual adoption of the rule should be accompanied by a precise enunciation of what is "public investment" (to account for immaterial spending like human capital formation, and to exclude creative accounting) furthermore, it would be advisable to update these definitions at regular and predictable intervals, in order to prevent opportunistic behavior by governments.

Another criticism of the "golden rule" is that it promotes public capital, though it is overall capital from the public and private sectors that should be incentivated (Balassone and Franco, 2000). Thus, it is argued that as long as public capital crowds out private investment, no positive expect is to be expected. The weakness of this criticism is that empirical evidence in favor of it is scant at best: Estimates of the direct effect of public investment on private investment have been performed by the EC (2003, Table III.2) and are inconclusive, except for Spain and Portugal (for which positive "crowding-in" effects are found) and the UK (for which a negative "crowding out" effect is found).[4] Such a weak evidence is theoretically all

[4] According to the EC, the negative relationship between public and private investment in the UK might result from a coincidence: the privatization process would have decreased public investment while increasing "to a certain extent" investment in the private sector.

but surprising, as traditional crowding out effects may be compensated by complementarities between public and private investment (think of infrastructures for example), and thus improve total factor productivity.[5]

The empirical literature on "public capital productivity" is extremely vast. Table 1 overleaf reports the major contributions on the impact of public investment on economic growth, using different methods. It appears clearly how the evidence is mixed. In particular, the VAR literature seems to find no or little effect of public investment on growth.

3. Specifications and identifications

3.1 Elaborating on Blanchard and Perotti (2002)

The benchmark specification of the model is a variant of that elaborated by Blanchard and Perotti (2002), extended to distinguish between government consumption and government investment (excluding interest payments). Let g_c, g_i, τ and y denote respectively the real values of government consumption (hereafter current outlays), government investment (hereafter public investment), net taxes (tax revenues less transfers to households and businesses), and GDP, all stated in logs.

Let Y_t and U_t denote the vector of endogenous variables and of reduced-form residuals of the VAR, respectively. The reduced form VAR can be written:

$$Y_t = A(L)Y_{t-1} + U_t$$

where $Y_t = [g_{c,t}\ g_{i,t}\ \tau_t\ y_t]'$ and $U_t = [u_{gc,t}\ u_{gi,t}\ u_{\tau t}\ u_{yt}]'$. A(L) is the L-quarter lag operator.

The identification methodology consists in isolating structural shocks by a three-step procedure, like in Blanchard and Perotti (2002). The residuals of the canonical VAR are uninformative on the response of endogenous variables to shocks; to obtain response functions meaningful for the analysis of economic policy we need to isolate structural shocks. Thus, while the canonical residual of, say, the tax rate collects information on all the unexpected movements of the variable, the corresponding structural residual is obtained by eliminating all feedback mechanism (automatic or discretionary) triggered by changes in the other variables. Thus, the structural residual will be interpreted as an autonomous, discretionary shock, whose effects on the other variables can be examined by means of the impulse response functions (IRF).

5 Aschauer (1989b) shows that the productivity slowdown in the US private sector during the Seventies and Eighties was the consequence of a shortage of investment in public infrastructure.

Table 1a

A Parsimonious Survey on the Contribution of Public Capital to Economic Growth

Methodology	**Contribution of public capital to economic growth**
Production-function approach	**Elasticity**
Ratner (1983)	= 0.056 (US data)
Aschauer (1989a)	= [0.29, 0.56] depending on assumptions regarding productivity (US data)
Ram and Ramsey (1989)	= 0.24 (US data)
Garcia-Mila and McGuire (1992)	= 0.05 (48 US states)
Eisner (1994)	= 0.27 (US data)
Sturm and De Haan (1995)	= 0.41 (US data)
Vijverberg *et al.* (1997)	= 0.48 (US data)
Evans and Karras (1994)	estimates are fragile and generally not significant (7 OECD countries)
Dessus and Herrera (1996)	= 0.26 (panel, 28 countries)
Merriman (1990)	= 0.58 (9 Japanese regions)
Berndt and Hansson (1991)	= 0.68 (Swedish data)
Bajo-Rubio *et al.* (1993)	= 0.19 (Spanish data)
Otto and Voss (1994)	= 0.38 (Australian data)
Wylie (1996)	= 0.51 (Canadian data)
Gong *et al.* (2004)	= 0.50 (US data) = 0.29 (German data)
Estimations including the budget composition	
Kneller, Bleaney and Gemmel (1999) Bleaney, Gemmel and Kneller (2001)	a 1-point increase in productive public expenditures increases per capita growth by 0.29 points; and a 1-point increase in distortionary taxation decreases per capita growth by 0.45 points

Table 1b

VAR Studies

Study	Data	Variables	Conclusions
Clarida (1993)	USA, France, Germany, United Kingdom: 1964-89	Multifactor productivity, public capital stock	MFP and public capital are cointegrated but direction of causality is unclear
McMillin and Smyth (1994)	USA: 1952-90	Hours of work per unit of capital; relative price of energy; ratio public capital to private capital; inflation	No significant effect of public capital
Otto and Voss (1996)	Australia: 1959-82	Private sector GDP; private capital stock; public capital stock; number of working hours	No significant relation between public capital and output
Sturm, Jacobs and Groote (1999)	Netherlands: 1863-1913	Private sector GDP; private capital stock; public capital stock; private labor	Public infrastructure Granger-causes output
Ligthart (2000)	Portugal : 1965-95	GDP; private capital stock; public capital stock; private labor	Public capital Granger-causes output
Otto and Voss (2002)	USA: 1951-97 Canada:1951-96	GDP, relative price of public and private investment goods, real interest rate and shares of private and public investment in output	Public investment crowds out private investment in both countries

The reduced form residuals of the three policy variables are linear combination of these three components (structural, automatic and discretionary) and can be written:

$$\begin{aligned} u_{gc,t} &= \alpha_{gc,y} u_{y,t} + \beta_{gc,gi} e_{gi,t} + \beta_{gc,\tau} e_{\tau,t} + e_{gc,t} \\ u_{gi,t} &= \alpha_{gi,y} u_{y,t} + \beta_{gi,gc} e_{gc,t} + \beta_{gi,\tau} e_{\tau,t} + e_{gi,t} \\ u_{\tau,t} &= \alpha_{\tau,y} u_{y,t} + \beta_{\tau,gi} e_{gi,t} + \beta_{\tau,gc} e_{gc,t} + e_{\tau,t} \end{aligned} \tag{1}$$

where $e_{gc,t}$, $e_{gi,t}$ and $e_{\tau,t}$ are the structural shocks to the three policy variables. The first term on the RHS of each equation in block (1) captures the automatic response of fiscal policy to a change in GDP. The second and third terms capture the discretionary responses to a structural shock on another policy variable, whereas the last term captures the structural policy shock.

The identification, following Blanchard and Perotti (2002), is based on restrictions in the contemporaneous correlation matrix. In particular, Blanchard and Perotti use the institutional features of the American tax system to impose constraints to the matrix. After including a relationship between the canonical residual on *y* and the structural shock on *y* in the system (1), and if we write the relationship between canonical (u_t) and structural (e_t) residuals as $M_1 u_t = M_2 e_t$, the identification procedure consists in imposing constraints on the elements of the two matrices that allow writing $e_t = M_2^{-1} M_1 u_t$.

The constraints are of three economic kinds. First, we rely on institutional information about tax, transfer and spending programs to construct the parameters $\alpha_{i,y}, \forall i = gc, gi, \tau$. For instance, regarding taxes, some do depend on immediate GDP (VAT is an example) whereas some others do not as their base is time-delayed (the UK corporation tax return needs to be paid with the Inland Revenue, now HM Revenue and Customs, 12 months after the end of the period of account in which the accounting period falls). Taking this into account, one can compute immediate elasticities for those policy variables that may change with quarterly GDP.

With these elasticities, one can define the cyclically-adjusted fiscal shocks:

$$\begin{aligned} u_{gc,t}^{CA} &\equiv u_{gc,t} - \alpha_{gc,y} u_{y,t} = \beta_{gc,gi} e_{gi,t} + \beta_{gc,\tau} e_{\tau,t} + e_{gc,t} \\ u_{gi,t}^{CA} &\equiv u_{gi,t} - \alpha_{gi,y} u_{y,t} = \beta_{gi,gc} e_{gc,t} + \beta_{gi,\tau} e_{\tau,t} + e_{gi,t} \\ u_{\tau,t}^{CA} &\equiv u_{\tau,t} - \alpha_{\tau,y} u_{y,t} = \beta_{\tau,gi} e_{gi,t} + \beta_{\tau,gc} e_{gc,t} + e_{\tau,t} \end{aligned} \tag{2}$$

The second type of constraint is related to the ordering of the different policy variables in the VAR model. There is no *a priori* reason to favor one ordering over the others. However, one can rely on economic theories and empirical findings to gauge the relationships between the three policy variables under study. As for the causality between taxes and spending at large, two theories compete: on the one hand, spending may cause taxation; on the other hand, taxation may cause spending.

These two are respectively named the "spend & tax" (*argument 1*) and "tax & spend" *(argument 2*) public finance frameworks (see Musgrave, 1966). In the first case, public expenditures appear first and second in the VAR model, taxes, third; in the second case, taxes appear first, expenditures, second and third.

Yet, the ordering of the two different kinds of public expenditures has not been cleared. Among the two of them, which one is the most likely to "constrain" the other? Here again, two possible cases arise. First, government consumption may come first, government investment second (*argument 3*). This context describes a situation Balassone and Franco (2000) disclosed during the European transition process towards the euro: compliance with the Maastricht deficit limit was shown to have provoked a sharp reduction in public investment *vis-à-vis* public consumption. Second, government investment may come first, government consumption second (*argument 4*). This situation would resemble that of the Golden Rule of Public Finance: the constraint on public expenditure would hinge on government consumption, hence leaving some margins for manoeuver for public investment.

This leaves us with 4 possible orderings. Because we are mostly interested in the responses of public spending shocks on the economy, we will favor argument 1 and test it with either argument 3 or argument 4. Argument 2 may illustrate the possible robustness of our former results and will be left to further research.

Our first case study (mixing arguments 1 and 3, call it *case A*) will be written:

$$\begin{aligned} u_{gc,t}^{CA} &\equiv u_{gc,t} - \alpha_{gc,y} u_{y,t} = e_{gc,t} \\ u_{gi,t}^{CA} &\equiv u_{gi,t} - \alpha_{gi,y} u_{y,t} = \beta_{gi,gc} e_{gc,t} + e_{gi,t} \\ u_{\tau,t}^{CA} &\equiv u_{\tau,t} - \alpha_{\tau,y} u_{y,t} = \beta_{\tau,gi} e_{gi,t} + \beta_{\tau,gc} e_{gc,t} + e_{\tau,t} \end{aligned} \tag{3}$$

whereas *case B* (mixing arguments 1 and 4) is written:

$$\begin{aligned} u_{gi,t}^{CA} &\equiv u_{gi,t} - \alpha_{gi,y} u_{y,t} = e_{gi,t} \\ u_{gc,t}^{CA} &\equiv u_{gc,t} - \alpha_{gc,y} u_{y,t} = \beta_{gc,gi} e_{gc,t} + e_{gc,t} \\ u_{\tau,t}^{CA} &\equiv u_{\tau,t} - \alpha_{\tau,y} u_{y,t} = \beta_{\tau,gi} e_{gi,t} + \beta_{\tau,gc} e_{gc,t} + e_{\tau,t} \end{aligned} \tag{4}$$

In both cases, the first structural shock is identified with the related cyclically-adjusted canonical shock. Of course, in so far as public investments are considered, it is not legitimate to assume an instantaneous impact of GDP: $\alpha_{gi,y} = 0$. The second structural shock is identified with the residual of the regression of the related cyclically-adjusted canonical shock on the structural shock of the previously ordered policy variable using ordinary-least squares. The third structural shock is obtained in the same way, except that the two first structural shocks are now used in the OLS regression.

The third constraint is related to the estimation of the GDP variable in the VAR model. Estimating the structural shock on GDP is not the heart of our present analysis and we will leave GDP in fourth position of cases A and B:

$$u_{y,t} = \gamma_{y,gc} u_{gc,t} + \gamma_{y,gi} u_{gi,t} + \gamma_{y,\tau} u_{\tau,t} + e_{y,t} \tag{5}$$

By construction, the structural shocks on the three policy variables are respectively orthogonal to all other structural shocks and they can be used as instruments for the canonical residuals in estimating (5).

Above all, cases A and B will be used to perform estimations of GDP responses to a structural shock on public investment. As such, they will not tell much about the incidence of adopting a Golden Rule of Public Finance in the UK since 1998. For data since then are too scarce, we cannot estimate impulse response functions before and after 1998. We will therefore give a first but imperfect assessment of the incidence of this Rule following a three-step procedure. First, we will perform the VAR over the entire dataset[6] and with variables transformed into a $I(0)$ process.[7] Second, we will perform the same VAR on a sub-sample excluding the years from 1998 onwards. We will then gauge the difference between the coefficients on public investment in the GDP equation of the VARs. A statistically significant difference will be attributed to a change in the set of fiscal rules, while the direction of the (possible) change will give some information on the (possible) effects of adopting a Golden Rule.

3.2 *Elaborating on Creel, Monperrus-Veroni, Saraceno (2005)*

One drawback with Blanchard and Perotti's identification is its reliance on short-run dynamics. To cope with the long-run properties of fiscal policies, Creel *et al.* (2005) have extended the specification to include public debt dynamics and they have assumed that some restrictions could be linked to the Fiscal theory of the price level (FTPL).

A macroeconomic version of the underlying model in a closed economy is presented below. The stability conditions are also given. The model hinges on Leith and Wren-Lewis (2000) and Creel and Sterdyniak (2002)'s extensions to a FTPL's framework of the Blanchard (1985)'s perpetual youth model.

The first equation is an aggregate demand relationship (all variables are real; fiscal variables are expressed in percent of GDP):

$$y_t = cy_{t-1} + (1-c)[-\tau_t - \delta r_t + \varphi b_t + g_{c,t} + g_{i,t}] \tag{6}$$

---

6 Until then, we have abstracted from the inclusion of quarterly dummies, constant and a possible time-trend.

7 With $I(0)$ variables, VAR coefficients are statistically consistent.

where y is output, τ tax revenues, r the interest rate, b public debt; real public debt affects demand positively (due to a wealth effect), the real interest rate has a negative influence on demand, and public expenditure is the sum of public investment and current outlays $g_i + g_c$.

Aggregate supply is a standard Lucas-supply curve relating inflation to the level of output:

$$\pi_t = E_{t+1}\pi_t + \nu(y_t - y^*) \tag{7}$$

where E is the expectation operator and starred-variables are steady-state variables.

Real debt cumulates according to the law of motion:

$$b_t = b_{t-1}(1+r_t) - \tau_t + g_{i,t} + g_{c,t} \tag{8}$$

Finally, two last equations define the reaction functions of fiscal and monetary authorities:

$$\tau_t = \tau^* + h(b_t - b^*) \tag{9}$$

and:

$$r_t = r^* + \alpha(\pi_t - \pi^*) \tag{10}$$

Equation (9) states that the fiscal authority reacts to deviations of debt from its steady state value, while equation (10) is a standard Taylor rule relation if α is positive (hence an inflationary shock would provoke a rise in the *real* interest rate).

Transforming the above-mentioned model with the methodology first elaborated by Blanchard and Perotti (2002) gives the cyclically-adjusted components of the primary deficit: public investment, current outlays and tax revenues:

$$\begin{aligned} u_{gi,t}^{CA} &\equiv u_{gi,t} - \alpha_{gi,y}u_{y,t} - \alpha_{gi,\pi}u_{\pi,t} = e_{gi,t}; \\ u_{gc,t}^{CA} &\equiv u_{gc,t} - \alpha_{gc,y}u_{y,t} - \alpha_{gc,\pi}u_{\pi,t} = \beta_{gc,gi}e_{gc,t} + e_{gc,t}; \\ u_{\tau,t}^{CA} &\equiv u_{\tau,t} - \alpha_{\tau,y}u_{y,t} - \alpha_{\tau,\pi}u_{\pi,t} = \beta_{\tau,gi}e_{gi,t} + \beta_{\tau,gc}e_{gc,t} + e_{\tau,t}. \end{aligned} \tag{12}$$

Canonical residuals are corrected for economic growth and inflation variations, in order to extract the respective discretionary parts of fiscal and tax variables. All fiscal and tax variables are net of interest payments and receipts; hence they are independent contemporaneously of the interest rate. In a variant to equation (9), tax revenues are here supposed to react to public expenditures variations rather than to debt variations. This assumption keeps the original structure of fiscal and tax variables that Blanchard and Perotti modeled. The β terms are estimated like in Blanchard and Perotti.

Box 1
Stability conditions

If dx is the time derivative for variable x, *i.e.* $dx(t)/dt$, the full model can be rewritten under matrix algebra form,

$$\begin{bmatrix} db'(t) \\ d\pi'(t) \end{bmatrix} = A \begin{bmatrix} b'(t) \\ \pi'(t) \end{bmatrix} \tag{11}$$

where $A = \begin{bmatrix} \bar{r} - h & \alpha \bar{b} \\ \nu(\varphi - h) & -\alpha\nu\delta \end{bmatrix}$; a primed variable denotes deviations from the steady state and a variable with an upper bar denotes steady state value.

Under rational expectations, the forward-looking Phillips curve requires that $\nu < 0$. A sufficient stability condition of the model is that $\det A < 0$. This is possible under the usual Leeper (1991)'s conditions. The model is locally-stable under two different features of monetary and fiscal policies: either both policies react toughly to respective deviations from their objectives ($h > \frac{\delta\bar{r} + \varphi\bar{b}}{\delta + \bar{b}}$ *and* $\alpha > 0$); or both policies react mildly ($h < \frac{\delta\bar{r} + \varphi\bar{b}}{\delta + \bar{b}}$ *and* $\alpha < 0$), with the real interest rate decreasing after an inflationary shock.

Under adaptive expectations, the backward-looking Phillips curve requires that $\nu > 0$. With two pre-determined variables, stability conditions require that $\det A > 0$ *and* $tr\ A < 0$. If $\alpha > 0$, the condition on the reaction of fiscal policy towards deviations of public debt is: $h > \frac{\delta\bar{r} + \varphi\bar{b}}{\delta + \bar{b}}$ *and* $h > \bar{r} - \alpha\nu\delta$. If $\alpha < 0$, stability requires that the government does not react too much but also not too few to public debt deviations, $h < \frac{\delta\bar{r} + \varphi\bar{b}}{\delta + \bar{b}}$ *and* $h > \bar{r} - \alpha\nu\delta$.

The adjusted component of public debt gives:

$$u_{b,t}^{CA} \equiv u_{b,t} - \alpha_{b,\pi} u_{\pi,t} - \alpha_{b,r} u_{r,t} = \beta_{b,gi} e_{gi,t} + \beta_{b,gc} e_{gc,t} + \beta_{b,\tau} e_{\tau,t} + e_{b,t}. \tag{13}$$

Public debt is corrected for the presence of indexed bonds and for the part of debt with flexible rates. This debt component is then supposed to react to unexpected shocks on tax revenues and expenditures.

The system of canonical residuals for output, inflation and interest rates follows:

$$\begin{aligned} u_{y,t} &= \gamma_{y,gi}u_{gi,t} + \gamma_{y,gc}u_{gc,t} + \gamma_{y,\tau}u_{\tau,t} + \gamma_{y,b}u_{b,t} + \gamma_{y,\pi}u_{\pi,t} + \gamma_{y,r}u_{r,t} + e_{y,t} \\ u_{\pi,t} &= \gamma_{\pi,y}u_{y,t} + e_{\pi,t} \\ u_{r,t} &= \gamma_{r,y}u_{y,t} + \gamma_{r,\pi}u_{\pi,t} + e_{r,t} \end{aligned} \tag{14}$$

The first equation in system (14) is estimated in a two-step procedure. By construction, $e_{gi,t}$, $e_{gc,t}$, $e_{\tau,t}$ and $e_{b,t}$ are orthogonal to all other structural shocks; they can thus be used as instruments for $u_{gi,t}$, $u_{gc,t}$, $u_{\tau,t}$ and $u_{b,t}$ to estimate the first four parameters of this equation where the terms in inflation and interest rate are not taken into account; then, $\gamma_{y\pi}$ *and* γ_{yr} are estimated by OLS in the following equation:

$$u_{y,t}^{CA} \equiv u_{y,t} - (\gamma_{y,gi}u_{gi,t} + \gamma_{y,gc}u_{gc,t} + \gamma_{y,\tau}u_{\tau,t} + \gamma_{y,b}u_{b,t}) = \gamma_{y,\pi}u_{\pi,t} + \gamma_{y,r}u_{r,t} + e_{y,t}$$

As already mentioned, the correction of public investment for economic growth is irrelevant contemporaneously; hence, the discretionary part of public investment – the structural shock on public investment – is the canonical residual of public investment corrected for shocks on inflation: the real value of public investment is supposed to be reduced by shocks on inflation.

3.3 *Data and elasticities*

The source of UK data has been the OECD. Series are seasonally adjusted, a feature absent from the data available at the UK Central Statistical Office. Real series (GDP, tax revenues, current outlays, public investment, public debt) have been deflated by the GDP deflator. Inflation is based on the consumer price index. Public debt is end-of-year net financial government liabilities.

The variable "tax revenues" is the difference between government's total receipts and transfers. Transfers are defined as the sum of social benefits other than in kind, interest payments, property income paid by government and other current and capital transfers paid including acquisitions less disposals of non-produced non-financial assets which are excluded from investment.

The variable "public investment" is government gross fixed capital formation.

The variable "current outlays" corresponds to total public expenditures in goods and services, excluding GFCF; it thus corresponds to total government final consumption, *i.e.* the sum of wage consumption expenditure, social transfers in kind and subsidies.

The values of elasticities are:

- $\alpha_{gc,y}$ = –0.73411; $\alpha_{\tau,y}$ = –0.30100: these two elasticities state that current outlays and tax revenues increase at a slower pace than GDP's (recall that "g_c" and "τ" are expressed in percent of GDP);
- $\alpha_{gi,\pi}$ = 0.00134; $\alpha_{gc,\pi}$ = –5.71959e–05; $\alpha_{\tau,\pi}$ = 3.48482e–04: inflation contemporaneously increases the public investment to GDP ratio, meaning that GDP's reaction to inflation is higher in absolute value than public investment's; current outlays and tax revenues are contemporaneously as reactive to inflation as GDP, so that their respective ratios to GDP remain constant;
- $\alpha_{b,\pi}$ = –0.26987; $\alpha_{b,r}$ = 0.07101: these two elasticities are fully consistent respectively with the share of indexed public sector debt (it was equal to 23.3 per cent of total public sector debt at the end of 2004) and with the share of public sector debt issued at a variable interest rate (HM Treasury bills represented 6.8 per cent of total public sector debt at the end of 2004).

4. Results

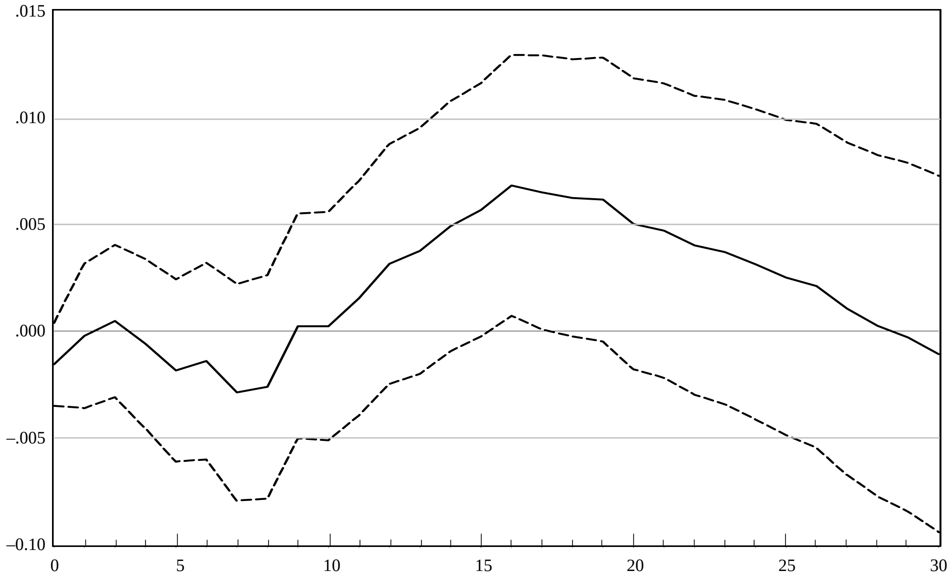
4.1 A canonical VAR

As reported in the first part of the paper, empirical VAR results on the impact of public investment on GDP are generally inconclusive. Before turning to SVAR, we have computed the responses of GDP (in log) to shocks respectively on public investment and current outlays. Responses are shown in Figure 1. With a canonical VAR, over what we will call "full sample" (1972:1-2004:4), the response of GDP to public investment would be statistically significant only 4 years after the shock, and significance would vanish afterwards. The response of GDP to current outlays is never significant.

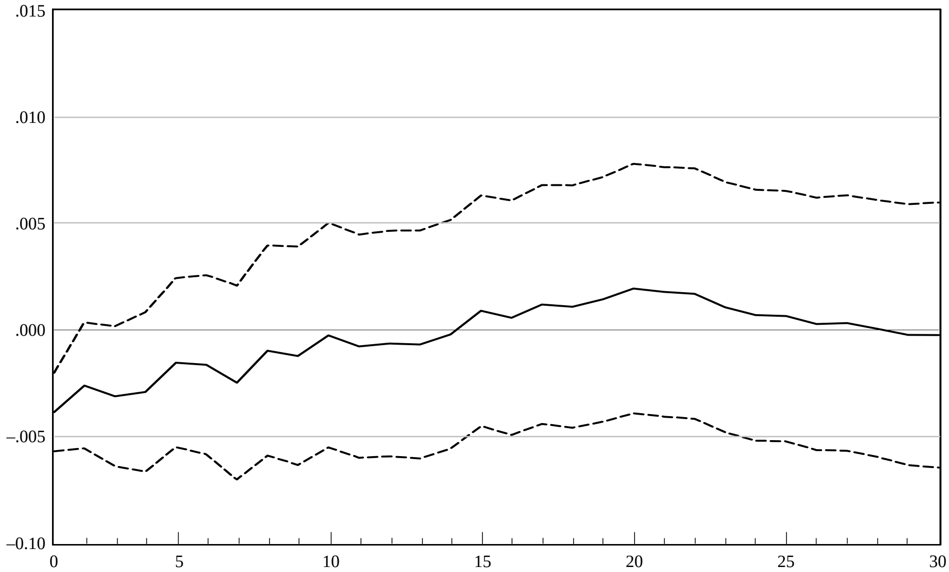
This result could mark the end of our investigation, eliminating public investment from the variables capable of enhancing growth; nevertheless, such a result shows a puzzling inconsistency with both theoretical and empirical results. Theoretically, standard textbook analysis emphasizes the positive role of public spending on economic growth, at least in the short run. The development of endogenous growth theory has also given considerable importance to public aid and productive government services in fostering innovation, the production of human capital and economic growth (Barro and Sala-i-Martín, 1995; Aghion and Howitt, 1998). Empirically, we saw above that various studies have pointed to the positive incidence of public investment on economic growth, although generally not with a VAR methodology.

Figure 1

Canonical VAR of the Full Model, First Ordering, Full Sample, UK
Response of LPIB to GIPIB



Response of LPIB to GCPIB



Reconciling this body of evidence with VAR analysis clearly requires that the variables at stake – public investment, current outlays and tax revenues – are corrected for their feedback effects: as was recalled earlier, current outlays may be crowding out public investment when the public deficit is considered to be too high by political authorities. Thus, reliance on Blanchard and Perotti's methodology can be justified on the ground that it helps to distinguish between automatic stabilizers, feedback reactions to other fiscal or tax variables, and discretionary actions.

4.2 SVAR with Blanchard and Perotti's identification

Figure 2 reports the dynamic responses of public investment, current outlays, tax receipts and GDP to structural shocks on respectively public investment and current outlays (*case B*, as a benchmark). Estimations were based on Blanchard and Perotti's methodology extended to a decomposition of public expenditures, following the steps described in the section above. Estimations were implemented with variables expressed in first difference, hence stationary variables. Unit root tests were performed using the Augmented Dickey-Fuller test. Results are reported in Table 2.

Table 2

Unit Root Tests[(1)]

	ΔGDP	$\Delta \mathbf{g_c}$	$\Delta \mathbf{g_i}$	$\Delta \boldsymbol{\tau}$
ADF test stat.[(2)]	–7.11	–12.73	–12.62	–13.50

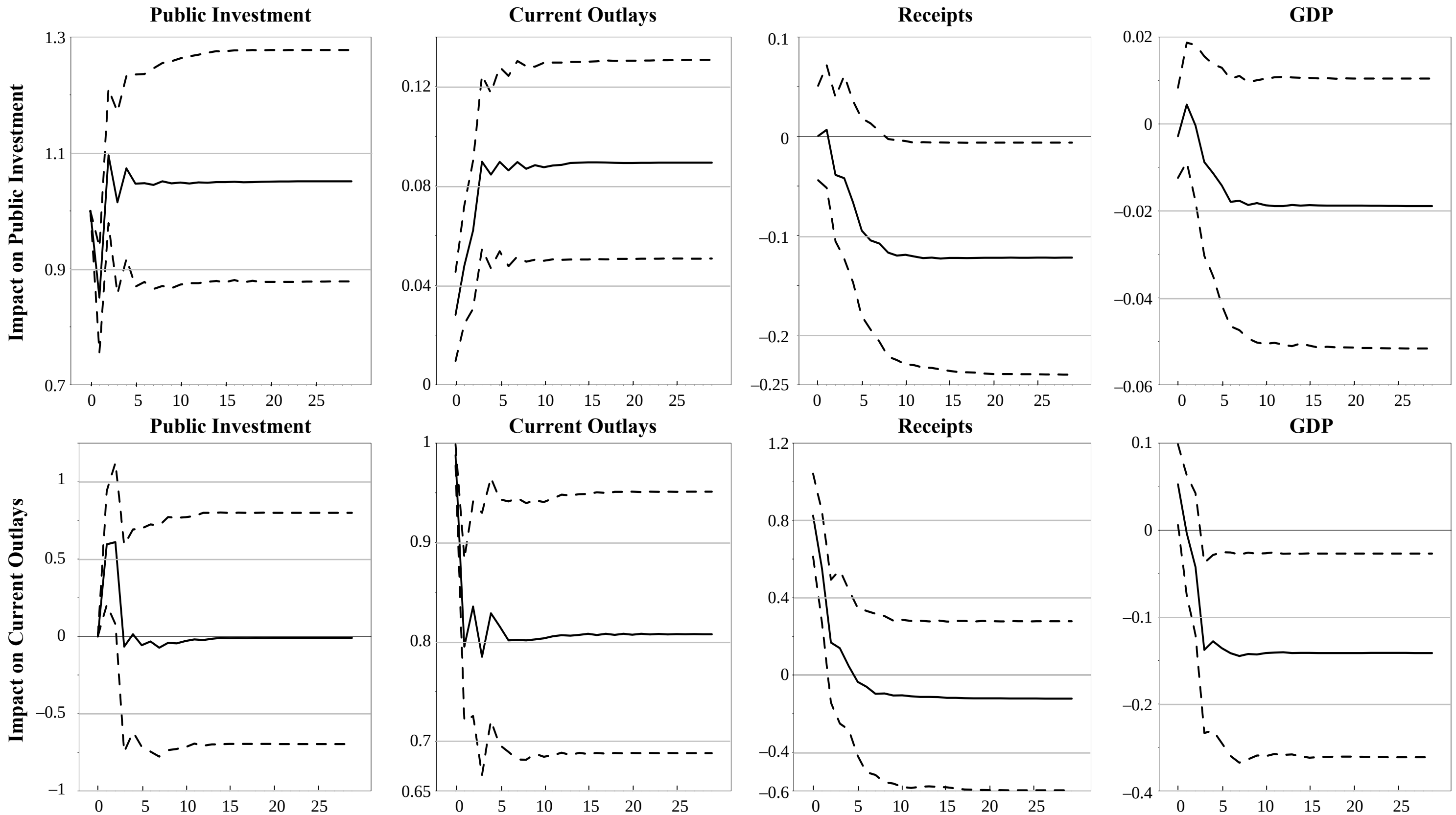
(1) Test critical value at 1 per cent: –4.02.
(2) ADF test with a constant and a linear trend.

Impulse response functions reported on Figure 2 are cumulated impulse responses and are therefore expressed in percentage points or percentage variations of, on the one hand, fiscal and tax variables, and, on the other hand, GDP.

The results are consistent with the canonical VAR, and even more counterintuitive. They substantially replicate Perotti's (2004) estimations for the UK, although he also introduced inflation and interest rates in his model. First, public investment would have no discretionary impact on GDP: responses are not statistically significant. Since public investment is fully discretionary by definition when it is ordered first, expect the possible impact of inflation on it, this means that public investment has no impact at all on UK GDP. Public investment would only impinge on other fiscal and tax variables: with growing public investment, civil servants would negotiate higher wages and/or higher public employment whereas

Figure 2

Blanchard and Perotti's Framework with a Decomposition of Government Outlays, UK
Impulse Response Functions



public enterprises would ask for higher subsidies;[8] meanwhile, tax receipts would be decreasing.

The sharp increase in primary deficit that emerges from our estimation can be compared with the actual figures for the UK (see Figure 3). The UK has only undergone two episodes of sharp increase in their primary deficit since 1972: between 1989 and 1993, and between 2000 and 2003. Do these periods fit the empirical outcomes? Two opposite answers can be suggested: On the one hand, 9 years out of 33 for the full sample and their alleged incidence on empirical results should not be overstated; because there is no clear evidence of a long lasting decline in government primary deficit, empirical results should be taken with caution. On the other hand, the second period almost exactly corresponds to the years over which the Code for Fiscal Stability has been implemented, so that the results reported in Figure 2 testify for the suboptimality and unsustainability of the Golden Rule of Public Finance in the UK. Fortunately, the unsustainability of UK public finances can be ruled out thanks to the "sustainable investment rule" over the economic cycle that limits the ratio of net public sector debt to GDP to a "stable and prudent level" of no more than 40 per cent of GDP. As for suboptimality, Figure 3 clearly shows that both episodes of steep increase in UK primary deficit have been concomitant with an increase in government gross capital formation and the efficiency of this fiscal variable therefore seems at stake. It is worth noticing however that the respective increases in UK public investment between 1988 and 1994 and between 1996 and 2004 have never exceeded 1 percentage point; basing upon the responses reported in Figure 2, a shock of this level for public investment would increase the primary deficit by 1.4 percentage point in the long run, quite at odds with the 10 percentage points increase in the primary deficits between 1989 and 1993, and between 2000 and 2003.

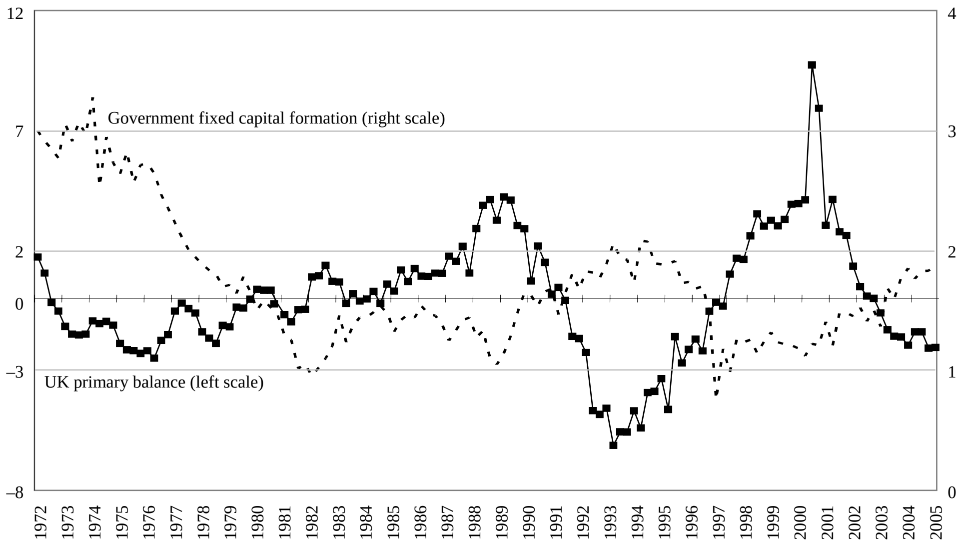
We thus argue that relying on these responses and on an apparent correlation between GFCF and the primary deficit to minimize the impact of public investment on economic growth in the UK would not be prudent. A quotation of an IFS Briefing Note (Emmerson, Frayne and Love, 2004) can be interestingly put forward: "During the economic cycle running from 1986-87 to 1996-97, the golden rule was far from met, with the deficit on current budget averaging over 4 per cent of GDP between 1991-92 and 1996-97. This was due to high levels of public borrowing combined with low levels of public investment" (p. 3). At the beginning of this period, the GFCF was close to 2 per cent of GDP; in the fourth quarter of 1996, it had plunged to 0.75 per cent of GDP. After the implementation of the Code for Fiscal Stability, public investment has finally been retrieved but it is still below the level it had reached at the beginning of the Nineties. Compared with current outlays, it is still negligible and cannot be seriously considered responsible for the long lasting increase in current outlays, as Figure 2 would show.

---

[8] This is generally called "hijacking of expenditure for the specific benefit of special pressure groups" (see Afonso, Schuknecht and Tanzi, 2006, for a survey on conceptual issues related to the efficiency of public expenditures).

Figure 3

UK Government Primary Balance and Government Gross Capital forMation
(percent of GDP)



Source: OECD.

Another result stemming from the dynamic responses reported on Figure 2 is the negative impact of current outlays on GDP, except in the very short run. The negative impact comes so early as to contradict textbook analyses.

Both results – total ineffectiveness of public investment and negative effects of current outlays – are counterintuitive so that they ask, to say the least, for robustness tests.

Two direct tests for robustness checks were performed with Blanchard and Perotti's methodology: First, a change in the ordering; second, a change in the sample. Changing the ordering – with current outlays coming first and public investment second, *case A* – or removing the "Golden Rule years" (1998 onwards) from the sample would not change the impulse response functions.[9] Thus our results appear to be robust and consistent with the existing literature following similar approaches. We need then to look in a different direction to explain this puzzling set of results. Recognizing the inherent long term characteristics of investment behavior we extend the model to take into account long run factors. This requires the explicit consideration of debt among the variables to track, in the line of Creel, Monperrus-Veroni and Saraceno (2005).

———————

[9] The corresponding figures are available from the authors upon request.

4.3 A long term SVAR: Introducing debt

In the remainder, the model made of the systems of equations (12) and (14) and equation (13) is tested and discussed. Variables are no longer in first difference. We follow Sims' (1980) recommendation against differencing even if the variables contain unit roots because the goal of a VAR analysis is to determine the inter-relationships among the variables, not to determine estimates. As reported in Sims, Stock and Watson (1990), VARs with non stationary variables incur some loss in estimators' efficiency without any costs in terms of estimators' consistency.

After performing a VAR lag exclusion Wald test, 5 lags were chosen. Figures 4 to 7 display the responses of the 7 endogenous variables to two different shocks on two different samples: first a shock to public investment; second a shock to current outlays, each equal to 1 percent of GDP. The figures also display the two symmetric one-standard error bands computed by bootstrapping, as in Stock and Watson (2001). The two samples are 1972:1-2004:4 and 1972:1-1997:4, the latter excluding the years over which the Code for Fiscal Stability has been implemented

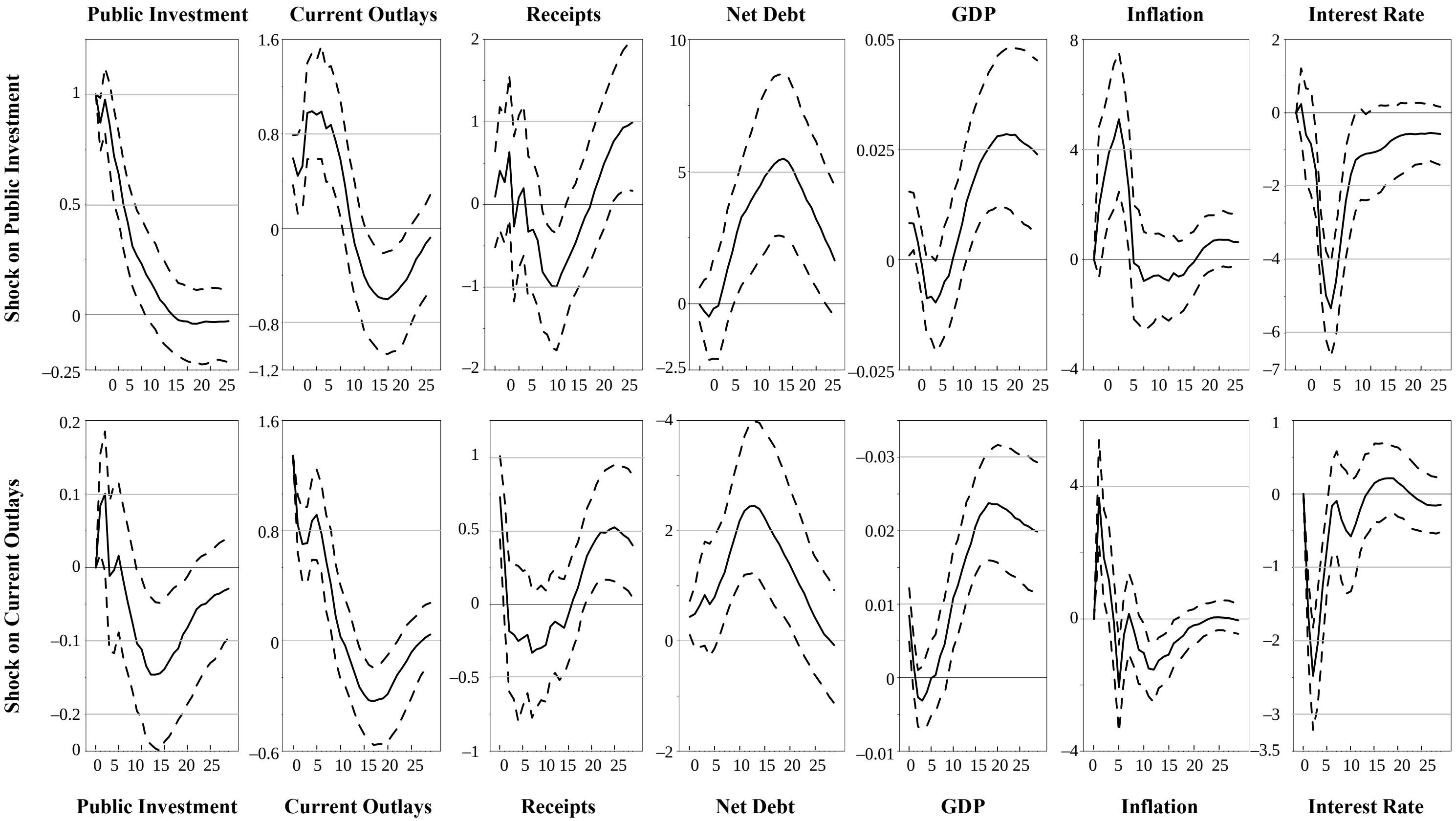
Results displayed on Figure 4 are at odds with previous ones as regards the impact of public investment on GDP. The shock immediately produces an increase in GDP that may be related to growth accounting. After one year, GDP is decreasing and then, after one more year, GDP increases again, persistently this time. Although the decrease in GDP may be attributed to organization delays, it may also be due to higher inflation, through disturbances to households and firms' behaviors. Nevertheless, one important thing here is definitely the positive impact of public investment on GDP in the long run. Recall that this positive effect was also obtained temporarily with a simple VAR; in this new setting, however, the whole evolution of GDP after the shock is statistically significant and the positive impact is long-lasting.

Outcomes of the shock on public investment do produce the same response function for current outlays as with Blanchard and Perotti's identification until the mid-run. In this new setting, however, the response of current outlays finally returns towards the initial steady state in the long run. With the progressive decrease in public investment (the shock is temporary), public debt stops increasing 4 years after the shock. It then returns towards its initial steady state ratio on GDP. Inflation and interest rates are also back to their respective steady states. The shock on public investment does not produce imbalances but only higher economic growth.

In contrast with the results obtained so far, the shock on current outlays is not shown to be detrimental to economic growth. The main difference with the previous shock is that the fiscal variable which is not hit by the shock (public investment, here) is rapidly reduced; hence, public debt does not increase by as much as after the shock on public investment. The relationship between public investment and current outlays gives credit to the following analysis that many economists, mostly political economists, have endorsed: it is easier to reduce investment than current outlays and, in case where investment increases, policymakers are eager to open the Pandora

Figure 4

Full Sample, First Ordering, UK
Impulse Response Functions



box, satisfying the claims for higher current expenditures. Anyway, the resulting increase in the public debt to GDP ratio is only temporary.

In the following, we assess the robustness of our results: public investment efficiency; to a lesser extent, current outlays efficiency; and the asymmetry in the interactions between fiscal variables depending on which one underwent a positive shock.

First, the ordering of fiscal variables has been changed: it has now been assumed that current outlays do not respond immediately to the structural shock on public investment, whereas the reverse is now true for public investment. Results are reported in Figure 5. In this setting, public investment is less efficient (as far as real GDP is concerned) than in the previous ordering: the immediate rise in output is no longer significant (which is not completely unlikely) and its long-run rise is no longer statistically significant over the entire time span. The short run response of GDP may have been influenced by the reaction of the interest rate: it is now increasing in the short run, and significantly so. Note nevertheless that public investment has still a positive impact on real GDP around 5 years after the shock occurred. All in all, the significant positive impacts of public investment on economic growth on the entire time span are higher than their significant negative impacts (they are scarce).

As for the relative efficiency of current outlays in boosting economic growth, on the one hand, and the asymmetry between both fiscal variables on the other hand, they seem to be robust to the change in the ordering.

Second, excluding the years over which the Code for Fiscal Stability has been implemented shows very interesting results, reported in Figure 6 and Figure 7 depending on the ordering. Focusing on a shock on public investment, it is shown that within the most favorable ordering (public investment, first), public investment has a significant impact on real GDP on very short periods: over two quarters in the short run and 2 to 3 years after the shock occurred. Significant responses of real GDP when the ordering is changed are even scarcer.

We interpret this result – the lower efficiency of public investment on output when the Code for Fiscal Stability is removed from the sample – as a first – though rough – evidence of the positive impact on the UK economy of the application of the Golden Rule of Public Finance at the national level.

Now focusing on the shock on current outlays, it is shown that they have lost their positive and significant impact on real GDP in the short run, in comparison with the IRFs obtained on the full sample. In the mid- and long run however, current outlays still positively impinge on economic growth; responses are significant.

Finally, the asymmetry between fiscal variables seems fairly robust to the sample and ordering changes, although to a lesser extent with the second ordering on the subsample excluding the Code for Fiscal Stability. In this situation, the immediate and short-run increases in current outlays following a structural shock on public investment are no longer significant.

Figure 5

Full Sample, Second Ordering, UK
Impulse Response Functions

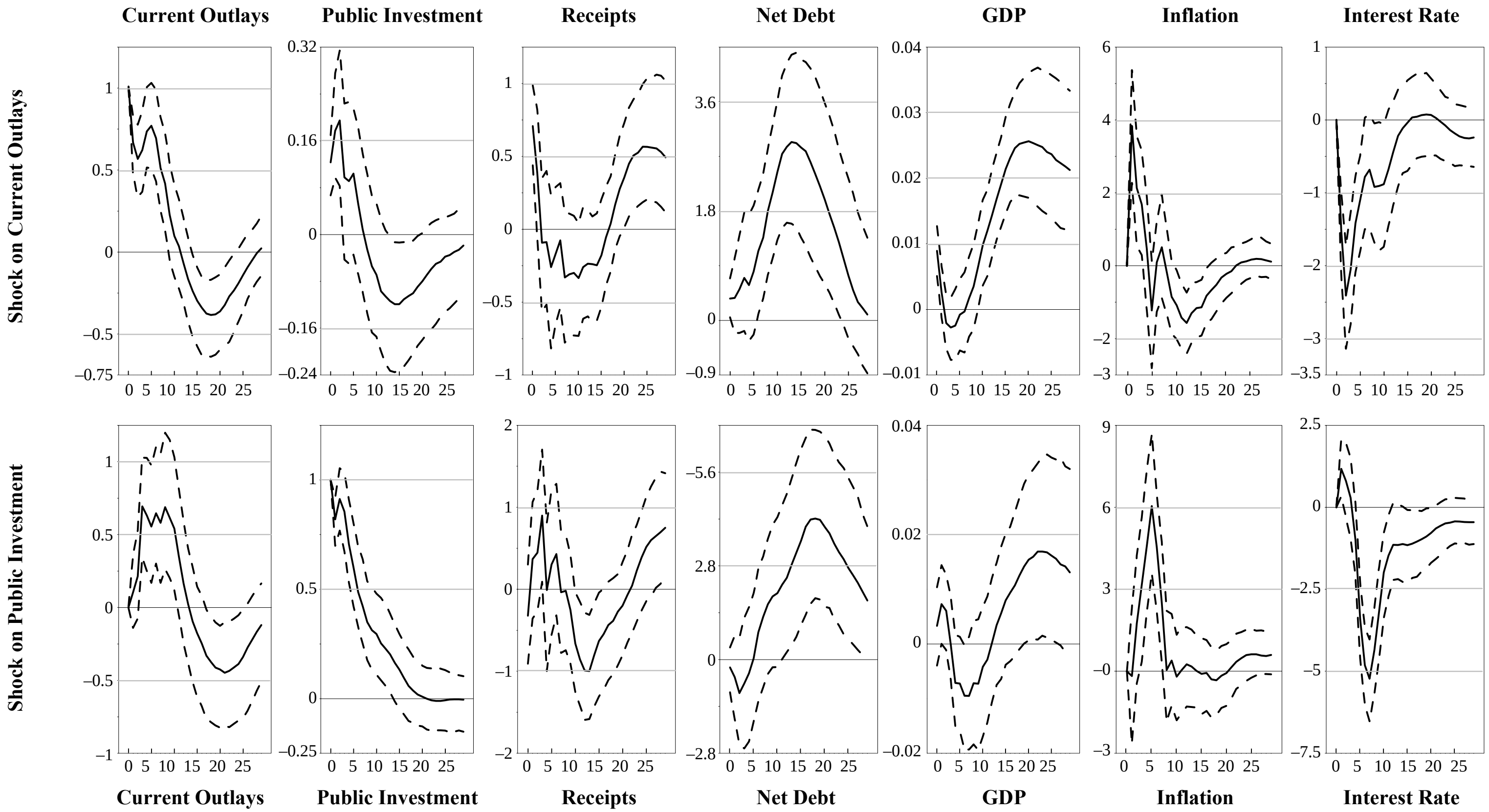


Figure 6

Short Sample, Excluding the Years of the Code for Fiscal Stability, First Ordering, UK
Impulse Response Functions

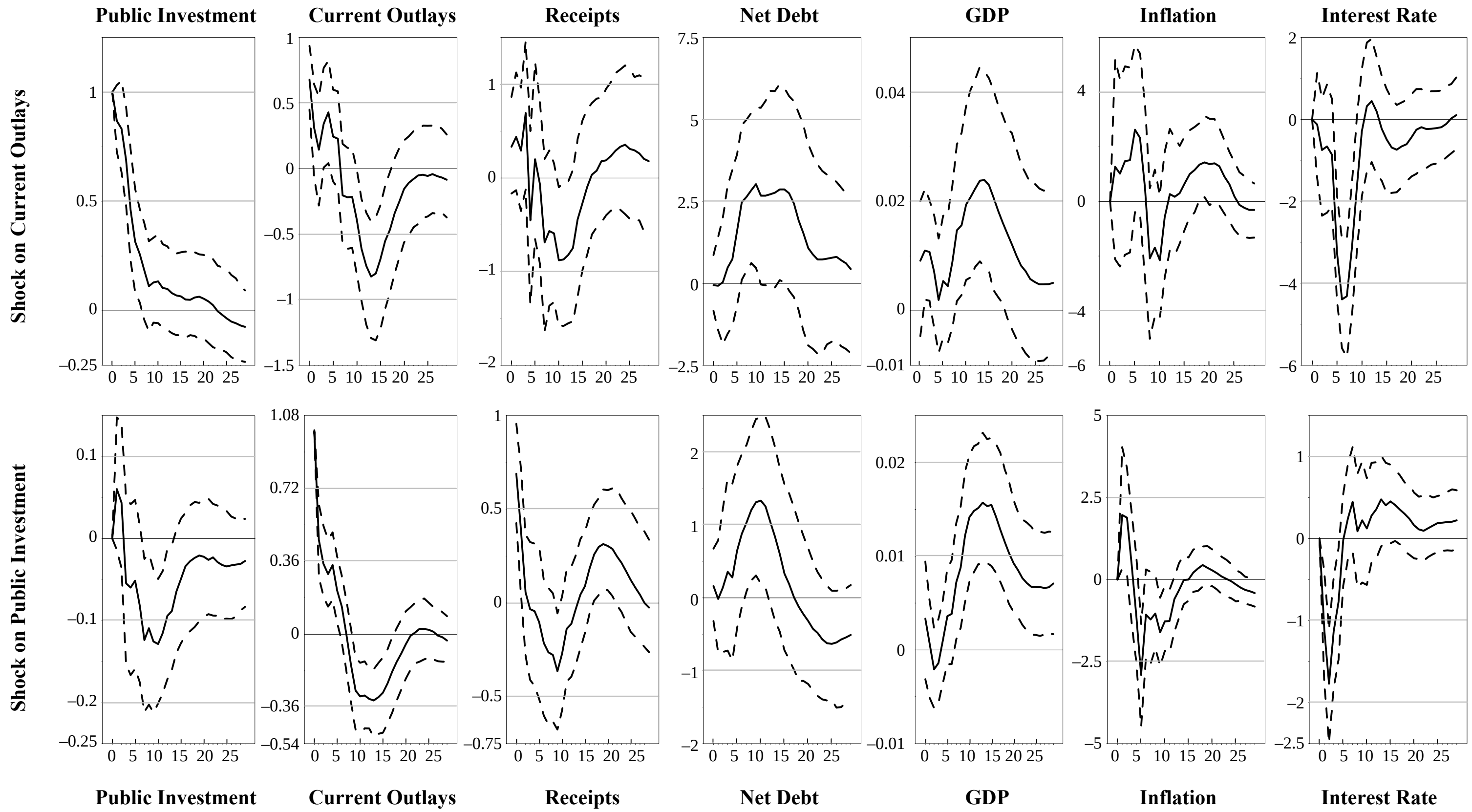
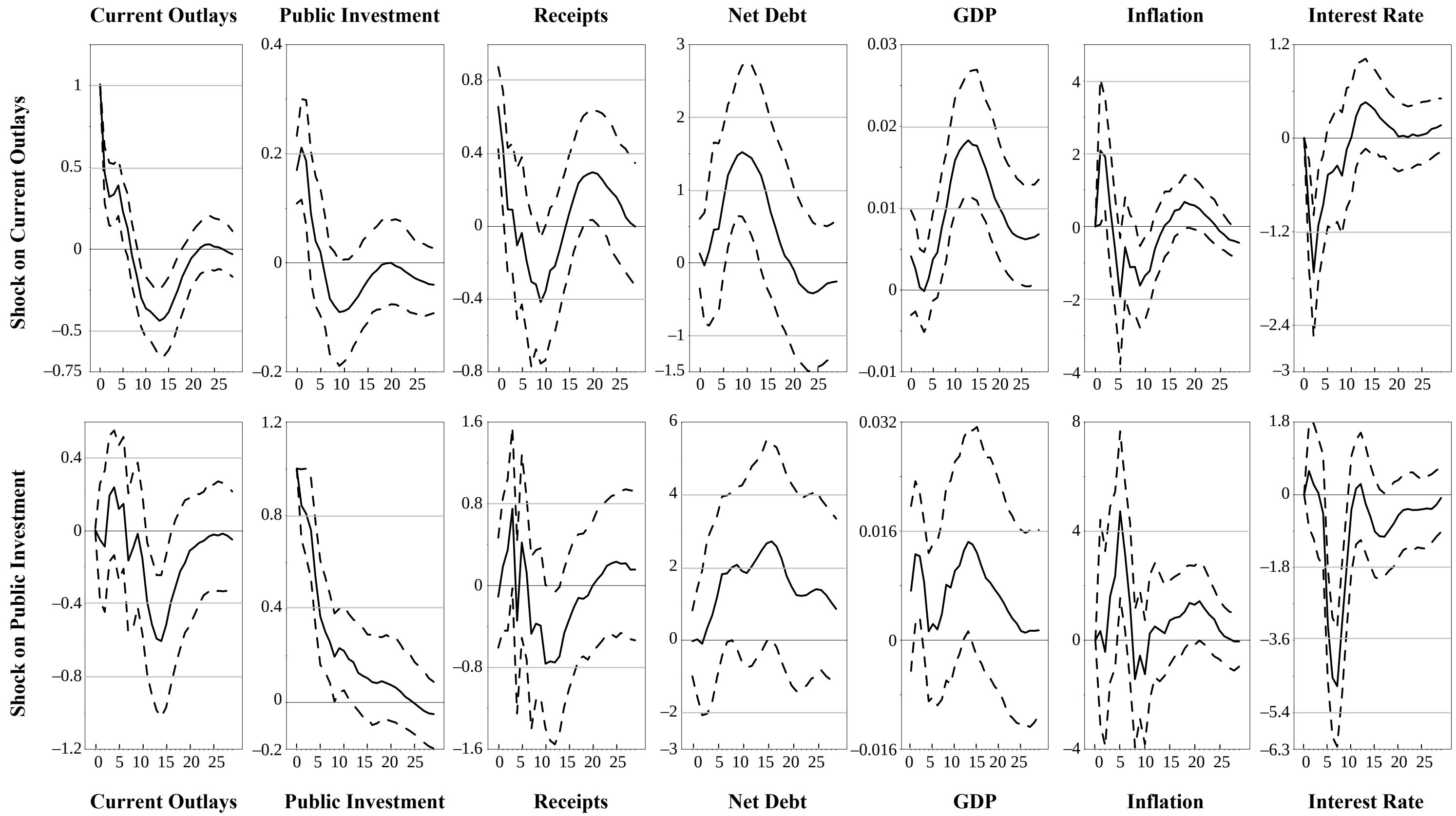


Figure 7

Short Sample, Excluding the Years of the Code on Fiscal Stability, Second Ordering, UK
Impulse Response Functions



5. Conclusion

Different tests have been performed to assess the incidence of public investment on key macroeconomic variables: fiscal and tax variables, public debt, inflation rate, interest rate, and real GDP. The introduction of debt is coherent with the long term model structure that we deem necessary to study the effects of investment. We argue that in the UK context, as well as in the more general context of studying the application of the Golden Rule of Public Finance, public debt cannot be ruled out. Without it, we substantially replicate Perotti's (2004) results on the UK economy, in spite of a slightly different specification. On the other hand we showed that incorporating public debt in the empirical analysis had a major influence on the results. Four important findings have emerged from a study incorporating public debt:

- Public investment in the UK has positive and permanent effects on real GDP, *i.e.* public investment is productive;
- Current outlays are also productive, thus eliminating the puzzle that emerged from the benchmark specification.
- There is evidence that a change has occurred since the Code for Fiscal Stability has been implemented: public investment was less efficient before that period;
- There is evidence that there still exists a asymmetry in the interactions between current outlays and public investment, depending on which one has undergone a positive shock.

REFERENCES

Afonso, A., L. Schuknecht and V. Tanzi (2006), "Public Sector Efficiency, Evidence for New EU Member States and Emerging Markets", ECB, Working Paper No. 581, January.

Aghion, P. and P. Howitt (1998), *Endogenous Growth Theory*, The MIT Press.

Aschauer, D.A. (1989a), "Is Public Expenditure Productive?", *Journal of Monetary Economics*, Vol. 23, No. 2, pp. 177-200.

——————— (1989b), "Public Investment and Productivity Growth in the Group of Seven", *Journal of Economic Perspectives*, No. 13, pp. 17-25.

Bajo-Rubio, O. and S. Sosvilla-Rivero (1993), "Does Public Capital Affect Private Sector Performance? An Analysis of the Spanish Case, 1964-88", *Economic Modelling*, Vol. 10, No. 3, July.

Balassone, F. and D. Franco (2000), "Public Investment, the Stability Pact and the 'Golden Rule'", *Fiscal Studies*, Vol. 21, No. 2.

Barro, R.J. and X. Sala-i-Martín (1995), *Economic Growth*, McGraw-Hill.

Berndt, E.R. and B. Hansson (1992), "Measuring the Contribution of Public Infrastructure Capital in Sweden", *Scandinavian Journal of Economics*, No. 94.

Blanchard, O.J. (1985), "Debt, Deficits, and Finite Horizons", *Journal of Political Economy*, Vol. 93, No. 2, April.

Blanchard, O.J. and F. Giavazzi (2003), "Improving the SGP through a Proper Accounting of Public Investment", *European Economic Perspectives Newsletter*, CEPR, No. 1, February.

Blanchard, O.J. and R. Perotti (2002), "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *Quarterly Journal of Economics*, Vol. 117, No. 4, pp. 1329-68.

Bleaney, M., N. Gemmel and R. Kneller (2001), "Testing Endogenous Growth Model: Public Expenditure, Taxation and Growth over the Long Run", *Canadian Journal of Economics*, Vol. 34, No. 1.

Buti, M., S.C.W. Eijffinger and D. Franco (2003), "Revisiting the SGP: Grand Design or Internal Adjustment?", CEPR, Discussion Paper, No. 3692, January.

Buiter, W.H. (2001), "Notes on 'A Code for Fiscal Stability'", *Oxford Economic Papers*, Vol. 53, No. 1.

Clarida, R.H. (1993), "International Capital Mobility, Public Investment and Economic Growth", NBER, Working Paper, No. 4506.

Creel, J. (2003), "Ranking Fiscal Policy Rules: the Golden Rule of Public Finance vs. the Stability and Growth Pact", OFCE, Working Paper, No. 2003-04.

Creel, J., P. Monperrus-Veroni and F. Saraceno (2005), "Discretionary Policy Interactions and the Fiscal Theory of the Price Level: A SVAR Analysis on French Data", in Banca d'Italia (ed.), *Public Expenditure*. Also OFCE Working Paper.

Creel, J. and H. Sterdyniak (2002), "The Fiscal Theory of the Price Level and Sluggish Inflation: How Important Shall the Wealth Effect Be?", Working Paper, OFCE, No. 2002-01.

Dessus, R. and Herrera S. (1996), "Le rôle du capital public dans la croissance des pays en développement au cours des années 80", Centre de Développement, OECD, Technical Document, No. 115.

Emmerson, C., C. Frayne and S. Love (2004), "The Government's Fiscal Rules", *IFS Briefing Notes*, No. 16, August.

European Commission (2003), "Public Finances in EMU 2003", *European Economy*, No. 3, European Commission.

Evans, P. and G. Karras (1994), "Is Government Capital Productive? Evidence from a Panel of Seven Countries", *Journal of Macroeconomics*, No. 16, pp. 271-79.

Fitoussi, J.P. and J. Creel (2002), *How to Reform the ECB*, Center for European Reform, London, October.

Garcia-Milá, T. and T.J. McGuire (1992), "The Contribution of Publicly Provided Inputs to States' Economies", *Regional Science and Urban Economics*, No. 22, pp. 229-41.

Gong, G., A. Greiner and W. Semmler (2004), "Estimating an Endogenous Growth Model with Public Capital and Government Borrowing: US and Germany 1960-1995", *Computational Economics*, Vol. 23, No. 1, February.

Heijdra, B.J. and L. Meijdam (2002), "Public Investment and Intergenerational Distribution", *Journal of Economic Dynamics and Control*, Vol. 26, No. 5, May.

HM Treasury (2002), *Core Debt: An Approach to Monitoring the Sustainable Investment Rule*, April.

Kneller, R., M.F. Bleaney and N. Gemmell (1999), "Fiscal Policy and Growth: Evidence from OECD Countries", *Journal of Public Economics*, Vol. 74, No. 2, November.

Knight, M., N. Loayza and D. Villanueva (1993), "Testing the Neoclassical Theory of Economic Growth", IMF, Staff Papers, Vol. 40, pp. 512-41.

Le Cacheux, J. (2002), "A Golden Rule for the Euro Area?", paper presented at the *Fiscal Discipline Workshop*, CDC-Ixis and CEPII, Paris, November.

Leeper, E.M. (1991), "Equilibria under 'Active' and 'Passive' Monetary and Fiscal Policies", *Journal of Monetary Economics*, Vol. 27, No. 1, pp. 129-47.

Leith, C. and S. Wren-Lewis (2000), "Interactions between Monetary and Fiscal Policy Rules", *Economic Journal*, Vol. 110, No. 462.

Ligthart, J.E. (2000), "Public Capital and Output Growth in Portugal: An Empirical Analysis", IMF, Working Paper, No. 11.

Mc Millin, W.D. and D.J. Smyth (1994), "A Multivariate Time Series Analysis of the United States Aggregate Production Function", *Empirical Economics*, Vol. 19, pp. 659-73.

Merriman, D. (1990), "Public Capital and Regional Output: Another Look at some Japanese and American Data", *Regional Science and Urban Economics*, Vol. 20, pp. 437-58.

Musgrave, R. (1966), "Principles of Budget Determination", in H. Cameron and W. Henderson (eds.), *Public Finance: Selected Readings*, Random House.

Otto, G.D. and G.M. Voss (1994), "Public Capital and Private Sector Productivity", *Economic Record*, Vol. 70, No. 209, June.

—————— (1996), "Public Capital and Private Production in Australia", *Southern Eastern Journal*, Vol. 62, pp. 723-38.

—————— (2002), "Public and Private Investment in the United States and Canada", *Economic Modelling*, Vol. 19, No. 4, pp. 641-64.

Perotti, R. (2004), "Public Investment: Another (Different) Look", IGIER, Working Paper, No. 277, Bocconi University, December.

Ram, R. and D. Ramsey (1989), "Government Capital and Private Output in the United States", *Economics Letters*, Vol. 30, No. 3, September.

Ratner, J.B. (1983), "Government Capital and the Production Function for U.S. Private Output", *Economic Letters*, Vol. 13, pp. 213-17.

Sims, C. (1980), "Macroeconomics and Reality", *Econometrica*, Vol. 48, No. 1, January, pp. 1-48.

Sims, C.A., J.H. Stock and M.W. Watson (1990), "Inference in Linear Time Series Models with Some Unit Roots", *Econometrica*, Vol. 58, No. 1, January, pp.113-44.

Stock, J.H. and M.W. Watson (2001), "Vector Autoregressions", *Journal of Economic Perspectives*, Vol. 15, No. 4, pp. 101-15.

Sturm, J.E. and J. De Haan (1995), "Is Public Expenditure Really Productive? New Evidence for the U.S. and the Netherlands", *Economic Modelling*, Vol. 12, pp. 60-72.

Sturm, J.E., J.P.A.M. Jacobs and P. Groote (1999), "Output Effects of Infrastructure Investment in the Netherlands 1853-1913", *Journal of Macroeconomics,* Vol. 21, No.2.

Vijverberg, W.P.M., C.P.C. Vijverberg and J.L. Gamble (1997), "Public Capital and Private Productivity", *Review of Economics and Statistics*, Vol. 79, No. 2, May.

Wylie, P.J. (1996), "Infrastructure and Canadian Economic Growth", *Canadian Business Economics*, Vol. 3, No. 2, Winter.

Yaari, M. (1965), "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer", *Review of Economic Studies*, No. 32, April.

PUBLIC INFRASTRUCTURE AND GROWTH: NEW CHANNELS AND POLICY IMPLICATIONS

Pierre-Richard Agénor[*] and Blanca Moreno-Dodson[**]

This paper provides an overview of the various channels through which public infrastructure may affect growth. In addition to the conventional productivity, complementarity and crowding-out effects typically emphasized in the literature, the impact of infrastructure on investment adjustment costs, the durability of private capital and the production of health and education services are also highlighted. Effects on health and education are well documented in a number of microeconomic studies, but macroeconomists have only recently begun to study their implications for growth. Links between health, infrastructure and growth are illustrated in an endogenous growth model with transitional dynamics and the optimal allocation of public expenditure is discussed. The conluding section draws implications of the analysis for the design of strategies aimed at promoting growth and reducing poverty.

1. Introduction

Much of the current international debate on ways to spur growth, reduce poverty and improve the quality of human life in low-income developing countries has centered on the need to promote a large increase in public investment. Reports by the United Nations Millennium Project (2005), the Blair Commission (2005) and the World Bank (2005*a*, 2005*b*) have indeed dwelt on the importance of a "Big Push" in public investment in core infrastructure, financed by generous debt relief and a substantial increase in aid.

A common argument for a large increase in public spending on infrastructure is that infrastructure services may have a strong growth-promoting effect through their impact on the productivity of private inputs and the rate of return on capital – particularly when, to begin with, stocks of infrastructure assets are relatively low.[1] In that regard, low-income countries are at a particular disadvantage. In Sub-Saharan Africa for instance, only 16 per cent of roads are paved, and less than one in five

---

[*] Hallsworth Professor of International Macroeconomics and Development Economics, University of Manchester, and co-Director, Centre for Growth and Business Cycle Research.

[**] Senior Economist, PREM Vice Presidency, World Bank.

A Technical Appendix containing the solution of the model presented in Section IV is available upon request.

We are grateful to Eduardo Lora, Peter Montiel, and Emmanuel Pinto-Moreira for helpful comments on a previous draft. The views expressed in this paper are our own and do not represent those of the World Bank.

[1] Infrastructure in this paper is broadly defined to include transport, water supply and sanitation, information and communication technology (ICT), and energy.

Africans has access to electricity. The average waiting time for a fixed telephone connection is three and a half years. Transport costs are the highest of any region. A 1999 study by the African Development Bank on exports of the region to the United States found that freight charges, as a proportion of cif value, are on average 20 per cent higher for exports of poor countries of the region than for comparable products from other low-income countries. Given that prospects for public-private partnerships (PPPs) in infrastructure investment for the region, and low-income countries in general, are limited (if not inexistent, in many cases), closing the infrastructure gap will indeed require a substantial increase in public investment.[2]

At the same time, recent analytical and empirical research has highlighted the fact that public infrastructure, in addition to its direct effects on the productivity of private inputs and the rate of return on private capital, may spur growth through a variety of other channels. For instance, it has been argued that good public infrastructure (such as a reliable power grid or well-maintained roads), by reducing the need for the private sector to spend on maintenance of its own stock of physical capital, may raise the rate of capital formation and spur growth. A significant body of microeconomic evidence suggests also that infrastructure may have a significant impact on health and education outcomes. Moreover, this impact tends to be magnified through interactions between health and education themselves. In particular, better health has been shown to have a strong impact on the ability to learn and study, in addition to enhancing the productivity of workers.

Surprisingly enough, development macroeconomists and international institutions involved in providing policy advice to low-income countries have only recently begun to study, analytically and empirically, the implications of these channels for growth. In its review of the links between public investment and growth, the International Monetary Fund (2004) did not even mention any of these channels. Similarly, most recent empirical studies that have attempted to gauge the link between infrastructure and growth – such as those of Balducci *et al.* (2004), Calderón and Servén (2004), and Estache, Speciale and Veredas (2005) – did not attempt to account for some of the externalities associated with infrastructure.

This paper provides an overview of the recent literature in this area, with a particular emphasis on the interactions between public infrastructure, education and health outcomes. In that sense, our coverage is broader than earlier surveys on the role of infrastructure and growth, such as those of Gramlich (1994), Kessides (1996) and more recently Romp and de Haan (2005). Unlike these studies, we focus squarely on the evidence on (and policy lessons for) developing countries and

---

[2] The need to enhance infrastructure is not limited, of course, to low-income countries. A report by Fay and Morrison (2005) on infrastructure in Latin America and the Caribbean (LAC) found that the region is currently spending less than 2 per cent of its GDP on infrastructure, down from 3.7 per cent during 1980-85. They estimate that spending would need to reach 4-6 per cent a year for infrastructure to catch up. Moreover, the value of LAC infrastructure with private participation dropped to $16 bn in 2003, down from a peak of $71 bn in 1998. By total project value, 93 per cent of private investment in LAC infrastructure over 1990-2003 went to just six countries (Argentina, Brazil, Chile, Colombia, Peru and Mexico), and mostly into telecommunications and energy.

address econometric issues only sparingly – essentially to highlight the biases created by an inadequate account of the various ways through which public infrastructure may affect economic growth. However, we do not address issues associated with the political economy of infrastructure investment decisions – a topic that has attracted much interest in industrial countries in recent years (see, for instance, Valila and Mehrotra, 2005, and Cadot, Roller and Stephan, 2006).

The remainder of the paper is organized as follows. Section 2 briefly reviews the "conventional" channels through which public infrastructure is deemed to affect growth, namely, productivity, complementarity and crowding-out effects. Section 3 identifies several other channels through which public capital in infrastructure may have an impact on growth. These include an indirect effect on labor productivity, an effect on adjustment costs associated with private investment, an impact on the durability of private capital and an effect on education and health outcomes. In addition, we also highlight the fact that the impact of infrastructure on growth may be magnified as a result of interactions between health and education.

Dwelling on this discussion, Section 4 illustrate the links among health, infrastructure and growth in an endogenous growth model with transitional dynamics. After a brief description of the model and a characterization of the balanced growth path, we examine the short- and long-run effects of a revenue-neutral reallocation of public spending from health to infrastructure and discuss how these effects depend on the technology for producing goods and health services. We then derive the optimal (growth-maximizing) allocation of public expenditure and examine the properties of the optimal rule. Section 5 draws together some of the practical policy implications of the analysis for the design of strategies to promote growth and reduce poverty in low-income countries.

2. Conventional channels

Macroeconomists typically emphasize three "conventional" channels through which public infrastructure may affect growth: a direct productivity effect on private production inputs, a complementarity effect on private investment, and a crowding-out effect on private spending through the financial system.

2.1 Productivity of private inputs

The direct productivity effect of infrastructure is the argument that is most commonly proposed to account for a growth effect of public capital. If, as it is normally the case, production factors are gross complements, a higher stock of public capital in infrastructure would tend to raise the productivity of other inputs, such as labor and the stock of private capital, thereby reducing unit production costs.[3] Given decreasing returns, the magnitude of this effect would depend, of course, on the initial stock of public capital. In mature economies, productivity effects are likely to be limited; but in low-income countries, they could be substantial. In turn, the increase in the productivity of private capital may raise the rate of private investment (given that the return to capital is higher) and spur growth.

To illustrate this effect, suppose for instance that the production function of the private sector takes the Cobb-Douglas form:

$$Y = (K_I)^{\alpha} L^{\beta} (K_P)^{1-\alpha-\beta} \tag{1}$$

where Y is output, KI the stock of public capital in infrastructure, L labor, KP the stock of private capital, and $\alpha, \beta \in (0,1)$. Constant returns to scale therefore prevail in all factors. The marginal product of private capital is given by $(1-\alpha-\beta)(K_I/K_P)^{\alpha}(L/K_P)^{\beta}$, whereas the marginal product of labor is given by $\beta(K_I/K_P)^{\alpha}(K_P/L)^{1-\beta}$. Thus, a higher stock of public capital (relative to private capital) increases the marginal product of both inputs – although it does so at a decreasing rate, given that $\alpha < 1$. In the endogenous growth model that we present in Section 4, we will show that the (steady-state) growth rate itself, in addition to the level of output, depends positively on the public-private capital ratio, K_I/K_P.

Of course, the positive effect of public capital on the marginal productivity of private inputs may hold not only for infrastructure but also for other components of public capital – such as in education and health, which may both affect the productivity of labor (see the discussion below). Moreover, other components of public spending, related for instance to the enforcement of property rights and maintenance of public order, could also increase productivity and exert a positive effect on private investment and growth, despite the fact that they may not be considered as being directly "productive". But, as noted earlier, infrastructure capital may have a particularly large effect in countries where initial stocks are low and basic infrastructure services (such as electricity and clean water) are lacking, as is the case in many low-income countries.[4] Conversely, a study by the African Development Bank suggests that transport and energy costs, at 16 and 35 per cent respectively, represent by far the largest share of firms' indirect costs in Sub-Saharan Africa. A large fraction of these costs is the result of the poor quality of basic infrastructure. For instance, because of inadequate transport facilities and unreliable supply of electricity, firms often incur additional expenses in the form of more expensive transportation means and onerous energy back-up systems.[5]

---

3 Several country-specific studies based on the estimation of cost functions have found indeed that public infrastructure typically entails cost reductions in private production. See for instance Cohen and Paul (2004), and Teruel and Kuroda (2005).

4 For instance, data from China (1978-97), India (1970-93) and Uganda (1992-99), countries that have managed to stimulate growth and reduce poverty on a large scale, show that the marginal returns to public incremental expenditures on rural roads were always among the highest.

5 Firms that do not undertake these additional investments may still incur costs in the form of lost production resulting from equipment breakdowns.

The productivity and cost effects of public infrastructure may be magnified in the presence of externalities associated with the use of some production factors, such as, for instance, learning-by-doing effects resulting from a high degree of complementarity between physical capital and skilled labor. As shown by Torvik (2001) in particular, by enhancing labor productivity and lowering (unit) labor costs, learning by doing may magnify the growth effect of public infrastructure. Indeed, an increase in public capital may affect the rate of total factor productivity growth, independently of its effect on private capital accumulation.

2.2 Complementarity effect on private investment

Another channel through which public capital in infrastructure can exert a positive effect on growth is private capital formation. As noted earlier, public infrastructure increases the marginal productivity of private inputs. In so doing, it raises the perceived rate of return on, and may increase the demand for, physical capital by the private sector.[6] For example, the rate of return to building a factory is likely to be much higher if the country has already invested in power generation, transportation and telecommunications.

The complementarity effect has been well documented in the empirical literature on private capital formation in developing countries (see Agénor, 2004, Chapter 2). Albala-Bertrand and Mamatzakis (2004) for instance found that in Chile, public infrastructure capital had a significant positive effect on private investment. In Vietnam, the decision to improve National Highway No. 5 and rehabilitate the port of Haiphong in the early 1990s led to a massive increase in investment (much of it foreign) in major industrial zones, spurring growth and employment in the northen part of the country in general (Mitsui, 2004).

Conversely, the study of Uganda by Reinikka and Svenson (2002) illustrates well how inadequate public infrastructure may adversely affect private investment. A survey of 243 manufacturing firms conducted in 1998 in that country showed that the lack of adequate electricity sources was ranked as the most important constraint to investment. Firms on average did not receive electricity from the public grid for 89 operating days on average, which led to 77 per cent of large firms (in addition to 44 per cent of medium and 16 per cent of small firms) purchasing generators, representing 25 per cent of their total investment in equipment and machinery in 1997. The same survey showed that for a firm without a privately-owned generator, a one per cent increase in the number of days without power results in a 0.45 per cent reduction in investment.

---

[6] Greater availability of public capital in infrastructure could in principle also reduce the demand for private inputs, at a given level of output (net substitution effect). But if inputs are gross complements, higher availability of public capital will normally increase the marginal productivity of private inputs, as noted earlier, and thus demand for these inputs. The evidence suggests indeed that public infra-structure and private physical capital tend to have a high degree of complementarity, that is, a small elasticity of (net) substitution.

In the short run, public capital in infrastructure may also affect private capital formation indirectly, through changes in output and relative prices. As noted earlier, public capital in infrastructure may raise the marginal productivity of all factor inputs (capital and labor), thereby lowering marginal production costs and increasing the level of private production. In turn, this scale effect on output may lead, through the standard accelerator effect, to higher private investment – thereby raising production capacity over time and making the growth effect more persistent.

Another indirect channel is through the effect of public infrastructure on the price of domestic consumption goods relative to the price of imported goods, that is, the (consumption-based) real exchange rate. An increase, for instance, in public investment in infrastructure would raise aggregate demand and put pressure on domestic prices. If the nominal exchange rate does not depreciate fully to offset the increase in domestic prices, the domestic-currency price of imported consumption goods will fall in relative terms (that is, the real exchange rate will appreciate), thereby stimulating demand for these goods. The net effect on domestic output may be positive or negative, depending on the intra-temporal elasticity of substitution between domestic and imported goods. If this elasticity is low (as one would expect in the short run), the net effect may well be positive. Again, through the accelerator effect, private investment may increase, and this may translate into a more permanent growth effect.

At the same time, to the extent that the increase in government spending on infrastructure raises the relative price of domestic capital goods, and the switch in private consumption demand toward imports translates into a nominal appreciation, the domestic-currency price of imported capital goods may fall in relative terms, resulting in a drop in the user cost of capital. If a large fraction of the capital goods used by the private sector are imported (as is often the case in developing countries) this may lead to an increase in private investment. Moreover, this relative price effect is not only short term in nature; it may translate into a growth effect, as suggested by the evidence reported in Sala-i-Martín, Doppelhofer and Miller (2004).

2.3 Crowding-out effects

In the short term, an increase in the stock of public capital in infrastructure may have an adverse effect on activity, to the extent that it displaces (or crowds out) private investment. This short-run effect may translate into an adverse growth effect if the drop in private capital formation persists over time.

Crowding-out effects may take various forms. For instance, if the public sector finances the expansion of public capital through an increase in distortionary taxes, the reduction in the expected net rate of return to private capital, may lower the propensity to invest. A similar, and possibly more detrimental, effect on private capital formation may occur if the increase in public infrastructure outlays is paid for by borrowing on domestic financial markets, as a result of either higher domestic interest rates (in countries where market forces are relatively free to operate) or a greater incidence of rationing of credit to the private sector. Moreover, if an investment-induced expansion in public borrowing raises concerns about the sustainability of public debt over time and strengthens expectations of a future increase in inflation or explicit taxation, the risk premium embedded in interest rates may increase.[7] By raising the cost of borrowing and negatively affecting expected after-tax rates of return on private capital, an increase in the perceived risk of default on government debt may have a compounding effect on private capital accumulation. In particular, private investors may revise downward their investment plans because of anticipated hikes in tax rates to cover the increase in public investment.

In principle, crowding-out effects associated with public infrastructure should be short term in nature; to the extent that an increase in the public capital stock raises output growth in the medium and longer term, future government borrowing needs may actually fall as a result of higher tax revenues. In that sense, deficits today will pay for themselves tomorrow, a common logic when discussing tax cuts and increases in expenditure in a growth context (see, for instance, Ireland, 1994, and Agénor and Yilmaz, 2006). However, as noted earlier, these effects may also persist beyond the short term, and turn into longer-run (adverse) effects on growth. For instance, if higher tax rates create permanent incentives for tax evasion, lower resources may reduce durably the government's capacity to invest in infrastructure and other areas in the future, or its ability to ensure adequate maintenance of the public capital stock (as discussed later). If so, then, despite the complementarity effect mentioned earlier, the net effect of an increase in public infrastructure may well be to hamper, rather than foster, economic growth.

3. New channels

Recent research has identified several channels, other than those identified in the previous section, through which public infrastructure may have an impact on growth. This section provides an overview of these "new" channels, which include an indirect effect on labor productivity, an effect on adjustment costs associated with private investment, an impact on the durability of private capital, as well as an effect on education and health outcomes.

3.1 Indirect effect on labor productivity

Independently of its direct effect on the marginal product of factor inputs in the production process (as discussed earlier), public infrastructure may have an

[7] In a small open economy with open capital markets facing a fixed world interest rate, crowding-out effects through a rise in domestic interest rates cannot occur. But for small developing countries, the supply curve of foreign capital is upward-sloping rather than horizontal. In such conditions, and if the risk premium faced on world capital markets is positively related to the debt-to-GDP ratio, an increase in domestic public debt induced by a rise in public investment in infrastructure may still lead to both lower credit to the private sector and higher domestic interest rates.

indirect, additional impact on labor productivity. The idea, first suggested by Ferreira (1999, p. 544) and elaborated upon by Agénor and Neanidis (2006*b*), is that with better access to roads and other means of public transportation (such as railways), workers can get to their job more easily, therefore spending less time commuting from home or moving across different work locations. This would tend to reduce traffic-related stress, which can be detrimental to concentration on the job. With greater access to electricity and telecommunications, workers can perform a number of tasks more rapidly (such as checking price quotations), as well as additional tasks away from the office (such as checking work-related e-mails from home). In turn, higher productivity would tend to enhance growth.

3.2 Effect on adjustment costs

Implicit in the view that public infrastructure and private investment are positively related is the idea that public capital may reduce the incidence of adjustment costs associated with increases in private capital formation. Some of the recent literature has clarified the nature of these adjustment costs as well as the mechanisms through which public infrastructure may affect them.

Adjustment costs typically represent frictions that prevent firms from adjusting their capital stock fully and instantaneously in response to, say, a demand shock, a change in the relative price of capital, or an increase in productivity.[8] It has been increasingly recognized that poor infrastructure, particularly in low-income countries, may be an important cause for these frictions.[9] For instance, an expansion in the road network may not only reduce congestion on highways and facilitate the shipment of goods across regions (thereby reducing unit production costs, as noted earlier) but also reduce expenses associated with the construction of a new factory or the transportation of heavy equipment for installation to a new, remote production site. In large and sparsely populated countries, the impact on the cost of investment can be fairly substantial. Thus, by lowering not only production costs but also adjustment costs related to investment, public capital in infrastructure will tend to raise expected rates of return and therefore stimulate private capital formation. This positive effect may be particularly important for small firms. As documented by Tybout (2000) and Bigsten *et al.* (2005) for instance, in low-income countries the size distribution of firms is often heavily skewed to the right, with a high proportion of very small firms. These firms tend to be especially affected by adjustment costs. Indeed, in the study of Uganda by Reinikka and Svenson (2002) mentioned earlier,

---

8 They include therefore costs associated with the sale, purchase or productive implementation of capital goods, over and above the price of these goods. Such costs are associated with, for instance, searching for, and deciding upon, the proper type of equipment needed for a particular purpose, scrapping obsolete machines, installing the new capital stock, and reorganizing and training the workforce (see Hamermesh and Pfann, 1996). Note also that, with time-to-plan and time-to-build constraints, investment itself (rather than the stock of capital) could be subject to adjustment costs; see, for instance, Gertler and Gilchrist (2000).

9 Other factors, such as underdeveloped or poorly functioning capital markets, may of course be equally (if not more) important in these countries.

only a small fraction of small firms (less than 20 per cent, compared to almost 80 per cent for large firms) were able to purchase generators to alleviate a chronic lack of access to government-provided electricity. Similarly, in a study of the constraints imposed by deficiencies in public infrastructure on manufacturing industries in Nigeria, Indonesia and Thailand, Lee, Anas and Oh (1999) found that small firms bear a significantly greater burden than large firms.

The link between public capital in infrastructure and adjustment costs was formalized by Turnovsky (1996) and Agénor and Aizenman (2006). To illustrate the argument, suppose that a typical firm faces adjustment costs that are a convex function of the rate of change of the firm's capital stock. In the absence of depreciation, this rate is simply $I = dK_P/dt$, where I is investment and K_P the private capital stock. In standard models of investment, the adjustment cost function, $C(I,K_P)$, is often taken to be a continuously differentiable function in the investment rate, I/K_P, and to satisfy the conditions $C(0) = 0$, $C'(0) = 0$, and $C'' > 0$. These assumptions imply therefore that it is costly for the firm to increase or decrease its capital stock, and that the marginal adjustment cost is increasing in the size of the adjustment. A function satisfying these properties is:

$$C(I,K_P) = I\cdot\{1 + \kappa(K_I/K_P)\cdot(I/K_P)/2\} \tag{2}$$

where K_I denotes again public capital in infrastructure.[10] The function $\kappa(K_I/K_P)$ captures the impact of public infrastructure (scaled by the stock of private capital) on adjustment costs. Assuming that firms maximize the present value of all future cash flows, it can be shown that the optimal rate of accumulation of private capital is:

$$I/K_P = (q - 1)/\kappa(K_I/K_P)$$

where q is the shadow value of capital (or Tobin's q).

Both Turnovsky (1996) and Agénor and Aizenman (2006) assume that the function $\kappa(K_I/K_P)$ has the properties are $\kappa' < 0$ and $\kappa'' > 0$. Thus, the above equations imply that an increase in public capital (at a given level of private capital) tends to reduce costs and facilitate the accumulation of private capital; but the reduction in adjustment costs occurs at a declining rate. Put differently, the benefit of a higher stock of public infrastructure on private investment is subject to diminishing returns. Nevertheless, there is again, in a sense, a complementarity effect between public capital in infrastructure and private investment, but this time it operates through overall adjustment costs, rather than exclusively through the direct rate of return on private capital.

Another channel through which public capital may reduce adjustment costs is by facilitating the reallocation of capital from one sector to another (from, say, the nontradable to the tradable sector), in response to changes in relative prices. Put

10 Note that in equation (2) adjustment costs are assumed to be quadratic. With that specification, the marginal cost is constant in the investment rate. This implies that the firm will adjust to the long-run equilibrium gradually, by making continuous, small adjustments every period.

differently, if shifting capital across activities is (very) costly, greater availability of public infrastructure may help to reduce these costs substantially.

To illustrate the argument, let K_P denote now the economy's total stock of private capital, and let K_{PT} (respectively, K_{PN}) denote the stock of private capital in the tradable (respectively, nontradable) sector. The assumption that capital is costly to reallocate across sectors can be captured by specifying a factor transformation curve between the components of the overall capital stock:

$$K_P = F(K_{PT}, K_{PN})$$

where $F(\cdot)$ is a CES function. Suppose now that the elasticity of substitution between K_{PT} and K_{PN} is positively related to the ratio of public capital in infrastructure to total private capital, K_I/K_P. This may be because shifting capital from the nontradable sector (say, cash crops in rural areas) to the traded sector (say, export crops) is made easier by the existence of public assets such as wells (which facilitate irrigation) and rural roads (which allow faster shipment to ports and foreign markets). Then an increase in public capital would reduce adjustment costs faced by the private sector if, for instance, following a shock, capital must be reallocated between sectors. By enhancing the ability of the private sector to respond to price signals, lower adjustment costs may be accompanied by efficiency gains, which may translate into permanent growth effects.

3.3 *Effect on the durability of private capital*

Good public infrastructure may have a positive effect on growth by improving the durability of private capital. This has important implications for spending on maintenance and the quality of public capital.[11] Lack of public spending on infrastructure maintenance has been a recurrent problem in many developing countries. According to the World Bank (1994, p. 1), technical inefficiencies in roads, railways, power and water in developing countries caused losses equivalent to a quarter of their annual investment in infrastructure in the early 1990s. Paved roads, in particular, deteriorate fast without regular maintenance. Insufficient maintenance of a railroad system will cause frequent breakdowns and lower its reliability, creating potentially severe losses for users. Thus, increasing maintenance spending, by reducing power losses, telephone faults and so on, would help to enhance the productivity effects of public infrastructure on private production. For instance, in Vietnam, the World Bank (1999, p. 44) estimated that reducing a road's roughness from 14 IRI (International Roughness Index) to 6 IRI would save between 12 and 22 per cent in vehicle operating costs. A reduction from 14 IRI to 3 IRI would save from 17 to 33 per cent in those costs. More dramatically perhaps, Gyamfi and Guillermo (1996, p. 5) estimated that for Latin America and the Caribbean, each

[11] Hulten (1996) argued forcefully for paying more attention to the quality of infrastructure capital in the growth process; and Calderón and Servén (2004) found a link (albeit weak) between indicators of infrastructure quality and the rate of economic growth in a cross-country study. Appendix 2 discusses issues associated with the measurement of the quality of public infrastructure.

dollar not spent on road maintenance leads to a \$3.0 increase in vehicle operating costs as a result of poor road conditions. Thus, to the extent that public expenditure on maintenance affects the durability, as well as the quality, of private physical capital, it may have a sizable impact on growth.

A formal analysis of the impact of public infrastructure maintenance on private investment and growth is provided by Agénor (2005*c*), who developed an endogenous growth framework in which maintenance expenditure not only increases the durability of public capital, as in Rioja (2003) and Kalaitzidakis and Kalyvitis (2004), but also raises the efficiency and durability of private physical capital. The key assumption of the model is that the rate of depreciation of private capital depends on both the amount of maintenance spending on infrastructure by the government and "usage", as measured by the stock of private capital itself. The underlying idea is that expanding and maintaining the quality of public roads, for instance, enhances the longevity of trucks and other means of transportation used by the private sector to move goods and workers across regions within a country or across borders. With a more reliable power grid, electrical equipment may last longer. Put differently, if maintenance spending increases the reliability of publicly-provided sources of energy, machines and other equipment (such as trucks and computers) used by private sector firms may break down less often.

The implication of the model is that, as long as the effect of maintenance expenditure on the efficiency and/or durability of the public capital stock is sufficiently high, the higher the marginal effect of maintenance spending on the depreciation rate of private capital, the higher should be the growth-maximizing share of spending on maintenance, and the lower should be the share allocated to new investment in infrastructure. Put differently, the share of resources that should be allocated to maintenance expenditure depends positively not only on the marginal effect of that category of spending on the rate of depreciation of public capital (as is conventionally assumed), but also on its ability to enhance the durability of the private capital stock. Neglecting this effect may result in a sub-optimal allocation of resources toward new investment in infrastructure.

Another implication of the analysis dwells on the fact that the quality of the private capital stock depends also on spending by the private sector *itself* on maintenance. To the extent that the government spends sufficiently to keep roads, for instance, in good condition, the private sector would need to spend less on maintaining its trucks in good working order to transport goods and workers across destinations. Such spending could then be reallocated to new investment. Thus, by by reducing the need for private spending on maintenance, an increase in public spending on maintenance could have an additional positive growth effect.

3.4 Impact on health and nutrition

It is now well recognized that infrastructure may have a sizable impact on health outcomes in developing countries. As documented in the various micro-economic studies summarized by Brenneman and Kerf (2002), access to safe water and sanitation helps to improve health, particularly among children. Recent surveys suggest that in some African cities, the death rate of children under five is about twice as high in slums (where water and sanitation services are poor, if not inexistent), compared to other urban communities. More formal studies by Behrman and Wolfe (1987), Lavy *et al.* (1996), Lee, Rosenzweig and Pitt (1997), Newman *et al.* (2002), Leipziger *et al.* (2003), and Wagstaff and Claeson (2004, pp. 170-74) found that access to clean water and sanitation infrastructure helps to reduce infant mortality. In their study of Bolivia, for instance, Newman *et al.* (2002) found that investments in water systems led to declines in under-five mortality that were similar in size to those associated with health interventions. Greater access to clean water and sanitation also has a significant effect on the incidence of malaria, as documented by McCarthy, Wolf and Wu (1999).

Access to electricity, by reducing the cost of boiling water, helps to improve hygiene and health as well. Availability of electricity is essential for the functioning of hospitals and the delivery of health services; vaccines, for instance, require continuous and reliable refrigeration to retain their effectiveness.[12] Getting access to clean energy for cooking in people's homes (as opposed to smoky traditional fuels, such as wood, crop residues and charcoal) improves health outcomes, by reducing indoor air pollution and the incidence of respiratory illnesses (such as asthma and tuberculosis). According to World Bank estimates, more than half of the population in the developing world still relies on traditional biomass fuels, such as wood and charcoal, for cooking and heating (see Saghir, 2005). In Sub-Saharan Africa alone, the proportion cooking on biomass is over 90 per cent. Traditional sources of energy represent serious health hazards; Warwick and Doig (2004) estimated that indoor air pollution from the burning of solid fuels kills over 1.6 million people (predominantly women and children) a year. More efficient electric stoves would reduce this death toll, which is almost as great at that caused by unsafe water and sanitation, and greater than that caused by malaria.

Better transportation networks also contribute to easier access to health care, particularly in rural areas. Recent data produced by national Demographic and Health Surveys in Sub-Saharan Africa show that a majority of women in rural areas rank distance and inadequate transportation as major obstacles in accessing health care (see African Union, 2005). In Morocco, a program developed in the mid-1990s to expand the network of rural roads led – in addition to reducing production costs and improving access to markets – to a sizable increase in visits to primary health care facilities and clinics (see Levy, 2004). In Malaysia and Sri Lanka, the World Bank (2005*c*, p. 144) found that the dramatic drop in the maternal mortality ratio (from 2,136 in 1930 to 24 in 1996 in Sri Lanka, and from 1,085 in 1933 to 19 in 1997 in Malaysia) was due not only to a sharp increase in medical workers in rural and disadvantaged communities, but also to improved communication and transportation services – which helped to reduce geographic barriers. Transportation

---

[12] As noted by the World Health Organization (2005, p. 36) lack of safe water and electricity has not only hampered the provision of health services in poor countries but also raids their cost.

(in Malaysia) and transportation subsidies (in Sri Lanka) were provided for emergency visits to health care centers. Moreover, in Malaysia, health programs formed part of integrated rural development efforts that included investment in clinics, roads and schools. A similar approach was followed in Sri Lanka – better roads made it easier to get to rural health facilities. At a more formal level, Wagstaff and Claeson (2004, pp. 170-74) found, using cross-section regressions, that road infrastructure (as measured by the length of the paved road network) had a significant effect on a number of health indicators, such as infant and female mortality rates.

3.5 Impact on education

A large body of evidence, based predominantly on microeconomic studies, has also documented the existence of a significant link between infrastructure and educational attainment. As summarized by Brenneman and Kerf (2002), these studies have found a direct positive impact of various types of infrastructure services (namely, roads, electricity, water and sanitation and telecommunications) on learning indicators.

Studies have indeed found that a better transportation system and a safer road network (particularly in rural areas) help to raise school attendance. In the Philippines, for instance, after rural roads were built, school enrollment went up by 10 per cent and dropout rates fell by 55 per cent. A similar project in Morocco raised girls' enrollments from 28 per cent to 68 per cent in less than 10 years (see Khandker, Lavy and Filmer, 1994, and Levy, 2004). The quality of education also improved, as greater accessibility made it easier to hire teachers and facilitate commuting between rural and urban areas.

Similarly, researchers have found that greater access to safe water and sanitation in schools tends to raise attendance rates (particularly for girls) and the ability of children to learn, by enhancing their health. In many developing countries, the sanitary and hygienic conditions at schools remain appalling, with inadequate water supply and hand washing facilities. Schools that lack access to basic water supply and sanitation services tend to have a higher incidence of major childhood illnesses among their students. Improvements in those areas tend therefore to have a high payoff. In Bangladesh, for instance, girls' attendance rates in schools went up by 15 per cent following improved access to water and sanitation facilities. In Morocco, the sharp increase in girls' enrollment rates mentioned earlier was in part due to improved access to water and sanitation in schools.

A number of micro studies have also found that access to electricity helps to improve the learning process, by allowing children to spend more time studying and by providing more opportunities to use electronic equipment. Computers, for instance, may enhance the quality of learning by improving access to information. In purely quantitative terms, access to electricity can make a sizable difference in terms of its impact on schooling. In the late 1990s in Nicaragua, 72 per cent of children living in a household with electricity were attending school, compared to only 50 per cent for those living in a household without electricity (see Saghir, 2005).

3.6 Magnification effect through health and education

It is increasingly recognized that health and education are interlinked in their contribution to growth. Higher levels of education increase public awareness and the capacity of families to address their health needs. At the same time, better health enhances the effective and sustained use of the knowledge and skills acquired through education, while reducing at the same time the rate of depreciation of that knowledge. We begin by reviewing some of the recent evidence on interactions between health and education and then examine how infrastructure can magnify its impact on growth by enhancing these outcomes, as described earlier.

3.6.1 Impact of health on education

Several studies have found that health can have a sizable indirect effect on growth through education and the accumulation of human capital. Indeed, good health and nutrition are essential prerequisites for effective learning. Healthier children tend to do better in school, just like healthier workers perform their tasks better. Conversely, inadequate nutrition, which often takes the form of deficiencies in micronutrients, reduces the ability to learn and study. Poor nutritional status can therefore adversely affect children's cognitive development, and this may translate into poor educational attainment (see Behrman, 1996, and Bundy *et al.*, 2005). Poor health (often taking the form of respiratory infections in developing countries) is also an important underlying factor for low school enrollment, absenteeism and high dropout rates.

In Bangladesh for instance, the Food for Education program, which provided a free monthly ration of food grains to poor families in rural areas if their children attended school, was highly successful in increasing school enrollment (particularly for girls), promoting attendance and reducing dropout rates (see Ahmed and Arends-Kuenning, 2006). In Tanzania, the use of insecticide-treated bed nets reduced the incidence of malaria and increased attendance rates in schools (Bundy *et al.*, 2005, p. 2). In Western Kenya, deworming treatment improved primary school participation by 9.3 per cent, with an estimated 0.14 additional years of education per pupil treated (see Miguel and Kremer, 2004). McCarthy, Wolf and Wu (1999) found that malaria morbidity (viewed as a proxy for the overall incidence of malaria among children) has a negative effect on secondary enrollment ratios. Bloom, Canning and Weston (2005) found that children vaccinated against a range of diseases (including measles, polio and tuberculosis) as infants in the Philippines performed better in language and IQ scores at the age of ten, compared to unvaccinated children – even within similar social groups. Thus, (early) vaccination appears to have a significant effect on (subsequent) learning outcomes.

Thus, increasing the health of individuals may also increase the effectiveness of education, as in the "food for thought" model of Galor and Meyer (2004). Bundy *et al.* (2005), in their overview of experience on the content and consequences of school health programs (which include for instance treatment for intestinal worm infections), have emphasized that these programs can raise productivity in adult life not only through higher levels of cognitive ability, but also through their effect on school participation and years of schooling attained. At a more aggregate level, the cross-country regressions of Baldacci *et al.* (2004) show that health outcomes (as proxied by the under-five child mortality rate) have a statistically significant effect on school enrollment rates.

Another channel through which health can improve education outcomes and spur growth is through higher life expectancy and reduced pressures to reallocate time among household members. Increases in life expectancy tend to raise the incentive to invest in education (in addition to increasing the propensity to save), because the returns to schooling are expected to accrue over longer periods. Thus, at the individual level, to the extent that spending on health increases the individual's lifespan, it may also raise the returns (as measured by the discounted present value of wages) of greater expenditure on education. Conversely, intra-family allocations regarding school and work time of children tend to be adjusted in the face of disease within the family; in turn, these adjustments may influence the aggregate rate of accumulation of physical and human capital and thus the rate of economic growth. For instance, as discussed by Corrigan, Glomm and Mendez (2005), when parents become ill, children may be pulled out of school to care for them, take on other responsibilities in the household, or work to support their siblings. Indirect evidence suggesting that reallocation of family time may indeed be important in practice is provided by Kalemli-Ozcan (2006), who found that AIDS lowered school enrollment rates in many countries in Sub-Saharan Africa between 1985 and 2000. Hamoudi and Birdsall (2004) also provide evidence that AIDS reduced schooling rates in Sub-Saharan Africa. These results are consistent with the view that the risk that children may be infected by AIDS tends to deter parents from investing in their education, as argued by Bell, Devarajan and Gerbasch (2006). Put differently, an environment where there is great uncertainty about child survival may create a precautionary demand for children, with less education being provided to each of them. In turn, the lack of human capital accumulation may hamper economic growth, as illustrated by Arndt (2006) in his study of AIDS and growth in Mozambique.

3.6.2 Impact of education on health

A significant body of research (at both the micro and macro levels) has shown that higher education levels can improve health outcomes.[13] The positive effect of education on health works partly through income; but there are other channels as

[13] Glewwe (2002) reviews the evidence on how schooling affects adult and child health.

well. Several studies have found that where mothers are better educated (and presumably more aware of health risks to their children), infant mortality rates are lower and attendance rates in school are higher (see Glewwe, 1999 and 2002, as well as the cross-country regressions of Baldacci *et al.*, 2004, and Wagstaff and Claesson, 2004). Better-educated women tend, on average, to have more knowledge about health risks.[14] In developing countries in general, during the period 1970-95, improvements in female secondary school enrollment rates are estimated to be responsible for 43 per cent of the total 15.5 per cent reduction in the child underweight rate (see Smith and Haddad, 2000). For Sub-Saharan Africa as a whole, it has been estimated that five additional years of education for women could reduce infant mortality rates by up to 40 per cent (see Summers, 1994). In the cross-section regressions for developing countries reported by McGuire (2006), average years of female schooling have a statistically significant impact on under-five mortality rates.[15] In Niger alone, researchers have found that infant mortality rates are lower by 30 per cent when mothers have a primary education level, and by 50 per cent when they have completed secondary education. Similarly, Paxson and Schady (2005), in a study of Ecuador, found that the cognitive development of children aged 3 to 6 years varies inversely with the level of education of their mother.

A low level of education may also lead to *maternal* malnutrition, with dire consequences for children. Inadequate intakes of nutrients during pregnancy have been found to have irreversible effects on children. Recent research at the National institute of Health in the United States, for instance, has shown that the children of mothers who ate food with little omega-3 fatty acids had a lower IQ than children who did. In addition, they also lacked physical coordination and had greater difficulties to engage in normal social relations. Inadequate diets may also have adverse effects on mental health (and therefore the ability to raise children), as argued in a report by the Mental Health Foundation (2006).

3.6.3 Magnification effect

The foregoing discussion suggests that the close interactions between health and education can magnify the effects of an increase in public infrastructure on growth. By investing in roads, for instance, governments may not only reduce production costs for the private sector and stimulate investment, but also improve education and health outcomes, by making it easier for individuals to attend school and seek health care. With their health improving, individuals become not only more productive, but they also tend to study more. In turn, a higher level of education

---

[14] However, as noted by Fuchs (2004, p. 658), the observed high correlation between women's education and the health of children in developing countries may be the result of omitted variables. For instance, countries where women have the greatest opportunities to acquire an education may also have other traditions and policies in place that are more favorable to them; in turn, these traditions and policies could have an independent effect on health.

[15] In a study based on a large sample of industrial and developing countries over the period 1850 to 1990, Tamura (2006) found that higher levels of human capital (as measured by the number of years of schooling of the average 25-year old) tend also to lower the mortality rate of young adults.

makes individuals more aware of potential risks to their own health and that of their family members. Moreover, investment in infrastructure, by improving health and life expectancy, may reduce uncertainty about longevity and the risk of death, thereby increasing the propensity to save. As a result of these various effects, the impact of infrastructure on growth is compounded.

4. Implications for growth and public spending allocation

The foregoing analysis suggests that it is crucial, in designing growth-promoting strategies, to account for the variety of channels, direct and indirect, through which infrastructure affects the economy. This is important because the complementarities that appear at the micro level among infrastructure, health and education (as discussed earlier) may give way to potential trade-offs at the macro level. The reason is that the provision of any type of services requires the use of (limited) public resources. Understanding the nature of these trade-offs is essential for determining the composition of public spending in a growth context.

To illustrate the issues involved, this section examines the optimal allocation of government spending between health and infrastructure in an endogenous growth framework where public capital is an input in the production of final goods as well as the production of health services.[16] Put differently, what matters to produce health services is not only spending on health *per se*, but the combination of public spending on health and infrastructure. As noted earlier, to function properly, hospitals need access to electricity. With inadequate water, sanitation and waste disposal facilities, hospitals cannot provide the services that are expected from them. The model also assumes, more conventionally, that individuals can provide effective services from human capital only if they are healthy. Thus, by enhancing productivity, health influences growth indirectly.[17]

The first part of this section presents the framework, which assumes that all public services are provided free of charge and financed by a distortionary tax on output. It also gives the expression for the balanced growth path. The second examines the short- and long-run effects of a budget-neutral increase in spending on infrastructure. The third derives the optimal (growth-maximizing) allocation rule between spending on infrastructure and health. The issue that we address is whether (given that the production of health services depends on infrastructure) a rise in public spending on infrastructure is the most efficient method to stimulate growth.

---

16 Barro (1990) was one of the first to propose a formal analysis of the link between public infrastructure and growth. See Zagler and Durnecker (2003) for an overview of some of the literature spawn by Barro's contribution. Our focus here is on the links between infrastructure and health.

17 Although we focus here solely on the link between infrastructure and health, similar arguments can be made regarding the link between infrastructure and education. Agénor (2005b, 2005c, 2005d) developed a variety of models in which the production of human capital requires not only teachers and public spending on education services, but also access to infrastructure capital. We will return to these models later on.

As noted earlier, the provision of each category of services requires resources and this (given the overall constraint on revenues) creates potential trade-offs.

4.1 The health-infrastructure link: an endogenous growth framework

Despite the compelling nature of the microeconomic evidence, the link between health and infrastructure has not received much attention in the existing literature on government spending and endogenous growth. In what follows we extend the model presented in Agénor (2005*f*) to account for a "stock" effect of public capital. We begin with a brief description of the model and continue with a discussion of the balanced growth path.[18]

4.1.1 The model

Consider an economy with a constant population and an infinitely lived representative household who produces and consumes a single traded good. The good can be used for consumption or investment. The government spends on infrastructure and health. It provides health services free of charge and levies a flat tax on output to finance its outlays.

Output, Y, is produced with private physical capital, K_P, public infrastructure capital, K_I, and "effective" labor, defined as the product of the quantity of labor and productivity, A. As emphasized for instance by van Zon and Muysken (2001), human capital is embodied in workers; as a result, people can provide "effective" human capital services only if they are healthy. Health is thus labor augmenting.

Normalizing the population size to unity and assuming that technology is Cobb-Douglas, yields:[19]

$$Y = (K_I)^{\alpha} A^{\beta} (K_P)^{1-\alpha-\beta} \tag{1}$$

where $\alpha, \beta \in (0,1)$.

Productivity depends solely on the availability of health services, H, with a unit elasticity:[20]

$$A = H \tag{2}$$

Combining (1) and (2) yields

$$Y = (K_I/K_P)^{\alpha} (H/K_P)^{\beta} K_P \tag{3}$$

which implies that in the steady-state, with constant ratios of K_I/K_P and H/K_P, the output-private capital ratio is also constant.

---

18 Detailed derivations are relegated to a Technical Appendix, available upon request.

19 The time index t is omitted in what follows to simplify notations.

20 A more general specification would be to relate productivity not only to health but also directly to infrastructure, as noted earlier. See Agénor and Neanidis (2006b) for a formal treatment.

The household's discounted utility function is:

$$V = (1-1/\sigma)^{-1}\int_0^{\infty}[(C_I)^{\kappa}H^{1-\kappa}]^{1-1/\sigma}\exp(-\rho t)dt \quad (4)$$

where C is consumption, $\rho > 0$ the discount rate, $\kappa \in (0,1)$ and $\sigma \neq 1$ is the intertemporal elasticity of substitution. Coefficient κ (respectively, $1-\kappa$) measures the relative contribution of consumption (respectively, health) to utility, whereas σ is the elasticity of intertemporal substitution. This specification implies that utility is non-separable in consumption of goods and health services; an increase in consumption of health services raises the utility derived from consuming final goods. There is therefore gross complementarity.[21]

The household maximizes V in (4) subject to the resource constraint:

$$C + dK_P/dt = (1 - \tau)Y \quad (5)$$

where $\tau \in (0,1)$ is the tax rate on income. For simplicity, the depreciation rate of private capital is assumed to be zero.

Production of health services requires combining government spending on health, G_H and public capital in infrastructure. Assuming also a Cobb-Douglas technology yields:

$$H = (K_I)^{\mu}\,(G_H)^{1-\mu} \quad (6)$$

where $\mu \in (0,1)$.

The government spends on infrastructure and health services, and levies (as noted earlier) a flat tax on output at the rate τ. It keeps a balanced budget at each moment in time. The government budget constraint is thus:

$$G_H + G_I = \tau Y \quad (7)$$

Both categories of spending are taken to be a constant fraction of tax revenue:

$$G_h = \upsilon_h \tau Y \quad (8)$$

where $\upsilon_h \in (0,1)$ and $h = H,I$. Using (8), equation (7) can therefore be written as:

$$\upsilon_H + \upsilon_I = 1 \quad (9)$$

Finally, assuming no depreciation for simplicity, the government stock of public capital in infrastructure changes over time according to:

$$dK_I / dt = \phi\, G_I \quad (10)$$

where $\phi \in (0,1)$ is an efficiency parameter that measures the extent to which public investment creates public capital. As discussed at length by Agénor *et al.* (2005), the

---

21 We also assume that the discount rate ρ is constant; Agénor (2006) considers the case where, instead, the degree of impatience (and thus the propensity to save, as discussed earlier) is inversely related to the consumption of health services.

case $\phi < 1$ reflects the fact that investment outlays are subject to inefficiencies, which tend to limit their positive impact on the public capital stock.[22]

4.1.2 The balanced growth path

The model can be manipulated to give a system of two non-linear differential equations in $c = C/K_P$ and $k_I = K_I/K_P$. These equations, together with an initial condition on $k_I(0)$ and a transversality condition on the private capital stock, characterize the dynamics of the economy.

As established in the Technical Appendix, the long-run equilibrium is saddle-point stable and the balanced growth path (BGP) is unique. Along that path, consumption and the stocks of both private and public capital grow at the same constant rate γ, which can be written in two equivalent forms, one of which is:

$$\gamma = \phi \upsilon_I \tau^{1/\Omega} \upsilon_H^{(1-\mu)\beta/\Omega} (k_I^{SS})^{-\eta/\Omega} \tag{11}$$

where $\Omega \equiv 1 - (1-\mu)\beta > 0$, $\eta \equiv 1 - \alpha - \beta > 0$ and k_I^{SS} denotes the (constant) steady-state value of k_I. It can be established from this result that the higher the efficiency of public investment in infrastructure, the higher the steady-state growth rate.

The long-run equilibrium is shown in the phase diagram depicted in Figure 1. Curve KK corresponds to the combinations of $\{c,k_I\}$ for which k_I is constant over time (that is, $dk_I / dt = 0$), whereas curve CC corresponds to the combinations of (c,k_I) for which c is constant over time (that is, $dc/dt = 0$). Both curves are strictly increasing and strictly concave, but saddlepath stability requires that the slope of KK be steeper than the slope of CC (see the Technical Appendix). The saddlepath, denoted SS, also has a positive slope and is flatter than CC. The initial balanced growth equilibrium obtains at point A.

4.2 Revenue-neutral increase in spending on infrastructure

Let us now examine the short- and long-run effects of a revenue-neutral shift in government spending from health to infrastructure, that is, $d\upsilon_I = -d\upsilon_H$. In general, a shift of this type has an ambiguous effect on the growth rate, γ, as well as the steady-state values of the consumption-private capital ratio, c^{SS}, and the public-private capital ratio, k_I^{SS}, depending on the elasticity of the production of health services with respect to infrastructure, μ, the parameters characterizing the goods production technology, α and β, and the structure of preferences, as captured by the coefficient κ in the objective functional (4).

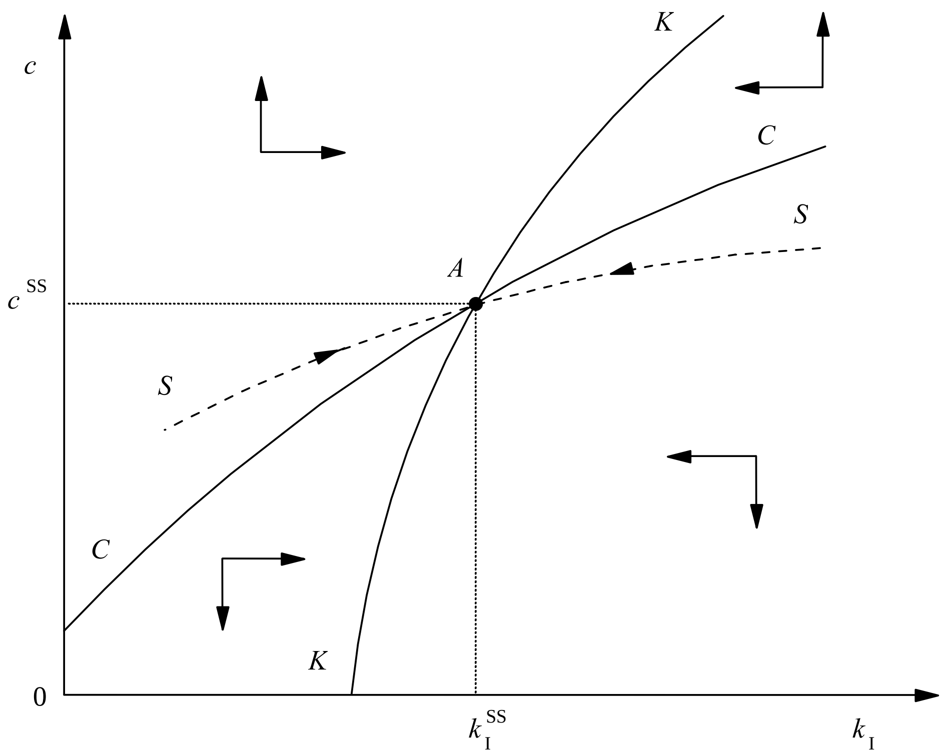
Consider first the "standard" case where $\mu = 0$ and the health production technology depends only on the flow of government spending on health. In that

---

22 Arestoff and Hurlin (2005), for instance, estimate the value of φ to vary between 0.4 and 0.6 for a group of developing countries.

Figure 1

The Balanced-growth Equilibrium



Source: Adapted from Agénor and Yilmaz (2006).

case, the long-run value of the public-private capital ratio rises unambiguously, whereas the consumption-private capital ratio may either increase or fall. The reason is the complementarity between health services and private spending. The production of health services tends to fall (as can be inferred from (6) and (8)), despite the fact that the increase in public capital tends to raise output. In turn, the reduction in supply of health services tends to lower consumption, as well as labor productivity. At the same time, a higher rate of public investment in infrastructure tends to raise the economy's stock of public capital relative to private capital (despite the fact that lower consumption increases savings and private investment), and the growth rate increases if the adverse effect on labor productivity is not too large. This tends to raise consumption. If health services have no effect on utility (that is, if $\kappa = 1$ in equation (4)), the positive effect is likely to dominate.

Consider now the case where $\mu \neq 0$ and the health production technology depends also on the public capital stock in infrastructure. Long-run effects are now potentially less negative. The reason is that the production of health services does not necessarily fall, in contrast to the previous case. In fact, as can be inferred again from (6) and (8), the reallocation of government spending from health to infrastructure may actually lead to a *higher* output of health services, if μ is sufficiently high. If this is indeed the case, then labor productivity and consumption would unambiguously increase, together with the public-private capital ratio. The steady-state growth rate is also likely to increase. Put differently, if μ is sufficiently high, the structure of preferences (as summarized by κ) matters less for long-run outcomes.

Transitional dynamics are illustrated in Figure 2. Graphically, curve KK shifts to the right, whereas curve CC can shift in either direction, depending on the parameters of the model. If, as noted earlier, μ is relatively low and κ is close to unity, or conversely if μ is relatively high (close to unity), CC shifts to the left, as depicted in the upper panel. At the new equilibrium (point A'), both the public-private capital ratio and the consumption-capital ratio are higher. By contrast, if μ is relatively low (with, at the same time, a low value of κ), CC shifts to the right (as illustrated in the lower panel of the figure), and the new equilibrium (point A') will be characterized by a higher public-private capital ratio and a lower consumption-capital ratio. In both cases the adjustment path corresponds to the sequence ABA'.

The important implication of the foregoing analysis is thus that, if public infrastructure is sufficiently "productive" in the health production technology (in the sense that the elasticity of output of health services with respect to public capital is sufficiently high), the positive effect of an increase in infrastructure spending may outweigh the negative effect of lower public spending *per se* on health services on consumption and growth. Put differently, the best strategy for increasing the supply and consumption of health services in the long run and stimulate growth may not be to increase direct government spending on health, but rather to increase spending on other "production" inputs, in this particular case infrastructure.[23] This is an important policy message, to which we will return in the next section.

4.3 Growth-maximizing allocation rule

Setting $d\gamma / d\upsilon_I = 0$ in equation (11), it can readily be established that the growth-maximizing share of spending on infrastructure, υ_I^*, is given by:[24]

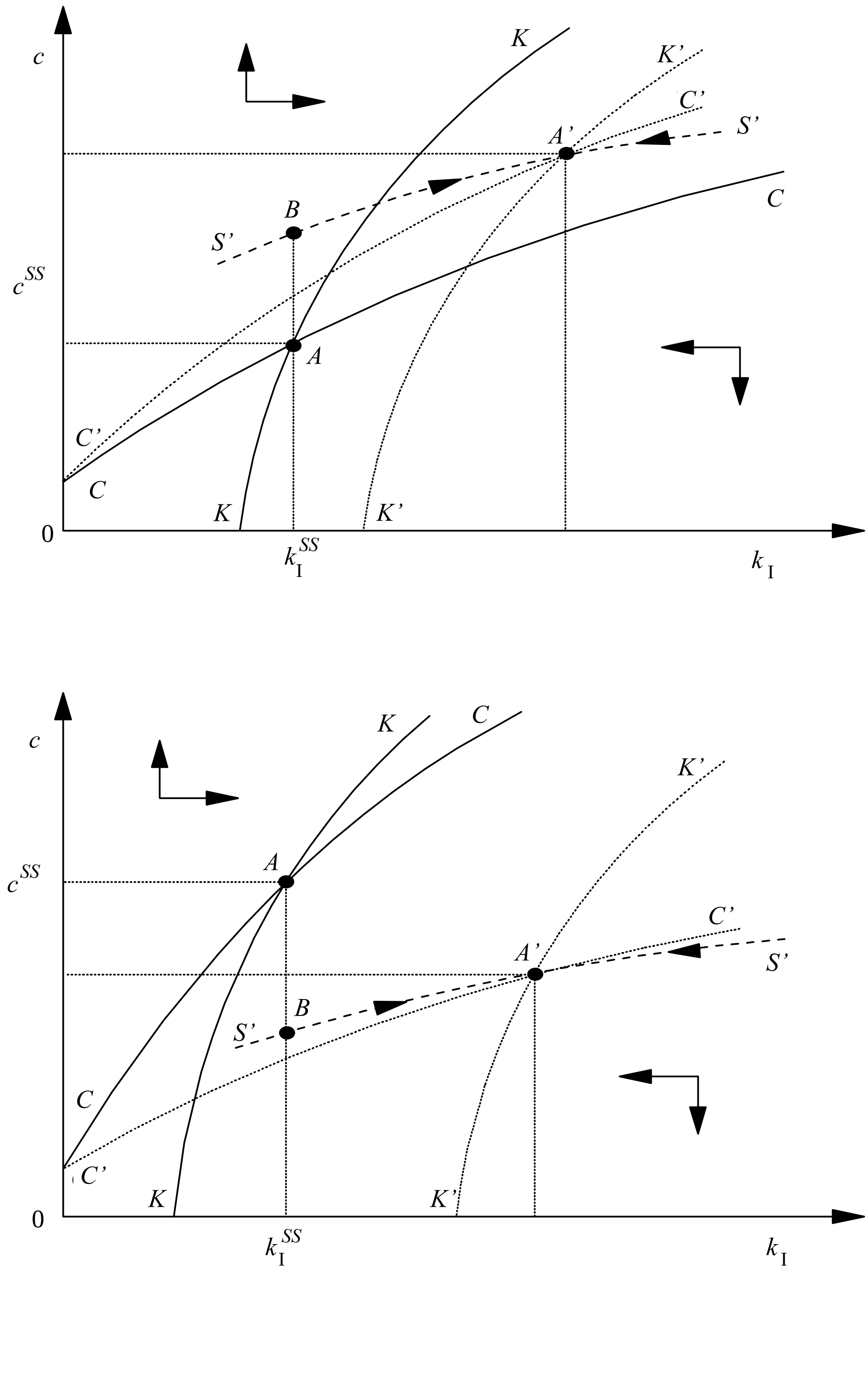
---

[23] Our results may also help to understand why several empirical studies (such as Filmer, Hammer and Prichett, 2000) found no significant correlation between public health spending and health outcomes; this may be because infrastructure may have been a binding constraint.

[24] See Agénor (2005f) and Agénor and Neanidis (2006a) for a derivation of the welfare-maximizing allocation in related models, as well as a comparison with the growth-maximizing solution.

Figure 2

Revenue-neutral Shift in Spending from Health to Infrastructure



$$\upsilon_I^* = (\alpha+\mu\beta)/(\alpha+\beta) \tag{12}$$

so that, from (9), $\upsilon_H^* = 1-\upsilon_I^*$. Formula (12), first established in Agénor (2005*f*), has the following properties. If $\mu = 0$, that is, in the "standard" case where health services are produced only with government spending on health, $\upsilon_I^* = \alpha / (\alpha+\beta)$. This essentially indicates that the share of spending on infrastructure must be equal to the elasticity of goods output with respect to public capital in infrastructure, divided by the sum of the elasticities with respect to public capital and effective labor (α and β).[25] By contrast, if $\mu = 1$, all spending should be allocated to infrastructure ($\upsilon_I^* = 1$). More generally, the higher is the elasticity of output of health services with respect to infrastructure capital, the lower should be the share of spending on health. This result is consistent with the analysis of a revenue-neutral shift in spending described earlier: the best way to increase production of health services, raise output growth and improve welfare, may not be to increase direct spending on health but rather to invest more on infrastructure.

Although our focus in the foregoing discussion was solely on the link between infrastructure and health, similar arguments can be made regarding the link between infrastructure and education. Indeed, Agénor (2005*a*, 2005*c*, 2005*e*) has developed several models in which the production of human capital (or, more specifically, educated labor) requires not only teachers and public spending on education services, but also access to infrastructure capital. In an extension of these models, Agénor and Neanidis (2006*a*) have accounted for not only the effect on infrastructure on education, but also the effect of health on education. The implicit view in all of these models is that access to infrastructure services such as roads, electricity and telecommunications, may enhance the ability of individuals to study and acquire skills. As noted earlier, this is a particularly important consideration for low-income developing countries, where the lack of an adequate network of roads makes access to schools (particularly in rural areas) difficult; dropout rates tend to be higher when children must walk long distances to get to schools. The lack of access to electricity hampers the ability to study, both in the classroom and at home. In some countries, the lack of adequate toilet facilities for girls in rural area schools has led many parents to deny an education to their daughters. Accounting for the impact of infrastructure on the schooling technology has important implications for the determination of the optimal allocation of government expenditure between education and infrastructure. Again, depending on how "productive" public infrastructure is in the education technology, the best way to accumulate human

---

[25] If the supply of labor is fixed, and health has no effect on the efficiency of labor, formula (12) gives $\upsilon I^* = \alpha$, which corresponds to Barro's (1990) result. See Agénor (2005a, 2005c) for a more detailed discussion. Note also that formula (12) shows that the optimal allocation of spending between health and infrastructure does not depend on the degree of efficiency of investment, that is, the parameter ϕ in equation (10), despite the fact that (as noted earlier) changes in ϕ affect the steady-state growth rate. The reason is fairly intuitive: what matters is the productivity effect of the stock of public capital in the goods and health production technologies (relative to the productivity effect of effective labor), not the flow of spending. The result would be different, of course, if we were to consider the efficiency of the public capital stock itself (see Agénor, 2005d).

capital and spur growth in a sustained fashion may not be to increase direct spending on education, but rather to spend more on infrastructure.

The foregoing analysis also has important methodological implications for the empirical analysis of the determinants of growth, based on either standard growth accounting techniques, or (reduced-form) cross-country regressions. Many existing studies based on cross-country growth regressions tend to focus on *flow* variables, by considering either investment ratios (as, for instance, in Devarajan, Easterly and Pack, 2003) or capital expenditure (see Devarajan, Swaroop and Zou, 1996). As made amply clear in previous sections, a proper assessment of the supply-side effects of public infrastructure should be based on *stocks*, not spending flows. In tne same vein, growth accounting exercises that do not account separately for public and private capital accumulation cannot begin to ascertain with any degree of precision the respective impact of these two components on growth, given the possibility of large complementarity and crowding-out effects.[26]

Moreover, existing studies (even those based on stocks of infrastructure assets) usually do not capture the externalities associated with public infrastructure, through for instance their impact on the durability of private capital (and thus the rate of return on private invetment) or their effect on health and education. Consequently, they are likely to underestimate the contribution of public infrastructure to growth. This is a key limitation of the studies of Bhargava *et al.* (2001), Balducci *et al.* (2004), Calderón and Servén (2004), Loayza, Fajnzylber and Caldéron (2004), and Estache, Speciale and Veredas (2005).

On a related point, several cross-country studies have found that health outcomes have a sizable impact on growth (see Appendix 1 for a brief overview of the recent evidence). As can be inferred from the discussion in the previous sections, this may still underestimate the true impact of health, which may operate through a variety of indirect channels – such as the impact of better health on the incentives to acquire skills and accumulate human capital, and the effect of a higher expected lifetime on the rate of time preference and the propensity to save. At the same time, however, improvements in health outcomes themselves may be the consequence of greater access to public infrastructure, for the reasons outlined earlier. Because most cross-country studies do not account for these indirect effects, the true contribution of infrastructure to growth tends to be underestimated. Country-specific studies, such as the analysis of long-run growth in South Africa by Fedderke, Perkins and Luiz (2006), suffer from the same shortcomings.[27] Simulation exercises aimed at

---

[26] One reason why, for instance, Devarajan, Easterly, and Pack (2003) do not find public investment rates to be significantly associated with growth in Sub-Saharan Africa may be the fact that much of public investment outlays were subject to waste (as noted earlier), implying that only a fraction of them contributed effectively to public capital accumulation. In addition, looking at total investment rates is not adequate to assess the importance of infrastructure investment *per se*, given that non-infrastructure investment may generate large crowding-out effects.

[27] Some of these studies suffer from other limitations as well. In particular, they do not always account for the fact that the impact of public spending on growth depends on how the increase in outlays is financed. Ignoring the government budget constraint invalidates the use of the model for a number of purposes, such as calculations of investment needs. Moreover, existing studies do not provide an adequate treatment of

(continues)

evaluating, say, infrastructure needs and their impact on growth are bound to be misleading, because they are based on mispecified models.

Future work based on cross-country growth regressions must provide a more careful attempt to disentangle the various channels through which infrastructure affects growth, possibly through the use of simultaneous equations models. An alternative approach is to develop country-specific structural macroeconomic models, which have considerable advantages (compared to small econometric models), given the flexibility that they provide to account explicitly for the various externalities associated with public infrastructure. Important classes of models in this area are the SPAHD models developed by Agénor, Bayraktar and El Aynaoui (2006), and Agénor *et al.* (2005), or the more advanced IMMPA framework described in the contributions contained in Agénor, Izquierdo and Jensen (2006). A key feature of both types of models is indeed an explicit account of the composition of public capital (with at the same time a proper distinction between "efficiency-adjusted" flows and stocks), as well as the type of interactions described earlier among infrastructure, health and education. By their very nature, these models provide an ideal setting for capturing the microeconomic complementarities and macroeconomic trade-offs, involved in designing growth-promoting, medium-term public investment programs in developing countries (see Agénor, Bayraktar and Pinto Moreira, 2006).

5. Implications for growth strategies and poverty reduction

The foregoing analysis suggests that public infrastructure can affect economic growth by *a*) enhancing indirectly the productivity of workers, in addition to the direct effect on the productivity of labor used as input in the production function; *b*) facilitating adjustment costs associated with private capital formation and its mobility to relatively more profitable activities; *c*) enhancing the durability of private capital; and *d*) improving health and education outcomes, as well as compounding their effect on growth. These channels operate in parallel with the more traditional productivity and complementarity effects associated with infrastructure.

From a policy standpoint, the "new" channels provide important lessons. Facilitating road transportation and communications can translate into higher productivity of workers, even when maintaining the same capital to labor ratio in the infrastructure sector. For instance, in Kenya and Uganda, facilitating access to communications allowed farmers to be better informed about international commodity prices and was conducive to higher agricultural productivity.

non-linearities – which may be quite important in assessing the impact of infrastructure on growth, as a result of network effects. See Agénor (2006), Hurlin (2006), and Arestoff and Hurlin (2005) for a discussion of this last point.

Eliminating infrastructure constraints, such as water shortages, electricity outages and difficult road access, can facilitate the process of shifting private resources to more productive sectors, for instance from nontradables to tradables, or from agriculture to services and manufacturing. Similarly, by facilitating movement of people and goods, improved infrastructure can lead in the medium term to higher investments in the rural sector and greater agricultural diversification. Farmers must be able to obtain inputs at reasonable costs, and also to sell their outputs at remunerative prices. Transportation costs, in particular, are crucial for them to decide whether or not to engage in certain activities. For instance, while China increased agricultural productivity in rural areas, investments in infrastructure, coupled with labor mobility, increased flows of labor and capital to urban centers and facilitated growth in the manufacturing and services sectors.

With respect to the durability of private capital, infrastructure plans, when they present an appropriate balance between capital and current expenditures (in such as way that they ensure rehabilitation and maintenance), can promote the profitability of all (public and private) existing investments and assets. This is a critical policy issue for many low-income countries. While many rural roads have been built in these countries, the cost of maintaining them in good condition has often not been considered as a priority in national spending plans. As noted earlier, expanding and maintaining the quality of public roads would enhance the durability of private vehicles and encourage mobility across regions and areas. Similarly, eliminating or reducing electricity outages may encourage private investments, because firms would be less concerned about the functioning (and durability) of their equipment and the need to prevent them from deteriorating in the longer term.[28] In practice, unfortunately, policymakers have a perverse incentive: given their higher visibility, new public investment projects are politically more attractive than economically crucial, but politically less rewarding, spending on infrastructure maintenance. It is therefore important to insulate maintenance budgets in public expenditure programs and make them consistent with the overall investment budget.

As described at length earlier, when better access to schools and hospitals is provided to the population (not only to the ones in need but also to health and education workers), the quality of services is enhanced.[29] Thus, public infrastructure spending can exert strong positive effects on health and education outcomes. Furthermore, better infrastructure can improve the durability and profitability of existing investments in education and health. In fact, as illustrated by our analytical framework, the best way to improve the provision of health services may not necessarily be to engage exclusively in direct spending on health but also to allocate

---

[28] The need for increasing operations and maintenance expenditures, to ensure the durability of capital, may be equally important in middle-income countries (such as those in Eastern Europe and Central Asia) where infrastructure investments have already achieved wide country coverage.

[29] As noted earlier, recent surveys in a number of Sub-Saharan African countries show that around 60 per cent of households in the bottom two income-quintiles find distance to health services a major obstacle to accessing them, exacerbated in some countries by difficulties in securing transport; see African Union (2005).

a significant share of resources to building infrastructure capital. The same conclusion holds with respect to the production and delivery of education services.

More generally, in order to trigger the desired results, the composition of public spending in infrastructure must take into account the needs of the population in education and health, and not be biased by political priorities. Infrastructure network plans must be inclusive of remote areas where the neediest live. In many low-income countries, priority has often been given to infrastructure spending in urban and politically visible regions, somehow neglecting rural and isolated areas. Growth-promoting infrastructure strategies should assess what might be needed for the poor to access health and education services, as opposed to deciding *ex post* how infrastructure could be used by the poor. Tailoring infrastructure projects by incorporating the voice of the poor into the planning process can bring more benefits to them. Lack of adequate consultation with citizens in the planning process has been seen as a cause of unsatisfactory outcomes in previous public infrastructure projects. The success of the rural roads program in Morocco is mainly due to its multidimensional nature, inclusive of health and education needs, and its focus on "access" as opposed to "number of roads/miles built", coupled with its very participatory nature to capture the preferences of the beneficiaries (see Moreno-Dodson, 2005).

Priority should be given to rehabilitate and improve demand-driven infrastructure services, which already serve the population, sometimes at a very high cost in terms of risk, time and poor quality, or have the potential to do so immediately. On the contrary, a realization that there is no road to go from point A to B should not be an argument strong enough to recommend building a new one, unless there is solid evidence to predict that it will be used.[30] In other words, as numerous examples of low profitability infrastructure investments in the past suggest, supply does not necessarily create demand. Infrastructure planning should take place in an integrated manner, particularly taking into account education and health needs, and income earning potential opportunities. Otherwise, when infrastructure assets are being underused, their contribution to economic efficiency and growth is jeopardized. They can even become a liability for the population (often associated with borrowing and/or taxes) particularly when they are not well maintained and mobility across areas and regions becomes more difficult.

A key policy lesson also is that traditional efficiency analysis should not underestimate the immediate benefits of promoting access to rural roads for health and education outcomes. For instance, reducing the time needed to take a pregnant woman or a sick child requiring urgent treatment to a hospital nearby, by improving the condition of the road, can translate into lower maternal and infant mortality rates. Adequate transportation can also ensure reliable availability of supplies such as drugs, vaccines, bednets and spare parts of water systems, all of them critical to improve the quality of health services. Infrastructure spending can also improve the

---

30 Capital spending often receives a disproportionate share of outlays on infrastructure from politicians (as noted earlier) and donors, given their relatively higher visibility and political importance.

profitability of existing investments in the health sector. In many countries, it is striking to see the relatively low use of some rural health centers, which sometimes results into closing them in spite of the initial fixed costs already paid.[31] These developments suggest the possibility that the productivity of public spending in health may be increased, by facilitating access to basic infrastructure and transportation to those centers. Therefore, allocating additional public funds to improve the infrastructure network could increase their utilization rates. Similarly, facilitating travel mobility for qualified nurses and doctors could translate into higher health service quality and higher attendance. Increasing collaboration between transport and health authorities should focus on the logistics of drug distribution, qualified staff participation and patient access.

Similarly, in the education sector, easier, cheaper and physical movement is often associated with improved attendance at primary and secondary schools. For instance, as noted earlier, in Morocco the presence of paved roads in rural areas led to a sharp increase in girls' school attendance rate. Infrastructure planners need to take into account education goals per region and district, and participate in the monitoring of their attainments. Infrastructure planning based on a basic access approach would give priority to least-cost interventions, which provide reliable, all-season access to infrastructure to as many villages as possible (see Lebo and Schelling, 2001).

As important as the amounts of public spending allocated to infrastructure, a second critical element to take into consideration when planning infrastructure spending and trying to predict its effects on growth and the well being of the population relates to regulations, procedures, controls and even illegal activities resulting in corruption, which may reduce any potential benefits (see World Bank, 2006). For instance, if a rural producer traveling from the village to town to sell agricultural products in the market saves time and trouble because of the existence of a well-maintained road but needs to stop several times because of illegal controls, the social benefit from building the road will be lower than desirable. Government regulatory frameworks must be comprehensive and set up a solid implementation track record in order to eliminate these artificial obstacles. Improvements in regulations affecting infrastructure should be introduced hand-in-hand with any increases or reallocations in public spending.

Another important policy issue is how to avoid the potential crowding-out effects associated with financing of any additional public spending in infrastructure. The key here is to consider alternatives financing options that may weaken crowding-out effects and mitigate adverse effects on private investment and growth. For instance, the government may use earmarked taxes (such as gasoline taxes to finance road maintenance), instead of general tax revenues, use road tolls or water and electricity tariffs (user fees) to cover part of the expenses, as a way to establish a link between the users and the costs (the benefit principle). Another option is to use

[31] Unless these centers are not being used because they were built too far from markets and schools – in which case improving infrastructure alone would not trigger the desired effects.

"betterment taxes", or taxes levied on the increased value of the properties resulting from building the infrastructure assets.

Although from a macroeconomic standpoint the effect of levying these taxes may be less distortionary than the effect associated with general taxation, there is an issue of who ultimately bears the burden of those taxes/fees, given that those who pay them may shift them to others, such as the final consumers of the transported goods. In addition, user fees raise equity concerns when the payers benefiting from those services (access to water, electricity and roads) belong to low-income groups. More generally, if higher taxes distort private behavior, as a result for instance of increased incentives to engage in tax evasion, they could mitigate significantly the benefits of higher spending on infrastructure.

Governments could also choose to allow a private operator to build, finance and operate an infrastructure project for some time and then return the asset to the private sector, in which case tolls or fees usually help to recover the cost. There is also the option of promoting complete private provision of infrastructure or entering into a public-private partnership. However, the recent experience does not suggest that these are realistic options for many low-income countries. In fact, as noted in the introduction, even in middle-income countries the value of infrastructure investment with private participation has fallen significantly in recent years.

For low-income countries, the most sensible approach, particularly if a large-scale program in public infrastructure is to be considered, is to rely, at least partially, on grants or highly concessional aid. However, grants soften budget constraints and may create moral hazard with respect to tax collection, for instance. And because funds are fungible, they may encourage unproductive spending. They also contain an element of unpredictability (or volatility), due to changes in donor preferences, which can be detrimental to the design of medium-term investment programs (see Agénor, Bayraktar and Pinto Moreira, 2006). In the end, as discussed by González-Páramo and Moreno-Dodson (2003), the ultimate impact will depend on whether they affect positively the allocation of public resources and lead to better policies in the sectors they finance.

Finally, an issue worth thinking about is the sequencing of infrastructure investment. The foregoing discussion has argued that essentially all components of infrastructure may generate large positive externalities. Should we conclude therefore that countries should invest simulatenously in all components at the same time? Or, on the contrary, is there an optimal sequencing of investment between railways, roads, telecommunications, and water and sanitation? The evidence suggests that in poor countries, the share of spending on water/sanitation tends to be higher than in middle- and high-income countries, whereas investment in telecommunications and power tend to be higher in middle- and high-income countries (World Bank, 1994). As noted by Fedderke, Perkins and Luiz (2006, p. 1054), this may suggest that "phases" of infrastructure investment may (or should) reflect the transformation of a country's production structure, such as a shift away from agriculture and mining, toward manufacturing and services.

APPENDIX 1
THE IMPACT OF HEALTH ON ECONOMIC GROWTH: RECENT EVIDENCE

The effect of health on economic growth has been the subject of much recent empirical and analytical research. A key premise of the literature is that good health enhances worker productivity and stimulates growth.

Regarding productivity effects, two important studies are those of Sohn (2000) and Bloom and Canning (2005). Sohn (2000) found that improved nutrition increased available labor inputs in South Korea by 1 per cent a year or more during 1962-95. Using a production function approach, Bloom and Canning (2005) found that a one per centage point in adult survival rates raises labor productivity by 2.8 per cent – a somewhat higher value than the (calibrated) value of 1.7 per cent used by Weil (2005).

Regarding growth effects, the evidence is quite compelling. Wagstaff (2002) noted that up to 1.7 per cent of annual economic growth in East Asia between1965 and 1990 (about half the total GDP increase for the period) has been attributed to massive improvements in public health. Bloom, Canning and Sevilla (2004), in a sample consisting of both developing and industrial countries, found that good health (proxied by life expectancy) has a sizable, positive effect on economic growth. A one-year improvement in the population's life expectancy contributes to an increase in the long-run growth rate of up to 4 percentage points. Sala-i-Martín, Doppelhofer and Miller (2004) also found that initial life expectancy has a positive effect on growth, whereas the prevalence of malaria, as well the fraction of tropical area (which may act as a proxy for exposure to tropical diseases) are both negatively correlated with growth.

Lorentzen, McMillan and Wacziarg (2005) found that countries with a high rate of adult mortality also tend to experience low rates of growth – possibly because when people expect to die relatively young, they have fewer incentives to save and invest in the acquisition of skills.[32] They also found that the estimated effect of high adult mortality on growth is large enough to explain Africa's poor economic performance between 1960 and 2000. Indeed, in the 40 countries with the highest adult mortality rates in their sample of 98 countries, all are in Sub-Saharan Africa, except three.

Jamison, Lau and Wang (2004), using a sample of 53 countries, found that improvements in health (as measured by the survival rate of males aged between 15 and 60) accounted for about 11 per cent of growth during the period 1965-90. In countries like Bolivia, Honduras and Thailand, health improvements added about

---

[32] They measure adult mortality as the probability for a fifteen-year old of dying before reaching the age of sixty. They argue that such an indicator provides a quite distinct proxy for health, compared to life expectancy and infant mortality. In fact, they found that adult mortality is a robust and economically significant predictor of economic growth, investment and fertility even when infant mortality is controlled for.

half of a percentage point to the annual rate of growth in income per capita. According to the estimation results of Gyimah-Brempong and Wilson (2004), between 22 and 30 per cent of the transition growth rate of per capita income in Sub-Saharan Africa can be attributed to health factors. Along the same lines, Weil (2005), using microeconomic data (such as height and adult survival rates) to build a measure of average health, found that as much as 22.6 per cent of the cross-country variation in income per capita is due to health factors – roughly the same as the share accounted for by human capital from education, and larger than the share accounted for by physical capital. Conversely, estimates by the United Nations (2005) suggest that malaria (which claims each year the lives of 1 million people in poor countries and infects 300 million more) has slowed economic growth in Sub-Saharan Africa by 1.3 percentage point a year. According to a recent report on HIV-AIDS by the same institution, in Sub-Saharan Africa – a region where on average 7 out of 100 adults, and up to a quarter of the population in the southern part of the continent, are HIV-positive – the epidemic has reduced annual growth rates by anywhere between 0.5 to 1.6 percentage point (see UNAIDS, 2004).[33] McCarthy, Wolf and Wu (1999) found that malaria morbidity is negatively correlated with the growth rate of output per capita across countries. In Sub-Saharan Africa, a one-percentage point in the morbidity rate associated with the disease tends to reduce the annual growth rate per capita by an average of 0.55 per cent. McDonald and Roberts (2006) found similar results; HIV prevalence and the proportion of the population at risk of malaria tend to affect negatively health outcomes in sub-Saharan Africa, and through that channel the rate of economic growth.

The link between nutrition, health and growth has also received much emphasis in recent research (see Strauss and Thomas, 1998, and Hoddinott, Alderman and Behrman, 2005). Inadequate consumption of protein and energy as well as deficiencies in key micronutrients (such as iodine, vitamin A, and iron) are key factors in the morbidity and mortality of children and adults. The United Nations estimate that 55 per cent of the nearly 12 million deaths each year among under five-year-old children in the developing world are associated with malnutrition (Broca and Stamoulis, 2003). Iron deficiency is also associated with malaria, intestinal parasitic infestations and chronic infections. Moreover, the chronically undernourished may be so unproductive that they do not get hired at any wage. If poor people are so badly nourished that they are too weak to perform up to their physical potential, a "nutrition-based" poverty and low-growth trap may emerge. Inadequate nutrition may thus engender poor health, low productivity and continued low incomes (Mayer-Foulkes, 2005). Malnutrition reduces life expectancy and may therefore have an adverse, indirect effect on growth. Arcand (2001) and Wang and Taniguchi (2003) have found indeed that better nutrition enhances growth, in addition to improving human welfare, directly through the impact of

[33] It should be noted, however, that with respect to industrial countries, some studies have found evidence of reverse causation. By raising real incomes, economic growth may enable individuals to spend more on health services. In addition, as shown by Benos (2004), there is also evidence of non-linearities in the relationship between health and growth.

nutrition on labor productivity, as well as indirectly through improvements in life expectancy and possibly by speeding up the adoption of new production techniques.[34]

[34] Jamison, Lau and Wang (2004), however, conluded that differences in the impact of health on growth across countries were unlikely to be the result of differences in the endogenous effect of health on the rate of technical progress.

APPENDIX 2
QUALITY OF PUBLIC CAPITAL AND CONGESTION COSTS

Improving the quality of public capital in infrastructure, even without increasing its actual stock, can reduce adjustment costs and exert a positive growth effect.[35] In practice, however, measuring the quality (or efficiency) of the public capital stock in practice is quite difficult. A common procedure to estimating the quality of public infrastructure capital is to calculate the index proposed by Hulten (1996). His composite measure of public capital efficiency is based on four basic indicators: mainline faults per 100 telephone calls for telecommunications; electricity generation losses as a percent of total electricity output; the percentage of paved roads in good condition; and diesel locomotive utilization as a percentage of the total rolling stock. In practice, researchers have found that these individual quality indicators tend to be highly correlated with the quantities of each type of infrastructure.[36] Thus, much of the variation in infrastructure quality may be well captured by variations in its quantity.

The individual quality indicators proposed by Hulten (1996) are subject to limitations. For instance, electric power losses include both "technical" losses, reflecting the quality of the power grid, and theft; in general, the breakdown between the two components is not available. Moreover, these series tend to fluctuate significantly over time, and these fluctuations are not always easy to interpret as changes in quality as opposed to, say, measurement errors or "abnormal" shocks.

Agénor, Nabli and Yousef (2005) defined two alternative quality indicators. The first is an "ICOR-based" measure. Aggregate ICORs (calculated as the ratio of total domestic investment divided by the change in output) are commonly viewed as a measure of the efficiency of investment. They apply this idea to public infrastructure, by calculating an ICOR coefficient defined as public capital expenditure on infrastructure divided by the change in GDP. They take a 3-year moving average, in order to smooth out the behavior of the series over time.

Their second indicator is an "excess demand" measure. The idea is that, if growth in the demand for infrastructure services tends to exceed growth in supply, pressure on the existing public capital stock will intensify and quality will deteriorate. To construct these indicators proceeds in two steps. First, individual

---

35 Guasch (2004, p. 5) has argued that poor quality and reliability of infrastructure forces firms in Latin America to maintain higher inventory levels (often by a factor of two) than those observed in industrial countries. By tying up (expensive) capital, this raises unit production costs and lowers productivity. However, there are a number of alternative reasons why firms may choose to hold high levels of inventories – most notably a high (expected) degree of demand volatility.

36 Calderón and Servén (2004a, p. 19) found a high degree of correlation between the individual quality indicators listed above with the related quantities of infrastructure (that is, between power generation capacity and power losses, or between road density and road quality, the latter measured by the proportion of paved roads in total). In a companion study (Calderón and Servén, 2994b, p. 11) they obtain the same result with their two synthetic indicators of quantity and quality of infrastructure. Esfahani and Ramírez (2003, p. 446) also note the existence of a close correlation between stocks of infrastructure capital and quality in their sample.

indicators of "excess demand" are calculated for alternative categories of infrastructure services (such as electricity; telephone mainlines; and paved roads). To estimate demand for infrastructure service *h*, the annual growth rate of real GDP per capita can be applied to the stock of public capital in *h* at the base period. Elasticity values may vary, depending on available estimates.[37] Actual stocks are used to estimate supply of each type of infrastructure services. Individual indicators of excess demand for each component of infrastructure services are then calculated, by taking the ratio of supply to "predicted" demand. This ratio gives therefore an indicator of adequacy between supply and demand; a fall in the ratio would indicate excessive pressure on existing infrastructure and therefore a deterioration in quality. Second, a "composite" excess demand indicator is calculated. To do so they use the same procedure used by Hulten (1996) to calculate his quality index, that is, we standardized each of the three series (by subtracting the mean and dividing by the standard error) and calculated the unweighted, arithmetic average of the standardized series.

Much research has examined the issue of quality and congestion costs in infrastructure and their implications for private capital formation and the optimal allocation of public expenditure. But almost none has focused on congestion costs in education. This is a particularly important factor in determining the quality of schooling in low-income countries, where (according to recent data from UNESCO and the World Bank) student-teacher ratios may dramatically exceed average ratios in industrial countries. For instance, at 44 to 1, the pupil-teacher ratio in Sub-Saharan Africa is on average three times higher than that of developed countries; moreover, one in four countries in the region has ratios above 55 to 1 (see UNESCO, 2005).

Similarly, quality and congestion costs may be important in assessing the effect of health capital on growth. A recent press release by the World Health Organization noted that hospitals in Sub-Saharan Africa are "getting worse in terms of both the scope and quality of health care they provide". For instance, the number of hospital beds per 1,000 people varies only from 0.9 to 2.9 in the region, compared to 4.0 in the United States and 8.7 in France. Similarly, the number of doctors per 100,000 people is 16 in Sub-Saharan Africa, compared to between 33 and 48 in South Asia, and 200 and 300 in developed countries. Pressure on health capital may alter the quality of the services being produced, and therefore mitigate their growth-enhancing effects.

---

[37] Agénor, Nabli and Yousef (2005) used an elasticity of unity in each case. In their estimation of demand functions for infrastructure services based on panel data, Fay and Yepes (2003, p. 8) found long-term elasticities of 0.375 for electricity, 0.5 for telephone mainlines, and 0.14 for paved roads. However, the regressions on which these estimates are based do not include a price (or user cost) variable, so the estimated income elasticities may be biased.

REFERENCES

African Union (2005), *Transport and the Millennium Development Goals*, Addis Ababa, February.

Agénor, P. (2004), *The Economics of Adjustment and Growth,* 2nd edition, Boston (Mass.), Harvard University Press.

—————— (2005*a*), "Infrastructure, Public Education and Growth with Congestion Costs", Centre for Growth and Business Cycle Research, Working Paper, No. 47, University of Manchester, January.

—————— (2005*b*), "The Macroeconomics of Poverty Reduction", *Manchester School of Social and Economic Studies*, No. 73, pp. 369-434, July.

—————— (2005*c*), "Fiscal Policy and Endogenous Growth with Public Infrastructure", Centre for Growth and Business Cycle Research, Working Paper, No. 59, University of Manchester, October. Forthcoming, *Oxford Economic Papers*.

—————— (2005*d*), "Infrastructure Investment and Maintenance Expenditure: Optimal Allocation Rules in a Growing Economy", Centre for Growth and Business Cycle Research, Working Paper, No. 60, University of Manchester, October.

—————— (2005*e*), "Schooling and Public Capital in a Model of Endogenous Growth", Centre for Growth and Business Cycle Research, Working Paper, No. 61, University of Manchester, October.

—————— (2005*f*), "Health and Infrastructure in Models of Endogenous Growth", Centre for Growth and Business Cycle Research, Working Paper, No. 62, University of Manchester, October.

—————— (2006), "A Theory of Infrastructure-led Development", work in progress, Centre for Growth and Business Cycle Research, University of Manchester, October.

Agénor, P., N. Bayraktar, E. Pinto Moreira and K. El Aynaoui (2005), "Achieving the Millennium Development Goals in Sub-Saharan Africa: A Macroeconomic Monitoring Framework", Policy Research, Working Paper, No. 3750, World Bank, October. Forthcoming in *World Economy*.

Agénor, P., M.K. Nabli and T.M. Yousef (2005), "Public Infrastructure and Private Investment in the Middle East and North Africa", Policy Research, Working Paper, No. 3661, World Bank, July.

Agénor, P. and J. Aizenman (2006), "Public Capital and the Big Push", work in progress, University of Manchester, October.

Agénor, P., N. Bayraktar and K. El Aynaoui (2006), "Roads out of Poverty? Assessing the Links between Aid, Public Investment, Growth, and Poverty Reduction", revised, World Bank, July.

Agénor, P., N. Bayraktar and E. Pinto Moreira (2006), "Linking Public Investment Programs and SPAHD Macro Models: Methodology and Application to Aid Requirements", Policy Research, Working Paper, No. 3944, World Bank, June.

Agénor, P., A. Izquierdo and H. Tarp Jensen (eds.) (2006), *Adjustment Policies, Poverty and Unemployment: The IMMPA Framework*, Oxford, Blackwell Publishing.

Agénor, P. and K. Neanidis (2006*a*), "The Allocation of Public Expenditure and Economic Growth", Centre for Growth and Business Cycle Research, Working Paper, No. 69, University of Manchester, March.

——— (2006*b*), "Optimal Taxation and Growth with Productive Public Goods", work in progress, University of Manchester, October.

Agénor, P. and P.J. Montiel (2006), *Development Macroeconomics*, 3rd edition in preparation, Princeton (NJ), Princeton University Press.

Agénor, P. and D. Yilmaz (2006), "The Tyranny of Rules: Fiscal Discipline, Productive Spending, and Growth", Centre for Growth and Business Cycle Research, Working Paper. No. 73, July.

Ahmed, A. and M. Arends-Kuenning (2006), "Do Crowded Classrooms Crowd Out Learning? Evidence from the Food for Education Program in Bangladesh", *World Development*, pp. 665-84, April.

Albala-Bertrand, J.M. and E.C. Mamatzakis (2004), "The Impact of Public Infrastructure on the Productivity of the Chilean Economy", *Review of Development Economics*, No. 8, pp. 266-78, June.

Arcand, J. (2001), "Undernourishment and Economic Growth: The Efficiency Cost of Hunger", unpublished, University of Clermont-Ferrand, October.

Arestoff, F. and C. Hurlin (2005), "The Productivity of Public Capital in Developing Countries", unpublished, University of Orléans, March.

Arndt, C. (2006), "HIV/AIDS, Human Capital, and Economic Growth Prospects for Mozambique", *Journal of Policy Modeling*, No. 28, pp. 477-89, July.

Baldacci, E., B. Clements, S. Gupta and Q. Cui (2004), "Social Spending, Human Capital, and Growth in Developing Countries: Implications for Achieving the MDGs", Working Paper, No. 04/127, International Monetary Fund, November.

Barro, R.J. (1990), "Government Spending in a Simple Model of Endogenous Growth", *Journal of Political Economy*, No. 98, pp. s103-s25, October.

Behrman, J.R. (1996), "The Impact of Health and Nutrition on Education", *World Bank Research Observer*, No. 11, pp. 23-37, February.

Behrman, J.R. and B.L. Wolfe (1987), "How Does Mother's Schooling Affect Family Health, Nutrition, Medical Care Usage, and Household Sanitation?", *Journal of Econometrics*, No. 36, pp. 185-204, September.

Bell, C.S. Devarajan and H. Gersbach (2006), "The Long-run Economic Costs of AIDS: A Model with an Application to South Africa", *World Bank Economic Review*, No. 20, pp. 55-89, March.

Benos, N. (2004), "Fiscal Policy and Economic Growth: Empirical Evidence from OECD Countries", unpublished, University of Cyprus, July.

Bhargava, A., D.T. Jamison, L.J. Lau and C.J. Murray (2001), "Modeling the Effects of Health on Economic Growth", *Journal of Health Economics*, No. 20, pp. 423-40, May.

Bigsten, A. *et al.* (2005), "Adjustment Costs and Irreversibility as Determinants of Investment: Evidence from African Manufacturing", unpublished, Oxford University, September.

Bloom, D.E., D. Canning and J. Sevilla (2004), "The Effect of Health on Economic Growth: A Production Function Approach", *World Development*, No. 32, pp. 1-13, January.

Bloom, D.E. and D. Canning (2005), "Schooling, Health, and Economic Growth: Reconciling the Micro and Macro Evidence", unpublished, Harvard School of Public Health, February.

Bloom, D.E., D. Canning and M. Weston (2005), "The Value of Vaccination", *World Economics*, No. 6, pp. 1-13, July.

Bose, N., M.E. Haque and D.R. Osborn (2003), "Public Expenditure and Economic Growth: A Disaggregated Analysis for Developing Countries", unpublished, University of Manchester, June.

Brenneman, A. and M. Kerf (2002), "Infrastructure and Poverty Linkages: A Literature Review", unpublished, World Bank, December.

Broca, S. and K. Stamoulis (2003), "Micro- and Macroevidence on the Impact of Undernourishment", in K. Taniguchi and X. Wang (eds.), *Nutrition Intake and Economic Growth*, Rome, Food and Agriculture Organization.

Bundy, D. *et al.* (2005), "School Health and Nutrition Programs", in D. Jamison *et al.* (eds.), *Disease Control Priorities in Developing Countries*, 2nd ed., forthcoming, New York, Oxford University Press.

Cadot, O., L.H. Roller and A. Stephan (2006), "Contribution to Productivity or Pork Barrel? The Two Faces of Infrastructure Investment", *Journal of Public Economics*, No. 90, p. 1133-53, August.

Calderón, C. and L. Servén (2004), "The Effects of Infrastructure Development on Growth and Income Distribution", Policy Research, Working Paper, No. 3400, World Bank, September.

Chakraborty, S. (2004), "Endogenous Lifetime and Economic Growth", *Journal of Economic Theory*, No. 116, pp. 119-37, May.

Cohen, J.P. and C.J.M. Paul (2004), "Public Infrastructure Investment, Interstate Spatial Spillovers, and Manufacturing Costs", *Review of Economics and Statistics*, No. 86, pp. 551-60, May.

Commission for Africa (2005), *Our Common Interest: Report of the Commission for Africa*, Department of International Development, London, March.

Corrigan, P., G. Glomm and F. Méndez (2005), "AIDS Crisis and Growth", *Journal of Development Economics*, No. 77, pp. 107-24, June.

Deininger, K., A. Crommelynck and G. Kempaka (2005), "Impact of AIDS on Family Composition, Welfare, and Investment: Evidence from Uganda", *Review of Development Economics*, No. 9, pp. 303-24, November.

Devarajan, S., W.R. Easterly and H. Pack (2003), "Low Investment is Not the Constraint on African Development", *Economic Development and Cultural Change*, No. 51, pp. 547-71, April.

Devarajan, S., V. Swaroop and H.F. Zou (1996), "The Composition of Public Expenditures and Economic Growth", *Journal of Monetary Economics*, No. 37, pp. 313-44, April.

Estache, A., B. Speciale and D. Veredas (2005), "How much does Infrastructure Matter to Growth in Sub-Saharan Africa?", unpublished, World Bank, June.

Fay, M. and M. Morrison (2005), *Infrastructure in Latin America and the Caribbean: Recent Developments and Key Challenges*, two volumes, Washington (D.C.), World Bank.

Fedderke, J.W., P. Perkins and J.M. Lutz (2006), "Infrastructural Investment in Long-run Economic Growth: South Africa 1875-2001", *World Development*, No. 34, pp. 1037-59, June.

Ferreira, P.C. (1999), "Inflationary Financing of Public Investment and Economic Growth", *Journal of Economic Dynamics and Control*, No. 23, pp. 539-63, February.

Filmer, D., J.S. Hammer and L.H. Pritchett (2000), "Weak Links in the Chain: A Diagnosis of Health Policy in Poor Countries", *World Bank Research Observer*, No. 15, p. 199-224, June.

Fuchs, V.R. (2004), "Reflections on the Socio-economic Correlates of Health", *Journal of Health Economics*, No. 23, pp. 653-61, July.

Galor, O. and D. Mayer-Foulkes (2004), "Food for Thought: Basic Needs and Persistent Educational Inequality", Brown University, June.

Gilchrist, S. and M. Gertler (2000), "Hump-shaped Output Dynamics in Rational Expectations Models: the Role of Investment Delays", unpublished, New York University, December.

Glewwe, P. (1999), "Why does Mother's Schooling Raise Child Health in Developing Countries?", *Journal of Human Resources*, No. 34, pp. 124-59, June.

—————— (2002), "Schools and Skills in Developing Countries: Education Policies and Socioeconomic Outcomes", *Journal of Economic Literature*, No. 40, pp. 436-82, June.

González-Páramo, G. and B. Moreno-Dodson (2003), "The Role of the State and Consequences of Alternative Forms of Public Expenditure Financing", unpublished, World Bank, June.

Gramlich, E.M. (1994), "Infrastructure Investment: A Review Essay", *Journal of Economic Literature*, No. 32, pp. 1176-96, September.

Guasch, J.L. (2004), *Granting and Renegotiating Infrastructure Concessions: Doing It Right*, Washington (D.C.),World Bank, Institute Development Studies.

Gupta S., B. Clements, E. Baldacci and C. Mulas-Granados (2005), "Fiscal Policy, Expenditure Composition, and Growth in Low-Income Countries", *Journal of International Money and Finance*, No. 24, pp. 441-64, April.

Gyamfi, P. and G. Ruan (1996), "Road Maintenance by Contract: Dissemination of Good Practice in Latin America and the Caribbean Region", Latin America and the Caribbean Regional Studies Program Report, No. 44, Washington (D.C.), World Bank, October.

Gyimah-Brempong, K. and M. Wilson (2004), "Health, Human Capital, and Economic Growth in Sub-Saharan African and OECD Countries", *Quarterly Review of Economics and Finance*, No. 44, pp. 296-320, May.

Hamermesh, D. and G. Pfann (1996), "Adjustment Costs in Factor Demand", *Journal of Economic Literature*, No. 34, pp. 1264-92, September.

Hamoudi, A. and N. Birdsall (2004), "HIV/AIDS and the Accumulation and Utilization of Human Capital in Africa", in M. Haacker (ed.), *The Macroeconomics of HIV/AIDS*, Washington (D.C.), International Monetary Fund.

Hashimoto, K. and K. Tabata (2005), "Health Infrastructure, Demographic Transition and Growth", *Review of Development Economics*, No. 9, pp. 549-62, November.

Hoddinott, J., H. Alderman and J. Behrman (2005), "Nutrition, Malnutrition and Economic Growth", in G. López-Casasnovas, B. Rivera and L. Currais (eds.), *Health and Economic Growth: Findings and Policy Implications*, Boston (Mass.), MIT Press.

Hulten, C.R. (1996), "Infrastructure Capital and Economic Growth: How Well You Use It May be More Important than How Much You Have", National Bureau of Economic Research, Working Paper, No. 5847, December.

Hurlin, C. (2006), "Network Effects of the Productivity of Infrastructure in Developing Countries", Policy Research, Working Paper, No. 3808, Washington (D.C.), World Bank, January.

Ireland, P.N. (1994), "Supply-side Economics and Endogenous Growth", *Journal of Monetary Economics*, No. 33, pp. 559-71, June.

International Monetary Fund (2004), "Public Investment and Fiscal Policy", IMF, Fiscal Affairs Department, unpublished, March.

Jamison, D.T., L.J. Lau and J. Wang (2005), "Health's Contribution to Economic Growth in an Environment of Partially Endogenous Technical Progress", in G. López-Casasnovas, B. Rivera and L. Currais (eds.), *Health and Economic Growth: Findings and Policy Implications*, Boston (Mass.), MIT Press.

Kalaitzidakis, P. and S. Kalyvitis (2004), "On the Macroeconomic Implications of Maintenance in Public Capital", *Journal of Public Economics*, No. 88, pp. 695-712, March.

Kalemli-Ozcan, S. (2006), "AIDS, Reversal of the Demographic Transition and Economic Development: Evidence from Africa", Working Paper, No. 12181, National Bureau of Economic Research, May.

Kessides, C. (1996), "A Review of Infrastructure's Impact on Economic Development", in D.F. Batten and C. Karlsson, *Infrastructure and the Complexity of Economic Development*, Berlin, Springer Verlag.

Khandker, S., V. Lavy and D. Filmer (1994), "Schooling and Cognitive Achievements of Children in Morocco", Discussion Paper, No. 264, World Bank, February.

Lavy, V., J. Strauss, D. Thomas and P. de Vreyer (1996), "Quality of Health Care, Survival and Health Outcomes in Ghana", *Journal of Health Economics*, No. 15, pp. 333-57, June.

Lebo, J. and D. Schelling (2001), "Design and Appraisal of Rural Transport Infrastructure", World Bank, Technical Paper, No. 496, Washington (D.C.).

Lee, L.F., M.R. Rosenzweig and M.M. Pitt (1997), "The Effects of Improved Nutrition, Sanitation, and Water Quality on Child Health in High-Mortality Populations", *Journal of Econometrics*, No. 77, pp. 209-35, March.

Lee, K.S., A. Anas and G.T. Oh (1999), "Costs of Infrastructure Deficiencies for Manufacturing in Nigerian, Indonesian, and Thai Cities", *Urban Studies*, No. 36, pp. 2135-49, December.

Leipziger, D., M. Fay, Q. Wodon and T. Yepes (2003), "Achieving the Millennium Development Goals: The Role of Infrastructure", Working Paper, No. 3163, World Bank, November.

Levy, H. (2004), "Rural Roads and Poverty Alleviation in Morocco", unpublished, World Bank, May.

Loayza, N., P. Fajnzylber and C. Calderón (2004), "Economic Growth in Latin America and the Caribbean: Stylized Facts, Explanations, and Forecasts", Central Bank of Chile, Working Paper, No. 265, June.

Lorentzen, P., J. McMillan and R. Wacziarg (2005), "Death and Development", National Bureau of Economic Research, Working Paper, No. 11620, September.

Mental Health Foundation (2006), *Feeding Minds – The Impact of Food on Mental Health*, London, January.

McCarthy, D., H. Wolf and Y. Wu (1999), "The Growth Costs of Malaria", unpublished, Georgetown University, December.

McGuire, J.W. (2006), "Basic Health Care Provision and under-5 Mortality: A Cross-National Study of Developing Countries", *World Development*, pp. 405-25, March.

McDonald, S. and J. Roberts (2006), "AIDS and Economic Growth: A Human Capital Approach", *Journal of Development Economics*, No. 80, pp. 228-50, June.

Miguel, E. and M. Kremer (2004), "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities", *Econometrica*, No. 72, pp. 159-217, January.

Mills, A. and S. Shillcutt (2004), "Challenge Paper on Communicable Diseases", background paper for the Copenhagen Consensus, February.

Mitsui, H. (2004), "Impact Assessment of Large Scale Transport infrastructure in Northen Vietnam", unpublished, World Bank, May.

Moreno-Dodson, B. (ed.) (2005), *Reducing Poverty on a Global Scale*, Washington (D.C.), World Bank Publications.

Newman, J., M. Pradhan, L.B. Rawlings, G. Ridder, R. Coa and J.L. Evia (2002), "An Impact Evaluation of Education, Health, and Water Supply Investments by the Bolivian Social Investment Fund", *World Bank Economic Review*, No. 16, pp. 241-74, June.

Paxson, C.H. and N. Schady (2005), "Cognitive Development among Young Children in Ecuador: The Roles of Wealth, Health and Parenting", Policy Research, Working Paper, No. 3605, Washington (D.C.), World Bank, May. Forthcoming in *Journal of Human Resources*.

Pritchett, L. (1996), "Mind your P's and Q's: The Cost of Public Investment is Not the Value of Capital", Policy Research, Working Paper, No. 1660, Washington (D.C.), World Bank, October.

Reinikka, R. and J. Svensson (2002), "Coping with Poor Public Capital", *Journal of Development Economics*, No. 69, pp. 51-69, October.

Rioja, F.K. (2003), "Filling Potholes: Macroeconomic Effects of Maintenance versus New Investment in Public Infrastructure", *Journal of Public Economics*, No. 87, pp. 2281-304, September.

Romp, W. and J. de Haan (2005), "Public Capital and Economic Growth: A Critical Survey", in *Infrastructure, Economic Growth, and the Economics of PPPs*, EIB Papers, European Investment Bank, Vol. 10, March.

Saghir, J. (2005), "Energy and Poverty: Myths, Links, and Policy Issues", Energy Working Paper, No. 4, Washington (D.C.), World Bank, May.

Sala-i-Martín, X., G. Doppelhofer and R. Miller (2004), "Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach", *American Economic Review*, No. 94, pp. 813-35, September.

Smith, L.C. and L. Haddad (2000), "Explaining Child Malnutrition in Developing Countries: A Cross-Country Analysis", Research Report, No. 111, International Food Policy Research Institute, May.

Sohn, B. (2000), "How Much Has Health Improvement Contributed to the Korean Economic Growth?", unpublished, Brown University, May.

Strauss, J. and D. Thomas (1998), "Health, Nutrition and Economic Development", *Journal of Economic Literature*, No. 36, p. 766-817, June.

Sturm, J.E. and J. de Haan (2005), "Determinants of Long-Term Growth: New Results Applying Robust Estimation and Extreme Bounds Analysis", *Empirical Economics*, No. 30, pp. 597-617, December.

Summers, L.H. (1994), *Investing in All the People: Educating Women in Developing Countries*, Washington (D.C.), World Bank.

Tamura, R. (2006), "Human Capital and Economic Development", *Journal of Development Economics*, No. 79, pp. 26-72, January.

Teruel, R. and Y. Kuroda (2005), "Public Infrastructure and Productivity Growth in Philippine Agriculture, 1974-2000", *Journal of Asian Economics*, No. 16, pp. 555-76, June.

Torvik, R. (2001), "Learning by Doing and the Dutch Disease", *European Economic Review*, No. 45, pp. 285-306, February.

Turnovsky, S.J. (1996), "Fiscal Policy, Adjustment Costs, and Endogenous Growth", *Oxford Economic Papers*, No. 48, pp. 361-81, July.

Tybout, J. (2000), "Manufacturing Firms in Developing Countries: How Well Do They Do and Why?", *Journal of Economic Literature*, No. 38, pp. 11-44, March.

UNAIDS (2004), *2004 Report on the Global AIDS Epidemic*, Geneva, World Health Organization.

UNESCO (2005), *Education for All Global Monitoring Report 2005: The Quality Imperative*, Paris, Unesco.

United Nations (2005), *The Millennium Development Goals Report 2005*, New York, United Nations.

Valila, T. and A. Mehrotra (2005), "Evolution and Determinants of Public Investment in Europe", Economic and Financial Report, No. 05/1, European Investment Bank, February.

van Zon, A. and J. Muysken (2001), "Health and Endogenous Growth", *Journal of Health Economics*, Vol. 20, pp. 169-85, March.

Wagstaff, A. (2002), "Health Spending and Aid as Escape Routes from the Vicious Circle of Poverty and Health", British Association for the Advancement of Sciences.

Wagstaff, A. and M. Claeson (2004), *The Millennium Development Goals for Heath: Rising to the Challenges*, Washington (D.C.), World Bank.

Wang, L. (2002), "Health Outcomes in Poor Countries and Policy Implications: Empirical Findings from Demographic and Health Surveys", Policy Research, Working Paper, No. 2831, Washington (D.C.), World Bank, April.

Wang, X. and K. Taniguchi (2003), "Does Better Nutrition Enhance Economic Growth? Impact of Undernourishment", in K. Taniguchi and X. Wang (eds.), *Nutrition Intake and Economic Growth*, Food and Agriculture Organization, Rome.

Warwick, H. and A. Doig (2004), *Smoke – The Killer in the Kitchen*, London, ITDG Publishing.

Webber, D.J. (2002), "Policies to Stimulate Growth: Should we Invest in Health or Education?", *Applied Economics*, No. 34, pp. 1633-43, September.

Weil, D.N. (2005), "Accounting for the Effect of Health on Economic Growth", Working Paper, No. 11455, National Bureau of Economic Research, July.

World Bank (1994), *Investing in Infrastructure*, World Development Report 1994, New York, Oxford University Press.

————— (1999), *Vietnam: Moving Forward – Achievements and Challenges in the Transport Sector*, World Bank, April.

————— (2005*a*), *Millennium Development Goals: From Consensus to Momentum*, Global Monitoring Report 2005, Washington (D.C.), World Bank.

————— (2005*b*), *Meeting the Challenge of Africa's Development: A World Bank Group Action Plan*, Africa Region, Washington (D.C.), World Bank.

————— (2005*c*), *World Development Report 2006: Equity and Development*, Washington (D.C.), World Bank and Oxford University Press.

——— (2005*d*), "Infrastructure Finance for Africa: Strategic Framework", unpublished, World Bank, September.

——— (2006), "Infrastructure: Lessons from the Last Two Decades of World Bank Engagement", Infrastructure Network, Washington (D.C.), World Bank, January.

World Health Organization (2005), *Health and the Millennium Development Goals*, Geneva, World Health Organization.

Zagler, M. and G. Durnecker (2003), "Fiscal Policy and Economic Growth", *Journal of Economic Surveys*, No. 17, pp. 397-418, July.

FUNDAMENTAL DETERMINANTS OF THE EFFECTS OF FISCAL POLICY

Dennis Botman and Manmohan S. Kumar[*]

We explore the underlying determinants of the macroeconomic effects of fiscal policy and tax and social security reform using the IMF's Global Fiscal Model (GFM). We show that the planning horizon of consumers, access to financial markets, and the elasticity of labor supply, as well as the characteristics of utility and production functions, and the degree of competition are all critical for determining the impact of fiscal policy. Four topical fiscal policy issues, for a representative large and small economy, are examined: the effects of changes in government debt; higher government spending; tax reform; and privatization of retirement savings.

1. Introduction

With the advent of the New Open Economy Macroeconomics (NOEM), a new paradigm has emerged to analyze the effects of macroeconomic policies and of international interdependence. NOEM models are general equilibrium models rooted in rigorous microfoundations allowing for the consideration of underlying or "fundamental" factors that affect the qualitative effects of macroeconomic policies while providing an opportunity to bring theory closer to the data. These models have so far mostly been applied to monetary policy issues, and this paper applies the general NOEM approach, as implemented through the recently developed IMF's Global Fiscal Model (GFM), to analyze the effects of fiscal policy in one consistent and rigorous framework.

Specifically, the paper undertakes simulations using the GFM to revisit the fundamental determinants of four recurrent topics in fiscal policy:

(i) the macroeconomic implications of changes in tax policies that lead to higher government debt and the spillover effects of such policies to other countries;

(ii) the effects of higher current government spending on private consumption;

(iii) the distortions created by alternative forms of taxation and the resulting macroeconomic benefits of revenue neutral tax reform; and

(iv) the macroeconomic implications of proposals to privatize the pension system where such a reform can take place in either a compulsory or a

[*] International Monetary Fund. E-mail: dbotman@imf.org and mkumar@imf.org

We are grateful to seminar participants, and in particular our discussant Nouriel Roubini, at FAD's Academic Panel Conference in February 2006 in Washington (D.C.), for many helpful comments and suggestions.

voluntary manner.[1]

GFM is a multicountry dynamic general equilibrium model that is rooted in the NOEM tradition, but is specifically designed to explore fiscal policy issues. This paper allows for an extension of the previous work on the above topics as a result of four complementary features:

- GFM features a richer non-Ricardian structure as it incorporates overlapping generations in the spirit of Blanchard-Weil, allows for distortionary taxation, and includes the realistic assumption that not all consumers have full access to financial markets. As a result, we can assess to what extent such fundamental factors as consumer myopia, the sensitivity of workers to the real wage, the flexibility of the production structure, and the extent of non-participation in financial markets have a bearing on the effects of fiscal policy.
- The explicit microeconomic structure of the model allows for the consideration of a number of key factors that are not often given adequate attention when assessing the effects of fiscal policy. These include, for example, the sensitivity of consumption to changes in the real interest rate, which we will show is an important determinant of the macroeconomic effects of fiscal policy and tax and pension reform. Also, as in NOEM models, GFM incorporates the assumption of monopolistic competition. This assumption implies that output is partly demand determined in the short term – with important implications for the effects of fiscal policy – and this setup allows us to consider the effects of price markups for the distortionary effects of taxation.
- The multi-country dimension of GFM allows for additional channels through which fiscal policy operates and points to the degree of trade openness as another fundamental determinant of fiscal policy effects.
- Contrary to previous studies, which use a variety of modeling strategies and assumptions, GFM provides one uniform framework to study policy issues.

The remainder of the paper is organized as follows. Section 2 highlights the key features of GFM, while Section 3 discusses calibration of the model to a large and a small open economy, respectively, and includes a discussion of the baseline parameters. Section 4 studies the macroeconomic implications of changes in tax policies that lead to higher government debt and the spillover effects of such policies to other countries. Section 5 examines the fundamental factors that influence the relationship between government spending shocks and private consumption, including the timing and type of tax policy changes needed to prevent higher government debt. Section 6 analyzes the distortions caused by respectively labor, personal, and corporate income taxation. Given that these taxes imply different degrees of distortions, we also study the benefits of revenue-neutral tax reform, and the extent to which these benefits depend on behavioral assumptions. Section 7

[1] For applications of the model in the context of fiscal reform in respectively Canada and the United States see Bayoumi and Botman (2005), Bayoumi, Botman and Kumar (2005), Kumhof, Laxton and Muir (2005), and Botman and Laxton (2004).

addresses the effects of pension reform, specifically the privatization of pension saving in either a compulsory or voluntary manner. Section 8 concludes.

2. Key features of the global fiscal model

It should be emphasized at the outset that if the Ricardian equivalence hypothesis holds fully, many of the fiscal policy questions posed in this paper and in the real world would be virtually irrelevant. Generally speaking, complete Ricardian equivalence, on which there is scant empirical evidence, will hold in case consumers are homogenous and have an infinite planning horizon, if taxation is lump sum, if access to financial markets by all agents is complete, and if government debt is riskless. In such a setting, temporary changes in tax policy that increase government debt will affect the composition of national saving, but not its level. Any increase in the government deficit will be matched by higher private savings as agents anticipate having to make higher future tax contributions, with no effect on interest rates, consumption, investment incentives, or output. Also, any real effects of a temporary increase in government spending – followed by a contraction in spending in the future – will be offset by an equal reduction in private consumption. Furthermore, since there is only lump-sum taxation, there are no benefits from tax reform.

It should also be noted that traditional NOEM models do not depart from the Ricardian equivalence hypothesis enough to allow detailed consideration of fiscal policy issues.[2] Instead, since these models feature a representative agent framework with lump-sum taxation, the analysis is restricted to the effects of balanced budget fiscal policies.

The IMF's Global Fiscal Model (GFM) extends the NOEM framework to incorporate sufficient degree of non-Ricardianness to allow for an analysis of the effects of fiscal policy and of interdependence.[3] There are three reasons why full Ricardian equivalence does not hold in GFM. First, the model features overlapping generations in the spirit of Blanchard-Weil. The use of overlapping generations allows the assumption of Ricardian equivalence to be relaxed, implying that government debt is perceived as net wealth. Essentially, consumers have short planning horizons, which implies that even temporary changes in fiscal policy affect their incentives to consume and work as they discount any future fiscal policy reaction. Second, GFM incorporates the assumption that some consumers do not have sufficient access to financial markets to smooth their consumption over time.

---

2 See Obstfeld and Rogoff (1995, 1996), Betts and Devereux (2001), Caselli (2001), Corsetti and Pesenti (2001) and Ganelli (2003a). In a recent paper, Erceg, Guerrieri and Gust (2005) add rule-of-thumb consumers to a model based on the representative agent paradigm and then use the model to study the effects of recent U.S. fiscal deficits on the current account deficit. Not surprisingly, they find much smaller effects than in models that allow for the possibility that permanent increases in government debt can have permanent consequences for the stock of net foreign liabilities and the world real interest rate.

3 GFM is described in more detail in Botman *et al.* (2006).

This is consistent with overwhelming evidence that even in the advanced economies up to a third of the consumers are liquidity constrained. Liquidity-constrained agents consume their entire disposable income every period and therefore any change in fiscal policy that affects this disposable income will have real effects. Third, GFM allows labor supply and capital accumulation to be endogenous and respond to changes in incentives related to the after-tax real wage or the after-tax rate of return of capital. This in turn allows the model to incorporate the assumption of distortionary taxes, and analyze the consequences of changes in these taxes.

One further difference between traditional NOEM models and GFM is the absence of nominal rigidities in the latter. In the current setup, it is still assumed that wages and prices are fully flexible. This assumption implies that the central bank follows money targeting, which limits the analysis of the interaction between monetary and fiscal policy. Also, short-term multipliers will be smaller than is the case for models with nominal rigidities. In this context, it should also be noted that capital mobility in GFM is perfect implying that interest rates are set in world markets. As a result, especially for small open economies, the crowding-out effects of government debt via higher interest rates will tend to be smaller than would be the case if there were impediments to capital flows and international trade. These features nonetheless provide a useful benchmark for the analysis, especially regarding the medium- and long-term effects of fiscal policy.

NOEM models have been extended over the past two-three years to allow for an analysis of fiscal policy issues. An overlapping generations setting has been brought into NOEM framework by Ghironi (2003a and 2003b), and by Ganelli (2003a and 2003b).[4] The former does not consider the effects of government debt, but shows that an overlapping generations structure following Blanchard (1985) and Weil (1989) ensures the existence of a well-defined steady state for net foreign asset holdings (for an early analysis of this, see Buiter, 1981). Ghironi, Iscan, and Rebucci (2005) describe how differences in agents' discount rates across countries gives rise to nonzero net foreign asset positions in the long run.

Ganelli (2003b) is the first attempt to analyze alternative fiscal policies in a NOEM model with finite lives. Apart from including endogenous labor supply and liquidity-constrained consumers, GFM extends this approach in four other major directions:

- The utility function is less restrictive, permitting the analysis of alternative values for the intertemporal elasticity of substitution. This parameter affects the sensitivity of consumers to changes in the real interest rate. Although it is not given sufficient attention, as shown below, it has important implications for an assessment of the impact of fiscal policy.
- At the same time, the production structure is extended to include endogenous capital formation, which provides an additional channel through which

[4] See Frenkel and Razin (1992) for a diagrammatic exposition of a two-country overlapping-generations model without distortionary taxation.

government debt can potentially crowd out economic activity and allows for the consideration of corporate and personal income taxation. In GFM, investment is driven by a Tobin's Q relationship, with firms responding sluggishly to differences between the future discounted value of profits and the market value of the capital stock. In addition, the supply of labor is made endogenous and consequently labor income taxes will be distortionary.

- The model features both traded and non-traded goods, which allows us to consider the terms of trade effects of changes in fiscal policy and potentially the implications of various degrees in home bias in either private or government consumption.
- Compared to other fiscal models, GFM features a richer menu of taxation. The taxes included are a labor income tax levied on wage compensation paid by workers, a corporate income tax levied on accounting profits of firms, and a personal income tax levied on labor income, accounting profits, government transfers, and interest income (on government bonds and net foreign assets). Each of these taxes has a single, albeit different, marginal rate, which coincides with the average tax rate. While at present GFM does not incorporate a sales tax or VAT, it should be noted that a consumption tax in many ways is identical to labor income taxation in the sense that both taxes affect the consumption-leisure decision in a similar manner.[5]

GFM also has a stylized financial sector block, with two kinds of assets, namely government debt (which can be traded internationally) and equity (which is held domestically). Changes in the outstanding stock of debt have direct implications for long-term interest rates through a variety of channels that are discussed below.

3. Calibrating the model

For the purposes of analyzing the issues noted earlier, the key macroeconomic parameters of the model are based on two sets of values reflecting respectively features of a large open economy and a small open economy (Table 1).[6] The calibration reflects in particular only the key aspects of the macroeconomic and fiscal structure of these economies. The macroeconomic aspects include the ratios to GDP of consumption, investment, wage income, and income from capital. The fiscal aspects include tax revenue from labor income, corporate income, and personal income in GDP as well as the ratios of government debt and government spending to GDP.

---

5 Nevertheless, since increasing a VAT also taxes accumulated savings, it is likely to be less distortionary than a tax on labor income, which partly explains its popularity in many countries as an important source of revenue.

6 The calibration of the model broadly replicates the United States as the large economy, and the Czech Republic as the small economy, although it should be emphasized that the calibration is not intended to capture all the key characteristics of these two economies, but rather to provide an illustrative benchmark for the large and the small economies.

Table 1

Key Macroeconomic Variables in the Initial Steady State

	Large Economy	Foreign	Small Economy	Foreign
Country Size	30.0	70.0	5.0	95.0
percent share of world real income	29.4	70.6	4.0	96.0
National expenditure accounts at market prices				
Consumption	62.4	65.4	50.6	64.6
rule-of-thumb	9.3	9.3	7.7	9.3
forward-looking	53.2	56.1	43.0	55.3
domestic	45.5	57.6	24.8	63.3
imported	17.0	7.8	25.9	1.3
Investment	15.5	15.4	21.9	15.5
for tradables	5.6	5.3	9.1	5.4
for non-tradables	9.9	10.2	12.8	10.1
domestic	11.3	13.6	10.7	15.1
imported	4.2	1.9	11.2	0.3
Government expenditures	20.0	20.0	26.0	20.0
Exports	23.2	8.8	38.6	1.6
of consumption goods	18.8	7.1	31.1	1.1
of investment goods	4.4	1.8	7.4	0.5
Imports	21.2	9.7	37.1	1.6
of consumption goods	17.0	7.8	25.9	1.3
of investment goods	4.2	1.9	11.2	0.3
Tradable/Non-tradable Split				
Tradables	32.7	30.8	40.6	31.3
domestic	9.8	22.1	3.7	29.8
imported	20.8	9.5	35.5	1.6
Non-tradables	67.4	69.2	59.4	68.7
Factor Incomes				
Capital	37.8	37.7	46.9	37.8
Labor	62.2	62.3	53.1	62.2
Interest Rates and Inflation				
Nominal short-term interest rate	5.1	5.1	6.1	5.1
Real short-term interest rate	3.0	3.0	3.0	3.0
CPI inflation	2.0	2.0	3.0	2.0
Government				
Deficit	0.9	0.9	0.7	0.9
Debt	45.0	45.0	24.0	45.0
Tax Rates				
On total income (effective)	20.5	20.5	25.8	20.5
gross rate	26.2	26.1	30.8	26.2
transfer rate	5.7	5.7	5.0	5.7
On labor income (effective)	15.0	14.0	33.2	14.3
as a percent of income	7.1	6.6	16.2	6.8
gross rate	27.0	25.9	43.4	26.2
transfer rate	12.0	11.9	10.2	11.9
On capital income	11.0	11.0	9.0	11.0
as a percent of income	1.9	1.9	2.2	1.9
On dividend income (profits)	11.0	11.0	9.0	11.0
as a percent of income	4.1	4.1	2.6	4.1
On personal income	8.5	8.5	6.0	8.5
as a percent of income	7.4	7.9	4.8	7.8

Source: GFM simulations.

The size of the large economy is posited to be 30 per cent of that of its trading partners, which essentially constitute the world economy, while the corresponding value for the small economy is assumed to be around 5 per cent of that of its trading partners. Given the specification of the GFM as a "two-country model", the spillover effects of any policy change can be assessed vis-à-vis the "foreign" economy.[7]

The discount rates for both economies are computed residually to generate a steady-state real interest rate of 3 per cent. The effective discount rate is the product of the resulting pure rate of time preference and of average longevity. Following the Blanchard-Weil setup, this is parameterized as the probability of living. The discount rate constitutes one of the key underlying parameters of the economy. Indeed, differences in discount rates across countries have a significant bearing on whether in the steady state a country is a net debtor or net creditor vis-à-vis the rest of the world. In general, the more impatient country will optimally run a trade balance deficit with corresponding accumulation of net foreign liabilities. In addition to giving rise to a non-Ricardian framework, this was another important reason why several modelers adopted the Blanchard-Weil OLG framework and incorporated it into both small open-economy models as well as multi-country models.[8]

The behavioral parameters are based on microeconomic estimates and set equal across the two benchmark economies (Table 2).[9] This includes the parameters characterizing real rigidities in investment, the sensitivity of workers to changes in the real wage, the elasticity of substitution between labor and capital, the share of liquidity-constrained consumers, and the elasticity of intertemporal substitution. However, price mark-ups and depreciation rates, as well as the shares of labor and capital in national income, are set to reflect the differential estimates for the two economies.

The fact that we set most of the parameters equal indicates that there is little comparable empirical evidence about these fundamental factors across countries or large and small economies. This is a lacuna as we will argue that these parameters have a fundamental bearing on the effects of fiscal policy and it is likely that these parameters will in reality vary across countries – not only between small and large economies, but also between open and more closed economies, developed and less developed economies, and countries with large versus those with small social protection systems.

Apart from the size of the economy, the paper explores the following five main fundamental determinants of the effects of fiscal policy, with the first three reflecting consumption and saving decisions and the last two the production framework:

---

7 Although the version of the model discussed here features a two-country setup, a multi-country version exists (see Kumhof, Laxton and Muir 2005 for an application of a four-country version).

8 For a collection of early models with these features, see Buiter (1981), Blanchard (1985), Weil (1989), McKibbin and Sachs (1991), Black *et al.* (1994, 1997), Faruqee, Laxton and Symansky (1997), Laxton *et al.* (1998), and Faruqee and Laxton (2000).

9 See Laxton and Pesenti (2003) for a more detailed discussion of evidence on parameter values.

Table 2

Behavioral Assumptions and Key Parameters in the Initial Steady State

	Large Economy	Small Economy	Foreign
Behavioral Assumptions Subject to Sensitivity Analysis			
Planning horizon of consumers	10 years	10 years	10 years
Labor disutility parameters	0.96	0.96	0.96
Fraction of rule-of-thumb consumers	0.25	0.25	0.25
Intertemporal elasticity of substitution	0.33	0.33	0.33
Elasticity of substitution between capital and labor	0.80	0.80	0.80
Other Key Parameters			
Effective discount rate	0.87	0.87	0.92
Depreciation rate on capital	0.10	0.20	0.10
Capital adjustment cost parameters	2.0	2.0	2.0
Elasticity of substitution between varieties			
Tradables sector	6.0	10.0	6.0
Price markup over marginal cost	1.2	1.1	1.2
Non-tradables sector	3.5	7.5	3.5
Price markup over marginal cost	1.4	1.2	1.4
Capital share in production tradables sector	0.50	0.55	0.50
Capital share in production non-tradables sector	0.50	0.55	0.50
Utility from real money balances	0.02	0.02	0.02
Price stickiness parameters	0	0	0
Home bias in government consumption	yes	yes	yes
Home bias in private consumption	no	no	no
Elasticity of substitution between traded and non-traded goods	0.75	0.75	0.75
Bias towards domestically produced tradable over non-tradables	0.40	0.54	0.40

Source: GFM simulations.

- *The consumers' "degree of impatience"*. This parameter is proxied by the wedge between the rate of time preference and the yield on government bonds. This parameter has not been subject to much microeconomic analysis. The baseline value of the wedge is set to 10 per cent – which translates into a planning horizon of 10 years – with an alternative simulation using values consistent with a longer planning horizon. In GFM, owing to the overlapping generations structure, the parameter guiding the planning horizon is the probability of living. The baseline value is obviously much lower than the probability of survival for most of the population, but it is a simple way of introducing a form of myopia into the model that many others have emphasized is necessary to generate plausible dynamics.[10]
- *Limited participation in financial markets*. This is the fraction of consumers that does not have access to credit markets and hence cannot smooth consumption over time. In the baseline, 25 per cent of the population is assumed to be liquidity constrained (empirical evidence suggests that the proportion may be as high as 33 per cent), with the consumers spending their entire disposable income every period. This combined with a planning horizon of 10 years generates plausible dynamics and correlations between consumption and disposable income.[11] To investigate the importance of this assumption, an alternative simulation assumes that all consumers can use credit markets to smooth their consumption over time. It should be noted that despite the fact that liquidity-constrained consumers represent a quarter of the population in the baseline, they account for a much smaller share of total private consumption because their incomes are lower and they do not have any wealth.
- *The sensitivity of consumers to changes in the real interest rate.* Lower values of the intertemporal elasticity of substitution will result in larger increases in real interest rates when government debt increases. The baseline value for this parameter is –0.33, which is consistent with the upper end of the range of empirical models without habit persistence.[12] The parameter value in the alternative simulation, -0.20, is consistent with the lower end of microeconomic estimates for models without habit persistence.
- *The sensitivity of labor supply to the real wage (Frisch elasticity)*. The absolute value of this elasticity in the baseline (-0.04) is at the mid-range of values found in micro-economic studies. Such a value can be characterized as a moderately elastic labor supply: most empirical studies indeed find a modest elasticity for males and a somewhat more elastic labor supply for females. The elasticity of labor supply is a key determinant of the crowding-out effects of government as it

---

10 Other studies, for example, McKibbin and Sachs (1991) assume an even shorter planning horizon. However, since GFM also incorporates liquidity-constrained consumers who essentially have a one-year planning horizon we use a longer planning horizon for optimizing agents.

11 Models without finite planning horizons, such as infinitely-lived representative agent models, sometimes assume a much larger share of liquidity-constrained consumers to generate a more plausible correlation between disposable income and consumption – see Erceg, Guerrieri and Gust (2005), who use a value of 0.5.

12 Patterson and Pesaran (1992) and Attanasio and Weber (1993) argue that the elasticity of intertemporal substitution falls between 0.1 and 0.3 in models with habit formation.

affects the distortion created by labor income taxes. To illustrate this, alternative simulations assume values consistent with more elastic labor supply respectively inelastic labor supply.

- *The elasticity of substitution between labor and capital in the production function.* The ease with which firms can substitute between factors of production is an indication of the flexibility of the production structure of the economy, with the elasticity likely to exhibit large variation between different sectors in the economy. The baseline value is –0.8, with an alternative simulation using a higher value of -1 which is the value for a Cobb-Douglas production function.

4. The macroeconomic effects of government debt

This section studies the macroeconomic implications of changes in tax policies that lead to higher government debt and the spillover effects of such policies to other countries, and in the process illustrates some of the key properties of the model. We draw a distinction between, on the one hand, a reduction in labor income taxes that results in permanently higher government debt and, on the other, temporary higher government debt resulting from a reduction in labor income taxes but followed by a fiscal consolidation.

4.1 Tax cut causing permanently higher debt

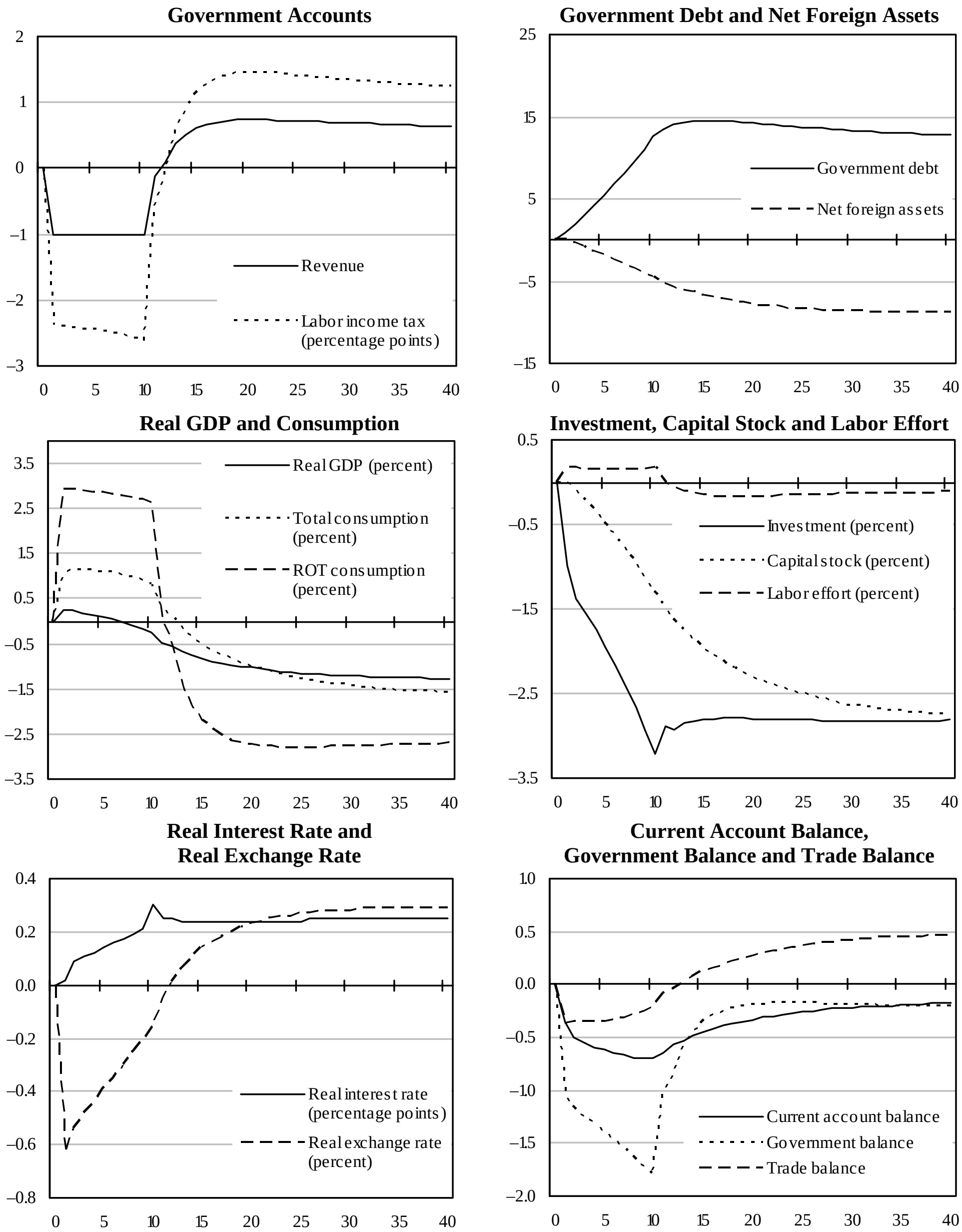
This simulation assumes a debt-financed temporary reduction in labor income taxes by the equivalent of 1 percent of GDP for 10 years. The macroeconomic effects of such a tax cut are depicted in Figures 1 and 2 for the large and the small economy respectively.

Consider first the large open economy. A 1 percent of GDP reduction in revenue corresponds to roughly a 2.5 percentage point cut in the labor income tax rate. Such a cut in taxes leads to an increase in government deficits, which are then reflected in an increase in government debt. There are a variety of other economic developments that accompany this temporary change in tax policy. A decline in taxes leads to an increase in labor effort as agents substitute work for leisure to take advantage of temporary lower tax rates and higher labor demand by firms. The combination of lower taxes and higher labor effort leads to an increase in after-tax wage income, which in turn leads to an increase in private consumption. This is despite the fact that the reduction in taxes is temporary, and it highlights the non-Ricardianness of the model. Specifically, the increase in consumption is particularly strong for liquidity-constrained consumers who consume the entire increase in disposable income. Optimizing agents, with access to credit markets, on the other hand do save part of their temporary higher income, although not the full amount, to anticipate for the possibility that they will face a higher future tax burden. Higher aggregate demand, given the assumption of monopolistic competition, increases GDP in the short term. As expected given the absence of nominal rigidities, the

Figure 1

Macroeconomic Effects of Permanently Higher Government Debt: Large Economy[1]

(deviation from initial steady state in percent of GDP unless otherwise noted)



[1] The effects of a 1 percent of GDP cut in labor income taxes for 10 years.

Source: GFM simulations.

short-term multipliers are small, with GDP increasing by less than a fifth of a percent in the first five years.

A decline in government savings is associated with an increase in real interest rates compared to the rest of the world, and an appreciation in the real exchange rate. The currency appreciation in the near term implies a positive wealth effect for consumers, which further stimulates aggregate demand, and initially supports higher GDP. The real interest rate increases by about 30 basis points in the long run. This is broadly consistent with evidence from reduced-form empirical evidence concerning the increase in world interest rates during the 1980s in countries with integrated capital markets (see Ford and Laxton, 1999). Higher interest rates have an adverse effect on investment and the capital stock, which pulls down potential growth in the medium and long run.

Given the real appreciation of the currency, and the fact that some of the additional consumption falls on imports, the trade balance moves into a deficit. Thus, twin deficits – government and the current account – emerge as a result of the expansionary fiscal policy. The deterioration in the current account is about half the size of the decline in the revenue-to-GDP ratio, during the entire period of fiscal loosening, which is consistent with the evidence reported in Kumhof, Laxton and Muir (2005) for the United States. Put differently, the magnitude of this response highlights the potentially important contribution fiscal adjustment in a large open economy suffering from twin deficits could make to reduce the external (and global) imbalances. These estimates are considerably larger than those obtained in another recent model-based analysis of this topic (see Erceg, Guerrieri and Gust, 2005). The model developed by Erceg, Guerrieri and Gust is based on the representative agent framework and the only source of non-Ricardian behavior is the presence of rule-of-thumb consumers. As such, the impact of government debt on the net foreign asset position is muted and this divergence of results highlights the critical role of short planning horizons in GFM.

Since the economy needs to run primary surpluses to finance the higher interest spending, after the ten-year period, labor income tax rates will be permanently higher by about 1 percentage point, where we assume that the increase in taxes after 10 years takes place in a gradual manner. As a result, consumption and labor effort over the medium term decline. These declines, together with the crowding out of investment as a result of higher interest rates noted above, causes a permanent decline in output.[13] Moreover, over the medium and long run, a permanent real exchange rate depreciation will be needed in order to run trade balance surpluses to service the stock of accumulated net foreign liabilities.[14]

---

[13] Consumption and labor effort are negatively correlated in the long term since leisure is a normal good.

[14] By contrast, a model with Ricardian equivalence posits that net foreign liabilities and real interest rates do not depend on the level of government debt in the long run. Lane and Milesi-Ferretti (2002) find empirical support that the stock of public debt is an important determinant of the net foreign asset position in both industrial and developing countries.

Next consider the results for a small open economy (Figure 2). There are a number of distinct differences compared to those for the large economy. First, the increase in consumption and output is greater and of somewhat longer duration – this is due primarily to a higher sensitivity of the real exchange rate to interest rate differentials. Second, compared to an increase in government debt in the large economy, the increase in interest rates in the long term is considerably smaller as fiscal policy in the small economy has a negligible effect on global saving and investment. Third, given the negligible effect on interest rates, there is a significantly smaller impact on investment and the capital stock, and hence on potential output in the long term. Notice also that the small open economy considered here has a relatively large share of exports and imports and therefore is more affected by the global trade and investment relationship. Therefore, in all there are marked differences in the macroeconomic consequences of higher debt for a small open economy compared to a large one. Also, the response of the current account is almost equal to the decline in government revenue as a share of GDP.

To highlight the importance of the behavioral assumptions, Table 3 reports the long-term effects of higher government debt on real GDP and real interest rates under alternative parameterizations. The crowding-out effects of government debt, for both the large and small open economy cases, depend in particular on the planning horizon of consumers as well as the sensitivity of consumption to changes in the real interest rate. The presence of rule-of-thumb consumers, the sensitivity of workers to changes in the real wage, and the substitutability between factors of production matter less for the long-term crowding-out effects of government debt.

A longer planning horizon for optimizing agents implies that a higher fraction of the temporary cut in taxes will be saved to prepare for higher future tax liabilities. As a result, national saving declines by less, as reflected in a smaller accumulation of net foreign liabilities. This in turn implies a considerably smaller increase in long-term real interest rates and smaller crowding out of investment. A lower intertemporal elasticity of substitution implies that consumption is less responsive to changes in the real interest rate. Since both types of economies need to run trade balance surpluses to service foreign liabilities, this implies that real interest rates need to increase by more to induce lower domestic consumption. As a result, crowding-out effects will be stronger.

Simulation results (not reported) also indicated that for a less open small economy, the interest rate would increase by more in the short term for the same policy change, with a correspondingly much larger real exchange rate appreciation. Further note that a corollary of the results above is that crowding-out effects of government debt are larger for economies that are relatively closed to international trade.

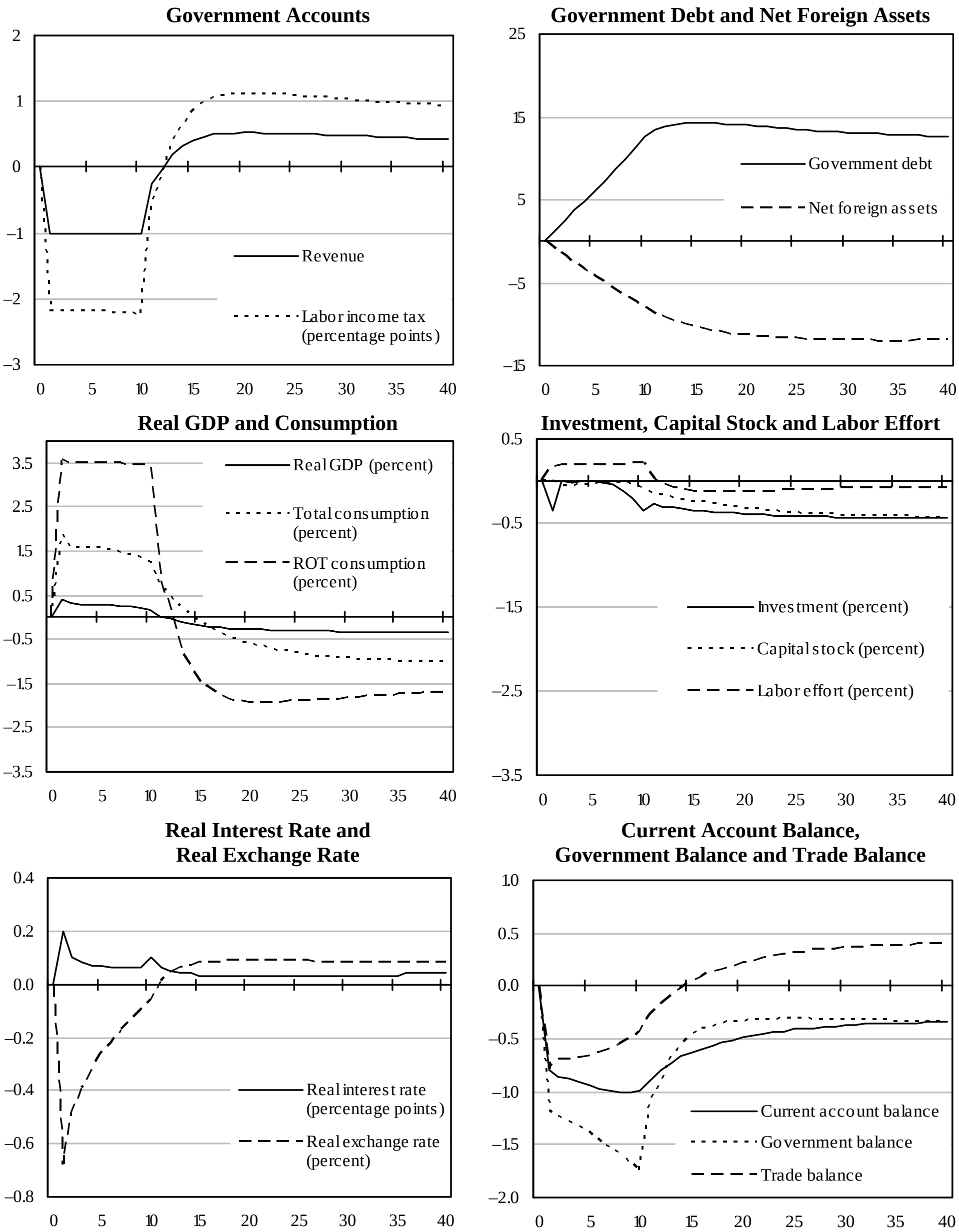
4.2 International spillover effects of government debt

The above differences between the large and small economy are reflected in the spillover effects to the rest of the world of the change in tax policy. The

Figure 2

Macroeconomic Effects of Permanently Higher Government Debt: Small Economy[(1)]

(deviation from initial steady state in percent of GDP unless otherwise noted)



[(1)] The effects of a 1 percent of GDP cut in labor income taxes for 10 years.

Source: GFM simulations.

Table 3

Sensitivity Analysis: Long-term Effects of Permanently Higher Government Debt on Real GDP and Real Interest Rates under Alternative Parametrizations

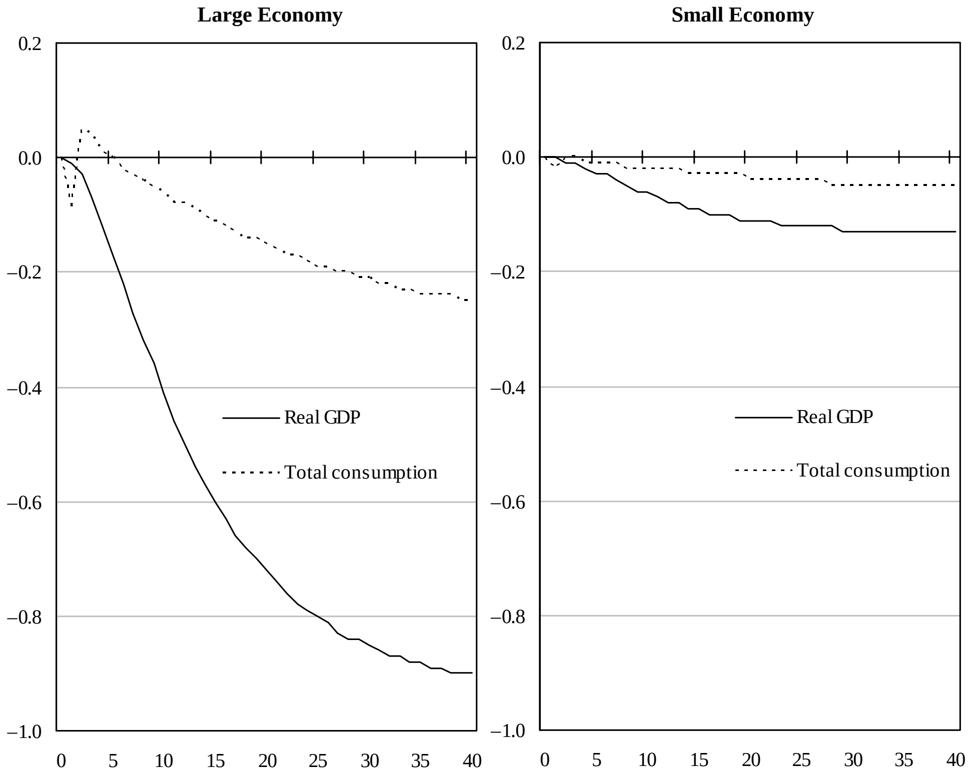
	Large Economy	Foreign		Small Economy	Foreign
Baseline[1]					
Real GDP	–1.25	–0.89		–0.33	–0.13
Real interest rate	0.25	0.25		0.03	0.03
Longer Planning Horizon[2]					
Real GDP	–0.23	0.02		–0.18	0.00
Real interest rate	0.01	0.01		0.00	0.00
Inelastic Labor Supply[3]					
Real GDP	–1.24	–0.88		–0.30	–0.13
Real interest rate	0.25	0.25		0.04	0.04
All Consumers Have Access to Financial Markets[4]					
Real GDP	–1.11	–0.78		–0.29	–0.11
Real interest rate	0.21	0.21		0.03	0.03
Lower Intertemporal Elasticity of Substitution[5]					
Real GDP	–2.63	–2.13		–0.48	–0.32
Real interest rate	0.58	0.58		0.08	0.08
Cobb-Douglas Production Function[6]					
Real GDP	–1.67	–1.28		–0.36	–0.18
Real interest rate	0.25	0.25		0.03	0.03

(1) See Table 2 for parameter values in the baseline; long term refers to the new steady state value.
(2) Planning horizon is 100 years.
(3) The absolute value of the elasticity of labor supply is –0.001.
(4) The share of rule of thumb consumers is 0.
(5) The intertemporal elasticity of substitution is –0.20.
(6) The elasticity of substitution between capital and labor is 1.

Source: GFM simulations.

Figure 3

Spillover Effects from Fiscal Policies in Large and Small Economies
(deviation from initial steady state in percent)



Source: GFM simulations.

exchange rate and interest rate movements, together with trade linkages, are the main channels through which such spillover effects occur (Figure 3). The initial real appreciation of the exchange rate in the home economy and the corresponding depreciation in the rest of the world imply a negative wealth effect for the rest of the world, although the magnitude of this varies significantly between the large and the small economies. The adverse effect on output that this entails is accompanied by the higher demand for the foreign economy's imports that provides a positive stimulus to rest-of-the-world output. For both the large and the small economy case these effects more or less balance in the short term, implying modest changes in output and consumption. However, over the long term higher government debt in the larger economy crowds out economic activity abroad as well via higher interest rates and lower demand for its exports, with an increasingly adverse effect on potential output. As might be expected, in the case of the small open economy, the spillover effects are small, even in the long term.

4.3 Temporary tax cut followed by fiscal consolidation

The above analysis is based on the assumption that labor income tax rates only increase to stabilize government debt. As a result, government debt remains permanently higher. An alternative scenario is where the policymakers cut taxes in the short term, but after a while change policy direction and instead focus on reducing government debt by increasing taxes. In other words, how do the above results change if instead the rise in debt is expected to be temporary? As Figures 4 and 5 indicate, for both types of economies, in contrast to a permanent increase in debt, the labor income tax rate needs to increase for a prolonged period for government debt to gradually decline so that in the long run it is back to the original level.

The macroeconomic consequences during the period of fiscal expansion reflecting a tax cut are similar to the scenario studied above, but the medium- and long-term effects are quite different. The decline in consumption and output is more marked in the medium term, but in contrast, there is no permanent loss to potential output. More importantly from a policy perspective, the medium-term output losses following fiscal adjustment exceed by a wide margin the short-term output gains associated with a fiscal stimulus. This is particularly the case for the large open economy and follows from the need to finance the interest burden on transition deficits.

4.4 Fundamental determinants of the effects of temporary fiscal stimulus

The above results are sensitive to the key structural and behavioral assumptions in the model. For instance, the extent to which consumption increases following the cut in labor income taxation depends on whether consumers expect to pay higher future taxes. This in turn is critical for the extent of medium-term consumption and output losses once taxes are increased. As such, the assumptions regarding the planning horizon of optimizing agents, together with the fraction of liquidity-constrained or "rule-of-thumb" consumers is critical. Furthermore, the results are materially affected by the extent to which labor effort responds to the initial decline, and subsequent increase, in taxes, as well as the substitutability between factors of production at the level of the firm. The extent to which the real exchange rate needs to depreciate in the long term depends on the sensitivity of consumers to changes in the real interest rate.

In order to evaluate the importance of these assumptions, Figures 6 and 7 report the macroeconomic effects of higher government debt on real GDP and real interest rates under alternative parameterizations.

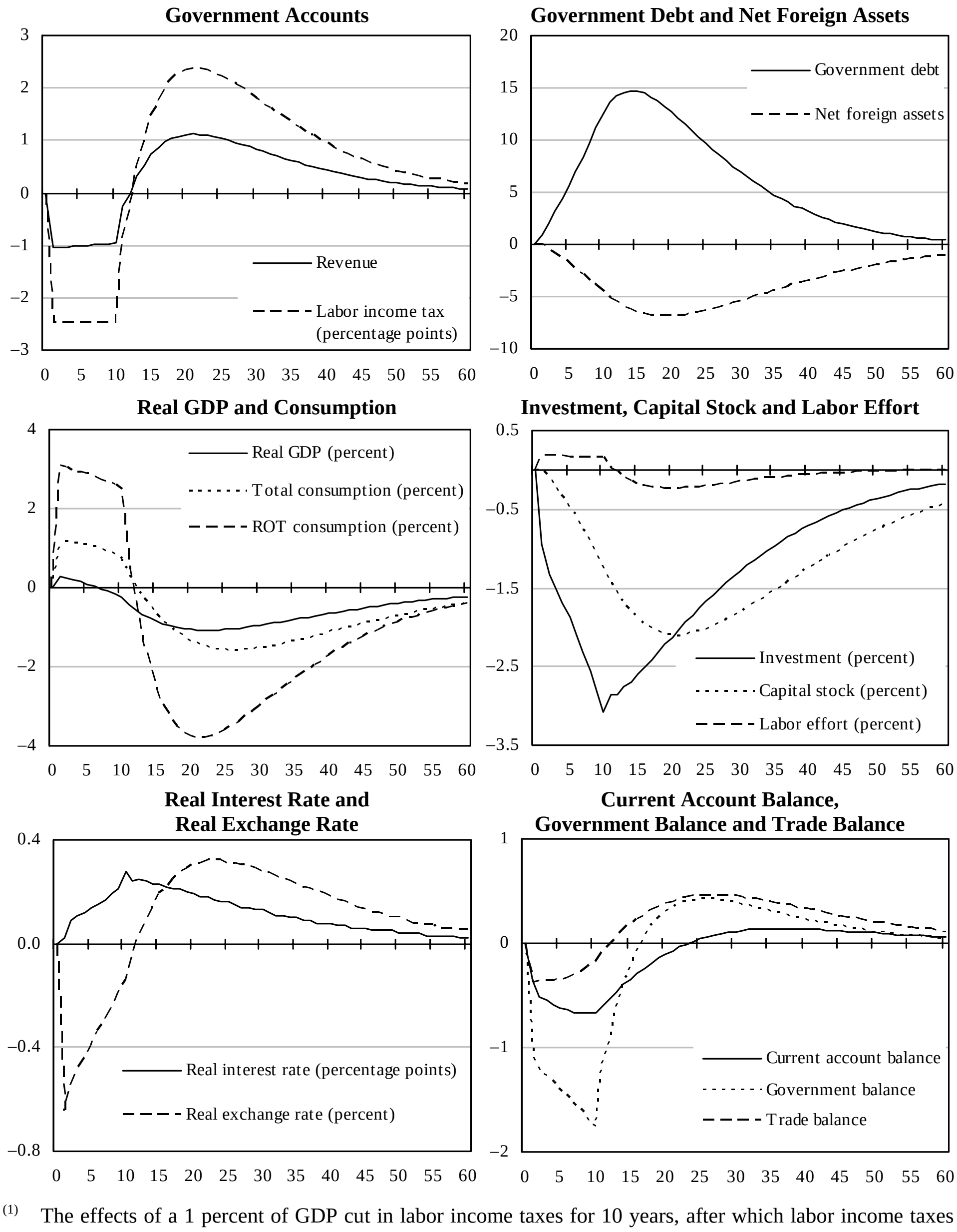
The simulations illustrate the following:

- The crowding-out effects of government debt, for both the large and the small open economy case, depend in particular on the *planning horizon of consumers.* A longer planning horizon for optimizing agents implies that a higher fraction of

Figure 4

Macroeconomic Effects of Temporary Higher Government Debt: Large Economy(1)

(deviation from initial steady state in percent of GDP unless otherwise noted)



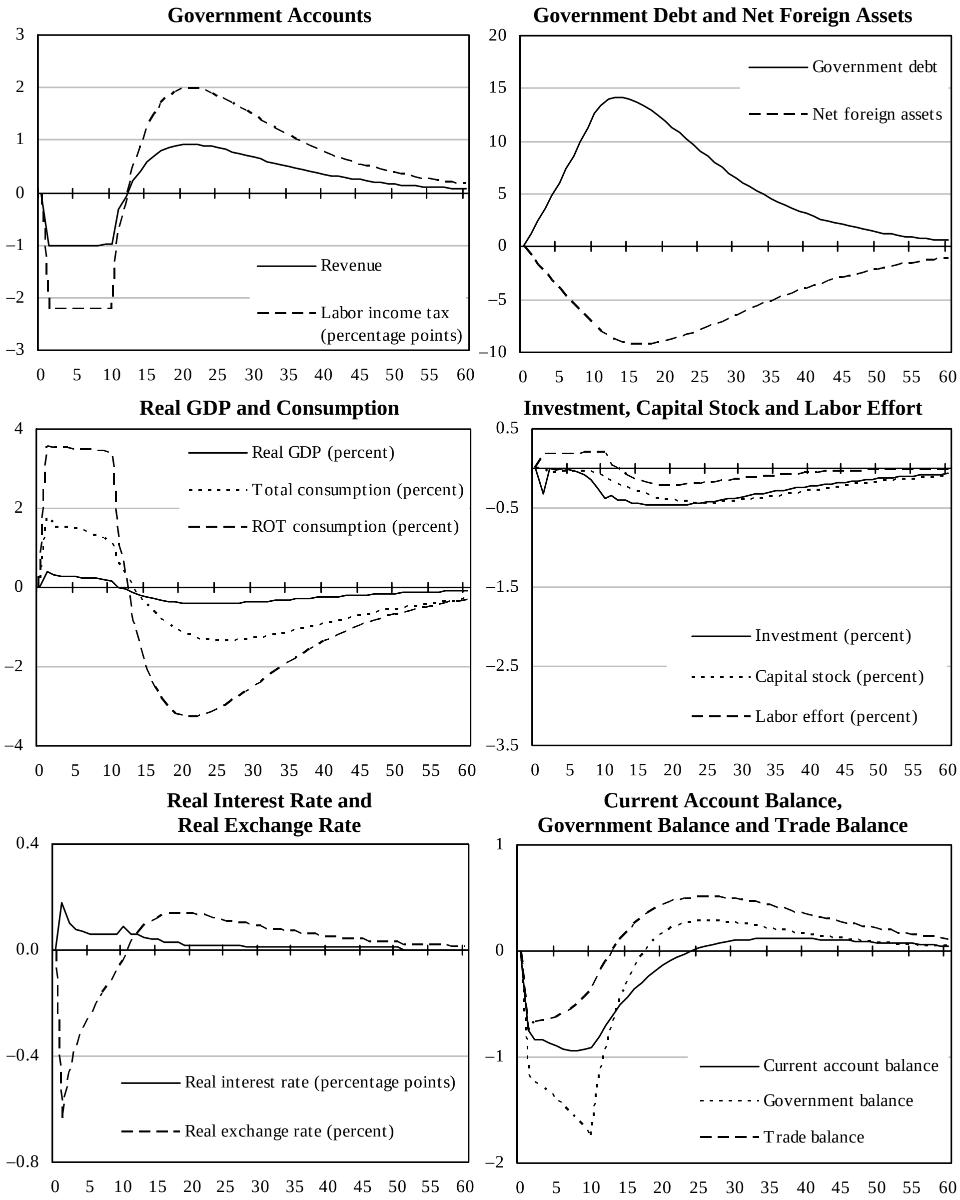
(1) The effects of a 1 percent of GDP cut in labor income taxes for 10 years, after which labor income taxes adjust to prevent higher government debt in the long term.

Source: GFM simulations.

Figure 5

Macroeconomic Effects of Temporary Higher Government Debt: Small Economy(1)

(deviation from initial steady state in percent of GDP unless otherwise noted)

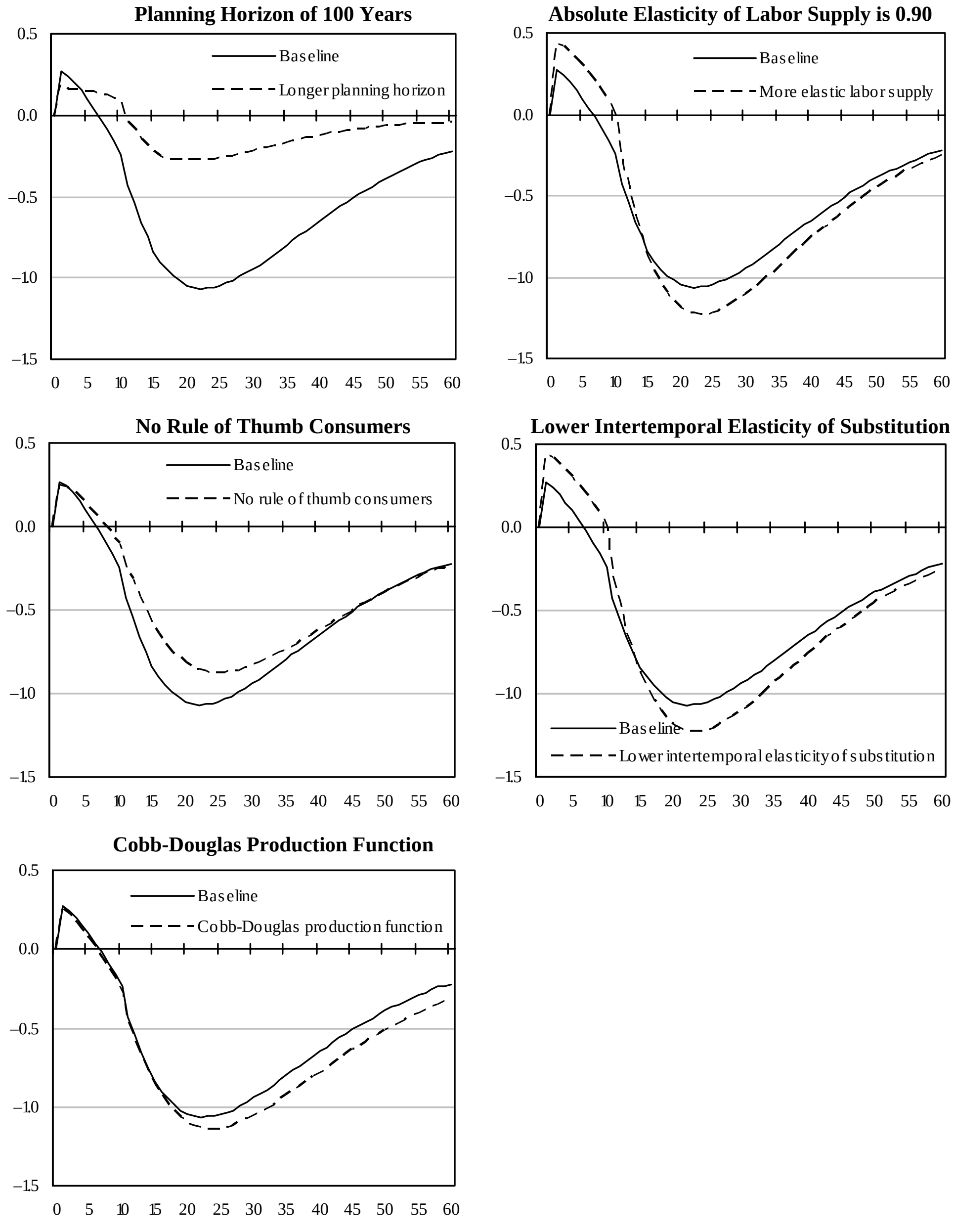


(1) The effects of a 1 percent of GDP cut in labor income taxes for 10 years, after which labor income taxes adjust to prevent higher government debt in the long term.

Source: GFM simulations.

Figure 6

Effects on GDP in a Large Economy of Temporary Higher Government Debt: An Analysis of the Fundamental Determinants[1]

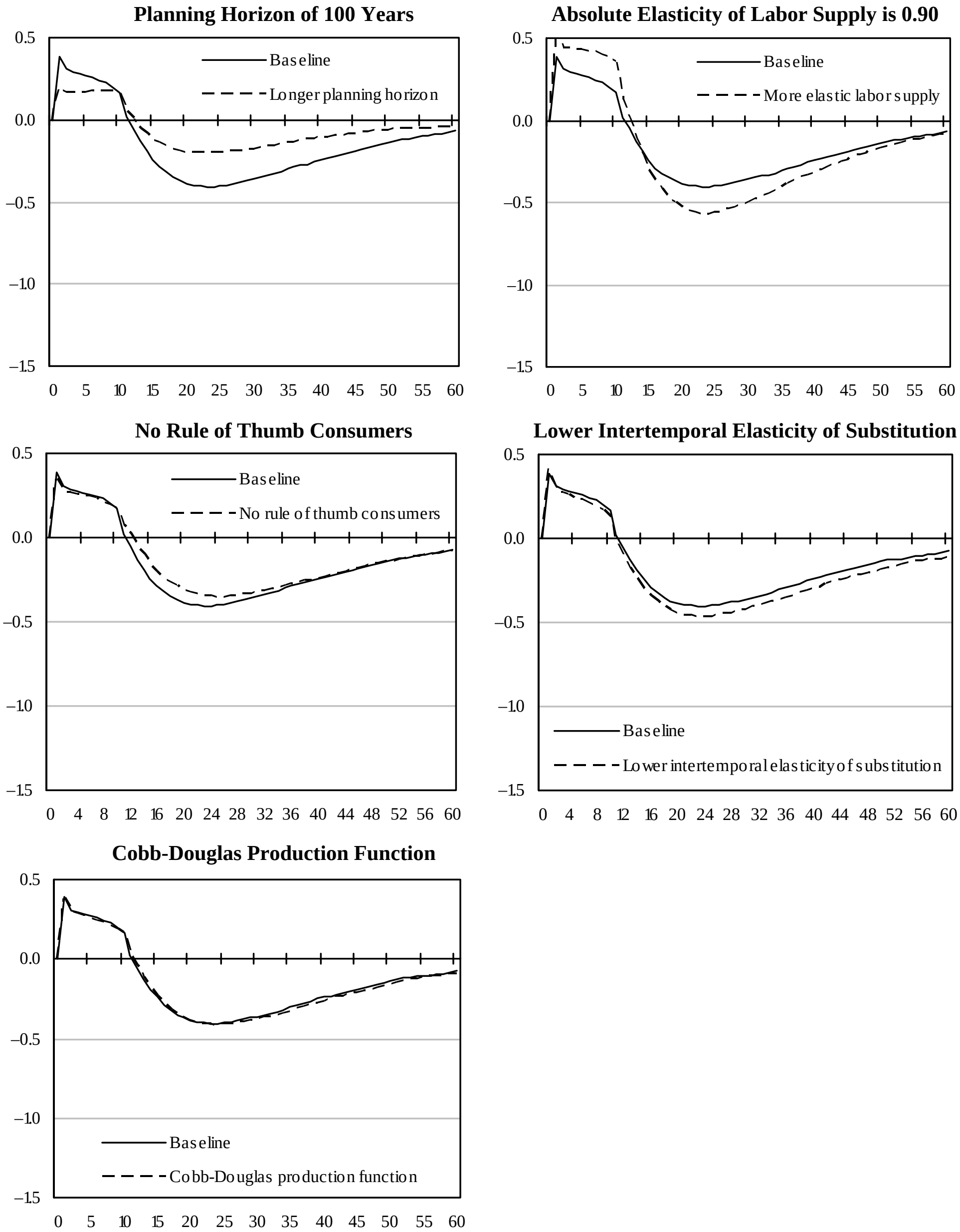


(1) The effects of a 1 per cent of GDP cut in labor income taxes for 10 years, after which labor income taxes adjust to prevent higher government debt in the long term. For baseline parameter values, see Table 2.

Source: GFM simulations.

Figure 7

Effects on GDP in a Small Economy of Temporary Higher Government Debt: An Analysis of the Fundamental Determinants(1)



(1) The effects of a 1 per cent of GDP cut in labor income taxes for 10 years, after which labor income taxes adjust to prevent higher government debt in the long term. For baseline parameter values, see Table 2.

Source: GFM simulations.

the temporary cut in taxes will be saved to prepare for higher future tax liabilities. As a result, national saving declines by less, as reflected in a smaller accumulation of net foreign liabilities. This in turn implies a considerably smaller increase in long-term real interest rates and smaller crowding out of investment. Essentially, a longer planning horizon offsets the short-term gains from a fiscal expansion and correspondingly mutes the medium-term costs in terms of foregone output once the fiscal contraction occurs. This smoothing effect is particular pronounced for the large economy.

- The presence of *liquidity-constrained or rule-of-thumb consumers* has a similar effect as a longer planning horizon, although to a much smaller extent. Essentially, with all agents optimizing, the crowding-out effects and the output decline in the medium-term is somewhat smaller. The fact that non-participation in financial markets matters less than consumer myopia is directly related to the fact that liquidity-constrained consumers account for only a small fraction of aggregate consumption.
- A *lower intertemporal elasticity of substitution* implies that consumption is less responsive to changes in the real interest rate. Both the large and the small economy need to run trade surpluses to service the transitory stock of net foreign liabilities. As a result, domestic consumption needs to decline, which implies that real interest rates need to increase to provide the incentive for additional saving. As consumption becomes less sensitive to changes in the real interest rate, the real interest rate needs to increase by more. As a result, crowding out of capital accumulation in the medium term will be stronger, and there will be a larger adverse effect on GDP growth. As such, the open-economy dimension of GFM underlines the important role for decision making by consumers in assessing the effects of fiscal policy.
- Increasing *the sensitivity of workers to changes in the real wage* implies a stronger increase of hours worked in the short term following the decline in labor income taxation. Similarly, in the medium term, labor effort declines by more when taxes increase as the emphasis of fiscal policy changes to reducing the stock of debt.
- For changes in tax policy centered on labor income taxation, the *substitutability between factors of production* does not appear to have a marked impact on the crowding-out effects of government debt.

5. Government spending shocks and private consumption

5.1 The effects of higher government spending on private consumption

Keynesian theories and neoclassical real business cycle theories predict an opposite response of private consumption to higher government spending. In the IS-LM model, all consumers essentially behave in a rule-of-thumb fashion, which, together with sticky prices, implies that higher government spending financed through higher government debt increases private consumption. Conversely, in real business cycle models with infinitely lived representative agents, consumers anticipate the higher future tax burden and, therefore, to smooth their consumption over time, save more. As a result, private consumption is expected to decline after a positive government spending shock.

Most of the empirical evidence finds a positive correlation between government spending and private consumption, thus supporting the Keynesian rather than the neoclassical view (see Galí, López-Salido and Vallés 2005, for a recent overview of the empirical evidence; also see Fatás and Mihov, 2001; Blanchard and Perotti, 2002; and Perotti, 2004 for earlier analysis). Galí, López-Salido and Vallés construct a model in the spirit of NOEM models to account for this empirical finding. Similar to GFM, in their framework, investment is determined by a Tobin's Q relationship with capital adjustment costs as well as monopolistically competitive firms. However, contrary to GFM, their model incorporates sticky wages and prices and monetary policy follows a Taylor rule. In combination with a significant proportion of rule-of-thumb consumers this can explain the observed positive correlation between government and private consumption. Indeed, it is the combination of nominal rigidities and the presence of non-Ricardian consumers that gives rise to this positive correlation.

Apart from sticky wages and prices and rule-of-thumb consumers, there is little in the existing literature about the fundamental factors that affect the correlation between government and private consumption. There are four key areas of interest where our analysis diverges from that of Galí, López-Salido and Vallés. First, in Galí, López-Salido and Vallés, agents are infinitely lived while one would expect that the planning horizon is a key determinant of the response of private consumption to government spending shocks – as evidenced by the critical role of rule-of-thumb consumers. Second, Galí, López-Salido and Vallés posit lump sum taxation. As a result, changing the composition and timing of higher taxation following the rise in government spending cannot be analyzed, but is likely to be an important determinant for the response of consumers. Third, unlike the setup in Galí, López-Salido and Vallés, GFM is an open-economy model allowing for wealth effects operating through the real exchange rate to affect private consumption as well as to study whether the response is different for large and small economies. Finally, we will analyze the extent to which the production technology and sensitivity of consumers to changes in the real interest rate affect the response of private consumption to government spending shocks.

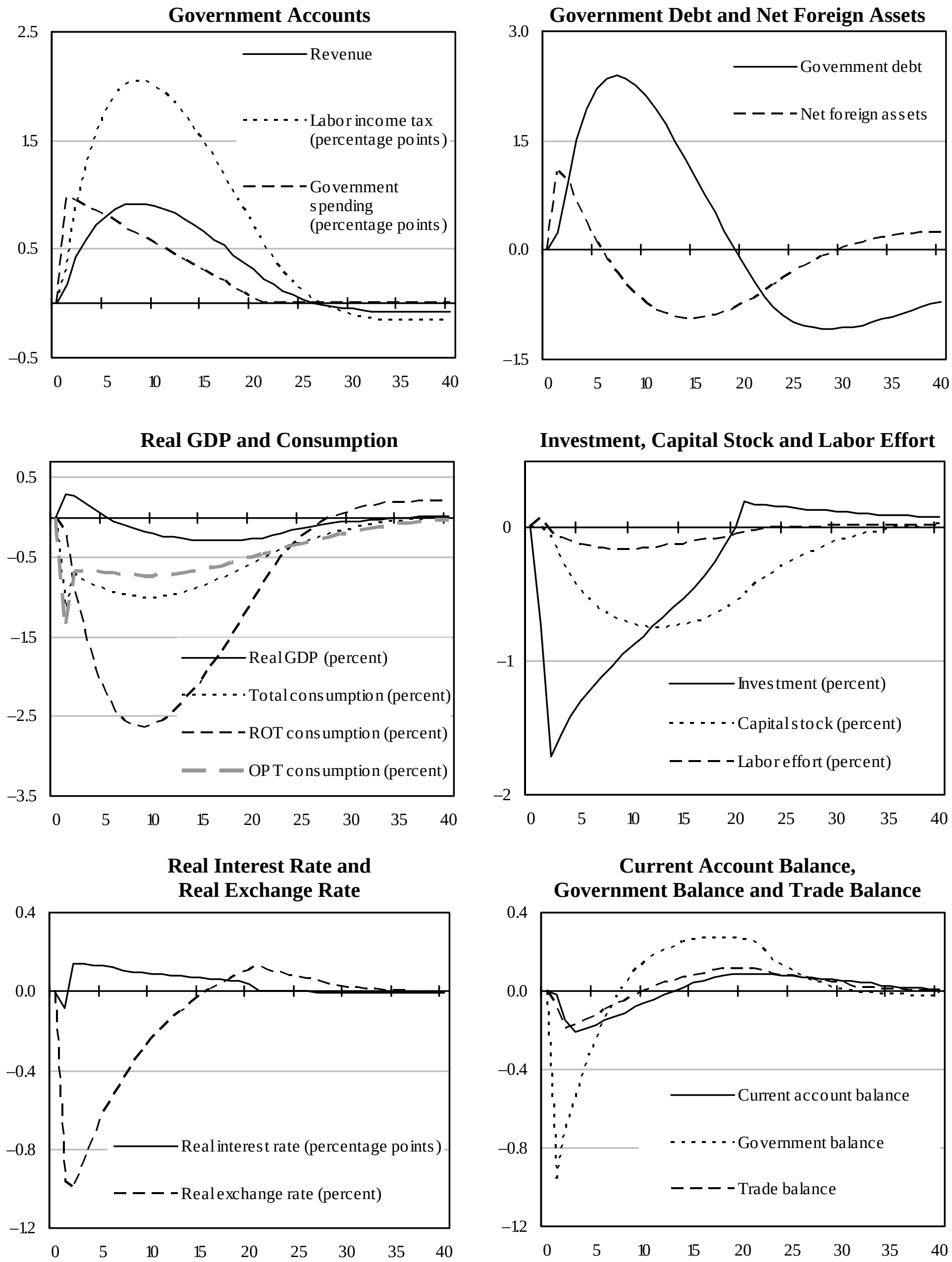
The effects of a temporary shock to current government spending for the large and small open economy are illustrated in Figures 8 and 9, respectively. Real government spending is assumed to increase by 1 percent of real GDP after which the shock gradually wanes off during a period of 20 years – similar to the shock investigated in Galí, López-Salido and Vallés. Labor income taxes are assumed to adjust immediately, although gradually, to mitigate the increase in government debt.

Higher government spending increases output in the non-traded goods sector given complete home bias in government spending. Since labor income taxes are increased, however, private consumption declines. On impact, the consumption of

Figure 8

Macroeconomic Effects of a Temporary Government Spending Shock: Large Economy

(deviation from initial steady state in percent of GDP unless otherwise noted)

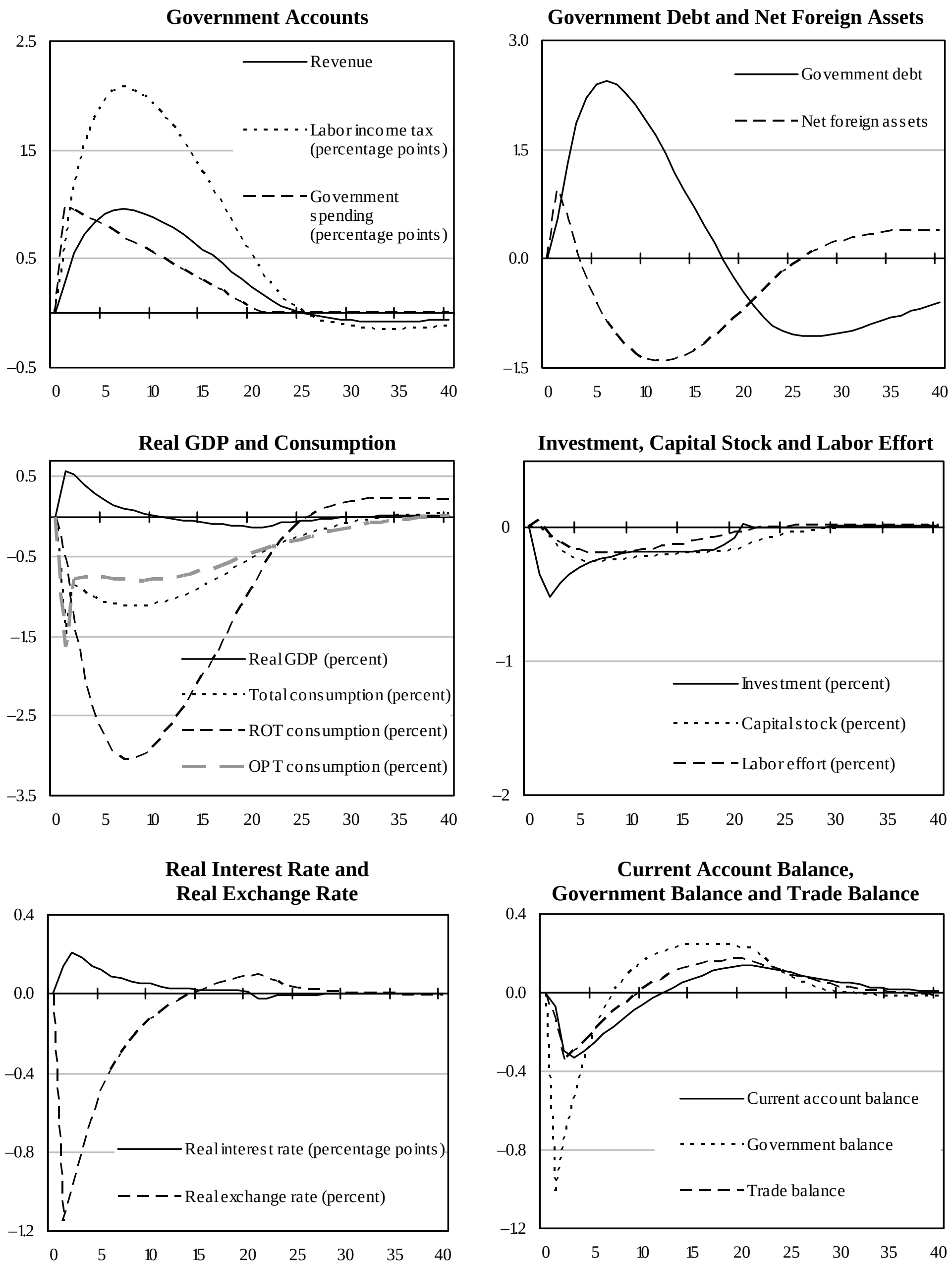


Source: GFM simulations.

Figure 9

Macroeconomic Effects of a Temporary Government Spending Shock: Small Economy

(deviation from initial steady state in percent of GDP unless otherwise noted)



Source: GFM simulations.

optimizing and liquidity-constrained consumers declines, closely following the path of higher taxes in light of the limited response of hours worked. Consumption by optimizing agents initially declines by more as they anticipate the gradually increasing path of labor income taxation and start to save more in response. In the medium term, the consumption decline is substantially greater for liquidity-constrained consumers as they are unable to take similar contingency measures. The maximum decline in the consumption for this group occurs when taxes reach their maximum. Overall, the decline in aggregate private consumption is about equal to the increase in government consumption. Note that the deterioration of the current account in response to higher government spending is smaller compared to the case in which taxes are reduced. This follows from the fact that government spending is characterized by a high degree of home bias and implies that consolidation measures aiming to increase government revenue can contribute relatively more to reducing external (and global) imbalances.

Investment declines quite quickly as a result of higher interest rates following the temporary increase in government debt. Labor effort and (pre-tax) real wages increase on impact, but decline during the period of rising taxes. In fact, labor effort increases in the non-tradeables sector, while it declines in the tradables sector. Output increases as a result of the wealth effect of real exchange rate appreciation with the increase in non-tradables production more than offsetting the decline in production in tradables sector.

In the case of the small open economy, while some of the effects are similar, there are two notable differences. First, output initially increases substantially more, and subsequently declines less as the real exchange rate is more responsive due to the higher trade openness. Second, the decline in investment is muted as the path of real interest rates is more benign.

5.2 Determinants of the government-private consumption correlation

As in the first exercise, sensitivity analysis was undertaken to assess the extent to which the above results regarding the impact of government spending shocks on private consumption are affected by different behavioral assumptions and parameter values (Table 4).

The planning horizon of consumers is the only fundamental determinant that affects the correlation between government and private consumption. Optimizing agents reduce their consumption by less as they take into account the fact that the increase in taxation is only temporary. Overall consumption declines by less on impact (ROT consumers respond the same way as in the base case as their disposable income declines to the same extent). The result is similar across both the large and the small economies, although it is somewhat more pronounced in the latter. The other fundamental determinants that were shown to play an important role in the previous section for changes in tax policy matter little for the short-term effect of government spending shocks.

Table 4

Sensitivity Analysis: Effect of Government Spending on Private Consumption: Alternative Parametrizations and Types and Timing of Consolidation

	Large economy					Small economy				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Immediate adjustment through higher labor income taxes[1]										
Baseline	–1.2	–0.7	–0.8	–0.9	–0.9	–1.5	–0.9	–1.0	–1.0	–1.1
Longer planning horizon	–0.9	–0.8	–0.9	–0.9	–1.0	–1.1	–0.9	–0.9	–1.0	–1.0
Inelastic labor supply	–1.2	–0.7	–0.8	–0.8	–0.9	–1.5	–0.8	–0.9	–1.0	–1.0
Less consumers have access to financial markets[2]	–1.1	–0.7	–0.8	–0.9	–1.0	–1.3	–0.8	–1.0	–1.1	–1.1
Lower intertemporal elasticity of substitution	–1.1	–0.7	–0.8	–0.9	–0.9	–1.4	–0.8	–0.9	–1.0	–1.1
Cobb-Douglas production function	–1.3	–0.7	–0.8	–0.9	–0.9	–1.6	–0.9	–1.0	–1.1	–1.1
Higher mark-up in the traded goods sector[3]	–1.1	–0.7	–0.8	–0.9	–0.9	–1.4	–0.8	–0.9	–1.0	–1.0
Alternative types of immediate fiscal adjustment										
Corporate income taxes	–0.4	–0.6	–0.7	–0.8	–0.8	–0.3	–0.5	–0.6	–0.7	–0.8
Personal income taxes	–0.9	–0.8	–0.9	–0.9	–0.9	–1.0	–0.9	–1.0	–1.0	–1.0
Alternative timing of fiscal adjustment										
Taxes adjust after 5 years										
Labor income taxes	–0.9	–0.3	–0.3	–0.3	–0.4	–0.8	–0.1	–0.1	–0.1	–0.2
Corporate income taxes	–0.6	0.0	0.0	0.0	0.1	–0.3	0.3	0.3	0.3	0.3
Personal income taxes	–0.7	–0.1	–0.1	–0.1	–0.1	–0.5	0.1	0.1	0.1	0.1
Taxes adjust after 10 years										
Labor income taxes	–0.8	–0.2	–0.2	–0.2	–0.2	–0.4	0.1	0.2	0.2	0.1
Corporate income taxes	–0.7	0.0	0.0	0.1	0.1	–0.2	0.4	0.4	0.4	0.4
Personal income taxes	–0.7	0.0	0.0	0.0	0.0	–0.3	0.3	0.3	0.3	0.3

(1) See Table 2 for alternative parameter values unless otherwise noted.
(2) 40 per cent rule of thumb consumers.
(3) Mark-ups in the traded goods sector are doubled.

Source: GFM simulations.

Changes in the *composition of fiscal adjustment as well as its timing* substantially affect the correlation between government and private consumption. In this context, increasing corporate income taxes rather than labor income taxes has two implications. First, that liquidity-constrained consumers reduce their consumption by less as they are not affected by this increase in taxes. In fact their consumption increases slightly as a result of higher labor effort and real wages increase. Second, since higher corporate income taxation reduces the incentives for capital accumulation, optimizing agents substitute savings for consumption, mitigating the decline in their consumption. The net result is a significantly smaller initial impact on aggregate private consumption compared to higher labor income taxes. This is particularly so in the case of the small economy and reflects a more muted effect on interest rates. The differential impact persists, albeit in a much reduced manner, especially in the large economy. Regarding increasing personal income taxes, since the tax base consists of both capital and labor income – as well as some other components – the effect on consumption is in between that resulting from the effect of higher labor respectively higher corporate income taxation.

The adverse effects on consumption are substantially reduced if the increase in taxes is postponed. The effects then depend in a marked way on the types of taxes that are increased. Delaying adjustment also implies that the negative correlation between government and private consumption is delayed.

6. Tax distortions and the benefits of tax reform

6.1 The distortionary effects of taxation

The previous section indicated that labor and corporate income taxation can have qualitatively distinct macroeconomic effects. To analyze this topic further we consider the impact of a permanent increase in lump-sum transfers by one percent of GDP. To prevent an increase in government debt, labor, corporate, or personal taxes adjust. Since this simulation is revenue neutral, the main implication of this policy change is that tax distortions in the economy increase as the size of the government expands in a non-distortionary manner.

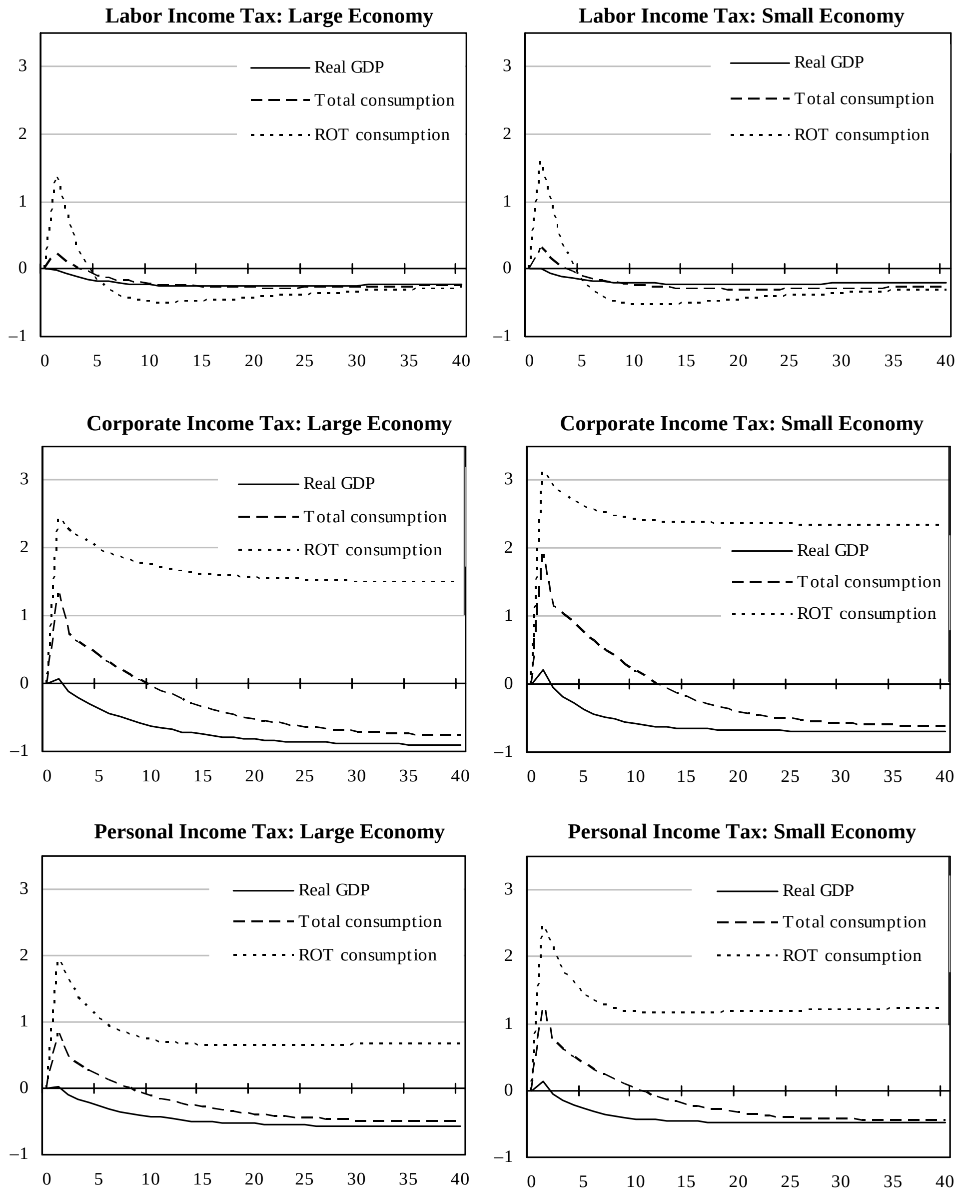
Given that labor supply is relatively inelastic in the baseline, the distortions created by increasing labor income taxation are relatively small as reflected by the small decline in potential output in the long term (Figure 10). These long-term output costs are considerably larger for corporate income taxation, confirming the traditional view that corporate income taxation affects the returns to capital, which is a reproducible factor of production. The effect of personal income taxation is in between that of the corporate and the labor income tax.

It is evident that initially consumption increases more when corporate income taxes are increased than when labor income taxes are increased. The reason is that higher lump-sum transfers increase disposable income for liquidity-constrained consumers. Optimizing agents smooth their consumption over time, implying a more

Figure 10

The Distortionary Effects of Alternative Forms of Taxation[(1)]

(deviation from initial steady state in percent)



(1) Lump-sum transfers permanently increase by 1 percent of GDP. Labor, corporate or personal income taxes adjust to prevent an increase in government debt.

Source: GFM simulations.

subdued response of their aggregate demand in the short term. In essence, this is a policy of redistribution from optimizing agents that own all the assets in the economy to poorer agents, albeit entailing a distortion of the tax system.

In the case of the small economy, for corporate income taxes, savings increase by less as interest rates increase by less. The latter mitigates the decline in investment while the former implies that the increase in consumption is larger. The overall effect is thus a somewhat larger expansion in the short term, with a more muted decline in output compared to the large economy case in the longer term.

6.2 The macroeconomic effects of revenue-neutral tax reform

Given that taxes create distortions to different degrees, we next consider the effects of a particular type of tax reform that has received considerable attention in recent years: that of eliminating the double taxation of dividends. Essentially, the current setup in many countries is that profits are taxed at the level of the firm and again when the after-tax profits are paid out in the form of dividends when they become subject to personal income taxation. As such, eliminating the double taxation of dividends is a form of tax reform aimed at stimulating incentives to save. Here we consider this reform to take place in a revenue-neutral manner, that is, the elimination of this double taxation is accompanied by an increase in labor income taxes. If the tax bases are broadly the same, the increase in labor income taxes would be broadly equal to the decline in personal income taxation of dividend income. It should be noted that GFM reflects the traditional view that taxation of dividends negatively affects capital accumulation.[15] Narrowing the personal tax base to labor and interest income and transfers – thus eliminating the personal income taxation of capital – should therefore reduce economic distortions.

Eliminating the personal income taxation of capital in a revenue-neutral manner has significant long-term positive effects in the large economy (Figure 11). In the short run, narrowing the personal income tax base while raising rates on labor income to prevent revenue losses causes a small decline in real GDP as higher labor taxes dampen consumption as this policy is essentially regressive – as reflected in the large decline in consumption by liquidity-constrained consumers. Over time, however, national saving increases substantially, the interest rate declines, and increased capital accumulation results in output increasing about 2¾ percentage points above the baseline.[16] As such, this particular type of tax reform also contributes to improving the current account balance in a sustained manner.

---

[15] The new view argues that borrowing by debt issuance rather than equity issuance is the main form of financing of investment. Since debt financing is tax deductible, capital income is effectively taxed only once, and hence there is no need to reduce the personal income taxation of capital. This has little impact on the simulations in this paper, which focus on the macroeconomic consequences of reducing the taxation of personal capital income, rather than on the welfare implications of taxation across factors of production.

[16] If tax reform results in a reduction in the taxation of overall savings, instead of capital income only, the benefits are smaller. The reason is that increasing labor income taxes to reduce taxes on interest income

(continues)

Table 5

Sensitivity Analysis: Long-Term Effects on Real GDP of Revenue-Neutral Tax Reform Under Alternative Parametrizations[1]

	Large economy	Foreign	Small economy	Foreign
Baseline	2.72	1.26	1.76	0.25
Longer planning horizon[2]	2.34	0.74	1.87	0.15
More elastic labor supply[3]	1.48	1.27	0.56	0.23
All consumers have access to financial markets	2.49	1.07	1.72	0.21
Lower intertemporal elasticity of substitution	4.34	2.75	2.04	0.56
Cobb-Douglas production function	4.17	2.07	2.21	0.36
Higher mark-up in the traded goods sector	2.55	1.33	1.62	0.27

(1) See Table 2 for alternative parameter values unless otherwise noted.
(2) Planning horizon equal to 20 years.
(3) The absolute value of the elasticity of labor supply is –0.100.

Source: GFM simulations.

In the small economy, the long-term benefits are less pronounced – with about 1 percentage point less gain in potential output compared with the large economy (Figure 12). This is so since the increase in investment is not as marked, following a smaller reduction in real interest rates as the increase in savings in the small open economy has a smaller effect on world savings. Savings in this economy, however, increase by more, leading to a large increase in the current account balance.

6.3 *Sensitivity analysis of the benefits of tax reform*

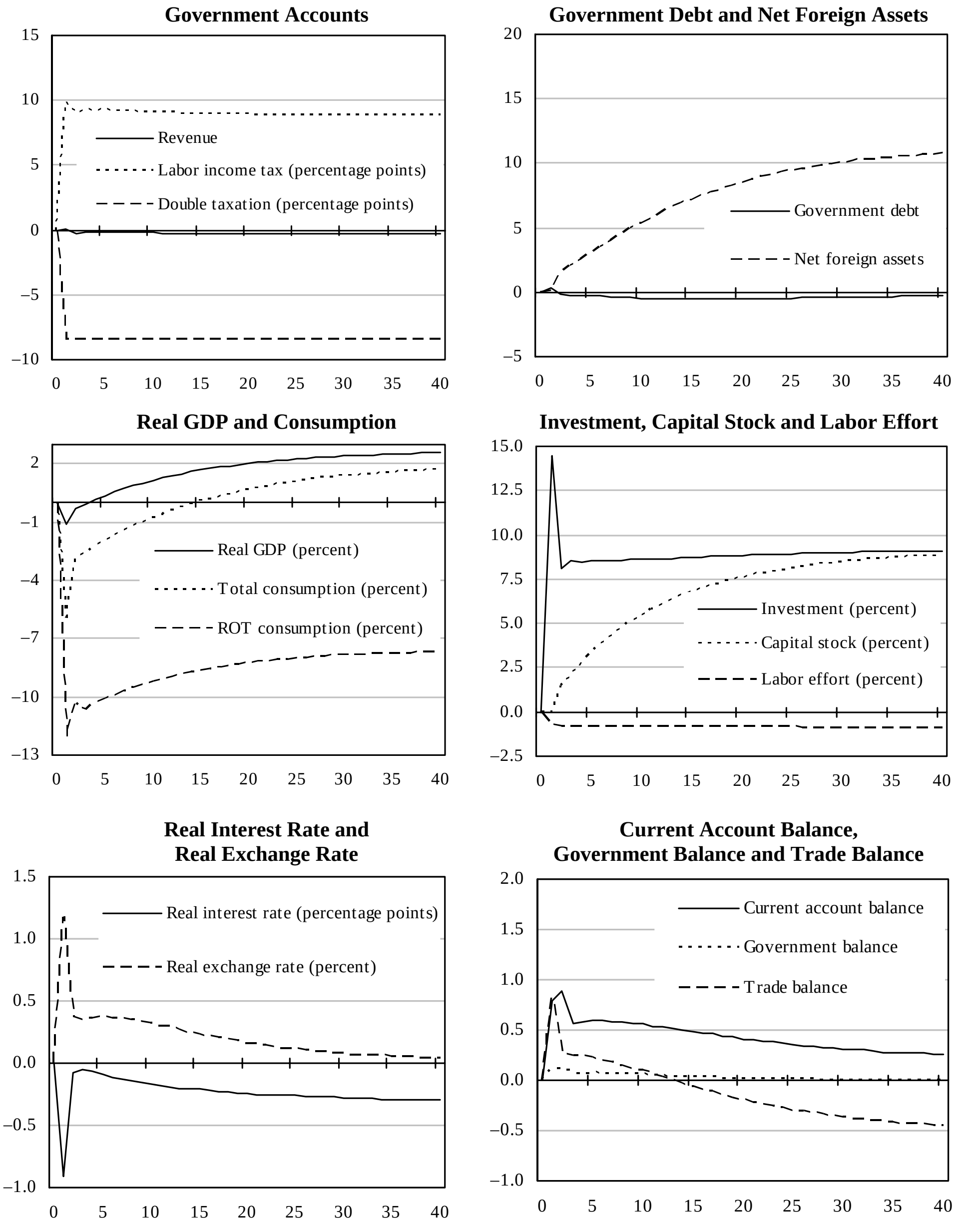
The benefits of tax reform, as well as its spillover effects depend on several factors. First, if consumers have a longer planning horizon, the decline in initial consumption is smaller as optimizing agents capitalize on their anticipation of lower corporate income taxation and therefore higher returns on investment in the future (Table 5). The counterpart of this result is that saving does increase by more in the

increases distortions in the economy. Also, see Bayoumi, Botman and Kumar (2005) for a discussion of the implications of non-revenue-neutral tax reform.

Figure 11

Macroeconomic Effects of Tax Reform: Large Economy[(1)]

(deviation from initial steady state in percent of GDP unless otherwise noted)



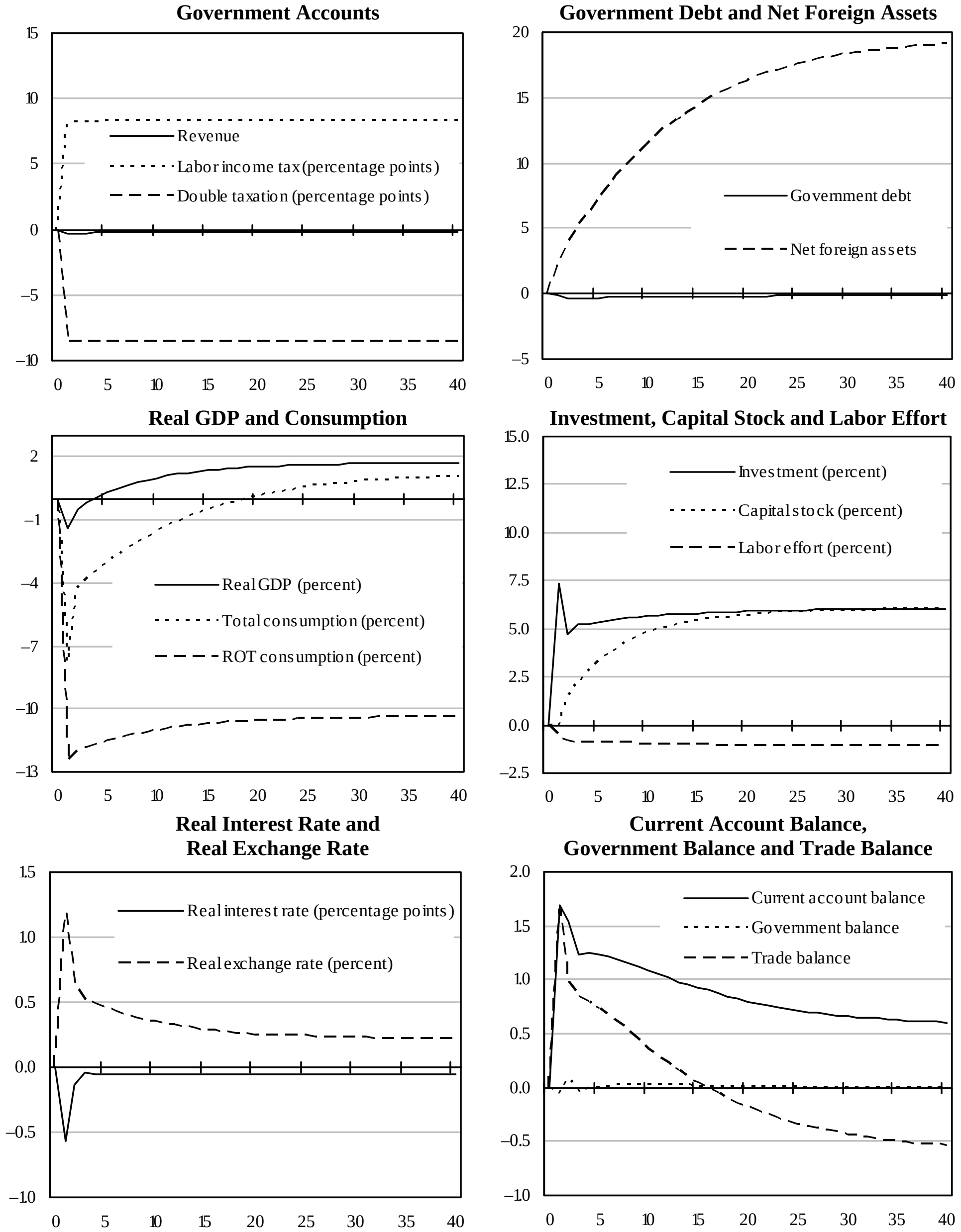
(1) The effects of eliminating the personal income taxation of dividend income in a revenue-neutral manner by adjusting labor income taxes.

Source: GFM simulations.

Figure 12

Macroeconomic Effects of Tax Reform: Small Economy[1]

(deviation from initial steady state in percent of GDP unless otherwise noted)



[1] The effects of eliminating the personal income taxation of dividend income in a revenue-neutral manner by adjusting labor income taxes.

Source: GFM simulations.

medium term. However, overall investment increases by less in this case even though savings in the long term increase much more with longer planning horizons.

Second, a more elastic labor supply implies more distortionary labor income taxation, and therefore smaller benefits from shifting the tax burden from capital to labor. The benefits are particularly muted for the smaller economy. If all consumers are optimizing and have access to financial markets, the results move in the same direction as for an extension of the planning horizon although to a much smaller degree.

Third, a lower intertemporal elasticity of substitution has a substantial effect on the benefits of tax reform, particularly for the large economy. Following the increase in national savings, the current account turns positive, and trade deficits are needed to stabilize the current account in the long term. As a result, interest rates need to decline to stimulate higher consumption and mitigate the increase in saving. If consumers are less responsive to changes in the real interest rate, it needs to decline by more to induce the required increase in consumption. This in turn stimulates capital accumulation and produces significantly larger long-term output gains. The effect in the small economy is much more muted, however, given smaller effects on the world real interest rate.

Fourth, a Cobb-Douglas production function implies greater substitutability between capital and labor compared with the baseline and therefore a stronger response of investment and somewhat larger decline in labor effort following this policy change. This again implies substantially larger long-term output gains in the larger economy. In the smaller economy, the effects are less marked as the increased after-tax return of capital interacts with the decline in the real interest rate.

Finally, higher mark-ups reduce the distortionary effects of dividend taxation as a larger share falls on rents rather than capital accumulation. As a result, the benefits of tax reform are somewhat smaller for both economies.

7. The effects of privatizing retirement saving

7.1 Compulsory pension reform

This section explores the macroeconomic effects of (partially) privatizing saving for retirement. This privatization can take place through either a compulsory or a voluntary reform. Given the rising concerns about the solvency of the public funded pension systems and adverse demographics, such schemes have been proposed or are under consideration in a variety of industrial as well as emerging market countries, including the United States and the Czech Republic. The modalities of such schemes vary widely, and in part are related to the considerable divergence of views regarding what the consequences of such a reform would be. To explore this issue in a systematic way, the simulations discussed below are based on the following characteristics of the reform. (i) It is assumed that workers can divert 4 percentage points of social security contributions into Personal Retirement Accounts

(PRAs).[17] (ii) Accumulation of assets into PRA's matures after 45 years. It is assumed that workers up to the age of 45 can participate and that they retire at 65, so that PRAs start paying benefits after 20 years. However, aggregate contributions to PRAs exceed benefit payments for a further 25 years, when the youngest workers that participated at the start of the program (assumed to be 20 years old) reach retirement. (iii) Withdrawals from PRAs result in equal reductions in government transfers.[18]

The simulations suggest a significant increase in federal deficits and debt over several decades (Figure 13). As payroll contributions are diverted from the Social Security system to PRAs, government revenue declines markedly, falling by 2 percentage points of GDP relative to the baseline. As a result, government debt starts rising quickly and is about 50 per cent of GDP above baseline after 20 years, and reaching a peak of almost 60 per cent after another 5 years. This is when the benefit payments from PRAs start, and as they do so, "traditional" Social Security payments decline by a corresponding amount, which allows government deficits and debts to begin to decline. Nonetheless, in the long run, government debt still exceeds the baseline by 50 percentage points of GDP.

In this simulation we assume compulsory saving for retirement. As a result, private saving through PRAs offsets government dissaving and there is no impact on national saving. Real interest rates are virtually unchanged and there is little effect on investment. Hence, there is no significant impact from privatizing retirement saving in a compulsory manner on GDP, national saving, and financial markets. However, it should be emphasized that these results follow from the stipulation that workers cannot borrow against accumulated savings held in their PRAs. In this case, a shift from government to private saving does not affect perceived wealth, and there is no change in consumer behavior. These results hold for both a large and a small open economy.

Introducing PRAs could, however, lead to perceptions of higher future transfer payments. Survey evidence suggests that workers, especially younger ones, are skeptical about the value of their future Social Security benefits, possibly reflecting the underfunded nature of the Social Security system. Placing contributions into individual accounts could be interpreted as a reducing the likelihood of a default on future benefit payments. Workers could perceive this as an effective increase in their permanent income. However, if workers currently assume that the government will not fully meet its promises, this also implies that workers correspondingly should expect a smaller increase in future government debt or taxes in the absence of PRAs. (Bayoumi, Botman, and Kumar, 2005, discuss this possibility and offer an illustrative simulation for the case of the United States).

---

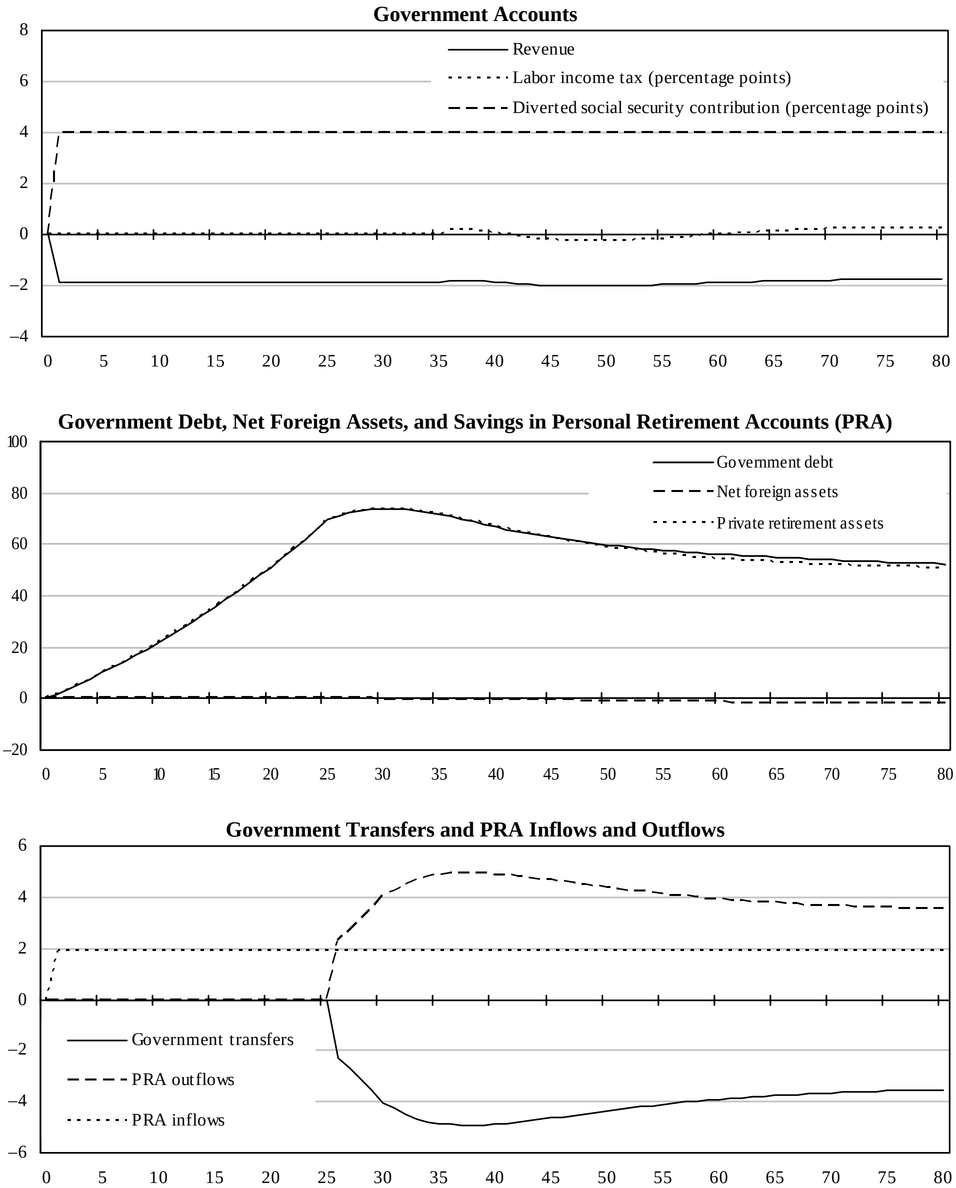
[17] A more gradual introduction of PRAs in the context of the United States was assumed in Bayoumi, Botman and Kumar (2005).

[18] Reflecting the stylized nature of financial markets in the model, there is no equity premium to be exploited by owners of PRAs.

Figure 13

The Effects of Introducing Compulsory Personal Retirement Accounts[1]

(deviation from initial steady state in percent of GDP unless otherwise noted)



(1) The effects are the same for a small and large open economy. Workers are allowed to divert 4 percentage points of social security contributions into personal retirement accounts (PRAs). Workers withdraw from these accounts after 25 years; *i.e.*, workers up to age 40 can participate and the retirement age is 65. The reduction in social security transfers from the government is equal to outflows from PRAs.

Source: GFM simulations.

It should be noted that financial markets may also expect PRAs to lead to an additional increase in government debt. Financial markets may underestimate implicit liabilities in anticipation of future reforms of benefits that reduce payment obligations of Social Security. If PRAs increase the estimated size of future liabilities by making implicit debt explicit, the risk premium on government bonds may increase.

7.2 Compulsory reform with fiscal consolidation

Contrary to the above case, model simulations suggest that significant macroeconomic benefits may accrue when PRAs are accompanied by greater fiscal discipline that prevents PRA-related increase in government debt. In essence, such a policy amounts to prefunding higher future pension liabilities. By making future liabilities explicit, PRAs could lead to greater public awareness, and lead to both public and as well as financial market pressure to offset the resulting increase in government debt. If such deficit reduction can be achieved, the question is whether there is any significant difference with regard to whether it is achieved through higher labor income, corporate income, or personal income taxes.

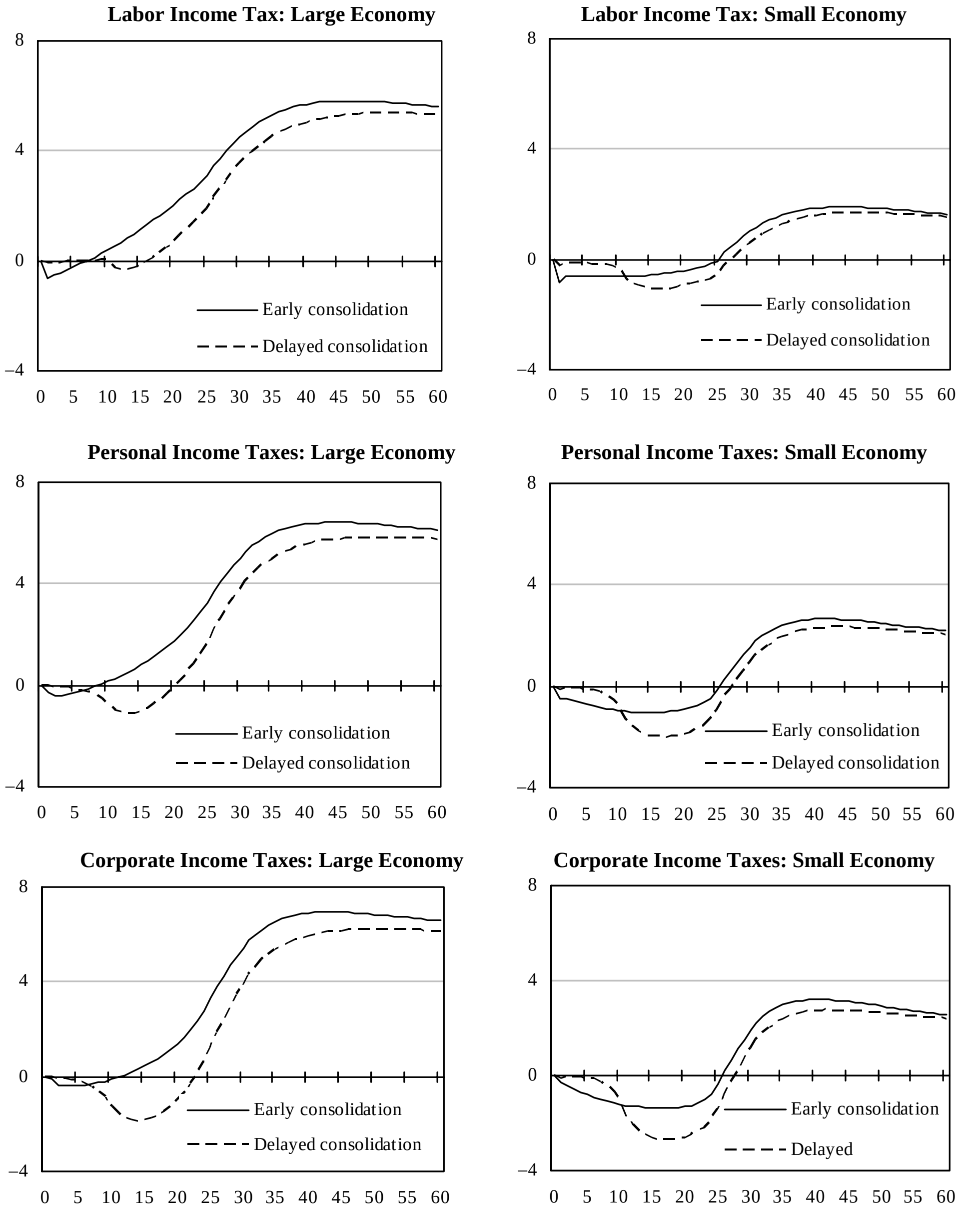
Simulation results suggest that the short-run effects are broadly invariant to the type of tax increase. In general, output falls modestly below the baseline over the short run. Over the longer run, higher government saving and lower government debt reduces the real interest rate and boosts investment (Figure 14). This is particularly the case for a large open economy. Nonetheless, there are some differences, with labor income tax-based consolidation yielding quicker but somewhat smaller long-run benefits. The reason is that labor income taxes are less distortionary compared to personal and corporate income taxes given the relatively low elasticity of labor supply. Fiscal consolidation through higher corporate income taxes provides larger long-term output and consumption gains when these taxes can be reduced after traditional benefit payments decline. The results for personal income taxation are in between the two, since its base combines both labor and corporate income. Delaying consolidation by 10 years provides modest short-term output gains, but at considerable medium-terms costs.

7.3 Voluntary opt-out

The absence of a consumer’s net wealth effect on mandatory personal retirement accounts hinges on the fact that workers who contribute into private accounts are not allowed to borrow against these savings. If this constraint is not binding, the simulation essentially transforms into a permanent tax cut – social security contributions decline – followed by lower future public pension outlays. One could thus consider the above scheme whereby workers are allowed to divert 4 percentage points of social security contributions into personal retirement accounts, but can opt out.

Figure 14

Introducing Personal Retirement Accounts with Alternative Forms of Fiscal Consolidation: Effects on Real GDP(1)



(1) Introduction of personal retirement accounts; labor, personal, or corporate income taxes adjust either immediately (early consolidation) or after ten years (delayed consolidation) to prevent an increase in government debt.

Source: GFM simulations.

Contributions to private pension funds are voluntary, while the rate of exit from the public pension system is assumed to be the same as in the baseline simulation above. Given the resulting incentives – whether to save for future retirement or to consume – consumers who are liquidity constrained and the optimizing ones that are impatient or myopic do not fully save the surplus that accrues from the reduction in social security taxes. Effectively, the myopic consumers discount the lack of traditional social security benefits in the future. Consumption and output increase in the short run at the expense of a long-run decline. In the long run, consumption falls due to a decline in the social security benefit payments and an increase in taxes required to stabilize debt (Figure 15).

The macroeconomic impact of voluntary private pension contributions depends to a large extent on the extent of consumer myopia (Figure 16). If consumers have longer planning horizons – making them more Ricardian – there is less of an initial consumption boom as they factor in the loss of traditional pension benefits in the long run. Consumers save more in the form of private pension contributions, which results in higher capital accumulation, output, and consumption over the long run. Conversely, if labor supply is relatively inelastic, the effective tax reduction does not induce greater incentives to work and higher output, lowering savings, which results in a somewhat greater output loss over the long run.

Rule-of-thumb consumers affect the results similarly as a longer planning horizon. Assuming a Cobb-Douglas production function has little impact. A lower elasticity of substitution implies large losses in the medium term to consumption and output for the large economy. The reason is the same as before: the current account moves substantially into deficit, requiring large real interest rate increases to stimulate savings. The impact on interest rates will only start to wane when social security transfers start to decline. This is also illustrated in Figure 16, with the response of private saving after the change in the system for retirement financing. The question of whether individuals will actually save for retirement is shown to depend primarily on the extent to which they wish to smooth their consumption over time, as formalized by the intertemporal elasticity of substitution. Also, a longer planning horizon results in a relatively more flat savings profile.

For a small open economy, the sensitivity analysis yields similar qualitative results, although the quantitative effects are substantially smaller than in the case of the large economy (Figure 17). The incentive to save is shown to depend primarily on the planning horizon of individuals (Figure 18). All in all, therefore, we can conclude that voluntary opt-out of retirement system is unlikely to generate sufficient long-term private saving to compensate for lower future social security benefits from the traditional system if individuals have a smaller desire to smooth their consumption over time and have short planning horizons.

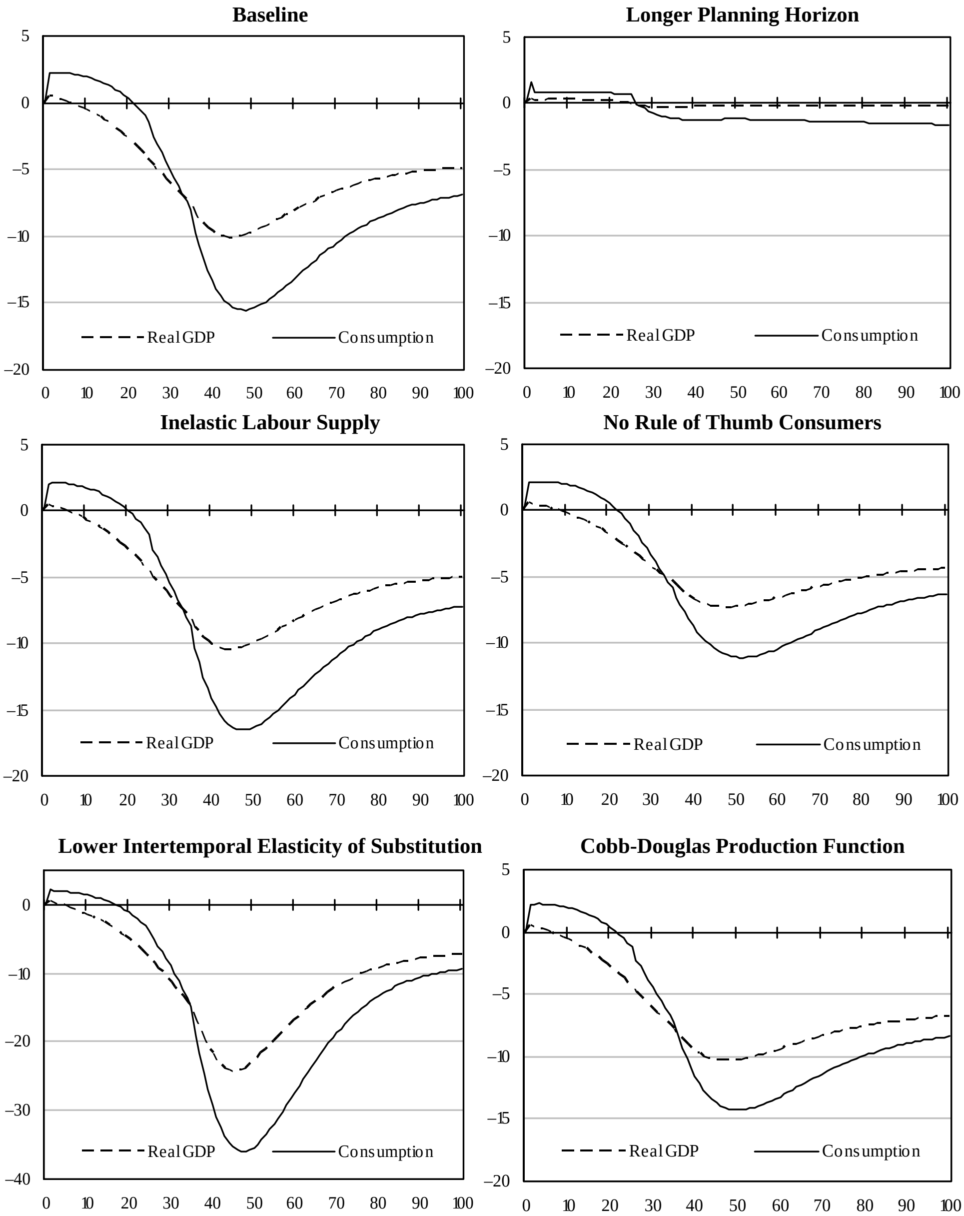
8. Concluding remarks

This paper utilizes the IMF's Global Fiscal Model to analyze the underlying

Figure 15

Voluntary Opt-out: Large Economy[1]

(deviation from initial steady state in percent)

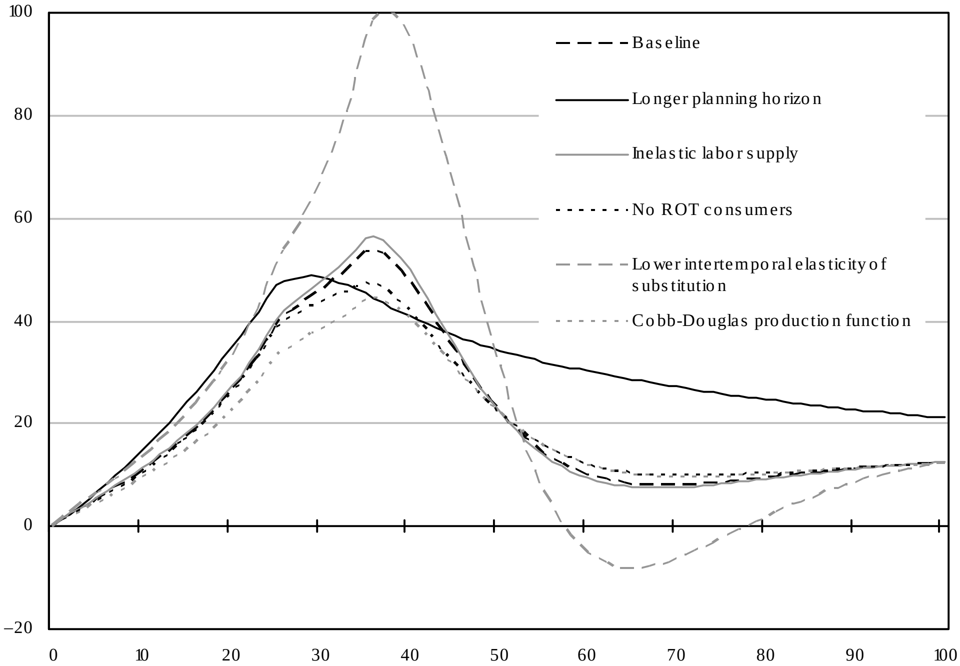


(1) Workers are allowed to divert 4 percentage points of social security contributions into personal retirement accounts, but are given the option to consume or save. Government transfers decline after 25 years as illustrated in Figure 13.

Source: GFM simulations.

Figure 16

Response of Private Saving to Voluntary Retirement: Large Economy(1)
(deviation from baseline in percent of GDP)



(1) See Table 2 for alternative parameter values except for the intemporal elasticity of substitution, which is equal to –0.25.

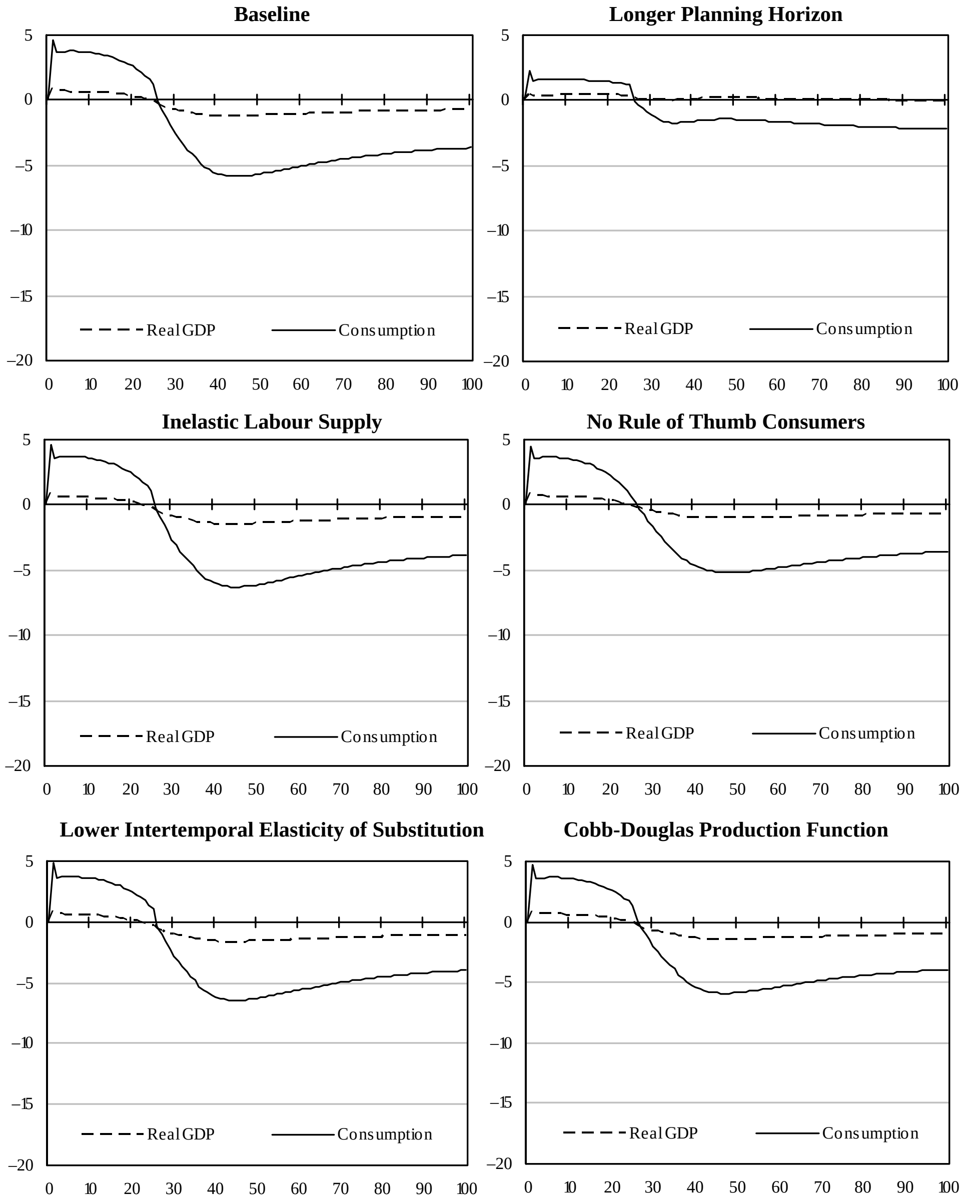
Source: GFM simulation.

determinants of the macroeconomic effects of fiscal policy and tax and social security reform and to explore their spillover effects. GFM is a multi-country non-Ricardian dynamic general equilibrium model rooted in the NOEM tradition, and it is used to specifically address four current issues in fiscal policy: (i) the macroeconomic implications of changes in tax policies that lead to higher government debt and the spillover effects of such policies to other countries; (ii) the effects of higher current government spending on private consumption; (iii) the distortions created by alternative forms of taxation and the resulting macroeconomic benefits of revenue-neutral tax reform; and (iv) the macroeconomic implications of proposals to privatize the pension system where such a reform can take place in either a compulsory or a voluntary manner.

This paper explores the extent to which the planning horizon of consumers, the fraction of liquidity-constrained consumers, and the elasticity of labor supply determine the qualitative and quantitative effects of fiscal policy. Furthermore, as

Figure 17

Voluntary Opt-out: Small Economy[(1)]
(deviation from initial steady state in percent)



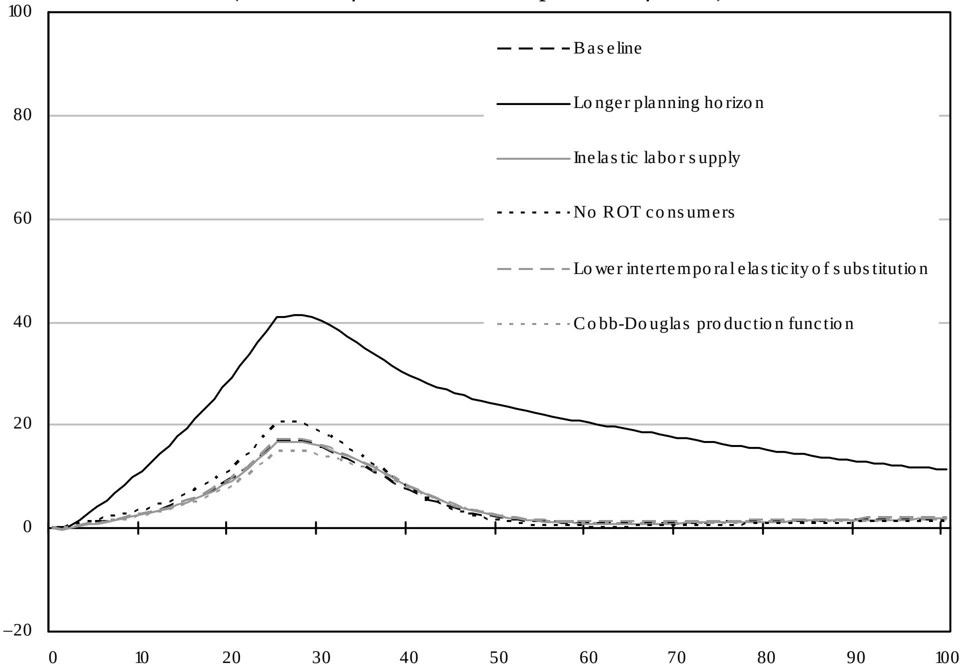
(1) Workers are allowed to divert 4 percentage points of social security contributions into personal retirement accounts, but are given the option to consume or save. Government transfers decline after 25 years as illustrated in Figure 13.

Source: GFM simulations.

Figure 18

Response of Private Saving to Voluntary Retirement: Small Economy[1]

(deviation from baseline in percent of GDP)



(1) See Table 2 for alternative parameter values except for the intemporal elasticity of substitution, which is equal to –0.25.

Source: GFM simulation.

GFM is rooted in consumer and producer optimization, the extent to which the effects of fiscal policy depend on the sensitivity of consumption to changes in the real interest rate – the intertemporal elasticity of substitution – and the substitutability between capital and labor, as reflected in the production structure of the economy, are also investigated. In addition, since GFM features monopolistic competition, we analyze the extent to which the degree of competition matters for the effects of fiscal policy. The two-country dimension of GFM allows a consideration of the relative size of an economy in the world economy that affects the response of the real interest rate to changes in fiscal policy.

The simulation analysis shows that the crowding-out effects of government debt are substantial, both at home and abroad. Fiscal deficits lead to a substantial deterioration in the current account, about half the size of the decline in the revenue-to-GDP ratio, during the entire period of fiscal loosening. The magnitude of this response highlights the potentially important contribution fiscal adjustment in a large open economy suffering from twin deficits could make to reduce the external (and global) imbalances. Furthermore, the short-term benefits of a debt-financed fiscal expansion do not outweigh the long-term cost when fiscal adjustment takes place. This is particularly the case if agents have short planning horizons, if labor supply is elastic, if a large share of consumers is liquidity constrained, if consumption is less sensitive to changes in the real interest rate, or if the production structure is more flexible. Throughout the paper we highlight the important role of the size of the economy relative to its trading partners. In general, the less open an economy is, the larger the crowding-out effects of permanently higher government debt.

We also show that the fundamental determinants of the effect of government spending shocks on private consumption include the planning horizon of agents, as well as the timing and composition of the tax policy response to make the spending shock debt neutral.

Corporate income taxation creates more distortions than labor or personal income taxation. However, there is an equity concern here. Higher spending on transfers by the government, in a lump-sum manner, compensated by higher taxation creates larger distortions in small open economies. Revenue-neutral tax reform aiming to increase incentives to save could yield significant gains in potential output by stimulating incentives to save and invest. The benefits of eliminating the double taxation of dividends is shown to depend in particular on the distortions created by offsetting tax policy changes as well as by the sensitivity of consumption to changes in real interest rate and the flexibility of the production structure to take advantage of changes in the marginal cost of different production factors.

Retirement reform aimed at increasing private saving for retirement, but in a compulsory manner, leads to a considerable increase in government debt. Prefunding future pension liabilities, which essentially is a combination of compulsory private retirement saving and fiscal consolidation, could yield substantial long-term benefits. This is particularly the case if lower future traditional social security payments could lead to lower corporate income taxation. Instead, changing the system toward private retirement system but allowing individuals to opt out, could lead to a short-term increase in output as individuals prefer to consume rather than save. The long-term costs of such a policy in terms of potential output could be substantial.

REFERENCES

Attanasio, O.P. and G. Weber (1993), "Consumption Growth, the Interest Rate and Aggregation", *Review of Economic Studies*, Vol. 60, pp. 631-99.

Bayoumi, T., D. Botman and M.S. Kumar (2005), "Effects of Social Security and Tax Reform in the United States", in *United States – Selected Issues*, IMF, Country Report, No. 05/258, and IMF, Working Paper, 05/208, Washington (D.C.), International Monetary Fund.

Bayoumi, T. and D. Botman (2005), "Jam Today or More Jam Tomorrow? On Cutting Taxes Now Versus Later", in *Canada – Selected Issues*, IMF, Country Report, No. 05/116, Washington (D.C.), International Monetary Fund.

Betts, C. and M. Devereux (2001), "The International Monetary Transmission of Monetary and Fiscal Policies in a Two-Country Model", in M. Obstfeld and G. Calvo (eds.), *Essays in Honor of Robert A. Mundell*, Cambridge (Mass.), MIT Press.

Black, R., V. Cassino, A. Drew, E. Hansen, B. Hunt, D. Rose and A. Scott (1997), "The Forecasting and Policy System: The Core Model", Reserve Bank of New Zealand, Research Paper, No. 43, Wellington.

Black, R., D. Laxton, R. David and R. Tetlow (1994), "The Steady-state Model: SSQPM – The Bank of Canada's New Quarterly Projection Model, Part 1", Bank of Canada, Technical Report, No. 72, Ottawa.

Blanchard, O.J. (1985), "Debt, Deficits, and Finite Horizons", *Journal of Political Economy*, Vol. 93, pp. 223-47.

Blanchard, O.J. and R. Perotti (2002), "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *Quarterly Journal of Economics*, Vol. 117, pp. 1329-68.

Botman, D. and D. Laxton (2004), "The Effects of Tax Cuts in a Global Fiscal Model", Box 2.2 in *World Economic Outlook*, April, Washington (D.C.), International Monetary Fund.

Botman, D., D. Laxton, D. Muir and A. Romanov (2006), "A New Open Economy Macromodel for Fiscal Policy Evaluation", IMF, Working Paper, No. 06/45, Washington (D.C.), International Monetary Fund.

Buiter, W.H. (1981), "Time Preference and International Lending and Borrowing in an Overlapping-Generations Model", *Journal of Political Economy*, Vol. 89, pp. 769-97.

Caselli, P. (2001), "Fiscal Consolidation Under Fixed Exchange Rates", *European Economic Review*, Vol. 45, pp. 425-50.

Corsetti, G. and P. Pesenti (2001), "Welfare and Macroeconomic Interdependence", *Quarterly Journal of Economics*, Vol. 116, pp. 421-45.

Erceg, C.J., L. Guerrieri and C. Gust (2005), "Expansionary Fiscal Shocks and the Trade Deficit", International Finance Discussion Paper, No. 825, Washington (D.C.), Board of Governors of the Federal Reserve System, International Finance Division.

Faruqee, H., D. Laxton and S. Symansky (1997), "Government Debt, Life-Cycle Income and Liquidity Constraints: Beyond Approximate Ricardian Equivalence", IMF, Staff Papers, Vol. 44, pp. 374-82, September.

Faruqee, H. and D. Laxton (2000), "Life-Cycles, Dynasties, Saving: Implications for Closed and Small Open Economies", IMF, Working Paper, No. 00/126, Washington (D.C.), International Monetary Fund.

Fatás, A. and I. Mihov (2001), "The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence", unpublished, INSEAD.

Ford, R. and D. Laxton (1999), "World Public Debt and Real Interest Rates", *Oxford Review of Economic Policy*, Vol. 15, pp. 77-94.

Frenkel, J.A. and A. Razin (1992), *Fiscal Policies and the World Economy*, Cambridge (Mass.), MIT Press, 2nd edition.

Galí, J., J. David López-Salido and J. Vallés (2005), "Understanding the Effects of Government Spending on Consumption", unpublished, CREI.

Ganelli, G. (2003a), "Useful Government Spending, Direct Crowding-Out and Fiscal Policy Interdependence", *Journal of International Money and Finance*, Vol. 22, pp. 87-103.

—————— (2003b), "The New Open Economy Macroeconomics of Government Debt", *Journal of International Economics*, Vol. 65, pp. 167-84.

Ghironi, F., T.B. Iscan and A. Rebucci (2005), "Net Foreign Asset Positions and Consumption Dynamics in the International Economy", IMF, Working Paper, No. 05/82, Washington (D.C.), International Monetary Fund.

Ghironi, F. (2003a), "Macroeconomic Interdependence Under Incomplete Markets", mimeo, Boston College.

—————— (2003b), "Understanding Macroeconomic Interdependence: Do We Really Need to Shut Off the Current Account?", mimeo, Boston College.

Kumhof, M., D. Laxton and D. Muir (2005), "Consequences of Fiscal Consolidation for the U.S. Current Account", in *United States – Selected Issues*, IMF, Country Report, No. 05/258, Washington (D.C.), International Monetary Fund.

Lane, P.R. and G.M. Milesi-Ferretti (2002), "Long-Term Capital Movements", in B. Bernanke and K. Rogoff (eds.), *NBER Macroeconomics Annual 2001*, Cambridge (Mass.), MIT Press.

Laxton, D., P. Isard, H. Faruqee, E. Prasad and B. Turtleboom (1998), "MULTIMOD Mark III: The Core Dynamic and Steady-State Models", IMF, Occasional Paper, No. 164, Washington (D.C.), International Monetary Fund.

Laxton, D. and P. Pesenti (2003), "Monetary Rules for Small, Open, Emerging Economies", *Journal of Monetary Economics*, Vol. 50, No. 5, pp. 1109-52.

McKibbin, W.J. and J.D. Sachs (1991), *Global Linkages: Macroeconomic Interdependence and Cooperation in the World Economy,* Washington (D.C.), Brookings Institution.

Obstfeld, M. and K. Rogoff (1995), "Exchange Rate Dynamics Redux", *Journal of Political Economy*, Vol. 103, pp. 624-60.

——————— (1996), *Foundations of International Macroeconomics*, Cambridge (Mass.), MIT Press.

Patterson, K. and B. Pesaran (1992), "Intertemporal Elasticity of Substitution in Consumption in the United States and the United Kingdom", *Review of Economics and Statistics*, Vol. 74, pp. 573-84.

Perotti, R. (2004), "Estimating the Effects of Fiscal Policy in OECD Countries, IGIER, Working Paper.

Weil, P. (1989), "Overlapping Families of Infinitely-Lives Agents", *Journal of Public Economics*, Vol. 38, pp. 183-98.

AN EMPIRICAL INVESTIGATION OF FISCAL POLICY IN NEW ZEALAND

Iris Claus,[*] Aaron Gill,[*] Boram Lee and Nathan McLellan[*]

1. Introduction

This paper examines the effects of fiscal policy, as measured by government spending and net tax, on New Zealand GDP. The focus is on the temporary, business cycle effects of fiscal policy on GDP.[1] The work provides a basis for evaluating the impact of fiscal policy on New Zealand GDP, thereby complementing existing fiscal indicators, such as the cyclically-adjusted fiscal balance and other measures of fiscal impulse. This paper also furthers previous work examining the sources of fluctuations in New Zealand GDP (Buckle, Kim, Kirkham, McLellan and Sharma, 2002; Buckle, Kim and McLellan, 2003) by analysing the contribution of fiscal policy to New Zealand business cycles.

Different approaches have been used to measure the effects of fiscal policy on key economic aggregates, like GDP, inflation and interest and exchange rates. One approach is to simulate fiscal policy changes using large-scale structural macroeconomic model. An alternative approach is to estimate smaller empirical models, such as vector autoregression (VAR) models to assess the effects of changes in fiscal policy on the economy. A variety of techniques have been used to identify the effects of fiscal policy using these smaller empirical models. For example, Blinder (1981) and Ramey and Shapiro (1998) examine the effects of fiscal policy on the United States economy by identifying particular fiscal episodes or events, such as the temporary income tax reductions in 1968 and 1975 or increases in defence spending associated with the military build-up during the Korean and Vietnam wars. Blanchard and Perotti (2002) and Perotti (2004), who examine fiscal policy in the United States and a selection of OECD economies, use a structural VAR model to measure the dynamic impact of fiscal shocks to output.

---

* New Zealand Treasury, P.O. Box 3724, Wellington – New Zealand.
Tel. ++64-4-472 2733. Website: www.treasury.govt.nz; E-mail: information@treasury.govt.nz
Iris Claus: E-mail: Iris.Claus@treasury.govt.nz, Tel. ++64-4-471-5221.
Aaron Gill: E-mail: Aaron.Gill@treasury.govt.nz, Tel. ++64-4-917-6261.
Nathan McLellan: E-mail: Nathan.McLellan@treasury.govt.nz, Tel. ++64-4-471-5130.

We would like to thank Bob Buckle, Dasha Leonova and Kam Szeto for useful comments and suggestions.

[1] Fiscal policy also has important long-run economic effects. For a discussion of the long-run economic effects of fiscal policy see Kneller, Bleaney and Gemmell (1999).

Their innovation is to use institutional information on the tax and transfer system to identify the effects of fiscal policy shocks on output.

This paper builds on Blanchard and Perotti (2002). It replicates Blanchard and Perotti's three-variable vector autoregression (VAR) model, which was originally estimated using United States data, for New Zealand. The model, which includes gross domestic product (GDP), net tax (*i.e.* tax revenue less transfer payments) and government spending, is then used to examine the effects of changes in net tax and government spending and their historical contributions of fiscal policy to New Zealand business cycles. Blanchard and Perotti's model is also extended by examining the separate impact of taxes and government transfers.

The remainder of the paper is organised as follows. Section 2 outlines the model and data. Section 3 discusses the instantaneous (contemporaneous) dynamic effects of shocks in both net tax and government spending. Section 4 reports sensitivity analysis, robustness testing, and compares the New Zealand results to that from other models and economies. The historical contributions of net tax to New Zealand business cycles are examined in Section 5. Key conclusions are discussed in Section 6.

2. Model and data

This section outlines the modelling framework used to assess the impact of fiscal policy on New Zealand output. The framework of analysis is a structural vector autoregression (VAR) model, employing estimation and identification techniques used by Blanchard and Perotti (2002). This section derives the fiscal VAR model and the restrictions used to identify the effects of net tax and government spending on gross domestic product (GDP). It describes the fiscal and economic data and discusses their time series properties and trend specification.

2.1 Fiscal VAR and identification

The fiscal VAR model is described by a system of reduced-form equations. Ignoring constant terms, it is given by:

$$A(L)y_t = \varepsilon_t \tag{1}$$

where $A(L)$ is a p^{th} order matrix polynomial in the lag operator L, such that $A(L)_t = I - A_1L - A_2L^2 - ... - A_pL^p$. Throughout, p is set equal to four as quarterly data are used in the analysis.[2] In this model, $y_t \equiv [T_t, G_t, Z_t]'$ is a three-dimensional vector in the logarithms of quarterly net tax (government tax revenue less transfers payments), government spending and GDP, although our extension of this model also disaggregates net tax into taxes and government transfers. Each variable is expressed in real per capita terms, where all nominal variables are deflated using the GDP deflator. $\varepsilon_t \equiv [\varepsilon_t^T, \varepsilon_t^G, \varepsilon_t^Z]'$ is the vector of reduced form residuals for net tax, government spending and GDP respectively. The reduced form residuals are unexpected movements in net tax, government spending and GDP and are composite errors of the shocks to the economy.

To gauge the impact of fiscal policy on GDP, restrictions need to be imposed on the reduced form errors. To derive the identification scheme adopted in this paper, write:

$$\varepsilon_t^T = a_1\varepsilon_t^Z + a_2u_t^G + u_t^T \quad (2)$$

$$\varepsilon_t^G = b_1\varepsilon_t^Z + b_2u_t^T + u_t^G \quad (3)$$

$$\varepsilon_t^Z = c_1\varepsilon_t^T + c_2\varepsilon_t^G + u_t^Z \quad (4)$$

where u_t^T, u_t^G, and u_t^Z are the mutually uncorrelated structural residuals for net tax, government spending and GDP. These structural shocks need to be recovered to identify the impact of net tax and government spending on GDP.

Equation (2) shows that unexpected movements in net tax are a function of unexpected movements in GDP and structural shocks to government spending and net tax. Equation (3) states that unexpected movements in government spending are also owing to unexpected movements in GDP and structural shocks in net tax and government spending. Finally, equation (4) states that unexpected movements in GDP are related to unexpected movements in net tax and government spending and structural shocks to GDP.

The key challenge is to estimate the parameters of equations (2) to (4). This is done using the identification procedures developed by Blanchard and Perotti (2002) and Perotti (2004) for the purpose of evaluating the effects of fiscal policy on GDP for the United States and a group of OECD economies.

---

2 In the specification of the VAR model used by Blanchard and Perotti to estimate the impact of fiscal policy on United States GDP, seasonal dummy variables are interacted with per capita GDP, net tax and government spending to account for seasonal patterns in net tax. This specification made little difference to New Zealand results, therefore a simpler VAR specification is adopted that excludes interact seasonal dummy variables.

Contemporaneous changes in net tax and government spending in response to GDP movements could potentially occur for two reasons. First, net tax and government spending may automatically change in response to GDP movements under existing fiscal policy settings. Second, the government may discretionarily vary net tax and spending in response to movements in GDP by changing fiscal policy settings. However, as noted by Blanchard and Perotti (2002), the use of quarterly data virtually eliminates the operation of the second channel owing to recognition and implementation lags with regards to discretionary fiscal policy. Therefore, a_1 and b_1 can be obtained from independent estimates of elasticities of net tax and government spending to output.

Girouard and André (2005) provide estimates of output elasticities for direct taxes on individuals, corporate income taxes, and indirect taxes for a number of OECD countries. They estimated New Zealand tax to output elasticities using annual data for the period 1989 to 2003. Based on these estimates a_1 is set equal to one. This means that a one percentage point increase in GPD leads to a one percentage point increase in taxes. Following Blanchard and Perotti (2002) and Perotti (2004) it is assumed that government spending does not automatically respond to unexpected movements in GDP, therefore b_1 is set equal to zero.

Estimates for a_1 and b_1 provide the basis for estimating the parameters c_1 and c_2 of equation (4). Following Blanchard and Perotti (2002), cyclically-adjusted reduced form net tax and government spending residuals are used as instrumental variables to estimate c_1 and c_2. The cyclically-adjusted net tax ($\varepsilon_t^{T^*}$) and government spending ($\varepsilon_t^{G^*}$) reduced form residuals are calculated as $\varepsilon_t^{T^*} = \varepsilon_t^T - a_1\varepsilon_t^Z = \varepsilon_t^T - \varepsilon_t^Z$ and $\varepsilon_t^{G^*} = \varepsilon_t^G - b_1\varepsilon_t^Z = \varepsilon_t^G$. The cyclically-adjusted reduced form residuals $\varepsilon_t^{T^*}$ and $\varepsilon_t^{G^*}$ can be used as instruments as they are not correlated with the structural net tax shock u_t^T.

Finally, estimates are required for a_2 and b_2. As noted by Blanchard and Perotti (2002), it is difficult to determine the ordering of government net tax and spending decisions. Do governments make a decision to tax first and then spend, or do they spend and then tax? In the baseline model net tax is ordered before government spending. But because there is no clear answer to the question, the reverse ordering is considered in the sensitivity analysis in Section 4. When net tax is ordered before government spending $a_2 = 0$ and b_2 is estimated. When government spending is ordered before net tax $b_2 = 0$ and a_2 is estimated. As is discussed in Section 4, in practice this issue is of little consequence because the dynamic response of GDP to both net tax and government spending shocks is basically invariant to the ordering of net tax and government spending.

2.2 Data

To estimate the fiscal VAR for New Zealand at least three variables are required: net tax (*i.e.* government tax revenue less transfer payments), government spending (purchases of goods and services), and GDP. GDP is measured by Statistics New Zealand's real production GDP series. The net tax variable is the sum of direct and indirect taxes less total transfer payments. Government spending includes both current (consumption) and capital (investment) spending. All data enter the model in real per capita, seasonally adjusted terms. Fiscal data are deflated using the implicit GDP deflator. The real per capita data are plotted in Figure 1.

Quarterly aggregate data are collated for all variables from June 1982. All fiscal series cover central government with the exception of government investment, which also includes local government, because a central government investment series is unavailable. The purchase of frigates in 1997 and 1999 are removed from both the purchases of government goods and services and the goods and services tax (GST) series.

Quarterly fiscal data were constructed using two data sources: Statistics New Zealand National Accounts Data and the New Zealand Crown Accounts (and their supporting financial data). Data on government purchases of goods and services (both current and capital) were drawn from the National Account (1993) expenditure GDP series for the period June 1982 to date, and were backdated to June 1982 using the National Accounts (1968) expenditure GDP series.

For direct taxes (source deductions and gross companies tax payments), data are available on a quarterly basis from June 1982. These series account for in excess of 73 percent of annual total tax receipts prior to the introduction of GST in December 1986, and in excess of 86 percent thereafter. Where quarterly data at a disaggregate level are unavailable (between June 1982 and June 1987), quarterly data are estimated by allocating the annual figures in the crown financial statements over the quarters based on the distribution of receipts in the later period (post June 1987). Total tax receipts and the sum of direct and indirect tax have been reconciled back to the crown financial statements from 1983/84 to 1990/91. In 1991/92 the crown accounts moved from a cash basis to accruals basis. Due to GST and source deductions being on a cash basis, our cash receipts figures no longer reconcile back to the Crown Financial Statements. However, the variance between the calculated total tax receipts and the crown financial statements is small, with the average error being around 1.4 percent. Prior to 1994 transfer payments data are available on a less frequent basis. Based on the known relative quarterly allocations, the quarterly transfer payments data can be constructed.[3]

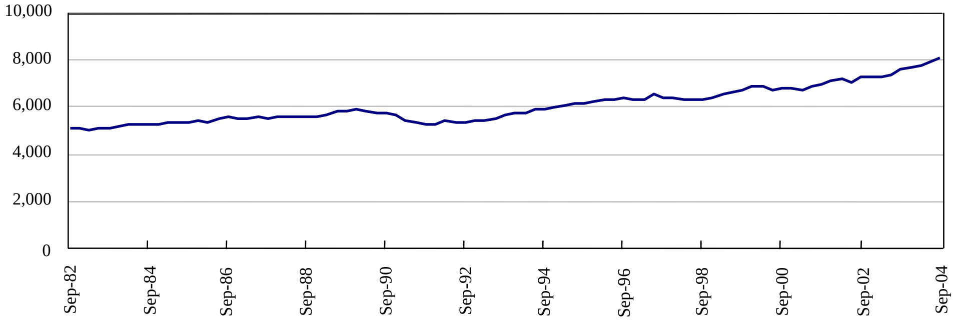
---

[3] The variance in the quarterly government transfer series is small (observed from the later period), with the total average quarterly transfer ranging from 24.5 percent to 25.5 percent of the total annual transfers.

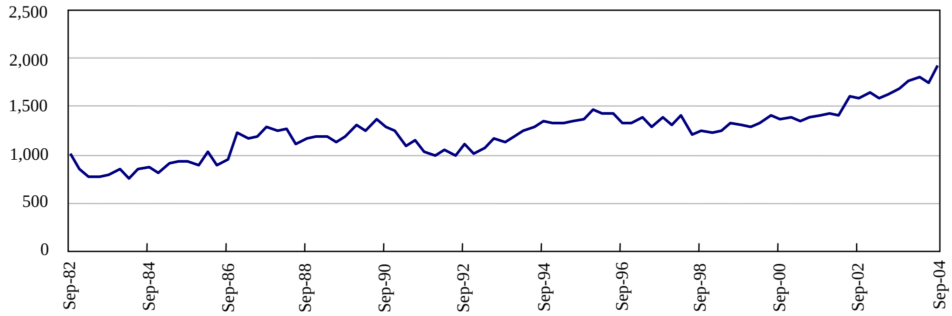
Figure 1

Variables Used in the Estimation of the Fiscal VAR
(dollars)

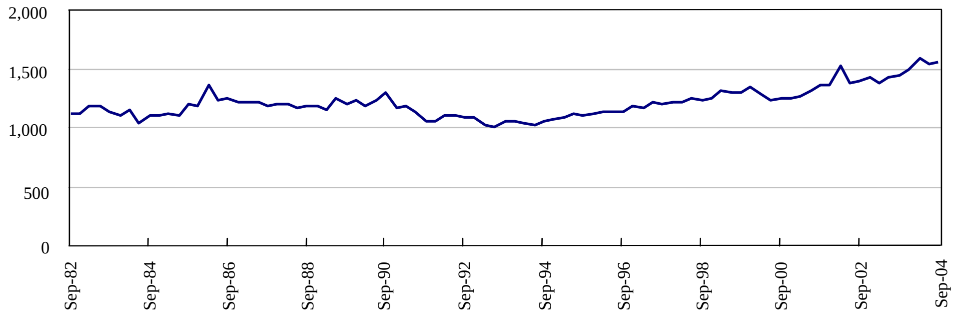
Real Quarterly GDP Per Capita



Real Quarterly Tax Less Transfers Per Capita



Real Quarterly Government Spending Per Capita



2.3 Time series properties of the data and trend specification

Figure 1 shows that per capita real GDP, net tax and government spending have grown over time. To account for the upward trend in the data structural VAR models are often specified to identify shocks that move variables temporarily away from their long-run paths. Structural VARs in this tradition include Sims (1980), Bernanke and Blinder (1992) and Dungey and Pagan (2000). This modelling approach is also adopted by Buckle, Kim, Kirkham, McLellan and Sharma (2002) for their structural VAR model of the New Zealand economy. It is also the modelling approach followed by Blanchard and Perotti (2002) and in this paper.

Blanchard and Perotti (2002) adopt two trend specifications for their United States fiscal VAR: one allowing for deterministic time trends in the data and the other allowing for stochastic trends. The deterministic specification includes time and time squared as additional regressors on the logarithms of per capita net tax, government spending and GDP. The assumption here is that variables grow along long-run equilibrium paths that are a function of time. The stochastic specification is estimated using the first differences of the logarithms of net tax, government spending, and GDP less a changing mean that is calculated as the geometric average of past first differences with a decay parameter set equal to 0.025 per quarter.[4] The stochastic specification allows for persistent shocks to variables' long-run equilibrium paths. Variables that exhibit persistent shocks (upward or downward movements) are said to be non-stationary.

One way to assess the appropriateness of the deterministic versus stochastic trend specification is to test whether time series are stationary. A test of stationarity is the unit root test. Appendix 1 reports the results for the augmented Dickey and Fuller (Said and Dickey, 1984) unit root test. The results provide evidence that the level of per capita net tax, government spending, and GDP are non-stationary, suggesting the stochastic specification may be more appropriate. Therefore, in the sensitivity analysis in Section 4 two alternative stochastic trend specifications are considered. First, net tax, government spending and GDP are first differenced. Second, the data are detrended by removing time varying stochastic trends using the Hodrick and Prescott (1997) filter. The second alternative specification is consistent with previous work that examines the impact of international and domestic shocks on the New Zealand economy using structural VAR methodology (Buckle *et al.*, 2002 and Buckle, Kim and McLellan, 2003).

---

4 Blanchard and Perotti (2002) note that varying the decay parameter used to calculate the geometric average does not change their results for the United States.

3. Effects of fiscal policy

This section replicates Blanchard and Perotti's (2002) deterministic and stochastic trend models using New Zealand data. It first examines the instantaneous (contemporaneous) effects of government spending and net tax shocks and then assesses the dynamic effects using impulse response analysis.

3.1 Contemporaneous effects

Table 1 reports the estimated coefficients of the relationships between shocks shown in equations (2) to (4) for both the deterministic and stochastic specifications. Although the parameters a_2, b_2, c_1 and c_2 are elasticities, to aid interpretation, the point estimates in Table 1 have been transformed to derivatives evaluated at their means and, therefore, can be interpreted as the constant dollar change in one variable per constant dollar in another.

The direction of the contemporaneous impact of GDP from both the net tax and government spending shocks are consistent with the predictions of a simple neo-Keynesian model, with limited price flexibility in the short-run. Both the deterministic and stochastic specifications show that the contemporaneous effect of a net tax shock on GDP (c_1) is negative, while the contemporaneous effect of a government spending shock on GDP (c_2) is positive. These estimates also suggest the initial absolute impact of an increase in net tax on GDP is larger than an equivalent increase in government spending.

Table 1

Estimated Contemporaneous Coefficients

	a_2	b_2	c_1	c_2
	Deterministic Specification			
Coefficient	–0.16	–0.06	–0.25	0.14
t-statistic	–0.88	–0.87	–2.23	0.76
	Stochastic Specification			
Coefficient	–0.12	–0.05	–0.25	0.13
t-statistic	–0.68	–0.68	–2.27	0.70

For the deterministic specification, a one dollar increase in net tax immediately reduces GDP by 0.25 dollars. For the stochastic specification, the immediate impact is equal – with a one dollar increase in net tax also reducing GDP by 0.25 dollars in the first quarter.

For a government spending shock, the contemporaneous impact on GDP is also almost the same for the deterministic specification and the stochastic specification. The estimate for c_2 under the deterministic specification shows an increase in government spending by one dollar results in an immediate increase in GDP of 0.14 dollars. For the stochastic specification, the increase in GDP is 0.13 dollars. Note that point estimates for c_1 are statistically significant from zero at the 5 percent significance level. This is not the case for c_2.

Table 1 also suggests the issue of whether net tax or government spending are ordered first is inconsequential. Because the correlation between cyclically-adjusted net tax and government spending shocks is low, the point estimates for a_2 (*i.e.* when net tax are ordered first) and b_2 (*i.e.* when government spending is ordered first) are close to zero. This result is confirmed in the sensitivity analysis in Section 4.

3.2 Dynamic effects

Next, the dynamic effects of fiscal shocks are assessed using impulse response functions, which trace out the response over time of variables to an exogenous shock. Here, the responses of net tax, government spending and GDP to both a discretionary net tax shock and a discretionary government spending shock are considered.

In the deterministic model, variables grow along a long-run equilibrium path and only temporarily deviate from this set path. Impulse responses, which capture these transitory deviations from steady state, therefore eventually converge back to zero. For example, a government spending shock may cause GDP to temporarily move away from its long-run growth path, but eventually GDP returns to the level implied by its long-run growth path. Therefore, if the model is stationary, while shocks may have long-lasting effects they are not permanent.

In the case of the stochastic specification, the interpretation of the impulse responses is somewhat different. Because the endogenous variables are believed to be non-stationary, and are therefore transformed and modelled as first differences less a moving average of past first differences, in contrast to the deterministic specification, fiscal shocks have a permanent impact on the *level* of these variables. This means that the impulse responses do not converge back to zero following a fiscal shock. For example, a government spending shock causes GDP to converge to a new, higher or lower, level.[5]

Figures 2 and 3 show the responses of net tax, government spending and GDP to two fiscal shocks. The first shock is to net tax (Figure 2) and the second shock is to government spending (Figure 3). Both shocks are temporary; that is, net tax and government spending unexpectedly increase by one dollar for one quarter. All impulses are normalised to show the constant dollar shock of the response variables to the respective fiscal shock. Sixty-eight percent symmetric confidence bands, which were computed using 1000 bootstrap simulations, are shown by dotted lines in Figures 2 and 3.[6]

For the deterministic specification, Figure 2 shows the immediate response of a one dollar increase in net tax is to decrease GDP by 0.24 dollars. This negative impact on GDP persists for a couple of quarters, after which it is partly reversed with GDP increasing above trend, before the impact of the net tax shock dissipates. One possible explanation for the increase in GDP, after the decrease in GDP, is that other macroeconomic variables (such as interest and exchange rates) adjust in response to the initial fall in GDP, eventually stimulating the increase in GDP after the first year. To confirm this explanation it would be necessary to include these additional variables within the fiscal VAR model.[7] The response of government spending to the net tax shock is minimal.

For the stochastic specification, Figure 2 shows that in response to a one dollar increase in net tax, GDP falls by almost the same magnitude as in the deterministic specification. This negative impact on GDP persists for a couple of quarters, after which it is temporarily reversed with GDP increasing above trend, before converging to a lower long-run level. Like the corresponding deterministic specification, the response in government spending from the net tax shock is small. The permanent impact on net tax of the initial shock is to increase net tax by around 0.55 dollars per quarter.

For the deterministic specification, a one dollar increase in government spending leads to an immediate 0.14 dollar increase in GDP (see Figure 3). This

---

5 To aid comparison of the deterministic and stochastic specifications of the fiscal VAR, the impulse response show the constant dollar responses for a fiscal policy shock. For the stochastic specification, where the endogenous variables are modelled as first differences less a moving average of first differences, this requires the impulses to be accumulated to make them comparable with the deterministic specification.

6 For each simulation, random draws (with replacement) are taken from the series of estimated residuals and used to form synthetic data for each endogenous variable. The VAR model is then re-estimated and impulse response functions are computed. When the 1000 simulations are completed, the standard deviation of the impulse response is calculated at each time horizon.

7 The inclusion of additional variables is left for future work.

positive effect persists for around one year, before the impact of the government spending shock on GDP becomes negative. Net tax also increases in response to the government spending shock. Note, however, that while net tax immediately increases by around 0.03 dollars, the peak response occurs after about a year and a half. This most likely reflects lags in the collection of tax revenue and the lagged impact of changes in GDP on the labour market (and hence transfer payments like unemployment benefits). The initial increase in government spending persists for over two years, although the stimulus reduces from the initial one dollar increase in the first quarter to around 0.36 dollars by the second quarter.

For the stochastic specification, the initial one dollar shock to government spending has a permanent positive impact on itself, net tax and GDP. The immediate one dollar increase in government spending diminishes over the first year, eventually resulting in a permanent 0.67 dollar increase in government spending per quarter. The peak response in output occurs during the first year, eventually leading to a permanent increase in GDP of around 0.26 dollars. Net tax permanently increases by around 0.04 dollars.

Results reported in this section show that for both the deterministic and stochastic specifications an increase in government spending leads to an increase in GDP. In the case of the deterministic specification, the positive stimulus to GDP lasts just over one year. For the stochastic specification, the government shock results in a permanent increase in the level of GDP.

To assess the individual effects of tax revenue and transfer payments we re-estimate the stochastic model by splitting net tax into tax revenue and transfer payments. The fiscal VAR now includes four variables; GDP, government spending, tax revenue and transfer payments.

Figure 4 shows the impulse responses of GDP, government spending, tax revenue and transfer payments to a government spending, tax revenue and transfer payments shock, respectively. The results show that following a tax revenue shock, GDP declines and remains at a lower level. But the decline is small. In contrast, following a rise in transfer payments GDP initially rises and then falls. Moreover, GDP falls by more following the rise in transfer payments than it falls following the increase in tax revenue.

The finding of a negative effect of tax revenue on output is in line with recent international literature that finds distortionary taxes have a negative long-run impact on economic growth (e.g. Widmalm, 2001, Padovano and Galli, 2002, and Li and Sarte, 2004). The result of a negative effect on output of an increase in transfer payments, on the other hand, is supportive of the empirical finding that transfer payments are unproductive government spending (e.g. Kneller, Bleaney and Gemmell, 1999, and Bleaney, Gemmell and Kneller, 2001). Increased transfer payments may reduce economic growth because of adverse labour supply incentives, for example.

Figure 2

Responses to a Net Tax Shock

Deterministic Specification **Stochastic Specification**

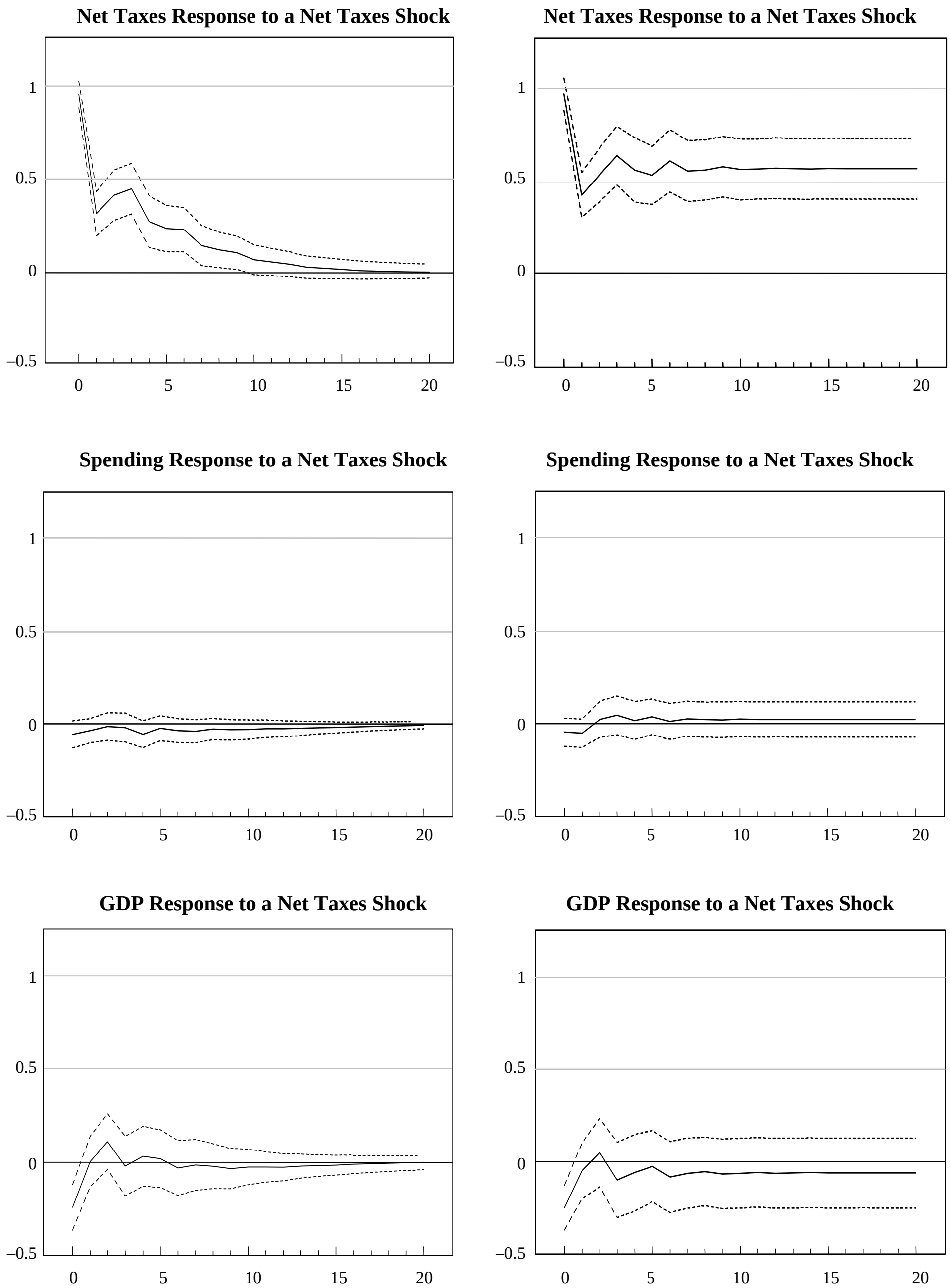


Figure 3

Responses to a Government Spending Shock

Deterministic Specification **Stochastic Specification**

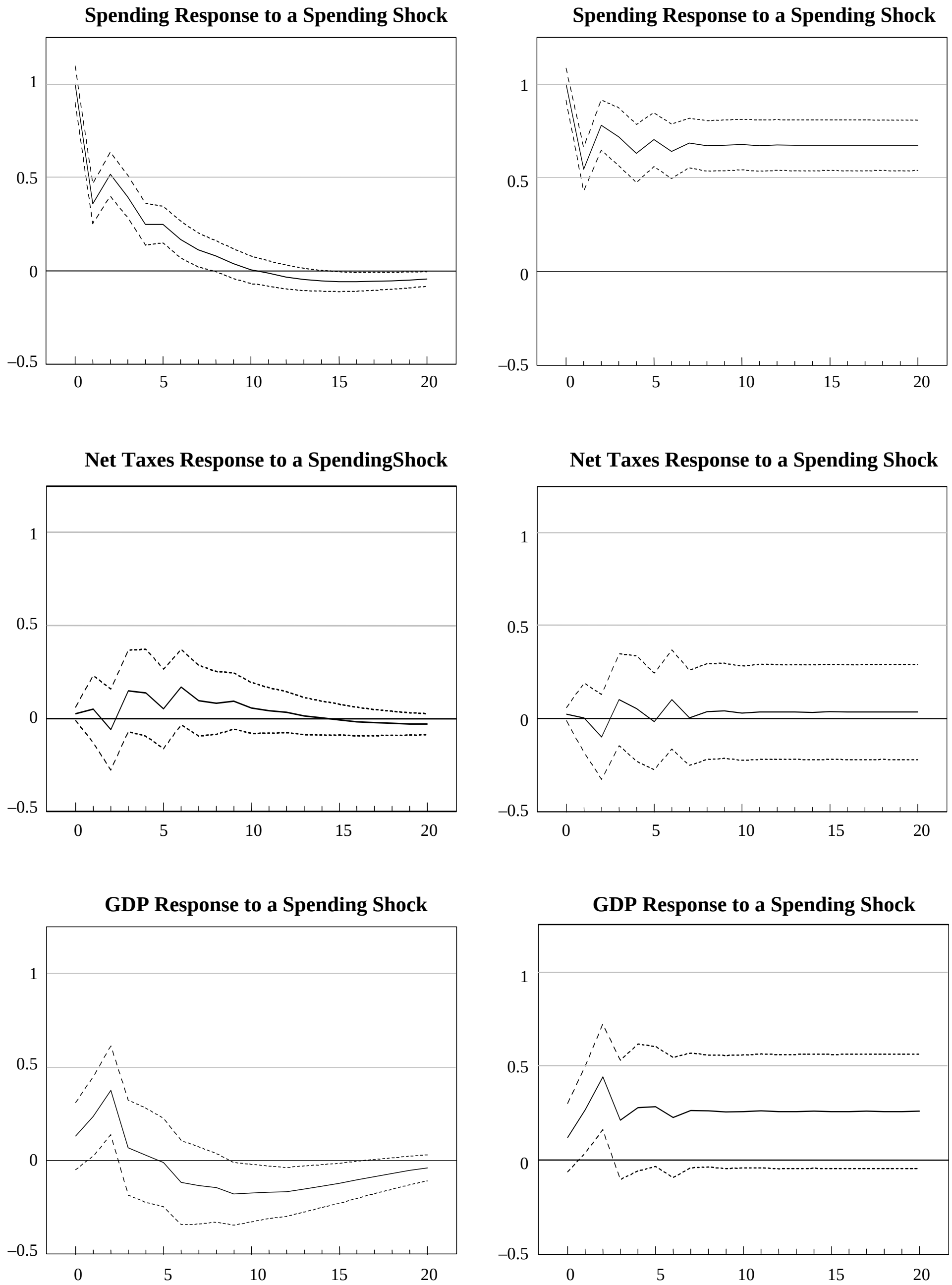
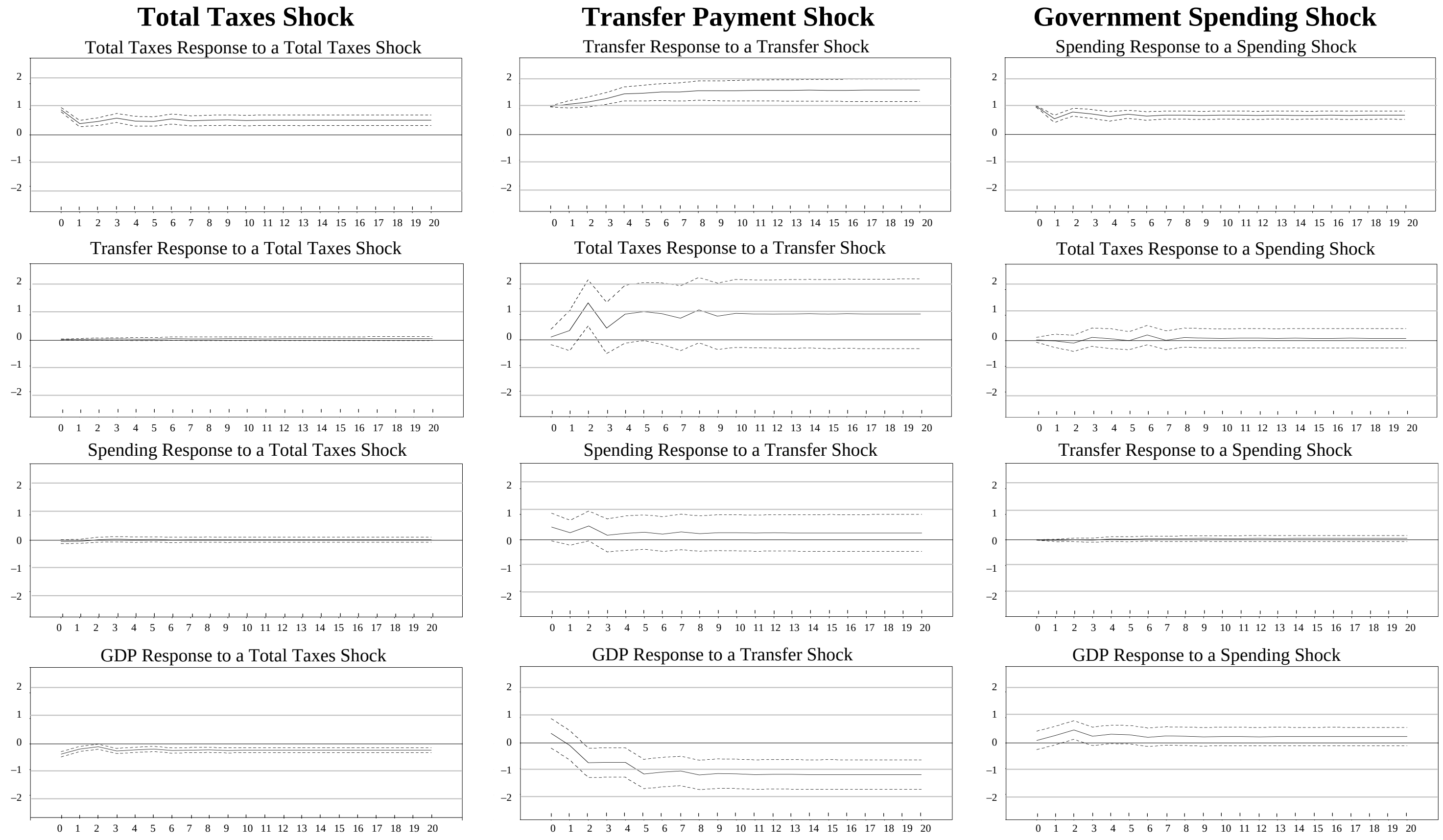


Figure 4

Four Variable VAR for the Stochastic Specification



4. Sensitivity analysis

This section reports some sensitivity analysis of the baseline three variable fiscal VAR. To test the robustness of the results, we estimate two alternative fiscal VAR models. We then provide diagnostic tests and consider alternative ordering of variables and elasticities for the baseline model. We also compare the New Zealand results to that from other models and economies.

4.1 Alternative specifications

Unit root tests discussed in Section 2 suggest that net tax, government spending, and GDP are non-stationary and that the stochastic specification may be more appropriate than the deterministic model. This section considers two alternative stochastic trend specifications. First, net tax, government spending and GDP are included in first differences. Second, the data are detrended by removing time varying stochastic trends using the Hodrik-Prescott filter.

The parameter estimates of the contemporaneous relationships shown in equations (2) to (4) for the first difference and Hodrick-Prescott trend specification of the fiscal VAR are reported in TABLE 2. As with the baseline deterministic and stochastic specifications, the tax to output elasticity (a_1) is set equal to one and the government spending to output elasticity (b_1) is set equal to zero.

A comparison of the estimated contemporaneous coefficients from the baseline deterministic and stochastic models (Table 1) with the estimates from the two alternative specifications (Table 2) shows broadly similar results. The contemporaneous effect of a net tax shock on GDP (c_1) is negative, while the

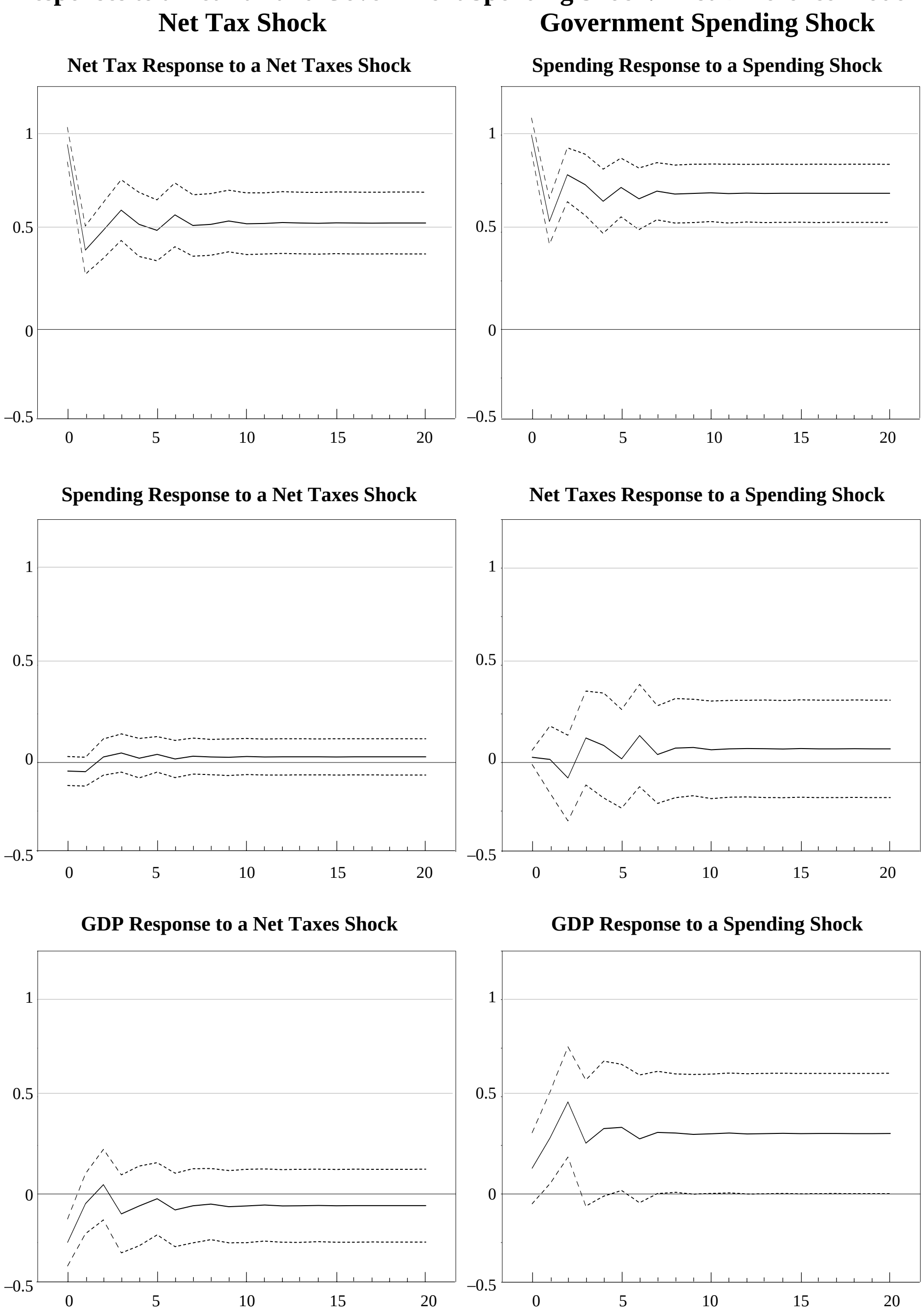
Table 2

Estimated Contemporaneous Coefficients: Alternative Model Specifications

	a_2	b_2	c_1	c_2
	First Difference Specification			
Coefficient	–0.12	–0.04	–0.26	0.14
t-statistic	–0.64	–0.64	–2.27	0.78
	Hodrick–Prescott Specification			
Coefficient	–0.06	–0.02	–0.21	0.03
t-statistic	–0.32	–0.32	–1.89	0.16

Figure 5

Responses to a Net Tax and Government Spending Shock: First Difference Model



contemporaneous effect of a government spending shock on GDP (c_2) is positive. The coefficient estimates for the first difference model are almost identical to the estimates from the baseline stochastic model. For the Hodrick-Prescott specification, the estimate for c_1 is slightly smaller than for the first difference, deterministic and stochastic specifications and the estimate for c_2 is smaller than for the other models.

The impulse responses of net tax, government spending and GDP to a one dollar net tax and government spending shock are plotted in Figure 5 for the first difference model and in Figure 6 for the Hodrick-Prescott specification. Figure 5 shows that the impulse responses of the first difference and baseline stochastic trend model are virtually identical.

For the Hodrick-Prescott specification, Figure 6 shows that the fiscal shocks lead to temporary deviations of variables from their long-run time varying trend (as measured by the Hodrick-Prescott filter) but eventually the impulse responses converge back to zero, as is the case for the deterministic model. For the Hodrick-Prescott specification, the reduction in GDP caused by the net tax shock persists for around two quarters, before the economy experiences a period where GDP is above trend. As suggested earlier, this period where GDP increases above its long-run path could be owing to the influence of other macroeconomic variables (such as interest and exchange rates) that change in response to the initial net tax shock. The decline in GDP may also cause the small decrease in government spending. Following the net tax shock, government spending initially declines (as in the case of the deterministic, stochastic and first difference specifications). This result is further discussed in Section 4.3.

One noticeable difference is that the government spending shock is less persistent for the Hodrick-Prescott specification than the deterministic model. The one dollar government spending shock dissipates over the first year. The positive effect on GDP from the government spending shock lasts for less than one year, before the economy experiences a period where GDP falls below its trend path. The impact of the government spending shock on net tax is broadly similar to the deterministic specification.

4.2 Diagnostic tests

To assess the stability of parameter estimates, Hansen's (1992) stability test can be used. A key advantage of this test is that it does not require selecting potential structural break points. Moreover, no special treatment of lagged dependent variables is required (Hansen, 1992). However, the test requires variables to be stationary.

The Hansen stability test produces two types of statistic: a joint test statistic and individual test statistics. Individual test statistics represent the stability of each parameter in the reduced-form equations in (1), while the joint test assesses the stability of all the parameters jointly in each of the equations in (1). The null hypothesis of stable estimates is rejected if the individual or joint test statistics are significant, *i.e.* the *p*-values are low. The results for the baseline and alternative models, which are reported in Appendix 2, show that, overall, the parameter estimates are fairly stable for both the individual and joint tests. Although some parameters are unstable individually, they appear to be stable jointly over time.

To test for model stability we verify the stationary condition of the fiscal VAR models. This formally tests that the impulse responses converge following a fiscal shock. We compute the value of root from the eigenvalues of the companion matrix derived from the parameter estimates. A value of root of greater than one indicates that a model is systematically unstable. The results, also reported in Appendix 2, show that the baseline and alternative models are stationary. The values of roots are less than one although they are larger for the deterministic and Hodrick-Prescott models compared to the stochastic trend and first difference models.

To detect possible misspecification of the models we test that the residuals from the reduced-form equations in (1) are normally distributed using Jarque and Bera's (1987) test of normality. The results, reported in Appendix 3, show that the equations have normally distributed errors except for the government expenditure equation in the deterministic and the Hodrick-Prescott model.

We also use Ramsey's (1969) RESET test of specification error to determine possible misspecification of the models. The RESET test allows assessing the linearity assumption in the reduced-form equations in (1). The results, also reported in Appendix 3, show that the hypothesis of model misspecification is rejected for all equations except for the deterministic model. This finding and the results from the normality tests strongly suggest that the deterministic model does not fit the New Zealand data well. The finding is in line with the unit root tests, which suggest that a model specification that assumes non-stationary variables is more appropriate for New Zealand.

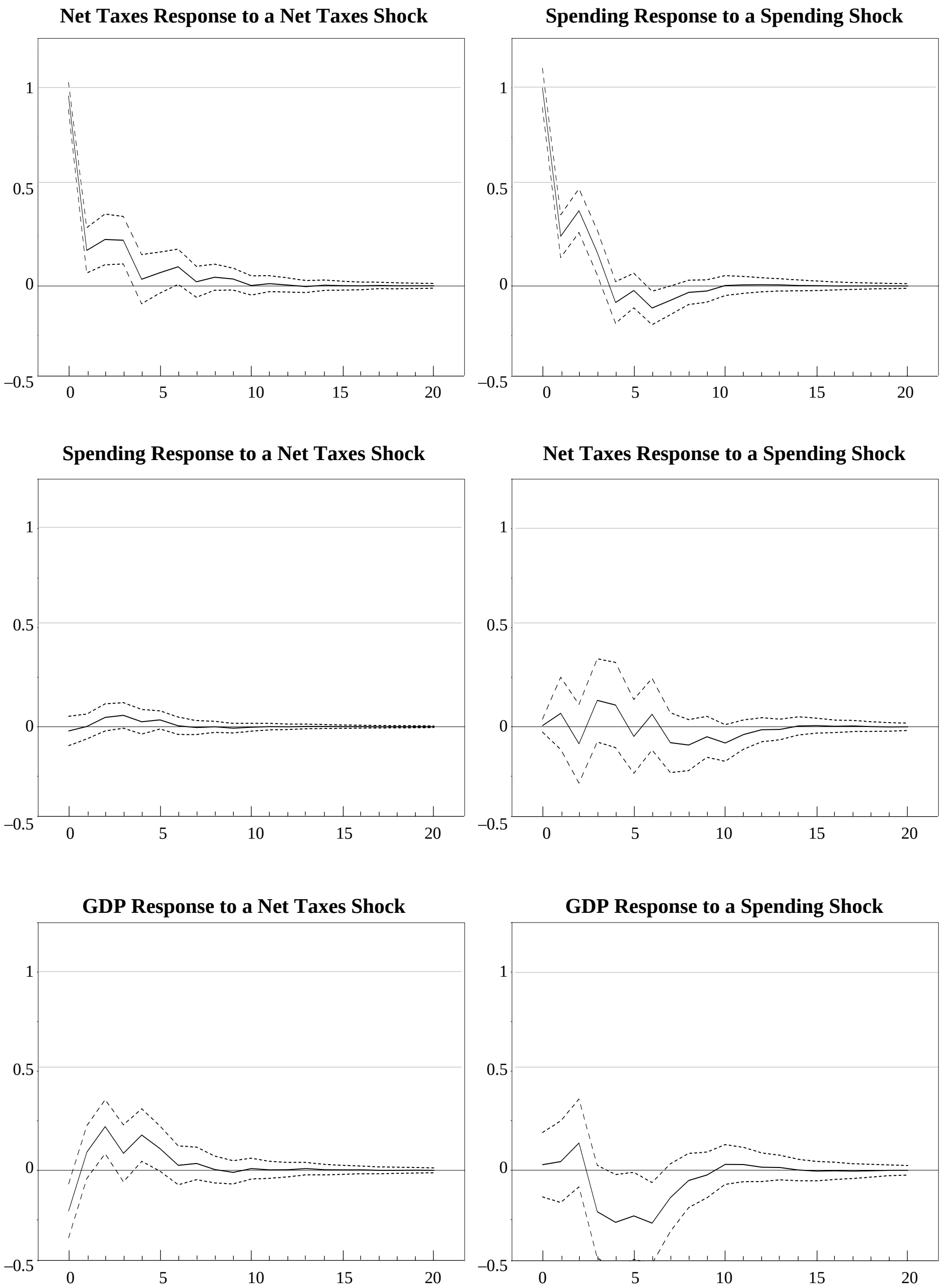
4.3 Alternative ordering of variables and elasticities

In the baseline model, net tax is ordered before government spending. To assess the sensitivity of the impulse responses the ordering is reversed and government spending is placed before net tax. The results, which are plotted in Appendix 4, show that the impulse responses from the alternative ordering are similar. For the stochastic and first difference models, there is only a minor difference that the immediate response of each fiscal variable from the shock to the other fiscal variable is somewhat larger when net tax are ordered first.

Figure 6

Responses to a Net Tax and Government Spending Shock: Hodrick-Prescott Specification

Net Tax Shock **Government Spending Shock**



For the Hodrick-Prescott specification, there are small differences in the immediate response of net tax to a government spending shock, and the immediate response of government spending to a net tax shock. With the alternative ordering, where government spending is placed before net tax, government spending no longer declines following a net tax shock. Moreover, with the alternative ordering net tax immediately declines in response to an increase in government spending. The opposite occurs with the baseline Hodrick-Prescott specification.

To test the sensitivity of the fiscal VAR to the tax-output elasticity, two alternative elasticities of 0.5 and 1.5 are used instead of 1. The tax-output elasticity is a key variable in forming the cyclically-adjusted net tax residuals that are used as instrumental variables to estimate the contemporaneous effect of a change in net tax on output. The impulse responses with the alternative elasticities are plotted in Appendix 5 for the stochastic, first difference and Hodrick-Prescott models. The results show that the impact of increasing the tax-output elasticity from 1 to 1.5 is to marginally increase the impact that a net tax shock has on output for all three models. The result of decreasing the tax-output elasticity from 1 to 0.5 is to reduce the negative impact on GDP over the short term of the net tax shock. Overall, despite substantial changes in the tax-output elasticity, the responses of GDP to the net tax shock are similar.

4.4 Comparison with other models and economies

Finally, we compare the New Zealand results to that from other models and economies. Table 3 summarises the fiscal multipliers estimated from the New Zealand VAR and prior work by Blanchard and Perotti (2002), and Perotti (2004). Contemporaneous, peak and long term responses are reported.[8]

While there is considerable variation between economies in the contemporaneous responses of GDP to fiscal shocks, they are generally positive for government spending and negative for a net tax shock. However, in absolute terms the impact of a government spending shock on GDP tends to be larger than a net tax shock. The peak and long-term responses of GDP to government spending shocks differ substantially across economies, being positive in some countries and negative in others. Results for the United States suggest that the peak and long-term government spending multipliers are sensitive to the time period and whether or not inflation and the 10 year nominal interest rate are included in the VAR model. The peak and long-term tax multipliers are generally negative, although again there is considerably variation across economies.

[8] Although Perotti's (2004) estimates of the fiscal response are over a similar time period as for New Zealand the model specification is different as it includes inflation and a 10-year nominal interest rate. For this reason we re-estimate the fiscal response for Blanchard and Perotti (2002).

Table 3

GDP Response to a Government Spending and Net Tax Shock

Study	Country	Sample	Trend	Spending Response of GDP			Net Tax Response of GDP		
				Impact	Peak**	Long-term*	Impact	Peak**	Long-term*
Blanchard and	United States	1960-1997	DT	0.84	1.29 (15)	0.97	–0.69	–0.78 (5)	–0.22
Perotti (2002)		1960-1997	ST	0.90	0.90 (1)	0.66	–0.70	–1.33 (7)	–1.29
Re-estimated		1974-1997	DT	2.39	2.47 (2)	0.30	–1.04	–1.04 (1)	–0.06
		1974-1997	ST	1.23	1.23 (1)	0.44	–0.80	–1.11 (8)	–1.04
Perotti (2004)***	United States	1980-2000	DT	0.60	–0.60 (1)	–0.10	–0.25	–0.90 (8)	–0.15
	Germany	1980-2000	DT	0.60	–1.70 (1)	–0.20	–0.20	–0.50 (13)	0.25
	United Kingdom	1980-2000	DT	–0.05	–0.50 (4)	–0.45	–0.05	–0.35 (7)	0.05
	Canada	1980-2000	DT	0.05	–1.70 (1)	–0.80	0.10	0.80 (6)	0.30
	Australia	1980-2000	DT	0.30	0.40 (14)	0.20	–0.30	–0.50 (6)	–0.05
Claus, Gill, Lee and	New Zealand	1982-2004	DT	0.13	0.37 (3)	0.00	–0.24	–0.24 (1)	0.00
McLellan (2005)		1982-2004	ST	0.12	0.44 (3)	0.26	–0.25	–0.25 (1)	–0.06
		1982-2004	FD	0.13	0.47 (3)	0.31	–0.25	–0.25 (1)	–0.06
		1982-2004	HP	0.03	–0.26 (5)	0.00	–0.20	0.22 (3)	0.00

* Long-term is taken to be after 20 quarters.
** Peak is the largest absolute deviation from zero.
*** Model includes 5 variables: government spending, net tax, output, inflation and a nominal interest rate.
DT, ST, FD and HP indicate at a deterministic trend, stochastic trend, first difference and a Hodrick-Prescott trend.

Note that for Australia and New Zealand, which are both small open economies, the fiscal multipliers are relatively small compared with the larger economies, possibly reflecting the role that imports, private savings, interest and exchange rates play in influencing the way these economies adjust to fiscal shocks.

The contemporaneous response of GDP to fiscal shocks displayed in Table 3 does not capture the dynamic response of GDP to these shocks. Therefore, to compare the dynamic response of GDP to fiscal shocks across the various VAR models, Table 4 reports the cumulative response of GDP after four and twelve quarters. Consistent with prior work, the twelve quarter cumulated response is referred to as the long-run multiplier. Table 4 shows that government spending tends to also have a positive effect on GDP in the medium and long run. However, the immediate negative effect on GDP of a net tax shock does not persist for all countries in the long run. Net tax increases because of an increase in tax revenue and/or a decline in transfer payments. A positive response of GDP to a discretionary net tax shock may therefore be the result of a decline in transfer payments having a positive effect on GDP that more than offsets any negative effects of increased taxation. Alternatively, an increase in net tax may be the result of tax policy reform that has raised tax revenue but at the same time has reduced the distortionary effects of taxation, for example, by broadening the tax base.

In summary, the results from the sensitivity analysis and robustness testing suggest that the fiscal VAR with a specification that assumes non-stationary variables is well specified and appropriate for New Zealand. Moreover, the estimated effects of fiscal policy on output fall within the range of international evidence. In fact, our results suggest that the New Zealand data may actually fit the Blanchard and Perotti (2002) model better than the US data. Performing the same sensitivity analysis and robustness testing for the US model as for the New Zealand fiscal VAR, we found evidence of parameter and model instability and potential model misspecification for the US model. For example, the equations for the US model have non-normally distributed errors, especially for the net tax equation. In addition, we found that the US equations with temporary tax cut dummy variables have unstable estimates for the joint test although the equations become stable once the dummy variables are removed from the equations.[9]

5. Contributions of fiscal policy to New Zealand business cycles

In Section 3 we investigated the dynamic response of output to net tax and government spending shocks via impulse response analysis. In this section, we use the three variable fiscal VAR to measure the historical contribution of fiscal policy

---

9 The results are not reported but available upon request.

Table 4

Cumulative GDP Response to a Spending/Tax Shock

Study	Country	Sample	Trend	Cumulative Response of GDP to a Spending Shock		Cumulative Response of GDP to a Net Tax Shock	
				4	12	4	12
Blanchard and	United States	1960-1997	DT	2.13	6.63	–2.89	–8.18
Perotti (2002)		1960-1997	ST	2.09	5.12	–3.60	–14.45
Re-estimated		1974-1997	DT	9.70	20.07	–3.53	–8.48
		1974-1997	ST	3.66	7.34	–2.99	–11.54
Perotti (2004)*	United States	1980-2000	DT	–0.25	–1.02	0.43	2.11
	Germany	1980-2000	DT	0.34	–0.09	–0.02	0.29
	United Kingdom	1980-2000	DT	0.44	–3.47	0.23	0.91
	Canada	1980-2000	DT	–0.22	–0.17	–0.30	–1.81
	Australia	1980-2000	DT	0.12	0.41	0.36	1.16
Claus, Gill, Lee	New Zealand	1982-2004	DT	0.80	–0.09	–0.15	–0.25
and McLellan		1982-2004	ST	1.04	3.13	–0.35	–0.82
(2005)		1982-2004	FD	1.16	3.68	–0.35	–0.82
		1982-2004	HP	0.00	–0.92	0.20	0.55

* Model includes 5 variables: government spending, net tax, output, inflation and a nominal interest rate.
DT, ST, FD and HP indicate at a deterministic trend, stochastic trend, first difference and a Hodrick-Prescott trend.

to New Zealand business cycles. The aim is to assess the extent to which fiscal policy has added to or subtracted from GDP growth or percentage deviations in GDP from trend. The section also compares the fiscal VAR measures of fiscal impulse with another indicator of fiscal impulse developed by Philip and Janssen (2002).

5.1 Fiscal policy and New Zealand business cycles

We use the first difference and Hodrick-Prescott specifications, two specifications that are commonly used, to represent business cycles. The Hodrick-Prescott specification measures deviations in GDP from its trend growth path, the output gap. Historical decompositions thus assess the contributions from discretionary net tax and government spending shocks to the output gap. The first difference specification, also known as the growth cycle, measures the effect of discretionary fiscal policy on GDP growth, which is approximated by logarithmic first differences of GDP.

Historical decompositions are derived from the structural shocks and impulse responses as follows:

$$Z_t = \textit{initial conditions} + \sum_{i=0}^{t-1} \sum_{j=1}^{3} \theta_i^j u_{t-i}^j \qquad j = T, G, Z \tag{5}$$

In equation (5) Z_t measures the output gap or GDP growth rate at time *t*, θ_i^j is the i^{th} impulse response associated with the j^{th} structural shock, where the structural shocks correspond to discretionary net tax, government spending and output shocks.

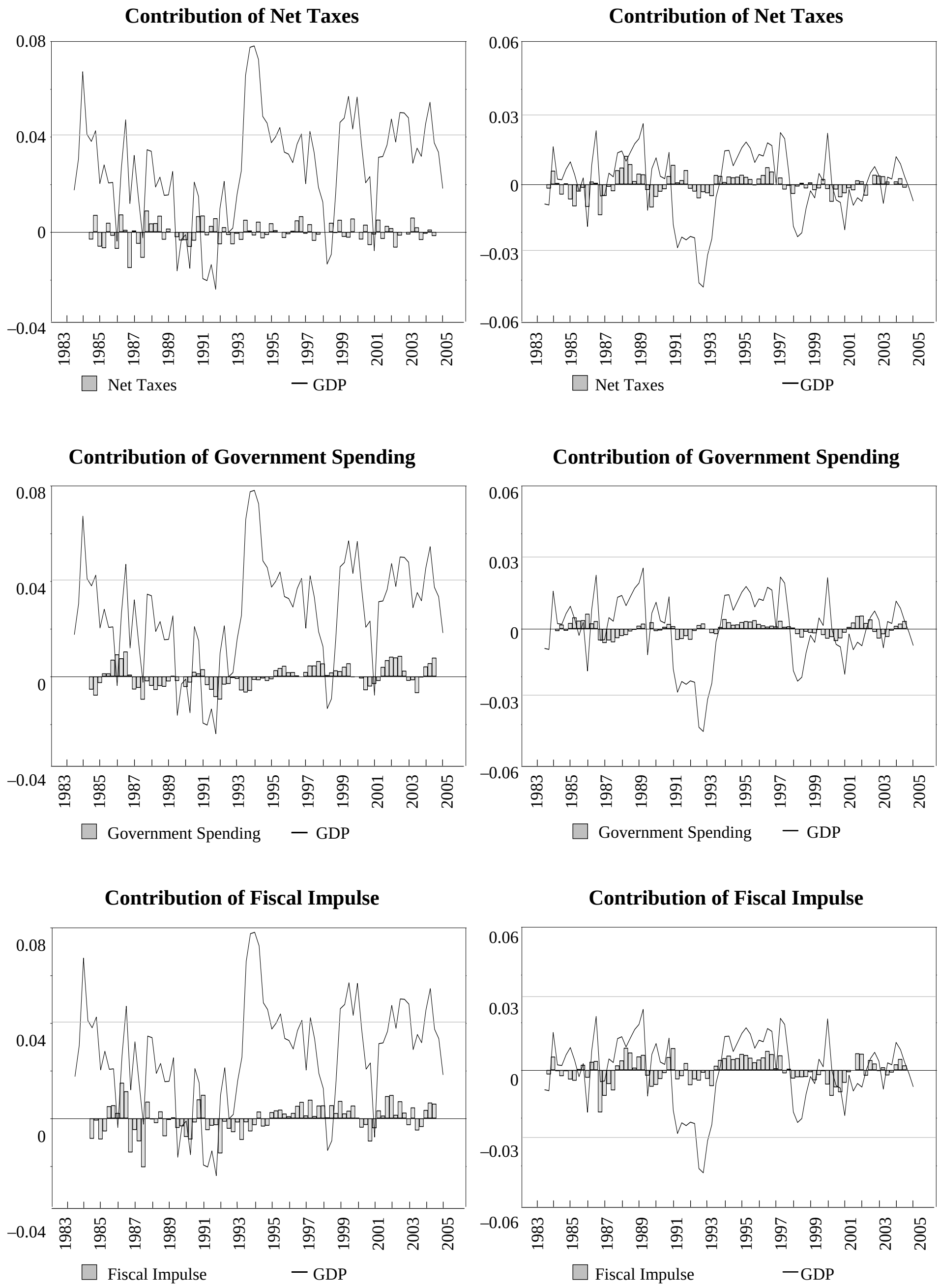
Figure 7 shows the contribution to New Zealand business cycles from net tax and government spending, and the combination of both for the period 1983 to 2005. Results are presented for both the first difference and Hodrick-Prescott specifications. Figure 7 shows that the business cycles for each specification are somewhat different. The volatility of the growth rate tends to be larger than for the Hodrick-Prescott specification. The zero line in each chart represents the point where each respective shock is making no contribution to the business cycles. Therefore, when the grey bars are positive, this implies the respective component is making a positive contribution to the output gap or GDP growth rate.[10]

[10] At the beginning of the sample period initial conditions may make a substantial contribution to detrended output. However, over time the contribution from initial conditions will converge towards zero. Therefore, the focus of the analysis in from the late 1980s onwards.

Figure 7

Contribution of Fiscal Policy to New Zealand Business Cycles

First Difference Specification **Hodrick-Prescott Specification**



For the first difference specification, which have been presented as the contribution to annual GDP growth to aid interpretation, shows the contribution from net tax to GDP growth is relatively small compared to the contribution of discretionary government spending. Over the period 1983 to 2005 it is difficult to determine whether discretionary changes in government spending were pro- or counter-cyclical. During the recession in the early 1990s the combined contribution of net tax and government spending (*i.e.* the total contribution from discretionary fiscal policy) was to generally exacerbate the recession, albeit that the impact was somewhat small. Discretionary fiscal policy tended to add to output growth during the mid- to late-1990s, when New Zealand had relative high growth rates, but again the size of the impact was small. During the past five years, the contribution from discretionary fiscal policy has tended to accentuate movements in output, *i.e.* fiscal policy has been pro-cyclical.

Turning to the Hodrick-Prescott specification, net tax appears to play a greater role, compared with the first difference specification. Furthermore, over the entire period 1982 to 2005, the contribution from net tax is generally pro-cyclical; more so than the pro-cyclicality between the contribution from discretionary government spending and the output gap. Looking at the total contribution from discretionary fiscal policy, during the 1991 to 1992 recession, discretionary fiscal policy accentuated the negative output gap according to the Hodrick-Prescott trend specification. As the economy recovered and the output gap became positive, discretionary fiscal policy made a positive contribution to the output gap. Discretionary fiscal policy contributed little to deviations in output from trend during the 1998 recession, and since then has tended to have a pro-cyclical effect.

5.2 Comparison with Treasury's measure of fiscal impulse

This section compares a measure of fiscal impulse, developed by Philip and Janssen (2002), with those produced by various specifications of the fiscal VAR. We start by noting the conceptual similarities and differences between the alternative measures of fiscal impulse and then compare quantitative estimates.

The Philip and Janssen indicator of fiscal impulse is defined as the change in the estimated structural primary cash balance. The structural primary cash balance is constructed by taking cyclically-adjusted tax receipts and subtracting cyclically-adjusted government spending (which includes some capital items that are deemed to have an impact on aggregate demand) and net interest payments. At a general level (and ignoring net interest payments) this measure of fiscal impulse (FI_t^1) can be denoted as follows:

$$FI_t^1 = T_t^* - T_{t-1}^* - (G_t^* - G_{t-1}^*) \tag{6}$$

where the superscript * indicates the variable has been cyclically adjusted. This indicator of fiscal impulse is seen as measuring whether changes in fiscal policy are adding to, or subtracting from, aggregate demand pressure in the economy (although it is not always specified how aggregate demand is being measured) and is usually estimated using annual data.

This type of measure of fiscal impulse has two widely cited limitations. First, the composition of fiscal policy changes are not taken into account, so for example tax decreases and government spending increases are treated symmetrically in terms of their impact on aggregate demand. Second, at best, this type of indicator only captures the first round impacts of changes in fiscal policy, and not additional dynamic effects.

Interpreting measures of fiscal impulse from VAR models depends on the trend specification adopted. To see this, first denote fiscal impulse (FI^2) from the deterministic and Hodrick-Prescott fiscal VAR specifications as follows:

$$FI_t^2 = T_t^M - T_t^* - (G_t^M - G_t^*) \tag{7}$$

where the superscript M indicates model-adjusted government spending and net tax (adjusted to isolate the discretionary components of fiscal policy) and the superscript * indicates the time or Hodrick-Prescott trend in net tax and government spending. In this specification fiscal impulse arises from discretionary changes in fiscal policy in which net tax and government spending deviate from their long-run growth paths (as measured by their time or Hodrick-Prescott trends) and is estimated using quarterly data.

The measure of fiscal impulse (FI_t^3) that emerges from the first difference specification of the fiscal VAR can be denoted as follows:

$$FI_t^3 = T_t^M - T_{t-1}^M - (G_t^M - G_{t-1}^M) \tag{8}$$

In this specification fiscal impulse arises because of changes in taxes and government spending. This measure of fiscal impulse gauges the contribution of fiscal policy to GDP growth.

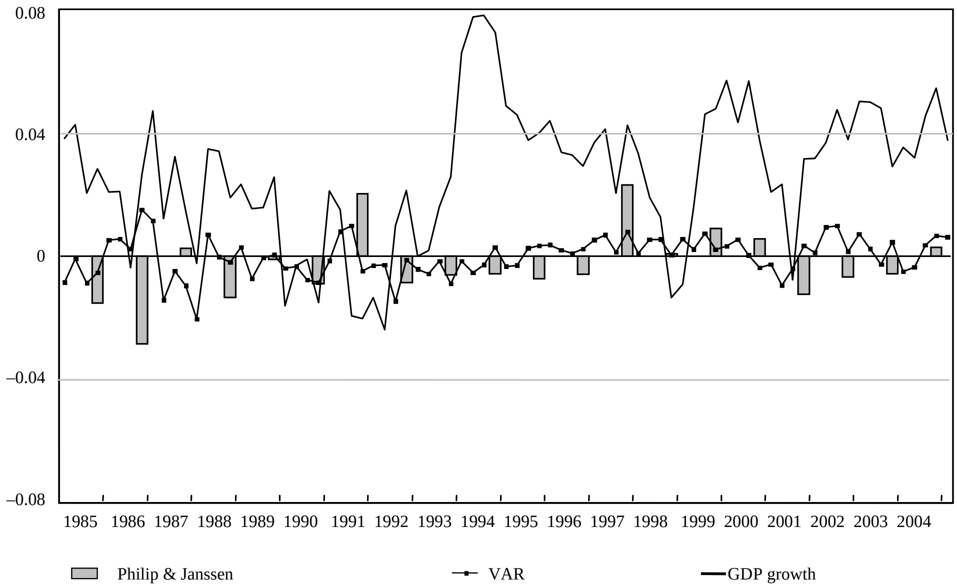
The VAR measures of fiscal impulse overcome the two main limitations of indicator type measures of fiscal impulse. First, the VAR measures of fiscal impulse account for changes in the composition of fiscal policy. This is because they feed through a system of equations that allows for different impacts of tax and spending changes on GDP. Second, because dynamic interactions are specifically modelled within the VAR model, second round effects are captured.

Figure 8 shows the two measures of fiscal impulse from the first difference and Hodrick-Prescott specifications of the fiscal VAR and compares them with the Philip and Janssen indicator measure of fiscal impulse. The chart on the upper half of Figure 8 corresponds to the first difference fiscal VAR specification and shows the contribution of fiscal impulse to annual GDP growth. The chart on the

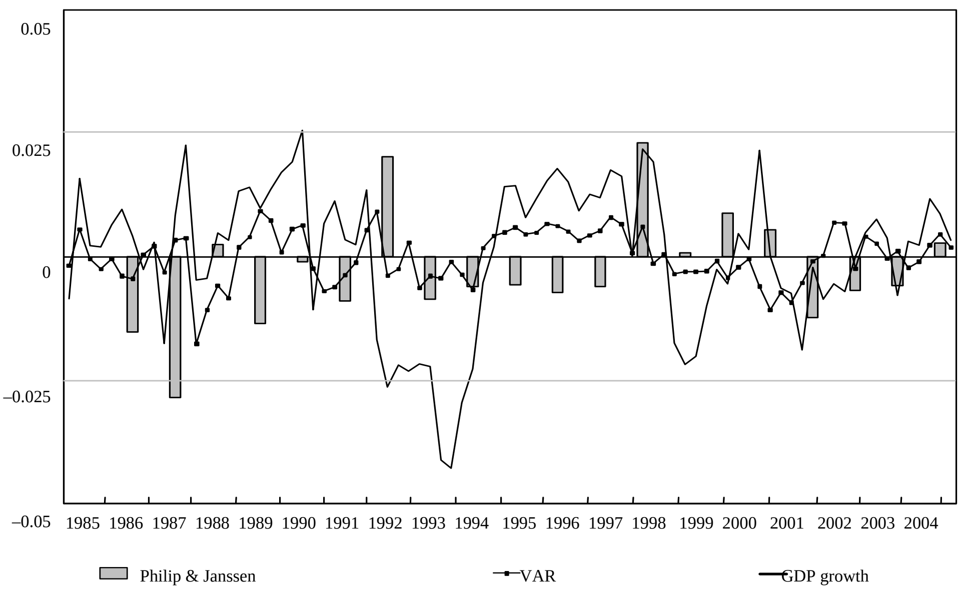
Figure 8

Alternative Measures of Fiscal Impulse

First Difference Specification
(annual growth)



Hodrick-Prescott Specification
(annual growth)



lower half of Figure 8 corresponds to the Hodrick-Prescott fiscal VAR specification and shows the contribution of fiscal impulse to deviations in GDP from trend (that is, the output gap). The Philip and Janssen measure of fiscal impulse has been inverted, compared to the way it is usually presented, to aid comparison with the fiscal VAR measures of fiscal impulse. Because initial conditions can make substantial contributions to GDP growth or deviations in GDP from trend this analysis focuses from the mid-1980s onwards.

Figure 8 suggests that in general the sign and magnitude of the first difference fiscal VAR specification and the Philip and Janssen measures of fiscal impulse are similar, although there are periods where there are differences. It is interesting to note that Treasury's current measure of fiscal impulse tends to display larger absolute changes than the measure of fiscal impulse from the first difference fiscal VAR model.

In the late 1980s both measures of fiscal impulse suggest that fiscal policy was acting to dampen GDP growth; this was more so for the Philip and Janssen measure of fiscal impulse. During the 1991 and 1992 recession, the measure of fiscal impulse from the first difference fiscal VAR suggests that fiscal policy made a larger negative contribution during this period, than is suggested by the Philip and Janssen measure of fiscal impulse. Throughout the remainder of the 1990s both measures are in broad agreement about the contribution of fiscal policy to GDP growth (although the stimulus from fiscal policy in 1997 is considerably larger for the Philip and Janssen measure compared to the VAR measure of fiscal impulse). In the period from 2002, at least until more recently, the two measures suggest different impacts of fiscal policy on GDP growth.

In general, there has also been some degree of congruence between the measure of fiscal impulse produced from the Hodrick-Prescott VAR specification and the Philip and Janssen measure of fiscal impulse, particularly over the last five years. However, one period where the two measures noticeably differ is in the mid-1990s, when the Philip Janssen measure suggests discretionary fiscal policy was subtracting from positive deviations in GDP from trend, whereas the fiscal VAR measure suggests fiscal policy was adding to positive deviations in GDP from trend.

6. Conclusions

This paper has examined the dynamic effects of fiscal policy on New Zealand GDP using a structural VAR model. Following the modelling procedures developed and implemented by Blanchard and Perotti (2002) and Perotti (2004), the impact of government spending (purchases of goods and services), taxes and transfers on GDP was identified by assuming that discretionary fiscal policy is unable to respond to GDP shocks within one quarter. Institutional information on the tax and transfer system are therefore used to quantify the automatic effects of changes in GDP on government spending, taxes and transfers.

Results showed that an increase in government spending led to an increase in GDP in the short term, while an increase in net tax reduced GDP in the short-term. The size of the response in GDP to changes in government spending and net tax was dependent on the trend specification adopted. The estimated impact of increases in government spending or net tax on New Zealand GDP was smaller than the estimated effects of changes in government spending or net tax on GDP for the United States. In this respect, results for New Zealand are similar to those for Australia and most likely reflect the small, open nature of both economies. When the fiscal VAR model was estimated with the net tax variable separated into taxes and government transfers, impulse responses revealed that a tax revenue shock lowered GDP (although the decline was small), while a government transfer shock lead to an increase in GDP in the short-term, but a decline in GDP over the medium-term.

The structural VAR model was also used to analyse the historical contributions of fiscal policy to New Zealand business cycles. Two measures of fiscal impulse were examined: one based on a first difference VAR specification and the other based on detrending data using the Hodrick-Prescott filter. The fiscal impulse measure based on the first difference specification showed that fiscal policy dampened GDP growth in the early 1990s, while adding to growth in the mid-to-late 1990s. Since 2001 fiscal policy has tended to add to GDP growth. The fiscal impulse measure based on the Hodrick-Prescott trend specification showed that fiscal policy subtracted from positive deviations in GDP from trend in the early 1990s, but made a positive contribution during the period 1993 to 1998. Since 1998 fiscal policy tended to subtract from positive deviations in GDP from trend. Although there is a reasonable degree of congruence between the Philip and Janssen measure of fiscal impulse and the alternative structural VAR measures (especially for the first difference specification), there are periods where the measures differ significantly on the contribution of fiscal policy to GDP.

This paper provides a basis for further work on fiscal policy and the New Zealand economy. One area of work is to disaggregate government spending and tax data to analyse the differential effect of changes in different spending and tax categories on GDP. A further area of work is to explicitly incorporate the government budget constraint. Another extension of this work is to include fiscal variables in a larger structural VAR model of the New Zealand economy (for example, the structural VAR model developed by Buckle, Kim, Kirkham, McLellan and Sharma, 2002) to measure the effect of changes in fiscal policy on other economic variables, such as inflation, interest and exchange rates, and private sector output. This larger model could also be used to examine the impact of exogenous shocks on the fiscal balance and, using techniques developed by Buckle, Kim and Tam (2001), the *ex ante* fiscal balance required to maintain some specified lower or upper bound for the fiscal balance.

APPENDIX 1
AUGMENTED DICKEY-FULLER UNIT ROOT TESTS

Table 5

Unit Root Test Results

	Fiscal Balance	Net Tax	Government Spending	GDP
None	–3.279	–0.629*	0.594	3.300
Intercept	–3.055	–1.262*	–0.683*	0.440*
Intercept and Trend	–2.754*	–2.183*	–1.315*	–1.564*

* Indicates statistically significant unit root.

APPENDIX 2
STABILITY TESTS

Table 6

Stability Test Results for Equations and Individual Parameters

	Deterministic Specification			Stochastic Specification			Hodrick-Prescott Specification			First Difference Specification		
	Tax	G.E.	GDP	Tax	G.E.	GDP	Tax	G.E.	GDP	Tax	G.E.	GDP
Test	stats (p-val)	stats (p-val))	stats (p-val)	stats (p-val)	stats (p-val))	stats (p-val)	stats (p-val)	stats (p-val))	stats (p-val)	stats (p-val)	stats (p-val))	stats (p-val)
Joint	3.47 (1.00)	3.32 (1.00)	2.85 (1.00)	2.84 (1.00)	3.16 (1.00)	1.76 (1.00)	3.22 (1.00)	2.96 (1.00)	2.02 (1.00)	2.75 (1.00)	3.13 (1.00)	1.75 (1.00)
Individual												
Variance	0.50 (0.04)*	0.17 (1.00)	0.12 (1.00)	0.61 (0.02)*	0.39 (0.08)*	0.13 (1.00)	1.08 (0.00)*	0.23 (1.00)	0.12 (1.00)	0.63 (0.02)*	0.34 (0.11)*	0.13 (1.00)
Constant	0.07 (1.00)	0.03 (1.00)	0.05 (1.00)	0.19 (1.00)	0.32 (0.13)*	0.16 (1.00)	0.06 (1.00)	0.05 (1.00)	0.09 (1.00)	0.17 (1.00)	0.35 (0.10)*	0.18 (1.00)
Net Tax{1}	0.10 (1.00)	0.06 (1.00)	0.09 (1.00)	0.15 (1.00)	0.05 (1.00)	0.12 (1.00)	0.14 (1.00)	0.12 (1.00)	0.16 (1.00)	0.15 (1.00)	0.04 (1.00)	0.11 (1.00)
Net Tax{2}	0.09 (1.00)	0.06 (1.00)	0.07 (1.00)	0.08 (1.00)	0.04 (1.00)	0.02 (1.00)	0.03 (1.00)	0.14 (1.00)	0.06 (1.00)	0.08 (1.00)	0.02 (1.00)	0.02 (1.00)
Net Tax{3}	0.11 (1.00)	0.05 (1.00)	0.06 (1.00)	0.10 (1.00)	0.13 (1.00)	0.03 (1.00)	0.14 (1.00)	0.05 (1.00)	0.05 (1.00)	0.11 (1.00)	0.10 (1.00)	0.04 (1.00)
Net Tax{4}	0.12 (1.00)	0.03 (1.00)	0.06 (1.00)	0.02 (1.00)	0.09 (1.00)	0.20 (1.00)	0.11 (1.00)	0.13 (1.00)	0.10 (1.00)	0.02 (1.00)	0.07 (1.00)	0.20 (1.00)
G.E.{1}	0.07 (1.00)	0.02 (1.00)	0.06 (1.00)	0.19 (1.00)	0.14 (1.00)	0.04 (1.00)	0.06 (1.00)	0.07 (1.00)	0.10 (1.00)	0.17 (1.00)	0.19 (1.00)	0.05 (1.00)
G.E.{2}	0.08 (1.00)	0.02 (1.00)	0.06 (1.00)	0.06 (1.00)	0.23 (0.11)*	0.05 (1.00)	0.21 (1.00)	0.31 (0.14)*	0.07 (1.00)	0.07 (1.00)	0.20 (1.00)	0.04 (1.00)
G.E.{3}	0.08 (1.00)	0.02 (1.00)	0.06 (1.00)	0.04 (1.00)	0.34 (0.16)*	0.05 (1.00)	0.09 (1.00)	0.10 (1.00)	0.12 (1.00)	0.04 (1.00)	0.38 (0.08)*	0.06 (1.00)
G.E.{4}	0.09 (1.00)	0.02 (1.00)	0.06 (1.00)	0.05 (1.00)	0.29 (1.00)	0.03 (1.00)	0.49 (0.05)*	0.15 (1.00)	0.04 (1.00)	0.05 (1.00)	0.24 (0.20)*	0.04 (1.00)
GDP{1}	0.08 (1.00)	0.03 (1.00)	0.05 (1.00)	0.08 (1.00)	0.12 (1.00)	0.11 (1.00)	0.06 (1.00)	0.12 (1.00)	0.11 (1.00)	0.08 (1.00)	0.19 (1.00)	0.11 (1.00)
GDP{2}	0.08 (1.00)	0.03 (1.00)	0.05 (1.00)	0.20 (1.00)	0.34 (0.11)*	0.12 (1.00)	0.05 (1.00)	0.38 (0.08)*	0.10 (1.00)	0.23 (1.00)	0.19 (1.00)	0.15 (1.00)
GDP{3}	0.08 (1.00)	0.03 (1.00)	0.05 (1.00)	0.24 (0.20)*	0.29 (1.00)	0.23 (1.00)	0.05 (0.20)*	0.27 (0.18)*	0.25 (0.19)*	0.16 (1.00)	0..04 (1.00)	0.13 (1.00)
GDP{4}	0.08 (1.00)	0.03 (1.00)	0.05 (1.00)	0.12 (1.00)	0.12 (1.00)	0.03 (1.00)	0.15 (1.00)	0.14 (1.00)	0.06 (1.00)	0.17 (1.00)	0.08 (1.00)	0.04 (1.00)
Dummy{1}	0.08 (1.00)	0.15 (1.00)	0.11 (1.00)	0.08 (1.00)	0.06 (1.00)	0.19 (1.00)	0.09 (1.00)	0.17 (1.00)	0.10 (1.00)	0.07 (1.00)	0.05 (1.00)	0.20 (1.00)
Dummy{2}	0.25 (1.00)	0.20 (1.00)	0.10 (1.00)	0.24 (1.00)	0.43 (0.06)*	0.03 (1.00)	0.12 (1.00)	0.29 (0.16)*	0.19 (1.00)	0.23 (1.00)	0.45 (0.06)*	0.03 (1.00)
Dummy{3}	0.11 (1.00)	0.16 (1.00)	0.04 (1.00)	0.16 (1.00)	0.17 (1.00)	0.07 (1.00)	0.11 (1.00)	0.19 (1.00)	0.05 (1.00)	0.16 (1.00)	0.20 (1.00)	0.08 (1.00)
Time	0.12 (1.00)	0.03 (1.00)	0.05 (1.00)	-	-	-	-	-	-	-	-	-
Time square	0.13 (1.00)	0.02 (1.00)	0.05 (1.00)	-	-	-	-	-	-	-	-	-

* Indicates statistically significant unstable estimates.

Tax = Net tax, G.E. = Government Expenditure.

Table 7

Stability Test Results for the Fiscal VAR Model

Deterministic	Stochastic	Hodrick-Prescott	First Difference
0.219	0.273	0.132	0.233
0.352	0.273	0.365	0.233
0.444	0.503	0.507	0.483
0.444	0.503	0.637	0.483
0.477	0.527	0.637	0.516
0.477	0.527	0.685	0.516
0.514	0.534	0.690	0.519
0.691	0.534	0.690	0.519
0.691	0.609	0.690	0.610
0.779	0.609	0.690	0.610
0.886	0.690	0.718	0.691
0.886	0.690	0.718	0.691

APPENDIX 3
NORMALITY AND LINEARITY TESTS

Table 8

Test Results for Normality of Residuals

	Net Tax		G.E.		GDP	
	Statistics	P-Value	Statistics	P-Value	Statistics	P-Value
Deterministic	0.111	0.946	19.387	0.000*	2.001	0.368
Stochastic	2.377	0.305	3.206	0.201	3.641	0.162
Hodrick-Prescott	1.651	0.438	19.453	0.000*	3.728	0.155
First Difference	1.700	0.427	4.593	0.101	4.763	0.092

* Indicates statistically significant non-normal distribution of residuals.

Table 9

Test Results for Linearity

			D.T.	S.T.	H.P.	F.D.
Net Tax	Powers = 2	Statistics	0.702	0.185	0.027	0.233
		P-Value	0.405	0.669	0.869	0.631
	Powers = 2,3	Statistics	4.176	1.392	0.029*	1.417
		P-Value	0.020*	0.256	0.972	0.250
	Powers = 2,4	Statistics	2.763	1.122	0.448	1.099
		P-Value	0.049*	0.346	0.720	0.356
G.E.	Powers = 2	Statistics	0.340	1.898	0.067	3.139
		P-Value	0.562	0.173	0.797	0.081*
	Powers = 2,3	Statistics	0.173	1.177	0.046	1.872
		P-Value	0.841	0.314	0.955	0.162
	Powers = 2,4	Statistics	0.166	0.935	0.030	1.276
		P-Value	0.919	0.429	0.993	0.290
GDP	Powers = 2	Statistics	105.813	0.385	0.008	1.247
		P-Value	0.000*	0.537	0.931	0.268
	Powers = 2,3	Statistics	150.911	0.470	0.057	1.007
		P-Value	0.000*	0.627	0.945	0.371
	Powers = 2,4	Statistics	99.604	0.558	0.082	0.694
		P-Value	0.000*	0.644	0.969	0.559

* Indicates significant non-linearity.
D.T. = Deterministic, S.T. = Stochastic, H.P. = Hodrick-Prescott and F.D. = First Difference tests.

APPENDIX 4
ALTERNATIVE ORDERING

Figure 9

Alternative Ordering of Net Tax and Government Spending for the Deterministic Trend Specification

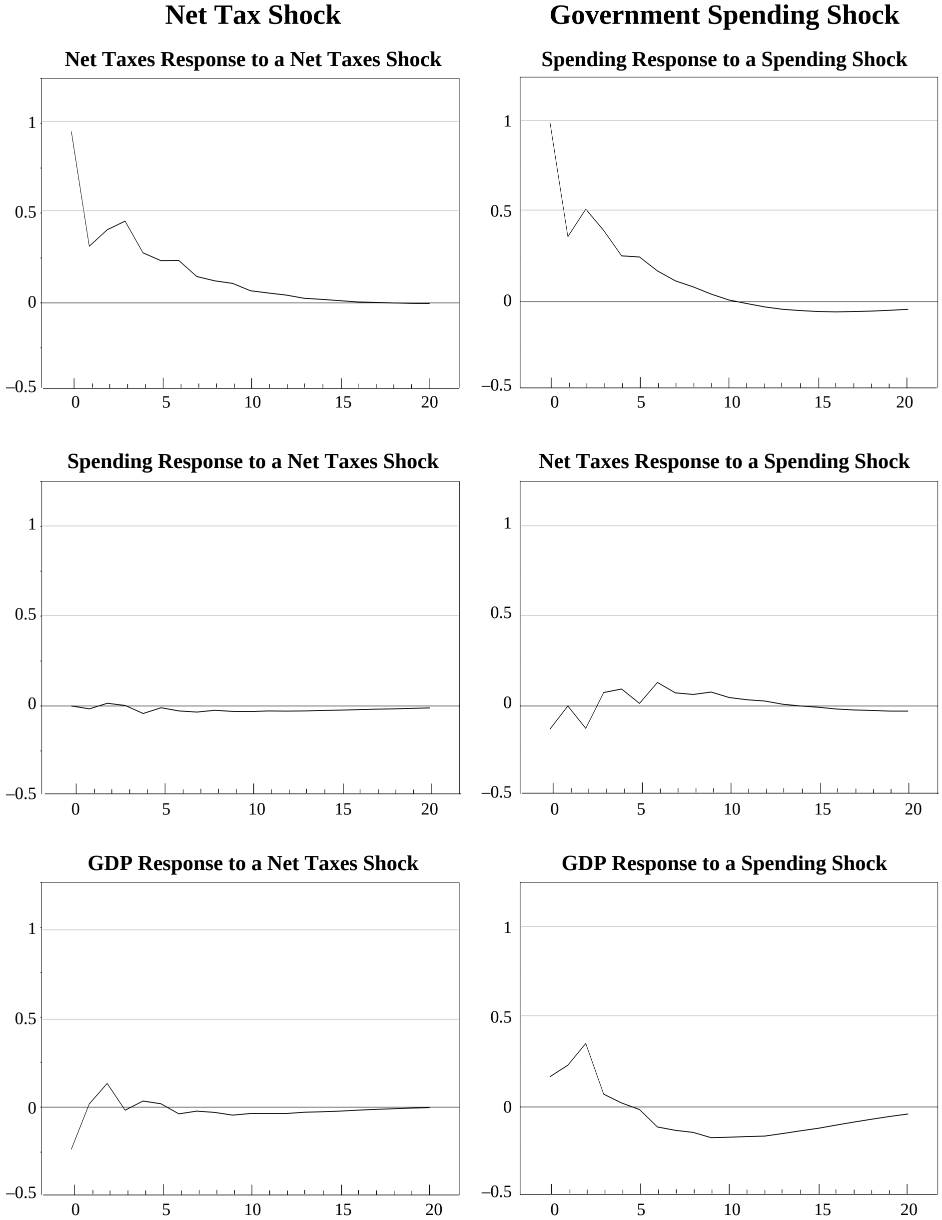
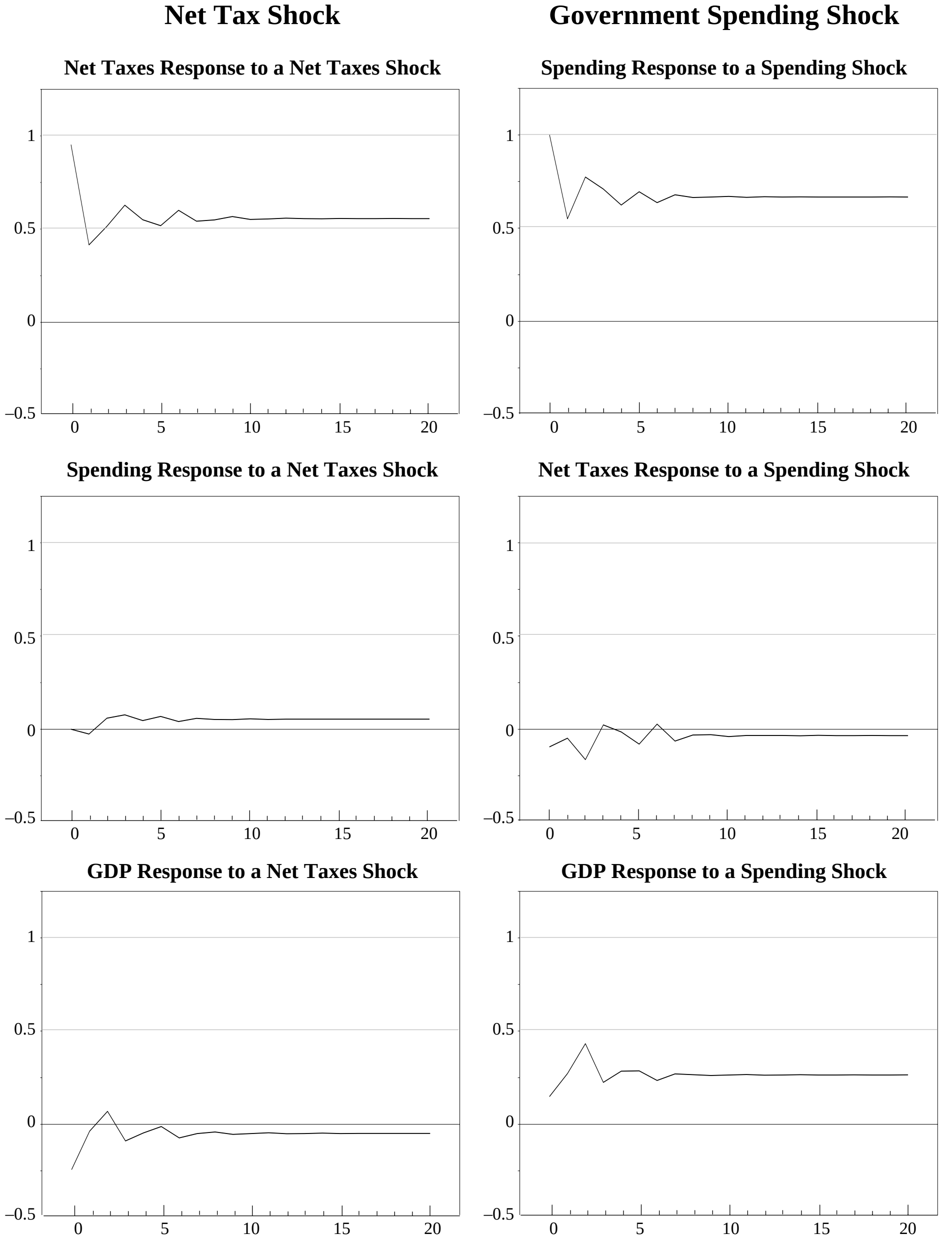


Figure 10

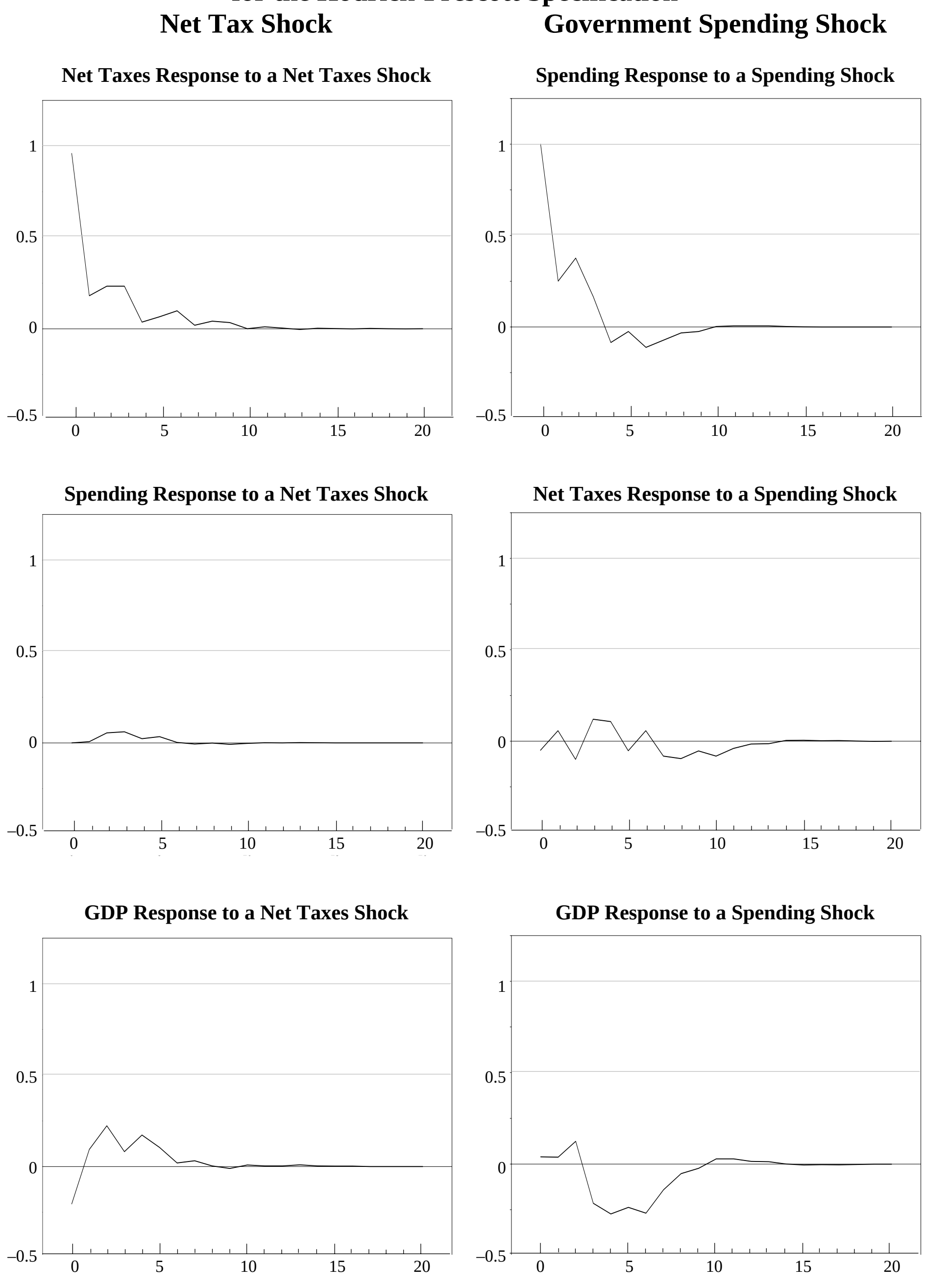
Alternative Ordering of Net Tax and Government Spending for the Stochastic Trend Specification



Note: The figure for the first difference trend specification is not reported, as it is almost identical to the one for stochastic trend specification. However, it is available upon request.

Figure 11

Alternative Ordering of Net Tax and Government Spending for the Hodrick-Prescott Specification



APPENDIX 5
ALTERNATIVE ELASTICITIES

Figure 12

Sensitivity Tests for the Impulse Responses to Net Tax Shock

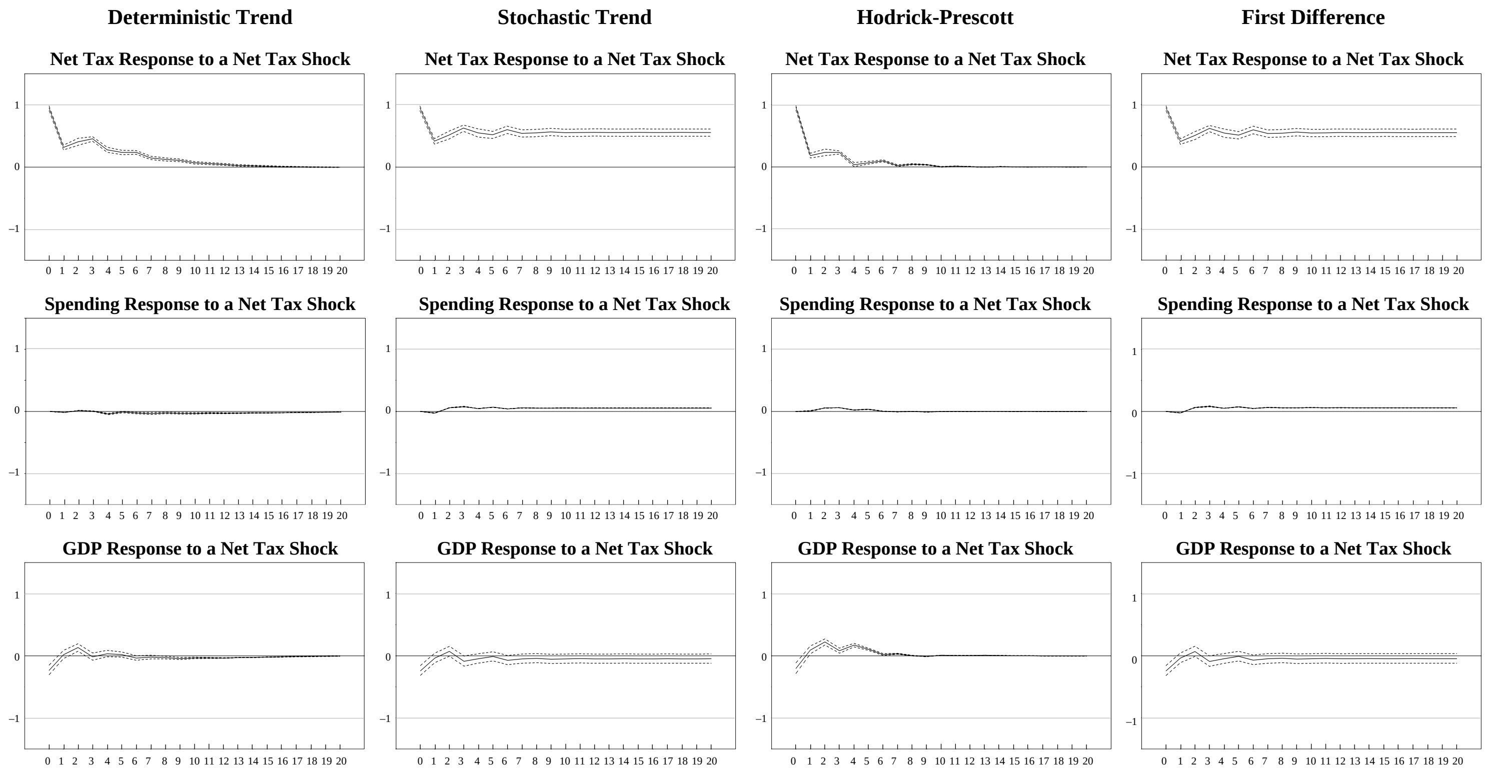
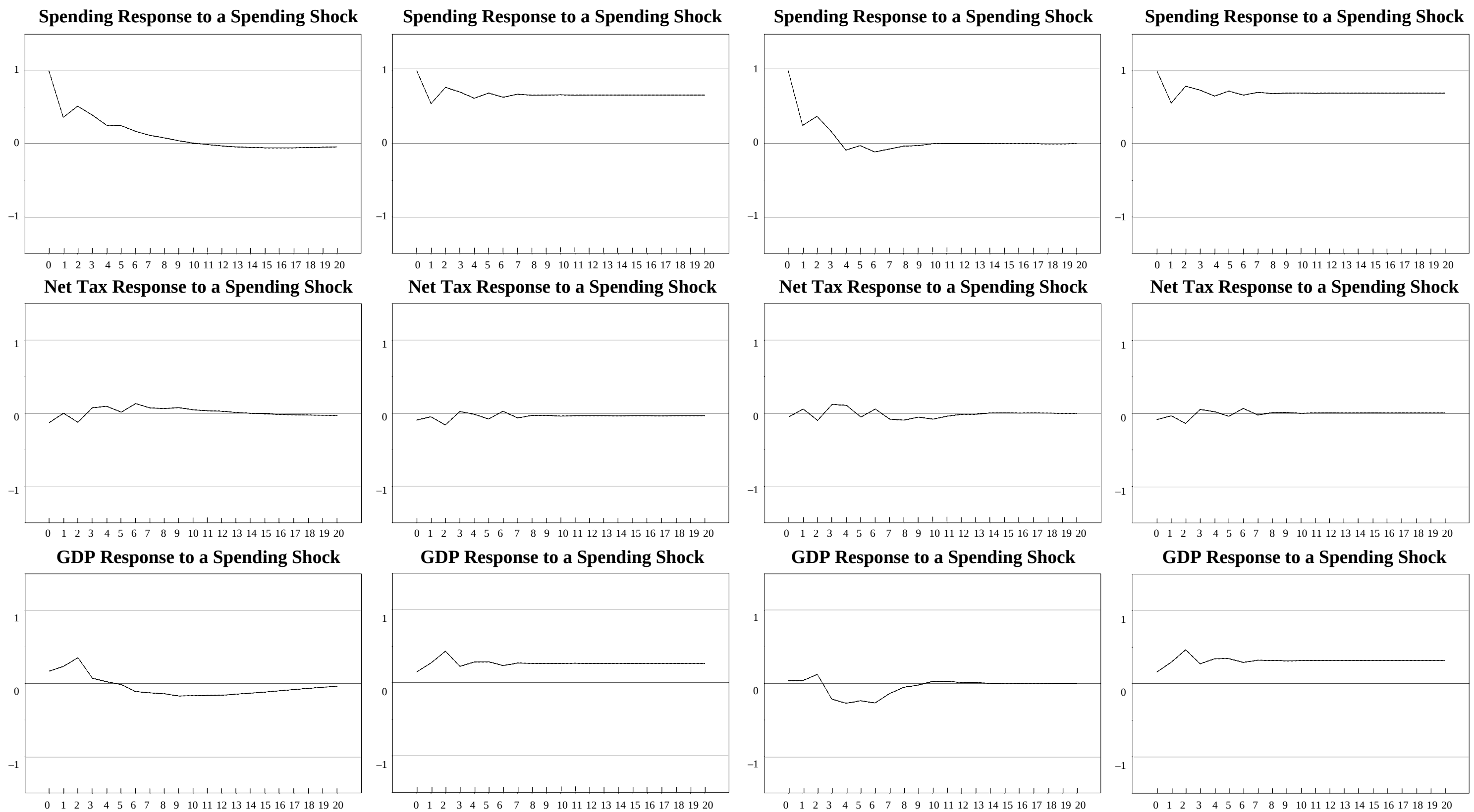


Figure 13

Sensitivity Tests for the Impulse Responses to a Government Spending Shock

Deterministic Trend | **Stochastic Trend** | **Hodrick-Prescott** | **First Difference**



REFERENCES

Bernanke, B.S. and A.S. Blinder (1992), "The Federal Funds Rate and the Channels of Monetary Transmission", *American Economic Review*, Vol. 82, No. 4, pp. 901-21.

Blanchard, O. and R. Perotti (2002), "An Empirical Characterisation of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *Quarterly Journal of Economics*, Vol. 117, No. 4, pp. 1329-68.

Blinder, A.S. (1981), "Temporary Income Taxes and Consumer Spending", *Journal of Political Economy*, Vol. 89, No. 2, pp. 26-53.

Brook, A.M. (2003), "Recent and Prospective Trends in Real Long-term Interest Rates: Fiscal Policy and Other Drivers", OECD, Working Paper, EKO/WKP(2003)21.

Buckle, R.A., K. Kim, H. Kirkham, N. McLellan and J. Sharma (2002), "A Structural VAR Model of the New Zealand Business Cycle", New Zealand Treasury, Working Paper, No. 02/26.

Buckle, R.A., K. Kim and J. Tam (2001), "A Structural VAR Approach to Estimating Budget Balance Targets", *New Zealand Economic Papers*, Vol. 36, No. 2, pp. 149-75.

Buckle, R.A., K. Kim and N. McLellan (2003), "Monetary Policy and New Zealand Business Cycles: Analysis Using a Structural VAR Model", New Zealand Treasury, Working Paper, No. 03/09.

Dungey, M. and A. Pagan (2000), "A Structural VAR Model of the Australian Economy", *Economic Record*, Vol. 76, No. 235, pp. 321-42.

Girouard, N. and A. Christophe (2005), "Measuring Cyclically-adjusted Budget Balances for OECD Countries", OECD, Economics Department, Working Paper, No. 434.

Hansen, B.E. (1992), "Testing for Parameter Stability in Linear Models", *Journal of Policy Modelling*, Vol. 14, No. 4, pp. 517-33.

Hodrick, R.J. and E.C. Prescott (1997), "Post-war US Business Cycles: An Empirical Investigation", *Journal of Money Credit and Banking*, Vol. 29, No. 1, pp. 1-16.

Jarque, C.M. and A.K. Bera (1987), "A Test for Normality of Observation and Regression Residuals", *International Statistical Review*, Vol. 55, No. 2, pp. 163-72.

Kneller, R., M.F. Bleaney and N. Gemmell (1999), "Fiscal Policy and Growth: Evidence from OECD Countries", *Journal of Public Economics*, No. 74, pp. 171-90.

Li, W. and P.D. Sarte (2004), "Progressive Taxation and Long-run Growth", *American Economic Review*, No. 94, pp. 1705-16.

OECD (1998), "Maintaining Prosperity in an Ageing Society", Organisation for Economic Cooperation and Development.

Padovano, F. and E. Galli (2002), "Comparing the Growth Effects of Marginal vs. Average Tax Rates and Progressivity", *European Journal of Political Economy*, No. 18, pp. 529-44.

Perotti, R. (2004), "Estimating the Effects of Fiscal Policy in OECD Countries", unpublished manuscript.

Philip, R. and J. Janssen (2002), "Indicators of Fiscal Impulse for New Zealand", New Zealand Treasury, Working Paper, No. 02/30.

Ramey, V.A. and M.D. Shapiro (1998), "Costly Capital Reallocation and the Effects of Government Spending", Carnegie-Rochester Conference Series on Public Policy, No. 48, pp. 145-94.

Ramsey, J.B. (1969), "Tests for Specification Errors in Classical Linear Least-squares Regression Analysis", *Journal of the Royal Statistical Society*, Series B (Methodological), Vol. 31, No. 2, pp. 350-71.

Said, S.E. and D.A. Dickey (1984), "Testing for Unit Roots in Autoregressive-moving Average Models with Unknown Order", *Biometrika*, Vol. 71, No. 3, pp. 599-608.

Sims, C.A. (1980), "Macroeconomics and Reality", *Econometrica*, Vol. 48, No. 1, pp. 1-48.

DYNAMIC EFFECTS OF FISCAL SHOCKS UPON DIVERSE MACROECONOMIC VARIABLES: A STRUCTURAL VAR ANALYSIS FOR ARGENTINA

Ernesto Rezk, Maria Cecilia Avramovich and Martín Basso[*]

The paper studies the dynamic effects of fiscal policy shocks upon Argentine macroeconomic variables such as the gross domestic product, the inflation rate and the level of unemployment; a structural Vector Autoregression model is resorted to in order to estimate the impulse response functions; the econometric analysis is carried out for the period 1984-2005 (second quarter) and quarterly logarithmic real variables are used for the VAR´s specification. Point estimation of impulse response functions indicate both a relatively low statistical significance of fiscal shocks upon macroeconomic variables and a short-lived impact of innovations while at the same time cast doubts upon some traditionally accepted Keynesian macroeconomic policy prescriptions.

1. Introduction

Argentine economic researchers traditionally analyzed the performance and impact of monetary and fiscal policies, for different scenarios and situations, by resorting to more or less complex Keynesian macroeconomic models whose econometric handling would assumedly enable them to recommend determined economic policy actions.

From a critical stance, Blanchard and Perotti (2002) pointed out some shortbacks of the above mentioned methodology, one out of the most notorious being that – in reason of their Keynesian structure – the models assumed rather than proved a positive effect of fiscal expansions upon output. In these authors' words episodes in which private consumption and output significantly grew while severe cuts in public spending took place cast – to say the least – doubts on the soundness of traditionally accepted theoretical approaches; Perotti (2004) stressed later a similar concern by recalling that neoclassical models predicted a private consumption fall following a positive shock to government spending and called for seeking more empirical evidence as a form of shedding light on the matter.

In this connection the present paper aims at studying the dynamic effects of fiscal shocks upon a set of Argentine macroeconomic variables (gross domestic product, inflation rate, unemployment) resorting to a structural Vector Autoregression approach that uses quarterly data from 1980 through 2005 (second quarter); correspondingly, Impulse-response Functions are estimated. As Kamps

[*] Institute of Economics and Finance – Faculty of Economic Sciences – National University of Córdoba (Argentina). E-mail: ernerezk@eco.unc.edu.ar

(2005) stressed it, within the context of a production function approach but nonetheless conceptually applicable to the case analyzed in this research, VAR formulations have several advantages in relation to alternative methodologies as no aprioristic sequence links are imposed among the variables and feedback effects among variables are not ruled out either; Enders (1995, chapter 5) also outlined these features by asserting that the VAR's goal is to find important inter relations among the variables and not make short-term forecasts.

Concerning the paper's organization, Section 2 includes a brief survey of recent articles that have dealt with the analysis of dynamic impact of fiscal variables, using VAR models; Section 3 deals with the model's specification and also discusses methodological aspects; Section 4 discusses Impulse-response Functions; Section 5 presents the dynamic impact of innovations and discusses robustness and Granger causality and Section 6 concludes.

2. A brief survey of the literature

Studies on impulse response functions' estimation in Argentina (*i.e.*, Utrera, 2004) were mainly oriented to monetary issues, for what not many papers are available in which VAR models are used to analyzing the dynamic impact of fiscal variables. Contrariwise, the international literature on the matter is ample and valuable and some of the leading papers whose objectives link to ours' are reviewed below.

Blanchard and Perotti (2002) resorted to a structural VAR specification to characterize the dynamic effects of shocks in government expenditure and taxes on economic activity in USA, during the post second world war period. The use of VAR was defended on grounds that it was better suited for fiscal policy studies as fiscal variables moved for many reasons (apart from output stabilization) and there were exogenous fiscal shocks; furthermore, decision and implementation fiscal policy lags ensured that the discretionary response of fiscal policy (within a quarter) to unexpected contemporaneous movements in output would be very rare. Their results consistently showed that positive innovations in public spending and in taxes respectively had a positive and an negative impact upon output; they also found that both positive shocks in spending and taxes had a strong negative effect upon private investment spending.

Perotti (2004) used a structural VAR model in order to analyze the effects of fiscal policy (per capita real public spending and net taxes) on gross domestic product, inflation and interest rates in five OECD countries since 1960 to 2001. The paper concluded that the effects of fiscal variables upon gross domestic product tended to be small whereas results did not either supply evidence that tax cuts worked faster or more effectively than expenditure increases. Another finding was that both the effects of spending shocks and tax cuts upon product and its components had become substantially weaker or negative over time, particularly on private investment. As regards the other variables, only in the post-1980 period

Perotti found evidence of positive effects of government spending on long term interest rates whereas, under plausible price elasticity values, expenditure had a small impact on inflation.

Giordano, Momigliano, Neri and Perotti (2005) used a structural Vector Autoregression model to analyzing also the impact of fiscal variables on product, inflation and interest rates, resorting in this case to Italian quarterly cash data corresponding to the period 1982:1 - 2003:4; for the estimation of impulse response functions fiscal variables were separated into real government spending on goods and services, real government wages and real net taxes. Conclusions pointed out that while a shock to government purchases had a sizeable and robust positive impact on both private consumption and investment (despite it low persistence) innovations in public wages did not have any significant short run effect upon output and employment but a negative effect after two years. With regard to inflation and interest rates, the response to public purchases and public wages was positive but short lived in the first case and positive and larger in the second one. Finally, negligible effects were reported on all variables' response to net revenue shocks.

Creel, Monperrus-Veroni and Saraceno (2005) estimated a structural VAR model of the French economy, based on the fiscal theory of the price level; they found econometric evidences to reject the predictions of FTPL that fiscal shocks and interest rates should cause an important impact upon prices while at the same time their results agreed with most of conventional Keynesian effects of fiscal policy. Thus, Creel et al emphasized the immediate negative impact of a positive surplus shock on output although they acknowledged that the favorable impact of an expansionary and discretionary fiscal policy on product would deploy its effects after a time; they also found that negative wealth effects (due to sharp public debt reductions) played a key role in the long lasting decrease in gross domestic product.

Kamps (2005) resorted in turn to the VAR methodology in order to assess dynamic effects of public capital in 22 OECD countries for the period 1960-2001 and used the following variables: public capital net stock, private capital net stock, real output and employment. In short, Kamps' results yielded proofs that shocks to public capital spending tended to have significant positive effects upon output although no evidence was found of the former's supernormal returns as was normally the case in production function approaches; in another striking result, Kamps found that public and private capital were – for most of countries analyzed – complementary in the long run while for the short run they were substitute in some countries and complementary in others. Finally, the study showed neither that the long run response of employment to innovations in public capital were statistically significant nor evidences that employment could be boosted by additional public capital.

3. Specification of the model

The specification of the VAR model used in the analysis includes quarterly[1] values of the following 5 Argentine macroeconomic variables: current public expenditure (PE) and tax revenues (TR) corresponding to the central government and the provinces,[2] gross domestic product (GDP) and unemployment (UNE) and inflation (INFL) rates. The sample period extends from 1984:1 through 2005:2 and series of fiscal variables and gross domestic product were seasonally adjusted using the Multiplicative Census X12 procedure. Fiscal and product variables are expressed in real terms, the Consumer Price Index available from the National Institute of Statistics and Censuses (INDEC) being used as the deflator.

Public Expenditures include public wages, government purchases of goods and services and transfers to the private sector; as for public capital spending, the series showed a marked irregularity throughout the period; although this feature has been recently stressed by the privatization in the nineties of most of public utilities (electricity and water provision, transport and oil producing firms) and the concession of road maintenance to the private sector, perhaps a more adequate explanation for the series' irregularity has to be sought at the fact that capital spending has in general behaved as a tool of discretionary fiscal policy. In reason of this, public capital outlays were excluded from the model's first estimation but were later considered together within public spending in a second estimation (variable PEK), with the object of ascertaining whether impulse response functions behaved differently.

Tax Revenues in turn comprises, on the one hand, taxes whose responsibility for collection resides in the central government as the yields of individual and corporate income taxes, transactions, consumption, property and wealth taxes, import and export duties and social security contributions.[3] On the other hand, the fiscal yield of provincial turnover, property and car taxes, as well as stamp duties, were also added to the series.

In order to avert the risk of spurious regressions, typical of non-stationary time series, the Augmented Dickey-Fuller Test was resorted upon in order to prove the existence of unit roots; the results are shown in the ensuing table:

---

1 Although Blanchard and Perotti (2002) pointed it out that the use of quarterly values for variables is extremely important as it enables seasonal patterns in variables' response to diverse shocks to be captured, in this case, in which stationality has been removed, the advantages of resorting to quarterly data reside in that more degrees of freedom are available and in that quarterly data give the possibility of analyzing short time periods elapsing since a shock takes place.

2 The decision to include national as well as subnational figures in the series rests on the fact that provinces' public expenditures and tax revenues account respectively for more than 50 per cent and 15 per cent of total when all government levels are considered.

3 Owing to the new pension systems (private capitalization scheme) existing in the country as of 1994, most of payroll taxes are directed straightaway to Pensions Funds; therefore, computed social security contributions are those directed to the residual public system.

Null Hypothesis: ORIG_GDP_X12_TC has a unit root		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	–0.655914	0.8517
Null Hypothesis: ORIG_PE_X12_TC has a unit root		
Augmented Dickey-Fuller test statistic	–2.545447	0.1083
Null Hypothesis: ORIG_PEK_X12_TC has a unit root		
Augmented Dickey-Fuller test statistic	–4.046548	0.0018
Null Hypothesis: ORIG_TR_X12_TC has a unit root		
Augmented Dickey-Fuller test statistic	–3.314716	0.0173
Null Hypothesis: ORIG_UNE_X12_TC has a unit root		
Augmented Dickey-Fuller test statistic	–1.101106	0.7127
Null Hypothesis: ORIG_INFL_X12_TC has a unit root		
Augmented Dickey-Fuller test statistic	–2.717007	0.0749

* MacKinnon (1996) one-sided *p*-values.

τ's critical values used to test the null hypothesis were the following ones:

Test critical values:	1% level	–3.501445
	5% level	–2.892536
	10% level	–2.583371

As indicated above, the null hypothesis could not be rejected for gross domestic product, current public expenditures and unemployment, at any significance level, whereas only public spending (inclusive of capital outlays) proved to be stationary at all significance levels. As for tax revenues and inflation, the existence of unit roots is rejected at 1 per cent level, in the former and at 1 and 5 per cent levels in the latter series; as shown by Table 7 in the Statistical Appendix, the ADF test proves that $I(1)$ series turn out to be stationary in all cases. In the light of quoted results, first differences of logarithms of gross domestic product (GDP), public expenditure (*PE* and *PEK*) and tax revenues (*TR*) were used together with first differences of unemployment (*UNE*) and inflation (*INFL*) rates.[4]

The ensuing expression (1) stands for the reduced form of the used VAR model:

$$X_t = A\,(L)\,X_{t-1} + U_t \tag{1}$$

where $X_t = [PE_t,\ TR_t,\ GDP_t,\ UNE_t,\ INFL_t]'$ denotes the vector of endogenous variables whose order is (5 x 1), A is the matrix of autoregressive coefficients of order (5 x 5), whereas the vector $U_t = [u_t^{pe}\ u_t^{tr}\ u_t^{gdp}\ u_t^{une}\ u_t^{infl}]'$, of order (5 x 1), includes the reduced form stochastic residuals. Ordinary Least Squares were resorted to in order to estimate the reduced VAR model's equations; estimated coefficient, *r*-squares and *F*-Statistics values are shown in Tables 1 and 4 in the Statistical Appendix, for public spending exclusive and inclusive of capital outlays respectively.

All equations include lags to each of endogenous variable, their appropriate length being determined by usual information criteria[5] and an intercept omitted in (1) for simplification.[6] Let it in this regard be said that the choice of the lag number took into account the trade-off between long lag lengths' costs, in terms of consumed degrees of freedom, and the small lag-lengths' risk of model misespecification. The matter was dealt with in a iterative way by starting with a lag number sufficiently large that met the "degrees of freedom" restriction. From Tables 2 and 5 (in the Statistical Appendix) which include the results for the various Lag Order Selection Criteria, and for public spending inclusive and exclusive of public capital formation respectively, Akaike's value for 12 lag order turned out to be the more significant for what this lag length was imposed to variables in the estimation of the VAR.[7]

4. Impulse-response Functions

As stressed by Perotti (2004), reduced form residuals (vector U_t above) may be also interpreted as a linear combination of the following three items: the *automatic* (or unanticipated) *response* of fiscal variables to shocks in other variables,

---

4 As, in general, the estimation of A yields consistent autoregressive coefficients, many authors directly resort to VAR in levels choosing to ignore the non-stationarity problem. Nevertheless, Kamps (2005) points out, quoting Phillips (1998), that impulse-response functions "...based in the estimation of unrestricted VAR models are inconsistent at long horizons in the presence of non-stationary variables".

5 That is, Akaike, Schwarz or Hannan-Quinn.

6 Econometric tests including dummy variables in those periods in which the Argentine economy faced situations of strain or underwent abrupt changes (*i.e.* hyperinflation in 1989 or the start of convertibility in 1991) did not render significantly different impulse-response, for which reason they were not considered in the model specification.

7 Many an econometrician would defend the point that 12 quarters (three years) suffice to capture the system's dynamics.

the sys*tematic discretionary response*[8] of policymakers to innovations in variables and the *random discretionary (or structural) shocks* to fiscal policy, the latter being the ones upon which the analysis is focused when impulse-response to fiscal shocks are estimated.

When analyzing dynamic effects of a VAR model, identification is a necessary step in order to ensure that impulse response functions yield proper structural interpretations and this is done by imposing appropriate contemporaneous restrictions on the vector U_t. In this case, the Choleski Decomposition of the residuals' matrix of covariances was resorted to and restrictions imposed to the model rendered expression (2) below that links random errors of the reduced form with structural errors:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} u_t^{pe} \\ u_t^{tr} \\ u_t^{gdp} \\ u_t^{une} \\ u_t^{\inf l} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{pe} \\ \varepsilon_t^{tr} \\ \varepsilon_t^{gdp} \\ \varepsilon_t^{une} \\ \varepsilon_t^{\inf l} \end{bmatrix} \quad (2)$$

Let it be pointed out that the variable ordering expressed by (2) assumes that: public expenditure does not contemporaneously react to innovations in the rest of variables, tax revenues are not contemporaneously affected by shocks to other variables except for public spending innovations, gross domestic product only reacts to contemporaneous shocks to public spending and taxes, unemployment is contemporaneously affected by innovations in all the variables but inflation and inflation contemporaneously reacts to shocks to the rest of variables in the model. Needless to emphasize, the above placed restrictions only apply to the initial period since all variables in the model are permitted to interact freely in all periods following the one in which the innovation takes place.

In relation to the possibility of cointegration among variables, its almost certain minor impact upon the estimation of impulse response functions, in the light of VAR methodology's results, avails the decision not to take the hypothesis into consideration;[9] in fact, diverse ordering and contemporaneous restrictions placed to variables (not shown in the paper) showed robust results.[10]

---

8 Following Blanchard and Perotti's viewpoint (2002), the assumption was upheld that discretionary responses take more than a quarter to respond and therefore they are not captured by the used quarterly data.

9 The possibility and effects of cointegration are more important when long run relations are being analyzed; it would be advisable, in that case, to use VECM as it explicitly considers such relations and ensures in turn a better treatment of series used for analysis and forecasting purposes.

10 See next section.

5. Dynamic impact of shocks, robustness and granger causality

Plots in Figure 1 display the dynamic impact of current public expenditure (wages, government purchases and transfers to the private sector) and taxes upon the gross domestic product, unemployment and inflation rates for a horizon of 18 quarters, the shocks amounting to a positive innovation (increase) of both the fiscal variables; furthermore, the impact of product, unemployment and inflation shocks upon fiscal variables is also depicted. Particularly, the purpose of estimating impulse response functions of fiscal variables, unemployment and inflation when supply shocks (positive innovations in product) occur was to empirically verify a possible inverse ordering between product and fiscal variables[11] as well as the impact of product's positive innovations, if any, upon employment and economic stability in Argentina.

Each graph includes a point estimation of impulse response functions[12] as well as lower and upper bounds for a 95 per cent confidence interval. As usual, the solid lines depict the variable percent change in response to a standard deviation of one in the respective fiscal variable whereas the dotted lines represent the 95 per cent error bands. Graphs in Figure 2 depict in turn impulse response estimations for gross domestic product only, assuming negative shocks to fiscal variables (spending and tax cuts) while the same quarter number and error bands are maintained.

Plots in the left hand side of Figure 1 (first two columns), with the response of variables to positive innovations in current public spending and taxes, show behavioral patterns that cast doubts on the real effect of shocks. In the first place, the magnitude of impact upon product, unemployment and inflation were surprisingly minimal as following a 1 percent increase in fiscal variables the former reacted with changes in general well below the mentioned percentage; furthermore, by including the error bands the 0-value in almost all the time path estimated impulse response functions fall short from being significant enough in most of cases.

Nevertheless, several cases deserve a comment: in current public spending as well as in taxes the reactions to their own shocks were statistically significant but short-lived (five and three quarters respectively). The explanation to this resides in that innovations to a variable impact all the variables in the system (included the variable itself) for what the impact of an initial shock may continue through time, given the lag structure, its being transmitted also to the same variable via the effects upon the rest. In the case of gross domestic product, the impulse response pattern permits to infer that – at the outset – the fiscal shock gives way to a typical but limited Keynesian demand push, lasting for two or three quarters; it is worth stressing here that apart from the fact that the lack of persistence is accompanied by a rather negligible response size (less than 0.5 per cent), the response soon becomes negative raising suspicions of crowding out effects.

---

[11] Diverse authors (Lütkepohl, 2001) accept that the impulse response analysis can also be regarded as a type of reverse causation test.

[12] Impulse response functions show the response of variables to an innovation of 1 percent.

Product's negative response to shocks to taxes depicted by the graph, and statistically significant for at least three quarters, seems to be somehow agreeing with supply-side supporters' view that a displacement of private economic activity is to be expected soon after a tax increase. Nevertheless, the markedly low impact and the lack of statistical significance along the time horizon calls for caution at the moment of uttering definite conclusions.

A much clearer pattern is shown in relation to unemployment, as the variable's response to spending shocks hardly differs from zero in the whole time horizon. This feature helps explaining the almost null influence of transfers to the private sector in employment creation, as is also evident from discretionary plans to assist household heads without income[13] rather than aiming at reinserting the jobless within formal labor markets.

The null effect of spending shocks on inflation is a rather intriguing result of the VAR estimation which still remains without explanation. However, a more predictable feature is rendered by the response of inflation to tax increases: while inflation slightly declines on impact (according to what macroeconomic theory would predict) it immediately climbs to reach a maximum in the fourth quarter from where the impact starts to cyclically fade away for the rest o the time horizon. This result is closely related to the overwhelming preeminence of indirect taxation causing that the first round effect of any positive tax change be a consumption reduction, followed later on by a price increase.

An interesting case of analysis arises out of the impact of spending shocks upon taxes: as the latter are clearly dragged by shocks to the former (as the plot's hump-shaped response shows), impulse response of spending to taxes are practically null and no evidence of inverse causation exists: in any case, spending's positive effect lasts until the fourth or fifth quarter with a maximum value around the fourth quarter. The results of the impulse response function thus prove what is intuitively perceived: there is a close correlation between the expansion of public spending and fiscal revenues whose sequence is what the traditional government budget constraint would indicate.

Plots in the third column of Figure 1 mainly aim at assessing whether results for impulse response functions enable to assume reverse causation among gross domestic product and fiscal variables, unemployment and inflation. In starting with the first graph, a positive impact of a supply shock upon public spending is shown as of the first through the fifth quarter, although the evidence is far from being conclusive given that estimations do not significantly differ from 0.[14] Nevertheless, a slight public spending increase cannot be ruled out following a product shock. In turn, tax revenues' lack of response (as shown by the second plot in the column) can be explained by the rather limited reaction of taxes to product shocks owing to the

---

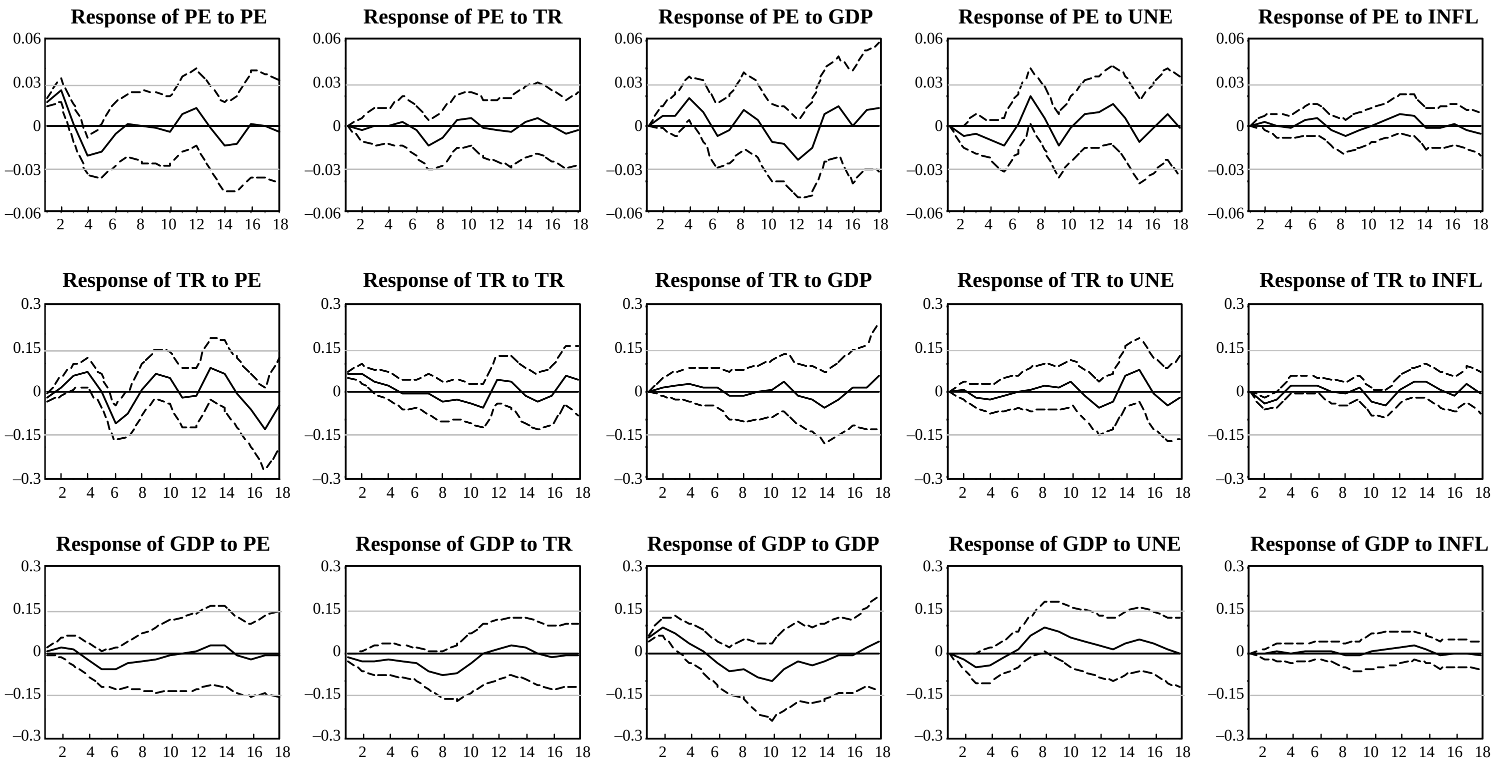
13 Known as Plan Jefes y Jefas de Hogar.

14 As is noticed, in many cases error bands include also the 0-value.

Figure 1

Impulse-response Functions: Response to Positive Fiscal Shocks*

Response to Cholesky One S.D. Innovations ± 2 S.E.

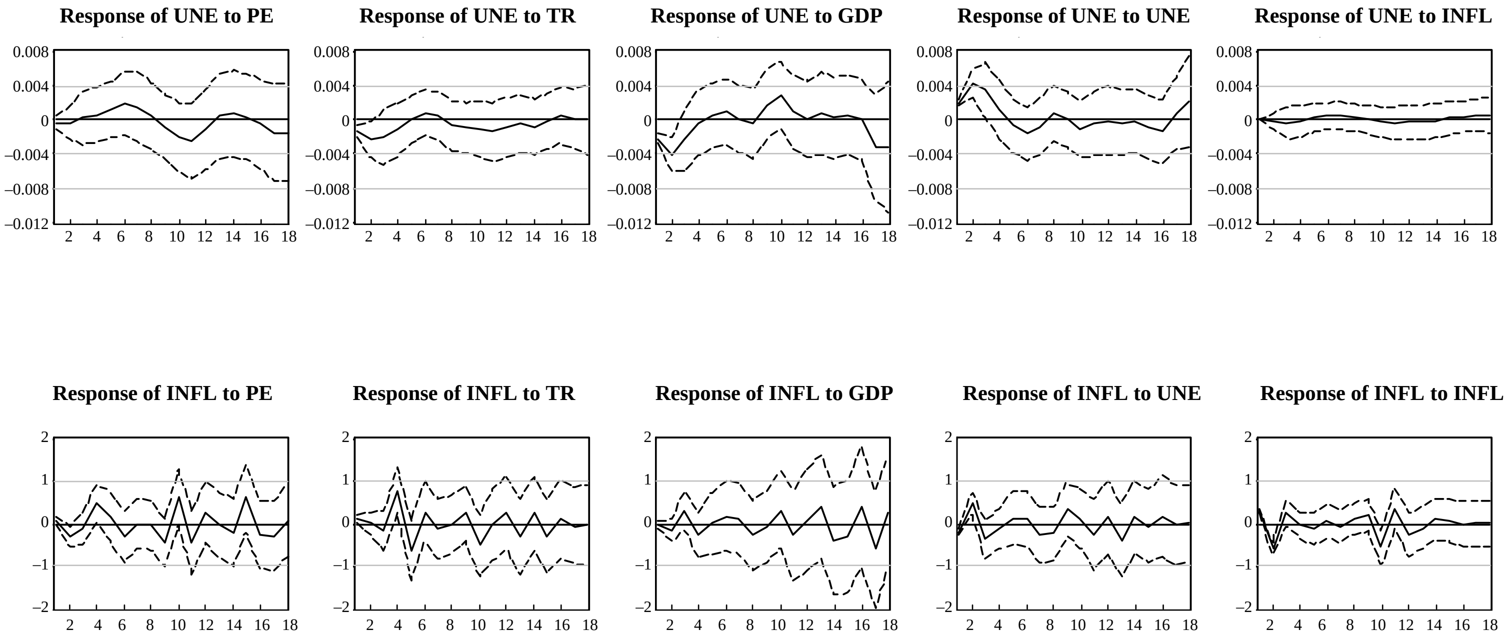


* Capital outlays not included in public expenditure.

Figure 1 (continued)

Impulse-response Functions: Response to Positive Fiscal Shocks*

Response to Cholesky One S.D. Innovations ± 2 S.E.

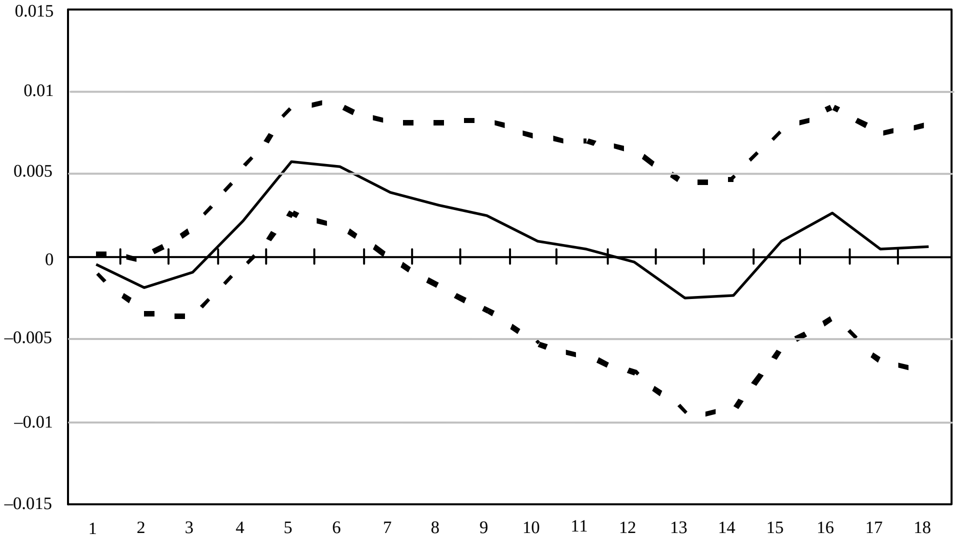


* Capital outlays not included in public expenditure.

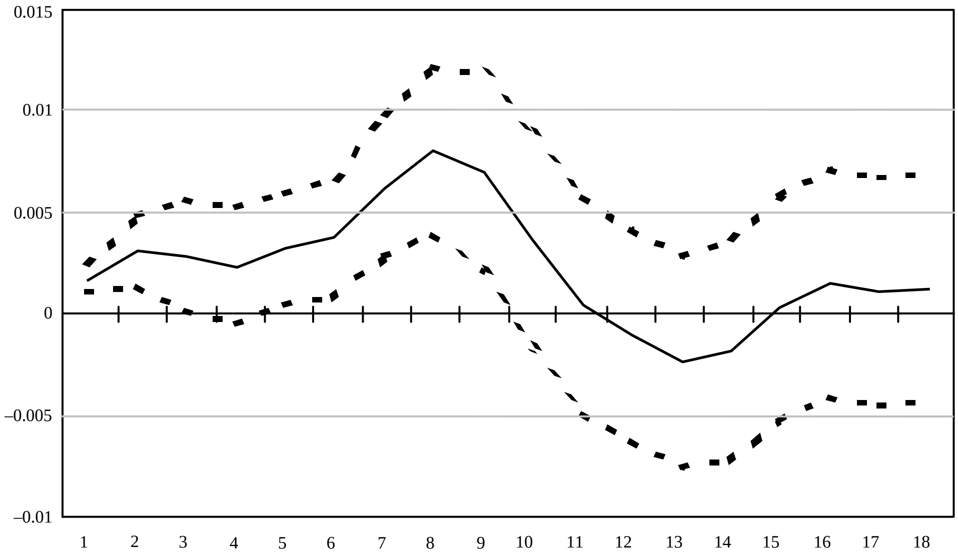
Figure 2

Impulse-response Functions: Response to Negative Fiscal Shocks*

Response of GDP to PE



Response of GDP to TR



* Capital outlays not included in public expenditure.

low income elasticity of the Argentine Tax System.[15]

Although unemployment behaves as expected (and predicted by economic theory) decreasing on impact, the negligible statistical relevance of results could be indicating a capital intensive feature of product innovations which would hardly in turn help to boosting employment to higher levels.

The response of inflation to product innovations is intriguing, to say the least: it is negative on impact as standard textbook presentations would indicate but thereafter not only that the effect is long-lived but also the plot shows a cyclical pattern with cycles of opposite sign successively offsetting each other as the effect tend to increase by the end of the time horizon (eighteenth quarter) although, again, different from 0 estimations for the impulse response are not guaranteed.

In interpreting results for shocks to inflation (fifth column in Figure 1) only two graphs seem to be worth mentioning: the negative impact on taxes, statistically significant in the first four quarters and the same variable's cyclical response to the innovation during the three first quarters. While a not straightaway explanation is at hand for the latter case, evidences of the Olivera-Tanzi effect may be underlying the impulse-response in the former case.

Finally, the short-lived persistence of shocks (between 2 and 5 quarters in the cases in which the impact is significant) falls in line with what many specialists have already pointed out. Suffice it in this connection to quote Fair (1979) saying that the forecasting performance of unrestricted VAR's is poor after about one year; the point has been also stressed by Blinder (in Kopcke, Tootell and Triest, 2006) who asserted that most of evidence from VARs and large-scale econometric models suggested that outside lags[16] for fiscal policy were substantially shorter than the corresponding to monetary policy.

In relation to the dynamic impact of negative fiscal innovations (spending and tax cuts) upon product, a first glance to plots in Figure 3 will lead one to assert that the results do not have statistical significance, in view that the maximum and minimum values for gross domestic product response to negative fiscal innovations hardly reach 0.5 and –0.2 per cent respectively. This conclusion cannot however be considered surprising in any way as it falls in line with results already shown by positive fiscal shocks; in fact, the impulse response function shows, in relation to negative spending shocks, that the product – after an initial fall lasting for 3 quarters – takes positive values until the twelfth quarter even when it results dubious to assert that estimates differ from 0 beyond the seventh quarter. As explained for positive spending shocks, results show at the outset a non persistent Keynesian demand push upon product but – as was already pointed out in the case of positive spending innovations – traces of crowding out effects upon private activity can not be discarded as the graph's hump-shaped response shows it.

---

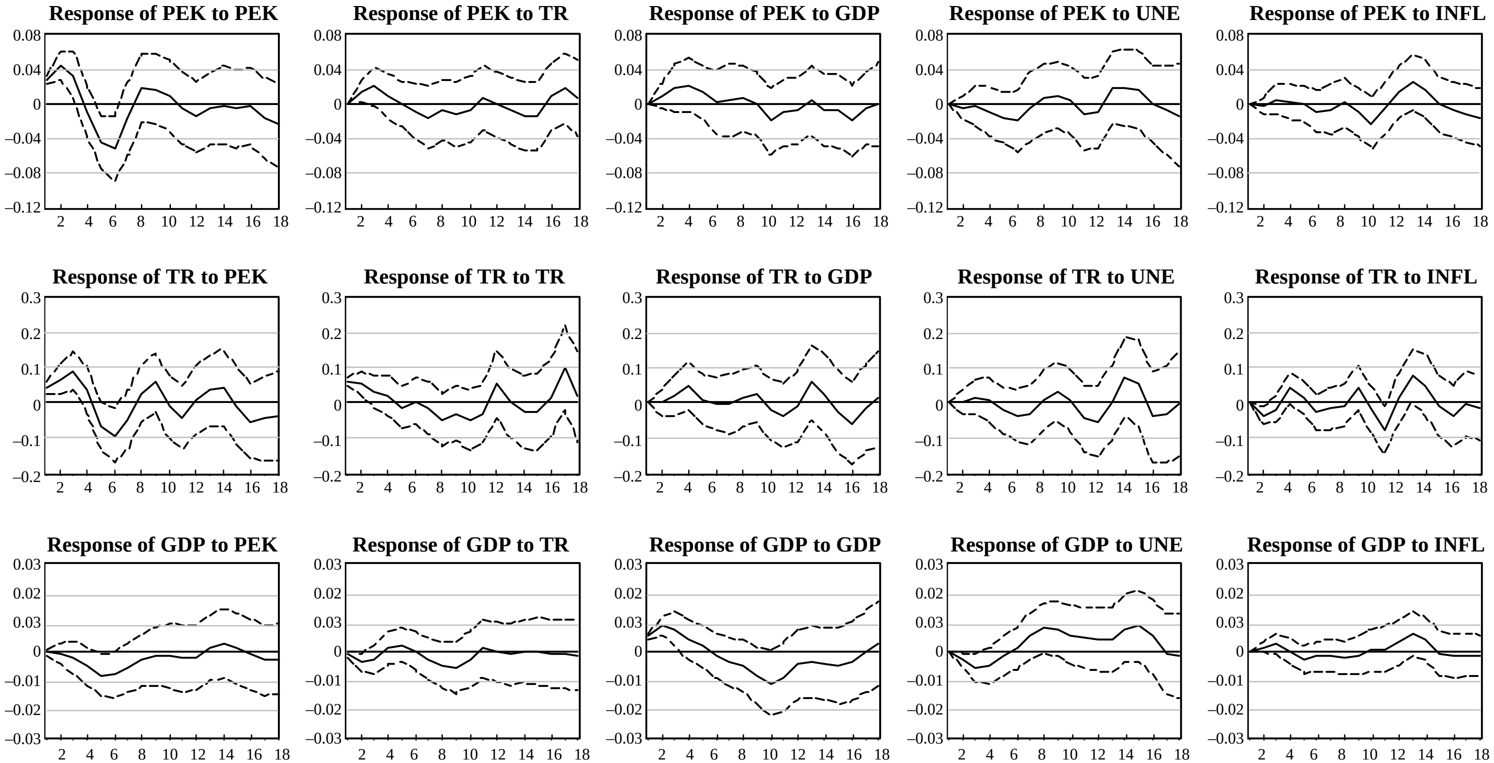
[15] This feature, and the need to correct it, have always been in policymakers' agendas as a prioritary subject still awaiting resolution.

[16] Outside lags stand for the time that runs between a policy shock and its effect upon the economy.

Figure 3

Impulse-response Functions: Response to Positive Fiscal Shocks*

Response to Cholesky One S.D. Innovations ±2 S.E.

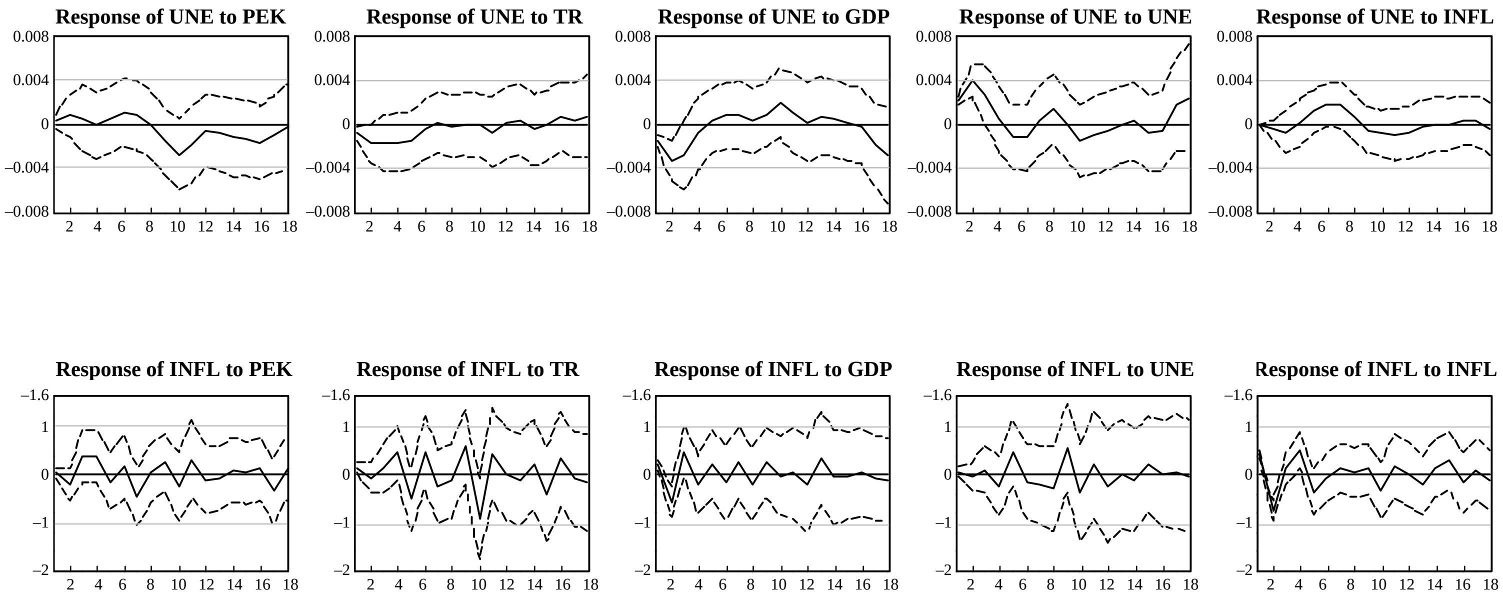


* Capital Outlays included in Public Expenditure.

Figure 3 (continued)

Impulse-response Functions: Response to Positive Fiscal Shocks*

Response to Cholesky One S.D. Innovations ±2 S.E.



* Capital Outlays included in Public Expenditure.

More conclusive and long lived – despite its low statistical significance – is the pattern of product response to a negative tax shock, which extends for eleven quarters and gives somehow support to supply-side economists' claims on the damaging effects of the fiscal hedge upon product[17] caused by distorting taxation.

In spite of the above mentioned difficulties for counting with sound capital formation series, let alone the matter of identifying who is actually building public investment in Argentina, impulse response functions plotted in Figure 3 overleaf were estimated in order to ascertain whether the dynamic impact of fiscal variables upon macroeconomic variables – when capital outlays are accounted for – differed markedly from the case in which only current public expenditure was considered. Thus, graphs in Figure 3 stand for product, unemployment and inflation's response to positive spending and tax innovations and also include the impact of supply shocks, unemployment and inflation upon all the other variables. Finally, the graph in Figure 4 shows the impulse response function of product to negative shocks (public spending cuts) to fiscal variables.

As may be seen, not only that impulse response functions' quality is not impaired by the inclusion of public capital outlays but this improves at least on the following two accounts: in some cases, impulse responses are now statistically different from 0 and in others shocks have a longer-lived impact upon variables. However, in most of the cases results do no exhibit noticeable changes except for minor differences in the plots' shape or maximum and minimum values reached.

Major differences were found particularly in public spending response to tax shocks and in the more significant and greater reaction of taxes to spending innovations bringing to surface a reverse causation situation not shown in the previous case. Also, inflation response to product innovations seems now to be higher, longer lived and clearly different from 0. Finally, impulse response for product and unemployment to product innovations show now short-lived and tenuous but expected reactions to inflation shocks, particularly in the latter case.

One of surprising results, despite its relative statistical significance, is the fall in product that follows a public spending (inclusive of capital outlays) innovation as it puts at a stake the idea of externalities associated to public capital provision. Strange as it may seem, the point has already been pointed out by Kamps (2005) who – in finding a similar pattern for some OECD countries – suggested that unless public capital were conceived to have a negative marginal productivity another possible explanation could be that public and private capital were substitutes in the short run for what the positive innovation to the former would crowd out the latter.[18]

---

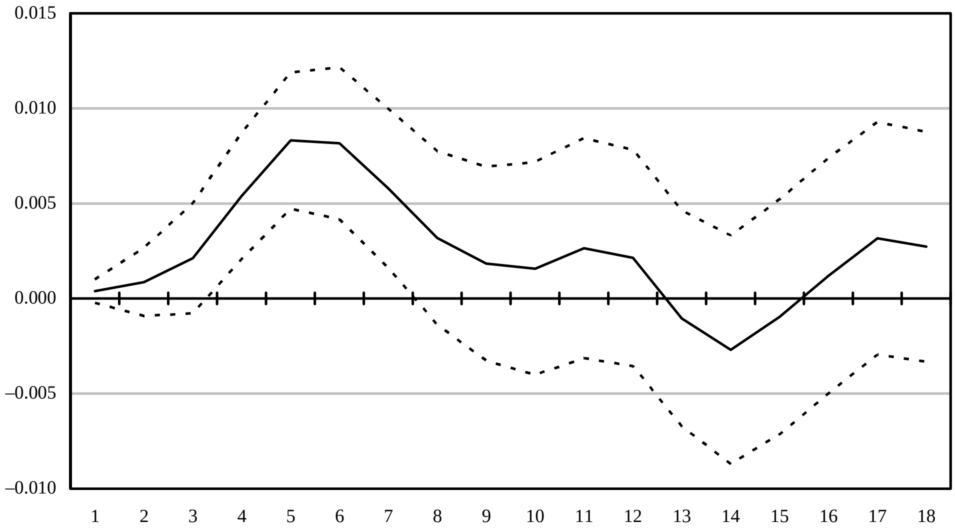
17 Although this conclusion seems to be at odds with allegedly available evidence about the very limited incidence upon the product of tax cuts implemented in Argentina in various opportunities, either in Social Security Contributions, or in provincial Transactions and Property Taxes, founded conclusions in this matter still wait for a thorough empirical analysis.

18 Kamps (2005) also suggested that crowding out effects could also reach employment and this is somehow depicted by point estimates of impulse response which increases at the beginning but it decreases after the eighth quarter.

Figure 4

Impulse-response Functions: Response to Negative Fiscal Shocks

Response of GDP to PEK



* Capital Outlays included in Public Expenditure.

Product reaction to a negative spending shock (Figure 4) in turn shows that the response magnitude is larger when public outlays are taken into account even when the impact of the shock is less persistent (7 quarters instead of almost 10) considering the section in which the impulse response is more significant. The feature is however stressed of a likely crowding out effect implicitly built-in the plot’s positive hump-shaped pattern as product increases when public spending dwindles.

Robustness of estimations was empirically dealt with in the paper by testing whether the impulse response functions achieved through the recursive approach of autoregressive vector methodology were sensitive to the variable ordering; for that, alternative variable orderings to the one in the benchmark model in (2) were econometrically tested, as for instance: allowing contemporaneous effects of product upon fiscal variables, changing the order between fiscal variables and also allowing product to receive contemporaneous effects of all other variables in the VAR model.

Although results (not shown here) can not be taken as definitive, as series improvement is always a possibility when applying VARs models, estimations found with alternative variable orderings did not substantially differ from those rendered by the benchmark specification (Figures 1 to 4). In sum, differences were hardly noticeable and lacked in general statistical significance even in cases where orderings showed an extreme departure from the benchmark model.

Public Spending exclusive of Capital Outlays	**Public Spending inclusive of Capital Outlays**
TR does not Granger cause PE	TR Granger causes PEK
GDP Granger causes PE	GDP Granger causes PE
UNE does not Granger cause PE	UNE does not Granger cause PE
INFL Granger causes PE	INFL Granger causes PE
PE Granger causes TR	PEK Granger causes TR
GDP Granger causes TR	GDP Granger causes TR
UNE Granger causes TR	UNE does not Granger cause TR
INFL Granger causes TR	INFL Granger causes TR
PE Granger causes GDP	PEK Granger causes GDP
TR Granger causes GDP	TR Granger causes GDP
UNE does not Granger cause GDP	UNE Granger causes GDP
INFL does not Granger cause GDP	INFL Granger causes GDP
PE does not Granger cause UNE	PEK does not Granger cause UNE
TR does not Granger cause UNE	TR does not Granger cause UNE
GDP does not Granger cause UNE	GDP does not Granger cause UNE
INFL does not Granger cause UNE	INFL does not Granger cause UNE
PE Granger causes INFL	PEK Granger causes INFL
TR Granger causes INFL	TR Granger causes INFL
GDP Granger causes INFL	GDP Granger causes INFL
UNE does not Granger cause INFL	UNE does not Granger cause INFL

Source: Tables 3 and 6 in the Statistical Appendix.

As known, Granger causality tests verify whether the lags of one variable enter into equations for other variables the implication being that, when the null hypothesis holds, the sequence of a variable does not cause other variables' sequence. As Enders (1995) states it, the latter amounts to saying that the past values of a variable's disturbance (ε) do not affect the other variables and therefore they cannot either improve the forecasting performance of the variables' sequence.[19]

Results for Granger causality shown in Tables 3 and 6 in the Statistical Appendix, for total public expenditure (exclusive and inclusive of capital public spending) indicate that the null hypothesis stating that a given variable does not Granger cause another variable is accepted eleven times and rejected seven in the first case whereas in the second one acceptances amount to seven and rejections to thirteen.

According to the test's results in Table 3, current public expenditure Granger causes tax revenues, gross domestic product and inflation, tax revenues in turn

[19] A point worth clarifying here is the difference between Granger causality and exogeneity, as the conditions for the latter require not only that past values, but also current values of a variable not to affect the other variables.

Granger causes gross domestic product and inflation, gross domestic product Granger causes public spending, tax revenues and inflation, unemployment Granger causes tax revenues and finally inflation Granger causes public spending and net revenues.

When total public spending is used (Table 6), only unemployment is not Granger caused by the other variables whereas it does not Granger cause public expenditure, tax revenues and inflation either.

As can be noticed, results of Granger tests naturally fall in line with the variables' degree of response to the various shocks, as depicted by Figures 1 and 3 above.

6. Conclusions

The VAR model used permitted to estimate impulse response functions to showing the impact of positive and negative shocks to fiscal variables upon various macroeconomic variables in Argentina. The exercise was carried out for the period 1984-2005 (second quarter) and quarterly data for public expenditure, tax revenues, gross domestic product, unemployment and inflation rates were used.

While the short impact duration and low statistical significance of many an estimated impulse response is the first feature to be emphasized, results showed that variables did not behave sometimes in the way standard textbook presentations would predict it.

In the first place, positive shocks to public spending caused product to increase on impact but soon after the plot's decreasing pattern supplied crowding out evidences. The latter helps also to explain – via the reduction in product – why tax revenues first increased but soon later reacted negatively to positive spending innovations.

The relevant finding of a short lived fall in unemployment, following a public spending increase, arose as a proof that transfer spending in Argentina fed "asistencialista" programs (relief to the poor) rather than promoting employment or reinsertion in formal labor markets.

The negative (although minimal) response of gross domestic product to tax increases and later the tax revenue reaction to positive product innovation, when reverse causation was ascertained, were respectively taken as an evidence of what supply side economics normally asserts and as the natural response to a tax system based mainly on indirect taxes and characterized by a low income elasticity of taxes.

The increase in public spending following a positive shock to taxes and the positive response of taxes to expenditure innovations is a result that, apart from indicating that both the instruments drag each other, deserves further microeconomic considerations (beyond the scope of this paper) related to the efficiency and efficacy of additional public outlays and revenues.

Impulse responses of product to public spending shocks, contrariwise to what the received economic theory predicts, show that both are substitutes in the short run and that crowding out effects cannot be ruled out

As regards the possibility of reverse causation between the product and the other variables, the point must be stressed that all behaved as Keynesian approaches would have predicted it (at least on impact or for a reduced number of quarters) following a supply innovation. Nevertheless, the negligible statistical significance in some of the considered cases endangered the chances of achieving sufficiently strong evidences.

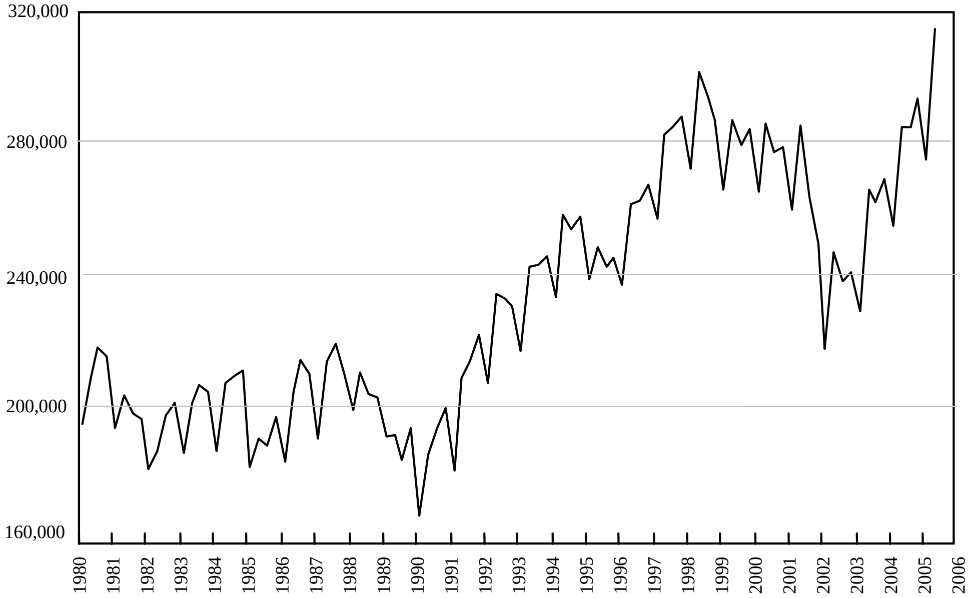
The product response to negative fiscal shocks (spending and tax cuts) not only confirmed but also strengthened evidences found in the preceding findings. Possibilities of crowding out and the damaging effect of distorting taxes upon product were backed by longer-lived shocks' impact and point estimates significantly different from 0.

Finally, Granger causality tests were performed to test the null hypothesis of one variable's lagged values not affecting other variables. The hypothesis resulted accepted in twelve cases and rejected in eight, confirming in general the impulse response analysis.

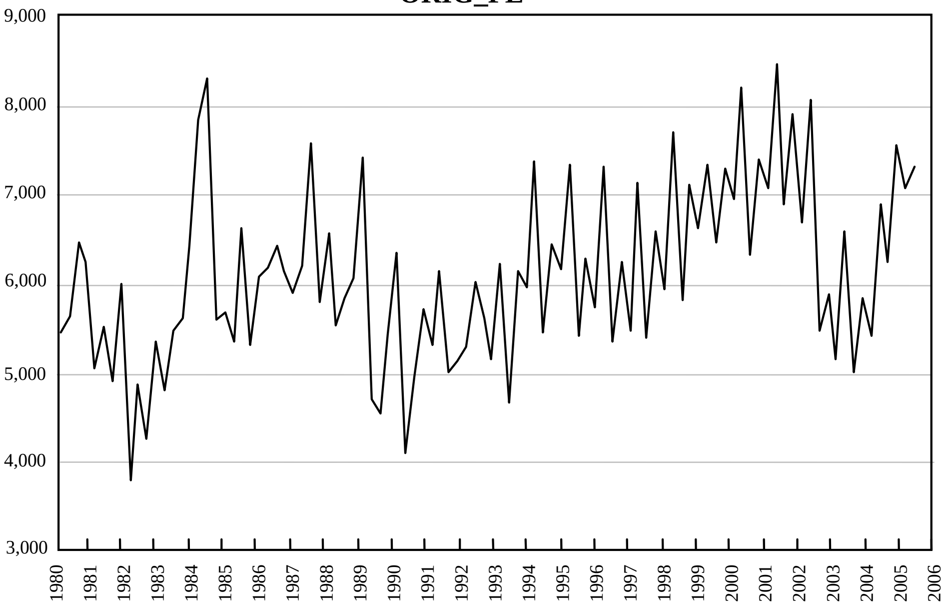
In summing up the main results, structural VARs estimates in the paper reassessed the widespread perception of certain fiscal policy shocks' weakness given their limited impact upon macroeconomic variables and that answering whether Keynesian or alternative macroeconomic policies should be resorted to is still an unsolved subject deserving more investigation.

GRAPHICAL APPENDIX[20]

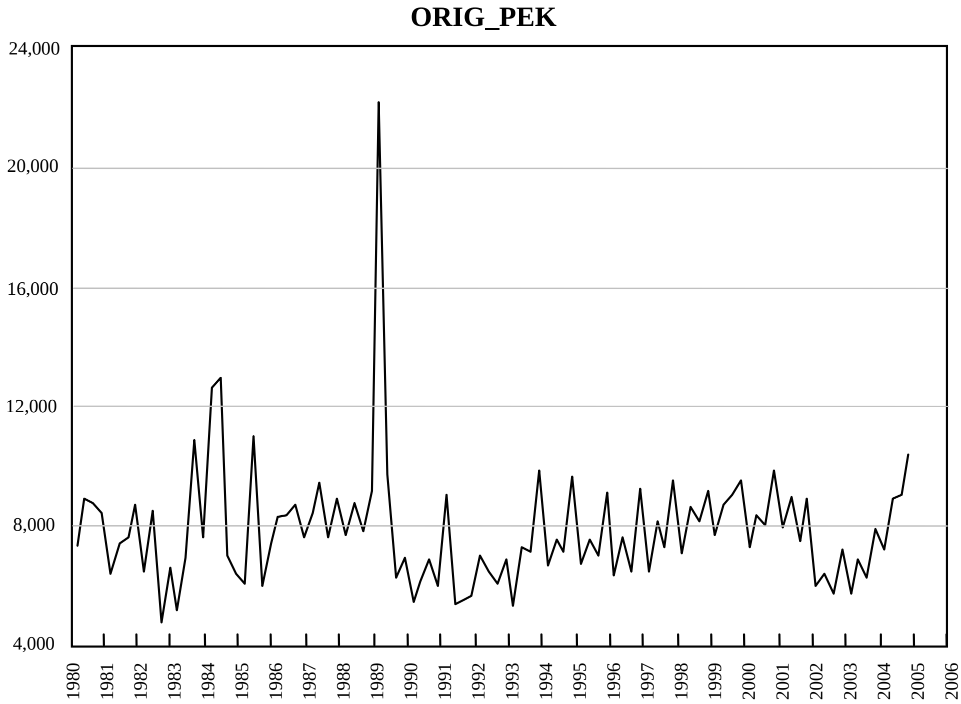
ORIG_GDP

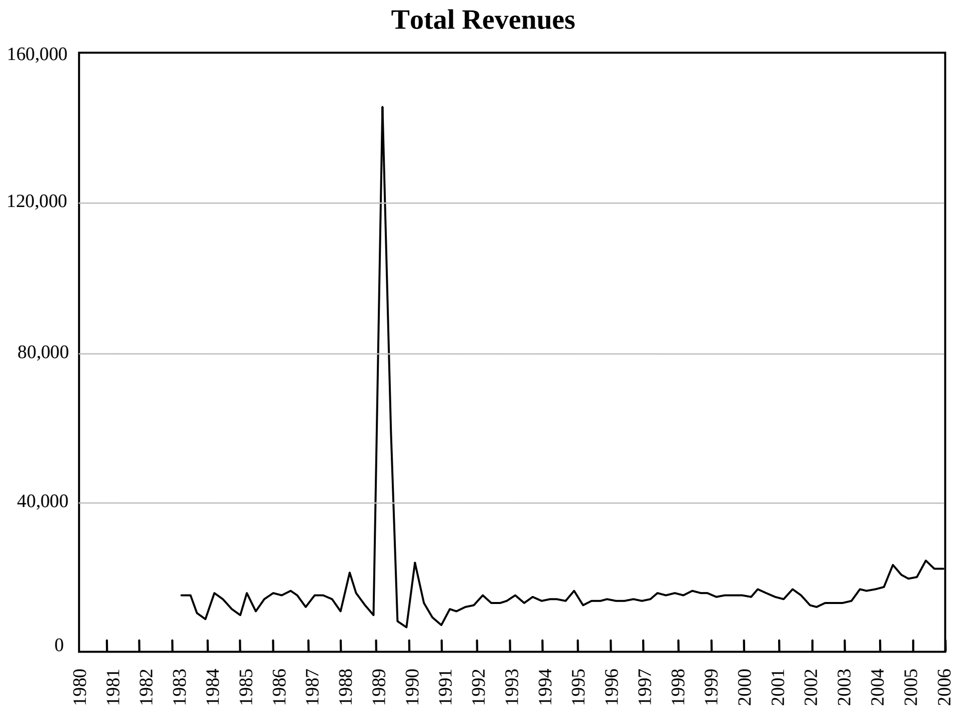


ORIG_PE

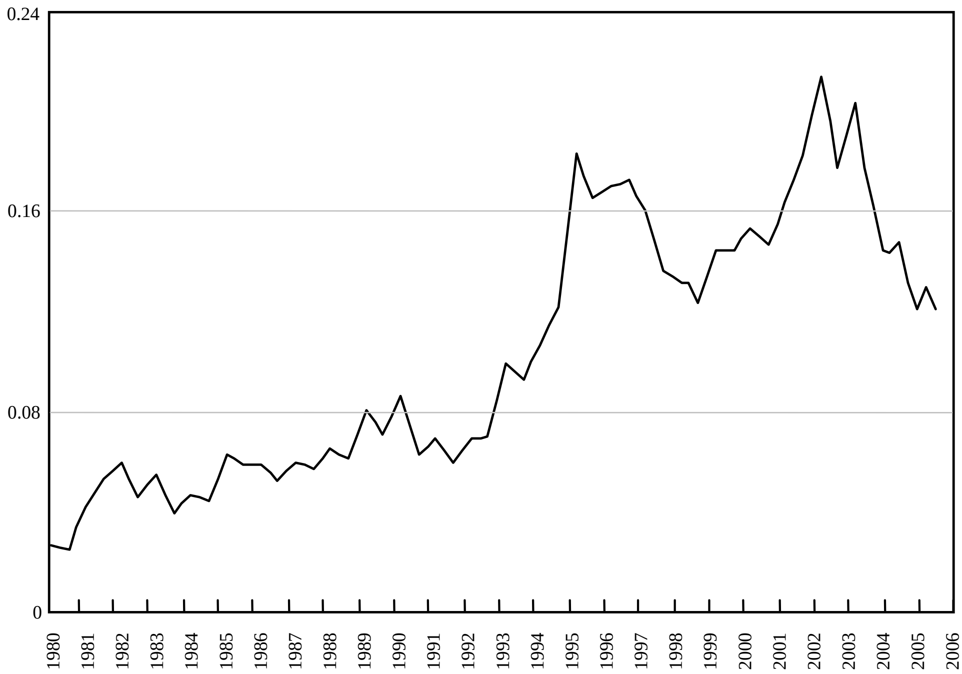


[20] Database including also series used is available from the author on request.

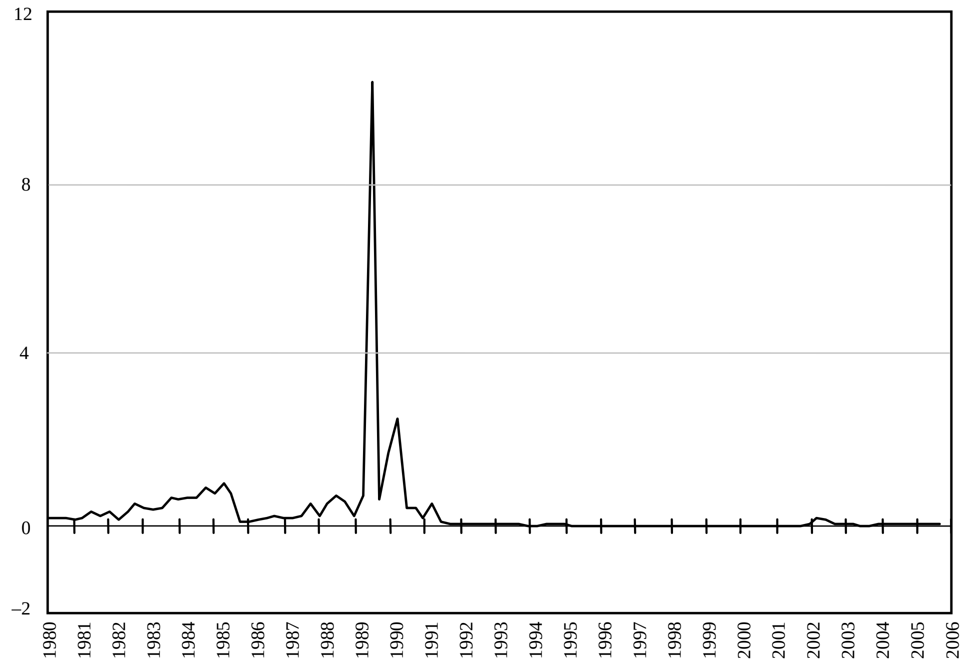

ORIG_PEK
24,000
20,000
16,000
12,000
8,000
4,000
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006


Total Revenues
160,000
120,000
80,000
40,000
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

ORIG_UNE



Inflation



STATISTICAL APPENDIX

Table 1

Application of VAR Methodology to the Model's Reduced Form: OLS Estimation when Public Expenditures Do not Include Capital Outlays[21]

Vector Autoregression Estimates

Sample (adjusted): 1986:2 – 2004:4

Included Observations: 75 after adjusting endpoints

Standard Errors in ( ) & *t*-statistics in [ ]

	PE	TR	GDP	UNE	INFL
PE(–1)	1.223343	2.826074	0.006534	0.032197	2.442398
	(0.24025)	(0.91080)	(0.07945)	(0.04773)	(5.78826)
	[5.09185]	[3.10285]	[0.08224]	[0.67456]	[0.42196]
PE(–2)	–1.094585	–2.063699	0.034755	–0.069201	–38.30984
	(0.55534)	(2.10528)	(0.18365)	(0.11033)	(13.3794)
	[–1.97101]	[–0.98025]	[0.18924]	[–0.62724]	[–2.86335]
PE(–3)	–0.026695	–1.482412	–0.028539	0.064482	37.79637
	(0.58730)	(2.22646)	(0.19422)	(0.11668)	(14.1494)
	[–0.04545]	[–0.66582]	[–0.14694]	[0.55266]	[2.67123]
PE(–4)	0.186995	2.479978	–0.180272	0.030350	–16.24888
	(0.28851)	(1.09374)	(0.09541)	(0.05732)	(6.95087)
	[0.64814]	[2.26743]	[–1.88943]	[0.52953]	[–2.33768]
PE(–5)	–0.302422	–0.517758	0.088361	–0.009189	–3.996361
	(0.27278)	(1.03411)	(0.09021)	(0.05419)	(6.57191)
	[–1.10866]	[–0.50068]	[0.97952]	[–0.16957]	[–0.60810]
PE(–6)	0.141171	1.311424	–0.034048	0.019695	6.787192
	(0.26566)	(1.00710)	(0.08785)	(0.05278)	(6.40024)
	[0.53141]	[1.30218]	[–0.38756]	[0.37318]	[1.06046]

[21] Complete Vector Autoregression Estimates are available from the author on request.

PE(–7)	–0.252343	–0.861805	–0.000187	–0.021879	–11.34191
	(0.27218)	(1.03184)	(0.09001)	(0.05407)	(6.55751)
	[–0.92710]	[–0.83521]	[–0.00208]	[–0.40462]	[–1.72961]
PE(–8)	–0.114914	–0.629174	–0.120953	0.027261	9.898751
	(0.29218)	(1.10767)	(0.09663)	(0.05805)	(7.03936)
	[–0.39329]	[–0.56802]	[–1.25178]	[0.46964]	[1.40620]
PE(–9)	0.392849	2.163988	–0.020850	0.023957	7.108713
	(0.27002)	(1.02365)	(0.08930)	(0.05364)	(6.50545)
	[1.45487]	[2.11399]	[–0.23350]	[0.44660]	[1.09273]
PE(–10)	–0.294416	–0.865236	–0.065824	–0.055651	–14.55478
	(0.36026)	(1.36573)	(0.11914)	(0.07157)	(8.67940)
	[–0.81724]	[–0.63353]	[–0.55250]	[–0.77758]	[–1.67693]
PE(–11)	0.066998	–0.669178	–0.025035	0.054155	16.19582
	(0.36983)	(1.40201)	(0.12230)	(0.07347)	(8.90995)
	[0.18116]	[–0.47730]	[–0.20470]	[0.73710]	[1.81772]
PE(–12)	0.250213	1.067416	–0.121018	–0.012514	–7.761067
	(0.16993)	(0.64421)	(0.05620)	(0.03376)	(4.09407)
	[1.47242]	[1.65693]	[–2.15347]	[–0.37069]	[–1.89568]
TR(–1)	–0.135098	1.067778	–0.045461	0.008403	5.925813
	(0.09503)	(0.36027)	(0.03143)	(0.01888)	(2.28957)
	[–1.42158]	[2.96383]	[–1.44655]	[0.44506]	[2.58818]
TR(–2)	0.207174	0.281335	0.022010	–0.003765	–1.629933
	(0.11548)	(0.43777)	(0.03819)	(0.02294)	(2.78206)
	[1.79409]	[0.64266]	[0.57636]	[–0.16412]	[–0.58587]
TR(–3)	–0.191414	–0.310863	0.002287	–0.003140	5.808556
	(0.09990)	(0.37870)	(0.03304)	(0.01985)	(2.40669)
	[–1.91614]	[–0.82087]	[0.06924]	[–0.15821]	[2.41350]
TR(–4)	0.050093	0.559696	0.021136	0.007767	3.163495
	(0.12116)	(0.45932)	(0.04007)	(0.02407)	(2.91902)
	[0.41345]	[1.21854]	[0.52751]	[0.32267]	[1.08375]

TR(–5)	0.102306	0.213069	–0.018545	–0.004074	0.826889
	(0.14104)	(0.53467)	(0.04664)	(0.02802)	(3.39790)
	[0.72538]	[0.39851]	[–0.39762]	[–0.14539]	[0.24335]
TR(–6)	–0.088744	–1.027070	0.062372	–0.003693	0.447133
	(0.10413)	(0.39475)	(0.03444)	(0.02069)	(2.50870)
	[–0.85225]	[–2.60181]	[1.81127]	[–0.17852]	[0.17823]
TR(–7)	–0.005050	0.444750	–0.045086	0.001508	3.630977
	(0.07409)	(0.28086)	(0.02450)	(0.01472)	(1.78487)
	[–0.06817]	[1.58356]	[–1.84025]	[0.10244]	[2.03431]
TR(–8)	0.045485	–0.146116	–0.006359	–0.002669	2.607119
	(0.04768)	(0.18077)	(0.01577)	(0.00947)	(1.14881)
	[0.95388]	[–0.80830]	[–0.40327]	[–0.28172]	[2.26940]
TR(–9)	–0.050508	0.229854	–0.003342	0.001795	0.691794
	(0.05370)	(0.20356)	(0.01776)	(0.01067)	(1.29366)
	[–0.94063]	[1.12917]	[–0.18820]	[0.16823]	[0.53476]
TR(–10)	0.036776	0.454391	0.006651	–0.000544	1.841223
	(0.05147)	(0.19511)	(0.01702)	(0.01022)	(1.23994)
	[0.71455]	[2.32891]	[0.39079]	[–0.05321]	[1.48493]
TR(–11)	0.023352	0.196270	0.006430	–0.003685	–2.310592
	(0.07108)	(0.26946)	(0.02351)	(0.01412)	(1.71243)
	[0.32853]	[0.72839]	[0.27355]	[–0.26099]	[–1.34931]
TR(–12)	0.014846	–0.130138	0.017149	0.001137	–1.039025
	(0.04576)	(0.17346)	(0.01513)	(0.00909)	(1.10234)
	[0.32446]	[–0.75026]	[1.13333]	[0.12505]	[–0.94256]
GDP(–1)	–0.227153	–1.800562	1.182416	0.108817	6.755200
	(1.09914)	(4.16681)	(0.36348)	(0.21836)	(26.4807)
	[–0.20666]	[–0.43212]	[3.25301]	[0.49835]	[0.25510]
GDP(–2)	0.670073	2.899751	–1.104212	–0.066598	23.81466
	(1.62809)	(6.17205)	(0.53841)	(0.32344)	(39.2242)
	[0.41157]	[0.46982]	[–2.05088]	[–0.20590]	[0.60714]

GDP(–3)	0.318329	5.471023	0.920331	–0.040388	–68.51897
	(1.76540)	(6.69257)	(0.58381)	(0.35072)	(42.5322)
	[0.18032]	[0.81748]	[1.57641]	[–0.11516]	[–1.61099]
GDP(–4)	–1.025541	–18.62245	–0.393185	–0.054783	12.18401
	(2.30620)	(8.74274)	(0.76266)	(0.45815)	(55.5613)
	[–0.44469]	[–2.13005]	[–0.51555]	[–0.11957]	[0.21929]
GDP(–5)	1.387611	14.84410	–0.369957	0.209890	106.9265
	(3.44311)	(13.0527)	(1.13863)	(0.68402)	(82.9520)
	[0.40301]	[1.13724]	[–0.32491]	[0.30685]	[1.28902]
GDP(–6)	1.206243	–2.538099	0.643640	–0.216711	–135.2719
	(3.29756)	(12.5010)	(1.09050)	(0.65510)	(79.4454)
	[0.36580]	[–0.20303]	[0.59023]	[–0.33081]	[–1.70270]
GDP(–7)	–3.011195	–0.853938	–0.383072	0.161557	90.40920
	(2.17558)	(8.24757)	(0.71946)	(0.43221)	(52.4145)
	[–1.38409]	[–0.10354]	[–0.53244]	[0.37380]	[1.72489]
GDP(–8)	4.386099	–2.237034	0.203893	–0.151725	–53.15904
	(1.89271)	(7.17522)	(0.62592)	(0.37601)	(45.5995)
	[2.31736]	[–0.31177]	[0.32575]	[–0.40351]	[–1.16578]
GDP(–9)	–4.343686	–0.668087	–0.000528	0.131012	10.66574
	(2.11804)	(8.02944)	(0.70043)	(0.42077)	(51.0282)
	[–2.05080]	[–0.08320]	[–0.00075]	[0.31136]	[0.20902]
GDP(–10)	3.819838	1.381154	–0.020500	–0.080274	48.33269
	(2.14533)	(8.13289)	(0.70946)	(0.42620)	(51.6857)
	[1.78054]	[0.16982]	[–0.02890]	[–0.18835]	[0.93513]
GDP(–11)	–2.830412	3.516398	0.182817	0.006338	–75.10920
	(1.80839)	(6.85554)	(0.59803)	(0.35926)	(43.5679)
	[–1.56516]	[0.51293]	[0.30570]	[0.01764]	[–1.72396]
GDP(–12)	1.279406	–5.631765	0.097368	–0.008341	38.45437
	(0.87424)	(3.31420)	(0.28911)	(0.17368)	(21.0622)
	[1.46346]	[–1.69928]	[0.33679]	[–0.04803]	[1.82575]

UNE(–1)	–3.199470	–10.28805	–1.399851	2.063352	87.76050
	(1.94716)	(7.38164)	(0.64392)	(0.38683)	(46.9113)
	[–1.64315]	[–1.39373]	[–2.17394]	[5.33405]	[1.87077]
UNE(–2)	5.138224	32.82339	1.568243	–2.210147	–57.24728
	(3.01284)	(11.4216)	(0.99634)	(0.59854)	(72.5857)
	[1.70544]	[2.87380]	[1.57400]	[–3.69259]	[–0.78869]
UNE(–3)	–8.096930	–31.31128	–1.503020	1.804176	–123.1604
	(4.59906)	(17.4349)	(1.52090)	(0.91366)	(110.801)
	[–1.76056]	[–1.79589]	[–0.98824]	[1.97467]	[–1.11154]
UNE(–4)	9.291831	13.69399	2.200813	–1.521431	204.4272
	(6.14542)	(23.2971)	(2.03228)	(1.22086)	(148.057)
	[1.51199]	[0.58780]	[1.08293]	[–1.24619]	[1.38074]
UNE(–5)	–9.232287	–8.211915	–2.992681	1.211730	–210.0794
	(6.84943)	(25.9660)	(2.26510)	(1.36072)	(165.018)
	[–1.34789]	[–0.31626]	[–1.32121]	[0.89051]	[–1.27307]
UNE(–6)	8.178796	11.01770	3.109020	–0.325330	251.7698
	(7.71377)	(29.2427)	(2.55093)	(1.53243)	(185.842)
	[1.06028]	[0.37677]	[1.21878]	[–0.21230]	[1.35476]
UNE(–7)	–7.071396	–6.026399	–1.659264	–0.419115	–293.1388
	(9.18603)	(34.8240)	(3.03781)	(1.82491)	(221.311)
	[–0.76980]	[–0.17305]	[–0.54620]	[–0.22966]	[–1.32455]
UNE(–8)	5.726185	3.612634	1.968167	0.239752	272.7175
	(9.72452)	(36.8654)	(3.21588)	(1.93189)	(234.285)
	[0.58884]	[0.09800]	[0.61201]	[0.12410]	[1.16404]
UNE(–9)	–2.261995	–8.200830	–2.580861	0.276449	–285.3432
	(10.0058)	(37.9315)	(3.30889)	(1.98776)	(241.060)
	[–0.22607]	[–0.21620]	[–0.77998]	[0.13908]	[–1.18370]
UNE(–10)	–2.919757	2.054375	2.022701	–0.398562	333.3278
	(9.29627)	(35.2419)	(3.07426)	(1.84681)	(223.967)
	[–0.31408]	[0.05829]	[0.65795]	[–0.21581]	[1.48829]

UNE(–11)	4.496086	10.06172	–1.274402	0.225188	–231.7708
	(6.23081)	(23.6208)	(2.06052)	(1.23782)	(150.114)
	[0.72159]	[0.42597]	[–0.61849]	[0.18192]	[–1.54397]
UNE(–12)	–3.469115	–5.008386	0.707655	–0.181639	56.30471
	(2.36996)	(8.98445)	(0.78374)	(0.47082)	(57.0974)
	[–1.46379]	[–0.55745]	[0.90292]	[–0.38579]	[0.98612]
INFL(–1)	0.007416	–0.133096	–0.001112	–0.000585	–1.767720
	(0.00775)	(0.02938)	(0.00256)	(0.00154)	(0.18672)
	[0.95690]	[–4.53006]	[–0.43383]	[–0.38012]	[–9.46733]
INFL(–2)	–0.016869	–0.211387	–0.006773	7.98E–05	–1.506284
	(0.02028)	(0.07690)	(0.00671)	(0.00403)	(0.48871)
	[–0.83159]	[–2.74886]	[–1.00966]	[0.01981]	[–3.08217]
INFL(–3)	–0.014123	–0.036617	–0.015443	0.001564	–0.665998
	(0.03147)	(0.11930)	(0.01041)	(0.00625)	(0.75818)
	[–0.44878]	[–0.30692]	[–1.48392]	[0.25013]	[–0.87841]
INFL(–4)	0.003471	0.103421	–0.013711	0.001490	–0.732094
	(0.02519)	(0.09548)	(0.00833)	(0.00500)	(0.60680)
	[0.13780]	[1.08314]	[–1.64613]	[0.29771]	[–1.20648]
INFL(–5)	0.000693	0.090200	–0.004791	0.000718	–0.648126
	(0.01719)	(0.06516)	(0.00568)	(0.00341)	(0.41408)
	[0.04030]	[1.38436]	[–0.84293]	[0.21017]	[–1.56522]
INFL(–6)	0.003448	0.044370	–0.001656	0.000893	–0.637471
	(0.01369)	(0.05191)	(0.00453)	(0.00272)	(0.32988)
	[0.25179]	[0.85480]	[–0.36575]	[0.32839]	[–1.93243]
INFL(–7)	0.004721	–0.102392	–0.002127	0.001195	–0.806573
	(0.01171)	(0.04439)	(0.00387)	(0.00233)	(0.28212)
	[0.40321]	[–2.30656]	[–0.54937]	[0.51367]	[–2.85902]
INFL(–8)	–0.003322	–0.080480	–0.004385	0.001622	–0.067607
	(0.01561)	(0.05918)	(0.00516)	(0.00310)	(0.37610)
	[–0.21278]	[–1.35993]	[–0.84942]	[0.52296]	[–0.17976]

INFL(–9)	0.000171	–0.029559	–0.002916	7.71E–05	0.272718
	(0.01514)	(0.05739)	(0.00501)	(0.00301)	(0.36473)
	[0.01132]	[–0.51504]	[–0.58236]	[0.02563]	[0.74773]
INFL(–10)	–0.007805	–0.083898	–0.003718	–0.000736	0.734647
	(0.01208)	(0.04579)	(0.00399)	(0.00240)	(0.29098)
	[–0.64626]	[–1.83235]	[–0.93091]	[–0.30695]	[2.52471]
INFL(–11)	–0.006553	–0.059254	–0.004849	0.000614	0.729534
	(0.01405)	(0.05325)	(0.00464)	(0.00279)	(0.33838)
	[–0.46657]	[–1.11285]	[–1.04401]	[0.22011]	[2.15594]
INFL(–12)	0.006946	0.017928	–0.005436	0.000691	0.607210
	(0.00962)	(0.03646)	(0.00318)	(0.00191)	(0.23170)
	[0.72226]	[0.49174]	[–1.70938]	[0.36179]	[2.62071]
C	–0.000847	0.004284	–0.000293	0.000357	–0.060352
	(0.00278)	(0.01054)	(0.00092)	(0.00055)	(0.06696)
	[–0.30490]	[0.40661]	[–0.31846]	[0.64663]	[–0.90131]
R-squared	0.981957	0.987638	0.986913	0.958232	0.988704
Adj. *R*-squared	0.904632	0.934657	0.930825	0.779228	0.940294
Sum sq. resids	0.003805	0.054683	0.000416	0.000150	2.208538
S.E. equation	0.016486	0.062498	0.005452	0.003275	0.397181
F-statistic	12.69900	18.64154	17.59576	5.353135	20.42350
Log likelihood	264.4145	164.4678	347.4056	385.6258	25.77301
Akaike AIC	–5.424387	–2.759141	–7.637483	–8.656689	0.939386
Schwarz SC	–3.539497	–0.874250	–5.752592	–6.771798	2.824277
Mean dependent	0.001152	0.006624	0.005104	0.000937	–0.001216
S.D. dependent	0.053384	0.244492	0.020729	0.006970	1.625474

Determinant resid covariance (dof adj.)	1.03E–17
Determinant resid covariance	2.34E–21
Log likelihood	1249.286
Akaike information criterion	–25.18095
Schwarz criterion	–15.75650

Table 2

VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria

Endogenous variables: *PE TR GDP UNE INFL*

Exogenous variables: *C*

Sample: 1984Q1 2005Q2

Included observations: 75

Lag	Log*L*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	443.5028	NA	5.74e–12	–11.69341	–11.53891	–11.63172
1	563.5262	220.8432	4.57e–13	–14.22737	–13.30037	–13.85723
2	652.3231	151.5466	8.41e–14	–15.92862	–14.22912	–15.25003
3	717.8430	103.0846	2.92e–14	–17.00915	–14.53716	–16.02211
4	766.4200	69.95089	1.63e–14	–17.63787	–14.39338	–16.34238
5	813.1308	61.03548	9.80e–15	–18.21682	–14.19984	–16.61289
6	863.5188	59.12195	5.58e–15	–18.89384	–14.10436	–16.98145
7	912.1400	50.56599	3.51e–15	–19.52373	–13.96176	–17.30290
8	942.0100	27.08213	3.92e–15	–19.65360	–13.31913	–17.12432
9	980.5737	29.82260	3.83e–15	–20.01530	–12.90833	–17.17757
10	1055.436	47.91160	1.64e–15	–21.34495	–13.46549	–18.19877
11	1164.033	55.02280*	3.54e–16	–23.57422	–14.92226	–20.11959
12	1249.286	31.82764	2.03e–16*	–25.18095*	–15.75650*	–21.41787*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5 per cent level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 3

Pairwise Granger Causality Tests

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 1984Q1 2005Q2
Included observations: 75

Excluded	Chi-sq	Df	Prob.
Dependent variable: *PE*			
TR	14.37680	12	0.2773
GDP	28.90250	12	0.0041
UNE	16.68188	12	0.1620
INFL	30.57146	12	0.0023
All	260.6443	48	0.0000
Dependent variable: *TR*			
PE	47.40404	12	0.0000
GDP	76.13063	12	0.0000
UNE	28.24756	12	0.0051
INFL	144.8809	12	0.0000
All	449.6134	48	0.0000
Dependent variable: *GDP*			
PE	36.18907	12	0.0003
TR	21.61037	12	0.0421
UNE	16.71260	12	0.1607
INFL	12.61232	12	0.3978
All	115.7835	48	0.0000
Dependent variable: *UNE*			
PE	2.972939	12	0.9957
TR	2.041250	12	0.9993
GDP	2.713306	12	0.9973
INFL	2.164165	12	0.9991
All	10.61212	48	1.0000
Dependent variable: *INFL*			
PE	38.12807	12	0.0001
TR	154.5497	12	0.0000
GDP	19.96111	12	0.0678
UNE	17.02475	12	0.1487
All	673.6998	48	0.0000

Table 4

Application of VAR Methodology to the Model's Reduced Form: OLS Estimation when Public Expenditures Include Capital Outlays[22]

Vector Autoregression Estimates
Sample (adjusted): 1986Q2 2004Q4
Included observations: 75 after adjustments
Standard errors in ( ) & *t*-statistics in [ ]

	PEK	***TR***	***GDP***	***UNE***	***INFL***
PEK(–1)	1.195940	0.648436	0.095264	0.017225	–10.81482
	(0.28494)	(0.74281)	(0.05215)	(0.02812)	(4.81591)
	[4.19711]	[0.87295]	[1.82691]	[0.61252]	[–2.24564]
PEK(–2)	–1.104830	–1.176832	–0.041459	–0.034713	2.649430
	(0.40171)	(1.04720)	(0.07351)	(0.03965)	(6.78942)
	[–2.75031]	[–1.12379]	[–0.56397]	[–0.87560]	[0.39023]
PEK(–3)	0.110903	–0.676347	–0.110047	0.062879	–12.59024
	(0.45347)	(1.18214)	(0.08299)	(0.04475)	(7.66430)
	[0.24456]	[–0.57214]	[–1.32609]	[1.40499]	[–1.64271]
PEK(–4)	0.438272	1.545215	–0.042142	–0.016136	3.925443
	(0.42908)	(1.11855)	(0.07852)	(0.04235)	(7.25199)
	[1.02142]	[1.38145]	[–0.53669]	[–0.38105]	[0.54129]
PEK(–5)	–0.128133	–0.279720	0.025228	–0.010463	–5.789221
	(0.36619)	(0.95460)	(0.06701)	(0.03614)	(6.18909)
	[–0.34991]	[–0.29302]	[0.37646]	[–0.28953]	[–0.93539]
PEK(–6)	–0.025726	–0.128971	–0.050748	0.031208	–0.222835
	(0.26074)	(0.67970)	(0.04771)	(0.02573)	(4.40677)
	[–0.09867]	[–0.18975]	[–1.06357]	[1.21279]	[–0.05057]
PEK(–7)	–0.192804	–0.312212	–0.047126	–0.010156	–1.364968
	(0.25739)	(0.67099)	(0.04710)	(0.02540)	(4.35029)
	[–0.74906]	[–0.46530]	[–1.00049]	[–0.39981]	[–0.31376]

[22] Complete Vector Autoregression Estimates are available from the author on request.

PEK(–8)	0.455492	0.780262	–0.024439	–0.018484	–2.481661
	(0.26553)	(0.69219)	(0.04859)	(0.02621)	(4.48776)
	[1.71542]	[1.12723]	[–0.50294]	[–0.70534]	[–0.55298]
PEK(–9)	0.226103	1.111819	–0.031817	0.007823	3.494694
	(0.22808)	(0.59457)	(0.04174)	(0.02251)	(3.85483)
	[0.99133]	[1.86996]	[–0.76230]	[0.34754]	[0.90658]
PEK(–10)	–0.688412	–1.055015	–0.043302	–0.015171	1.367953
	(0.17627)	(0.45950)	(0.03226)	(0.01740)	(2.97911)
	[–3.90555]	[–2.29602]	[–1.34242]	[–0.87212]	[0.45918]
PEK(–11)	0.647202	0.483576	–0.006780	0.002934	–4.531160
	(0.24863)	(0.64814)	(0.04550)	(0.02454)	(4.20219)
	[2.60306]	[0.74609]	[–0.14901]	[0.11956]	[–1.07829]
PEK(–12)	0.057592	0.834051	–0.074266	–0.011071	3.141178
	(0.24974)	(0.65103)	(0.04570)	(0.02465)	(4.22092)
	[0.23061]	[1.28112]	[–1.62497]	[–0.44916]	[0.74419]
TR(–1)	0.264817	1.210042	–0.064974	–0.004078	2.642139
	(0.10652)	(0.27768)	(0.01949)	(0.01051)	(1.80031)
	[2.48609]	[4.35768]	[–3.33317]	[–0.38795]	[1.46760]
TR(–2)	–0.184335	–0.201092	0.031610	–0.003491	6.305015
	(0.16681)	(0.43484)	(0.03053)	(0.01646)	(2.81925)
	[–1.10508]	[–0.46245]	[1.03551]	[–0.21205]	[2.23641]
TR(–3)	–0.057151	0.179604	0.017692	–0.000468	9.829566
	(0.15718)	(0.40974)	(0.02876)	(0.01551)	(2.65652)
	[–0.36361]	[0.43834]	[0.61508]	[–0.03019]	[3.70017]
TR(–4)	0.049106	0.245122	0.004259	0.008693	–0.999946
	(0.19197)	(0.50044)	(0.03513)	(0.01895)	(3.24456)
	[0.25580]	[0.48981]	[0.12122]	[0.45884]	[–0.30819]
TR(–5)	–0.305618	–0.078527	0.028223	–0.014574	11.94811
	(0.16554)	(0.43155)	(0.03029)	(0.01634)	(2.79790)
	[–1.84614]	[–0.18196]	[0.93163]	[–0.89205]	[4.27038]

TR(–6)	0.148344	–0.414422	0.020021	0.014490	–4.891875
	(0.17597)	(0.45873)	(0.03220)	(0.01737)	(2.97414)
	[0.84300]	[–0.90341]	[0.62171]	[0.83436]	[–1.64480]
TR(–7)	0.000907	0.407473	–0.018570	–0.016161	5.118648
	(0.11384)	(0.29677)	(0.02083)	(0.01124)	(1.92409)
	[0.00797]	[1.37302]	[–0.89137]	[–1.43842]	[2.66029]
TR(–8)	–0.073819	–0.323148	0.005871	–0.006715	3.680403
	(0.09673)	(0.25216)	(0.01770)	(0.00955)	(1.63486)
	[–0.76314]	[–1.28152]	[0.33168]	[–0.70343]	[2.25121]
TR(–9)	0.098916	0.412317	–0.017898	0.002252	1.189148
	(0.10695)	(0.27879)	(0.01957)	(0.01055)	(1.80752)
	[0.92491]	[1.47894]	[–0.91450]	[0.21334]	[0.65789]
TR(–10)	–0.012725	0.432538	0.013715	–0.005929	6.007145
	(0.11222)	(0.29254)	(0.02054)	(0.01107)	(1.89663)
	[–0.11339]	[1.47858]	[0.66785]	[–0.53536]	[3.16728]
TR(–11)	–0.022972	0.109561	0.024612	–0.000461	0.858024
	(0.09850)	(0.25678)	(0.01803)	(0.00972)	(1.66478)
	[–0.23322]	[0.42668]	[1.36536]	[–0.04738]	[0.51540]
TR(–12)	–0.045364	–0.106733	0.018695	0.006822	1.032663
	(0.09691)	(0.25264)	(0.01773)	(0.00956)	(1.63794)
	[–0.46809]	[–0.42248]	[1.05414]	[0.71328]	[0.63047]
GDP(–1)	1.728147	4.247650	1.152537	–0.080419	–30.56518
	(1.36490)	(3.55810)	(0.24978)	(0.13470)	(23.0686)
	[1.26613]	[1.19380]	[4.61424]	[–0.59700]	[–1.32497]
GDP(–2)	–2.700659	–5.082614	–0.736259	0.074864	83.46892
	(2.26481)	(5.90403)	(0.41446)	(0.22352)	(38.2782)
	[–1.19244]	[–0.86087]	[–1.77642]	[0.33494]	[2.18059]
GDP(–3)	3.891573	6.145423	0.316260	–0.003879	–145.2896
	(2.73535)	(7.13065)	(0.50057)	(0.26996)	(46.2309)
	[1.42270]	[0.86183]	[0.63180]	[–0.01437]	[–3.14270]

GDP(–4)	–5.987042	–13.35528	0.411110	–0.206321	152.1442
	(3.04912)	(7.94862)	(0.55799)	(0.30092)	(51.5341)
	[–1.96353]	[–1.68020]	[0.73676]	[–0.68563]	[2.95230]
GDP(–5)	8.957057	15.64893	–1.167667	0.354497	–138.5000
	(3.61516)	(9.42419)	(0.66158)	(0.35679)	(61.1008)
	[2.47764]	[1.66051]	[–1.76497]	[0.99358]	[–2.26674]
GDP(–6)	–6.391110	–7.118135	1.374769	–0.348038	126.0763
	(4.07074)	(10.6118)	(0.74495)	(0.40175)	(68.8007)
	[–1.57001]	[–0.67077]	[1.84545]	[–0.86631]	[1.83249]
GDP(–7)	2.193193	1.714654	–0.631026	0.295744	–53.55265
	(4.05974)	(10.5831)	(0.74294)	(0.40066)	(68.6148)
	[0.54023]	[0.16202]	[–0.84937]	[0.73814]	[–0.78048]
GDP(–8)	–1.030055	–6.986465	–0.047477	–0.000860	–19.12325
	(3.76724)	(9.82065)	(0.68941)	(0.37179)	(63.6712)
	[–0.27342]	[–0.71141]	[–0.06887]	[–0.00231]	[–0.30034]
GDP(–9)	0.650273	9.552832	0.469207	–0.199070	55.83749
	(3.55970)	(9.27962)	(0.65143)	(0.35131)	(60.1635)
	[0.18268]	[1.02944]	[0.72027]	[–0.56665]	[0.92810]
GDP(–10)	1.099342	–8.212566	–0.348001	0.233155	–56.02486
	(3.06330)	(7.98557)	(0.56059)	(0.30232)	(51.7737)
	[0.35888]	[–1.02843]	[–0.62078]	[0.77122]	[–1.08211]
GDP(–11)	–2.599332	5.349135	0.297892	–0.140586	37.30793
	(2.13419)	(5.56353)	(0.39056)	(0.21063)	(36.0706)
	[–1.21795]	[0.96146]	[0.76273]	[–0.66747]	[1.03430]
GDP(–12)	1.183767	–3.984840	0.004028	0.050378	–15.60806
	(0.96811)	(2.52372)	(0.17717)	(0.09554)	(16.3623)
	[1.22276]	[–1.57895]	[0.02274]	[0.52727]	[–0.95390]
UNE(–1)	–1.379412	3.190965	–1.406797	1.806026	26.68535
	(2.79968)	(7.29836)	(0.51235)	(0.27630)	(47.3182)
	[–0.49270]	[0.43722]	[–2.74580]	[6.53635]	[0.56395]

UNE(–2)	4.619616	8.154132	1.813805	–2.035260	–27.78897
	(5.79179)	(15.0983)	(1.05990)	(0.57160)	(97.8886)
	[0.79761]	[0.54007]	[1.71129]	[–3.56064]	[–0.28388]
UNE(–3)	–11.91653	–18.54454	–1.453085	1.598628	5.474963
	(8.17605)	(21.3138)	(1.49623)	(0.80691)	(138.186)
	[–1.45749]	[–0.87007]	[–0.97117]	[1.98118]	[0.03962]
UNE(–4)	13.56433	10.77352	1.749199	–1.146286	–43.53725
	(9.92090)	(25.8623)	(1.81553)	(0.97911)	(167.676)
	[1.36725]	[0.41657]	[0.96346]	[–1.17075]	[–0.25965]
UNE(–5)	–11.80404	–4.934786	–2.374272	0.824916	67.58724
	(10.9976)	(28.6691)	(2.01257)	(1.08537)	(185.873)
	[–1.07333]	[–0.17213]	[–1.17972]	[0.76003]	[0.36362]
UNE(–6)	12.84187	8.979207	2.901098	–0.320998	–75.49881
	(11.5914)	(30.2169)	(2.12123)	(1.14397)	(195.909)
	[1.10788]	[0.29716]	[1.36765]	[–0.28060]	[–0.38538]
UNE(–7)	–16.39292	–15.95393	–1.677776	0.092404	110.5667
	(12.3997)	(32.3241)	(2.26915)	(1.22374)	(209.570)
	[–1.32205]	[–0.49356]	[–0.73938]	[0.07551]	[0.52759]
UNE(–8)	15.67667	10.05047	1.851114	–0.213730	–111.8485
	(13.4923)	(35.1723)	(2.46910)	(1.33157)	(228.036)
	[1.16190]	[0.28575]	[0.74971]	[–0.16051]	[–0.49049]
UNE(–9)	–11.36387	–6.239340	–2.471385	0.827270	107.3843
	(14.0367)	(36.5917)	(2.56874)	(1.38531)	(237.239)
	[–0.80958]	[–0.17051]	[–0.96210]	[0.59717]	[0.45264]
UNE(–10)	5.083813	4.565581	1.881498	–1.023513	–61.42023
	(12.6396)	(32.9495)	(2.31305)	(1.24742)	(213.625)
	[0.40221]	[0.13856]	[0.81343]	[–0.82051]	[–0.28751]
UNE(–11)	–0.306621	1.040849	–0.977376	0.626231	42.37856
	(9.08633)	(23.6867)	(1.66281)	(0.89674)	(153.571)
	[–0.03375]	[0.04394]	[–0.58779]	[0.69834]	[0.27595]

UNE(–12)	–1.862598	–1.736223	0.534146	–0.351625	–28.56581
	(4.07958)	(10.6349)	(0.74657)	(0.40262)	(68.9500)
	[–0.45657]	[–0.16326]	[0.71547]	[–0.87334]	[–0.41430]
INFL(–1)	–0.004344	–0.085923	0.003362	–0.001142	–1.797694
	(0.01086)	(0.02831)	(0.00199)	(0.00107)	(0.18357)
	[–0.39993]	[–3.03465]	[1.69140]	[–1.06502]	[–9.79293]
INFL(–2)	0.027404	–0.106621	0.001075	–0.001681	–2.642084
	(0.02284)	(0.05953)	(0.00418)	(0.00225)	(0.38597)
	[1.20001]	[–1.79100]	[0.25722]	[–0.74588]	[–6.84535]
INFL(–3)	0.033266	–0.037179	–0.006382	–0.002329	–2.341098
	(0.03152)	(0.08217)	(0.00577)	(0.00311)	(0.53276)
	[1.05532]	[–0.45245]	[–1.10631]	[–0.74863]	[–4.39431]
INFL(–4)	0.028554	0.000765	–0.007408	–0.001416	–1.464451
	(0.03402)	(0.08868)	(0.00623)	(0.00336)	(0.57495)
	[0.83937]	[0.00863]	[–1.18993]	[–0.42165]	[–2.54707]
INFL(–5)	0.004493	0.023215	–0.005621	0.000976	–0.663033
	(0.03058)	(0.07973)	(0.00560)	(0.00302)	(0.51691)
	[0.14692]	[0.29117]	[–1.00430]	[0.32326]	[–1.28269]
INFL(–6)	0.001130	0.006298	–7.72E–05	0.003302	–0.755618
	(0.02771)	(0.07224)	(0.00507)	(0.00273)	(0.46835)
	[0.04078]	[0.08719]	[–0.01523]	[1.20727]	[–1.61337]
INFL(–7)	–0.012414	–0.131505	0.006068	0.003032	–1.006177
	(0.02820)	(0.07352)	(0.00516)	(0.00278)	(0.47665)
	[–0.44019]	[–1.78874]	[1.17576]	[1.08931]	[–2.11095]
INFL(–8)	–0.001373	–0.120924	0.002050	0.002699	–1.333048
	(0.02758)	(0.07189)	(0.00505)	(0.00272)	(0.46606)
	[–0.04979]	[–1.68217]	[0.40613]	[0.99180]	[–2.86023]
INFL(–9)	–0.023152	–0.101497	0.001780	0.000738	–0.673057
	(0.02344)	(0.06109)	(0.00429)	(0.00231)	(0.39610)
	[–0.98786]	[–1.66133]	[0.41508]	[0.31893]	[–1.69922]

INFL(–10)	–0.019770	–0.102878	0.003237	–0.000792	–0.022506
	(0.02189)	(0.05706)	(0.00401)	(0.00216)	(0.36995)
	[–0.90319]	[–1.80293]	[0.80810]	[–0.36651]	[–0.06083]
INFL(–11)	–0.016274	–0.069399	–0.000947	–0.000597	–0.209476
	(0.01613)	(0.04205)	(0.00295)	(0.00159)	(0.27261)
	[–1.00896]	[–1.65051]	[–0.32072]	[–0.37518]	[–0.76842]
INFL(–12)	–0.012033	–0.006233	–0.001698	–0.000632	0.381016
	(0.01114)	(0.02904)	(0.00204)	(0.00110)	(0.18826)
	[–1.08023]	[–0.21465]	[–0.83290]	[–0.57523]	[2.02384]
C	0.001676	0.007104	–0.001780	0.000392	–0.165001
	(0.00668)	(0.01743)	(0.00122)	(0.00066)	(0.11298)
	[0.25072]	[0.40766]	[–1.45519]	[0.59470]	[–1.46048]
R-squared	0.982490	0.981869	0.987569	0.968027	0.982757
Adj. *R*-squared	0.907449	0.904162	0.934294	0.831002	0.908859
Sum sq. resids	0.011802	0.080204	0.000395	0.000115	3.371322
S.E. equation	0.029035	0.075689	0.005313	0.002865	0.490723
F–statistic	13.09268	12.63567	18.53729	7.064595	13.29886
Log likelihood	221.9657	150.1049	349.3354	395.6474	9.911479
Akaike AIC	–4.292418	–2.376131	–7.688944	–8.923932	1.362361
Schwarz SC	–2.407527	–0.491240	–5.804054	–7.039041	3.247251
Mean dependent	0.003106	0.006624	0.005104	0.000937	–0.001216
S.D. dependent	0.095439	0.244492	0.020729	0.006970	1.625474

Determinant resid covariance (dof adj.)	7.73E–17
Determinant resid covariance	1.75E–20
Log likelihood	1173.822
Akaike information criterion	–23.16860
Schwarz criterion	–13.74414

Table 5

VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria

Endogenous variables: *PEK TR GDP UNE INFL*

Exogenous variables: *C*

Sample: 1984Q1 2005Q2

Included observations: 75

Lag	Log*L*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	414.1239	NA	1.26e–11	–10.90997	–10.75547	–10.84828
1	533.3486	219.3734	1.02e–12	–13.42263	–12.49563	–13.05249
2	615.8479	140.7988	2.22e–13	–14.95594	–13.25645	–14.27736
3	675.1133	93.24424	9.12e–14	–15.86969	–13.39770	–14.88265
4	722.4176	68.11820	5.25e–14	–16.46447	–13.21999	–15.16898
5	778.0519	72.69551	2.50e–14	–17.28138	–13.26440	–15.67745
6	847.6146	81.62027	8.52e–15	–18.46972	–13.68025	–16.55734
7	900.6333	55.13937*	4.77e–15	–19.21689	–13.65492	–16.99605
8	940.3081	35.97185	4.10e–15	–19.60822	–13.27375	–17.07893
9	974.9411	26.78288	4.45e–15	–19.86510	–12.75813	–17.02736
10	1030.261	35.40469	3.21e–15	–20.67363	–12.79417	–17.52744
11	1087.759	29.13253	2.71e–15	–21.54025	–12.88829	–18.08562
12	1173.822	32.13017	1.52e–15*	–23.16860*	–13.74414*	–19.40552*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5 per cent level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 6

Pairwise Granger Causality Tests

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 1984Q1 2005Q2
Included observations: 75

Dependent variable: *PEK*

Excluded	Chi-sq	Df	Prob.
TR	18.67930	12	0.0966
GDP	21.29292	12	0.0463
UNE	12.19144	12	0.4304
INFL	24.11573	12	0.0196
All	191.1908	48	0.0000

Dependent variable: *TR*

Excluded	Chi-sq	Df	Prob.
PEK	27.86564	12	0.0058
GDP	39.58349	12	0.0001
UNE	8.783501	12	0.7213
INFL	37.02847	12	0.0002
All	302.0944	48	0.0000

Dependent variable: *GDP*

Excluded	Chi-sq	Df	Prob.
PEK	38.83948	12	0.0001
TR	19.94338	12	0.0682
UNE	28.68738	12	0.0044
INFL	20.59297	12	0.0567
All	122.6372	48	0.0000

Dependent variable: *UNE*

Excluded	Chi-sq	df	Prob.
PEK	8.172736	12	0.7715
TR	4.804001	12	0.9642
GDP	4.737421	12	0.9662
INFL	4.964929	12	0.9591
All	18.15224	48	1.0000

Dependent variable: *INFL*

Excluded	Chi-sq	df	Prob.
PEK	20.14887	12	0.0643
TR	91.09239	12	0.0000
GDP	22.29338	12	0.0344
UNE	6.300453	12	0.9002
All	436.5091	48	0.0000

Table 7

Unit Root Test

Null Hypothesis: D(ORIG_GDP_X12_TC) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic based on SIC, MAXLAG=12)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	–2.669638	0.0832

Null Hypothesis: D(ORIG_PE_X12_TC) has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic based on SIC, MAXLAG=12)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	–5.154067	0.0000

Null Hypothesis: D(ORIG_PEK_X12_TC) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	–11.63738	0.0001

Null Hypothesis: D(ORIG_TR_X12_TC) has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic based on SIC, MAXLAG=11)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	–4.037459	0.0020

Null Hypothesis: D(ORIG_UNE_X12_TC) has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic based on SIC, MAXLAG=12)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	–4.037847	0.0019

Null Hypothesis: D(ORIG_INFL_X12_TC) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic based on SIC, MAXLAG=12)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	–3.763025	0.0046

* MacKinnon (1996) one-sided *p*-values.

REFERENCES

Blanchard, O. and R. Perotti (2002), "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *The Quarterly Journal of Economics*, Vol. 117, No. 4.

Creel, J., P. Monperrus-Veroni and F. Saraceno (2005), "Discretionary Policy Interactions and Fiscal Theory of the Price Level: a SVAR Analysis on French Data", in Banca d'Italia (ed.), *Public Expenditure*, Roma, Banca d'Italia.

Enders, W. (1995), *Applied Econometrics Time Series*, John Wiley and Sons Inc., USA, Chapter 5.

Fair, R.C. (1979), "An Analysis of the Accuracy of Four Macroeconomic Models", *Journal of Political Economy*, No. 87.

Giordano, R., S. Momigliano, S. Neri and R. Perotti (2005), "The Effects on the Economy of Shocks to Different Government Expenditure Items: Estimates with a SVAR Model", in Banca d'Italia (ed.), *Public Expenditure*, Roma, Banca d'Italia.

Kamps, C. (2005), "The Dynamic Effects of Public Capital: VAR Evidence for 22 OECD Countries", *International Tax and Public Finance,* Vol. 12, No. 4.

Kopcke, R., G. Tootell and R. Triest (2006), *The Macroeconomics of Fiscal Policy*, Massachusetts Institute of Technology, USA.

Perotti, R. (2004), "Estimating the Effects of Fiscal Policy in OECD Countries", IGIER, Università Bocconi, Working Paper, No. 276, Milano.

Phillips, P.C.B. (1998), "Impulse Response and Forecast Error Variance Asymptotics in Non-stationary VARs", *Journal of Econometrics*, No. 83.

Utrera, G. (2004), "Vectores autorregresivos e identificación de shocks de política monetaria en Argentina", *Revista de Economía y Estadística*, I.E.F., F.C.E., U.N.C., Vol. XLII, No. 2.

IDENTIFYING FISCAL POLICY SHOCKS IN CHILE AND COLOMBIA

Jorge E. Restrepo[*] *and Hernán Rincón*[**]

Structural VAR and Structural VEC models were estimated for Chile and Colombia, aiming at identifying fiscal policy shocks in both countries between 1990 and 2005. The impulse responses obtained allow the calculation of a peso-for-peso ($/$) effect on output of a shock to public spending and to the government's net tax revenues, providing a good notion of the incidence of fiscal policy shocks in both countries. When public finances are under control, as they are in Chile, fiscal policy seems to be more effective than when they lack stability and credibility, as seems to be the case of Colombia since the mid-Nineties.

1. Introduction

The purpose of this paper is to identify the dynamic effects of taxes and government spending on economic activity in Chile and Colombia. Using Structural Vector Autoregression models (SVAR) and Structural Vector Error Correction Models (SVEC), we isolate structural shocks to taxes and fiscal expenditures and determine their effects on GDP.

Government is an important player in any economy, and its policies regarding taxes and spending affect disposable income, consumption, investment and private agents' decisions, in general. Adequate knowledge of the influence of government on aggregate demand – through its budget policies – is useful for fiscal and monetary authorities, altogether. Indeed, the Central Bank attains its main objective of stabilizing inflation via the regulation of aggregate demand through adjusting the interest rate. Therefore, it should foresee the pressure put on aggregate demand by the government. On the other hand, the bulk of the literature refers to developed economies and very few studies have tried to determine the effects of fiscal policy in developing countries.

---

[*] Senior Economist at Banco Central de Chile (Central Bank of Chile).

[**] Senior Researcher at Banco de la República (Central Bank of Colombia).

We thank Adolfo Barajas, Pablo García, Leonardo Luna, Igal Magendzo, Carlos E. Posada, Rodrigo Valdés and, especially, Carlos García and Michael Pedersen for helpful suggestions. We are also grateful to Margit Schratzenstaller (WIFO, Austria) and other participants in the 8th Banca D'Italia Workshop on Public Finance. Consuelo Edwards helped us with the edition. The first version of the paper was written as a requirement for the course "Macroeconomic Management and Fiscal Policy Issues" at the IMF Institute in June 2005. We thank its hospitality.

The contents of this article are the sole responsibility of the authors; they are not attributable to the organizations they work for.

Please address any comments to jrestrepo@bcentral.cl or hrincoca@banrep.gov.co

At the outset of the Eighties, Sims (1980) established an already long tradition of vector autoregression models (VARs). It was a reaction to the common practice among macroeconometricians of imposing *ad hoc* restrictions, which had been forcefully criticized by Lucas (1976). Many others contributed to develop the technique: Bernanke and Blinder (1986), Galí (1992), Bernanke and Mihov (1996), Christiano, Eichembaum and Evans (1999). Most of them concentrated on identifying monetary policy shocks, its effects, and transmission mechanisms. Some of the exceptions include the work by Blanchard and Quah (1989), who used long-run restrictions to identify supply and demand shocks and decompose GDP into a permanent trend and a transitory or cyclical component. Also, Clarida and Galí (1994) identified the sources of real exchange rate fluctuations. More recently, Blanchard and Perotti (2002), Perotti (2002), Fatás and Mihov (2001) and Mountford and Ulhig (2002) used VARs to identify fiscal policy shocks and quantify their consequences.[1]

This article takes advantage of such recent developments by applying them to new data sets from two developing countries: Chile and Colombia. Previous studies addressing the issue in Chile include Cerda, González and Lagos (2005), who find a negative effect of both public spending and taxes on GDP.[2] On the contrary, Franken, Lefort and Parrado (2006) find a positive effect using annual data. Lozano and Aristizabal (2003), the only paper the authors are aware of that addresses the issue in Colombia, find a positive relationship between taxes, expenditures, and output, which may indicate procyclicality of the Colombian fiscal policy.

Next section presents the most important features of recent fiscal policy in each country. The third section includes the econometric approaches. The fourth one presents the data and the estimation results. Section five concludes.

2. Recent fiscal policy

The purpose of explaining the main differences between the diverging experiences of Colombia and Chile is twofold: motivating the article and helping understand the econometric results obtained.

2.1 Chile

For centuries, austere and countercyclical behavior has been the recipe for long-lasting welfare, but countries seldom follow it in practice. It is even less

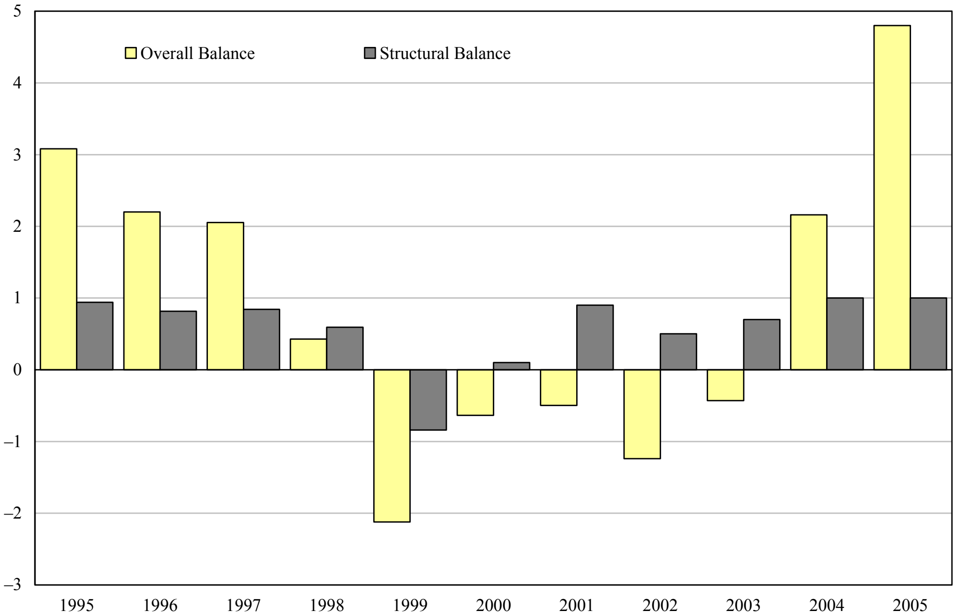
---

1 Stock and Watson (2001) present a survey on Vector Autoregressions (VAR). In addition Galí, López-Salido and Vallés (2006) present a modern theoretical model on the effects of government spending on consumption.

2 Cerda, González and Lagos (2005) use a cash-based data set with fiscal variables produced by the government's payment office (Tesorería General de la República). On the contrary, our variables for Chile were provided by the Ministry of Finance's budget office (DIPRES) and built on accrual accounting.

Figure 1

Chile: Central Government's Overall and Structural Balance
(percent of GDP)



Source: Central Bank of Chile and Budget Office of the Ministry of Finance.

common among emerging commodity-exporting economies, which makes the case of Chile a remarkable exception.

Indeed, since the late Eighties through 1997, Chile ran consecutive fiscal surpluses, which were used to reduce public debt. While in 1990 central government's gross debt amounted to around 40 per cent of GDP, at the end of 1998 it was less than 13 per cent. The economy grew at a fast pace, with annual GDP growth averaging more than 7 per cent between 1990 and 1997. In 1998, after being hit by the Asian crisis, the economy slowed down, and the fiscal accounts began showing moderate deficits. Government debt increased to 16 per cent in 2002 (Figures 1 and 2).

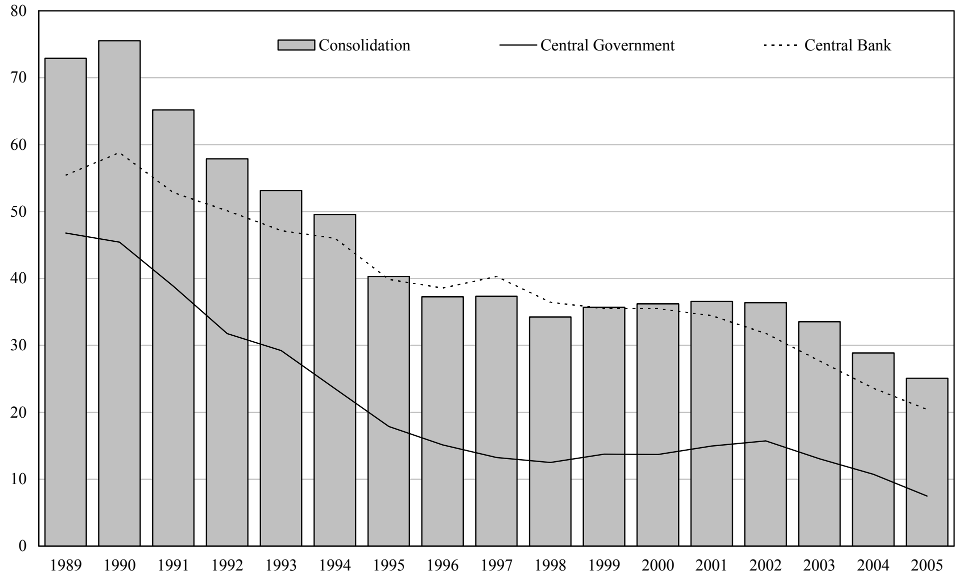
In 2004, the international copper price increased sharply, raising the revenues of the state-owned copper company CODELCO and with them, the transfers to the central government. The economy picked up, and deficits turned into surpluses again. This time, fiscal policy was formally made countercyclical with a fiscal rule that was put in place in 2001. At that time, the Minister of Finance decided that the central government's overall annual balances should be of a 1 percent structural surplus with respect to GDP. More specifically, spending was pegged to structural

Figure 2

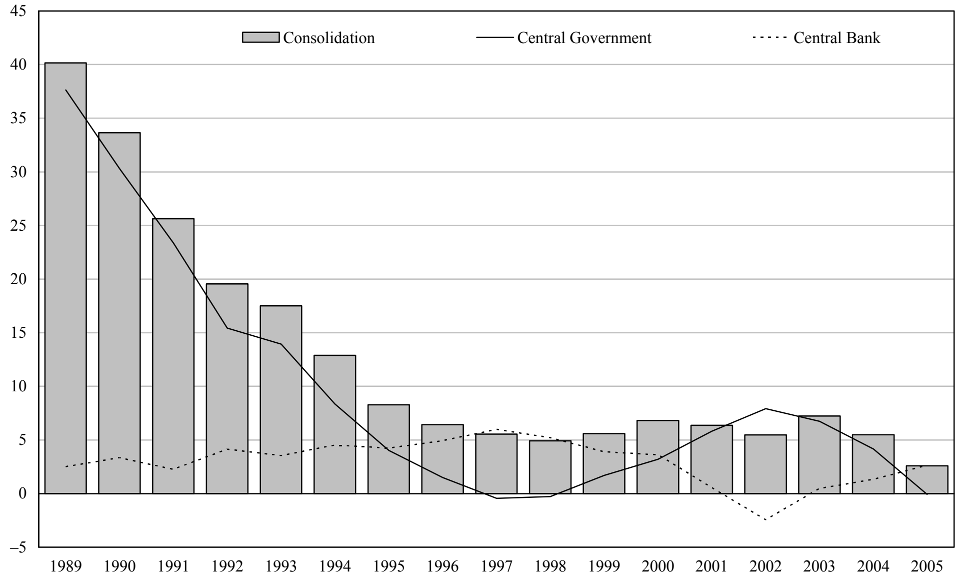
Chile: Public Debt

(percent of GDP)

Central Government, Central Bank and Consolidated GROSS Debt



Central Government, Central Bank and Consolidated NET Debt



Sources: Central Bank of Chile and Budget Office of the Ministry of Finance (2006).

(cyclically-adjusted) revenues in order to generate a 1 percent structural surplus. Both tax revenues and profits transferred from the public copper company are cyclically adjusted. A very significant feature of this adjustment in terms of credibility is that potential (trend) GDP and the long-run price of copper are estimated every year by two groups of independent and well recognized experts. In summary, the rule signaled a prudent fiscal policy while retaining some flexibility (García, García and Piedrabuena, 2005).

Current Chile's fiscal surpluses are used to build assets and prepay debt, which dropped again to 7.5 per cent of GDP at the end of 2005, over 30 GDP percentage points less than in 1990. The consolidated gross debt (central government and central bank) fell from 75 per cent of GDP in 1990 to 25 per cent in 2005. The profile of net debt was similar: in 1990 net debt amounted to 34 per cent, and declined dramatically to become negative in 1997 (–0.4). After a moderate transitory growth between 1998 and 2003, net debt declined again, to reach –0.1 per cent of GDP in 2005 (Figure 2).

Finally, it should be stressed that in Chile, public debt figures usually consolidate the central government and the central bank, because most domestic public debt is on the balance sheet of the central bank. The central bank issued debt during the early Eighties in order to finance the rescuing of the banking system, and at the beginning of the Nineties to finance the accumulation of foreign reserves (Figure 2).

2.2 Colombia

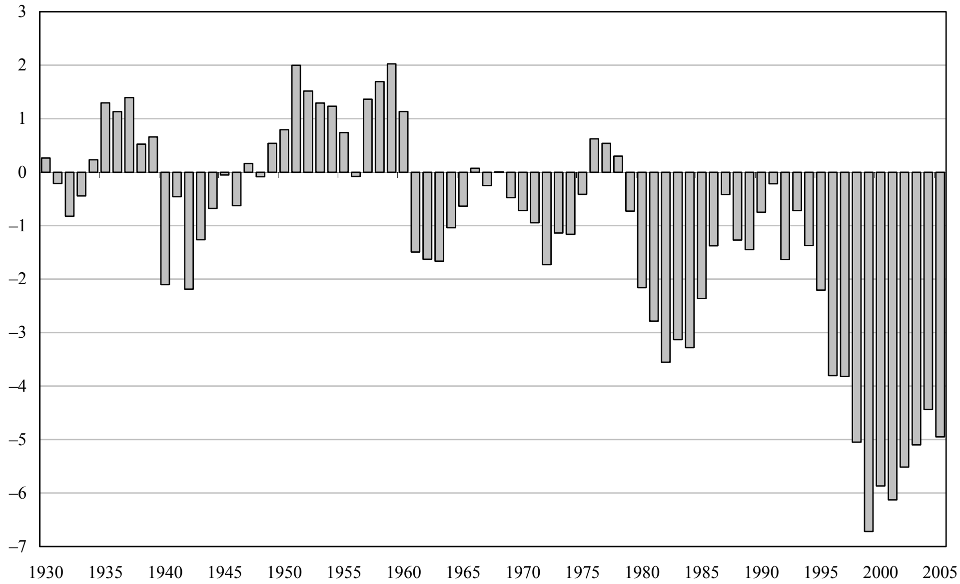
For decades, fiscal policy in Colombia was very prudent, with the deficit following business cycles, *i.e.* exhibiting modest deficits (surpluses) during downturns (booms). Both the tax burden and the size of government were small relative to international standards, which resulted in a weak government that did not provided enough public services to match the society's requirements. For instance, the Colombian tax burden was around 10 per cent between the Fifties and the Nineties and the government's size was around 20 per cent in the same period.

During the Nineties and the early 2000s, this picture totally changed. Spending ballooned, with expenditures growing faster than tax revenues. Indeed, by 2002 tax income had increased by 5 GDP percentage points while the government had doubled in size. With respect to the former, ten tax reforms were completed between 1990 and 2002. Expenditures increased to take care of additional responsibilities prescribed by the new constitution (issued in 1991) and several laws ("social spending" and institutional strengthening), to cover increasing pension payments, military expenses, and the growing burden of interest payments on public debt. On top of that, at the end of the Nineties the Colombian economy suffered the deepest recession in almost a century (real GDP fell –4.2 per cent in 1999). Although taxes were also increased, revenues were unable to match expenditures, generating large deficits and building up public debt in an unsustainable trend. As a

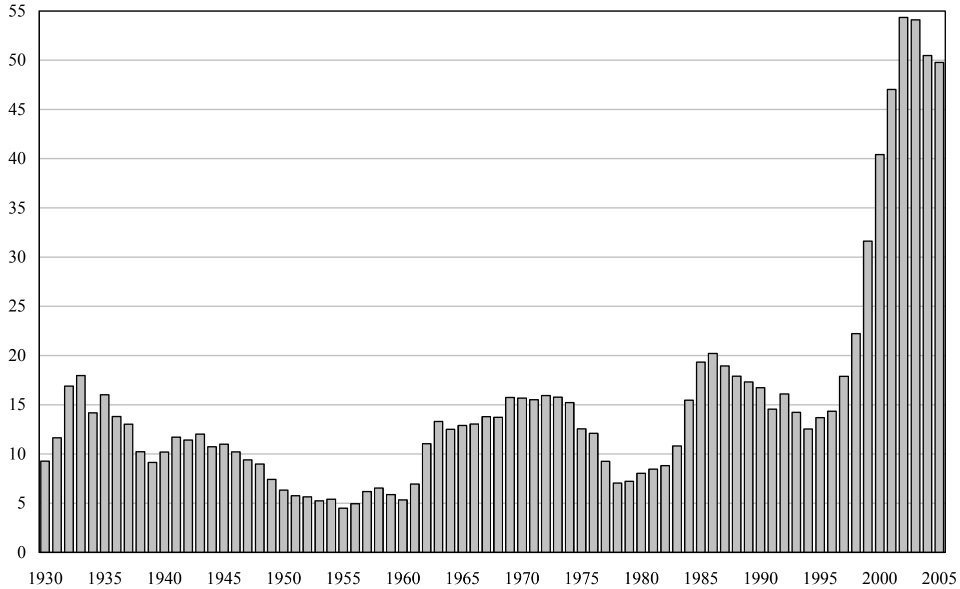
Figure 3

Colombia: Central Government Balance and Debt
(percent of GDP)

Central Government Overall Balance



Central Government GROSS Debt



Source: Junguito and Rincón (2004).

matter of fact, the central government gross debt jumped from around 17 per cent of GDP in 1990 to 54 per cent in 2002 (Figure 3).

In 2005, the fiscal situation of the non-financial public sector had improved as a result of a fiscal adjustment program,[3] the oil prices hike,[4] the accumulation of pension reserves, and the recovery of the economy, which regained its historical growth rate of 5 per cent. At the end of 2005 the tax burden amounted to 20 per cent of GDP, the non-financial public sector size was 35 per cent and the gross debt 55 per cent. Therefore, the Colombian fiscal situation has improved, but much more needs to be done to solve the structural fiscal problem of the central government.

2.3 Institutional differences

According to García, García and Piedrabuena (2005), the implementation of such a sound fiscal policy in Chile has been possible thanks to a set of institutional factors:

a) the spending initiative is the responsibility of the Ministry of Finance, *i.e.* Congress can only reduce – not increase – expenditures included in the budget proposal;
b) municipalities cannot issue debt unless authorized by the government;
c) the Constitutional Law grants independence to the central bank and forbids it to finance the government even indirectly;
d) the tax burden is moderate and a large share of spending goes to social programs;
e) since banking crises usually become also public finance mishaps, as was the case in 1982, Chile substantially improved prudential regulation and supervision, keeping this source of fiscal risk under control;
f) the Chilean budget process is determined once a year and is seldom modified.

Below is a comparison of these points:

a) In Colombia, the Ministry of Finance also has the spending initiative. Therefore, we have to look for differences between both countries elsewhere. The most salient examples are:
b) Municipalities contributed significantly to the increase in public debt during most of the Nineties in Colombia. For the sake of improving public finances, their ability to issue debt started to be significantly restricted after 2000.
c) The central bank of Colombia may face more political pressure than its Chilean counterpart due to the process of appointment of the Monetary Board, and, in particular, from the fact that the Minister of Finance chairs the committee with

---

[3] The adjustment program was implemented since the end of the Nineties under IMF supervision, which included additional tax reforms, expenditure cuts both at the national and sub national levels, pension reform, government downsizing, and privatizations.

[4] Colombia is a medium-sized oil exporter and the government owns the oil resources through a public company (ECOPETROL).

full rights.[5] In fact, the tenure of the Board's members, those members different from the minister and the bank's president, lasts for a twice renewable four-year term. Since the President of Colombia appoints them, he decides who will continue and who will be replaced. Therefore, it is the case that always some members of the board take part, as candidates, in the process of appointment. In Chile, each of the members of the Monetary Board is appointed for a precisely defined ten-year period with only one member being replaced every two years. Besides, the Minister of Finance may attend the meetings of the Board with the right to speak but not to vote.[6]

d) While the non financial public sector tax effort in Colombia is slightly smaller (20 per cent) than in Chile (21 per cent), the spending requirements are larger, after growing abruptly to finance the rights warranted by the Constitution of 1991, and the decentralization process.[7] Indeed, while the government has to transfer a material portion of its revenues to the regions, decentralization has led to a significant degree of duplication of functions between the central government and the regions.

e) In fact, spending is extremely rigid given that around 90 per cent of it cannot be adjusted. Moreover, the public debt is so large now that the central government's debt service accounts to 63 per cent of its tax revenues. In addition, pensions' expenses represent about 6 per cent of GDP currently.[8] To top it off, since 1990 military spending has gone up around 3 GDP percentage points to reach 5 per cent of GDP in 2005, due to the ongoing domestic conflict. It is worth noticing that military spending in emerging economies has a weak macro impact, given that a large share of it is used to import weapons.[9]

f) The latest financial crisis in Colombia is as recent as the end of the Nineties (1998 and 1999). The government had to take control of several institutions committing public resources to rescuing them, which indicates that prudential financial regulation and supervision was not as developed as desired.

g) Finally, the budget process in Colombia is less predictable, as there are frequent intra year additions to the budget combined with nearly one tax reform approved every other year, that is, the government cannot honor its commitments.

---

5 Of course, the Minister of Finance has more objectives than price stability.

6 In Chile, the Minister has the right to veto the decisions for a two-week period at most, but it can be revoked by the unanimous decision of the Board's members. In addition, the Minister of Finance plays no role in the agenda of the meetings.

7 The central government tax burden is 15 per cent in Colombia and 19 per cent in Chile.

8 Chile moved to a fully-funded pension system in 1980; at that time the government issued pension bonds acknowledging a debt with the workers, who had contributed to the old system. The outstanding pension bonds will only amount to around 10 per cent of GDP by the end of 2006. In contrast, Colombian pensions' debt is substantial. The net present value of the public pension debt amounts to at least 150 per cent of GDP, despite the fact that Colombia moved partially to a funded system since 1993.

9 A significant portion of public spending also goes to social programs, health and education.

In summary, as opposed to Chile, lack of stability and credibility of fiscal policy in Colombia translates into a weak macro impact and reduced ability to use it as a stabilizer or a countercyclical tool.

3. Econometric approaches

This section describes the strategies used to estimate the effects of fiscal policy on economic activity.

3.1 Structural VAR

We rely on the recent approach to identifying fiscal shocks developed by Blanchard and Perotti (2002) and Perotti (2002). Their approach is closely related to the one put forward by Bernanke and Mihov (1996) in order to identify monetary policy.

As usual, the strategy to isolate the structural shocks in a VAR consists of imposing restrictions based on economic theory and the behavior of policy makers. This largely used approach allows the identification of genuine shocks that hit the economy and in many cases the parameters of government reaction function as well. In our case study, the specification of the model is, for simplicity, presented as a first-order structural VAR (SVAR):[10]

$$T_t = a_{13}Y_t + d_{11}T_{t-1} + d_{12}G_{t-1} + d_{13}Y_{t-1} + b_{12}\varepsilon_t^G + \varepsilon_t^T$$

$$G_t = a_{23}Y_t + d_{21}T_{t-1} + d_{22}G_{t-1} + d_{23}Y_{t-1} + b_{21}\varepsilon_t^T + \varepsilon_t^G$$

$$Y_t = a_{31}T_t + a_{32}G_t + d_{31}T_{t-1} + d_{32}G_{t-1} + d_{33}Y_{t-1} + \varepsilon_t^Y$$

where T refers to net taxes, G corresponds to government spending on wages, goods and services and investment, and Y is real GDP. In matrix form, the SVAR is expressed as:

$$\overset{A}{\begin{bmatrix} 1 & 0 & -a_{13} \\ 0 & 1 & -a_{23} \\ -a_{31} & -a_{32} & 1 \end{bmatrix}} \overset{X_t}{\begin{bmatrix} T_t \\ G_t \\ Y_t \end{bmatrix}} = \overset{D}{\begin{bmatrix} d_{11} & d_{12} & d_{13} \\ d_{21} & d_{22} & d_{23} \\ d_{31} & d_{32} & d_{33} \end{bmatrix}} \overset{X_{t-1}}{\begin{bmatrix} T_{t-1} \\ G_{t-1} \\ Y_{t-1} \end{bmatrix}} + \overset{B}{\begin{bmatrix} 1 & b_{12} & 0 \\ b_{21} & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}} \overset{\varepsilon_t}{\begin{bmatrix} \varepsilon_t^T \\ \varepsilon_t^G \\ \varepsilon_t^Y \end{bmatrix}}$$

[10] In the estimation process the "true" value of the order of the VAR should be determined.

From the last system of equations, it follows that the reduced-form VAR is equal to $X_t = A^{-1}DX_{t-1} + A^{-1}B\varepsilon_t$ or, equivalently, to $X_t = FX_{t-1} + u_t$, where X_t is the vector [*T,G,Y*]' of variables and $F = A^{-1}D$:

$$\begin{bmatrix} T_t \\ G_t \\ Y_t \end{bmatrix} = \begin{bmatrix} 1 & 0 & -a_{13} \\ 0 & 1 & -a_{23} \\ -a_{31} & -a_{32} & 1 \end{bmatrix}^{-1} \begin{bmatrix} d_{11} & d_{12} & d_{13} \\ d_{21} & d_{22} & d_{23} \\ d_{31} & d_{32} & d_{33} \end{bmatrix} \begin{bmatrix} T_{t-1} \\ G_{t-1} \\ Y_{t-1} \end{bmatrix} +$$

$$\begin{bmatrix} 1 & 0 & -a_{13} \\ 0 & 1 & -a_{23} \\ -a_{31} & -a_{32} & 1 \end{bmatrix}^{-1} \begin{bmatrix} 1 & b_{12} & 0 \\ b_{21} & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^T \\ \varepsilon_t^G \\ \varepsilon_t^Y \end{bmatrix}$$

Therefore, the reduced-form innovations are a linear combination of the structural shocks, $u_t = A^{-1}B\varepsilon_t$, where the innovations of the reduced-form VAR can be represented by:

$$\begin{bmatrix} u_t^T \\ u_t^G \\ u_t^Y \end{bmatrix} = \begin{bmatrix} 1 & 0 & -a_{13} \\ 0 & 1 & -a_{23} \\ -a_{31} & -a_{32} & 1 \end{bmatrix}^{-1} \begin{bmatrix} 1 & b_{12} & 0 \\ b_{21} & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^T \\ \varepsilon_t^G \\ \varepsilon_t^Y \end{bmatrix}$$

As stated above, in order to recover the structural shocks in vector ε, that is, [$\varepsilon_t^T, \varepsilon_t^G, \varepsilon_t^Y$], and the structural coefficients, once the reduced form VAR is estimated, it is necessary to impose restrictions coming from economic theory and intuition on the relationship between the innovations U and the structural shocks ε.

In this particular strategy, several coefficients were estimated and imposed to the factorization matrix. Indeed, the elasticity of taxes to output a_{13} allows computing the cyclically-adjusted tax residuals, which are used as instruments to estimate the effect of taxes a_{31} and government spending a_{32} on GDP. The effect of output on government spending within the quarter was assumed to be null, $a_{23} = 0$. In other words, fiscal authorities do not adjust spending based on the same period's performance of the economy (output growth). Finally, we assumed that within the quarter there is no effect of a structural shock to spending on tax innovations, that is $b_{12} = 0$, leaving b_{21} to be estimated. Alternatively, it could be assumed that within the quarter a tax structural shock has no effect on spending innovations, that is $b_{21} = 0$. Both coefficients could also be estimated.

3.2 *Structural VEC*

The second econometric procedure used in this paper is a SVEC following Johansen and Juselius (1990), King *et al.* (1991), Jacobson *et al.* (1997), and Breitung *et al.* (2004). Firstly, tests for cointegration *à la* Johansen are carried out. As it is well known, it consists of a full information maximum likelihood estimation of a system characterized by Π cointegrating vectors. Secondly, in case cointegration exists, a SVEC procedure will be used.

Error-correction estimation is called for when the variables included in the system are nonstationary and cointegrated. In other words, there is a long-run stable relation among them. As will be clear in the next section, the tests performed point out to the existence of such a relationship among the Colombian time series. In that case, a VAR would not be the correct specification, because an error correction term would be missing from the estimated reduced-form VAR. For that reason, the model should take into account that the variables are cointegrated and include the previous period deviation from equilibrium, ΠX_{t-1}, in order to identify correctly the dynamics of the system after any shock.

The reduced-form of a first-order VEC can be written as: $\Delta X_t = \Pi X_{t-1} + \Gamma \Delta X_{t-1} + \eta_t$, where the forecast errors are: $\eta_t = A^{-1} B \varepsilon_t$. In this case, the structural system SVEC would be: $A \Delta X_t = A \Pi X_{t-1} + A \Gamma \Delta X_{t-1} + B \varepsilon_t$. Similarly to the SVAR procedure, several restrictions should be imposed to the A matrix in order to identify the structural shocks and coefficients.

4. Data and estimations

The quarterly data for Chile covers the period from 1989:1 through 2005:4 for the central government. The source for both taxes and spending of the central government is the Ministry of Finance of Chile. GDP comes from the national accounts produced by the Central Bank of Chile. In the case of Colombia, the series include quarterly data between 1990:1 and 2005:2 of the non-financial public sector and GDP, and are taken from the Ministry of Finance and the central bank (Banco de la República), respectively. Taxes are net of subsidies and grants, interest payments, social security payments and capital transfers. Government spending includes wages and salaries, goods and services and investment. In other words, we use taxes net of transfers and interest payments, and government spending does not include transfers either. Variables of interest are expressed all as logs of their real value.[11] Figure 7 in the Appendix depicts the main variables.

[11] Variables defined in per capita terms were also used, but results did not change significantly. Here we report only those results in real terms.

Table 1

Unit Roots Tests[(1)]

Variable[(2)]	τ [(3)]	**ADF**[(4)]	
		Levels	**First difference**
Chile			
t	$\tau_u =$	–2.92	–11.52**
g	$\tau_u =$	–0.92	–11.95**
y	$\tau_u =$	–2.48	–8.06**
tt	$\tau_u =$	–2.52	–6.59**
Colombia			
t	$\tau_u =$	–1.72	–6.92**
g	$\tau_u =$	–2.75	9.30**
y	$\tau_u =$	–1.62	–3.56**
tt	$\tau_\tau =$	–4.90**	-

(1) Output from Eviews.
(2) Variables are in logs of their real or deflated value.
(3) Test τ_μ is the statistics τ of a regression that includes an intercept and τ_τ is the one that includes an intercept and a trend. The symbols * and ** indicate statistical significance at the level of 5 and 1 per cent, respectively.
(4) The Q statistic was used for testing serial correlation and the Schwartz and Hannan-Quinn information criteria for choosing the lag length.

4.1 Unit root tests

The standard augmented version of the Dickey-Fuller unit root test (referred to as ADF) was implemented in all series.

Table 1 shows the results of ADF tests for both the levels and the first differences of all the series. The null hypothesis of unit root cannot be rejected at 5 per cent level of significance for all series in levels (Table 1). Notice that we found that the terms of trade (tt) series, which is used as an exogenous variable in the estimations, is trend stationary in the case of Colombia. The null hypothesis is rejected for all variables in first differences, indicating that they are $I(1)$ processes. Therefore, all variables are difference stationary for both countries with the only exception of the terms of trade for Colombia.

4.2 Results and impulse responses from the SVAR

All impulse responses were transformed to obtain a peso for peso result. In other words, the multiplier shows how many pesos of GDP are generated by a peso

Table 2

Contemporaneous Coefficients Estimated with TSLS

1. Dependent Variable: ΔT	**Coefficient**	***t*-statistic**	**1990:1-2005:4**
ΔY	a_{13} **=3.03**[(1)]	1.96	Elasticity of taxes to GDP
$\Delta T(-1)$	–0.28	–2.39	To capture tax structure
Dummies for tax reforms			
2. Dependent Variable: ΔY residuals			**1991:1-2005:3**
ΔT_residuals	a_{31} **= –0.034**	–1.87	Effect of taxes on GDP
ΔG_residuals	a_{32} **= 0.165**	3.88	Effect of G on GDP
Dummy			

[(1)] The elasticity obtained by Marcel, Tokman, Valdés and Benavides (2001) is much lower than the one obtained here with quarterly data similarly to what Blanchard and Perotti (2002) found.

of government spending.[12]

Chile

The first estimation corresponds to the reduced-form VAR, $X_t = FX_{t-1} + u_t$, where, again, X=[T,G,Y]'. Since the estimated VAR should be stationary, the variables should be differenced, if it is not possible to reject the unit root hypothesis, or detrended, if they are trend stationary. Following Blanchard and Perotti (2002), three elements of the matrix of contemporaneous relations among the variables were estimated and imposed as restrictions for the identification of the SVAR (Table 2). In both cases we used two stage least squares (TSLS) for the estimation. In the first place, we estimated the within-the-quarter (short-run) elasticity of T to Y. The instruments included several lags of ΔY and ΔT, the real exchange rate, and several dummies to take account of tax reforms implemented during the Nineties and in 2003, where Δ represents the first-difference operator. Next, we estimated the within-the-quarter (short-run) effect of taxes and spending on Y, running a regression of the residuals of the ΔY equation, on the residuals of the ΔT and ΔG

[12] The shock that hits the VAR in differences is of size 1. Thus the pesos for pesos response is approximately: $\Delta Y / \Delta G \approx \frac{Y_{-1}}{G_{-1}} * \frac{(Response\ of\ Y)}{1}$, given that $\Delta \log G_t = 1 \approx \frac{G_t - G_{t-1}}{G_{t-1}}$ and $\Delta \log Y_t = \mathrm{Re}sponse \approx \frac{Y_t - Y_{t-1}}{Y_{t-1}}$.

equations, all taken from the respective equations of the reduced-form VAR. In this case, an instrument for the residuals T_res of the ΔT equation was built by subtracting from them its cyclical component: $T' = T\_res - a_{13} Y$. Thus, the adjusted variable T' is not correlated with the error term of the regression. Other instruments include lagged values of the residuals of the ΔY and ΔG equations (spending residuals), terms of trade and a dummy for 1998.

Thus, the identification of the system and impulse responses can be obtained once a sufficient number of restrictions are imposed. Besides running the SVAR with the estimated coefficients plugged into the **A** matrix, we also run a SVAR where the effect of G on Y (a_{32}) is estimated endogenously, as well as the effect of tax shocks on spending innovations b_{21}. The outcome is very similar but the effect of spending on GDP is slightly larger. In this case, a_{32} is 0.195, which is larger than the result (0.165) obtained before (Table 2).

The impulse responses computed with Chilean data are consistent with economic intuition (Figure 4 A). Indeed, an increase of one Chilean peso in central government tax revenues has a transitory negative effect on GDP growth of 40 cents, at impact. On the other side, a one Chilean peso increase in real central-government spending has a transitory positive effect of $1.9 Chilean pesos on real GDP growth, which is only significant at impact. In addition, government spending and output shocks have a positive transitory effect on net tax revenues.

The accumulated responses show that a shock to taxes has a small negative and transitory (one to two quarters) impact on the level of GDP (Figure 4 B). Afterwards, the response is not significantly different from zero.

The accumulated responses also show that the effect on the level of GDP of the one-peso shock to government spending is positive and lasts from two to three quarters. Afterwards, it is statistically non significant. The point estimation quickly stabilizes at a level of 1.37, which implies that one peso $1 spent by the government generates 37 additional cents of GDP.

In addition, shocks to spending and output increase tax revenues. Therefore, an increase in spending is accompanied by the corresponding raise in taxes, implying sustainability. Tax increases do not result in higher spending however. This may reflect the sound fiscal policy followed in Chile, where the central government had surpluses in at least twelve out of the last sixteen years. In fact, some analysts claim that in the early Nineties, there was an implicit fiscal rule, which consisted in allowing government spending to grow less than GDP and government revenues.

Figure 4 A

Chile: Impulse Responses – Variables in Differences

Shock to ΔT | **Shock to ΔG** | **Shock to ΔY**

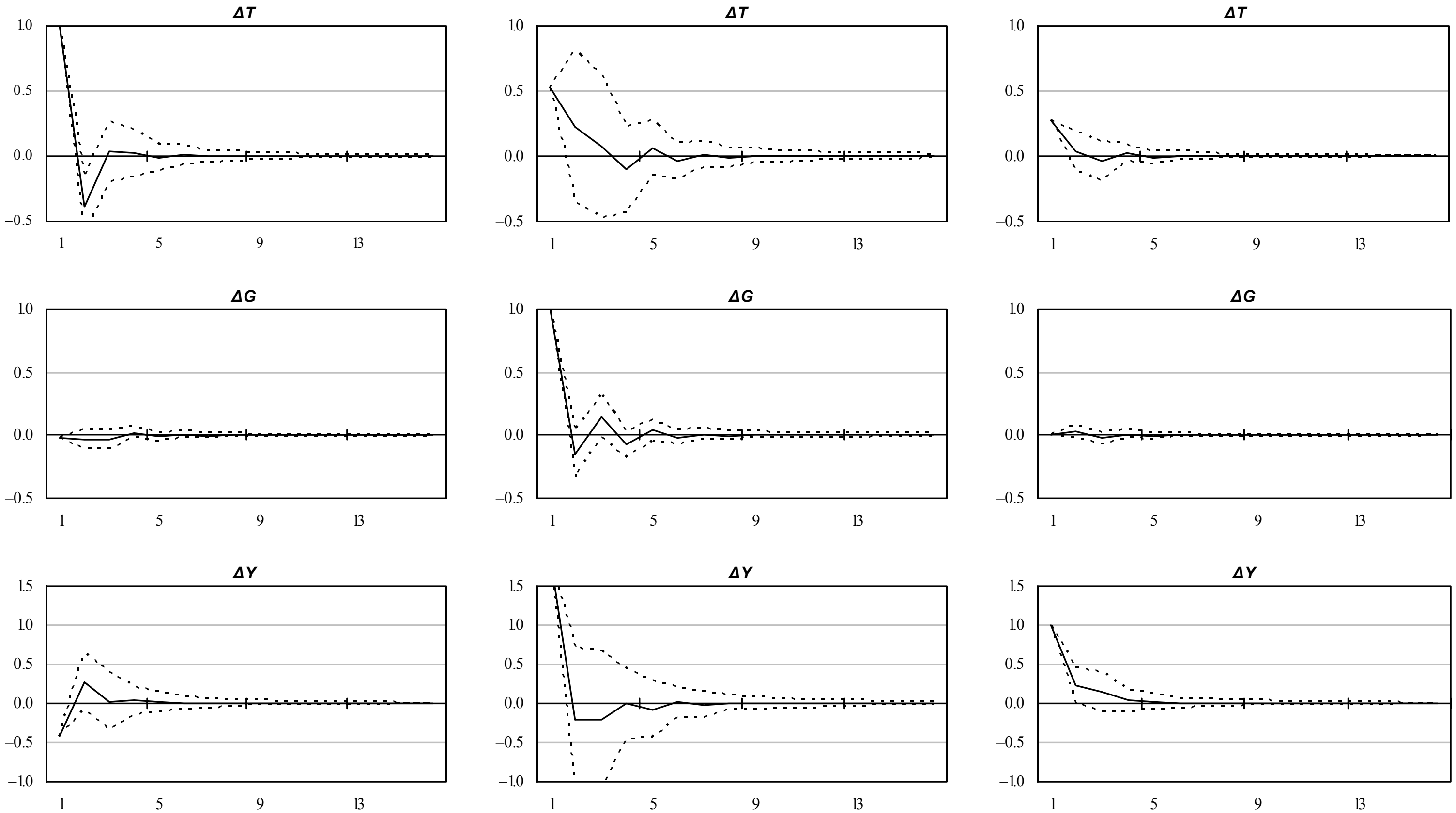
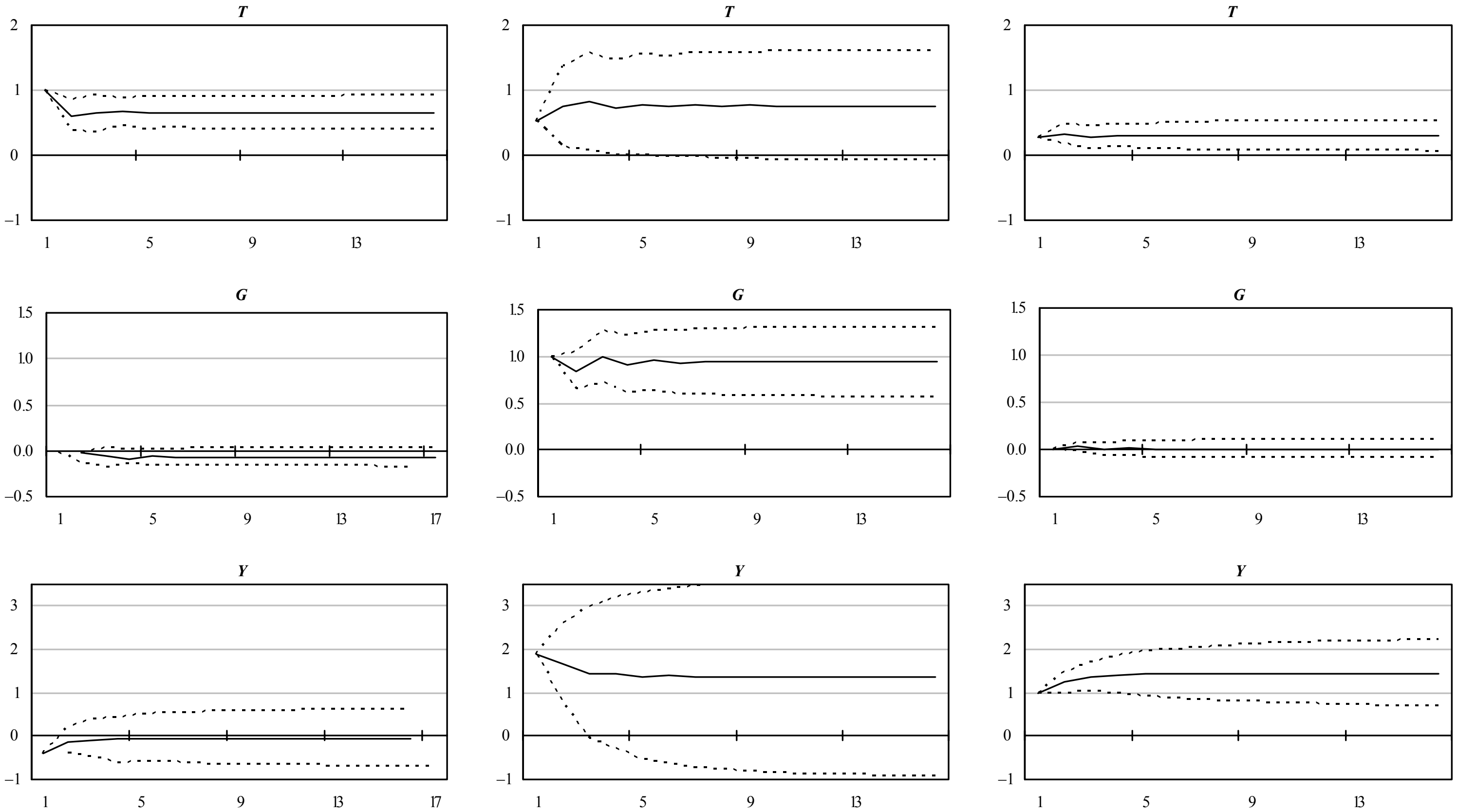


Figure 4 B

Chile: Accumulated Responses - Variables in Levels

Shock to *T* | **Shock to *G*** | **Shock to *Y***



Colombia

The same procedure was applied to the case of Colombia. The reduced-form VAR: $X_t = FX_{t-1} + u_t$ and also the same three elements of the matrix of contemporaneous relations among the variables were estimated here (Table 3). Then, they were imposed as restrictions for the identification of the structural VAR. The instruments used in the estimation of the within-the-quarter (short-run) elasticity of T to Y were: lags of ΔT, ΔY, terms of trade, and the real exchange rate. Several dummies were also included to capture the tax structure. The coefficient of the elasticity is not significant and the same happens with the response of T to a shock on Y.

The within-the-quarter (short-run) effect of taxes and spending on Y (GDP) was estimated using the same procedure as for Chile. We ran a regression of ΔY residuals on the residuals of ΔT (tax) and ΔG (public spending) taken from the respective equations of the reduced-form VAR. The instruments used this time were the cyclically-adjusted residuals of the tax equation (T'$= T\_res - a_{13} Y$), lags of GDP, and spending residuals, terms of trade, the real interest rate, and the real exchange rate. We used several dummies as well.

It is worth recalling here that the Nineties were turbulent in fiscal terms in Colombia. After decades of moderate deficits, fiscal accounts deteriorated dramatically to the point that in 1999 the deficit of the non-financial public sector

Table 3

Contemporaneous Coefficients Estimated with TSLS

Dependendent Variable ΔT	**Coefficient**	**T_statistic**	**1990:4-2005:2**
ΔY	a_{13} **=1.87**	0.7	Elasticity of taxes to GDP
$\Delta T(-1)$	–0.59	–5.03	
$\Delta T(-2)$	–0.29	–2.41	
Dummy 2001:4	–1.19	–31.9	
Dependent Variable: ΔY_residuals			**1991:1-2005:2**
ΔT_residuals	a_{13} = **0.002**	0.52	Effect of taxes on GDP
ΔG_residuals	a_{13} **= 0.025**	1.65	Effect of *G* on GDP
ΔY_residuals(–1)	–0.24	– 1.71	
Dummies			

reached 5.5 per cent of GDP, and that of the central government around 7 per cent.[13] The consolidated non-financial public sector deficit reached –0.8 per cent of GDP by the end of 2005. However, the central government is still running large deficits, –5 per cent of GDP.

The results obtained using Colombian data are unexpected with regard to the response of GDP to tax revenues and spending shocks (Figure 5 A). Output growth does not move significantly with the impact of a positive shock to taxes.[14] On the other hand, a shock to spending has a significant but small impact on output growth. In fact, an increase of one Colombian peso in public spending generates 12 cents of more output at impact.[15]

In the case of the accumulated responses, Figure 5 B shows that a shock to expenditures has no impact on taxes, consistently with the identification restrictions described above, and with recent history, given that spending has been financed to a large extent with debt. This result might indicate a non sustainable behavior of authorities. For instance, between 1996 and 2002 the non-financial public gross debt increased by 38 GDP percentage points. On the other hand, a positive shock to GDP increases tax revenues also in Colombia but only at impact. In addition, a shock to GDP has a positive effect on government spending, which could be interpreted as a sign of fiscal policy being procyclical: fiscal authorities spend more when the economy grows faster. Surprisingly, the effect of a spending shock on the level of GDP does not disappear as one would expect. It stabilizes at 17 cents of more output for one additional Colombian peso spent by the government.

4.3 VEC Estimations

This section tests the hypotheses about the relationship between taxes, expenditures, and real GDP, and estimates a statistical model under the specification vector $z_t = (t,g,y)'_t$. This vector is augmented with the terms of trade, which is an exogenous control variable, and a deterministic component into the cointegrating relationship. This section starts by testing whether the error-correction model representation of z (a *VECM representation*) correctly describes the structure of the data. Second, it tests if the matrix Π (using Johansen's notation) is of reduced rank. This test shows whether empirical evidence of cointegrating relations between the variables in the vector z exists.

13 For decades, Colombian economic growth rates were among the highest and most stable in Latin America. However, in 1999 Colombian GDP had an unexpected fall of –4.2 percent.

14 This result is noticeable. For that purpose, the Colombian government implemented almost one tax reform per year from 1998 to 2003.

15 The size of the multipliers obtained in both Chile and Colombia could be taken into account in future fiscal policy analysis, including the possible calibration of economic models.

Figure 5 A

Colombia: SVAR Impulse Responses – Variables in Differences

Shock to ΔT **Shock to ΔG** **Shock to ΔY**

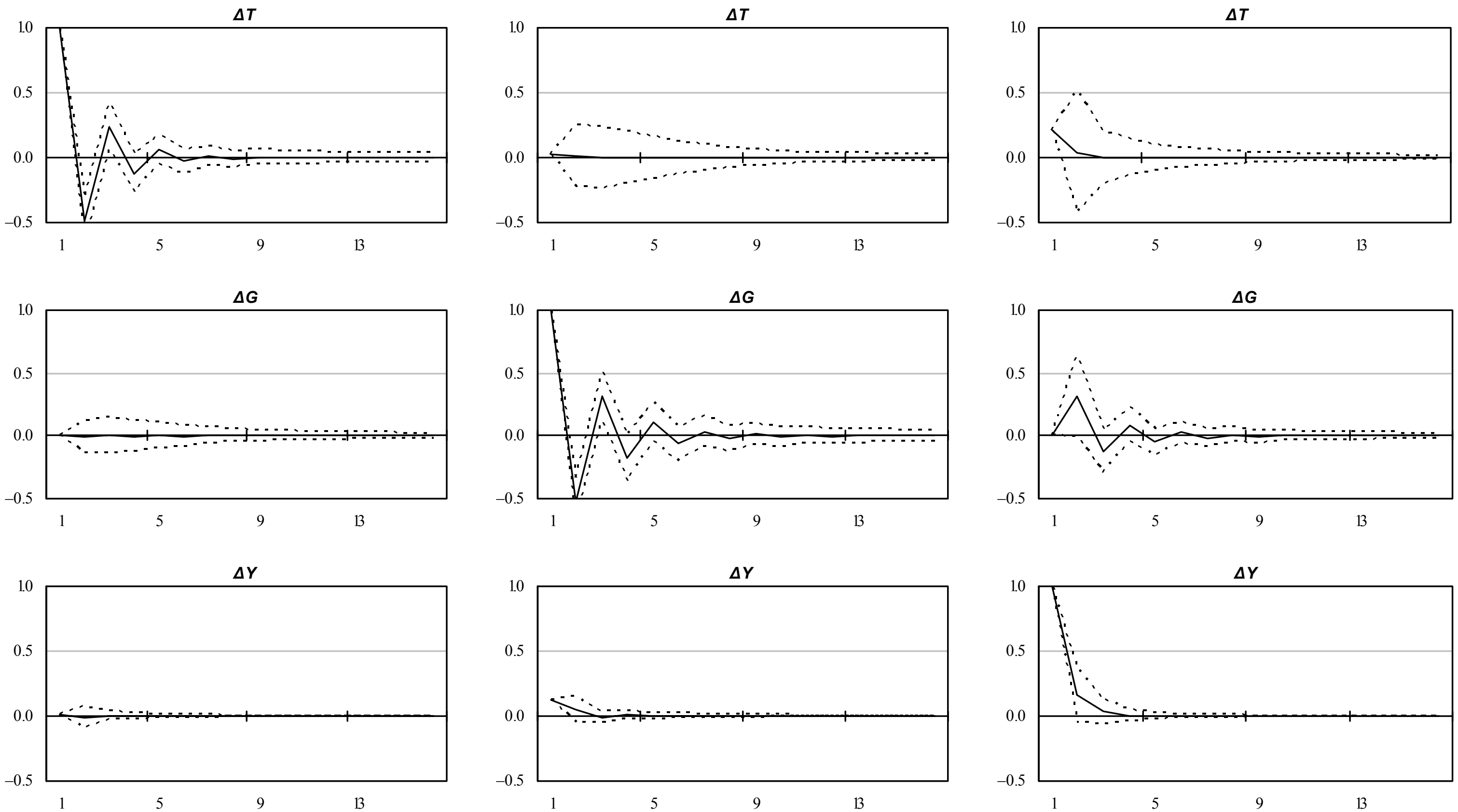


Figure 5 B

Colombia: SVAR Accumulated Responses – Variables in Levels

Shock to *T* | **Shock to *G*** | **Shock to *Y***

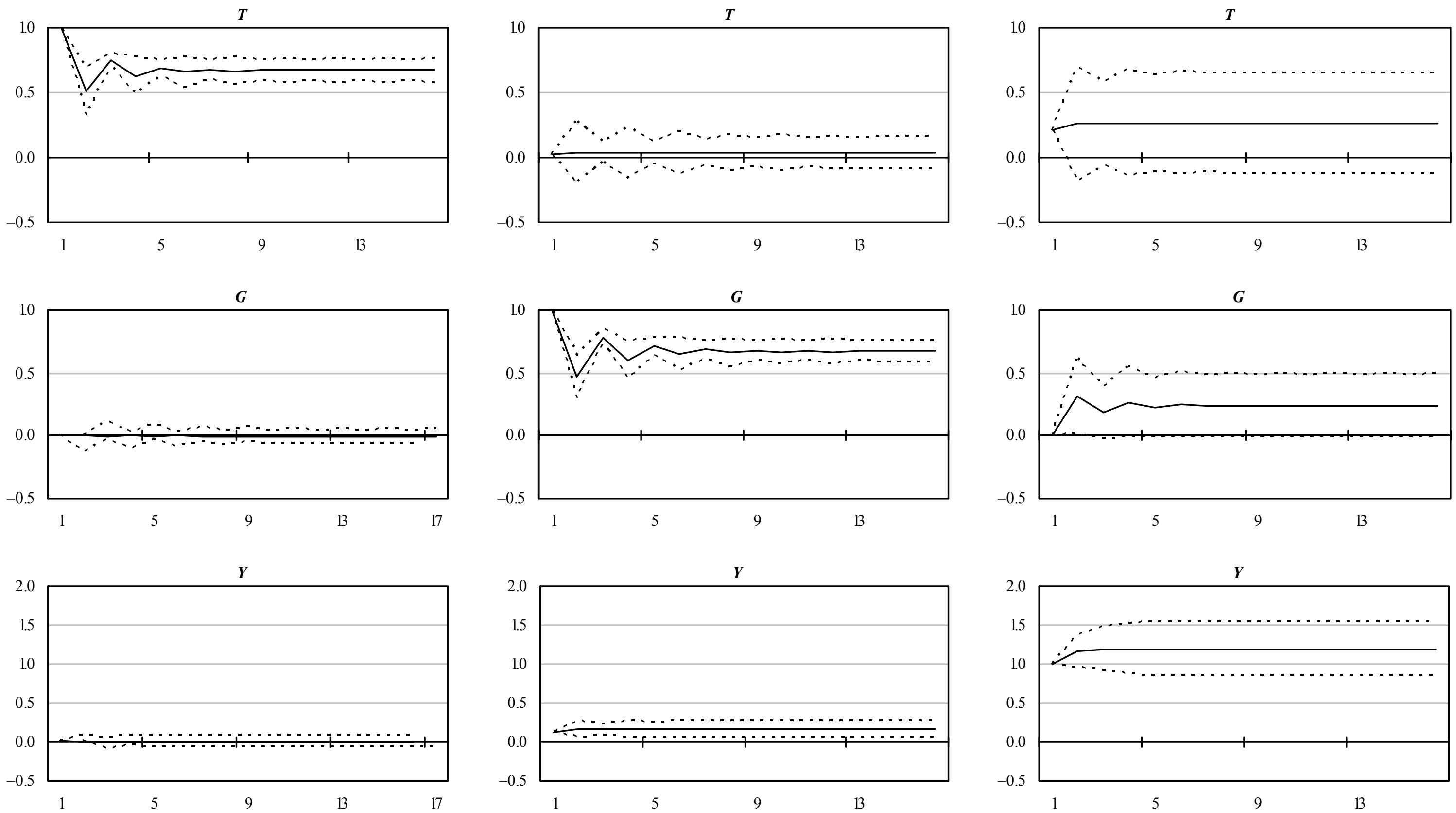


Table 4

Specification and Misspecification Tests[1]

	Univariate Statistics		**Multivariate Statistics**		
			Chile		
Equation	**ARCH (*k*)**	**Normality**	**Q (*j*)**	**LM (4)**	**Normality**
	K=2		*j*=16; 128.7 (p-val=.57)	12.3 (p-val=.20)	15.9 (p-val=.01)
ΔT_t	1.00	8,79			
ΔG_t	0.94	3.47			
ΔY_t	0.24	1.08			
			Colombia		
Equation	**ARCH(*k*)**	**Normality**	**Q(*j*)**	**LM(4)**	**Normality**
	k=1		*j*=15; 153.6 (p-val=.10)	5.2 (p-val=.81)	15.6 (p-val=.02)
ΔT_t	4.31	10.57			
ΔG_t	6.96*	3.98			
ΔY_t	2.66	1.90			

(1) Output from CATS. T is the log of taxes in real terms, G is the log of public expenditures real terms, and Y is the log of the real GDP. All tests are asymptotically χ^2-distributed. For univariate tests, * means significance at the 5 per cent level. An exogenous variable measuring the terms of trade was included for each country.

Specification and Misspecification Tests

One of the most critical parts of Johansen's procedure is determining the rank of matrix Π since the approach relies primarily on having a well-specified regression model. Thus, before any attempt to determine this rank or to present any estimation, the empirical analysis begins with specification and misspecification tests. They are used primarily to choose an 'appropriate' lag structure and to identify the deterministic components to be included in the model (e.g., whether or not to include an intercept in the cointegration space to account for the units of measurement of the endogenous variables, or to allow for deterministic trends in the data).

Once the lag structure and the deterministic component of the model are chosen, additional specification and misspecification tests are implemented. The first tests are multivariate tests for serial correlation (Ljung-Box Q test and Godfrey LM test) and normality (Hansen and Juselius, 1995). The second ones are a univariate type of test for autoregressive conditional heteroskedasticity (ARCH), normality

Table 5

Tests of Cointegration Rank[(1)]

Ho:	Ha:	λ_{max}	ACV (5%)	Ho:	Ha:	λ_{Trace}	ACV (5%)
				Chile			
$r=0$	$r=1$	12.9	20.9	$r=0$	$r>0$	21.5	29.7
$r=1$	$r=2$	5.4	14.1	$r\leq 1$	$r>1$	8.6	15.4
$r=2$	$r=3$	3.2	3.8	$r\leq 2$	$r>2$	3.8	3.8
				Colombia			
$r=0$	$r=1$	59.4*	20.9	$r=0$	$r>0$	75.2*	29.7
$r=1$	$r=2$	13.3	14.1	$r\leq 1$	$r>1$	15.2	15.4
$r=2$	$r=3$	2.5	3.8	$r\leq 2$	$r>2$	2.5	3.8

(1) Output from CATS. The test statistics have a small sample correction as suggested by Ahn and Reinsel (1990). It consists of using the factor $(T-kp)$ instead of the sample size T in the calculation of the tests. The critical values are taken from Osterwald-Lenum (1992). "ACV" stands for Asymptotical Critical Values. The symbol * means statistical significance at the 5 per cent level.

(Hansen and Juselius, 1995), and univariate serial correlation (Breusch and Godfrey test).

According to Table 4, the multivariate tests for serial correlation show that it is not present. They also show that the multivariate normality assumption fairly holds. The univariate tests are all met, except for heteroskedasticity in the case of the expenditures equation for Chile.

Finding the Rank of Matrix Π

Table 5 shows the tests of the rank of matrix $\boldsymbol{\Pi}$. The null hypothesis of $r = 0$ (no cointegration) is not rejected in favor of $r = 1$ by either test at the 5 per cent level for the case of Chile. The null hypothesis of $r = 1$ (or $r \leq 1$ using the λ_{Trace} test) in favor of $r = 2$ is not rejected by either test for this country. For the case of Colombia, one cointegation vector is found. Therefore, there is a long-run equilibrium relationship between tax revenues, public consumption, and real GDP for Colombia, but not for Chile.

It is worth mentioning that alternative specifications were run for Chile (excluding and including variables, and changing the lags of the VEC system) and the results of the tests changed significantly in some cases. The null hypothesis of no cointegration is rejected in some of them, that is T and Y might be cointegrated but the results of the tests are not as conclusive as desired. For completeness, however, we decided to also estimate a SVEC for Chile. No significant changes with respect to the SVAR findings were observed (the SVEC impulse responses for Chile are shown in the Appendix).

In conclusion, cointegration tests suggest that a VAR model may not be the correct specification for the case of Colombia, given that an error correction term would be missing from the estimated structural VAR. For that reason, the SVEC would be more appropriate since it takes into account that the variables are cointegrated and includes the error correction.

The results obtained by applying the SVEC procedure discussed above for Colombian data show again, that the response of GDP growth to a tax shock is nil, and to a spending shock is statistically significant but small (Figure 6 A).

It is worth pointing out that several results changed with respect to the ones obtained with the SVAR. For instance, a shock to spending had no impact on taxes (and vice versa), which was interpreted as a sign of a non sustainable fiscal policy, since spending should increasingly be financed with debt – as seem to be the case in Colombia from the second half of the Nineties onwards. However, this result changes when the model estimated is the SVEC, where the two shocks affect each other positively (Figure 6 B).

In fact, a shock to spending has now a significant and positive impact on taxes: one additional Colombian peso in public spending generates about 38 cents of more tax revenues. Conversely, an increase in taxes raises expenditures. If the country starts with a deficit, fiscal adjustment looks more difficult or, at least, will take longer, considering this result. Moreover, in the estimated SVAR impulse responses, a shock to GDP growth had a positive impact on public spending indicating a procyclical fiscal policy (Figure 5) but now, with the SVEC, this effect disappears (Figure 6). In this case the effect of spending on the level of GDP stabilizes at 14 cents – it does not disappear either.

In conclusion, when the estimated model for Colombia includes the error correction (SVEC), fiscal policy looks in better shape than it does with the SVAR model.

5. Conclusions

SVAR and SVEC models were estimated for Chile and Colombia aiming at identifying fiscal policy shocks in both countries, using quarterly data over 1989:1 through 2005:4 and 1990:1 and 2005:2, respectively.

The main findings for Chile indicate that a one Chilean peso ($1) increase in tax revenues has a transitory negative effect on GDP growth of 40 cents. On the other hand, a one peso increase in government spending has a transitory positive effect of $1.9 pesos on real GDP growth, which stabilizes at 1.37 cents. In addition, government spending and output shocks have a positive transitory effect on net tax revenues. With respect to the accumulated effects, the most important result shows that shocks to spending and output increase tax revenues, which implies fiscal sustainability. However, tax increases or GDP growth shocks do not result in higher

Figure 6 A

Colombia: SVEC Impulse Responses – Variables in Differences

Shock to ΔT **Shock to ΔG** **Shock to ΔY**

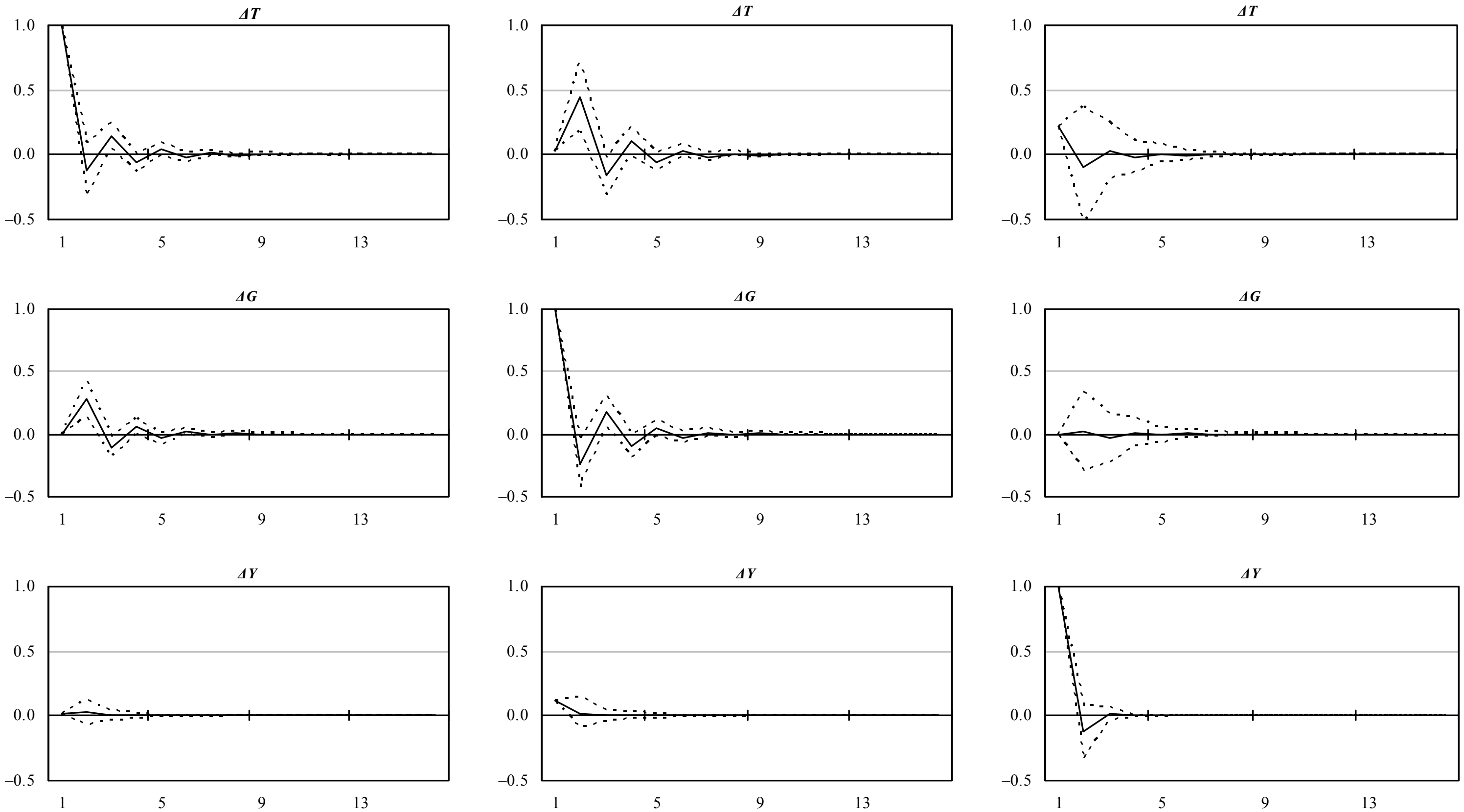
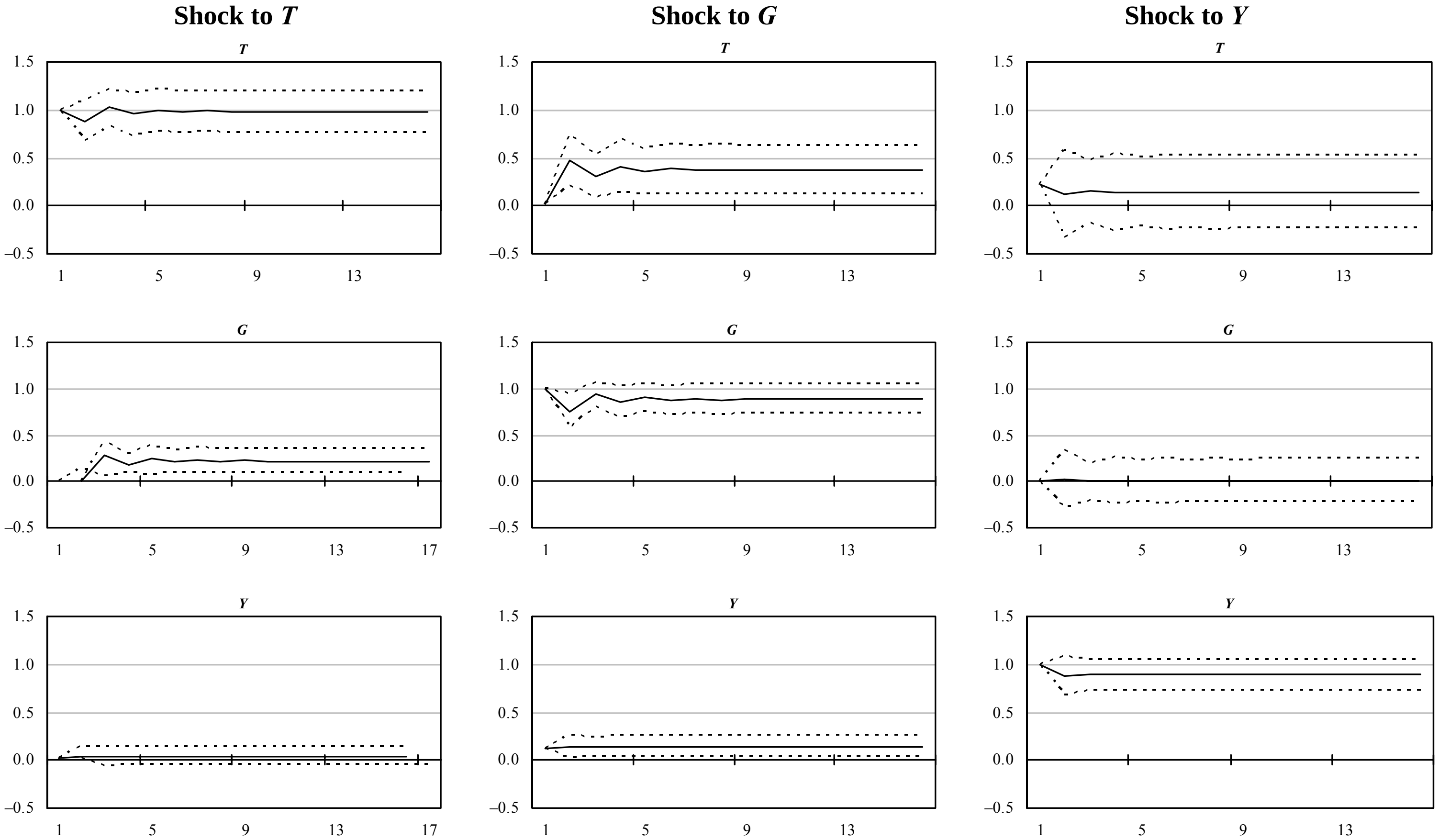


Figure 6 B

Colombia: SVEC Accumulated Responses – Variables in Levels



spending. This is consistent with the policy of running fiscal surpluses in place in Chile during most of the period considered.

On the other hand, some of the results obtained for Colombia are at odds with intuition at first sight. Indeed, a tax revenue hike has no impact on GDP and the effect of a spending shock is significant, but very small. A one peso increase in public spending translates, at impact, into a \$0.12 increase in the level of GDP and stabilizes at \$0.15 peso. The effect of a shock to GDP on taxes is not different from zero. Other results, change depending on the model estimated. As opposed to the SVAR, with the SVEC, tax and spending shocks affect each other positively, and GDP has no impact on public spending. In summary, fiscal policy in Colombia looks in a slightly better shape when the model estimated includes the error correction than when it does not.

The estimates provide a good notion of the effects of fiscal policy shocks in both countries. As an explanation for the differences found between them, we think that when public finances are under control, as is the case in Chile, fiscal policy is more effective, than when they lack stability and credibility as apparently is the case of Colombia from the mid-Nineties on.

As usually happens with empirical exercises, the analysis could be enriched by considering additional variables in the models, namely interest rates, consumption and investment. We leave it for future work.

APPENDIX

Figure 7

Chile: Observed Variables
(logs of 1996 million pesos)

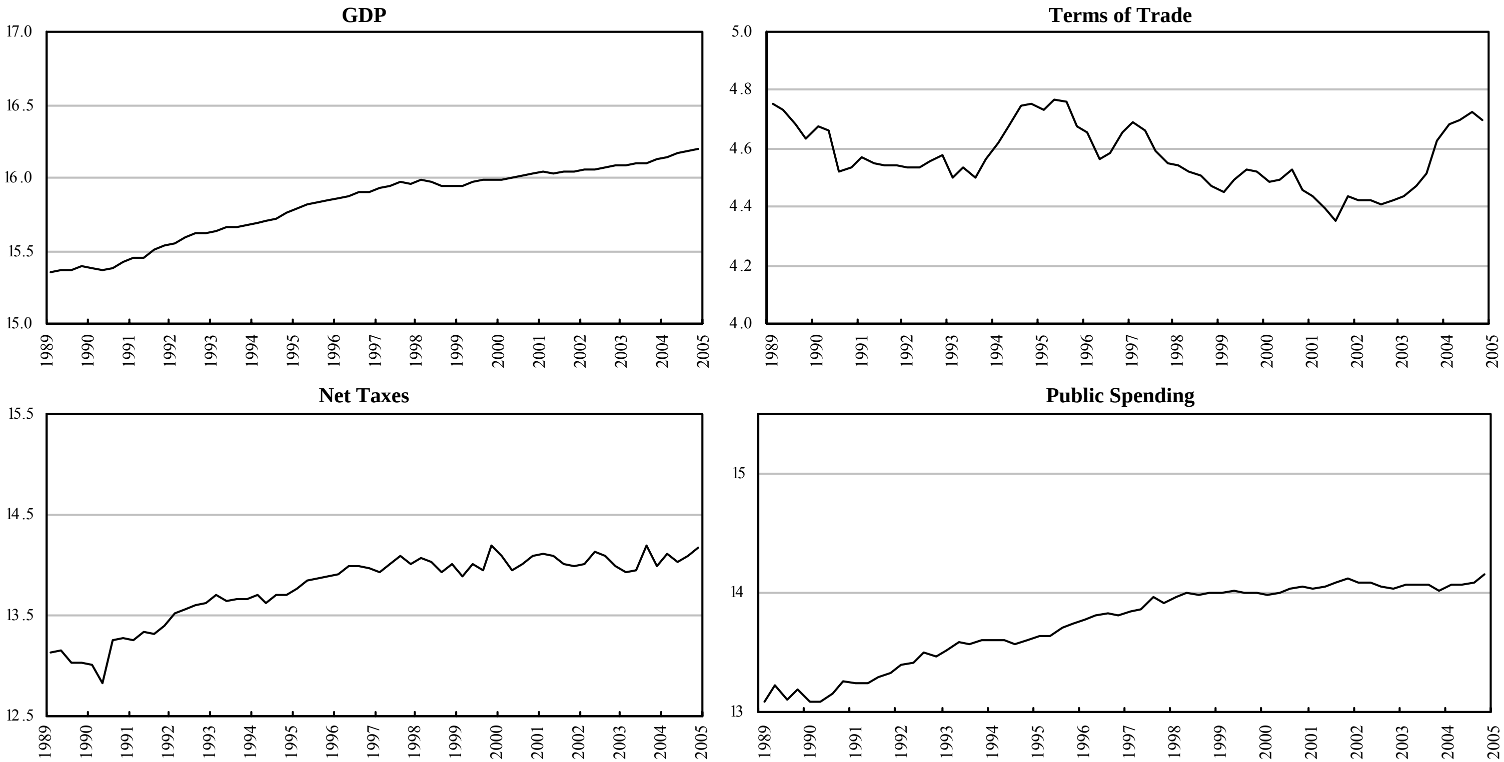


Figure 7 (continued)

Colombia: Observed Variables

(logs of 1994 million pesos)

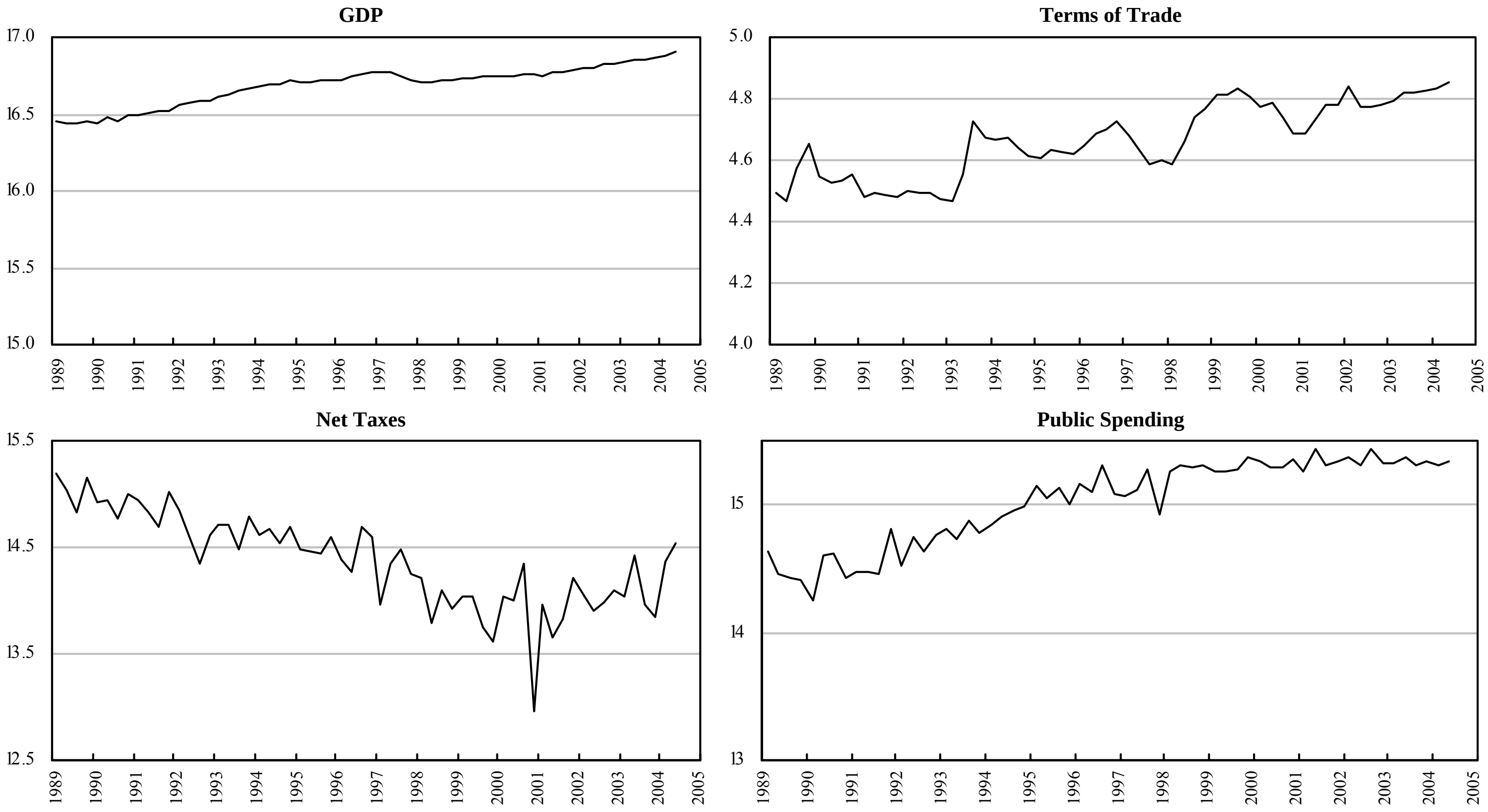


Figure 8

Chile: SVEC Impulse Responses – Variables in Differences

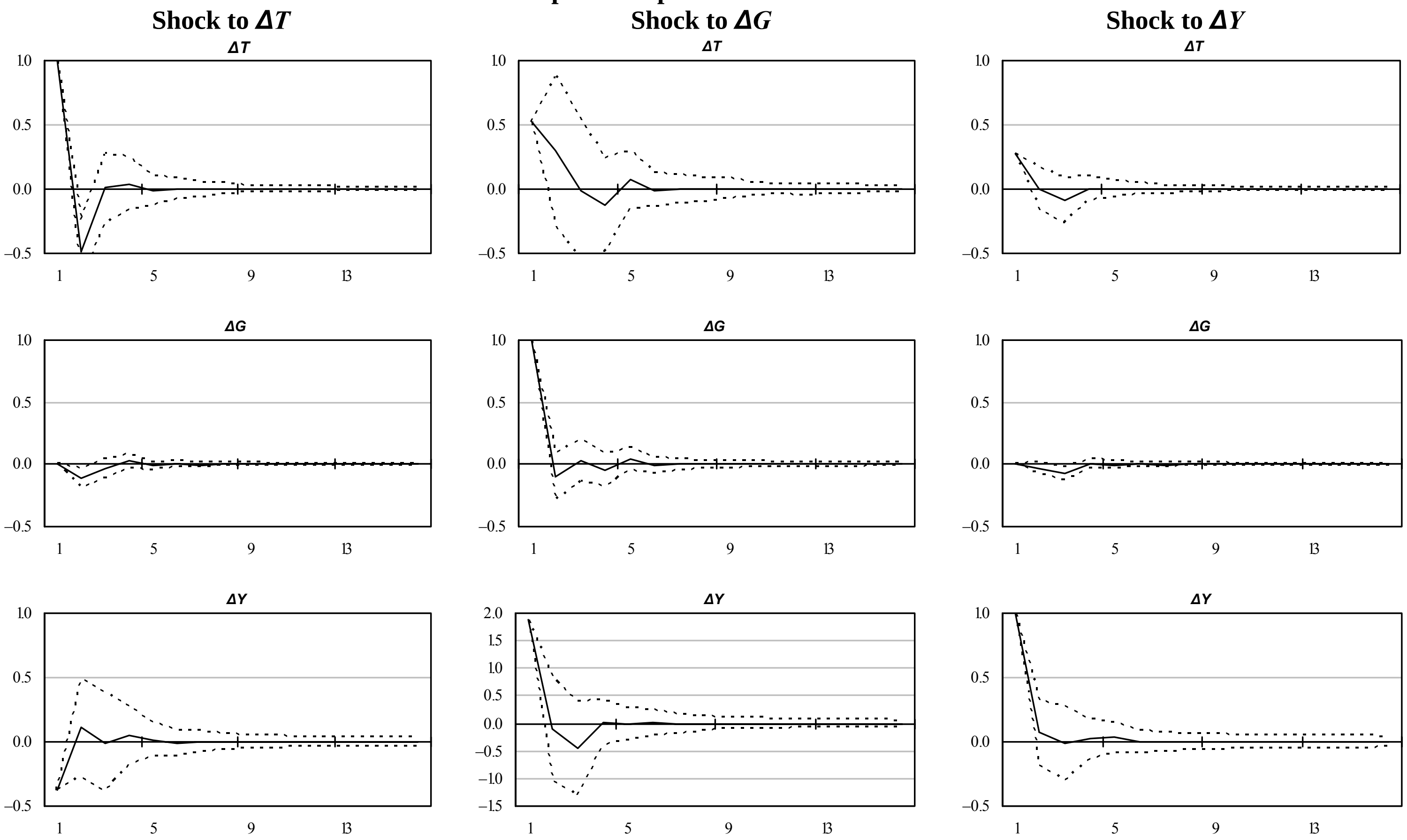
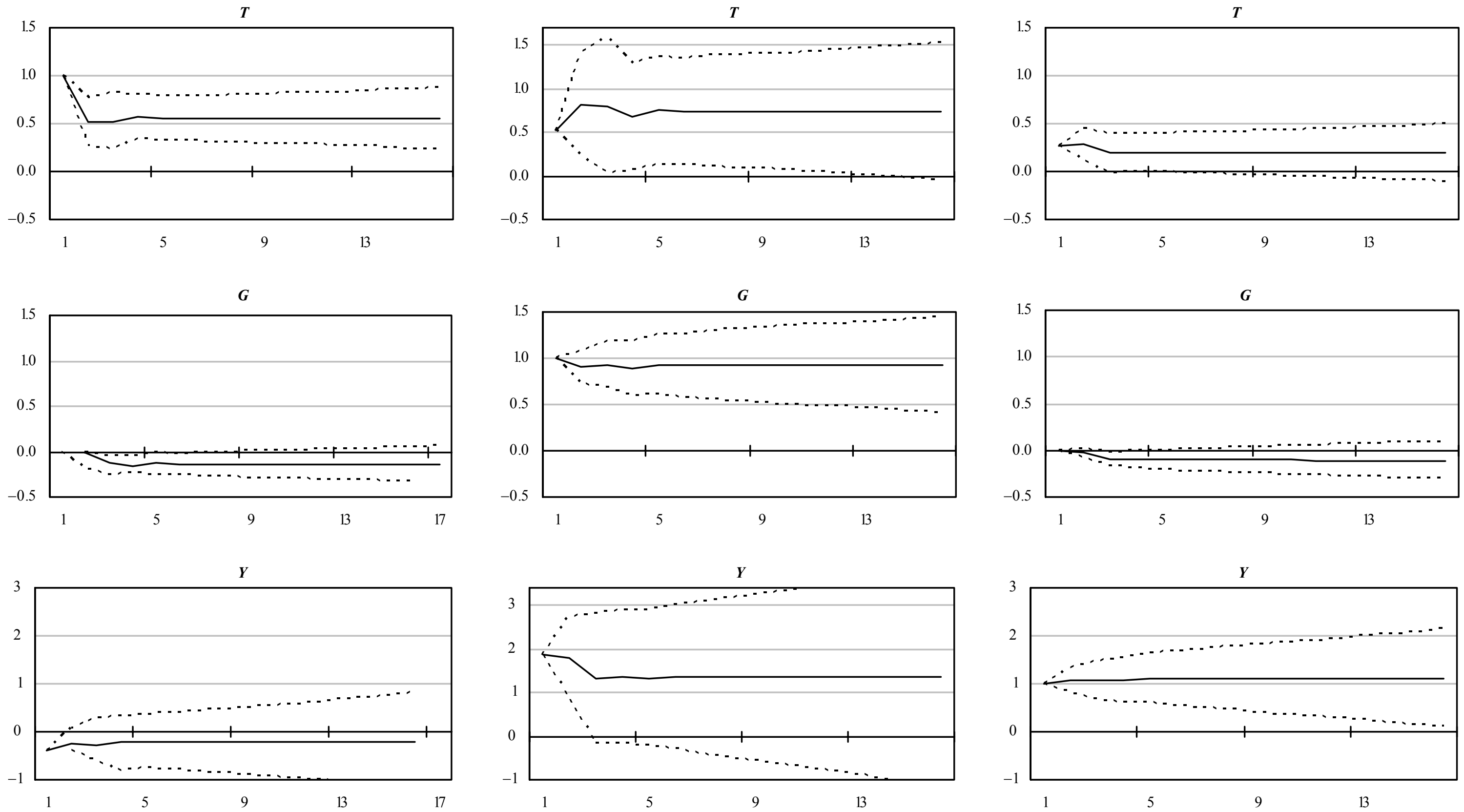


Figure 8 (continued)

Chile: SVEC Accumulated Responses – Variables in Levels

Shock to *T* | **Shock to *G*** | **Shock to *Y***



REFERENCES

Ahn, S.K. and G.C. Reinsel (1990), "Estimation for Partially Non-stationary Multivariate Autoregressive Models", *Journal of the American Statistical Association*, No. 85, pp. 813-23.

Bernanke, B. and A. Blinder (1992), "The Federal Funds Rate and the Channels of Monetary Transmission", *American Economic Review*, Vol. 82, No. 4, pp. 901-22.

Bernanke, B. and I. Mihov (1996), "Measuring Monetary Policy", *Quarterly Journal of Economics*, Vol. 113, No. 3, pp. 869-902.

Blanchard, O. and R. Perotti (2002), "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *Quarterly Journal of Economics*, Vol. 117, No. 4, pp. 1329-68.

Blanchard, O. and D. Quah (1989), "The Dynamic Effects of Aggregate Demand and Supply Disturbances", *American Economic Review,* Vol. 79, No. 4, pp. 655-73.

Breitung, J., R. Bruggemann and H. Lutkepohl (2004), "Structural Vector Autoregressive Modeling and Impulse Responses", in H. Lutkepohl and M. Kratzig (eds.), *Applied Time Series Econometrics*, Cambridge University Press, pp. 159-96.

Cerda, R., H. González and L.F. Lagos (2005) "Efectos dinámicos de la política fiscal", *Cuadernos de Economía,* Vol. 42, No. 1, pp. 63-77.

Christiano, L., M. Eichenbaum and C. Evans (1999), "Monetary Policy Shocks: What Have We Learned and to What End?", in J. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics*, Vol. 1, Elsevier Science.

Clarida, R. and J. Galí (1994), "Sources of Real Exchange Rate Fluctuations: How Important Are Nominal Shocks?", *Carnegie-Rochester Series on Public Policy*, No. 41, pp. 1-56.

Fatás, A. and I. Mihov (2001), "The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence", INSEAD, mimeo.

Franken, H., G. Lefort and E. Parrado (2006) "Business Cycles Responses and the Resilience of the Chilean Economy", in R. Caballero, C. Calderón and L.F. Céspedes (eds.), *External Vulnerability and Preventive Policies,* Central Bank of Chile.

Galí, J. (1992), "How Well Does the IS_LM model Fit Post-war US Data?" *Quarterly Journal of Economics,* Vol. 107, No. 2, pp. 709-38.

Galí, J., J.D. López-Salido and J. Vallés (2006), "Understanding the Effects of Government Spending on Consumption", in J. Galí's homepage.

García, M., P. García and B. Piedrabuena (2005), "Fiscal and Monetary Policy Rules: The Recent Chilean Experience", Working Paper, No. 340, Central Bank of Chile.

Hansen, H. and K. Juselius (1995), "CATS in RATS – Cointegration Analysis of Time Series", Estima Evanston.

Jacobson, T., A. Vedrin and A. Warne (1997), "Common Trends and Hysteresis in Scandinavian Unemployment", *European Economic Review*, No. 41, pp. 1781-816.

Johansen, S. and K. Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, No. 52, pp. 169-210.

Junguito, R. and H. Rincón (2004), "La Política Fiscal en el Siglo XX en Colombia", Borradores de Economía, No. 318, Banco de la República de Colombia.

Kim, S. and N. Roubini (2000), "Exchange Rate Anomalies in the Industrial Countries: A Solution with a Structural VAR Approach", *Journal of Monetary Economics*, Vol. 45, No. 3, pp. 561-86.

King, R.G., C.I. Plosser, J.H. Stock and M.W. Watson (1991), "Stochastic Trends and Economic Fluctuations", *American Economic Review*, No. 81, pp. 819-40.

Lozano, L.I. and C. Aristizábal (2003), "Déficit público y desempeño económico en los Noventa: el caso colombiano", Borradores de Economía, No. 298, Banco de la República de Colombia.

Lucas, R. (1976), "Econometric Policy Evaluation: A Critique", Carnegie-Rochester Conference Series on Public Policy, No. 1, pp. 19-46.

Marcel, M., M. Tokman, R. Valdés and P. Banavides (2001), "Structural Budget Balance: Methodology and Estimation for the Chilean Central Government 1987:2001", Dipres, Ministerio de Hacienda.

Mountford, A. and H. Ulhig (2002), "What Are the Effects of Fiscal Policy Shocks?", CEPR, Discussion Paper, No. 3338.

Ministry of Finance (2006), "Informe de estadísticas de la deuda pública", March.

Osterwald-Lenum, M. (1992), "A Note with Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics", *Oxford Bulletin of Economics and Statistics*, Vol. 54, No. 3, pp. 461-72.

Perotti, R. (2002), "Estimating the Effects of Fiscal Policy in OECD Countries", European Central Bank, Working Paper, No. 168.

Sims, C. (1980), "Macroeconomics and Reality", *Econometrica*, No. 48, pp. 1-49.

Stock, J. and M. Watson (2001), "Vector Autorregressions", *Journal of Economic Perspectives*, Vol. 15, No. 4, pp. 101-15.

COMMENTS ON SESSION 2:
DISCRETIONARY POLICY AND FISCAL IMPACT

*Cláudia Rodrigues Braz**

Introduction

I would like to start by thanking the organisation for the opportunity to participate as a discussant in this workshop. I found all the papers in this session very interesting but due to time constraints I will only comment on the papers by Golinelli and Momigliano, Claus *et al*. and Ernesto Rezk. I would also like to refer that this discussion is based on the draft versions of the papers presented at the workshop and some of the points raised may no longer be valid for the published versions.

1. Some comments on the paper by Golinelli and Momigliano

The authors constructed a model to analyse the characteristics of fiscal policies in the euro area in the 1988-2006 period, using as explanatory variables the initial state of public finances, the European fiscal rules, cyclical conditions and the political budget cycle. A Maastricht variable is defined to take into account, in the European context, the requirement to correct an excessive deficit with respect to the 3 per cent of GDP threshold. If this variable is binding, the discretionary fiscal action, measured by the change in the cyclically adjusted primary balance, is only a function of the Maastricht variable. Otherwise, it depends on the previous period output-gap, the initial state of public finances (measured by the previous period primary balance and debt level) and some dummy variables to capture the electoral cycle.

Concerning the data used, the main problem is related with the construction of the output-gap series, since real time data it is only available from 1994 onwards. A comparison between the two data sets, for the years for which it is possible, shows quite similar standard deviations (1.4 and 1.8 in the constructed and the published data series, respectively) but an average value still quite different (–0.4 in the authors estimates to be compared with –1.0 in the published data) and a low coefficient of correlation (0.7). Nevertheless, it is worth mentioning that the authors estimated the model on the basis of both sets of data, obtaining similar results.

The authors use real time data instead of *ex post* data for all explanatory variables with the exception of the debt level. Regarding this issue, two observations could be made. Firstly, I fully agree that governments base their fiscal policy decisions on the information actually available at that time as far as the cyclical

* Banco de Portugal. Exchange of views with Maximiano Pinheiro is gratefully acknowledged.

situation is concerned. However, concerning the initial state of public finances, the use of the same argument is not so obvious. Indeed, in most of the countries where significant statistical revisions occurred the authorities were probably aware of the actual situation of public finances. Secondly, the authors base the real time data on the December OECD Economic Outlook and argue that even though budget documents are the most direct source of real time information, the estimates required are not reported sometimes and might be distorted by political reasons, reflecting differences in risk aversion. The following table shows for the 2001-06 period the real time general government balance, on a National Accounts basis, in Portugal using the OECD December Economic Outlook and the Report of the State Budget. As it is shown, the estimates using the two sources are quite similar, with the exception of the years 2001 and 2002. Indeed, *ex post*, the data included in the Budget proved to be closer to the outturn than the OECD estimate since the fiscal authorities anticipated better a statistical revision of the budgetary data in 2001 and the implementation of temporary measures at the end of 2002.

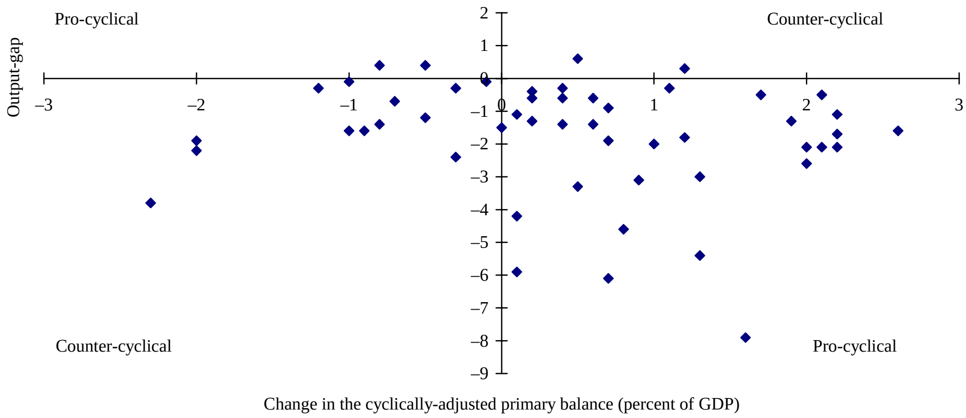
Regarding the specification of the model, I would like to raise three questions to the authors. Firstly, in the definition of the fiscal rule when the Maastricht variable is not binding, could it be used the output-gap of the current year instead of the one of the previous year? The authors argue that the output-gaps are highly persistent but since real time data is used, perhaps it could be a feasible option.

Real-time General Government Balance in Portugal (National Accounts)

	2001	**2002**	**2003**	**2004**	**2005**	**2006**
OECD December Economic Outlook						
2001	**–1.7**	–1.5				
2002		**–3.4**	–3.0			
2003			–2.9	–3.0		
2004				–2.9	–3.0	
2005					–6.0	–4.9
State Budget (October *t*–1)						
2002	**–2.2**	–1.8				
2003		**–2.8***	–2.4			
2004			–2.9	–2.8		
2005				–2.9	–2.8	
2006					–6.0	–4.6

* On a Public Accounts basis.

Output-gap and the Change in the Cyclically-adjusted Primary Balance (Euro Area, 1993-97)



Source: Ameco database, Autumn 2005.

Secondly, could the Maastricht variable, besides interest payments, also take into account the expected contribution of the cyclical component to the fiscal outcome? Finally, could the previous year cyclically adjusted primary balance be used as a measure of the initial state of public finances, instead of the primary balance itself?

Finally, as far as the results are concerned, I would like to comment only on the reaction of fiscal policy to cyclical conditions in the euro area. The findings in the literature for this issue are not homogeneous: fiscal policy appears pro-cyclical or counter-cyclical, asymmetric or symmetric. The authors found a sizeable counter-cyclical reaction of fiscal policy for the euro area countries, relatively stable across sub-periods in terms of point estimates, even in the period prior to the participation in the third phase of EMU (1993-97). This outcome is quite unexpected since we know that in most EU member-states at that time cyclical conditions were not very favourable and many countries had to implement a fiscal effort in order to ensure the participation in the euro area. Indeed, when we look into a simple chart with the change in the cyclically adjusted primary balance and the output-gap in the euro area in that period, using *ex post* data and not controlling for other variables, we find that most fiscal policies appear pro-cyclical (see below). As such, the result obtained by the authors might be biased and is probably only capturing a small sub-sample of the total set of observations. Indeed, the only thing that we can conclude is that for the 'well behaved' countries, *i.e.*, those with a deficit below the 3 per cent of GDP limit, for which the Maastricht variable was not binding, fiscal policies were counter-cyclical. I would admit that the number of observations in this sub-sample might be quite small, explaining the low significance of the results.

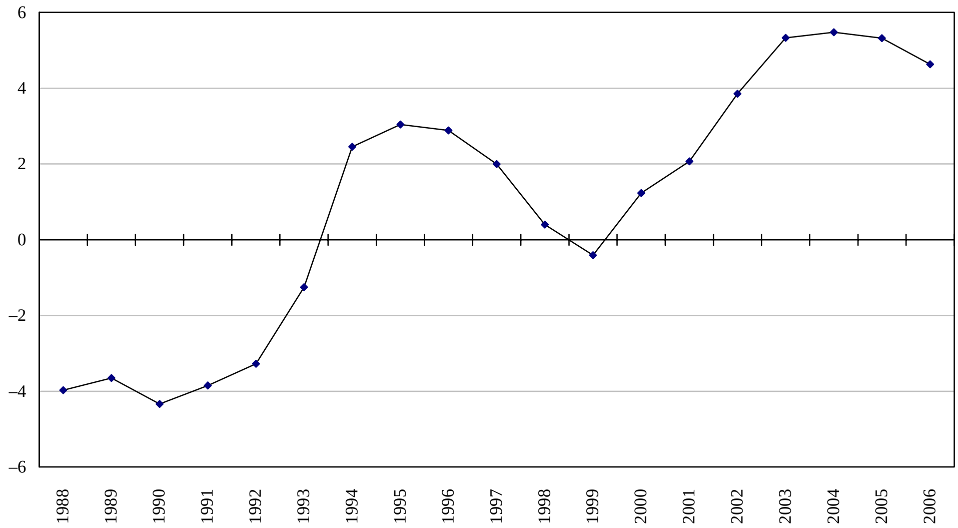
2. Some comments on the paper by Claus *et al*.

In this paper, the authors use a three variable VAR model (GDP, net tax and government spending) to assess the effects of fiscal policy in New Zealand. One of the main challenges in the implementation of this type of methodology is the assumption of identification restrictions to estimate the structural residuals. As the model is based on Blanchard and Perotti (2002), the same identification procedure is adopted.

The authors assume two alternative trend specifications in their fiscal VAR: a deterministic specification, where the variables are defined in logarithms, and a stochastic specification, which is estimated using the first differences of the logarithms of the variables. Then, they compare the contemporaneous and dynamic effects of government spending and net tax temporary shocks using the two specifications. However, the dynamic results are not comparable. With the deterministic specification, as the variables are defined in levels, the shock is indeed temporary. But, in the stochastic specification, the temporary shock in the variables' first difference is very similar to a permanent shock in levels (not completely in this case because the authors in the stochastic specification subtract a changing mean). This type of reasoning may explain why the impulse response functions in the deterministic specification tend to converge to zero but the same does not occur in the stochastic specification. The same results appear in the alternative model specification tested by the authors, which compares the stochastic specification with a 'Hodrick Prescott specification' (variables defined in levels but deducted by trends obtained using the Hodrick Prescott filter).

To assess the individual effects of tax revenue and transfer payments, the authors re-estimate the model splitting net taxes in two variables. In the case of a four variable VAR, six identification restrictions are needed (three more than in the previous specification). As mentioned above, the identification procedure is crucial for the interpretation of the results. However, this one is not specified in the text and can only be guessed through the analysis of the impulse response functions (like the no reaction of transfers to tax or spending shocks).According to Blanchard and Perotti, 2002, "the imposition of a cointegrating relation between G and T yields very similar results to our benchmark case". Indeed, the existence of cointegrating relations between the VAR variables changes the way the identification restrictions are imposed (for the econometric procedure proposed in this situation, see, for example, King, Plosser, Stock and Watson, 1991, AER). In the paper on New Zealand, the authors did not check this hypothesis. However, the analysis of the general government balance in this country between 1988 and 2005, suggests that net taxes and government spending are probably not cointegrated as the budget balance fluctuates a lot (see chart opposite). In any case, a reference to the results in the text could be added.

New Zealand – General Government Overall Balance
(percent of GDP)



Source: OECD Economic Outlook.

3. Some comments on the paper by Rezk

The author estimates a five variable VAR model (tax revenue, public expenditure, GDP, unemployment and inflation) to assess the effects of fiscal policy in Argentina for the period 1980-2005. Ten identification restrictions were imposed, including the assumption that public expenditure does not contemporaneously depend on unemployment. For this to be correct, public expenditure in Argentina should not include any type of unemployment benefits.

Concerning the cointegration relations between the VAR variables, the author refers that "the possibility of effects of cointegration are more important when long-run relations are being analysed". Nevertheless, as mentioned in the comments to the previous paper, the existence of cointegration in a VAR model may change the identification procedure. In this context, perhaps it could be checked by the author and a reference added to the text.

Finally, as mentioned in some cases by the author in the paper, some results still require further analysis. As an example, I would like to highlight three results whose interpretation is not very intuitive:

i) the negative response of tax revenues to a public expenditure shock, in spite of an increase in GDP;

(ii) the positive reaction of GDP to a positive tax revenue shock;

(iii) the "cyclical" reaction of inflation to a GDP shock.

COMMENTS ON SESSION 2: DISCRETIONARY POLICY AND FISCAL IMPACT

*Tomász Jędrzejowicz**

First of all I would like to thank the organisers of the workshop for the invitation and the opportunity to comment on three excellent papers from the session on Discretionary Policy and Fiscal Impact. The main theme of all three is essentially the impact of fiscal policy, but the detailed issues discussed and the approaches followed by their authors are quite different, and in my view in each case innovative.

The paper by Kąsek, Laursen and Skrok consists of an overview of theory and previous empirical work and three separate studies investigating different aspects of the impact of fiscal policy in the eight new EU Member States from Central and Eastern Europe (EU8). The first study, which is the most comprehensive and in my view the most significant of the three, deals with the impact of taxation and public expenditure on economic growth. The authors' specification is based on growth literature, and follows a framework of dividing taxation into distortionary and non-distortionary and public expenditure into productive and non-productive, as proposed . The other two studies focus on labour market distortions caused by the tax wedge and on the role of corporate income taxes in determining FDI flows, in the context of the "tax competition" debate related to Central and Eastern European countries.

The paper by Botman and Kumar presents the Global Fiscal Model, developed at the IMF. The GFM is a multi-country dynamic general equilibrium model with an extensive fiscal block, offering a unique, state-of-the-art tool for analysing fiscal policy in an international context.

The third paper, by Creel, Monperrus-Veroni and Saraceno, also proposes a very innovative framework in the form of an SVAR model with long-term public debt dynamics derived from the Fiscal Theory of the Price Level. This framework is employed to study the impact of public investment on long-term growth, using data for the UK, particularly in the context of the golden rule embodied in the Code for Fiscal Stability, introduced there in 1997.

Let me now briefly go over some of the main lessons to be drawn from economic theory and previous research as regards the impact of fiscal policy and relating to them the findings of the three papers.

I will start with a basic, stylised, government consumption shock. Empirical literature tells us, in line with Keynesian theories, that its effect on private consumption, at least in the short run, is likely to be positive, especially because of

* Narodowy Bank Polski, Macroeconomic and Structural Analyses Department.

The views expressed in these comments are those of the author and not necessarily those of the National Bank of Poland.

liquidity constrained and myopic consumers. The multiplier is likely to be less than unity, because of forward looking consumers anticipating the higher future tax burden and increasing their saving rate in response to the government consumption shock. A study by de Mello, Kongsrud and Price[1] of the OECD found that in the short-run, the private saving offset of public dissaving is likely to amount to ½, while in the longer run, it increases to ¾. However, this effect may depend on the initial state of public finances, notably the level of public debt. Based on a study of 19 OECD countries,[2] Perotti finds that in "normal" (low debt) times, the impact of an increase in government purchases of goods and services on private consumption is indeed positive. It turns negative in "difficult" (high debt) times, when consumers associate an increase in government consumption with an imminent tax increase.

Meanwhile, private investment is likely to decline in response to a government consumption shock, through the effect of "crowding out" of private savings in response to government dissaving. Moreover, the negative response of private investment may occur through another channel, namely the labour market. Alesina *et al.*[3] find that a government spending shock leads to an economy-wide increase in real wages, exerting a negative effect on profits and investment.

Most of these effects are very well reflected in the Global Fiscal Model, presented by Botman and Kumar. The model features myopic, liquidity constrained and forward looking consumers, allowing for the effects of public spending shocks on private consumption to mimic those reported in empirical studies. The paper clearly illustrates the difference between the impact of partly or fully reversed spending shocks, which is a close approximation of the actual behaviour of consumers, although an imperfect one, given that their reaction will not depend on the true nature of the shock, but their initial perception thereof. The model also features crowding out effects of government consumption, illustrating how they differ for large and small economies.

Another aspect of the impact of fiscal policy, also addressed in the papers presented, are tax distortions, particularly on labour income. The negative impact of the tax wedge on labour demand and supply is well established in theoretical and empirical literature and confirmed for Central and Eastern European countries in the Kąsek, Laursen and Skrok paper. The authors find that a 1 percentage point increase in the tax wedge is associated with a 0.5-0.8 percentage points decline in employment growth, which is a fairly strong effect compared to other studies. Considering that their study covers a distinct group of countries over a relatively short period of time, in which they had been undergoing their transformation to fully-fledged market economies, one could consider whether the estimation is not

---

[1] De Mello, L., P.M. Kongsrud and R.W.R. Price (2004), "Saving Behaviour and the Effectiveness of Fiscal Policy", OECD, Economics Department, Working Paper.

[2] Perotti, R. (1999), "Fiscal Policy in Good Times and Bad", *The Quarterly Journal of Economics*, Vol. 114, No. 4.

[3] Alesina, A., S. Ardagna, R. Perotti, F. Schiantarelli (1999), "Fiscal Policy, Profits and Investment", NBER, Working Paper, No. 7207.

affected by some extraordinary factors. One factor, which comes to mind, is the excessive employment these countries had experienced before their economic transition. This was shed over the transition period, partly at the beginning of the 1990s, but partly also during the analysed period. This is demonstrated by a back-of-the-envelope calculation showing a striking difference between employment growth in the EU15 and EU8 over the 1996-2004 period, on which the estimation is based. Employment in EU15 grew by 10.5% over that period, whereas in the EU8, it declined by 1.3 per cent.[4]

When discussing the effects of the tax wedge on the labour market, the impact of the opposite side of public finances comes to mind – namely disincentive effects associated with some categories of public spending. Firstly, social safety nets may exacerbate the high marginal effective tax rates faced by low income households in their work-leisure trade-off. Secondly, generous access to early retirement and disability pensions may cause many workers, particularly those close to retirement age, to leave the labour market, while still able to work. These effects did play a role in EU8 countries, notably the latter one is an important factor contributing to Poland's record-low labour activity rate. Unfortunately they are not included in the tax wedge and employment regression of the Kąsek, Laursen and Skrok paper, though admittedly, obtaining relevant data for the eight countries in a form which would allow for their use in the estimation would be a impossible task. The same can be said of the Global Fiscal Model presented by Botman and Kumar – it features distortions caused by the tax wedge, but not those arising from progressivity of tax and benefit schemes, which would require very detailed, country specific information.

The Kąsek, Laursen and Skrok paper also addresses another channel through which tax policy affects the economy, namely the role of corporate taxes in attracting foreign direct investment and the possible ensuing tax competition between countries. There is no clear empirical evidence that corporate taxes play a major role in attracting foreign direct investment. Nevertheless, it appears that in a group of countries among which there are no great differences in terms of other key determinants of FDI inflows, such as political and legal stability, openness of the economy, labour costs, education of the workforce, transport infrastructure, etc., corporate tax rates may play a role. This could be the case for countries of Central and Eastern Europe, a hypothesis further supported by the downward movement in corporate tax rates observed there in recent years. The estimation of Kąsek, Laursen and Skrok confirms previous empirical findings, as the corporate tax rate is found to be a statistically significant determinant of FDI flows, but less important than other factors.

A vital issue in the context of the impact of fiscal policy, addressed in many empirical studies, but with no unanimity in findings, is that of the structure of public expenditure, its effectiveness and the impact of different components of spending on growth. Kąsek, Laursen and Skrok estimate the impact of fiscal policy on economic

[4] Calculations made using data from the AMECO database. Unweighted average for EU8 countries.

growth in the framework of "productive" vs "unproductive" expenditure and "distortionary" vs "non-distortionary" taxation. Their findings for EU8 countries are similar to those of Kneller et al. for OECD countries – "productive" spending has a positive impact of growth. The division of various categories of public expenditure into productive and non-productive is clearly a controversial issue with implications for results. Kąsek, Laursen and Skrok include in the productive group general public services, educational, health and housing expenditure. Due to data limitations they could not include spending on transport infrastructure in this group, although normally this category would be a strong candidate for inclusion. In addition, the estimation spans a relatively short period of 10 years, which raises the issue of lags with which educational and health care expenditure could be expected to impact growth. The discussion of "productivity" of different public expenditure categories has important policy implications, which is one of the reasons for creation of the Working Group on the Quality of Public Finances under the Economic Policy Committee.

The one category of public expenditure, which studies show is most likely to have a positive impact on growth, is public investment. Theoretical literature – endogenous growth theory – as well as empirical studies, are relatively undivided on the existence of a general growth-enhancing impact. This does not of course apply to all situations, there appears to be a threshold beyond which returns are diminishing and the composition of public investment also matters. In order to promote productive spending, as well as to shift some of the burden of financing investment to those generations who will actually benefit from it, a golden rule deficit limit has been proposed by many authors and in some countries also actually introduced. The golden rule does have its drawbacks, as exclusion of capital spending from the deficit limit may among other things lead to an uncontrollable increase in public debt, as well as reduce the pressure on public investment projects to be effective *vis-à-vis* current expenditure, which is under closer scrutiny as it has to fit within the deficit limit. Creel, Monperrus-Veroni and Saraceno look at the effects of public investment in case of one of the best-known golden rule arrangements, namely in the United Kingdom. They confirm the positive impact of public investment on long-term growth, and show that it is additionally strengthened by the presence of the formal golden rule as featured in the Code for Fiscal Stability. This is a bold conclusion, considering that it has been less than 10 years since the introduction of the golden rule there. Another point worth mentioning is the transparency of the UK golden rule and framework for appraisal of public investment projects, which may be hard to replicate in other countries, so the (potential) success of the Code for Fiscal Stability is not necessarily an example which all countries can and should follow.

Let me now conclude with some specific questions and comments to each of the papers.

On the Kąsek, Laursen and Skrok paper I would like to raise two methodological concerns. The first, which I realise they can do little about, given data availability, is that their studies are based on samples dating from 1995 to 2004 or shorter, which are fairly short and in addition in case of EU8 countries include a large shock in the form of the Russian crisis, impacting on the results of their estimations. The second issue, which in my view can be dealt with, is that the fiscal variables in the estimation of the impact of taxes and spending on growth appear not to have been cyclically adjusted. This could distort results significantly and in particular seems to undermine the authors' finding that "a strong fiscal position appeared to be supportive of growth".

While the entire Botman and Kumar paper is very enlightening, I found the simulations and findings concerning pension reforms of particular interest. Firstly, as one of the benefits of a shift to a mandatory public funded pension system, the paper mentions the public and political awareness effect of making future pension liabilities explicit. I think this is a very valid point, which is often overlooked in the discussion of pension reforms of this nature, which have been introduced in Central and Eastern Europe in recent years. Secondly, I have a question on the assumed pension formula in the Personal Retirement Accounts they discuss, as pensions paid out appear to be the same under the PRA scheme as in the previously existing, unfunded system. This may be the case for the reform proposed in the U.S., but in case of most European reforms, the move to funding also entailed a change of the pension formula, which was the main driver of the improvement in overall fiscal sustainability. Thirdly, the authors refer to a voluntary opt-out of PRAs as a "permanent tax cut", but one could argue that a more appropriate description would be an "abolishment of a part of a public social security scheme" with the ensuing consequences, including potentially insufficient social security provision and the need for increased social assistance from the state.

Finally, I have a few comments on the Creel, Monperrus-Veroni and Saraceno paper. The authors base their conclusion of the effectiveness of the golden rule framework on the impact on results of exclusion of the 1997-2004 period from their estimation sample, which appears to be a bit of a fragile basis. In addition, the estimation does not take into account other structural and policy changes, which took place around 1997 or in preceding years, most notably the change of the monetary policy framework. The authors refer to the Pandora box effect in which if public investment increases, policymakers are more eager to satisfy the claims for higher current expenditures as well. It is worth noting, that this effect appears to be stronger with the Code for Fiscal Stability years *in the sample*, which undermines somewhat their positive assessment of introduction of the Code.

COMMENTS ON SESSION 2: DISCRETIONARY POLICY AND FISCAL IMPACT

Margit Schratzenstaller[*]

1. Comments on "Which Figures to Look: Confusion Over Various Fiscal Indicators" by Masato Miyazaki

The paper aims at an evaluation of several, debt-related indicators to assess the sustainability of public finances. Thereby the author does not deal with long-term fiscal sustainability in a forward-looking, long-term perspective as taken by the OECD or the European Commission, which have been dedicating special attention to the long-term implications of current budget policy and budgetary decisions in recent years (see, e.g., Blanchard *et al.*, 1990; Franco and Munzi, 1997; OECD, 1998). The paper rather focuses on the short-term dimension of fiscal sustainability and on two questions in particular: First, how large is the "true" current overall indebtedness of an economy's public sector and what are its implications for the short-term sustainability of public finances? Second, how do the (differences in) definitions which are underlying the indicators used to evaluate a country's short-term fiscal sustainability limit their informational value and their intertemporal as well as international comparability?

The issue of the paper is a very policy-relevant one. Ensuring the sustainability of public finances is one of the greatest challenges for policy-makers today. That fiscal sustainability has become a concern for more or less all industrialised countries is not only due to the "sins" committed in the past, which now burden present and future public budgets (e.g., running deficits in economically good times or using budget surpluses to increase public expenditures instead of paying off public debt). It is also upcoming long-term developments, particularly the growing demographic pressure practically all industrialised countries will be confronted with in the next decades, which endanger the sustainability of their public finances.

One dimension of fiscal sustainability (which is in the focus of this paper) is the current indebtedness of the public sector, *i.e.* the short-term sustainability of public finances. To assess fiscal sustainability and the "true" indebtedness of the public sector, adequate indicators are needed. "The" indicator of short-term fiscal sustainability does not exist, but there are several "consensual" indicators to capture an economy's indebtedness, the most important of which are the public deficit and the public debt in relation to GDP. In practice, however, the use of these indicators poses two problems: Firstly, the concrete construction of these indicators, and secondly, the data which are to be filled in (the latter strongly depends on the

---

[*] WIFO (Österreichisches Institut für Wirtschaftsforschung – Austrian Institute of Economic Research), Austria.

definition of the public sector, which – with extra-budgetary units and spin-offs gaining in importance in many countries – is increasingly becoming a non-negligible aspect).

The author considers three indicators and potential problems associated with their construction, the data to be filled in, and their interpretation: the public deficit, the public debt, and national balance sheets. The latter are particularly interesting, as only a few countries use them and accordingly practical experience is relatively scarce; based on the Japanese example the paper gives an insightful impression of the usefulness and limitations of national balance sheets.

The discussion of the paper will concentrate on two points: a methodological one and a more fundamental one, which concerns the scope of the exercise undertaken in the paper.

Firstly, the choice of appropriate and meaningful indicators for an economy's fiscal/budgetary situation depends on the question one is interested in. The question Miyazaki tries to answer is the "true" current indebtedness of the (Japanese) government and the short-term fiscal sustainability of public finances. His starting point is a very important one, the more as it is often neglected in the pure economic debate: namely, that the correct answer to the question of the overall indebtedness of the public sector is important from a democratic point of view. The taxpayer should get comprehensive and reliable information about the government's liabilities for which s/he is supposed to pay eventually, also to be provided with a sufficient informational basis for his/her election decisions. However, the indicators Miyazaki suggests to evaluate the short-term sustainability of public budgets may give an incomplete answer to his question. The indicator "yearly public deficit", for example, might be distorted by cyclical fluctuations or one-off measures (e.g. revenues from privatisation); in this case it would not give a correct picture of short-term fiscal sustainability. For this reason the public deficit figure as the simple balance of revenues and expenditures should be complemented by calculating a structural public deficit, as the European Commission and the EU member states do in their annual stability programmes, for example, to account for short-term economic or political factors which may produce an overly optimistic or pessimistic picture of the actual current state of public finances.

Secondly, Miyazaki's indicators neglect future developments. In addition to being correctly and fully informed about the government's current liabilities, the taxpayer should be "warned" about future burdens for the public budget. Therefore it is not only today's "explicit" debt which is relevant, but also the so-called implicit debt (*i.e.* total debt including discounted future net expenditures) and the expected future debt levels assuming unchanged policies and legislation, respectively. Despite the theoretical and empirical shortcomings of the methodology used to determine future debt levels (see, e.g., Franco and Munzi, 1997), and although the projections must be viewed with the more caution the farther they reach into the future, projected future debt levels may well serve as one useful orientation for policy-makers trying to overcome the myopic orientation which often characterises budget policy. A look at the projected debt levels in percent of GDP for 13 selected

Table 1

Projected Debt Levels for Selected EU Countries up to 2050
(percent of GDP)

Country	2004	2010	2030	2050
Czech Republic	38.6	54.8	140.8	447.1
Germany	65.5	73.6	91.0	138.7
Greece	110.5	105.2	202.4	562.8
France	64.8	70.3	158.4	383.3
Italy	106.0	99.1	119.8	218.0
Cyprus	73.8	72.2	125.5	253.8
Latvia	20.1	23.8	40.3	115.9
Luxembourg	5.0	11.2	49.7	104.0
Hungary	57.3	57.8	77.9	119.9
Malta	73.2	89.8	177.0	286.3
Netherlands	56.3	55.8	98.9	195.4
Slovenia	30.2	28.0	54.2	229.3
Slovak Republic	43.0	49.0	76.5	153.8

Source: European Commission (2005).

EU countries up to the year 2050, as determined in a recent publication by the European Commission (2005), should make this point clear.

These projections illustrate quite drastically that even countries which would be considered as having sound public finances based on their current debt levels and which seem to dispose of a large safety margin, as Latvia or Slovenia, are exposed to considerable future budgetary risks which date back primarily to demographic changes leading to a rapid growth of pension and health care expenditures. These few examples show that it is indispensable to complement the short-term perspective by a long-term one to arrive at a meaningful and comprehensive picture of a public budget's fiscal sustainability.

2. Comments on "Identification of Fiscal Policy Shocks in Chile and Colombia" by Jorge E. Restrepo and Hernán Rincón

Also this paper deals with a very topical issue which is highly relevant for policy-makers. The authors identify the effects of fiscal shocks (variations in public expenditures and/or taxes) on real GDP and analyse the relationships between taxes, expenditures, and real GDP for Chile and Columbia in comparison. Both the topic and the methodological approach the authors use are inspired by a recent analysis by Blanchard/Perotti (2002), which brought about a number of related country-specific studies during the last few years.[1]

Rather than focusing on the technical features of the kind of analysis as it is conducted in the paper, the following discussion concentrates on some of its more general aspects and implications.

Several aspects and strands of the current debate about the adequate design of fiscal policy and its effects form the background of the analysis carried out in the paper. Firstly, there is increasing doubt among economists and policy-makers about the positive effects of expansionary fiscal policy on GDP: concerning the size of these effects, their duration and sustainability (are they permanent or transitory only?), and the effectiveness of discretionary measures and/or automatic stabilisers in general. Secondly, there is a dispute about the (short- and long-term) effects of fiscal consolidation on growth, particularly with regard to negative expenditure shocks: the traditional Keynesian view of negative effects of consolidation measures is countered with the expectation of "non-Keynesian effects" that would allow for expansionary fiscal consolidations (see the seminal paper by Giavazzi/Pagano, 1990).[2] Thirdly, the debate on the "quality of public finances" initiated in the beginning of this century by the European Commission as one element of the so-called Lisbon strategy to foster growth and employment in Europe plays a role: namely the question whether the potential growth effects of (variations of) fiscal policy measures differ between different categories of spending and taxes.

One of the most interesting results of the work done in the paper is that fiscal shocks appear to have very different effects on real GDP in Chile and Columbia, as Table 2, which summarises the results of the empirical analysis, shows. Also the relations between taxes, public spending, and real GDP are not identical in the two countries analysed in the study.

These findings bring up the question how these sizeable differences in the effects of fiscal policy shocks in Chile and Columbia can be explained. The different results for Chile and Columbia point to the importance of structural economic and fiscal country-specific characteristics which cannot be captured within the estimated models, but seem to have a significant impact on the effectiveness of fiscal policy. In what follows some country-specific factors which might explain the observed differences between the two countries are considered briefly:

- The type of taxes involved in a shock to taxes (direct versus indirect taxes; social security contributions) should be a decisive determinant of the tax shock's effectiveness, due to different incentive effects connected with different tax

[1] See also the studies by Rezk, Avramovich and Basso on Argentina and by Claus, Gill, Lee and McLellan on New Zealand in this volume.

[2] For a review of recent theoretical and empirical studies on non-Keynesian effects of fiscal policy see Hemming, Kell and Mahfouz (2002), or Prammer (2004).

Table 2

Effects of Fiscal Policy Shocks in Chile and Columbia in Comparison

	Chile	**Colombia**
1 peso increase in tax revenues	–38 cents real GDP (transitory)	no effect on real GDP
1 peso increase in public spending	+1.9 pesos real GDP (transitory)	+12 cents real GDP (transitory)
relation between real GDP, taxes, and public spending	shocks to spending and GDP increase taxes shocks to taxes and GDP do not increase public spending	dependent on the model estimated

categories or because different types of taxes impact on different macroeconomic aggregates. The relation between GDP and taxes should depend on the structure of the tax system, more concretely: the direct-indirect-tax-mix, as individual tax categories react differently to variations in GDP.

- The structure of government expenditures ("productive" versus "non-productive" expenditures or public consumption versus public investment) and the variation of different expenditure categories should have different effects on real GDP.
- The degree of openness of the economy experiencing a fiscal shock, particularly the level of the import ratio, should also play a role: the higher the import ratio, the smaller the real GDP effect of additional public expenditures and the larger the spill-overs to the trading partners.
- Finally, it is plausible to assume that the general economic conditions ("trust" and expectations of private households and firms; the general investment climate) influence the positive or negative effects of fiscal policy shocks: tax increases, for example, should be more harmful in an economic environment which is characterised by unfavourable expectations with regard to the future economic development.

These short deliberations lead to a number of questions worthwhile to be explored within future research in this very interesting field. Firstly, the effects of different tax and spending categories on real GDP should be explored more systematically. Then there is the issue of "pure" (discretionary) fiscal policy shocks compared to the effects of automatic stabilisers built in into the tax and welfare system: for example, an analysis for Germany shows that the pure discretionary policy effect is significantly smaller than the effect including the endogenous working of the automatic stabilisers (Höppner, 2002). Of interest is also the question whether the effects of positive fiscal policy shocks compared to the effects of negative ones are symmetric or asymmetric: do the GDP effects of tax increases and decreases, for instance, just have reversed signs, or do they also differ in size? It would also be interesting to identify the influence of political and institutional factors (the party in power, the existence and design of fiscal rules, etc.) on the relation between expenditures, taxes, and real GDP: the authors themselves point out the sound fiscal policy in Chile as a possible explanation for the absence of a positive correlation between shocks to taxes and GDP on the one hand and public spending on the other hand. Finally there is the question if and how the results of this type of analysis can be reconciled with work done on the links between fiscal policy and medium-/long-term growth (see, e.g., Bleaney, Gemmell and Kneller, 2001). Trying to get more answers to these questions and to get a clearer and less unambiguous picture than we have now concerning the question what fiscal policy can and should (not) do is an indispensable precondition for deriving clearcut policy implications and recommendations.

REFERENCES

Blanchard, O., *et al.* (1990), "The Sustainability of Fiscal Policy: New Answers to an Old Question", OECD, *Economic Studies*, No. 15, pp. 7-36.

Blanchard, O. and R. Perotti (2002), "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output", *The Quarterly Journal of Economics*, Vol. 117, No. 4, pp. 1329-68.

Bleaney, M.F., N. Gemmell and R. Kneller (2001), "Testing the Endogenous Growth Model: Public Expenditure, Taxation, and Growth Over the Long Run", *Canadian Journal of Economics,* No. 34, pp. 36-57.

European Commission (2005), *Public Finances in EMU 2005*, Brussels.

Franco, D. and T. Munzi (1997), "Ageing and Fiscal Policies in the European Union", in European Commission Directorate-General for Economic and Financial Affairs (ed.), *The Welfare State in Europe: Challenges and Reforms, European Economy*, Reports and Studies, No. 4, pp. 239-388.

Giavazzi, F. and M. Pagano (1990), "Can Severe Fiscal Contractions Be Expansionary? Tales of Two Small European Countries", in *NBER Macroeconomic Manual 5*, pp. 75-111.

Hemming, R., M. Kell and S. Mahfouz (2002), "The Effectiveness of Fiscal Policy in Stimulating Economic Activity – A Review of the Literature", IMF, Working Paper, WP/02/208.

Höppner, F. (2002), "Fiscal Policy and Automatic Stabilisers: A SVAR Perspective", Bonn, mimeo.

OECD (1998), *Economic Outlook 64*, Paris.

Prammer, D. (2004), "Expansionary Fiscal Consolidation? An Appraisal of the Literature on Non-Keynesian Effects of Fiscal Policy and a Case Study for Austria", in *Monetary Policy and the Economy*, No. 3, pp. 34-52.