Session 4

POLICIES TO PROMOTE SUSTAINABLE GROWTH

FISCAL CONSOLIDATION NEEDS AND IMPLICATIONS FOR GROWTH

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Public debt in the OECD area passed annual GDP in 2011 and is still rising. For many countries, just stabilising debt - let alone bringing it down to a more sustainable level – is a major challenge. The debt overhangs can affect growth through channels such as raising the cost of capital. The main focus of this paper however is the implications for growth both in the short term and in the long term of reducing debt levels. Consolidation needs are large and most of the reduction in debt will need to come from improvements in the primary balance. In the short term, the pace of consolidation needs to balance consolidation requirements with the effects of fiscal retrenchment on aggregate demand. The trade-off will depend on the choice of fiscal instrument and on the ability of monetary policy to accommodate consolidation. However, other things being equal, a slow consolidation will ultimately require more effort to meet a fixed debt target. In this context, consolidation should aim to use instruments that are friendly to long-term growth. There is scope to improve budgetary positions by reforming transfer systems, raising the efficiency of public services, eliminating certain tax expenditures and collecting additional revenues from less distortionary tax bases.

Introduction

1 Public debt in the OECD area passed annual GDP in 2011 and is still rising. For many countries, just stabilising debt – let alone bringing it down to a more sustainable level – is a major challenge. Concerns about debt sustainability have manifested themselves in the euro area debt crisis, but could spread beyond that area.

2 Both high debt levels and efforts to reduce them can affect growth. The debt overhangs can affect growth through channels such as raising the cost of capital and increasing the burden of distortionary taxation. The main focus of this paper however is on the implications of reducing debt levels for growth both in the short term and in the long term. In the short term, the trade-off between macroeconomic stabilisation and consolidation creates a particular challenge, especially in an environment when many countries need to implement fiscal consolidation more-or-less simultaneously and with policy interest rates close to the zero lower bound giving little scope for monetary policy to accommodate fiscal consolidation. In this context, fiscal consolidation needs to be carefully designed, notably in the choice of policy instruments which will affect the trade-off not only with short-term but also long-term growth.

3 The rest of the paper is organised as follows: after a brief review of the lead up to the current debt debacle, the second section looks at the impact of high debt on economic growth and establishes consolidation needs, relying principally on fiscal gap calculations, and considers the factors likely to influence debt dynamics; the next section discusses the combined challenge of consolidation and macroeconomic stabilisation. This section also discusses the short-term impact through the multiplier effects of different instruments, with pension reform representing an extreme case of little initial impact but potentially large long-term impact on fiscal sustainability; the

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following section discusses available policy instruments and their implications for long-term growth. A final section concludes.

The size of debt overhangs

4 Debt levels in the OECD have trended upwards since the early 1970s, with countries often insufficiently ambitious in bringing debt levels down during expansions. Indeed, during the upswing that preceded the recent crisis, underlying deficits were not reduced much, such that debt levels were not brought down, notably in Greece, the United Kingdom and the United States. In some cases, declines in revenue shares during the expansion suggest that governments were engaging in a pro-cyclical easing of fiscal policy – something which has been a consistent feature of policy in some European countries since the early 1970s (Égert, 2010). The impact of lower interest rates and in some cases lower debt on debt servicing and the apparent strength of revenues seduced some governments into cutting taxes and relaxing control over spending. Indeed, new estimates of underlying budget balances that adjust not only for the effect of the economic cycle but also take account of asset price effects on revenues suggest significantly weaker balances as a share of GDP in a number of countries, notably Ireland and Spain (Price and Dang, 2011). As such, when fiscal positions appeared to improve before the financial crisis, they often gave an impression that was too flattering. And in retrospect, given the weaknesses in financial sector prudential policy, fiscal positions were insufficiently robust given the scale of the liabilities and contingent liabilities that some governments had to assume during the crisis.

5 What sets the crisis apart is how widespread and rapid the build-up of debt has been, making the need for fiscal consolidation pressing for most OECD countries. The automatic stabilisers played a role with spending on unemployment benefits surging and tax revenues evaporating. Tax revenues were further dented by asset price movements, which had boosted revenues in the pre-crisis period. Spending further jumped due to support packages and assuming various liabilities. In addition, a downward level shift in potential output as an effect of the crisis effectively meant that prevailing levels of spending became inconsistent with pre-existing tax rates and implied a need to tighten just to stand still. For the OECD as a whole, gross government debt is expected to rise to unprecedented levels, exceeding 100 per cent of GDP for the first time in 2011 (Figure 1). In Japan, this ratio has risen to over 200 per cent of GDP. Even in some low-debt countries gross debt increased quite strongly. Only Norway and Switzerland have bucked the trend, reducing debt levels.

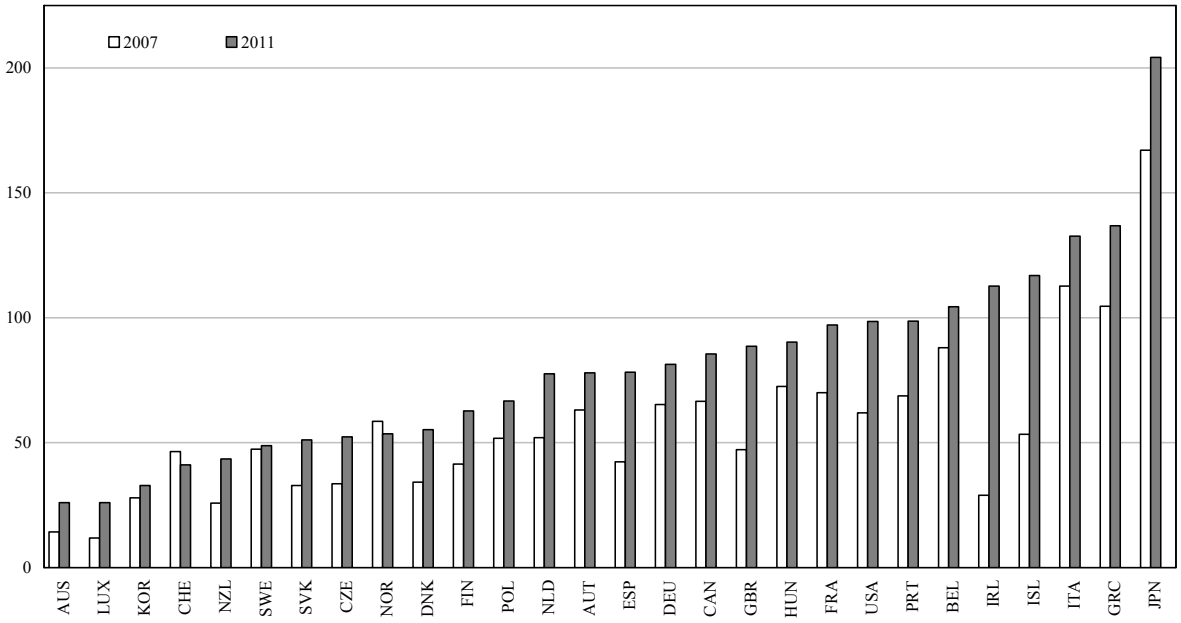
6 In emerging market economies, less debt build-up occurred over the crisis and debt levels are often more favourable than in many OECD countries, not least because high growth rates tend to ease debt dynamics. Nonetheless, in a number of countries debt levels are not negligible. In Brazil and India, debt levels were around 65 per cent of GDP at the end of 2010. Fiscal consolidation is underway in both countries and Brazil is already running a relatively large primary surplus. For India, consolidation will be difficult due to large spending pressures and possibly weaker revenue growth. In China, the official debt burden was low at 19 per cent of GDP in 2010. However, off budget sub-central government and state enterprise debt could potentially raise total debt well over one third of GDP at the end of 2010, with contingent liabilities in the financial sector of uncertain magnitude and the on-going push to provide affordable housing potentially adding to debt.

Consequences of high debt levels for growth

7 High public debt levels may have adverse effects on growth. Higher debt loads could affect output by raising the costs of capital or more speculatively through higher distortionary taxes,

Figure 1

Gross Government Financial Liabilities
(percent of GDP)



Source: OECD Economic Outlook 89 Database.

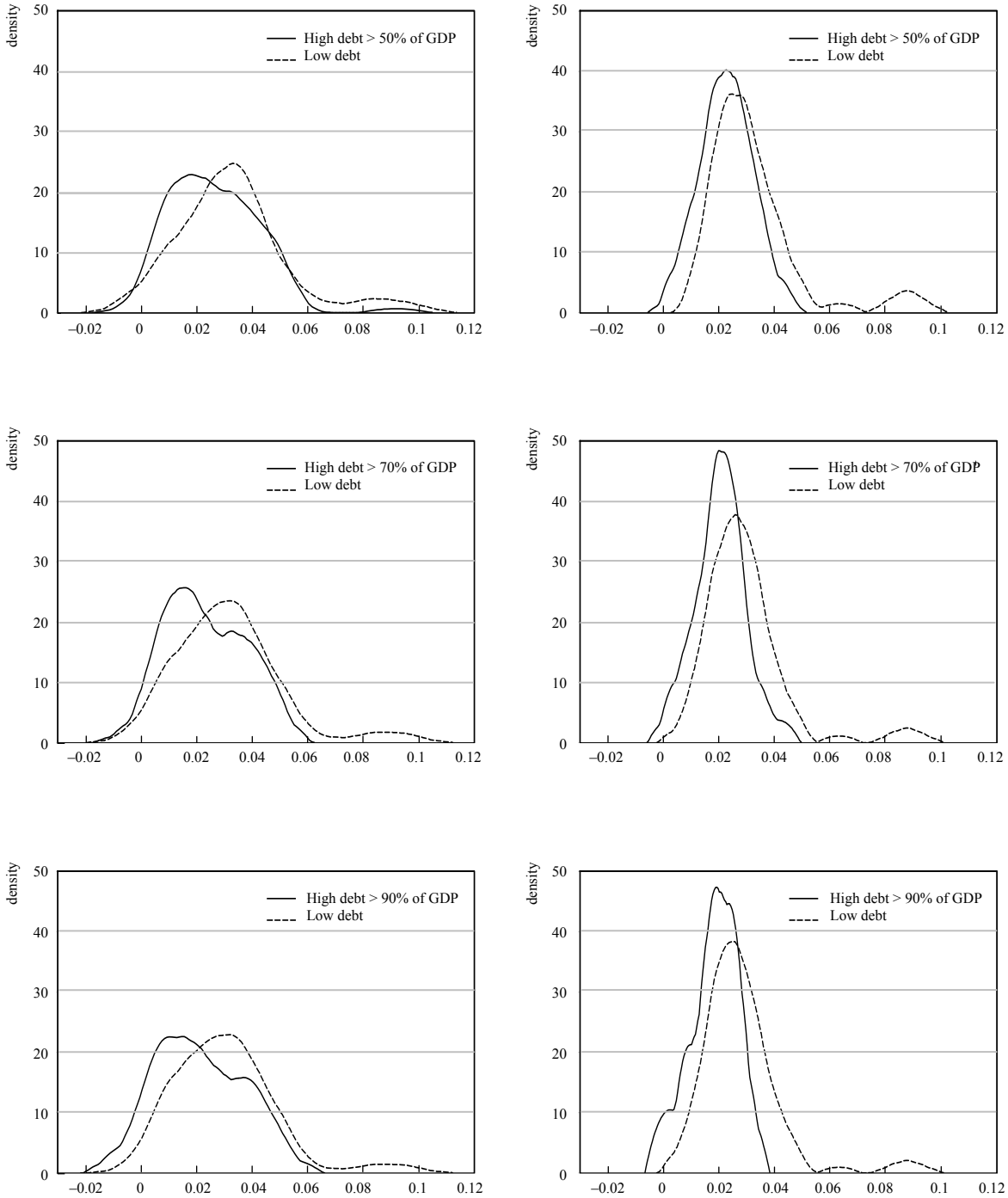
inflation or greater volatility in policy. Cournède (2010) demonstrated the potential impact of higher corporate financing costs, which may be a consequence of not only a normalisation of the artificially low risk premia that prevailed before the crisis but also of crowding out due to higher government issuance of debt. A higher cost of capital is likely to reduce the capital-to-labour ratio and hence productivity. Using the assumptions embodied in the OECD's medium-term baseline and a production function with three factors (labour, business sector capital and oil), the calculations suggest that the level of GDP in the long run would fall by just over 2 per cent in the United States and 2.6 per cent in the euro area for a normalisation of interest rates following the crisis, which would entail a real interest rate shock of around one percentage point in both the United States and the euro area. If higher government debt does lead to crowding out, with the real interest rate shock rising by around an additional percentage point, then the fall in GDP could be more substantial, with the level of output falling by around 5 per cent in both the United States and euro area.

8 The effects of higher costs of capital on the intensity of capital in production should essentially lead to a level shift in potential output and therefore to growth rate effects over some finite period only. More long-lasting effects on economic growth could arise to the extent higher costs of capital lead to reduced investment in research and development. More speculative and uncertain combinations of OECD research suggests that if the fall in potential output by 3 per cent as a result of lower capital intensity were combined with the above higher cost of capital, then the stock of R&D could fall by 5.4 per cent, which would reduce long-run total factor productivity (TFP) by 0.7 per cent, based on an estimated long-run elasticity (Guellec *et al*., 2004). In practice, evidence on TFP growth in OECD countries before and after past crises suggests that experience is very heterogeneous (Haugh *et al*. 2009). Since impacts of debt via R&D should be expected to accrue via TFP, this underlines the need to treat the calculations with care.

Figure 2

Growth Conditional on Past Debt Levels

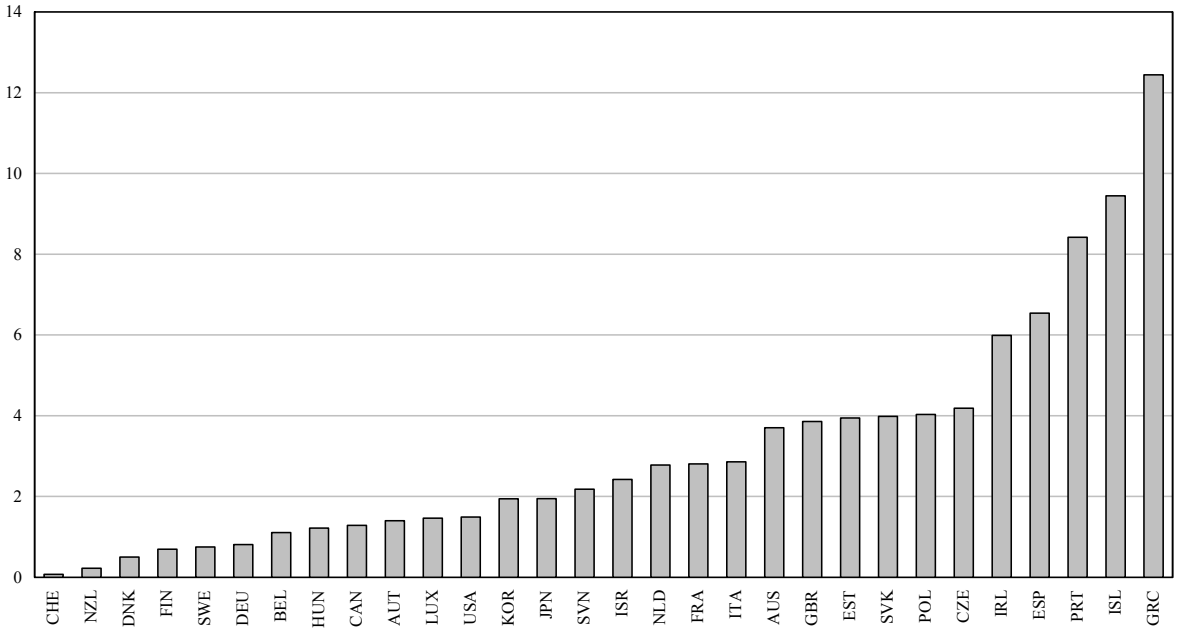
(left hand panel: growth in the following 5 years; right hand panel: growth in the following 10 years; top panel: debt threshold 50 per cent of GDP; middle panel: debt threshold 70 per cent of GDP; bottom panel: debt threshold 90 per cent of GDP)



Note: The distributions are kernel densities for growth rates in the subsequent 5 and 10 years when growth rates are above and below the given threshold.

Figure 3

Cumulative Fiscal Tightening Between the Deficit Trough and 2012
(change in underlying primary balance, percent of GDP)



Source: OECD Economic Outlook 90 Database.

9 Empirical work has identified various thresholds in the relationship between public debt and growth. For example, Reinhart and Rogoff (2010) found that growth rates in both developed and developing countries where the public debt to GDP ratio exceeds 90 per cent are about 1 per cent lower than in the less indebted countries (Cecchetti *et al.,* 2011 find a similar threshold effect). In a similar vein, Caner *et al*. (2010) found a threshold effect on growth rates at 77 per cent of GDP for a large sample of countries, with the threshold being lower for emerging markets, and Kumar and Woo (2010) found that a 10 percentage point increase in debt reduces annual real per capita GDP growth by 0.2 percentage points per year, with the effect being smaller for advanced economies and some evidence for non-linearity beyond a debt/GDP ratio of 90 per cent of GDP.

10 Indeed, fitting density functions to growth rates of OECD countries suggests that growth is typically lower in periods that follow years of high debt (Figure 3). This is more obvious when looking at growth rates over a short window of 5 years, where some of the effect may reflect that high debt is followed by consolidation with negative effects on the cycle. However, the effect appears to persist over 10 years when cyclical effects of consolidation should matter less. Even so, the relationship could be spurious to some degree given the secular tendency for debt levels to drift up and growth rates to trend down which may account for some of the relationship. Moreover, causality may be less than clear with, for example, less well managed countries likely to have both high debt and low growth.

11 In sum, high debt levels are likely to have negative impacts on growth. Hence, there are good reasons for many countries to reduce their debt overhangs, including creating room to react to future shocks. Reducing debt in turn has implications for growth both in the short and long term, with the scale of the necessary adjustment likely to give some indication of how painful fiscal consolidation will be. We turn to this issue in the next section.

Size of adjustment

12 Facing large debt overhangs, many countries have already started fiscal consolidation, which has implications for economic growth in the short term. In some cases, notably for those countries most under pressure from the bond markets, the on-going and announced tightening is substantial, rapid and unusually correlated by historical comparison (Figure 3). Between the trough (measured by the underlying primary balance) following the onset of the crisis, which was 2009 for most countries, and the projected value for 2012, five countries are expected to tighten by more than 5 per cent of GDP (Greece, Iceland, Ireland, Portugal and Spain). In 11 other countries, underlying primary balances are expected to have tightened by more than 2 per cent of GDP. Recent policy announcement imply that these numbers would be larger if recalculated today.

13 Additional fiscal consolidation will be required beyond 2012. Recent OECD work has assessed these post-2012 needs, both in terms of stabilising debt over the medium term and also meeting prudent long-term debt targets. The consolidation requirements to stabilise debt (OECD, 2011c), are based on stylised assumptions about a sustained and gradual annual tightening of the underlying primary balance by 0.5 per cent of GDP until debt stabilization is reached. The long-term fiscal gaps on the other hand make an alternative stylised assumption that the tightening will be implemented immediately and sustained until 2050 to meet a specific debt target (Merola and Sutherland, 2011). Both sets of assumptions ignore the implications for output, which will obviously be important (discussed below). Both approaches come to similar conclusions on the need for consolidation, but here we concentrate on the long-term fiscal gap calculations, which will be used later in the paper to illustrate consolidation options.

Fiscal gaps

14 The fiscal gap shows the *immediate* and *permanent* improvement in the underlying primary balance that is required to ensure that debt meets a target at a certain point in time, based on a simplified model of the economy and a number of assumptions about growth, interest rates, inflation and underlying fiscal policy (see Appendix). [1] The presentation of the results below typically reports the fiscal gaps for ensuring gross financial liabilities is 50 per cent of GDP in 2050 (Box 2). This is intended to be illustrative and not normative. Indeed, different debt targets will be appropriate for different countries. For example, a low gross debt target may be less compelling for countries with large government financial asset holdings. In other cases, the public has demonstrated a preference for very low levels of debt. Countries with large implicit liabilities due to a large financial sector may wish to err on the side of caution. Although the 50 per cent target is arbitrary it may nonetheless be supported by some arguments. Thus, empirical estimation suggests that changes in the functioning of the economy occur around debt levels of 70-80 per cent of GDP. For example, interest rate effects of debt seem to become more pronounced (Egert, 2010), offsetting saving responses to discretionary policy changes become more powerful (Röhn, 2010) and, as illustrated above, trend growth seems to suffer. Building in a safety margin to avoid exceeding the 70-80 per cent levels in a downturn may suggest aiming for 50 per cent or thereabout during normal times. In any case, over a very long period such as up to 2050, the size of fiscal gap does not depend strongly on the particular target debt level (see opposite).

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[1] Following a severe economic dislocation, estimating potential output and thereby the underlying primary balance represents a challenge. While the fiscal gap simulations do not directly assess uncertainties about potential output, the variety of simulations reported below reveal how varying different parameters affect the fiscal gap calculations.

Box 2
DEBT OBJECTIVES

Various choices have to be made in setting a debt target:

The target can be based on either gross or net debt/financial liabilities. Gross financial liabilities are a visible headline indicator and typically the measure used in empirical analysis. Net financial liabilities are in principle more appropriate when considering long-term sustainability, though government net worth, which also takes into account non-financial assets (the public capital stock), may be the more appropriate when also considering inter-generational issues. However, there are serious problems due to lack of comparability across countries, particularly when valuing government non-financial assets. Furthermore, government assets may not be easily used to offset liabilities, at least in the short term. For example, it may not be advisable to privatise public enterprises operating in sectors with significant market failures or when financial markets could not easily absorb large asset sales. There may also be asymmetries across levels of government and with social security funds between the holding of assets and liabilities.

The scope of the public sector can vary. For example, the debt target may affect only the central government, general government or an even wider definition, including for instance, public enterprises. The choice can make a sizeable difference. In the United Kingdom, recent whole of government accounts estimated net liabilities to be 84.5 per cent of GDP in 2009-10, whereas the national accounts net liabilities measure was 52.8 per cent of GDP (HM Treasury, 2011).

The target should address the effect of ageing on entitlement spending (ageing is not the primary driver of health spending but is used as a catch-all label here). The appropriate degree of consolidation will need to take into account the impact of ageing-related spending. Ageing-related spending pressures stem from two factors. First, in many OECD countries spending ramps up with the demographic transition as the post-war "baby boomers" move into retirement. As this transition is either already happening or is imminent, the policy options are limited. In this light, the "hump" in spending may need to be absorbed and adds to the consolidation requirement. A second, uncertain but potentially huge or even infinite, ageing effect on spending stems from longevity, which has been more or less steadily rising for more than 150 years across OECD countries. In this case, the appropriate response is to reform pension and other benefit systems, such as long-term care, rather than to attempt to pre-save to finance the rising ageing-related spending. Attempting to pre-save for future increase in longevity rather than adjusting pension and other programmes would be unfair across generations and would be difficult in light of uncertainty concerning the development of longevity.

More generally, the target should also consider inter-generational fairness. Pay-as-you-go pension systems present an obvious example of a transfer of resources between generations. Likewise, "excessive" deficits can transfer liabilities to future generations. In other cases, investment can create assets which will be enjoyed by future generations. As such, the degree of consolidation will need to consider the source of the transfer between generations and how much of a burden it is fair to pass onto future generations.

15 The fiscal gaps should be seen as giving a common metric for assessing the need for fiscal consolidation rather than being normative about how such a consolidation should be implemented. When the fiscal gap is large, it would be difficult to implement such a large consolidation effort immediately. Furthermore, sustaining the fiscal policy tightening, even seemingly modest ones, over very long periods may also present a considerable challenge. Finally, as the fiscal gaps are based on meeting arbitrary debt targets in 2050, the evolution of gross debt is unlikely to be stable as a share of GDP at the end of the simulation. In some cases, for example, the fiscal gap will involve substantial undershooting of the debt target early in the simulation, masking pressures on public finances that will continue to mount beyond the end of the simulation.

Baseline simulation

16 The baseline simulation shows the immediate tightening of the underlying primary balance in 2013 needed to ensure that gross financial liabilities are 50 per cent of GDP in 2050. The baseline assumes that pension, health and long-term care spending is constant as a share of GDP and, as such, the fiscal gaps present the minimum that is required to meet consolidation needs in the case when pensions and health schemes are reformed to alleviate any upward pressure on spending or when other spending categories are curtailed and taxes raised to accommodate such spending pressures (simulations incorporating spending pressures emanating from pensions, health and long-term care are presented below).

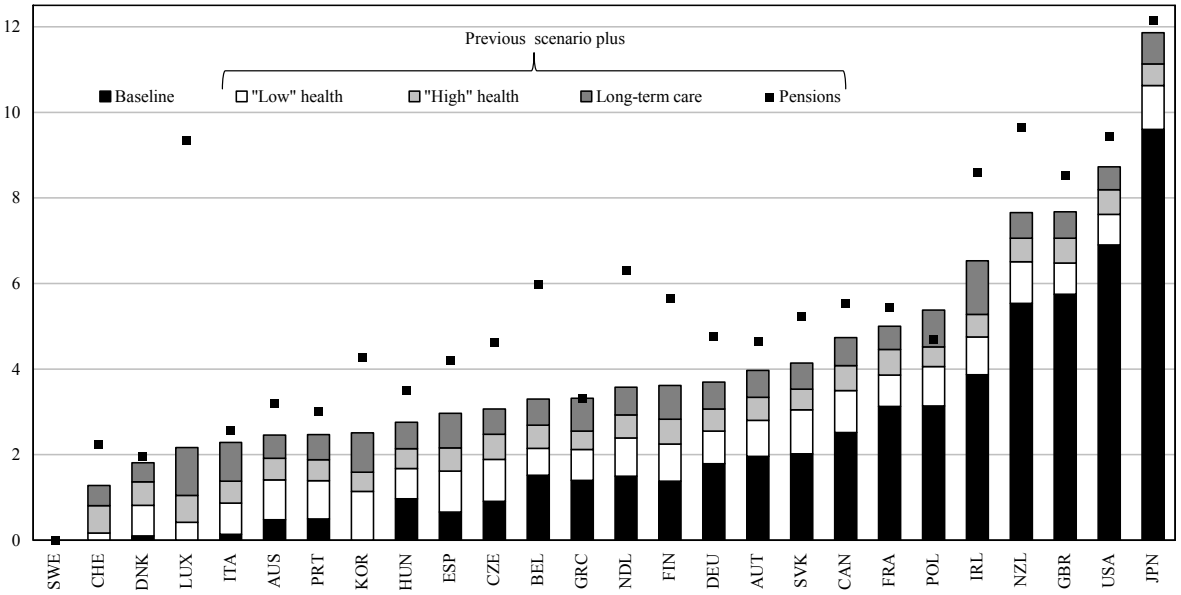
17 Fiscal gaps differ across countries mainly because of large differences in underlying deficits at the starting point and to some extent due to differences in the level of initial debt (Table 4 in the Appendix). Countries already undertaking large fiscal consolidations (Greece, Iceland, Portugal and Spain) generally face moderate fiscal gaps on the assumption that the present large improvements in underlying primary balances are maintained. Countries where underlying deficits are expected to remain substantial in 2012 face much larger fiscal gaps. For example, the fiscal gaps for Japan, the United States, the United Kingdom and New Zealand exceed 5 per cent of GDP. On the other hand, a number of countries – Korea, Luxembourg, Sweden and Switzerland – do not face any additional tightening requirements to meet the debt target. It may seem ironic that euro area countries with relatively modest fiscal gaps are the victims of a virulent debt crisis whereas other countries with much larger fiscal gaps enjoy very low bond yields at present. This partly reflects concerns about potential needs for intervention in euro area banking systems, but also that euro area debt essentially corresponds to foreign currency denominated debt for the individual country. Lately, pressures may also have reflected increased concerns about the integrity of the euro area more generally.

18 When spending pressures projected to arise from health and long-term care and pensions are included, all countries, with the exception of Sweden, will require significant additional fiscal consolidation.

- In the case of health care spending, higher levels of spending are not necessarily undesirable, but financing higher spending can create difficulties (Hall and Jones, 2007). Two different sets of health care spending projections are used (Oliveira-Martins and de la Maisonneuve, 2006). The average projected increases in health and long-term care spending by 2050 are 3½ per cent of GDP in a low spending scenario, when it is assumed that spending increases above those related to demographic change and to a unitary income elasticity will gradually fade, and around 6 per cent of GDP in a high spending one. As the projected increases are relatively similar across countries, because health spending is not primarily driven by demographics but rather to a large extent by expected supply developments, the impact on the fiscal gaps does not vary much across countries. Nonetheless, the fiscal gaps rise over 1.5 per cent of GDP in Canada, the

Figure 4

Fiscal Gaps, Baseline and with Health and Long-term Care Spending and Pensions
(immediate rise in the underlying primary balance needed to bring gross financial liabilities to 50 per cent of GDP in 2050, percent of GDP)



Note: "Low" health assumes policy action curbs health spending growth. "High" health is the additional cost pressure in the absence of these policy actions.

Czech Republic, Japan, New Zealand and Switzerland when greater cost pressures affect health spending (Figure 5).

- Including pension spending alters radically the fiscal gaps for many countries relative to the baseline scenario (Figure 4).[2] The fiscal gaps of the countries facing the largest pension problems, such as Luxembourg, Belgium and the Netherlands underscore that meeting these challenges would be better addressed by reform rather than pre-saving. In some cases, such as Greece and Spain, reforms to the pension systems in 2010, which are incorporated in the projections, have addressed significant pressures emanating from this source. In Sweden and Poland, the notionally-defined contribution pension system means that no additional or even less tightening is required to meet a gross financial liabilities debt target of 50 per cent of GDP in 2050.

19 The fiscal gaps do not change markedly relative to the baseline if alternative debt targets are used. This occurs because even relatively small changes to underlying fiscal positions add up when maintained for 40 years. It is the same effect that lies behind initial debt levels having an only modest effect on fiscal gaps compared with initial deficit levels. Taking government financial assets into consideration may indicate that fiscal positions are in relatively better shape, notably for Japan. In other cases, such as in Finland, the large net asset position reflects pre-funding for pension spending.

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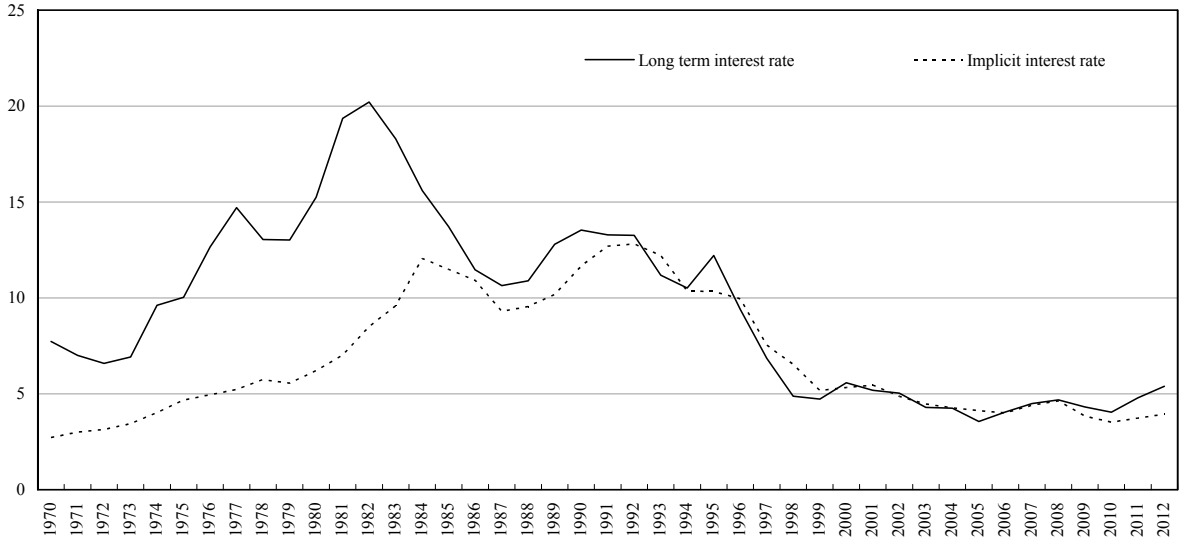
2 The pension projections are based on OECD (2011a). For Greece and Spain, estimates of the impact of reforms in 2010 and a change in the law in 2011, respectively, are used. For the United States, estimates from CBO (2011) are used. For most European countries, public sector occupational schemes are included. This is not the case for Canada and Japan. The path of projected public pension spending is phased in so that the spending profile follows the profile of the old-age dependency ratio.

Figure 5

Borrowing Rates in Italy
(percent)



Source: OECD Economic Outlook 90 Database.

Debt dynamics

20 How will the debt overhang be worked off? A review of episodes of declining debt since the early 1970s suggests that improvements in the primary balance are more consistently important in reducing debt, though at times interest rate and growth dynamics can help.[3] One possible decomposition of past debt developments shows the difference between the inertial contributions of debt dynamics on the one hand and the more direct policy lever of the primary balance on the other (Table 1). When debt has been falling in recent decades this has been typically accompanied by the primary balance having a negative effect on debt. The real interest rate and real growth rate effects often offset one another. That said, in some countries during the 1970s, negative real interest rates had an effect allowing them to run larger primary deficits.

The effects of stronger productivity growth

21 Going forward, debt dynamics can be influenced by stronger productivity growth. To illustrate this, simple calculations reveal the effect of productivity growth on debt levels over a 10 year period (Table 2). Extending the calculation beyond the medium term would have a larger impact. Nonetheless, for the countries with the largest fiscal gaps, while productivity gains would help, the fiscal challenge remains large. In these calculations, interest rates are assumed not to change, although they would likely rise with a boost in productivity, thereby undoing some of the potential gains. On the other hand, if government spending did not rise fully in line with GDP, the gains from higher growth could be substantial by improving the underlying primary balance.

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[3] In earlier periods of very high debt, overhangs were worked off by rapid growth, primary balances and negative real returns, helped in some cases by financial repression (see below). For example, Hall and Sargent (2011) estimate that the debt reduction as a per cent of GDP in the United States between 1945 and 1974 was mainly the result of high growth and primary surpluses with about one-fifth of the reduction stemming from negative real returns due principally to high inflation.

Table 1

Episodes of Falling Debt: The Contribution of the Primary Balance, Inflation and Growth

Country	Episode	Total Change in Gross Financial Liabilities, *(percent of GDP)*	Change After Accounting for Valuation Effects	of which:		
				Primary Balance	Real Growth	Real Interest
Australia	1996-2008	–27.7	0.0	–24.0	–11.6	17.6
Belgium	1994-2007	–52.6	0.0	–64.0	–37.8	63.9
Canada	1971-1976	–11.7	0.0	5.7	–10.9	–1.1
	1997-2000	–19.6	0.0	–21.7	–17.1	25.5
	2002-2007	–16.1	0.0	–13.6	–11.6	17.1
Denmark	1985-1989	–12.5	0.0	–31.7	–7.5	21.3
	1994-2007	–58.0	0.0	–41.3	–23.0	34.5
France	1999-2001	–6.0	0.0	–3.4	–5.8	6.8
Germany	1999-2001	–2.4	0.0	–5.0	–4.0	8.8
Italy	1999-2003	–15.7	0.0	–16.6	–9.2	14.6
Japan	1988-1991	–13.6	0.0	–11.2	–14.0	10.0
Spain	1999-2007	–33.2	0.0	–19.8	–19.3	3.2
Sweden	1985-1990	–24.6	0.0	–25.8	–9.4	13.4
	1997-2003	–23.6	0.0	–17.9	–15.9	18.7
United Kingdom	1972-1976	–20.1	0.0	8.6	–6.9	–12.8
	1978-1981	–11.8	0.0	4.5	–1.5	–4.8
	1985-1990	–18.3	0.0	–9.1	–9.1	11.9
	1999-2001	–12.2	0.0	–12.1	–4.6	5.4
United States	1972-1974	–5.4	0.0	–1.5	–4.5	–0.7
	1976-1979	–3.5	0.0	–0.2	–5.4	–0.2
	1994-2001	–17.4	0.0	–15.6	–18.5	24.7

Note: the decomposition is based on the relationship: $d_t - d_{t-1} = \frac{r_t}{1+g_t} d_{t-1} - \frac{g_t}{1+g_t} d_{t-1} - pb_t$, where d is the debt as a ratio of GDP, r is the real interest rate, g is the real growth rate and pb is the primary balance as a ratio of GDP.

Table 2

The Effect of Higher Productivity on the Real Growth Effect
(reduction in initial debt stock as per cent of GDP after 10 years with growth in the baseline (OECD Economic Outlook 89 medium term baseline) and with growth rates raised by 0.25 and 0.5 basis points)

Country	**Initial Debt Level** *(percent of GDP)*	**Real Growth Effect** *(percent of GDP)*		
		Baseline	**+ 0.25 Basis Points**	**+ 0.5 Basis Points**
Australia	31	7.2	7.5	8.0
Austria	82	12.9	14.2	15.6
Belgium	100	13.5	15.2	16.9
Canada	88	15.2	16.5	17.9
Czech Republic	51	10.7	11.3	12.0
Denmark	60	8.2	9.2	10.2
Estonia	19	4.1	4.3	4.6
Finland	66	12.1	13.1	14.1
France	100	16.0	17.6	19.2
Germany	87	9.5	11.1	12.7
Greece	159	35.8	37.7	39.9
Hungary	81	11.5	12.9	14.2
Iceland	120	26.7	28.1	29.8
Ireland	126	34.8	35.9	37.4
Isreal	70	19.5	20.2	21.1
Italy	128	14.7	17.1	19.4
Japan	219	32.8	36.4	40.0
Korea	33	7.5	7.9	8.4
Luxembourg	24	5.9	6.1	6.4
Netherlands	75	8.5	9.9	11.3
New Zealand	52	10.8	11.5	12.2
Norway	51	11.8	12.4	13.1
Poland	66	10.7	11.7	12.8
Portugal	116	26.7	28.1	29.6
Slovak Republic	51	10.2	10.9	11.6
Slovenia	56	6.8	7.9	8.9
Spain	75	17.8	18.7	19.7
Sweden	41	6.9	7.5	8.2
Switzerland	37	6.0	6.5	7.1
United Kingdom	93	17.1	18.5	19.9
United States	107	22.3	23.7	25.2

Inflation and interest rates

22 One possible way to deal with a high debt level is to erode it through higher inflation, but this is likely to be accompanied by drawbacks. Higher inflation is most likely to have an effect in an environment when debt is non-indexed, maturity is relatively long and rollover requirements are low, given that interest rates are likely to respond to higher inflation rates.[4] Even in this case, simulations presented in the *OECD Economic Outlook* 89 show that the contribution of inflation to reducing debt is modest (OECD, 2011c). For a standard country with debt around 100 per cent of GDP and an average maturity structure, 1 percentage point on inflation would typically reduce the debt ratio by some 5-6 percentage points assuming the interest rate on new borrowing rose in tandem with inflation. Getting debt to even lower levels would correspondingly require higher permanent inflation rates. The drawbacks of such an approach to reducing debt would be felt principally through the negative growth effects of higher rates of inflation, some of which may accrue through associated higher price volatility as well as distortions created through interactions with the tax and benefit system (Edey, 1994).

23 For higher inflation to make a marked dent in debt levels, some form of financial repression would probably be needed to ensure interest rates remain low relative to inflation.[5] Following the end of World War II until the beginning of the 1980s, financial repression often played a role in reducing the huge stocks of debt accumulated during the war. Reinhart and Sbracia (2011) estimate that financial repression contributed to a "liquidation effect" which, for example, amounted to a reduction of Italian government debt of around 5 per cent annually. Figure 5 presents suggestive evidence of financial repression during the 1970s, particularly after mid-decade when inflation was no longer surging, during which a large wedge existed between the yield on 10 year government bonds and the effective interest rate the government was paying on debt. While financial repression may be one avenue to liquidate debt there are adverse consequences. For example, Jonung (2011) argues that the imbalances which developed as a cause of financial repression contributed directly to financial crises in the Nordic countries in the late 1980s and early 1990s.

Dynamics of adjustment

24 The previous section suggested that relying on favourable debt dynamics to address the debt overhang may not be a viable option. Hence, improvements in the primary balance are called for. The pace of consolidation needs to balance consolidation requirements with the effects of fiscal retrenchment on aggregate demand. Ideally, in the short term, the pace should depend on the state of the public finances, the strength of the recovery, the ability of monetary policy to cushion the demand effects of fiscal tightening, and the need to signal a credible commitment to fiscal consolidation. However, there are significant uncertainties surrounding several of these factors, which make gauging the appropriate pace of consolidation complicated. These uncertainties would argue for a consolidation strategy that could be implemented flexibly, capable of adjusting the speed and intensity as new information becomes available. Moreover, it argues for implementation that initially favours policies with comparatively low multipliers and reforms that underpin credibility, but have little negative effect on demand in the short run. For example, pension reforms can have large effects on long-term sustainability and may have little negative effect in the short

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4 Aizenman and Marion (2009) show for the United States that the maturity structure of publically-held debt is shorter than in the post-war period, reducing the incentive to use inflation to reduce the debt overhang. On the other hand, a larger share of debt is held by foreigners, which pulls in the opposite direction.

5 Financial repression includes directed lending to government by captive domestic lenders, caps on interest rates, regulation of cross-border capital movements and a tighter connection between government and the operation of banks.

term. Indeed, insofar as postponed retirement reduces the need for future pensioners to save for retirement there could in principle even be a positive effect.

The pace of consolidation

25 Given high government debt-to-GDP ratios, some countries run the risk of unsustainable debt dynamics developing, especially if financing costs spike because of lack of credibility. While interest rates on government debt remain relatively low in many countries, debt levels in the wake of the crisis are significantly higher, implying latent upward pressure on borrowing costs. When interest rates are linked to government debt levels, this can tilt the case towards earlier consolidation. Even moderate delays may incur high costs with the development of particularly adverse debt dynamics (Corsetti *et al*., 2011). On average for the OECD, interest payments accounted for around 2.5 per cent of GDP in 2007, but higher debt levels coupled with a normalisation of interest rates could push up interest payments to over 4 per cent of GDP in 2026 (OECD, 2011c). Thus, in countries which are particularly exposed to a financial market reaction the extent of consolidation may need to be larger and the pace faster than may be optimal if the main concern was the strength of the recovery.

26 With policy rates low in many countries, and the zero lower bound still an important constraint, monetary policy is unlikely to be able to offer much support, arguing for a gradual phasing in of consolidation measures. As economies recover, monetary policy is less likely to be constrained by the zero bound and thus the pace of consolidation could be increased. Another argument for slower consolidation may arise when governments consolidate simultaneously; the implications for output are more severe due to international spillovers. Simulations reported in OECD (2009) suggest that multipliers increase by a factor of ¼-½ in major OECD regions when they consolidate jointly as opposed to individually.

27 The impact of fiscal consolidation on economic activity will depend on the size and time profile of the fiscal multipliers (Barrell *et al.* 2012). Differences across countries are largely related to the size and openness of the economy, the size of the public sector, the degree of dependence of consumption on current income and also the flexibility of the economy. The multipliers in the NiGEM model tend to be largest for government consumption, whereas tax impulses tend to have lower multipliers than spending. The differences in multipliers across instruments suggest that the sequencing of fiscal consolidations could start with tax increases before cutting government spending, though political economy considerations may suggest otherwise. Beyond the model-based multipliers, pension reform that delay retirement may, as argued above, have particularly attractive features.

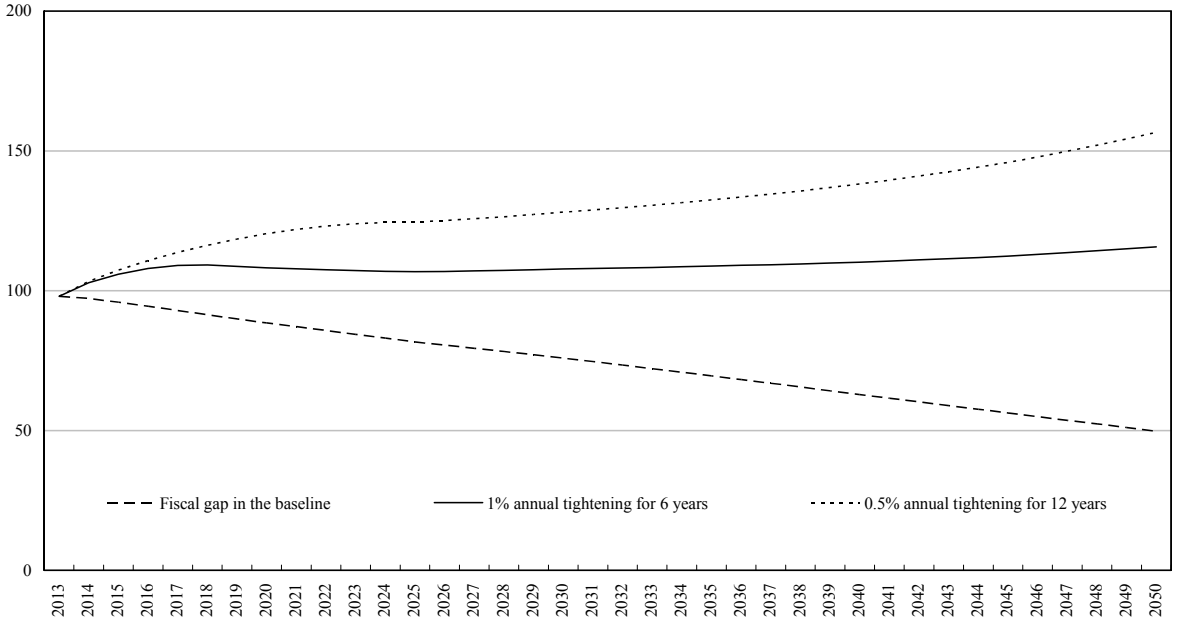
Consequences of gradual and delayed consolidation needs

28 When the state of fiscal policy doesn't dictate the pace of consolidation, more gradual tightening may minimise the short term pain but require a larger overall amount of consolidation. Simulations for the United States, using the long-run model behind the fiscal gaps and therefore assuming no impact of consolidation on output, shows that gradual tightening could allow adverse debt dynamics to develop (Figure 6). Thus, too slow a consolidation may require further fiscal tightening to bring debt down to prudent levels. This arises because debt levels above a threshold of around 75 per cent of GDP are assumed to incur a higher risk premium of four basis points for each additional percentage point of debt (Egert, 2010). Using the model, fiscal gap calculations examining the consequences of a short delay to fiscal consolidation generally find that for most countries this has little effect on the necessary tightening, as long as the subsequent consolidation is large, as implied by the fiscal gap. However, for countries where actual debt is high or current

Figure 6

The Pace of Fiscal Tightening

(evolution of gross financial liabilities for the United States when the underlying primary balance is tightened so that debt is 50 per cent of GDP in 2050 and the consequences of phasing in the same tightening more gradually, percent of GDP)



deficit levels imply a particularly rapid run-up in debt, such as New Zealand, the United Kingdom, the United States and Japan, even a short delay would visibly increase the required tightening of the underlying primary balance to reach prudent debt levels.

Long-term growth and choice of instruments

29 The scale of consolidation needs suggests that consolidation should aim to use instruments that are friendly to long-term growth. In addition, supporting structural reforms can help, both through their implied effects on primary budget balances and to the extent higher growth is beneficial for debt dynamics. As concerns the primary balance and the respective contributions from lower spending and higher revenues, the "optimal" size of government is not known. However, the marginal net social costs - including the excess burden of taxation – of additional public spending are usually thought to increase more than proportionately with the additional taxation needed to finance spending. Hence, given the current high level of public spending in many OECD countries and the future spending pressures due to population ageing, a large part of consolidation probably should consist of cuts in public spending and addressing drivers of future spending pressures. In countries where spending is low, greater emphasis may have to be put on revenue measures.

30 Given that spending cuts are largely unavoidable, a key question is how to maximise the positive and minimise the negative impacts on long-run growth, while at the same time considering other policy objectives such as equity concerns. In some cases, rethinking how distributional goals are achieved may offer scope to reduce transfers while encouraging greater labour force

Table 3

Quantifying the Contribution of Various Policy Instruments to Fiscal Consolidation
(percent of GDP)

	AUS	AUT	BEL	CAN	CHE	CZE	DEU	DNK	ESP	FRA	FIN	GBR	GRC	HUN	ISL
1. Social transfers															
A. Family benefits	0.5	0.7	0.6	-	-	0.1	-	1.4	-	1.1	0.9	1.3	-	1.4	1.0
B. Disability benefits	-	0.3	0.2	-	0.5	0.5	-	1.3	0.6	-	0.9	0.3	-	0.6	-
2. Pensions															
A. Eliminate tax breaks	2.7	0.1	0.1	2.0		0.1	0.8		0.2	0.0	0.1	1.2			1.0
3. Health care															
A. Increase efficiency	0.5	1.8	2.1	2.5	0.5	1.3	1.3	2.8	1.6	1.3	2.5	3.7	3.9	1.7	1.9
4. Education															
A. Increase efficiency in primary and secondary education	0.4	0.4	0.5	0.2	0.2	0.2	0.4	0.6	0.2		0.2	0.2		0.3	1.1
B. Introduce or raise tuition fees for tertiary education	-	0.4	0.4	-	0.4	0.3	0.4	0.4	0.2	0.3	0.4	-	0.4	0.4	0.3
5. Government wage bill															
A. Restore public-private sector pay relativities	-	0.3	0.6	-	-	0.4	0.2	2.0	1.0	-	0.5	1.8	-	-	-
6. Reduce subsidies as share of GDP to OECD average	-	2.3	0.8	-	2.4	0.7	-	1.2	-	0.2	-	-	-	-	0.4
7. Broaden VAT base	0.6	-	1.4	-	-	-	0.4	-	1.4	1.4	0.1	1.8	2.0	0.1	0.8
8. Introduce or increase taxes on immovable property	-	0.8	0.6	-	0.9	0.8	0.6	-	0.3	-	0.5	-	0.8	0.7	-
9. Environmental taxes															
A. Cut GHG emissions to 20 per cent below 1990 levels via an emission trading system with full permit auctioning	4.2	1.8	1.8	2.5	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	

Table 3 (continued)

Quantifying the Contribution of Various Policy Instruments to Fiscal Consolidation

(percent of GDP)

	IRL	ITA	JPN	KOR	LUX	MEX	NLD	NZL	NOR	POL	PRT	SVK	SWE	TUR	USA
1. Social transfers															
A. Family benefits	0.7	-	-	-	1.2	-	0.1	1.1	0.9	-	-	-	1.4	-	-
B. Disability benefits	-	-	-	-	0.1	-	0.8	0.7	1.8	0.6	0.3	-	1.3	-	-
2. Pensions															
A. Eliminate tax breaks	1.2	0.0	0.7		0.5	0.2			0.6	0.2	0.1	0.2			0.8
3. Health care															
A. Increase efficiency	4.8	1.1	0.8	0.6	2.0	0.7	2.7	2.6	1.5	1.5	1.0	2.7	2.7	1.5	2.7
4. Education															
A. Increase efficiency in primary and secondary education	0.3	0.4	0.2	-	0.5	-	0.3	0.3	0.8	0.2	0.1	0.2	0.5	-	0.8
B. Introduce or raise tuition fees for tertiary education	0.3	0.2	-	-	0.4	0.1	0.2	-	0.4	0.1	0.1	-	0.4	0.4	-
5. Government wage bill															
A. Restore public-private sector pay relativities	0.9	1.1	0.6	-	0.8	-	0.3	0.9	-	2.2	-	0.8	0.7	-	0.5
6. Reduce subsidies as share of GDP to OECD average	-	-	-	-	0.2	-	0.1	-	0.7	-	-	0.2	0.1	-	-
7. Broaden VAT base	0.4	2.6	-	-	-	2..5	-	-	0.2	1.4	1.2	0.6	-	3.3	
8. Introduce or increase taxes on immovable property	0.2	0.4	-	0.0	0.9	0.8	0.4	-	0.7	-	0.3	0.6	0.2	0.9	-
9. Environmental															
A. Cut GHG emissions to 20 per cent below 1990 levels via an ETS with full permit auctioning	1.8	1.8	1.2		1.8		1.8	4.2		1.8	1.8	1.8	1.8		2.2

Notes:
An empty cell indicates that no information was available. Cells with a dash indicate that no savings are available from this source.
Estimates for family benefits are based on reducing the figure reported in the OECD Socex Database to the unweighted OECD average as a per cent of GDP.
Estimates for disability benefits are based on reducing the figure reported in the OECD Socex Database to the unweighted OECD average as a per cent of GDP.
The elimination of tax breaks for retirement is based on data for 2007 from OECD (2011), Pensions at a Glance.
Health care efficiency estimates are from Joumard *et al.* (2010).
Education efficiency estimates are based on Sutherland et al. (2007) updated to 2007 spending figures.
Tuition fees for tertiary education are based on raising direct household expenditure for tertiary education institutions to the unweighted average of those countries where households spend on this category.
Government wage relativities are based on returning the government to private sector wage ratio in the early 2000s.
Estimates for subsidies are based on reducing national account data for 2009 to the unweighted OECD average.
The figures for broadening VAT base assume collection efficiency rises to the unweighted OECD average.
The figures for immovable property are based on the unweighted average for 2008 from the Revenue Statistics.
Revenues from greenhouse gas emissions are based on de Serres *et al.* (2010).

participation. In other cases, scope to minimise costs exists by aiming to improve both allocative efficiency (better use of resources) and technical efficiency (maximising output for a given level of inputs). In most OECD countries, fiscal consolidation will also entail revenue reforms. There is scope to increase revenue by base broadening measures, particularly targeting so-called tax expenditures. When marginal rates need to go up, orientating measures towards those tax bases that have less distortionary effects can help to make fiscal consolidation on the revenue side less costly to long-term output. Finally, taxation of negative externalities may improve both welfare and public budgets.

Instrument options

Social transfers

31 Reforms in a number of countries have aimed to transform social transfers so that vulnerable groups are protected while encouraging greater labour force attachment. This includes, for example, reforming previously unconditional unemployment benefit systems and re-orientating child and family benefits towards employment-conditional measures such as child-care support. In other cases, some transfers, such as disability benefits, have been prone to misuse. Measures which address inflows into disability rolls can be effective in reducing spending while encouraging greater labour force participation. If such measures allowed high spending countries to move towards the current cross-country average spending ratio on family and disability benefits, countries could enjoy savings of over 0.5 per cent of GDP on average and up to almost 3 per cent of GDP in some countries (Table 3), while boosting long-term output.

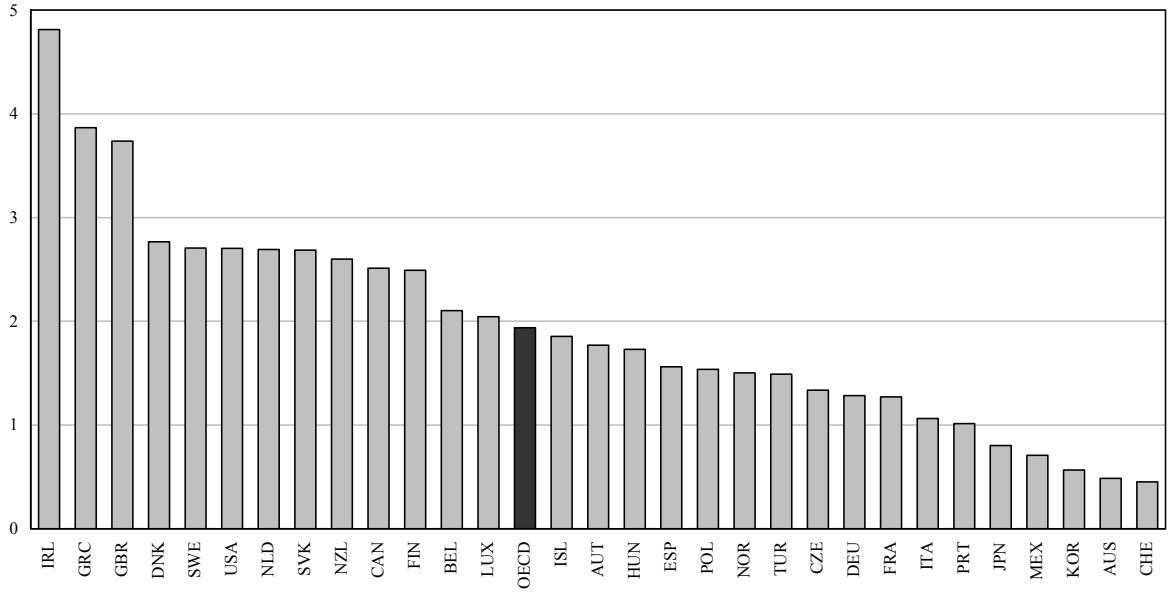
Greater efficiency

32 Work by the OECD has examined the opportunities to improve the efficiency in service delivery for health and education (similar savings are likely to be available in other spending programmes, Hagemann, 2011). These are important spending programmes accounting for about a quarter of government spending or on average across OECD countries around 10 per cent of GDP between them.

- No "one-size-fits-all" exists for health, in the sense that no "model" of health care delivery seems to be universally more cost efficient than other "models". However, within each "model" countries achieve widely divergent degrees of cost efficiency, suggesting that optimisation at the margin rather than a switch of model is the best way to achieve savings. Indeed, adopting best practice policies could see potential efficiency gains in the region of 2 per cent of GDP on average by 2017 (Joumard *et al.*, 2010), thereby allowing savings to be made without compromising service delivery (Figure 7, Table 3).
- For primary and secondary education, schools adopting best practice measures could realise important savings, up to around 1 per cent of GDP in some cases (Sutherland *et al.*, 2007). The estimates for school savings are based on benchmarking individual school performance against the best performing schools with similar student populations and resources (using data envelopment analysis). The implications of reducing inefficiency are then translated into aggregate resource savings by the implied possible reduction in staffing costs (Figure 8, Table 3).

Figure 7

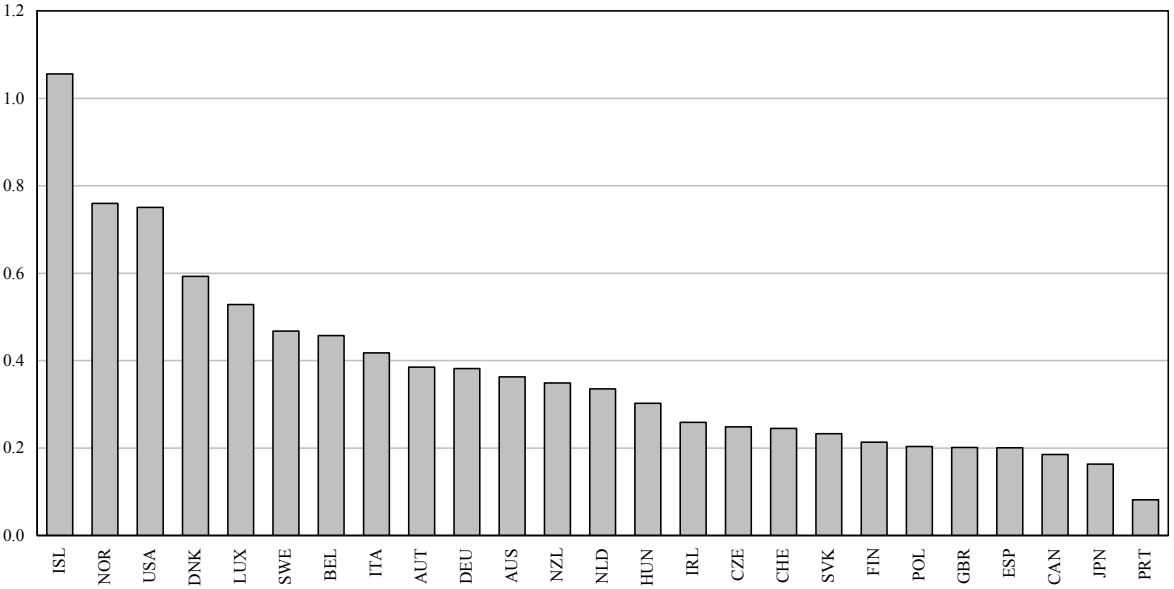
Potential Savings from Greater Efficiency in Public Health Care Spending
(percent of 2017 GDP)



Note: Potential savings represent the difference between a no-reform scenario and a scenario where countries would exploit efficiency gains. The no-reform scenario assumes that between 2007 and 2017 life expectancy and spending increase at the same pace as over the previous 10 years and that the mix between public and private spending remains constant over time.
Source: Joumard *et al.* (2010b).

Figure 8

Potential Savings from Greater Efficiency in Primary and Secondary Education Spending
(percent of GDP)



Source: Sutherland *et al.* (2007).

Government wages

33 Important gains can be achieved through management and pay reforms, and reducing the public sector wage bill is a candidate for fiscal consolidation in many countries. On average, the general government wage bill is close to 10 per cent of GDP and accounts for roughly one quarter of overall spending. Indeed, there are countries where a large public-private sector wage gap has developed over time. Restoring the wage relativities in the early 2000s could yield significant savings in a number of countries (Table 3). Ireland and Hungary have demonstrated recently that substantial cuts in public sector wages can be implemented if there is an urgent need for consolidation and a case arising from public-private pay relativities. That said, comparing public and private remuneration levels poses serious challenges, and requires valuation of working conditions and non-wage remuneration, such as defined benefit pension schemes. The ultimate test of adequacy is likely to be the difficulty or ease of recruitment into and retention in the civil service. From this perspective, budgetary savings achievable through reductions in the government wage bill should best be the outcome of a thorough review rather than across-the-board or arbitrary cuts in pay.

Subsidies

34 Subsidy reduction should rank high on the policy agenda as many subsidies may have surpassed their initial intended objective and may now have adverse economic effects. The elimination of subsidies (as defined in the national accounts), to the average for the OECD could yield sizeable savings in a number of countries (Table 3). Furthermore, by reducing the distortions they create, cutting subsidies offers the potential to boost growth.

Tuition fees

35 Close to a quarter of public spending on education is to support tertiary education, including tuition-free attendance in many countries, especially in continental Europe. A large share of returns to publicly-funded tertiary education accrue to individuals rather than to society (Blöndal *et al.*, 2002), and although some of the private returns are reduced by progressive taxes continued generous public support for higher education can be questioned. This is more so given the greater prevalence of tertiary education among middle and upper income households. The introduction or increase of tuition fees may also improve educational outcomes, by making schools more responsive to market demands, with long-term gains to human capital, the quality of labour supply, the economy's rate of potential growth, and overall fairness. Introducing or raising tuition fees to the average spending in countries that use tuition fees could yield additional revenues of around 0.4 per cent of GDP (Table 3). Concerns that such reforms would reduce enrolment by students from poor backgrounds could to a large extent be addressed by loan programmes with repayment conditional on subsequent income level.

Tax expenditures

36 All OECD governments use tax expenditures to promote a range of policy objectives. The scope of tax expenditures varies greatly across OECD countries, but they account for very substantial revenue leakages in some cases. Not all tax expenditures are undesirable, though, as some improve equity-efficiency trade-offs, like the case of earned income tax credits. Many, however, are distorting, poorly targeted, and contribute to a lack of transparency. In some cases, estimates of the revenues forgone by a tax expenditure can exceed a percentage point of GDP and the aggregate impact of all tax expenditures is likely to exceed several percentage points of GDP in

most OECD countries. Typically, the most costly tax expenditures are those aimed at boosting retirement savings, promoting homeownership, health insurance and charitable giving (OECD, 2010a).

37 Two examples reveal the potential importance for consolidation of reforming tax expenditures in personal income tax:

- Tax-favoured treatment of saving for retirement is found to boost retirement savings *per se*, but there is scant evidence that it raises aggregate private saving. Instead, such tax breaks result in a reallocation of saving from non-tax preferred to tax-preferred vehicles, while causing substantial revenue leakages, which may even reduce aggregate national saving. Phasing out such incentives could yield 1.7 per cent of GDP or more in additional revenues on average across a sample of OECD countries (Antolin *et al.*, 2004).
- Preferential tax treatment of owner-occupied housing is one of the costliest tax preferences in many OECD countries. The most important source of housing-related revenue leakages arises from the tax exemption granted to the implicit rental income of the owner-occupied home. Whereas the owner of a residence that is rented pays tax on the rental payments (less interest and operational costs), the implicit rental income of the owner-occupant is tax-exempt in the vast majority of member countries, except in the Netherlands, Sweden and Switzerland.[6] Despite the exclusion of the implicit rental income, some countries nevertheless allow the deductibility of mortgage interest, as well as property taxes (normally paid at the sub-national level). In addition, many countries provide favourable treatment to long-term capital gains from the sale of owner-occupied housing, adding further to the post-tax attractiveness of investment in housing. Thus, by removing a bias favourable to owner-occupied housing, reform could not only increase revenue but also improve the allocation of capital, boosting growth.

38 There are also important tax expenditures in indirect taxation. While VAT is widely recognised as an efficient and buoyant revenue source, its revenue potential is not fully used. Indeed, with the exception of New Zealand, a substantial portion of potential revenue is foregone in most countries due to a combination of reduced VAT rates, a narrow base, and low compliance (Figure 9). There is thus considerable scope for boosting revenue through VAT reforms (Table 3). Direct fiscal consolidation aside, broadening the base and reducing the number of rates offer scope to improve administration and compliance, by reducing complexity and countering political pressure for additional low rates. A more effective means to meet distributional objectives may be to target compensatory increased cash transfers or refundable tax credits to compensate low-income households.

39 Financial services are typically exempted from the VAT, largely due to technical difficulties in determining the precise tax base for margin-based services (*i.e.*, intermediation). Since much of VAT paid by financial service providers on inputs is non-recoverable, the sector's VAT exemption causes a number of economic distortions that result in more household consumption of financial services, and less use of and greater self-provision of financial services by businesses. However, the evolution of accounting methods and information systems has reduced the technical obstacles to imposing VAT on financial services considerably (OECD, 2010b). Moreover, following the recent financial crisis, there is increased interest among governments in both raising revenue from financial institutions and reducing moral hazard in the financial services sector via new taxes on financial services or (elements of) balance sheets.

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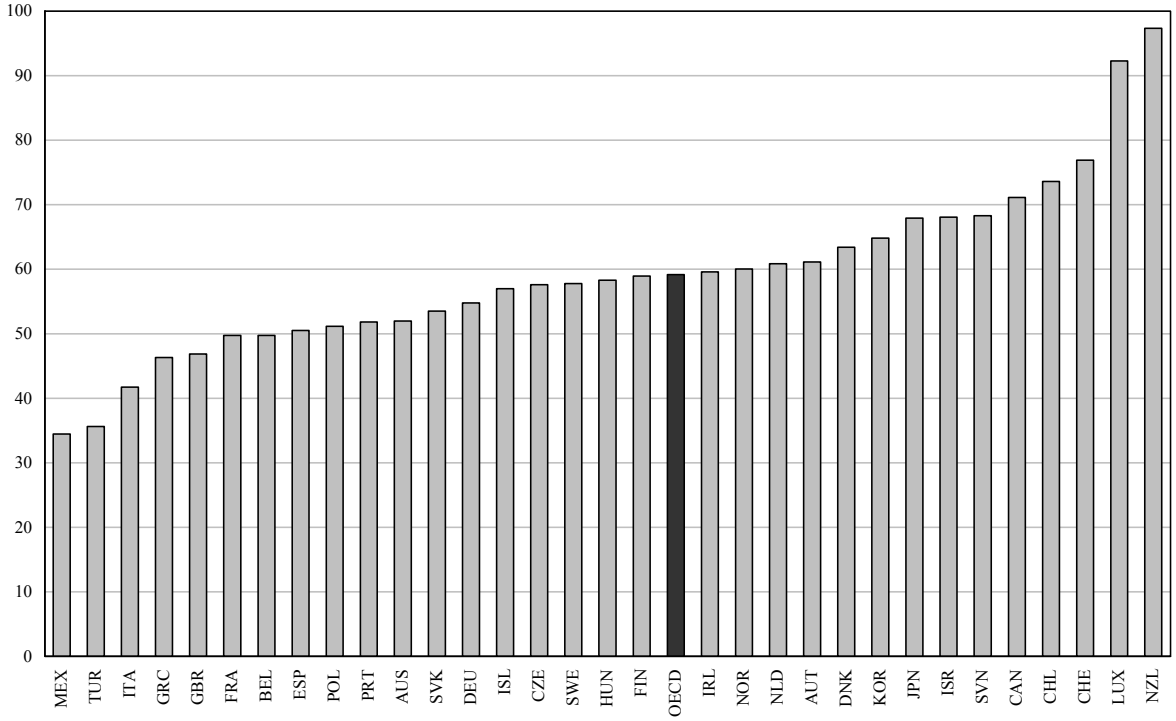
[6] In the Netherlands and Switzerland, however, taxable imputed rentals are very low, which combined with mortgage interest deductibility acts to reduce personal income tax revenues significantly.

Figure 9

Value Added Tax Performance: The VAT Revenue Ratio
(average 2007-08, percent)



Note: The VAT revenue ratio measures the difference between the VAT revenue actually collected and what would theoretically be raised if VAT was applied at the standard rate to the entire potential tax base in a "pure" VAT regime and all revenue was collected: The VAT revenue ratio equals VAT Revenue/(Consumption * Standard VAT rate)*100.
Source: OECD (2011), Consumption Tax Trends 2010: VAT/GST and Excise Rates, Trends and Administration Issues.

Less distortionary tax bases

40 When tax rates need to be raised, some taxes are natural candidates for fiscal consolidation programmes both from an efficiency and revenue-raising perspective. The efficiency costs of taxes on immobile property are lower than on consumption or income, but represent a small share of overall tax revenue in many OECD countries.[7] Where they are low or non-existent, corrective taxes such as so-called "sin" taxes that can help deter harmful behaviours (*e.g.* alcohol and tobacco consumption), or taxes on polluting activities or consumption (*e.g.* fossil fuels) can improve welfare while boosting revenues.

41 Environmental taxes hold the promise of both boosting revenue and helping to achieve environmental objectives by discouraging pollution. While some countries raise considerable revenues from such taxes, reaching 4 per cent of GDP in Denmark and the Netherlands in 2008, their yield is relatively low in several countries, notably Canada, New Zealand and the United States. Nonetheless, imposing a tax on carbon emissions or auctioning tradable emission rights to contain greenhouse gas emissions has become more widespread. For example, the European Union has auctioned permits as part of the Emission Trading Scheme. Despite such

[7] In most countries, property taxes are a main source of finance for sub-national governments, posing potentially challenging fiscal federalism problems should national property taxes be introduced or raised.

developments, many countries maintain differences in taxation depending on fuel type that run counter to estimates of environmental externalities. From a fiscal consolidation perspective, greenhouse gas levies consistent with international action to stabilise atmospheric concentrations of greenhouse gases by 2020, could generate around 2 per cent of GDP (de Serres *et al.*, 2010) (Table 3).

Summing up potential for primary balance adjustment

42 The potential contributions of spending and revenue measures to fiscal consolidation reported in Table 3 could inform a choice of where potential may exist to make savings or increase revenues. Even without being able to quantify all the possible measures across countries, and not taking into account any dynamic effects, the cumulative potential cuts in spending (benchmarked using the OECD average or estimates of potential efficiency gains) and increases in taxation (benchmarked using the OECD average) are sizeable. On average across countries, budget enhancements could reach around 7 per cent of GDP, with the larger part available on the spending side. Given that there are measures that are difficult to quantify this is a lower estimate. Furthermore, the potential tends to be somewhat greater in the English-speaking countries which generally face the larger consolidation needs. A large share of the savings in spending would come from reaping efficiency gains, which are likely to take some time to emerge. On the revenue side, relatively large opportunities exist for the greater use of environmental taxes and the broadening of income and indirect tax bases.

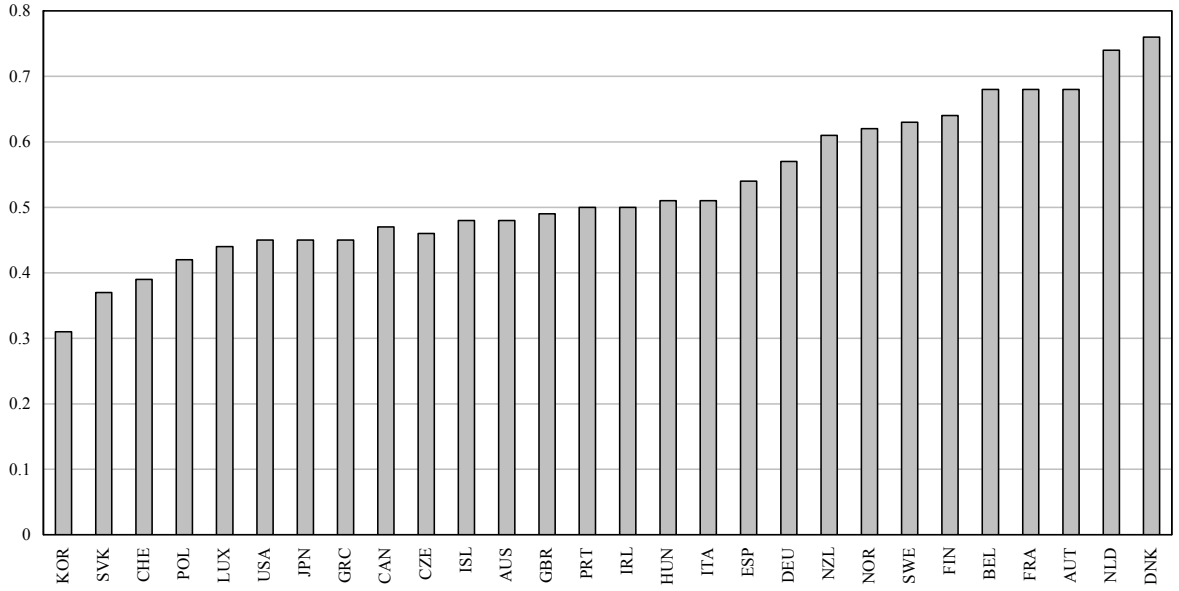
Supporting reforms

43 In a number of cases supporting reforms could assist fiscal consolidation. Aside from their direct budgetary impact, as discussed above, reforms to pension systems that delay retirement and increase labour force participation will boost revenues and thereby reduce long-run budget pressures. Reforms that link retirement age to gains in longevity would thus help cushioning budgets against future changes in longevity. More generally, growth-enhancing structural policy reform may support fiscal consolidation. This is most obvious when reforms, such as retirement reforms, lead to a higher sustainable employment level because such a change will have a permanent impact on the primary balance (Figure 10). The size of the effect will depend on the taxes levied on the additional income and consumption created as well as on whether the reform in question has any direct budgetary impact. The latter will be the case, for example, when additional spending on active labour market policy boosts aggregate spending or cutbacks on unemployment benefit duration reduces it. But many structural reforms have little direct impact on budgets while at the same time boosting employment levels, such as in the case of product market reforms that boost competition.

44 The effects of productivity-enhancing structural reforms on public budgets are less clear. Higher productivity in the private sector will tend to boost revenues but also spending unless public/private wage relativities change or transfer income replacement ratios are altered. Hence, the effect on the primary budget balance may be muted. However, to the extent higher productivity growth is not matched by a corresponding increase in real interest rates debt dynamics will be favourably affected. Such an effect is particularly likely for individual countries participating in a monetary union since the general structure of interest rates is unlikely to be strongly affected by structural reform in an individual country while at the same time higher growth may lead to a narrowing of risk premia.

Figure 10

Effect of 1 Per Cent Higher Potential Employment on the Primary Balance
(percent of GDP)



Source: OECD Economic Outlook 88 database; and OECD calculations.

Conclusions

45 Overall, the link between economic growth and the post-crisis debt overhang is complicated. On the one hand, high debt seems to be associated with lower growth. But, on the other hand, fiscal consolidation may weaken growth both in the near term and over a longer horizon. Realistically, debt problems are so serious in many countries that consolidation has the potential to hamper growth strongly.

46 In the short run, consolidation may weaken demand and monetary policy may not be able to compensate for such effects for some time to come. This argues for phasing in consolidation. Appropriate and clear fiscal objectives together with institutions that ensure accountability may help to preserve credibility in the process. However, to maintain credibility it may also be necessary to take some action up-front, in which case instruments with small short-term multipliers may be given some weight. This may involve some political economy risk, to the extent it skews consolidation towards inappropriate instruments. Slow consolidation may also entail a price insofar as it involves higher debt and thereby higher interest rates.

47 In the longer run, effects of consolidation on growth will depend on the choice of instruments. Some instruments are available that will have limited detrimental impacts on growth and little or no conflict with other policy objectives. Notably, increasing spending efficiency, reforming unsustainable pension systems, putting prices on environmental externalities and maximising the benefits of structural reforms could make sizeable contributions to consolidation. In addition, reviewing tax and benefit systems more generally could help identify how policy objectives could be achieved at lower cost and where support is less justified.

APPENDIX
FISCAL GAPS

48 The underlying model used to calculate fiscal gaps is deliberately simple (Merola and Sutherland, 2011). It builds on the assumptions underlying the *Economic Outlook* medium-term baseline on potential output growth, output gaps, interest and inflation rates until 2025. Between 2025 and 2050, GDP growth is determined by the growth rate of potential, which is driven by demographic developments and assumptions about productivity growth. The fiscal side of the model assumes that revenues adjusted for the cycle remain a constant share of GDP and, in the baseline, primary spending is also a constant share of GDP.

49 For any long-run fiscal projections, GDP growth, interest rates and inflation together with the fiscal assumptions determine long-run sustainability (Table 4). In the country models the main assumptions are as follows:

- GDP growth in the long term is driven by potential output. One of the main components of potential output that is varying over time is working age population growth, which is based on cohort data from long-term demographic projections. GDP growth is then determined by participation rates and employment and labour productivity growth. The latter is assumed to converge to 1.75 per cent by 2035 at the latest. The simulations ignore possible impacts of fiscal policy and debt developments on output.
- Interest rates on government borrowing are partly determined by monetary policy. The return of output to potential is accompanied by a normalisation of interest rates, such that the risk-free rate is at its estimated natural rate by 2025. Inflation converges to the monetary authorities' target, typically 2 per cent annually. Interest payments are determined by the stock of debt and an interest rate that is based on a mix of long and short-term rates, with the long-term rate including a premium of 4 basis points for each percentage point of financial liabilities in excess of 75 per cent of GDP. Japan is assumed to remain unusual, with the very high share of domestic financing keeping the risk premium at only 1 basis point for each percentage point of financial liabilities in excess of 75 per cent of GDP.
- The other major assumptions concern fiscal policy. In the baseline, underlying revenues and primary spending are constant as shares of GDP, though the automatic stabilisers operate while the economy moves back to potential. In some scenarios, ageing-related spending is added to underlying spending to highlight the fiscal pressures coming from population ageing. For health care, given that only a relatively small portion of the projected increase is ageing-related, additional spending is phased in linearly over the projection horizon.

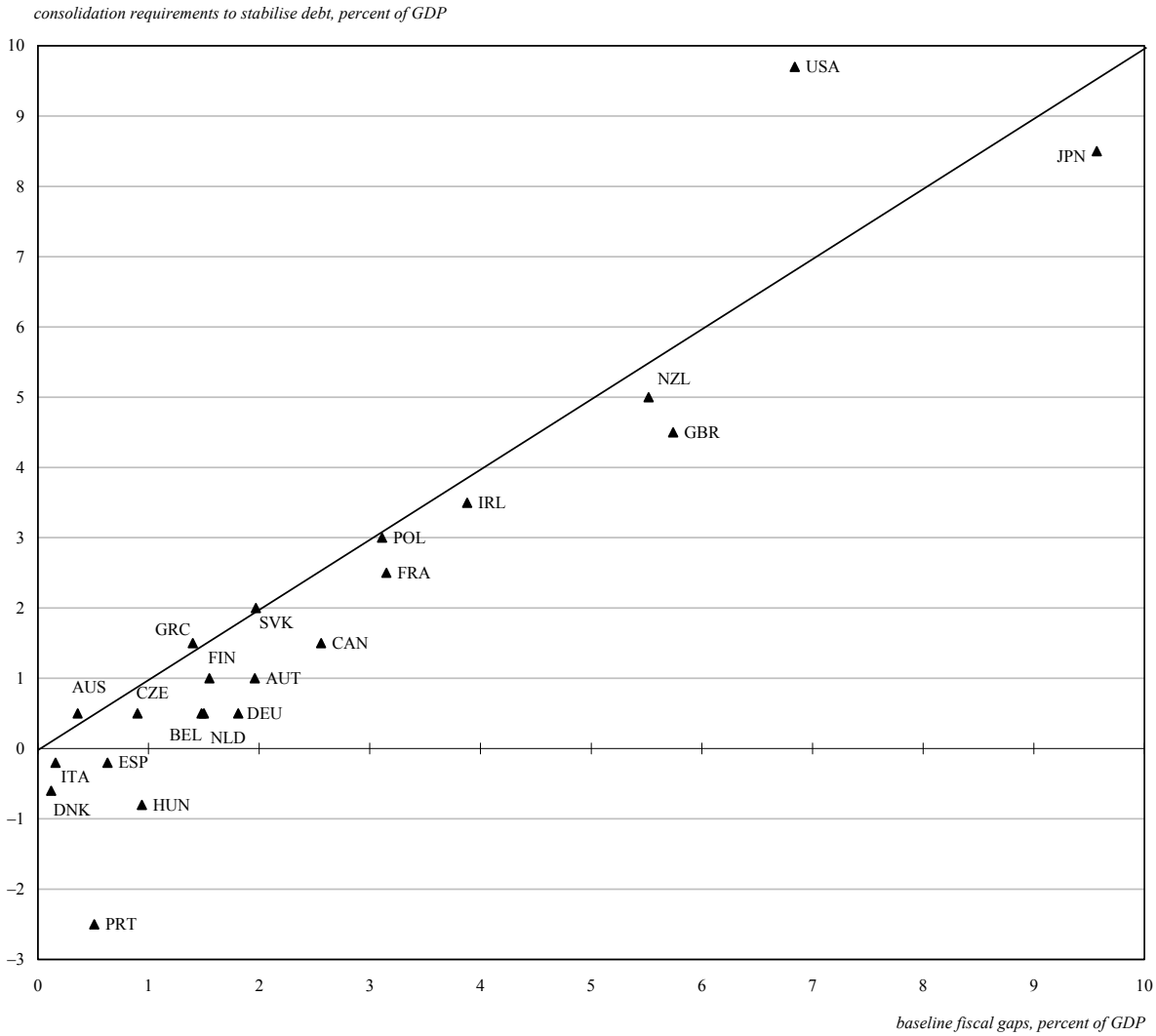
50 The fiscal gaps are distinct from recent work by the OECD that has assessed the consolidation requirements to stabilise debt (OECD, 2011c). These requirements are based on stylised assumptions about a sustained gradual annual tightening of the underlying primary balance by 0.5 per cent of GDP until debt stabilization is reached. The fiscal gaps on the other hand make the alternative stylised assumption that the tightening will be implemented immediately and sustained until 2050 to meet a specific debt target. Both sets of assumptions ignore the implications for output, which will obviously be important.

51 Overall the two approaches produce similar rankings of consolidation needs across counties (Figure 11). The two approaches differ in three ways. First the time path of consolidation is different. Second, the final debt level is different. Third, the time horizon is different. The first and third differences in particular pull in opposite directions for the two approaches. The combined effect of the differences leads to the additional tightening to bring debt down to 50 per cent of GDP in 2050 being typically not much greater than the gradual fiscal tightening needed after 2012 to stabilise debt levels. In general, the immediate consolidation assumed by the fiscal gap calculations is sufficient to bring debt dynamics under control more quickly which combined with the

assumption that the fiscal tightening is permanent over a longer time horizon will see debt levels gradually fall for the rest of the simulation. The estimates of the amount of consolidation needed to stabilise debt are particularly large for the United States and Japan and the gradual tightening takes considerably longer to stabilise debt. As a higher interest premium for each percentage point of debt above 75 per cent of GDP is assumed for the United States than Japan, the consequences of the gradual tightening for adverse debt dynamics are more severe, which explains why the relationship with the fiscal gap estimates differs from the other countries. If countries do not need to consolidate to meet the terminal debt target, such as in the case of Sweden, no fiscal gap is calculated and the country is excluded from the figure.

Figure 11

Relation Between Fiscal Gaps and Consolidation Requirements



Source: OECD (2011c), OECD Economic Outlook 89.

Table 4

Key Assumptions in the Baseline Simulation

Country	Starting Point, 2012		Average Over Simulation	
	Gross Debt *(percent of GDP)*	**Underlying Primary Balance** *(percent of GDP)*	**Effective Interest Rate**	**Nominal GDP Growth**
Australia	31	0.6	6.9	4.8
Austria	82	0.1	4.4	3.5
Belgium	100	0.9	4.7	3.8
Canada	88	–1.8	4.9	4.2
Czech Republic	51	0.3	4.4	4.2
Denmark	60	0.8	5.0	3.5
Finland	66	0.8	4.2	3.9
France	100	–0.6	4.1	3.6
Germany	87	0.6	4.3	3.0
Greece	159	3.5	5.5	3.4
Hungary	81	1.1	5.8	3.2
Ireland	126	–0.4	4.7	4.3
Italy	128	3.3	4.6	3.1
Japan	219	–4.2	3.0	2.2
Korea	33	0.5	5.6	2.4
Luxembourg	24	2.0	4.5	4.9
Netherlands	75	0.0	4.3	3.5
New Zealand	52	–4.0	5.8	4.3
Poland	66	–1.5	5.3	3.2
Portugal	116	3.5	4.6	3.1
Slovak Republic	51	–1.7	5.1	2.8
Spain	75	0.5	4.2	3.5
Sweden	41	2.6	4.7	4.0
Switzerland	37	1.2	2.9	2.9
United Kingdom	93	–3.0	4.6	4.1
United States	107	–5.8	4.6	4.3

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HUMAN CAPITAL FORMATION IN ARGENTINA: CONTRIBUTION TO GROSS DOMESTIC PRODUCT

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1 Introduction

The influence of human capital formation upon countries' gross domestic product and its long run growth path was always a matter of interest both for theorists on growth theory as well as for policy makers involved in the design of fiscal growth and development policies. The idea of the inclusion of human capital in production functions had already been considered by Uzawa (1965) and Lucas (1988) in their two sector endogenous growth models; in one sector, the final production stemmed from the combination of physical and human capital whereas in the other production and human capital accumulation were derived from human capital use alone.

Lucas theoretical contribution (1988, 1990) also dealt with externality features, by suggesting that investment in human capital not only enhanced individuals' earning abilities but might also generate an external effect that raised the aggregate level of productivity and served in turn to explaining countries' long run income diversity. Contemporaneously, Romer (1990) also highlighted the importance of human capital by putting forward his well-known $I + D$ and growth model in which the underlying research technology only depended on labour or human capital.

In assessing the hypothesis of human capital as "engine of growth", Frenkel and Razin (1996) carried out their analysis based on a classical textbook endogenous growth model including both physical and human capital and showed that the long-run growth rate was always positively related to the human capital saving rate but positively, negatively related or totally unrelated at all to the physical capital saving rate, this depending on the value taken by the reciprocal of the intertemporal elasticity of substitution in consumption; the above verification led Frenkel and Razin to defend public policies targeted at raising the human capital saving rate on grounds that they would directly impact on the economy's long-run growth rate.

In attempting to ascertain the role played by human capital, the influential paper by Mankiw, Romer and Weil (1992), focused on the empirics of economic exogenous growth and brought about a revaluation of the traditional Solow-Swan Model (SSM) by showing that the latter's predictions were somehow consistent with their own econometric evidences. Even though the SSM rightly predicted the directions of the effects of saving and population growth upon income, they found that estimates of parameters fell short of being satisfactory as they clearly overstated the size of the coefficient on physical capital compared to the actual capital share of one third usually assumed in the formulation of the Cobb Douglas production functions.

This empirical lack of consistency was dealt with by Mankiw *et al.* by building what they called an "Augmented Solow Model" which explicitly included human capital in the production function; the resulting log equation, holding now that real per capita income depended on population growth as well as on physical and human capital accumulation had, according to the econometric results, a much better performance as the human capital variable turned out to be significant, the size of the physical capital coefficient fell in line with it expected actual value and the fit of the equation improved compared to the regression in which human capital was omitted whereas the restriction that all three coefficients (on population growth and on propensities to accumulate physical and human capital) summed to zero was not rejected.

Following the line drawn by the above mentioned contributions, this research paper aims at assessing the impact of the Investment in Education in Argentina (as one of components of Human Capital Formation) upon the Gross Domestic Product, therefore the Augmented Solow Model is

used as underlying the theoretical framework. It is worth point out here that the empirical developments due to Mankiw *et al.*, given difficulties found in computing the variable, resorted to a proxy for the propensity to invest in human capital accumulation consisting in taking the percentage of the working age population enrolled in secondary school; in connection to this, one main contribution of this paper resides in furthering the empirical treatment of the "augmented SSM" on the following three accounts: a) the possibility is investigated of finding better representations for the average propensity to invest in human capital other than the one above mentioned, b) missing components, such as the opportunity costs incurred by parents and students are added to all government and educational levels' budgetary expenditures and c) a methodology is developed for the measurement of the stock of human capital in order that the variable be available to be used, in a second stage to this project, in place of the rate of human capital accumulation.

Furthermore, and given the widespread admission that valuable empirical and policy implications may arise from including human capital, the Augmented SSM econometric performance is assessed by resorting to cointegration and error correction models and innovation accounting involving impulse response function and variance decomposition analysis.

A worth stressing point is that the advance on methodological aspects relating data treatment and measurement, as well as the results from the carried out econometric estimation of equations, are expected to serve as inputs for the second stage in which the inclusion of human capital will be assessed in the frame of endogenous growth models.

In line with objectives held above, the rest of the paper is organized as follows: Section 2 summarizes the theoretical treatment given by Uzawa (1965) and Lucas (1988) to the inclusion of human capital in endogenous growth models as well as a review of the Mankiw, Romer and Weil's Augmented Growth Model (1992); in Section 3 a methodological alternative is introduced and applied to the Argentine economic scenario, for computing both the average propensity to invest in human capital and its stock; Section 4 presents a synthetic review of stylized facts that highlights the joint performance –in the period considered- of gross domestic product and human capital; Section 5 presents the econometric estimation for Argentina of the Augmented Growth Model's parameters by using an Error Correction Model as well as the evaluation of results with tools of innovation accounting; section 6 concludes.

2 Human capital inclusion in economic growth models[1]

Theoretical contributions aimed at stressing the role of human capital in models of economic growth, and at empirically assessing its real impact upon long-run growth path, are ample and can be traced back close in time to the moment when the classical Solow-Swan Growth Model came into being.[2] Three of these contributions were selected to be reviewed: in the first two, Uzawa and Lucas, resorted to an endogenous growth model in which they included human capital whereas in the third one Mankiw, Romer and Weil (1992) extended the Solow-Swan Model by adding what they deemed to be the omitted variable; that is, human capital accumulation.

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1 This section builds on papers by Uzawa (1965), Lucas (1988) and Mankiw *et al.* (1992) and on Heijdra and van der Ploeg (2002), ch. 14, and Sala-i-Martín (1994), ch. 8.

2 Suffice it in this connection to mention Schultz's communication (1961) on the impact of labour quality improvement upon the pattern of economic growth.

2.1 The Uzawa-Lucas Model

AK endogenous growth models including physical (K) and human capital (H) were founded on the assumption that both were similar goods, obtained with the same technology and able to be produced and accumulated out of not consumed units of production; as a consequence of this, the following two relationships between stocks of both capital variants were seen to hold implying that a temporal reduction in K (and in K/H ratio) would be made up by getting a part of H immediately converted in K:

$$\frac{K}{H} = \frac{\alpha}{1-\alpha} \tag{1}$$

$$H = K\frac{1-\alpha}{\alpha} \tag{2}$$

where $0<\alpha<1$ stood for the physical capital's share in the production function.

Simple and practical as it might appear, this unrealistic assumption was challenged by Uzawa by suggesting that technological knowledge could only be raised by devoting resources to this end, following a pattern of allocation conducive to optimum growth within the framework of a two sector aggregative growth model whose main features were intuitively simple. Uzawa started by drawing the productive sector represented by the production function (3) below, in which physical capital and labour used for final goods production combined and yielded a homogenous output which could be either instantaneously consumed or devoted to enhancing the stock of physical capital:

$$Y(t) = f\big(K(t), A(t)L_P(t)\big) \tag{3}$$

and where $A(t)$ stood for the state of technological knowledge at any time t[3] and L_P labour used in the production of final goods.

The second sector, broadly defined as "the educational sector", employed only labour and its impact diffused over the economy via the enhancement of labour efficiency $(\dot{A}L(t))$; Uzawa made the rate of change of labour efficiency to depend on non increasing marginal returns[4] and the ratio between labour employed by the educational sector and total labour force:

$$\frac{\dot{A_L}(t)}{A_L(t)} = \phi\left[\frac{L_E(t)}{L(t)}\right] \tag{4}$$

In interpreting expression in (4) it should be noticed that, for Uzawa, the larger the change in labour efficiency, the larger the amount of labour devoted to the educational sector (L_E) which, in the context of an inelastically supplied labour force growing at a rate n, amounted to meeting the restriction imposed by the identity (5):

$$L_E(t) + L_P(t) = L(t) \tag{5}$$

The rest of the model formulation was completed by traditionally stating the rate of physical capital accumulation as the difference between the positive annual rates of aggregate investment and of capital stock depreciation:[5]

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[3] For Uzawa, changes in technological knowledge were exclusively embodied in labour and therefore labour efficiency's increases did not depend on the amount of employed physical capital.

[4] Non increasing marginal returns to labour meant that $\phi'(s) \geq 0$ and $\phi''(s) \leq 0$ for all $0 \leq s \leq 1$.

[5] It must be noted that while Uzawa used this equation to define the rate of capital accumulation, both Lucas and Mankiw *et al.* used a similar formulation to express the net investment in physical capital or, in other words, the capital accumulation (see equation 33 below).

$$\frac{\dot{K}(t)}{K(t)} = I(t) - \delta_K K(t) \tag{6}$$

and by introducing a linear utility function whereby the optimum time path was characterized in terms of the discounted sum of per capita consumption:

$$U(0) = \int \frac{C(t)}{L(t)} e^{-\rho t} dt \tag{7}$$

In relation to the treatment of human capital in endogenous growth models, the main thrust represented by Uzawa's contribution was however extended by Lucas, at least on the following three accounts: a) while Uzawa broadly regarded $A_L(t)$ as embodying educational activities, health and provision and building of public goods, Lucas modified the idea by interpreting $A_L(t)$ as human capital; b) based on empirical evidence[6] showing that individual earnings were consistent with a linear knowledge production function, Lucas rejected the assumption of diminishing returns to knowledge accumulation implied by expression (4) and put forward in change a modified expression (4') for the human capital accumulation function in which $\phi_E > 0$ was now a parameter:

$$\frac{\dot{H}(t)}{H(t)} = \varphi_E \left[\frac{L_E(t)}{L(t)}\right] \tag{4'}$$

Expression (4') rested on Rosen's theory, applied to each finite-lived individual and extended by Lucas to the same technology applied to an entire infinitely-lived representative household; that is, individuals' acquired human capital were somehow transferred to next generations.[7]

The third change consisted in Lucas' introduction of a curved intertemporal utility function for the representative infinitely lived household, in place of the linear function (7), as expressed now in (7'):

$$U(0) = \int \frac{C(t)^{1-\theta} - 1}{1 - \theta} e^{-(\rho - n)t} dt \tag{7}$$

in which θ stood for the reciprocal of consumption's intertemporal elasticity of substitution. As known, $\theta = 1/\sigma$ is a constant that measures the degree of concavity of the utility function (7') its value in turn implying that the larger θ the greater the interest in smoothing consumption over time.

With the modifications introduced by Lucas (shown by equations (4') and (7')) the model development, and its resolution, followed endogenous growth models' standard procedures by incorporating the ensuing per capita equations[8] for physical and human capital accumulation in which the simplifying assumption of similar depreciation rates was used:[9]

$$\dot{k} = A(t)k(t)^{\alpha} \left(u\, h\,(t)\right)^{1-\alpha} - c(t) - (\delta + n)\, k\,(t) \tag{8}$$

$$\dot{h} = \varphi_E\,(1 - u)\, h\,(t) - (\delta + n)\, h\,(t) \tag{9}$$

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6 Rosen (1976).

7 The assumptions that individuals' capital formation followed the pattern depicted by 4' and that the initial level each family member began with was proportional to the level already accumulated by the family's older members led Lucas (1988, p. 19) to assert that human capital accumulation was a social activity with no counterpart in physical capital accumulation

8 Equations (8) and (9) were derived from accumulation equations $\dot{K}$ and $\dot{H}$ divided by L, making next $k = K/L$ and $h = H/L$, taking derivatives with respect to time in order to obtain $\dot{k} = \dot{K}/L - nk$ and $\dot{h} = \dot{H}/L - nh$ and replacing $\dot{K}/L$ and $\dot{H}/L$ for their equivalents in per capita accumulation equations.

9 Similar to the effect caused by δ, increases in the population's rate of growth (n) dwindle the available per capita physical and human capital stock.

Thus, while u stood for the proportion of total human capital used for the production of final goods, $(1–u)$ indicated in turn the effort devoted to human capital accumulation.[10] Let it be noticed that, if L were normalized to unity in (5), L_E and L_P would respectively equal to $(1–u)$ and u[2].[11]

In line with the usual procedure, Uzawa-Lucas made individuals to choose temporal trajectories for consumption and stocks of physical and human capital that maximized the utility function already introduced; that is, equation (7') was maximized subject to non leisure time individuals devoted to each of the two sectors (time constraint 10) and the accumulation restrictions 8 and 9, as represented by the Hamiltonian in (11), including now two state variables (k and h) and two control variables (c and u):

$$h(t) = u\,h\,(t) + (1 - u)\,h(t) \tag{10}$$

$$\begin{aligned}\mathcal{H}(t) = e^{-(\rho-n)t}\,\frac{C(t)^{1-\theta}-1}{1-\theta} + \eta_K[A(t)k(t)^{\alpha}\big(u\,h\,(t)\big)^{1-\alpha} - c\,(t) \\ -(\delta + n)\,k\,(t)] + \eta_H\,[\varphi_E(1-u)h(t) - (\delta+n)h(t)]\end{aligned} \tag{11}$$

where the co-state variables $\eta_K(t)$ and $\eta_H(t)$ respectively stood for shadow prices of per capita investment in physical and human capital $k(t)$ and $h(t)$. The corresponding first order conditions, resulting from the derivation of the Hamiltonian with respect to control and state variables, and the transversality conditions, were:[12]

$$e^{-(\rho - n)t}C(t)^{-\theta} = \eta_K(t) \tag{12}$$

$$\eta_K\,(t)\,A(t)\,k\,(t)^{\alpha}\,(1 - \alpha)u^{-\alpha}\,h\,(t)^{1-\alpha} = \eta_H(t)\varphi_E\,h(t) \tag{13}$$

$$-\dot{\eta}_K(t) = \eta_K\,(t)\left(A(t)\alpha\,k\,(t)^{\alpha-1}\left(u\,h(t)\right)^{1-\alpha} - (\delta + n)\right) \tag{14}$$

$$-\dot{\eta}_H(t) = \eta_K(t)(A(t)k(t)^{\alpha}\,u^{1-\alpha}\,(1-\alpha)h(t)^{-\alpha}) + \eta_H(t)\big(\varphi_E(1-u) - (\delta+n)\big) \tag{15}$$

$$\lim_{t\to\infty}\eta_K(t)k(t) = \lim_{t\to\infty}\eta_H(t)h(t) = 0 \tag{16}$$

What first order conditions were stating was that produced output must on the margin be equally valuable in its uses, either as consumption or investment goods (12), while at the same time individuals' non leisure time must also be equally valuable in its uses, namely, physical and human capital accumulation (13). Finally, first order conditions (14) and (15) reflected the fundamental principle of valuation of the perfect competition institutional setting whereby the rate of return on different assets (in this case physical and human capital) must also be equalized. In Lucas' words, "…equations (4') and (12)-(16) implicitly describe the optimal evolution of $k(t)$ and $h(t)$ from an initial mix of these two kinds of capital".[13]

By taking logarithms and derivatives with respect to time in (12), and replacing $\eta_K(t)$ by its expression in (14), the resulting consumption dynamic equation was obtained that placed the

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[10] Although physical capital may not straightforwardly be ruled out as an input for the production of human capital, the accumulation equation (9) reflects Uzawa-Lucas assumption that only human capital is used to enhancing human capital stock.

[11] What Lucas called effective workforce in production (or skill-weighted man hours devoted to current production) was precisely $N(t) = uH(t)$, or $N(t) = L_P H(t)$, were L is being normalized to unity.

[12] As known, equal to 0 first order conditions are required for derivatives of the Hamiltonian with respect to control variables whereas for Hamiltonian's derivatives with respect to state variables first order conditions must equal the negative of shadow prices' derivatives with respect to time.

[13] Lucas (1988), p. 21.

consumption growth rate in terms of the model's variables:[14]

$$\frac{\dot{c}}{c} = \gamma_C = \frac{1}{\theta}\left(A(t)\alpha k(t)^{\alpha-1}\left(uh(t)\right)^{1-\alpha} - (\delta + \rho)\right) \tag{17}$$

In accompanying Lucas' solution for steady state values of variables c, k and h,[15] it is easily verifiable that by passing to the left hand side of equation (17) all constant terms, and taking logarithms and derivatives with respect to time, the resulting expression will fall in line with the steady state underlying principle asserting that all variables (in this case physical and human capital) must exhibit an equal and constant growth rate:

$$0 = (\alpha - 1)\gamma_k^* + (1-\alpha)\gamma_h^* \qquad or \qquad \gamma_k^* = \gamma_h^* \tag{18}$$

By dividing next for k the equation for physical capital accumulation (8), and passing to the right hand side all steady state constant terms, equation (19) was obtained:

$$\frac{c}{k} = A(t)(u^*)^{1-\alpha}\left[\left(\frac{h(t)}{k(t)}\right)^*\right]^{1-\alpha} - (\delta + n) - \gamma_k^* \tag{19}$$

from which (20) was straigthforwardly assumed to follow:[16]

$$\gamma_k^* = \gamma_h^* = \gamma_c^* \tag{20}$$

Finally, by taking logarithms of the production function for final goods (y), and derivatives with respect to time, the rate of growth of final output would be depicted by the ensuing expression (21):

$$\gamma_y = \alpha\,\gamma_k + (1-\alpha)\gamma_u + (1-\alpha)\gamma_h \tag{21}$$

which for steady state growth rate values, and given that $\gamma_u^* = 0$, permitted also to include γ_y^* in expression (22):

$$\gamma_y^* = \gamma_k^* = \gamma_h^* = \gamma_c^* \tag{22}$$

Thus far, growth rates in (22), apart from including γ_h^*, did not add any other relevant element to the already traditional conclusion of endogenous growth models; that is, in the steady state all variables grow at a similar constant rate. It is therefore important to show in what Lucas-Uzawa Model's rates differ from those yielded by other endogenous growth models (as, for instance, the AK Model) which did not explicitly include human capital stock and accumulation.

The matter raised in the above paragraph is easily dealt with by following a few simple mathematical steps whereby both sides of the first order condition (13) are multiplied by u and appropriately cancelling where required:

$$\eta_K(t)A(t)k(t)^{\alpha}(1-\alpha)u^{1-\alpha}\,h(t)^{-\alpha} = \eta_H(t)\varphi_E\,u \tag{23}$$

In taking next logarithms and derivatives with respect to time, the expression turned into (24) showing equality of shadow prices' growth rates:[17]

$$\gamma_{\eta h}^* = \gamma_{\eta k}^* \tag{24}$$

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[14] As can be seen, the rate of growth of consumption was, in the Uzawa-Model, also function of the physical capital marginal product; nevertheless, the latter not only depends now on the stock of physical capital but also on the share of human capital stock used for the production of final goods.

[15] As the amount of human capital devoted to final goods production was a positive constant of the total stock h, the steady state value of u^* is also fixed and its rate of growth equal to 0.

[16] A constant quotient $(k/h)^*$ means that –in the steady state- both capital stocks grow at the same rate; as the same should apply to $(c/k)^*$, growth rates for consumption and physical capital will necessarily be equal and similar to the rate of growth of human capital.

[17] In obtaining (24) it must be remembered that all steady state terms in (23) were constant, except the two shadow prices.

The left hand side of (23) is identical to the first term in the right hand side of (15). Consequently, substituting it in the first order condition and cancelling terms, the steady state rate of growth of shadow price η_H is brought out:

$$\left(-\frac{\dot{\eta}_H}{\eta_H}\right)^* = -\gamma^*_{\eta h} = \varphi_E - \delta - n \tag{25}$$

By taking next logarithms and derivatives with respect to time of the first order condition (12), the ensuing equation results:

$$\frac{\dot{c}}{c} = \gamma_C = \frac{1}{\theta}\left(-\frac{\dot{\eta}_K}{\eta_K} - (\rho - n)\right) = \frac{1}{\theta}(\varphi_E - \delta - \rho) \tag{26}$$

and given that all variables must have, in the steady state, an equal rate of growth:

$$\gamma^*_y = \gamma^*_k = \gamma^*_h = \gamma^*_c = \frac{1}{\theta}(\varphi_E - \delta - \rho) \tag{27}$$

As can be seen, conversely to AK Models in which the rate of growth was affected by the production function's exogenous productivity constant, the long-run economic growth here is affected by the educational sector's productivity parameter φ_E. Needless to say, this result rests on Lucas' assumption that only human capital was used by the educative sector to producing human capital (equation (9)) and that there existed a linear knowledge production function (expression in (4')).

On the other side, feasibility of (27) will depend on the relationship between the intertemporal substitution elasticity, represented by $1/\theta$ and the productivity constant φ_E ; in this connection, expression in 4' suggested that if the entire non leisure time were devoted to human capital production (that is, if u=0) φ_E would be the maximum attainable γ_h , therefore (27) would stand if and only if and this would require in turn would the following upper limit to be placed upon the intertemporal elasticity of substitution:

$$\frac{1}{\theta} < \frac{\varphi_E}{\varphi_E - \rho} \tag{28}$$

Although not considered in the carried out review, it is important however to point out that Lucas stressed also out the possibility of knowledge having a positive external effect upon productivity, apart from the effects of and individual's on his own productivity, what he modeled as follows:

$$N(t)c(t) + \dot{K}(t) = A(t)k(t)^{\alpha}\left(u(t)h(t)N(t)\right)^{1-\alpha}h_a(t)^{\zeta} \tag{29}$$

In the above formulation the net national product (left hand side member) is still seen to depend on the levels of capital and labour inputs and on the level of a constant $A(t)$ technology, but also on the term $h_a(t)^{\zeta}$ intended to capture what Lucas called possible external effects of human capital.[18]

2.2 The Augmented Solow Model

In the very influential paper by Mankiw, Romer and Weil (1992), one of the outstanding features was its empirical success in revaluing Solow's Model by econometrically proving that their predictions were in principle consistent with evidence;[19] thus, while estimated coefficients' signs rightly predicted the direction of effects of investing in physical capital, and of population

[18] As stressed by Heijdra and van der Ploeg (2002, ch. 14, p. 463), in so doing Lucas aimed at reinforcing the notion that the formation of human capital was, in part, a social activity.

[19] In Mankiw *et al.*'s words, "…the Solow model gave the right answers to the questions it was designed to address".

growth, they failed in correctly predicting magnitudes. The matter of the assumedly failure of countries' income per capita convergence was also empirically analyzed and restated in the paper as the authors concluded that – instead of convergence – the Solow Model should rather be viewed as implying that countries would reach in general different steady states.[20]

The response to the deemed high influence of saving and population growth had to be sought, as explained below, at the exclusion of human capital from the traditional Solow Model which resulted in disproportionate larger but biased variables' estimated regression coefficients, as physical capital accumulation and population growth failed to reflect that part of their impact upon income was due to the omitted human capital variable.

The introduction of human capital within the traditional Solow Model permitted not only to solve the mentioned inconsistencies, arising when this variable, was omitted but also to use the model with greater confidence on its predictive potential. In this regard, and as is shown in the coming sections, the possibility of drawing empirically sound evidences from the model's testing enhances its policy implications with respect to the cost-benefit analysis of devoting tax revenue to human capital formation.

In presenting the augmented Solow Model, the equation (30) shows how the Cobb Douglas production function looks like after the omitted variable is included alongside physical capital:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} [A(t)L(t)]^{1-\alpha-\beta} \tag{30}$$

$K(t)$, $H(t)$ and $L(t)$ represent now the stocks of physical and human capital and labour availability respectively, $A(t)$ the technological level, $[A(t)\,L(t)]$ the effective units of labour[21] and α, β, and $(1-\alpha-\beta)$ the respective factor shares.[22] Similar to the original Solow-Swan Model, Mankiw *et al.* consider logarithmic labour and technology functions whose exogenous growth rates are respectively n and g:

$$L(t) = L(0)\, e^{nt} \tag{31}$$

$$A(t) = A(0)\, e^{gt} \tag{32}$$

The inclusion of human capital makes the model to consider now not only what determines the evolution of physical capital stock but also that of human capital, as the two ensuing capital accumulation equations show:

$$\dot{k}(t) = s_k y(t) - (n + g + \delta)\, k(t) \tag{33}$$

$$\dot{h}(t) = s_h y(t) - (n + g + \delta)\, h(t) \tag{34}$$

obtained by making $y=Y/AL$, $k=K/AL$, and $h=H/AL$ and s_k and s_h respectively standing for the fraction of income invested in physical and human capital.[23]

As in the traditional Solow-Swan Model, decreasing returns to scale entail that the economy will converge to a steady state in which $\dot{k}(t) = \dot{h}(t) = 0$ and $k(t) = k^*$ and $h(t) = h^*$; consequently, by using the production function in (30) and capital accumulation equations in (33) and (34), the following two expressions are obtained:

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[20] In connection to this argument, the point was emphasized that – when differences in saving and population growth rates were taking into consideration – convergence was seen to exist at a rate in line with the model's prediction.

[21] The effective units of labour grow at the compound rate $(n+g)$.

[22] In stating that $\alpha+\beta<1$, Mankiw, Romer and Weil keep Solow's assumption of decreasing returns to physical and human capital, although the assumption that $\alpha+\beta=1$ is also critically discussed in the paper.

[23] Equations (33) and (34) do not only imply that both types of capital have the same depreciation rate but also that one unit of consumption can costlessly be changed into either a unit of physical or human capital, which notoriously differ from the assumptions upheld in the Lucas-Uzawa model.

$$k* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}} \quad (35)$$

$$h^* = \left(\frac{s_k^{\alpha}\, s_h^{1-\alpha}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}} \quad (36)$$

By substituting (35) and (36) into the Cobb Douglas production function (30), and taking logarithms, the estimable expression in (37) standing for per capita income along the balanced growth path is achieved:[24]

$$\ln\left(\frac{Y(t)}{L(t)}\right) = \ln A(0) + gt - \frac{\alpha+\beta}{1-\alpha-\beta} ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta} ln(s_k) + \frac{\beta}{1-\alpha-\beta} ln(s_h) \quad (37)$$

It is worth emphasizing that although coefficients are still predicted as function of factor shares, the above expression is better fitted to explaining cross-country income differences, owing to the fact that human capital accumulation now accompanies population growth and physical capital accumulation. In this regard, Mankiw *et al.* pointed out in the first place that, even if $ln(s_k)$ were independent of other variables in the right hand side of expression (37), its coefficient would still be greater than in the classical Solow Model without human capital; since higher saving would lead to higher income, this would, in turn, lead to a higher steady-state level of human capital even if s_h remained unchanged, the implication being that the inclusion of human capital accumulation enlarged the impact of physical capital accumulation. Moreover, the coefficient on $ln(n+g+\delta)$ is, in absolute value, greater than $ln(s_k)$'s coefficient reflecting the fact that high population growth lowers income per capita as physical and human capital stocks need now to be spread over more individuals.

Mankiw, Romer and Weil also suggest an alternative way, stemming from the combination of (37) and the steady-state level of variable h in (36), whereby the impact of human capital upon per capita income can be highlighted. As can be seen below, the resulting equation renders now income per capita as a function of the propensity to accumulate physical capital, the population growth rate and the level of human capital:[25]

$$\ln\left(\frac{Y(t)}{L(t)}\right) = \ln A(0) + gt + \frac{\alpha}{1-\alpha} ln(s_k) - \frac{\alpha}{1-\alpha} ln(n+g+\delta) + \frac{\beta}{1-\beta} ln(h^*) \quad (38)$$

As there exist now two variants for the Augmented Solow Model's econometric estimation; that is, one in which the rate of human capital accumulation is resorted to and another including the level of human capital, Mankiw *et al.* aimed at empirically sorting out the posed testing dilemma by suggesting to verify – in the first place – whether human capital's available data corresponded to (s_h) or to (h) a matter that, for Argentina, will be dealt with in the next section.

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[24] The point is worth mentioning that, for Mankiw *et al.*, $lnA(0)$ also reflects, apart from technology, other features such as resource endowments or institutions, therefore the term is better depicted as being equal to $\alpha+\varepsilon$ where α is a constant and ε stands for a country's specific shock.

[25] It is easily noticed that the structure of 38 is practically similar to the traditional Solow-Swan equation without human capital in which the latter is part of the error term. Since saving and population growth rates influence h^*, human capital should be expected to be positively correlated with the saving rate and negatively in turn with population growth. In reason of this Mankiw *et al.* suggested that omission of the term on h^*, in Solow's Model, biased coefficients on saving and population growth.

3 Methodologies for computing the human capital stock and the average propensity to invest in human capital

3.1 Preliminary ideas

Even acknowledging the difference between this paper's aims and those in articles which explicitly refer to economic growth, such as Mankiw *et al.*, the construction of a variable that clearly serves the purpose of capturing the effect of human capital upon gross domestic product contributes to enriching future empirical results. Simple as it was, Mankiw's proxy did what it was intended to do, but it fell short from unveiling the policy effectiveness of budgetary efforts directed to human capital creation, therefore more accurate measures are in order.

Even by restricting to a single narrow variant of human capital, i.e. investment in education, Mankiw *et al.* acknowledged from the outset the "practical difficulties" involved in the variable's measurement, particularly if the model's second alternative (involving human capital level) were aimed at for econometric estimation. On grounds therefore of statistical feasibility, the first alternative was resorted to by using a proxy for the rate of human-capital accumulation (s_h) which simply approximated the percentage of the working-age population actually enrolled in secondary school; however, the authors pointed out that the measure was not free from flaws, at least on the following four accounts: primary and university education were not included, the input of teachers was also ignored, students' forgone earnings and their variation with the level of human capital investment were not considered, and the proxy resulted from two data series respectively embodying the eligible population (12 to 17 years) and the working age population of school age (15 to 19 years) that clearly covered different age ranges. Needless to say, these flaws did not impede that a one sector model were used; the mentioned omissions and inconsistencies would be however a bounding restriction should a proper production function for human capital were included.

In the light of the above comments, efforts in the rest of the section are oriented to describing components of investment in human capital and to computing both the variables better representing in Argentina the level of per capita human capital (h) and the rate of human capital accumulation (s_h); while the former is required for the estimation of equation (38), the latter, whose new computed value seeks to avert the criticisms Mankiw *et al.* placed upon their proxy variable, is in turn used for testing equation (37).

3.2 An alternative estimation of s_h *and* h

From the outset, the specification of what "investment in human capital" will mean or include is crucial as, despite that much has been said and written in this matter, the need of counting with an econometrically practical variable and the scarceness of available data imposed always severe constraints. In this connection, the following principles governed the methodology followed to achieving variables standing for human capital in Argentina:

i) Notwithstanding the relevance of activities in the form of health and construction and maintenance of public goods, whose importance as components of human capital was particularly stressed by Uzawa as they resulted in an improvement of labour efficiency, difficulties involved in gathering data[26] and jointly dealing with all of them advise to focus only in investment in education.[27]

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[26] This was particularly true for health expenditures as major modifications underwent by the system during the period considered made very difficult to obtain statistical series while at the same time benefits rendered by their inclusion were scant.

[27] Technical knowledge (derived from investment in education), must be built upon an inherited social capital, should it be expected to

(continues)

ii) In correctly ascertaining the real value of the variable, the opportunity costs of investment in education; that is, the forgone income of working age students, should be determined and added to the actual budgetary resources component. The importance of opportunity costs in empirical work has repeatedly been noticed, as was the case in Kendrick's calculations (1976). Maintenance costs of university students, borne by parents, must also be taken into account as a component of opportunity costs.

iii) Investment in education is an all inclusive term, therefore primary, secondary and higher education, as well as science and technology, are also encompassed.[28]

iv) Budgetary expenditures in the field of Culture are excluded on grounds that they generally yield consumption rather than productive goods.

v) In a country like Argentina, characterized by a federal institutional setting in which investment in education spreads over the three government levels, the variable's right assessment calls for national, provincial and municipal spending in education to be altogether considered.[29]

In order to meet the preceding general guidelines, the variable standing for investment in human capital is built considering the following methodological principles:

a) Educational expenditure is an overall item including actual budgetary outlays in basic education (primary and secondary levels) and higher education (tertiary and university studies) of all the three government levels: central government, provinces and municipalities.

b) National and subnational spending in science and technology is also included, inasmuch as they aim at raising productivity by helping to develop the current state of the applied scientific knowledge and productive techniques.

c) Minima legal wages are used to approximately computing opportunity costs on the following two grounds: they by definition represent households' cost of basic needs whereas they also serve as a proxy for incomes earned for working age students still no having completed their higher studies.
Nevertheless, secondary students' maintenance costs borne by parents are not added in opportunity costs, the idea being that households customarily support children up to the age of eighteen. By the same token, not forgone incomes are suppose to exist in the case of secondary students under fifteen as labour regulations and practical limitations are more strictly applied upon this particular age range. This explains the decision not to compute forgone earnings for secondary students under fifteen while only a minimum legal wage was taken for students above this age.

d) Contrariwise to what is asserted in the preceding paragraph, higher education and university students are expected to somehow support themselves, therefore the following three cases may be considered: a) they work full time and bear their maintenance costs; b) they work part time but their parents still bear their maintenance cost and c) they do not work at all and therefore, apart from forgone incomes, their maintenance cost is also borne by their parents. These three categories serves to explain the opportunity cost structure that follows: a double legal minimum wage is assigned to the percentage of higher education students who, according to statistical information drawn from household and university surveys, do not work; in this case, one

improving the country's productivity matrix. In this context the expression embodies elements such as institutions, values and social and collective behaviour.

[28] Expenditures devoted to different university's careers are not made explicit at this stage. Given that disciplines can have different marginal impacts on gross domestic product this could be a further step in future investigations.

[29] As of the nineties, primary and secondary education became in Argentina a provincial budgetary responsibility, the national government performing thereafter a subsidiary role through annual transfers sent to the subnational level (based on the so-called Ley del Financiamiento Educativo 26075). The national government keeps in change the responsibility of wholly financing national public universities whereas spending in science and technology is a shared commitment, though mostly funded by the central government.

minimum wage accounts for forgone earnings and the other for students' maintenance costs borne by parents. For the percentage of students having a job but still receiving economic support from their families, no forgone incomes are assumed and only one minimum wage is computed in order to reflect maintenance's costs. For students that work and defray their own expenses no opportunity costs are assigned.

e) Outlays in a)-b) above stand for the investment in human capital restricted to budgetary expenditures in Education, Science and Technology. By including c)-d) an augmented version of human capital investment is obtained which also includes opportunity costs. By dividing both variants of investment in Education by gross domestic product, average propensities to invest in human capital result.

f) In building up series for human capital stock the conventional assumption is upheld that actual educational investments, similarly to physical capital, are subject to an annual depreciation rate of 10 per cent.[30] The reason for using a single depreciation rate for both capital assets not only responds to computational simplification, but also seeks to reduce the loss of degrees of freedom: should more than one depreciation rate be used, more parameters will have to be estimated and the data constraint binds tighter.

g) All variables are in real terms, deflated by CPI series (see sources in Annex 1).

3.3 Variables' specification

Once components of investment in human capital are completely assessed and included, both variants of the average propensity to invest in human capital are computed; nevertheless, only the variant "average propensity to invest in human capital (inclusive of opportunity costs)" is used in the econometric estimation. The variable's computed values (with and without opportunity costs) are shown in Annex 1, whereas that its performance over time is depicted by figures in next section, in which stylized facts related to human capital performance in Argentina are considered.

As for human capital stock (H), the annual value of the variable includes the preceding years' still not depreciated investment together with the year's actual not amortized investment (e.g., if 1998's human capital stock is to be computed, 90 per cent of the year's investment is included plus the remaining not amortized investments from previous periods). The value of variable human capital stock (H) needs not be confused with the variable (h) in equation (38), representing per capita human capital stock.[31] The variants included here are in line with different forms of regarding human capital (with and without opportunity costs) and their graphical evolution is considered in the next Section. Although computing both H and h appears like a major step in fathoming with some of postulated questions, the econometric use of these variables has not proven fruitful in the present step of the investigation. Nevertheless, a better performance is expected from theirs being used in an endogenous model, where a human capital production function is included.

4 Stylized facts concerning the evolution of gross domestic product and human capital formation

In analyzing Figure 1 below, tracing the evolution, as of 1978, of the Argentine gross domestic product and human capital stock, this having been computed as explained in Section 3

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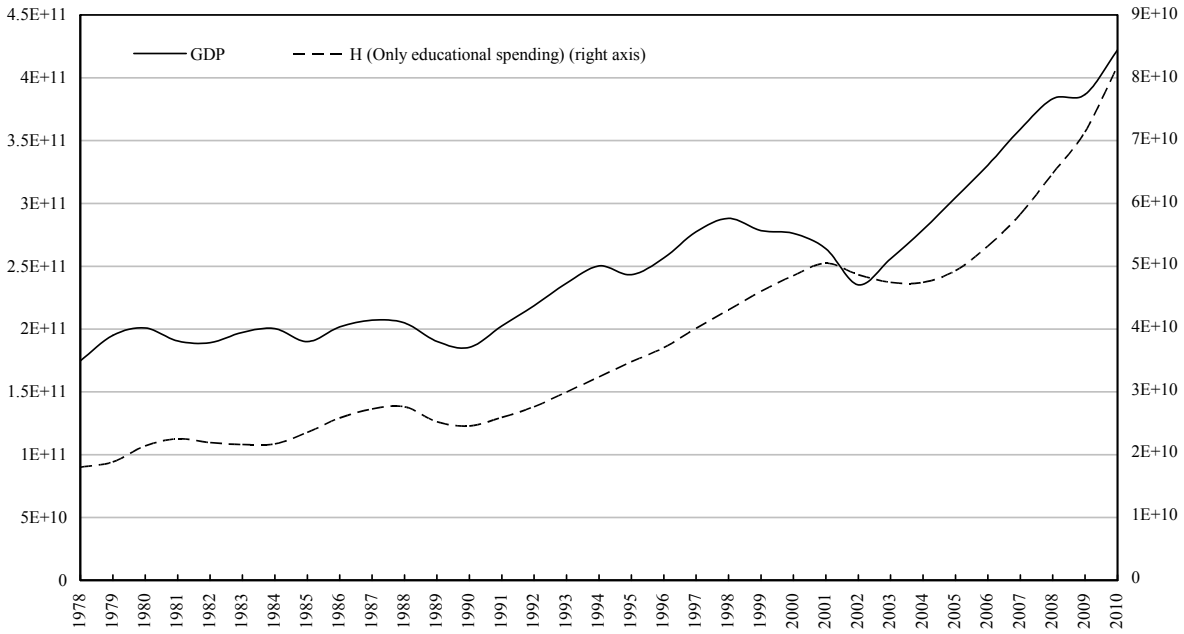
[30] It is obvious that this simplifying assumption does not rule out alternatives; thus, while Mankiw *et al.* prefer a longer amortization period (a smaller depreciation rate), the argument may also be defended that amortization need not be linear but decreasing.

[31] See the value for h (inclusive of opportunity cost) in Annex 1, quoted as HOCPC.

Figure 1

Series Stand for Gross Domestic Product and Human Capital Stock at Current Prices



and including only budgetary outlays in Education,[32] an immediate feature deserving being stressed is the direct correlation found between both series. A more careful inspection of the figures, however, sheds light on the matter of causation closely, which, in turn, is related to objectives motivating this research. As can be seen, the gap between GDP and H shrinks in time in coincidence with the working of the so-called "Ley de Financiamiento Educativo", whereby educational spending should be gradually increased until it reaches a determined percentage of GDP. One important preliminary conclusion, verified below by the econometric results and running counter to what it would have been expected, is that GDP clearly hauled human capital formation (represented here by investment in education), with little evidence of the reverse causation order significantly taking place.

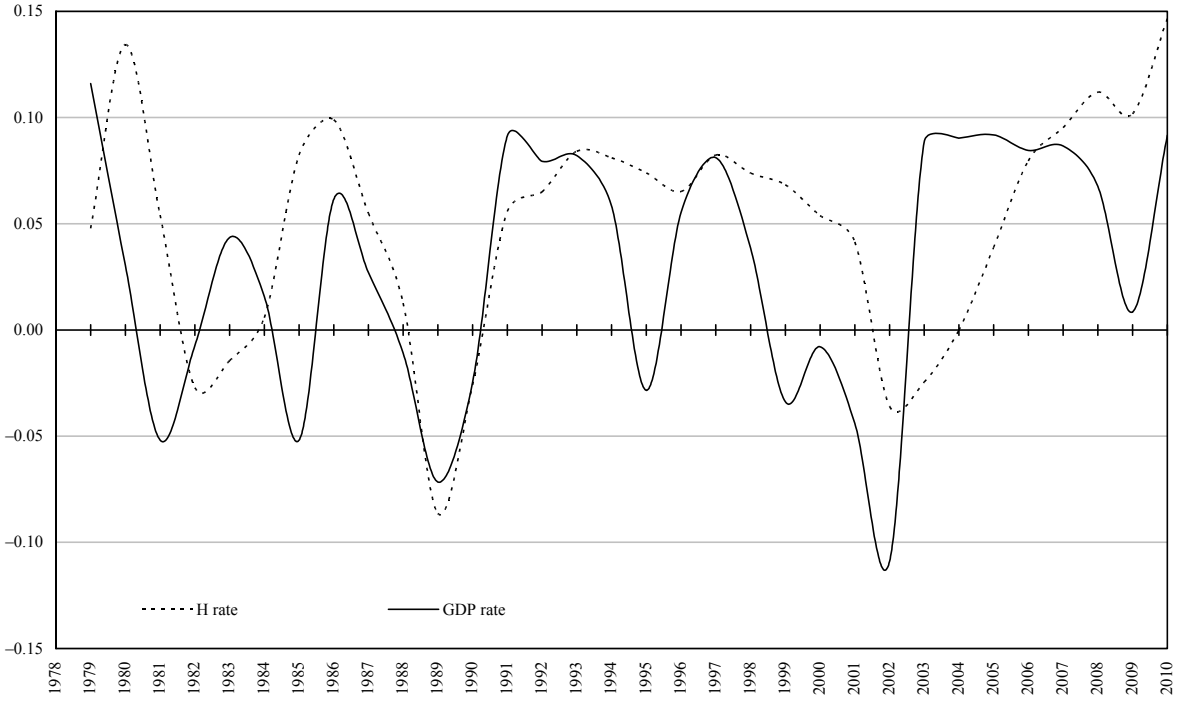
A conclusion somehow similar to the one just arrived upon in the previous diagram can be drawn when GDP and H's growth rates are jointly assessed, as in the following Figure 2: strikingly, except for a few periods in which both growth rates exhibited the same pattern, there seems not to be a particular positive correlation between the series' respective maxima and minima values; thus, growth rates, rather than coinciding, behave differently in a large part of the period considered and it is also noted that when both have a decline – as in the period 1983-2002) the fall is more deeper in the case of the gross domestic product growth rate. In line with what the cointegration analysis will show in Section 5, bad or good performances of the overall Argentine growth rate seem to be based in factors no considered here and it can hardly be argued that investment in education significantly counted as one of them.

It is therefore important to point out that, however expected the evolution of human capital stock following the path traced by GDP (mainly due to the form in which the variable was computed), hopes that H would somehow behave as a GDP's growing factor or stabilizer can be hardly fed from evidences in the figures shown.

[32] That is, investment in education is here computed exclusive of opportunity costs.

Figure 2

Gross Domestic Product and Human Capital Stock Growth Rates Derived from the Respective Series in Current Prices



The next diagram, in which the ratios of investment in education over gross domestic product and over the previous period's gross domestic product (the lag of the same variable) are respectively plotted, not only enriches the analysis of the real impact of human capital upon product but also help in reasserting conclusions derived in the preceding paragraphs by introducing an element that has so far not been considered. The steady increase of H throughout the whole period (see Figures 1 and 3) is seen to be practically accompanied by a similar performance of ratios H/GDP shown in Figure 3, except for some isolated cyclical decreases the latter underwent; since ratios stand for human capital stock per unit of product, it is possible to argue that the nature, quality and efficacy of human investment (measured as outlays for education) fell short of what was expected in terms of their product enhancing capacity and that may in turn explain why an incremental product-investment in education relationship failed to prevail.

Suffice it to mention that the second ratio was aimed at ascertaining whether human capital formation had a lagged impact upon product; needless to say, this hypothesis could not either being proven as the similar pattern exhibited by dashed line ruled out chances of a clearer relationship and higher impact between variables stemming from taking policy variables' lagged values.

The conclusion obtained from the graphs in Figure 3 is still more evident when the plots of product and average propensity to invest in human capital growth rates, shown in Figure 4, are carefully observed. Even though the former (already shown in Figure 2) shares its cyclical behaviour with S_h, ups and downs of the average propensity to invest in education and technology's growth rate were by far much more marked, and yet this did not seem to have had a definite weight upon the evolution of the product's growth rate, let alone the fact that their performance run counter in several time spans during the period analyzed.

Figure 3

Ratios of Human Capital Stock/Gross Domestic Product in 1993 Prices
(figures in left and right vertical axis respectively stand for the value of the ratio and the human capital stock)

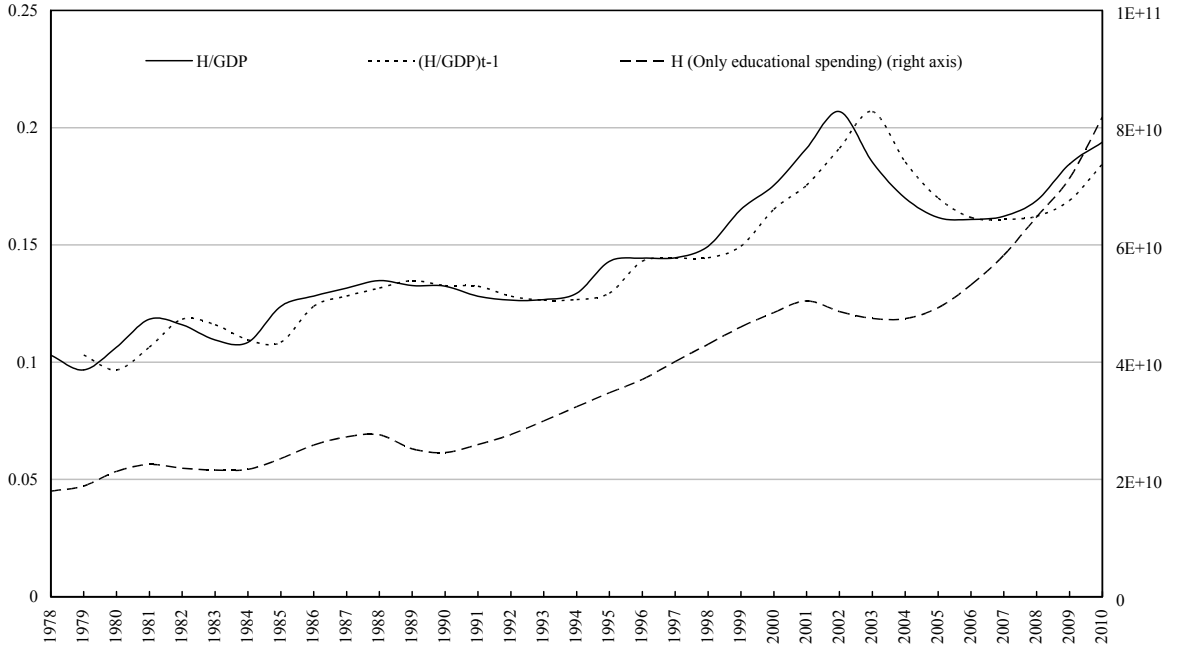


Figure 4

Rates of Growth of the Average Propensity to Invest in Human Capital (When Opportunity Costs are Not Considered) and of Gross Domestic Product

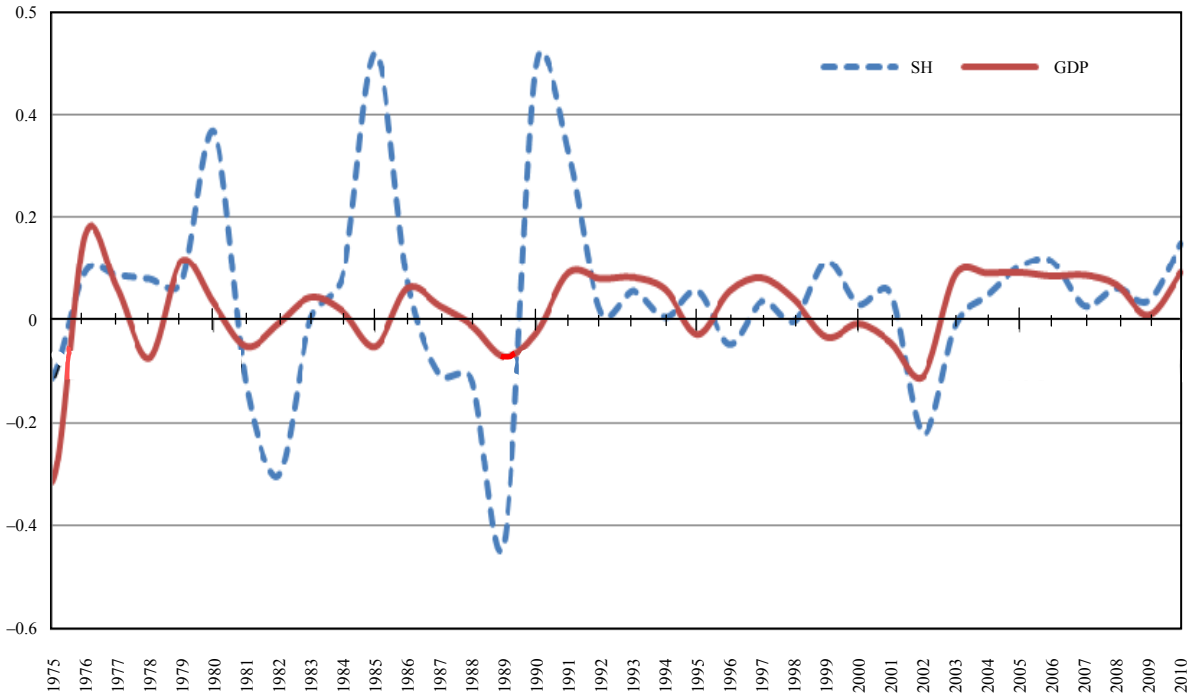
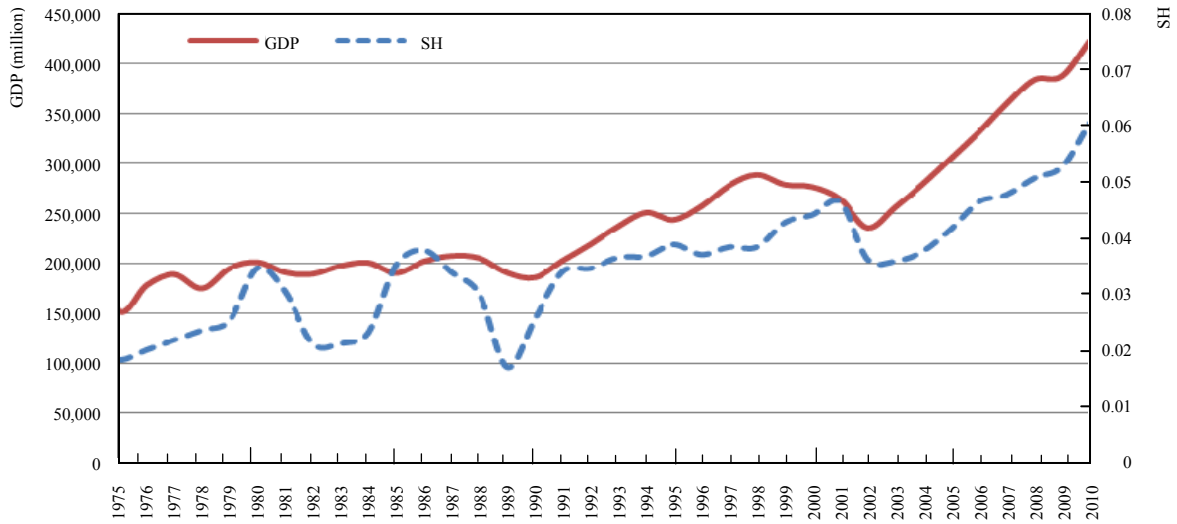


Figure 5

Series for Gross Domestic Product and Average Propensity to Invest in Human Capital



When the gross domestic product and average propensity to invest in human capital series are plotted together, as in Figure 5, their evolution did not seem to offer explanations different to what has so far been presented: for the first part of the period, S_h exhibited a marked cyclical behavior not accompanied by the steady low growth path of product while the stable increase of S_h as of 2003, for reasons given above, did not seem to have produced any particular incremental effect upon product but rather the other way round.

The performance in the period 1991-98 is however worth mentioning as it seems to have been the only case in which human capital formation exerted any incremental effect upon product; this situation was also reflected in Figure 4, as can be easily noticed when the behaviour of product and average propensity rates of growth is observed.

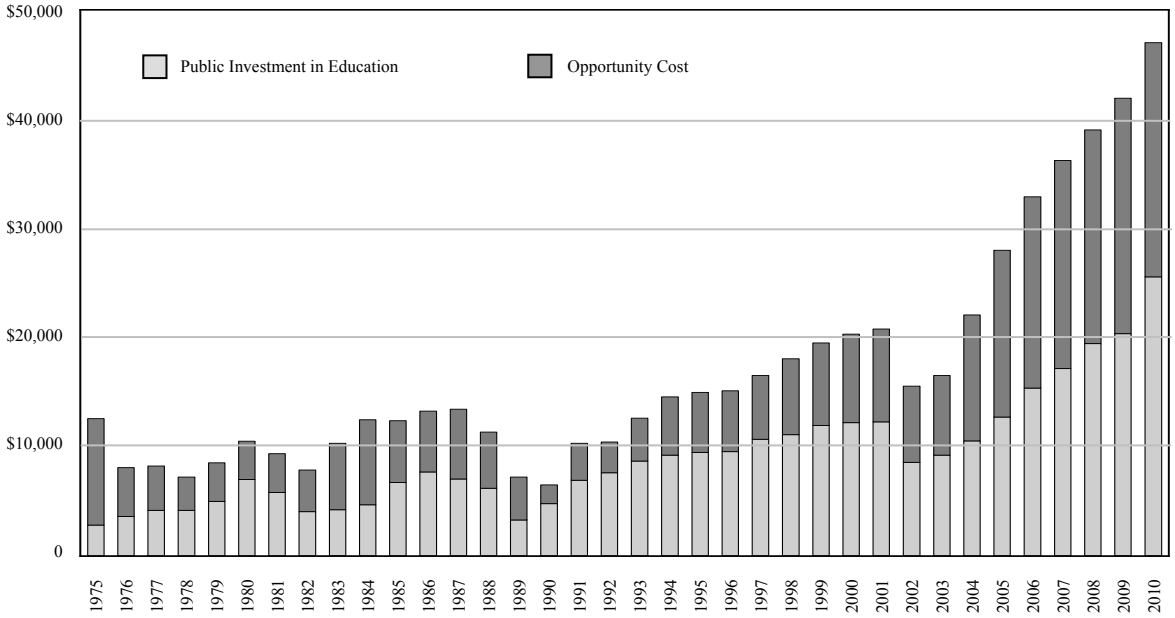
The presentation of stylized facts is completed with the analysis of the following figures in which the overall concept of investment in education, embodying budgetary outlays as well as the opportunity costs (as defined in the preceding section) is considered. In the first place, the graph in bars of Figure 6 showing the evolution of the actual investment in education aims at highlighting how their two components evolved throughout the period.

The first worth pointing out evidence shown by Figure 6 is that students' forgone earnings and maintenance costs supported by parents have been an important component of the overall investment in education all throughout the period; in this regard, the very magnitude of opportunity costs as a representation of the burden implied for the society as whole poses a question whose answer falls well beyond this paper's reach but that seems anyhow worth ascertaining in terms of cost benefit analysis.

The second evidence yielded by Figure 6 is that opportunity costs' percentage share within investment in education was not stable but underwent significant variations throughout the years. The explanation for that must be sought at the form opportunity costs were computed; that is, in terms of minima legal wages. It is therefore clear that opportunity costs' share of investment in education was straightaway conditioned by updating opportunities of minima legal wages by the government.

Figure 6

Public Investment in Education (Budgetary Outlays) and Opportunity Costs (Forgone Incomes and Maintenance Costs Borne by Households)
(million pesos of 1993)



Finally, the evolution of the overall average propensity to invest in education (Figure 7) is in turn split in order to show its two components' actual weight. Although bars in Figure 7 are expected to follow the pattern set by the investment in education in Figure 6, figures for S_h permit in turn to add some additional comments that shed light on human capital performance in Argentina during the period considered. In the first place, the evolution of both the overall average propensity to invest in education as well as components' share did not appear to follow a definite pace, conversely to what by and large happened as of the nineties.

However, one interesting feature revealed in the bar Figure 7 is that, apart from the positive effect of parliamentary mandated increases in education outlays, which subsequently raised the percentage participation of investment in education to gross domestic product, the opportunity cost component grew steadily as of the nineties to the extent that its participation ranged between 40 per cent and 45 per cent of the overall average propensity to invest.

5 Econometric estimation for Argentina of an Error Correction Model

5.1 Theoretical aspects of the Error Correction Model

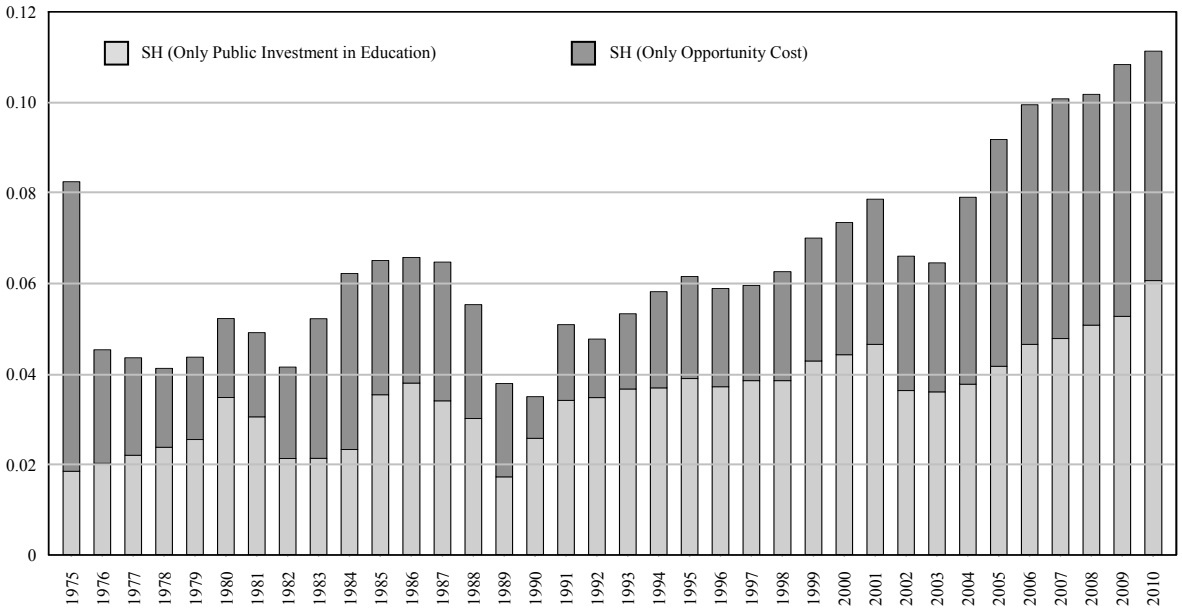
As known, an error correction model responds to the following structure:

$$\Delta X_t = \pi_0 + \pi X_{t-1} + \sum_{i=1}^{p} \pi_i \Delta X_{t-i} + \phi D_t + \varepsilon_t \tag{39}$$

where ΔX_t stands for a $(n \times 1)$ vector representing the set of endogenous variables, π_0 is a constant terms vector included in the VAR, ΔX_{t-1} stands in turn for the "i periods" lagged vector

Figure 7

Average Propensity to Invest in Education



of variables while the dummies vector D aims at capturing the model's structural break points. The term πX_{t-1} is important in so far as it differences the ECM from a VAR in differences by incorporating information contained in variables in levels; matrix π results from the product of matrices α' and β', the first embodying speed of adjustment parameters to short term changes respect of long run (or equilibrium) relations whereas the second one holds cointegration coefficients by means of which a linear combination of order one integrated variables comes up to be stationary. Thus, equation (39) can be similarly represented by the following expression:

$$\Delta X_t = \pi_0 + \alpha\beta' X_{t-1} + \sum_{i=1}^{p} \pi_i \Delta X_{t-i} + \phi D_t + \varepsilon_t \qquad (40)$$

The rank of matrix $\pi = \alpha\beta'$ suffices to determine the number of cointegration equations: if it were zero, the matrix would be null ($\pi=0$) and the model would be stated in terms of a VAR(p) in differences; if there is, on the contrary, a complete Rank matrix, all variables will be stationary, as a stationary variable cannot be equaled to a non-stationary one (in this case integrated of order one).

When the rank of π is r, (for $0<r<n$), there will be r cointegration equations, β will be now a $(n \times r)$ matrix, and product $\beta' X_{t-1}$ generates stationary variables that will stand for the short-run disequilibria with respect to each of the long-run relations. Matrix α also $(n \times r)$ holds the parameters determining the adjustment speed *vis-à-vis* these disequilibria.

The Johansen Methodology permits to calculate the rank of π by means of a Dickey-Fuller multivariate proof,[33] from which characteristic roots are obtained; the amount of distinct-from-0 roots will indicate the rank of π and the amount of linearly independent cointegration equations.

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[33] When having the expression $X_t = A_1 X_{t-1} + \varepsilon_t$, in which X is a vector, the Dickey-Fuller Proof permits to check whether the matrix π in $\Delta X_t = (A_1 - \mathrm{I})\, X_{t-1} + \varepsilon_t$, or in $\Delta X_t = \pi X_{t-1} + \varepsilon_t$, is null or not.

Trace and Maximum Eigen Value Statistics are used to identify the number of statistically different from zero roots: while the former one test the null hypothesis that the number of linearly independent cointegration equations is equal to or smaller than r, as against the alternative of greater than r, the second test is used to check the null hypothesis that the number of cointegration equations is r as against the alternative $r+1$.

It is expected to find, for the Augmented Solow Model, only one long run relation representing equation (37) above, from which all produced disequilibria will force variables to move till they newly reach equilibrium, both by means of long run effects included in the error correction term and through the VAR's short run effects.

5.2 Econometric estimation of the ECM for the Argentine case

The assessment of the impact of human capital upon the Argentine per capita gross domestic product is carried out for the period 1975-2010. Diverse data sources were resorted to in order to construct the series necessary for the econometric estimation of variables' coefficient, whose detail is referred to in Annex 1.

As will be shown below, variables in levels are not stationary (that is, not $\sim I(0)$), which can bring about the problem of spurious correlation and its undesired effects. Despite the fact that some controversy still exists in the literature as to whether to discard non stationary variables in time series regression, other solutions are at hand to deal with the problem,[34] as is the case of cointegration and the error correction model developed in the preceding section and used in this paper for estimating the previously introduced equation (37):

$$ln\left(\frac{Y(t)}{L(t)}\right) = \ln A(0) - \frac{\alpha + \beta}{1-\alpha-\beta}\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta}ln(s_h) \qquad (37)$$

Variables used in order to estimate the model are described below:

$ln[Y(t)/L(t)]$**,** indicating the log of per capita (or per effective labour unit) income (hereafter quoted as GDPPC);

$ln(n+g+\delta)$**,** standing for the log of the sum of population and knowledge rates of growth plus the depreciation rate (hereafter quoted as NDG). As it is obvious, the coefficient must be negative since the effect of a raise in the first two rates – by increasing both the population and the number of effective units of labour – will be a smaller per capita o per worker income.

$ln(s_k)$, $ln(s_h)$, respectively showing the log of the propensity to invest in physical (SK) or human capital. As in the previous case, their positive coefficients will indicate the expansive effect exerted by higher propensities. As said, s_h admits the two variants: actual expenditures in education over gross domestic product (SH) and actual expenditures in education plus opportunity costs over gross domestic product (SHOC); the statistical software EViews was used to obtain the econometric results of regression equation (37) shown above.

As the estimation process requires, in the first place, the order of integration of series used to be determined, Table 1 shows results of unit root tests;[35] as can be noticed, variables are not stationary.

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[34] In particular, the risk of spurious regressions disappears if a lineal combination of non stationary series happens to be stationary or $I(0)$. As Rezk and Irace (2008) pointed out, the economic significance is in this case no minor as the existence of cointegrated series indicate in turn a long run equilibrium relation among the variables.

[35] All variables are in logs and the amount of lags used for the Dickey-Fuller Test was automatically determined by Schwarz Information Criterium. The human capital stock (h^*) was not used in this case as its first difference turned out to be not stationary (see tests in Annex 3, Table 7).

Table 1

Augmented Dickey-Fuller and Phillips-Perron Test

Levels	ADF	PP	First Diff.	ADF*	PP*
GDPPC	–1.301158	–1.277143	Δ*GDPPC*	–6.328994	–6.328994
NDG	0.450308	0.180568	Δ*NDG*	–5.232868	–3.616207
SK	–2.979997	–2.501809	Δ*SK*	–5.060128	–4.931142
SHOC	–1.334194	–1.320521	Δ*SHOC*	–5.350248	–6.77113
SH	–1.471598	–1.120892	Δ*SH*	–6.315386	–10.48566

* In all cases, the null hypothesis is rejected for/at 1 per cent significance level.

Table 2

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Max-Eigen Statistic	0.05 Critical Value
None*	0.819268	98.19719	54.07904	61.58658	28.58808
At most 1**	0.390939	36.61061	35.19275	17.8501	22.29962
At most 2	0.26849	18.76051	20.26184	11.25518	15.8921
At most 3	0.188184	7.505336	9.164546	7.505336	9.164546

* The hypothesis of no integration equations is rejected for/at a 5 per cent significance level, as against the alternative of one equation (Max-Eigen Vaule) or more than one (Trace).
** The Trace Test rejects the null hypothesis of one cointegration equation as against the "more than one" alternative whereas the Max-Eigen Test does not reject the null hypothesis of one cointegration equation as against the "two cointegration equations" alternative.

Johansen Cointegration Method was resorted to for the ECM estimation, including respectively a constant term (both in the cointegration equation and the VAR) and a dummy for year 2002, when the country incurred in default of its external debt.[36] Given the constraint imposed by the scarce data availability, variables were in turn allowed only one lag.

Results for the Johansen Test are shown in Table 2 above, in which the computed Trace and Maximum Eigen statistics were compared with their respective critical levels for a significance level of 0.05.

Even though the Trace Statistic seems to suggest that two long run equilibrium relations exist, only one is pointed out by the Max-Eigen Statistic, therefore the ECM is finally estimated with one long run relation.[37]

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[36] The dummy variable previously included for 1989, the year of hyperinflation, but it was discarded as it turned to be not significantly different from 0 in all cases.

[37] On the basis of results yielded by the Trace Statistic, the error correction model was also estimated for two cointegration equations but, in one case, results were scarcely significant.

Table 3

The Cointegration Equation

	GDPPC		C	NDG	SK	SHOC
Coefficient	1	=	8.47	–0.33	0.34	0.17
t-statistic			*(31.14)*	*(–6.88)*	*(11.17)*	*(5.08)*

Cointegration coefficients (β matrix in equation (40)) turned out to be significant and held also the expected signs; after coefficients are normalized, and taking GDPPC as the dependent variable, the expression representing equation (37) of the Augmented Solow Model is obtained, as shown in Table 3.

Deviations with respect to this long run equilibrium relationship are stationary as shown by Table 4 in which the hypothesis of unit root is rejected at a 1 per cent significance level both by the Augmented Dickey-Fuller and Phillip-Perron Tests:[38]

Table 4

Augmented Dickey-Fuller and Phillip-Perron Tests

Level	ADF Stat.*	PP Stat.*
Coint. Eq.	–2.710985	–7.881003

* Unit root rejected at 1 per cent.

As short-run disequilibria are incorporated by the Error Correction Model via an "error correction vector", their actual impact upon endogenous variables is in turn determined by coefficients included in matrix α (equation (40)) standing for the adjustment speed. Table 5 shows the estimation's outcome.

The first column standing for matrix α, vector in this case, reveals that the speed of adjustment coefficients for both the gross domestic product and variable NDG are significantly different from zero, thus confirming the existence of an error correction vector. The following four columns (*endogenous variables*) represent matrix π_1 corresponding to the endogenous variables' first lag; finally, the last two columns stand for the vector of constant terms and dummies for year 2002 respectively.

Once the econometric estimation of coefficients is performed, tools provided by "innovation accounting" allow to assess the used model's adequacy, therefore the consideration of some impulse response functions (complete graphical detail in Annex 2) is accompanied by a variance decomposition analysis.[39] In the first place, Figure 8 highlights variables' response to a positive innovation in the average propensity to invest in human capital (inclusive of opportunity costs).

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[38] The amount of lags used resulted from the Schwarz Information Criterium (see Table 8 in Annex 3).

[39] For IRF and Variance Decomposition the Cholesky Decomposition was resorted to with the following imposed variable ordering: SHOC-SK-NDG-GDPPC.

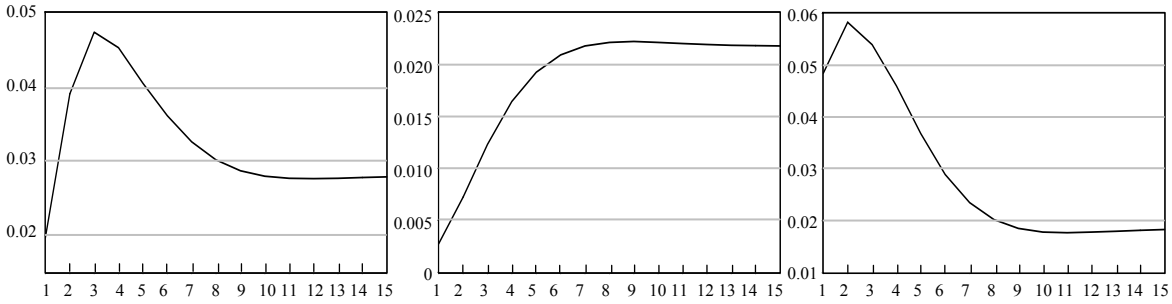
Table 5

	(α_i)	Endogenous Variables				Exogenous	
	$C.Eq_{t-1}$	$\Delta GDPPC_{t-1}$	ΔNDG_{t-1}	ΔSK_{t-1}	ΔSH_{t-1}	C	$D02$
$\Delta GDPPC_t$	**–1.002**	**0.3**	–1.3	–0.18	0.027	0.009	–0.19
	(–6.13)	***(2.13)***	*(–0.19)*	*(–1.79)*	*(0.34)*	*(0.54)*	*(–2.84)*
ΔNDG_t	**–0.011**	**0.008**	**0.76**	–0.003	0.0003	–0.0004	–0.001
	(–5.70)	***(4.96)***	***(9.56)***	*(–2.74)*	*(0.37)*	*(–2.06)*	*(–1.22)*
ΔSK_t	0.49	0.23	–24.43	0.19	0.088	–0.033	–0.34
	(1.51)	*(0.83)*	*(–1.84)*	*(0.92)*	*(0.57)*	*(–1.08)*	*(–2.49)*
ΔSH_t	0.46	**0.97**	–7.29	**–0.4**	0.24	0.003	–0.2
	(1.38)	***(3.41)***	*(–0.53)*	***(–1.95)***	*(1.52)*	*(0.08)*	*(–1.37)*

* *t*-statistics in parentheses.

Figure 8

Response to Cholesky One S.D. Innovations
Response of GDPPC, NDG and SK to shocks in SHOC[40]



As expected, gross domestic product's response to increases in the rate of expenditure in Education is positive and particularly greater in the first periods following the shock. The positive reaction of *NDG vis-à-vis* a *SHOC* innovation may be indicating that rises in the rate of investment in education somehow leads to more units of effective labour, as Mankiw *et al.* (1992) stated it in the Augmented Solow Model. Finally, *SK* also reacts in a positive way to a sudden rise in SHOC, which seems to suggest a sort of complementarity feature between both productive factors; nevertheless, the feature reverts when the impact on SH of a shock in SK (Figure 9) is considered, as in this sequence the negative response seems to indicate substitutability between both factors which deserves at least a further analysis.

[40] The used software EViews does not graphically show confidence intervals for the impulse response functions.

Figure 9

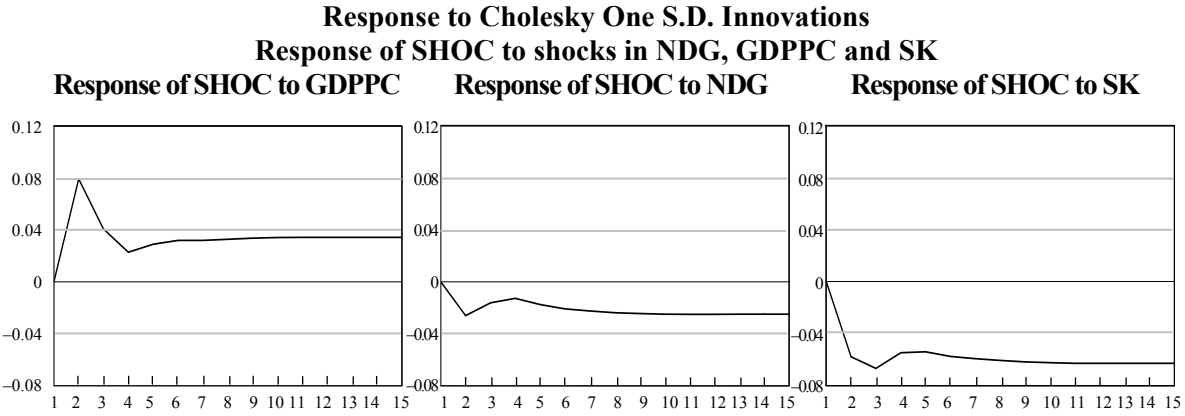
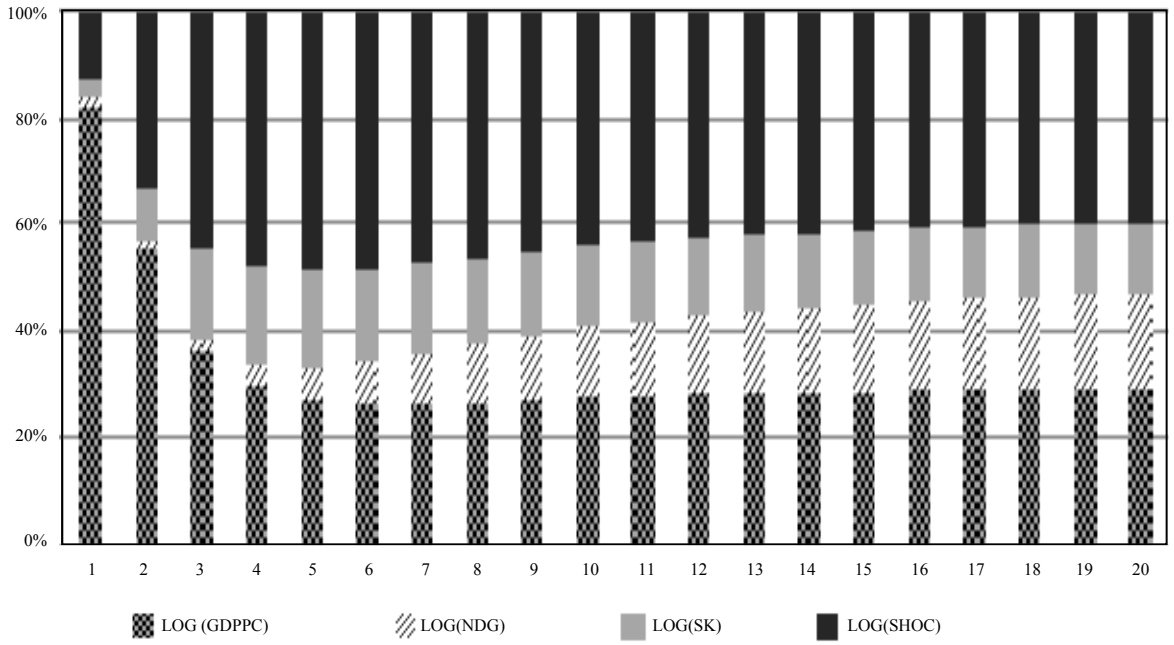


Figure 10



In completing the analysis of graphs in Figure 9, the expected positive response of SH to innovations in GDPPC reflects not only the common sense perception that societies will raise their demand for human capital formation as income per capita increases but, and for the Argentine case, the parliamentary decision that budgetary spending in Education should gradually reach 6 per cent points of GDP.

The recourse to variance decomposition permits in turn to ascertain the extent to which more relevant variables' total variance is explained by their own variance as compared to explanation

given by other variables' variance. In order to illustrate the preceding statement, Figure 10 is used to show variance decomposition in the case of GDPPC.[41]

In spite that both impulse response functions and variance decomposition reveal that human capital investment (measured here as investment in Education) somehow impact upon gross domestic product, values for the Granger Causality Test for the GDPPC equation (shown in Table 6) run counter the preceding evidence since, only for the case of average propensity to invest in physical capital, the hypothesis that the s_k does not cause gross domestic product is rejected at/for a 10 per cent significance level (that is, SK Granger Causes GDPPC), whereas the non-causality hypothesis cannot be rejected for the rest of variables. Therefore, for the case expected to entail policy implications, preliminary results show that SHOC does not Granger-Cause GDPPC.[42]

Table 6

VEC Granger Causality/Block Exogeneity Wald Test

Dependent variable: D(GDPPC)

Excluded	Chi-sq	df	Prob.
D(NDG)	0.039624	1	0.8422
D(SK)	3.230270	1	0.0723
D(SHOC)	0.168026	1	0.6819
All	3.601399	3	0.3078

On the other side, it can be noticed that both GDPPC and SK Granger Caused SHOC (see Annex 3, Table 10), which is not an unexpected outcome regarding GDPPC, due to the already quoted parliamentary acts mandating that educational spending should gradually reach a percentage of product.

In conclusion, cointegration analysis and the error correction model enabled the empirical study to be carried out even though the involved variables were not stationary, and permitted also to verify the existence of a long run equilibrium relationship between gross domestic product and average propensities to invest in physical and human capital and population growth rate.

Furthermore, the error correction model with one lag permitted to find short run relations the most notable being the one between product and s_h which, conversely to what was expected and suggested by the Augmented Solow Model, indicated inverse causality; that is, from product towards SHOC but not from the latter to the former variable.

Nevertheless, impulse response functions as well as variance decomposition analysis do show a human capital participation or impact upon the trajectory of product due to the incorporation of a cointegration equation in the model.

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41 Fort the rest of variables, variance decomposition is shown in graphs of Annex 4.

42 Although model included only one lag, Granger-causality was not reverted when it was allowed to include a larger amount of lags (see Granger-Causality Test in Annex 3, Table 10).

It is also worth pointing out, as a final comment, that residuals are normally distributed and that no heteroskedasticity was found when the joint test was performed; some point problems of autocorrelation were however detected. Test results are shown by Tables 11, 12 and 13 in Annex 3.

6 Preliminary conclusions

The proposed methodology allowed a new way of computing the series of marginal propensity to invest in human capital and of human capital stock in Argentina, which were later used in estimating the key equations of the Augmented Solow Model. One key aspect of the new methodology was that the variable standing for human capital formation (represented by Investment in Education) also included opportunity costs.

Given the econometric problems caused by variables' non stationarity feature, usual estimation procedures were discarded and alternative approaches, such as cointegration and the Error Correction Model, including lags and dummies, were resorted to. Results identified cointegration equations denoting in turn the existence of long run equilibrium relations among variables; in this connection, variables' coefficients showed the expected signs and were, in all cases, significantly different from zero.

Econometric estimates also exceeded the usual tests for specific problems. Traces of autocorrelation found in some of estimations remains as a point to be dealt with, although at this stage they did not affect results' soundness.

The Granger causality test did not indicate the expected sequence of causality between the average propensity to invest in human capital and the gross domestic product, but it did it in the opposite direction; that is, a change in human capital investment measured as public expenditure on education plus the opportunity cost, did not necessarily cause Argentine GDP to experience – in contemporaneous or subsequent periods – variations of the same sign.

Econometric results showing that per capita gross domestic product caused average propensity to invest in human capital, but not the other way round as suggested by empirical findings of the Augmented Solow Model, had also been sufficiently backed by the evidence yielded by stylized facts, which showed that in Argentina (and particularly as of 2003 when the Financiamiento Educativo law was enacted) investment in education was practically a function of income.

It follows from the above that although the formation of human capital (in part represented here by Expenditures in Education) grew substantially during the study period, there seemed not to exist a clear relationship between the characteristics and effectiveness of spending programmes and the needs of the country's productive technological matrix.

Innovation accounting tools, which include impulse response functions and variance decomposition analysis, were used in order to assess the adequacy of the model. VAR impulse response functions highlighting the response of GDP to shocks in average propensities to invest in physical and human capital appeared to be significantly different from zero, particularly in the early years following the innovations, in spite that what resulted from Granger Causality Tests.

Variance decomposition that shows the proportion of the movements in the sequence of a variable that is caused by its own shocks, versus shocks to the other variables, also yielded consistent results. Suffice it to point out here that despite different orderings imposed to the respective variables in Choleski decomposition, impulse response functions and variance decomposition yielded relatively similar results.

Bearing in mind the original objective of studying the link between human capital formation (represented here as investment in education) and economic growth, and of empirically assessing whether human capital helped enhancing the Argentine gross domestic product, it can be preliminary stated, in the light of commented results, that either it did not or it did it in a minor magnitude.

Although reasons for that were not sufficiently considered in the present study, it might be suggested that the nature, structure and design of current fiscal policies were in this field nor efficient neither efficacious to achieving human capital's greater contribution to product.

ANNEX 1

Argentine Macroeconomic Series

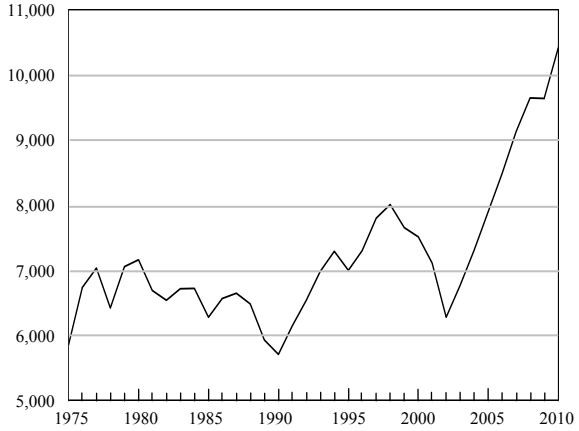
YEAR	GDPPC	NDG	SK	SH	SHOC	HOCPC
1970	7715.9264	0.1253	0.1997	0.0190	0.0470	
1971	7785.5126	0.1264	0.2105	0.0203	0.0526	
1972	7761.8169	0.1271	0.2100	0.0217	0.0526	
1973	9059.4481	0.1273	0.1641	0.0230	0.0558	
1974	8677.9784	0.1271	0.1752	0.0207	0.0693	
1975	5843.8484	0.1264	0.2564	0.0184	0.0825	
1976	6724.6234	0.1257	0.2422	0.0202	0.0453	
1977	7024.7289	0.1253	0.2761	0.0219	0.0435	
1978	6408.1012	0.1250	0.2600	0.0237	0.0412	1647.4577
1979	7045.6543	0.1250	0.2488	0.0254	0.0436	1563.9050
1980	7151.8987	0.1251	0.2544	0.0347	0.0522	1546.5807
1981	6678.3653	0.1253	0.2281	0.0304	0.0491	1491.0020
1982	6528.7571	0.1254	0.1840	0.0212	0.0414	1392.5059
1983	6709.6411	0.1254	0.1770	0.0213	0.0521	1388.3534
1984	6712.7158	0.1252	0.1671	0.0232	0.0622	1466.9411
1985	6270.0715	0.1250	0.1514	0.0353	0.0651	1540.4293
1986	6558.0232	0.1249	0.1583	0.0379	0.0657	1623.7858
1987	6636.7852	0.1249	0.1741	0.0340	0.0647	1692.6675
1988	6469.4241	0.1247	0.1698	0.0301	0.0553	1680.7746
1989	5921.0672	0.1244	0.1434	0.0171	0.0378	1544.7039
1990	5695.0102	0.1240	0.1222	0.0257	0.0349	1402.9336
1991	6130.8974	0.1237	0.1456	0.0341	0.0508	1377.9094
1992	6529.2661	0.1235	0.1789	0.0347	0.0476	1349.4917
1993	6972.9608	0.1232	0.1906	0.0366	0.0532	1379.4880
1994	7286.3332	0.1228	0.2047	0.0368	0.0581	1460.0144
1995	6992.3066	0.1224	0.1831	0.0389	0.0615	1543.1614
1996	7291.4349	0.1220	0.1889	0.0371	0.0589	1623.7531
1997	7792.3407	0.1216	0.2056	0.0385	0.0595	1733.5769
1998	8002.2277	0.1213	0.2110	0.0384	0.0626	1864.8330
1999	7647.7994	0.1209	0.1908	0.0428	0.0700	1999.7494
2000	7507.9856	0.1206	0.1792	0.0442	0.0735	2116.5662
2001	7105.0514	0.1201	0.1581	0.0465	0.0786	2216.1276
2002	6270.3354	0.1197	0.1128	0.0363	0.0660	2161.5160
2003	6760.6361	0.1194	0.1432	0.0360	0.0645	2124.0208
2004	7302.3836	0.1194	0.1765	0.0377	0.0790	2212.4454
2005	7897.0342	0.1196	0.1984	0.0417	0.0919	2418.6531
2006	8481.6154	0.1198	0.2161	0.0465	0.0995	2700.1878
2007	9126.0902	0.1199	0.2260	0.0478	0.1009	3010.3028
2008	9647.4593	0.1199	0.2309	0.0507	0.1018	3332.1291
2009	9635.2292	0.1198	0.2057	0.0527	0.1085	3663.9004
2010	10418.0894	0.1196	0.1822	0.0606	0.1114	4049.2467

Sources:
Gross Domestic Product: National Institute of Statistics and Censuses.
Gross Investment in Physical Capital: ECLAC STATS, Argentine Direction of National Accounts.
Consolidated budgetary educational expenditure and spending in science and technology: Direction for the Analysis of Public Spending and Social Programmes, Ministry of Economy of Argentina.
Consumer Price Index: National Institute of Statistics and Censuses and Statistics Direction, Province of San Luis, Argentina.
Population: National Institute of Statistics and Censuses.
Working Age Population: ECLAC, ILO.
Legal Minimum Wage: Ministry of Labour and Social Security.
Population enrolled in primary and secondary school and in universities: UNESCO.
Percentage of working age population over population in school age (secondary level): Argentine National Censuses.
University students having (not having) jobs and defraying (not defraying) their career and maintenance costs: Permanent Household Survey and information provided by the National Universities of Córdoba and La Plata.

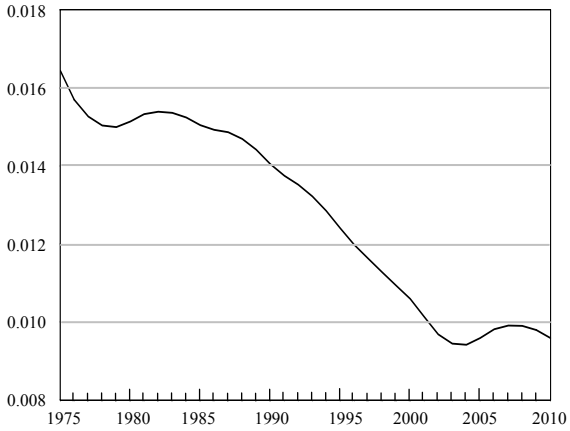
ANNEX 2

Argentina – Graphs in Levels of Macroeconomics Series

Per Capita Gross Domestic Product

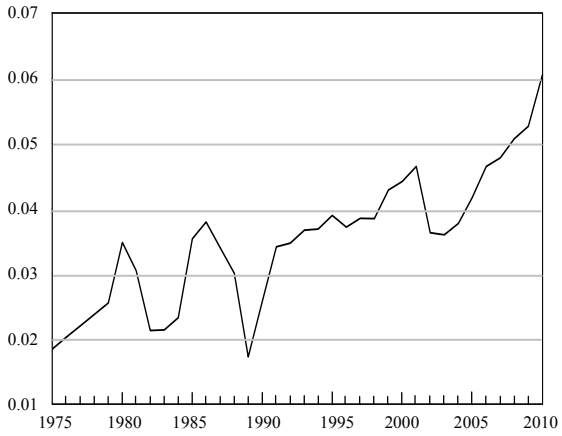


NDG

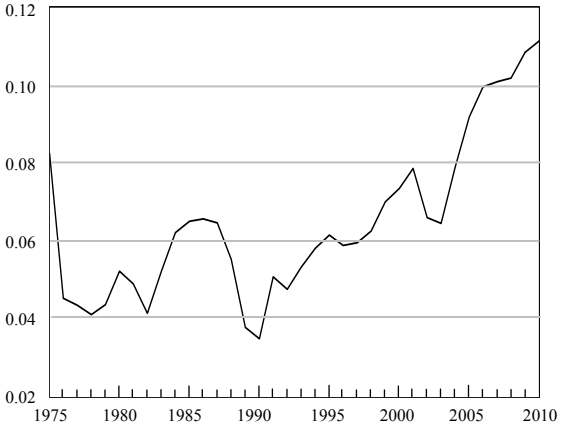


Average Propensity to Invest in Physical Capital

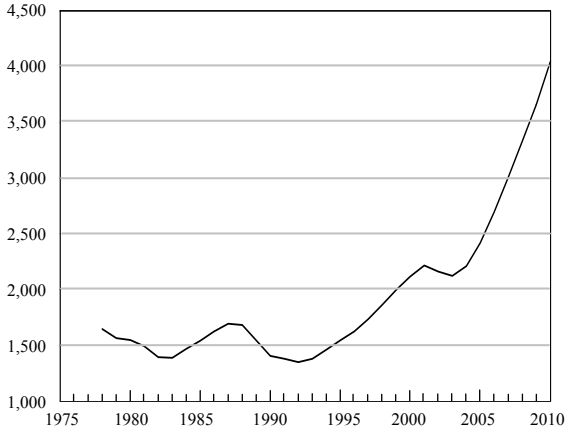
Average Propensity to Invest in Human Capital
(only public investment)



Average Propensity to Invest in Human Capital
(inclusive of opportunity costs)



Per Capita Human Capital Stock
(inclusive of opportunity costs)



ANNEX 3
ECONOMETRIC TESTS

Table 7

Unit root test for Per Capita Human Capital Stock
Augmented Dickey-Fuller test for Per Capital Human Capital Stock
(inclusive of opportunity cost)

Null Hypothesis: HOCPC has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic – based on SIC, maxlag=8)

		***t*-Statistic**	**Prob.***
Augmented Dickey-Fuller test statistic		2.489400	1.0000
Test critical values:	1% level	–3.670170	
	5% level	–2.963972	
	10% level	–2.621007	

* MacKinnon (1996) one-sided *p*-values.

Augmented Dickey-Fuller test for First Difference of Per Capital Human Capital Stock
(inclusive of opportunity cost)

Null Hypothesis: D(HOCPC) has a unit root
Exogenous: None
Lag Length: 1 (Automatic – based on SIC, maxlag=8)

		***t*-Statistic**	**Prob.***
Augmented Dickey-Fuller test statistic		–0.688838	0.4100
Test critical values:	1% level	–2.644302	
	5% level	–1.952473	
	10% level	–1.610211	

* MacKinnon (1996) one-sided *p*-values.

Augmented Dickey-Fuller test for First Second of Per Capital Human Capital Stock
(inclusive of opportunity cost)

Null Hypothesis: D(HOCPC,2) has a unit root
Exogenous: None
Lag Length: 0 (Automatic – based on SIC, maxlag=8)

		***t*-Statistic**	**Prob.***
Augmented Dickey-Fuller test statistic		–3.724724	0.0005
Test critical values:	1% level	–2.644302	
	5% level	–1.952473	
	10% level	–1.610211	

* MacKinnon (1996) one-sided *p*-values.

Table 8

Unit Root Test for Cointegration Equation Residuals
Augmented Dickey-Fuller Test for CEq residuals

Null Hypothesis: CE has a unit root
Exogenous: None
Lag Length: 1 (Automatic – based on SIC, maxlag=9)

		***t*-Statistic**	**Prob.***
Augmented Dickey-Fuller test statistic		–2.710985	0.0082
Test critical values:	1% level	–2.634731	
	5% level	–1.951000	
	10% level	–1.610907	

* MacKinnon (1996) one-sided *p*-values.

Phillips-Perron Test for CEq residuals

Null Hypothesis: CE has a unit root
Exogenous: None
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. *t*-Stat.	**Prob.***
Phillips-Perron test statistic		–7.881003	0.0000
Test critical values:	1% level	–2.632688	
	5% level	–1.950687	
	10% level	–1.611059	

* MacKinnon (1996) one-sided *p*-values.

Residual variance (no correction)	0.003609
HAC corrected variance (Bartlett kernel)	0.007622

Table 9

ECM Tests

Error Correction	**D(LOG(GDPPC))**	**D(LOG(NDG))**	**D(LOG(SK))**	**D(LOG(SHOC))**
R^2	0.620383	0.840351	0.324847	0.510517
Adj. R^2	0.541842	0.807320	0.185161	0.409244
Sum sq. resids	0.113939	0.001847	0.478804	0.497416
S.E. equation	0.062681	0.007981	0.128493	0.130967
F-statistic	7.898804	25.44145	2.325541	5.041027
Log likelihood	52.51918	126.7142	26.67790	25.99146
Akaike AIC	–2.528843	–6.650789	–1.093217	–1.055081
Schwarz SC	–2.220937	–6.342882	–0.785310	–0.747175
Mean dependent	0.005077	–0.016042	0.001096	0.013190
S.D. dependent	0.092604	0.018182	0.142346	0.170395
Determinant resid covariance (dof adj.)		3.50E-11		
Determinant resid covariance		1.47E-11		
Log likelihood		244.6247		
Akaike information criterion		–11.81249		
Schwarz criterion		–10.40491		

Table 10

Granger Causality Test

VEC Granger Causality/Block Exogeneity WaldTests
Date: 08/07/12 Time: 10:08
Sample: 1975 2010
Included observations: 36

Dependent variable: D(GDPPC)

Excluded	Chi-sq.	Df	Prob.
D(NDG)	0.039624	1	0.8422
D(SK)	3.230270	1	0.0723
D(SHOC)	0.168026	1	0.6819
All	3.601399	3	0.3078

Dependent variable: D(NDG)

Excluded	Chi-sq.	Df	Prob.
D(GDPPC)	15.96479	1	0.0001
D(SK)	3.704779	1	0.0543
D(SHOC)	0.118192	1	0.7310
All	17.88140	3	0.0005

Dependent variable: D(SK)

Excluded	Chi-sq.	Df	Prob.
D(GDPPC)	0.713625	1	0.3982
D(NDG)	3.141984	1	0.0763
D(SHOC)	0.222395	1	0.6372
All	3.313999	3	0.3457

Dependent variable: D(SHOC)

Excluded	Chi-sq.	Df	Prob.
D(GDPPC)	12.48611	1	0.0004
D(NDG)	0.476580	1	0.4900
D(SK)	4.269784	1	0.0388
All	13.63916	3	0.0034

Table 11

Normality Test

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 08/15/12 Time: 14:47
Sample: 1975 2010
Included observations: 36

Component	Skewness	Chi-sq.	df	Prob.
1	0.046288	0.012856	1	0.9097
2	–0.209914	0.264384	1	0.6071
3	0.397369	0.947411	1	0.3304
4	–0.202659	0.246425	1	0.6196
Joint		1.471075	4	0.8318

Component	Kurtosis	Chi-sq.	df	Prob.
1	2.942689	0.004927	1	0.9440
2	3.165719	0.041194	1	0.8392
3	2.975202	0.000922	1	0.9758
4	3.010935	0.000179	1	0.9893
Joint		0.047223	4	0.9997

Component	Jarque-Bera	Df	Prob.
1	0.017783	2	0.9911
2	0.305579	2	0.8583
3	0.948333	2	0.6224
4	0.246604	2	0.8840
Joint	1.518298	8	0.9924

Table 12

Heteroskedasticity Test

VEC Residual Heteroskedasticity Tests: Includes Cross Terms
Date: 08/15/12 Time: 14:48
Sample: 1975 2010
Included observations: 36

Joint test:					
Chi-sq	Df	Prob.			
221.1420	210	0.2854			
Individual components:					
Dependent	R^2	$F(21,14)$	**Prob.**	**Chi-sq.(21)**	**Prob.**
res1*res1	0.386844	0.420604	0.9645	13.92637	0.8727
res2*res2	0.506948	0.685455	0.7890	18.25012	0.6331
res3*res3	0.798639	2.644144	0.0330	28.75102	0.1201
res4*res4	0.460111	0.568154	0.8828	16.56399	0.7372
res2*res1	0.392246	0.430269	0.9608	14.12086	0.8644
res3*res1	0.689491	1.480342	0.2275	24.82166	0.2550
res3*res2	0.594404	0.977004	0.5318	21.39853	0.4348
res4*res1	0.472714	0.597669	0.8610	17.01770	0.7100
res4*res2	0.673155	1.373037	0.2744	24.23358	0.2819
res4*res3	0.568793	0.879383	0.6154	20.47656	0.4913

Table 13

Autocorrelation Test

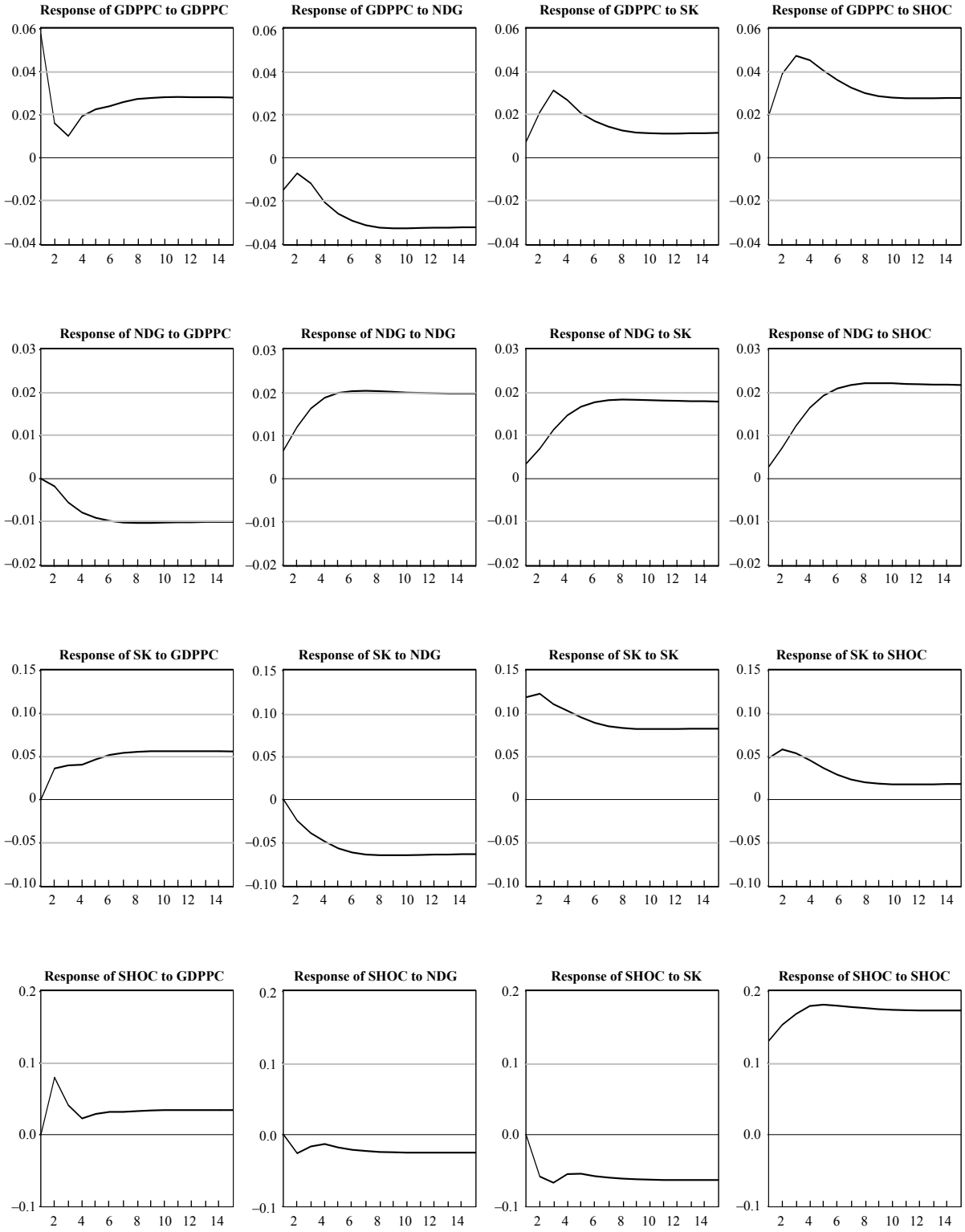
VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 08/15/12 Time: 14:50
Sample: 1975 2010
Included observations: 36

Lags	**LM-Stat.**	**Prob.**
1	51.97732	0.0000
2	25.25147	0.0655
3	22.28609	0.1342
4	12.98071	0.6742
5	14.12149	0.5897
6	28.47514	0.0277
7	24.30961	0.0830
8	17.28722	0.3673

Probs from chi-square with 16 df.

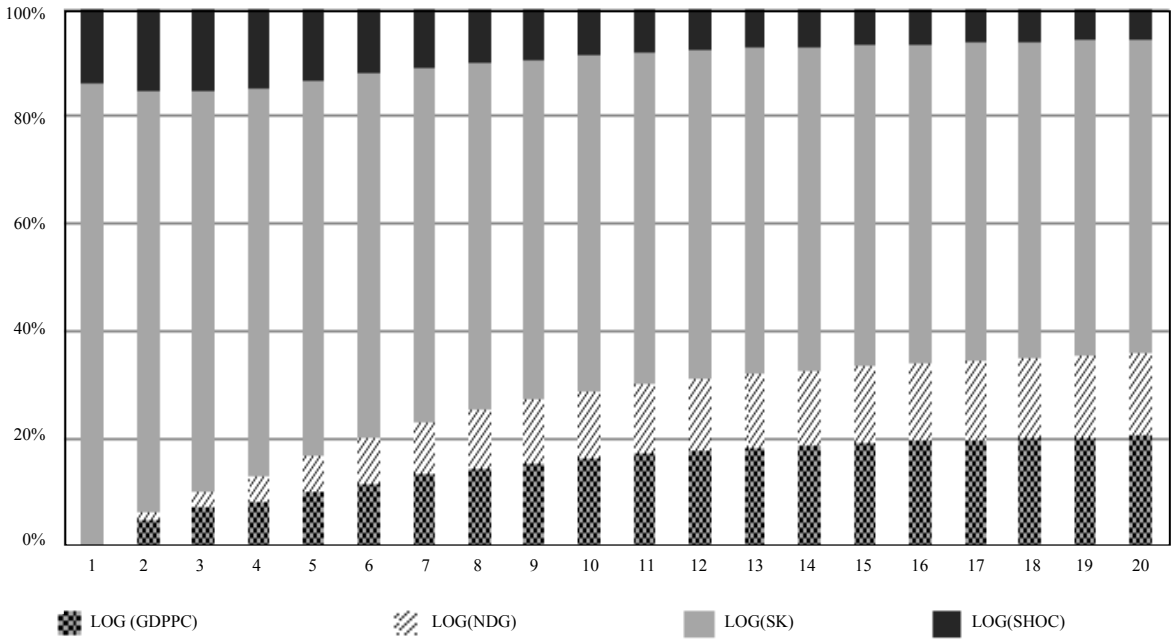
ANNEX 4
IMPULSE RESPONSE FUNCTION AND VARIANCE DECOMPOSITION

Impulse Response Functions
Response to Cholesky One S.D. Innovations



Variance Decomposition of Average Propensity to Invest in Physical Capital

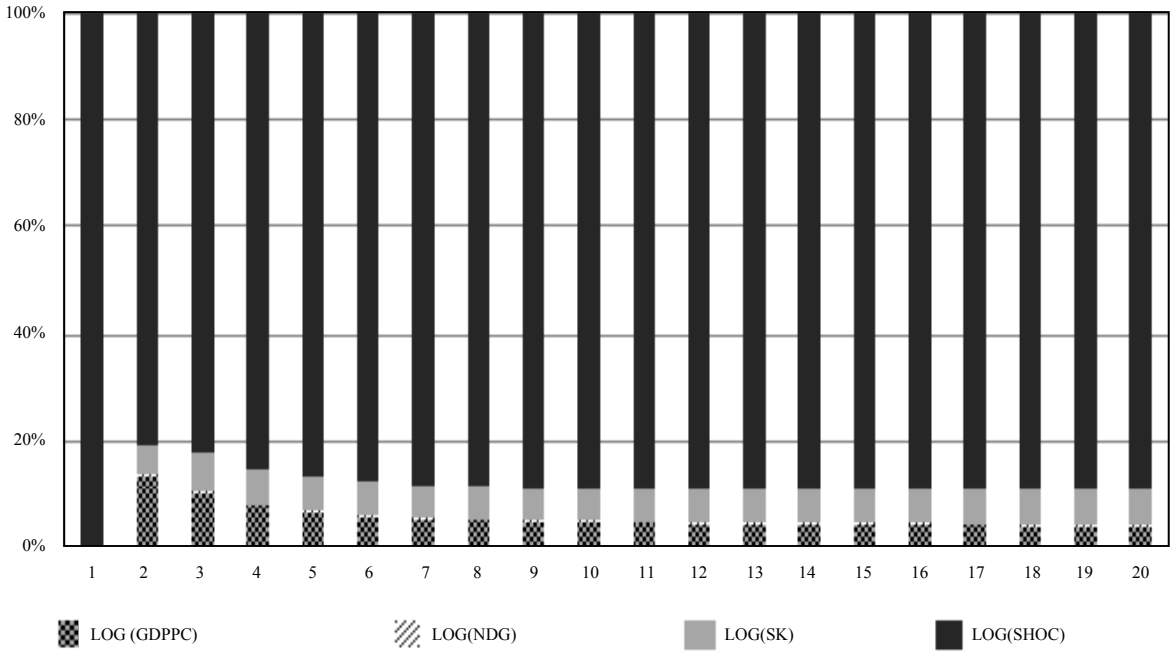
SK



Variance Decomposition of Average Propensity to Invest in Human Capital

(inclusive of opportunity costs)

SHOC



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PUBLIC DEBT AND ECONOMIC GROWTH: A QUICK LOOK AT THRESHOLD EFFECTS

Balázs Égert[*]

1 Introduction

The 2007-08 financial and economic crisis principally caused by the collapse of the US subprime market triggered economic recession in many countries. Governments and central banks of the developed world swiftly reacted by implementing substantial fiscal and monetary policy easing, coupled with State aid to the troubled financial sector. These actions no doubt helped contain the Great Recession but pro-cyclical discretionary fiscal expansion and the banking sector bail-outs led to an unprecedented rise in public debt-to-GDP ratios. Against this backdrop, Reinhart and Rogoff (2010) argued that an excessively high public debt (as a share of GDP) hampers economic activity. On the basis of descriptive statistics, they showed that there was a tipping point at 90 per cent of GDP: economic growth slows down sharply if the debt-to-GDP ratio exceeds 90 per cent of GDP. A number of recent papers investigated this issue and used more advanced statistical methods to analyse the non-linear negative relation between growth and public debt. Indeed, Cecchetti *et al.* (2011) find a threshold of about 85 per cent of GDP. Kumar and Woo (2010), Checherita and Rother (2010) and Baum *et al.* (2012) confirm the 90 per cent threshold.

The ambition of this note is to take a quick look at how robust the 90 per cent threshold is. In doing so, we use a subset of a variant of the Reinhart-Rogoff dataset. We estimate the bivariate relationship between growth and debt (and lagged debt) in a two-regime threshold model for a variety of thresholds. We also perform a robustness check of the 90 per cent threshold by jackknifing the sample, *i.e.*, dropping one country from the sample at a time. We find that the threshold may be different from 90 per cent, that it varies a lot whether we use contemporaneous or lagged debt and that the negative impact of debt on growth is sensitive to outlier observations.

2 Data and estimation issues

The main evidence in Reinhart and Rogoff (2010) is based on a sample of 20 industrialised countries for the period from 1946 to 2009. For this reason, we use in this note this subset of the Reinhart and Rogoff dataset. Reinhart and Rogoff (2010) do not give the sources of the data they use in their paper. But data on central government debt can be obtained from the data appendix of Reinhart and Rogoff (2011). Real GDP growth rates are available for a number of countries for the same time period from the Barro-Ursúa macroeconomic dataset (Barro and Ursúa, 2011). Matching these two datasets helps us reproduce the Reinhart and Rogoff dataset. The difference between their data and our dataset is that our data does not include Ireland but contains data for Switzerland. A marginal difference is that our dataset ends in 2010, while the data used in Reinhart and Rogoff (2010) stops in 2009. Table 1 below gives the differences.

Our estimation approach involves two steps. First, we estimate the linear bivariate relation between growth and debt (equation 1) and then go on to estimate threshold models (equation 2) with tipping points at 10, 15, 20, …, 90, 95, 100 per cent, …, 180 per cent of GDP).

$$\Delta y_t = \alpha + \beta\, debt_t + \varepsilon_t \qquad (1)$$

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The usual disclaimer applies.

Table 1

Data Coverage: Reinhart and Rogoff (2010) Versus the Dataset Used in the Paper

Country	Reinhart and Rogoff (2010)	Our Dataset, Which Uses Data from Reinhart and Rogoff (2011) for the Level of Central Government Debt and Barro and Ursúa (2012) for Real GDP Growth
Australia	1902-2009	1861-2009
Austria	1880-2009	1880-2009
Belgium	1835-2009	1847-2009
Canada	1925-2009	1871-2009
Denmark	1880-2009	1880-2009
Finland	1913-2009	1914-2009
France	1880-2009	1880-2009
Germany	1880-2009	1880-2009
Greece	1884-2009	1848-2009
Ireland	1949-2009	-
Italy	1880-2009	1862-2009
Japan	1885-2009	1872-2009
Netherlands	1880-2009	1814-2009
New Zealand	1932-2009	1831-2009
Norway	1880-2009	1880-2009
Portugal	1851-2009	1851-2009
Spain	1850-2009	1850-2009
Sweden	1880-2009	1801-2009
Switzerland	-	1880-2009
United Kingdom	1830-2009	1831-2009
USA	1790-2009	1791-2009

$$\Delta y_t = \begin{cases} \alpha_1 + \beta_1 \cdot debt_t + \varepsilon_t & if \quad debt < T \\ \alpha_2 + \beta_2 \cdot debt_t + \varepsilon_t & if \quad debt \geq T \end{cases} \tag{2}$$

where Δy is annual real GDP growth, *debt* stands for the central government debt-to-GDP ratio and T is the value of the debt threshold (10, 15, 20, …, 90, 95, 100, …, 180 per cent of GDP). Equations (1) and (2) are estimated for a pooled panel and with country fixed effects and for contemporaneous and lagged debt. Finally, equation (2) for the debt threshold equalling 90 per cent is jackknifed: one country is dropped from the sample at a time.

3 Estimation results

Linear bivariate panel regressions show a negative link between growth and public debt but this effect does not seem to be statistically significant (Table 2). When imposing a threshold of 90 per cent of public debt, the estimation results show that the contemporaneous relation between growth and debt is strongly negative if public debt is lower than 90 per cent of GDP, whereas the relation breaks down above that threshold. Carrying out the estimations using alternative threshold values (from 10 to 180 per cent of GDP by steps of 5 per cent) does not change this picture: the coefficient estimates are never statistically significant in the upper regime (in which observed debt is above the debt threshold). In addition, in the range from 25 to 55 per cent of GDP, the coefficient estimates are not different from zero in any of the two regimes. Let us now pick the model from the many estimated models, which seems to fit best the underlying data. The models, which minimise the Schwarz and Akaike information criteria and for which the adjusted R-squared is the highest, are the ones with threshold values of 170 and 175 per cent of GDP. These results basically imply an almost linear relationship given that most observations for public debt are below these thresholds.

To check the robustness of the results, we re-estimated the same models using lagged public debt as a right-hand side variable (Table 2). The results are markedly different. First, for the 90 per cent threshold, the coefficient estimates are not only negative but also statistically significant in both regimes, even though they are very similar in size. Second, for turning points higher than 135 per cent of GDP, the coefficient estimate in the upper regime becomes insignificant. Finally, the threshold is at 20 per cent of GDP for the model for which the information criteria are the lowest and the adjusted R-squared the highest. This is quite different from the 170-175 per cent threshold finding. In addition, there is a positive relation between debt and growth below 20 per cent and it becomes negative only above this threshold.

In a second step, we jackknife the sample for the model with a 90 per cent debt threshold. Table 3 shows the sensitivity of the results to specific countries. In particular, if the Netherlands is taken out from the sample, the coefficient on contemporaneous debt becomes negative and statistically significant in the upper regime, *i.e.* when public debt exceeds 90 per cent of GDP. When lagged debt is used as a right-hand side variable, the results are more robust in terms of statistical significance. In all cases, the coefficients remain negative and significant in both regimes. Nevertheless, it is worth mentioning that the variability in the size of the coefficient estimates (measured by the range between the lowest and highest coefficient estimate) is considerable higher in the upper regime than in the lower regime.

4 Conclusions

The ambition of this note was to provide a quick robustness check with regard to the 90 per cent threshold. Using a subset of a variant of the Reinhart-Rogoff dataset including industrialised countries for 1946 to 2010, we found that the non-linear effect linking growth and public debt is not particularly robust. First, whether there is a strong negative link between growth and debt above 90 per cent and how large it is depends on model specification and the inclusion of specific countries in the sample. Second, a simple model selection shows that the 90 per cent threshold may be considerably lower or higher, depending again on model specification.

Table 2

Estimation Results for Alternative Thresholds, 1946-2010

	Debt					Lagged Debt				
	Pooled Panel		Country Fixed Effects			Pooled Panel		Country Fixed Effects		
Linear model: $\Delta y_t = \alpha + \beta\, debt_t + \varepsilon_t$										
β	–0.007		–0.010			–0.007		–0.010		
Threshold Model: $\Delta y_t = \begin{cases} \alpha_1 + \beta_1 \cdot debt_t + \varepsilon_t & if \quad debt < T \\ \alpha_2 + \beta_2 \cdot debt_t + \varepsilon_t & if \quad debt \geq T \end{cases}$										
T	β_1	β_2	β_1		β_2	β_1	β_2	β_1	β_2	
10% of GDP	0.142 **	–0.004	0.132 *		–0.007	0.094 **	–0.011 **	0.086 *	–0.013 **	
15% of GDP	0.084 *	–0.002	0.067		–0.007	0.045	–0.010 **	0.032	–0.012 **	
20% of GDP	0.083 **	0.001	0.075 *		–0.004	**0.064** **	**–0.006** *	**0.058** **	**–0.009** **	
25% of GDP	0.050	–0.001	0.047		–0.005	0.028 *	–0.008 **	0.026 *	–0.011 **	
30% of GDP	0.028	–0.002	0.031		–0.006	0.003	–0.011 **	0.004	–0.012 **	
35% of GDP	0.014	–0.004	0.015		–0.007	–0.014	–0.013 **	–0.017	–0.015 **	
40% of GDP	0.004	–0.005	0.005		–0.007	–0.014	–0.013 **	–0.016	–0.014 **	
45% of GDP	–0.004	–0.006	0.000		–0.008	–0.019 **	–0.014 **	–0.019 *	–0.015 **	
50% of GDP	–0.009	–0.007	–0.007		–0.009	–0.024 **	–0.014 **	–0.024 **	–0.016 **	
55% of GDP	–0.012	–0.007	–0.014		–0.010	–0.017 **	–0.013 **	–0.019 **	–0.015 **	
60% of GDP	–0.019 *	–0.008	–0.021 *		–0.011	–0.024 **	–0.014 **	–0.026 **	–0.016 **	
65% of GDP	–0.025 **	–0.008	–0.026 **		–0.012	–0.027 **	–0.014 **	–0.027 **	–0.016 **	
70% of GDP	–0.025 **	–0.008	–0.027 **		–0.011	–0.027 **	–0.013 **	–0.027 **	–0.015 **	
75% of GDP	–0.023 **	–0.007	–0.024 **		–0.010	–0.027 **	–0.013 **	–0.026 **	–0.015 **	
80% of GDP	–0.022 **	–0.006	–0.024 **		–0.010	–0.019 **	–0.012 **	–0.017 **	–0.014 **	
85% of GDP	–0.024 **	–0.005	–0.026 **		–0.010	–0.019 **	–0.012 **	–0.017 **	–0.014 **	
90% of GDP	–0.023 **	–0.005	–0.026 **		–0.009	–0.020 **	–0.012 **	–0.019 **	–0.014 **	
95% of GDP	–0.023 **	–0.004	–0.027 **		–0.008	–0.021 **	–0.011 **	–0.020 **	–0.014 **	
100% of GDP	–0.023 **	–0.003	–0.029 **		–0.007	–0.020 **	–0.011 **	–0.021 **	–0.014 **	
105% of GDP	–0.023 **	–0.001	–0.030 **		–0.006	–0.020 **	–0.010 **	–0.022 **	–0.013 **	
110% of GDP	–0.020 **	0.002	–0.028 **		–0.002	–0.018 **	–0.010 **	–0.022 **	–0.011 **	
115% of GDP	–0.020 **	0.003	–0.029 **		0.000	–0.016 **	–0.010 **	–0.020 **	–0.012 **	
120% of GDP	–0.015 **	0.002	–0.024 **		0.000	–0.016 **	–0.010 **	–0.020 **	–0.011 **	
125% of GDP	–0.017 **	0.005	–0.026 **		0.003	–0.017 **	–0.009 *	–0.021 **	–0.009 **	
130% of GDP	–0.017 **	0.007	–0.026 **		0.005	–0.017 **	–0.008 *	–0.021 **	–0.009 *	
135% of GDP	–0.018 **	0.009	–0.027 **		0.007	–0.017 **	–0.007	–0.021 **	–0.009 *	
140% of GDP	–0.018 **	0.011	–0.027 **		0.009	–0.017 **	–0.007	–0.021 **	–0.008	
145% of GDP	–0.018 **	0.011	–0.027 **		0.009	–0.017 **	–0.007	–0.021 **	–0.008	
150% of GDP	–0.018 **	0.012	–0.025 **		0.010	–0.017 **	–0.006	–0.020 **	–0.008	
155% of GDP	–0.017 **	0.013	–0.025 **		0.011	–0.016 **	–0.007	–0.019 **	–0.008	
160% of GDP	–0.017 **	0.013	–0.025 **		0.011	–0.016 **	–0.007	–0.019 **	–0.008	
165% of GDP	–0.016 **	0.018	–0.023 **		0.017	–0.015 **	–0.006	–0.019 **	–0.006	
170% of GDP	**–0.016** **	**0.020**	**–0.024** **		**0.020**	–0.016 **	–0.004	–0.020 **	–0.003	
175% of GDP	**–0.016** **	**0.020**	**–0.024** **		**0.020**	–0.016 **	–0.004	–0.020 **	–0.003	
180% of GDP	–0.015 **	0.024	–0.022 **		0.024	–0.015 **	–0.004	–0.018 **	–0.004	

* and ** denote statistical significance at the 10 and 5 per cent levels, respectively. Shaded cells indicate the models which minimise the Schwarz and Akaike information criteria and for which the adjusted R^2 are the highest.

Table 3

Estimation Results for the Jackknifed Sample (Debt Threshold-90% of GDP), 1946-2010

	Debt								**Lagged Debt**							
	Pooled Panel				**Country Fixed Effects**				**Pooled Panel**				**Country Fixed Effects**			
Threshold Model: $\Delta y_t = \begin{cases} \alpha_1 + \beta_1 \cdot debt_t + \varepsilon_t & if \quad debt < T \\ \alpha_2 + \beta_2 \cdot debt_t + \varepsilon_t & if \quad debt \geq T \end{cases}$, T=90%																
Country Excluded	β_1		β_2		β_1		β_2		β_1		β_2		β_1		β_2	
AUS	–0.025	**	–0.005		–0.028	**	–0.010		–0.025	**	–0.011	**	–0.026	**	–0.015	**
AUT	–0.020	**	–0.003		–0.023	**	–0.008		–0.020	**	–0.008	**	–0.020	**	–0.012	**
BEL	–0.024	**	–0.007		–0.026	**	–0.010		–0.024	**	–0.009	**	–0.024	**	–0.012	**
CAN	–0.022	**	–0.004		–0.027	**	–0.009		–0.022	**	–0.009	**	–0.024	**	–0.013	**
DNK	–0.022	**	–0.005		–0.026	**	–0.009		–0.023	**	–0.010	**	–0.024	**	–0.013	**
FIN	–0.023	**	–0.005		–0.027	**	–0.009		–0.024	**	–0.010	**	–0.025	**	–0.013	**
FRA	–0.021	**	–0.004		–0.024	**	–0.008		–0.021	**	–0.009	**	–0.021	**	–0.012	**
DEU	–0.022	**	–0.004		–0.024	**	–0.008		–0.022	**	–0.009	**	–0.021	**	–0.012	**
GRC	–0.021	**	–0.003		–0.023	**	–0.007		–0.020	**	–0.008	**	–0.021	**	–0.011	**
ITA	–0.024	**	–0.002		–0.026	**	–0.005		–0.024	**	–0.008	**	–0.024	**	–0.010	**
JPN	–0.017	**	0.000		–0.018	**	–0.003		–0.017	**	–0.006	*	–0.015	**	–0.007	*
NLD	–0.028	**	–0.017	**	–0.030	**	–0.024	**	–0.025	**	–0.014	**	–0.024	**	–0.017	**
NZL	–0.023	**	–0.003		–0.029	**	–0.008		–0.021	**	–0.009	**	–0.023	**	–0.013	**
NOR	–0.024	**	–0.005		–0.028	**	–0.010		–0.023	**	–0.010	**	–0.025	**	–0.013	**
PRT	–0.020	**	–0.004		–0.023	**	–0.008		–0.020	**	–0.009	**	–0.020	**	–0.012	**
ESP	–0.022	**	–0.004		–0.026	**	–0.009		–0.022	**	–0.009	**	–0.023	**	–0.013	**
SWE	–0.023	**	–0.005		–0.027	**	–0.009		–0.023	**	–0.010	**	–0.024	**	–0.013	**
GBR	–0.022	**	–0.002		–0.026	**	–0.009		–0.022	**	–0.010	**	–0.024	**	–0.015	**
USA	–0.023	**	–0.003		–0.028	**	–0.008		–0.022	**	–0.009	**	–0.023	**	–0.012	**
CHE	–0.027	**	–0.006		–0.029	**	–0.010		–0.026	**	–0.011	**	–0.024	**	–0.013	**
MIN	**–0.028**		**–0.017**		**–0.030**		**–0.024**		**–0.026**		**–0.014**		**–0.026**		**–0.017**	
MAX	**–0.017**		**0.000**		**–0.018**		**–0.003**		**–0.017**		**–0.006**		**–0.015**		**–0.007**	

* and ** denote statistical significance at the 10 and 5 per cent levels, respectively.

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FISCAL POLICIES ENHANCING GROWTH IN EUROPE: CAN WE APPLY COMMON REMEDIES TO DIFFERENT COUNTRIES?

Carine Bouthevillain[*] *and Gilles Dufrénot*[**]

We provide evidence of heterogeneous reactions of the growth rates in the European Union countries to changes in taxes and public expenditure, when the governments' budget constraint is taken into account. Direct taxation exerts a much more damaging effect on the growth rate of the European emerging countries than on the most industrialized countries'. Indirect taxes are not inconsistent with growth in the latter, while they are harmful in the former. Increases in human capital expenditure stimulate growth in the low-growth countries, while welfare and sovereign spending are efficient for growth in the economies that grow rapidly.

1 Introduction

There is a widespread view in the European economic policy circles that in order to get out of the current economic depression while respecting at the same time the sustainability of their public finances, the European Union countries should implement common fiscal policies. Some people even suggest a fiscal federalism, by comparison with the United States, where a federal budget can be operated to conduct countercyclical policies. This paper argues against such a view. We provide evidence of great heterogeneities among the EU countries regarding the fiscal/growth relationship. We conclude that similar policies cannot work in a similar way in countries that are still experiencing a catch-up dynamics and which experienced the highest growth rates over the last 10 years (the most recent members of the Central and Eastern Europe and some countries such as Spain, Portugal and Ireland) and in countries whose growth rates have been lower (the older members). This conclusion is valid whether or not we consider demographic differences between the countries. For example, welfare and social spending, usually considered in the literature as non-productive, stimulate growth in countries with fast growth, but are harmful on the growth rates of low-growth countries. Tax cuts have stronger positive effects on the growth rate of the emerging economies than on the growth rate of the most industrialized countries. Increases in social security contributions inhibit the growth rates of the low-growth countries, but stimulate the growth rate of countries that are growing fast.

Such differences would not necessarily appear if we tried to link growth to fiscal variables by using aggregate indicators of spending and taxation, for instance, the ratio of total spending out of GDP, or the ratio of total taxes over GDP. Differences among the countries appear once we consider that the European countries face the joint problem of attempting to boost growth while simultaneously tracking a sustainable level of their public finance. This double choice is motivated by the fact that the fiscal policies are coordinated through the implementation of a Stability and Growth Pact which imposes restrictions on the levels of debt and deficits. Therefore, the fiscal/growth link rests on the structure of spending and taxes. For instance, suppose that governments decide to increase welfare spending to conduct countercyclical policies. To guard control on the sustainability of public deficits, they may decide to finance this increase by higher direct or indirect taxes, or to offset the increase in welfare expenditure by a decrease in other spending. In this case, the impact on growth will be different, as compared with a situation in

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which the structure of other spending and taxes are left unchanged, which would mean that higher welfare expenditure would result into a higher deficit. The argument that is put forward in this paper is that the effects of similar fiscal policies can differ across countries, because the economic growths react not only to the amounts of expenditure and revenue, but also to the structure of expenditure and revenue when a budgetary measure is adopted.

In previous papers of the literature, some authors relate the growth rate of the European countries to the structure of taxes and public spending, but they assume that the links are the same across countries. Afonso and Furceri (2010) find that a rise the following components of taxes and expenditures negatively affect growth: indirect taxes, social contributions, subsidies. An important contribution of their paper is the finding that the disaggregated components impact growth when changes occur in both their size and volatility. Nikos (2009) examines whether a reallocation of the components of public spending and revenues in 14 EU countries have enhanced their economic growth between 1990 and 2006. He concludes that government outlays on education, social protection and defense, as well as public expenditures on infrastructures, are growth-enhancing, while distorsionary[1] taxes depress growth. Furceri and Karras (2009) show that increases in social security contributions and in taxes on goods and services have had a larger negative effect on growth in the European countries between 1965 and 2003, than increases in income taxes.[2]

In contrast to these studies, we take in consideration the issue of heterogeneity. Quantile regression analysis provides a useful empirical framework within which we explore the idea of heterogeneous reactions of growth to fiscal policies in the European Union. In such a framework, it is possible to justify that the impact of changes in public spending and taxes varies across the conditional distribution of growth. This is an alternative methodology to the usual ones, either focusing on mean effects, or treating the issue of fiscal/growth heterogeneity by splitting the data into separated groups of countries.[3] Our approach differs from the previous empirical papers in two ways.

The first difference concerns the empirical methodology. Although there is a considerable literature on the fiscal policy/growth relationship, a relatively small amount of this literature is concerned with heterogeneous reactions in terms of growth to the same fiscal policies.[4] To our knowledge, three exceptions are Bassanini and Scapetta (2001), Arnold (2011) and Gemmel *et al.* (2011). These authors use the pooled mean group (PMG) and mean group (MG) estimators introduced by Pesaran *et al*. (1999). Although these estimators are useful in accounting for different slopes across the countries of a panel, the cost of using them is a reduction of the degrees of freedom. Indeed, they are based on an average of the estimates from individual countries regressions. We instead use an estimator that keeps the pooled dimension of the panel while allowing at the same time to deal with the diversity of reactions across the countries: a quantile regression estimator. One advantage is to consider the entire panel and to distinguish the countries by their location in the conditional distribution of growth. Instead of estimating models for conditional means functions, we consider a full range of other conditional quantile functions.

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1 Following the definition given by Kneller *et al.* (1999), distortionary taxes are those which affect the investment decisions of agents (with respect to physical and / or human capital), creating tax wedges and hence distorting the steady-state rate of growth. Non-distortionary taxation does not affect the saving / investment decisions because of the assumed nature of the preference function, and hence has no effect on the rate of growth.

2 There are other examples of papers linking growth to the composition of expenditure and tax structure in other industrialized countries, among which Lee and Gordon (2005), Angelopoulos *et al*. (2007), Gemmel *et al*. (2011).

3 See, for instance Angelopoulos *et al*. (2007), Arnold (2008), Arnold and Schwellnus (2008), Bleany *et al*. (2001), Gemmel *et al*. (2011), Lee and Gordon (2005), Peretto (2003, 2007), Vartia (2008).

4 In a survey of the growth empirics, Eberhart and Teal (2011) note that the possibility of heterogeneous parameters is ignored by a vast majority of studies.

Secondly, unlike many previous studies, we do not only consider estimates of fiscal/growth regressions based on the growth rate of the GDP per capita, but also the growth rate of the real GDP itself in a context where the European governments search to avoid a rise in the burden of public debt. Our approach is motivated as follows. Fiscal policy usually has several objectives. The first is equity. Taxation and expenditure are considered in terms of their ability to impact fairly personal incomes. In this case, using the growth rate of GDP per capita (or a multidimensional welfare indicator) as the endogenous variable is convenient. Previous papers examining the impact of fiscal measures on per capita growth implicitly assume that a higher growth of the real GDP translates into a higher standard of living within and across individuals, on average (but this is an assumption that would need to be proved, since average effects mask potential changes in income distribution). A second concern of fiscal policy is efficiency. This can be defined as the way in which expenditure and taxes "deliver" in terms of the growth rate of the real GDP. For instance, finding a negative elasticity of the latter with respect to welfare expenditure, or direct taxation, might be interpreted as the existence of waste in the public sector inducing inefficiencies in the global activity (the channels yielding such inefficiencies are for instance a lower productivity of the labor supply, a higher wage reservation level, a reduced competitiveness of firms, etc). In this paper, we adopt the interpretation in terms of both efficiency and equity. We thereby consider both the growth rate of the real GDP and the growth rate of per capita GDP.

The remainder of the paper is structured as follows. Section 2 describes the theoretical underpinnings, while section 3 presents the empirical methodology and data. Section 4 contains our estimation results and our comments. Finally, Section 5 concludes.

2 Theoretical underpinnings

In this section, we briefly explain the theoretical framework underlying our empirical equations. Although, we do not present the theoretical models formally, this is important to motivate the choice of our variables as well as some restrictions imposed on some coefficients of our equations. Our empirical framework relies upon two different strands of the theoretical literature on the fiscal/growth link. One is the correlation between growth and the composition of public spending and taxes. The second concerns the effects of fiscal policy on growth with respect to how a public spending or deficit is financed.

2.1 Linking growth to the structure of taxes and the composition of expenditure

The Lisbon strategy puts an emphasis on the efficiency of fiscal policy on the European countries' growth rate. Indeed, the EU member States agreed on improving the contribution of public spending to growth by directing public expenditure towards growth-enhancing investment in both physical and human capital.[5] Besides, in a report published in 2011, the European Commission points to several challenges of tax policy, among which the potential to make the tax structure more growth friendly.[6]

These issues cannot be examined within the first-generation endogenous growth models linking fiscal policy to growth. Indeed, as pointed by Agell *et al.* (2007) and Myles (2000), when the growth effects are apprehended by considering aggregate measures of tax burden and public expenditure, these models only capture the role of government size. In the second-generation

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[5] Wierts (2005) discusses some aspects of redirecting public expenditure under the Lisbon experience.

[6] The report published on October 2011 was entitled "Tax reform in EU member States 201: tax policy challenges for economic growth and fiscal sustainability".

models of endogenous growth the share of different categories of public expenditure and taxes is explicitly taken into account. A fairly simple approach consists in separating public spending between productive and non-productive components and distinguishing between distortionary and non-distortionary taxes. An important conclusion of the papers is that different spend-tax combinations yield different effects on growth. For instance, productive expenditure financed by non-distortionary taxes have a higher effect on growth than when they are financed by distortionary taxes. Another approach, widely used in the growth literature to identify the effects of fiscal policy, is to consider a fine disaggregation of public spending and taxes. On the spending side, it is usual to consider a functional disaggregation of government expenditure: spending on health, education infrastructure, defense, recreation, social protection, etc. On the revenue side, the decomposition of taxes is generally between personal income taxes, corporate income taxes, direct and indirect taxes, taxation of capital gains, etc. A motivation for doing this is that determining the direction of the response of growth to changes in the fiscal variables requires somewhat careful judgment on the transmission channels, for instance through their influence on private production, human capital accumulation, on productivity, or through the diffusion of innovations and network externalities.[7]

There are several findings in the theoretical literature regarding the direction of the different fiscal components on growth. Recommendations for tax policy and government spending from the view of endogenous growth models do not lead to consensual conclusions. In general, the conclusion of the endogenous growth models is that the mechanisms through which the different components of taxes and spending influence growth are diverse, thereby implying that the question of composition of government spending and tax structure on growth remains an open question. For instance, some models support the idea that income taxes are detrimental for growth through the decline of the rate of capital accumulation (see, for instance, Lucas 1990), Easterly and Rebelo 1993). This leads to the policy recommendation that reducing taxes on capital income could lead to increases in growth. However, in some other models, a positive impact on long-run growth of changes in income tax is shown to exist when these taxes are used to finance public services (see Rivas 2003). Another example, government consumption spending has been shown to affect growth alternatively negatively or positively depending upon whether public goods and services enter the households' utility function or whether they enter as inputs in the production function (see Barro 1990, Turnovsky and Fisher 1995, Dhont and Heylen 2008). Myles (2000) provides a literature review of the diversity of theoretical models analyzing tax incidence and its influence on growth. The channels through which taxation can affect growth are many: the elasticity of substitution between capital and labor in production, households' preferences over consumption in different periods of life over the life-cycle, the relationship between capital and the non-taxable factors, the share of physical capital in human capital, the way in which taxes affect risky assets, the proportion of wealth invested in foreign assets, etc.

Given the great variety of theoretical models, the diversity of their predictions regarding the effects of fiscal variable changes on growth, it is unlikely that the same model would illustrate the case of all the EU countries. Further, the balance between the various items of taxes and expenditure vary in each country and across time depending upon the juncture and their priorities. Our aim here is not to test a particular theory. The above brief review of the theoretical literature is useful to shed some light on the fact that, given the wide range of predictions from the theoretical models, imposing a priori common parameters across countries would be restrictive and may result in non robust conclusions.

When the purpose is to test the fiscal policy/growth relationship from the view of the endogenous growth model, whichever the theoretical apparatus, the empirical relationship is very

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[7] See, among others, Zeng and Zhang (2002), Zagler and Durnecker (2003), Blankenau and Simpson (2004), Linneman and schabert (2003), Greiner *et al.* (2005), Agenor and Yilmaz (2011), Peretto (2003, 2007), Semmler *et al.* (2007), Gosh and Gregoriou (2008).

often a linear equation between the growth rate of GDP per capita and the different items of taxes and public spending, for given control variables describing the economic environment. We modify the standard equation by taking into account the distributional heterogeneity of fiscal policy effects on growth. The specific form employed in this paper is the following:

$$\gamma_{it}(\theta) = \sum_{j=1}^{J} \alpha_{1j}(\theta)\Delta\gamma_{it-j} + \sum_{k=1}^{K} \alpha_2(\theta)\Delta F_{it-k} + \sum_{l=1}^{L} \alpha_3(\theta)\Delta X_{it-l} + \upsilon_{it}(\theta) \quad (1)$$

where i indicates a country, t is year, γ is the growth rate of real GDP, F is a vector of fiscal variables, X is a vector of control variables, $\beta_1(\theta)$, $\beta_2(\theta)$, $\alpha_1(\theta)$, $\alpha_2(\theta)$ are vectors of coefficients to be estimated, $\alpha_{1j}(\theta)$, is a lagged coefficient and υ_{it} is an error term.

Equation (1) provides a useful way to deal with the issues discussed above and to confront the predictions of the theoretical models with the experience of the European countries by considering the percentiles of the conditional distribution of the growth rates. The θ^{th} percentile is assumed to vary between 0 and 100 per cent. The idea is to obtain the value of the estimate of the parameter vectors which best fits the impact of the fiscal variables at various points along the conditional distribution of growth. This approach permits a flexibility to capture heterogeneity. Indeed, since we are considering a pooled panel, the percentiles do not only refer to countries but also allow time variation and therefore possible non-monotonic effects of the components of taxes and expenditure on growth. Finally, finding different coefficients according to the percentiles is a way of showing that fiscal changes in the European countries may result in multiple equilibriums both in terms of transitional growth and long-run growth.

2.2 Deficit financing and growth

Given the importance of the government budget constraint in the theoretical models, the influence of a given component of public spending on growth depends on how an increase in this component is financed. A government considering new spending programs must decide on how to raise the necessary revenue. A financing of productive public spending by higher direct taxes will not necessarily results in a positive impact on long-run growth, because of the negative effect of the taxes on the returns of capital. Also, as far as we consider the structure of taxes and the composition of public spending, the final decision is the result of different trade-offs. For instance, cuts in labor income or capital tax might be compensated by increases in indirect taxes; or a government can search to balance an increase in productive expenditure by a decrease in non-productive expenditure. Another example is that any change in a given spending or tax can be decided by maintaining a continuously balance budget, by keeping a constant share of expenditure and taxes in GDP, or alternatively by allowing a higher or lower fiscal balance. Taxes and public policies are thus restricted by the budget constraint.

The implication is that, different financing methods have different effects on the economic growth. In his seminal papers, Harberger (1964a, 1964b) showed that the mix of direct and indirect taxes in a growth-accounting framework has a negligible effect on growth. Mendoza *et al.* (1997) show that this conjecture can be supported within the framework of an endogenous growth model. In standard endogenous growth models, expansionary fiscal spending stimulates economic growth provided that they are financed by lump-sum taxes or by non-distorsionary taxes (see, Devereux and Love 1995, Palivos and Yip 1995). This finding is, however, challenged by Pelloni and Waldman (2000). The authors find that a small amount of capital taxation can increase the growth rate. Barro (1990), Blankeneau and Simpson (2004) show that spending funded by distortionary taxes such as taxes on capital or labor income has a non-monotonic effects: increases in productive spending is growth-enhancing in the short-run, but growth-depressing in the long-run. There are conflicting views in the theoretical literature about the growth implications of a financing of public

spending by public debt. Some authors conclude that the effect is unambiguously positive (for instance Greiner and Semmler 2000). Others reject this finding (Minea and Villieu 2010).

As pointed by Easterly *et al.* (2007), irrespective of the theoretical framework, it is likely that the combination of fiscal variables needed to obtain a positive impact on growth vary across countries and across time depending on a number of structural factors: the initial level of debt, the composition of revenues and taxes, fiscal institutions, different public finance constraints, etc. Again, the issue of heterogeneity is at stake.

What this implies in our case is the following. The government budget constraint can be written by considering the various components of the vector of fiscal variable F as follows:

$$\sum_{n=1}^{N} rev_{it}^{\ n} - \sum_{m=1}^{M} \exp_{it}^{\ m} + b_{it} = 0, \quad i=1,..,I \text{ and } t=1,...,T \tag{2}$$

where *exp* means expenditure and *rev* stands for revenue. We consider M components of public spending and N components of fiscal taxes. b is the budget surplus. As shown in a paper by Bleany *et al.* (1995), not taking into account this constraint when examining the fiscal policy/growth link yields strong biases in growth equations. Further, since the different components of the fiscal vector are linked through the budget constraint, considering all them in equation (1) yield inefficient estimates due to co-linearity between the variables. Some of them must be omitted. The omitted variables are interpreted as the financing instruments. To show this, consider for instance that we separate the taxes into distorsionary (*DIST*) and lump-sum (*LUMP*) taxes and that spending are categorized as productive (*PROD*) and non productive (*NPROD*). Equation (2) can be rewritten as follows:

$$DIST_{it} + LUMP_{it} - PROD_{it} - NPROD_{it} + b_{it} = 0 \tag{3a}$$

Assume that the omitted variable is the distorsionary tax. Then (3a) implies that:

$$[(DIST_{it} = -(LUMP_{it} - PROD)]_{it} - NPROD_{it} + b_{it}) \tag{3b}$$

In the general case, we decompose the vector F into two sub-vectors vectors F_1 and F_2 containing respectively the omitted and non-omitted variables. The constraint (3b) implies that $F_1 = -F_2$. Equation (1) can thus be rewritten as follows:

$$\blacksquare(\gamma_1 it\ (\theta) = \Sigma_{\downarrow}(j=1)^{\uparrow} J \boxplus [\alpha_1 1\ (\theta)\Delta]\ \gamma_{\downarrow}(it-j) + \Sigma_1(k=1)^{\uparrow} K \boxplus [\{\alpha_1 22\ (\theta) - \alpha_1 21\ (\theta)\}_1\ [\Delta F]\ _{\downarrow}(2it-k) +] \quad @$$

$$\Sigma_{\downarrow}(l=1)^{\uparrow} L \boxplus [\alpha_1 3\ (\theta)\Delta]\ X_1(it-l) + v_1 t \tag{4}$$

Therefore, the coefficients of the fiscal variables are interpreted as follows. They indicate how changes in given fiscal variables, offset by changes in omitted fiscal variables, affect the economic growth. Equation (4) is retained as our benchmark equation for testing the fiscal policy/growth link.

3 The econometric methodology and data

3.1 Quantile regressions

Equation (4) can be rewritten in matrix form as follows:

$$Y_{it}(\theta) = X'_{it}\beta(\theta) + \upsilon_{it}(\theta), \qquad i = 1, \ldots, N \text{ and } t = 1, \ldots, T \tag{5}$$

where X is the vector of explanatory variables, $\beta(\theta)$ is the vector of coefficients and Y is the endogenous variable. We apply a double-quantile regression to equation (5).

Before turning to the estimation, some discussion about the methodology of quantile regression is warranted. The idea is to model the percentiles of the conditional distribution of the growth rate as functions of the explanatory variables. In a situation of heterogeneous responses of the endogenous variable to changes in the explanatory variables the standard linear estimators (OLS, GLS, GMM, etc.) are not suited. Indeed, those methodologies focus on the estimation of a conditional mean function and conditional dispersion of the endogenous variable around its mean. So doing, one assumes that the conditional mean summarizes the behavior of all the observations in the endogenous variables. This approach is good as far as we consider that the fluctuations of Y_{it} around its conditional mean are erratic or "accidental". However, when the reaction of the endogenous variables to its covariates are assumed to vary across the sample, the standard methodologies do not fully account of the diversity of reaction across the distribution of Y_{it}. In this case, we need alternative estimators.

In panel data methodologies, a now widely used approach consists in using estimators but that allow slope variations across individuals and/or time. In a recent paper, Gemmel *et al.* (2011) use Pesaran *et al.* (1999)'s pooled mean group (PMG) and mean group (MG) estimators to study the impact of fiscal policy on growth using a panel of 17 OECD countries from 1970 to 2004. Although these estimators are useful to account for different slopes across the countries of a panel, the cost of using them is a reduction of the degrees of freedom. Indeed, they are based on an average of the estimates from individual country regressions either for the short or for the long-run coefficients. Quantile estimators avoid this caveat since growth estimators conditional on fiscal policy variables, for given control variables, are obtained by considering the entire sample and by distinguishing the countries and the years according to their location in the conditional distributional of growth. Quantile estimator allows a greater flexibility by allowing all the parameters in a regression to vary across the distribution.

Let $F(y)$ be the probability distribution function of Y. The θ^{th} percentile of Y is defined as the smallest y satisfying $F(y) \geq \theta$. In a regression context, it can be shown that the finding of θ amounts to estimating β such that:

$$\hat{\beta}(\theta) = \arg\min\left\{\sum_{i=1}^{T} H(\theta, \upsilon_t)\right\}, \qquad H(\theta, \upsilon_t) = \theta\upsilon_t^{+} + (1-\theta)\upsilon_t^{-} \tag{6}$$

where v_t^+ is the vector of residuals with positive value and 0 otherwise, v_t^- is the vector of negative residuals and 0 otherwise. We thus have as many estimators of β as values of $\theta \in (0,1)$. Therefore, a quantile regression leads to estimate β by changing the "representative" individual. The latter can be the "mean" (as in OLS), the median ($\theta = 0.5$) or any other percentile.

Basset and Koenker (1978) derive the asymptotic normality results for the quantile regression and show that:

$$\sqrt{T}\left(\hat{\beta}_\theta - \beta_\theta\right) \approx N\left(0, \theta(1-\theta)s(\theta)^2 J^{-1}\right) \tag{7}$$

$$J = \lim_{T\to\infty}\left(X' X / T\right) \tag{8}$$

$$s(\theta) = 1/f(F^{-1}(\theta)) \tag{9}$$

While the estimation of β is quite simple and requires the use of simplex algorithms (see Koenker and d'Orey, 1987), the estimate of the standard error of the estimated parameters is more complicated since it requires the estimation of the unknown probability distribution function of the endogenous variable and its derivative. The latter are required in order to estimate the quantile

density function $s(\theta)$, also called sparsity function. Here, the coefficient covariance matrix is computed using bootstrap resampling and the sparsity function is estimated by using a kernel density estimator as proposed by Powell (1984) and Buschinsky (1994).

All the variables in the right-hand side of equation (4) are purged from reverse causality (endogeneity) by using the double-stage quantile regression proposed by Kim and Muller (2004). They show that the double-quantile estimator is consistent for finite samples.[8] In order to obtain efficient estimates, we however depart from these authors by bootstrapping the standard errors of our estimated coefficients at the second step. Indeed, we are working with the EU countries and our data are contaminated by country cross-correlation. In order to avoid problem of inefficient estimation, we prefer a direct method of estimating the covariance matrix of the estimates by employing a bootstrapping technique (residual bootstrap).

Possible effects running from growth to control and fiscal variables are taken into account in the first step by instrumenting as fully as possible for those variables. We use the logarithm of per capita GDP, the lags of the growth rates of per capita GDP, the difference between the long and short-term interest rate, the ratio of labor force to population as well as lags of the explanatory variables themselves. In addition, endogenous relationships are avoided by not considering the contemporaneous effects of the fiscal variables.

Finally, in each regression, unobserved heterogeneity is taken into account through country fixed effects.

3.2 Data

Our dataset cover 22 countries of the European Union from 2000 to 2010.[9] Our motivation for considering the recent ten years is the following. The current members of the EU are composed of three groups of countries regarding the date of adhesion. 15 were members before the 2000s, 10 countries entered the Union in the early 2000's (in 2004) and 2 in 2007. We consider as many countries as possible and not limit our attention to EU 15. With the exception of Romania and Bulgaria whose adhesion is very recent, we therefore consider the other countries. Luxembourg has a very high GDP therefore may appear as an "outlier". To avoid a strong influence on our results, we drop it from the panel. We also do not include Cyprus and Malta for problem of data availability. This leaves us with 22 countries. Regarding the choice of the time period, we restrict years from 2000 to 2010. We begin after the introduction of the euro, since after 1999, a new institutional framework for fiscal policy was set up (Stability Growth Pact, multilateral surveillance) intended to reinforce the coordination of national fiscal policies. For the countries which joined the EU in 2004, they also had to change the conduct of their fiscal policy at least 4 to 5 years before their adhesion (the Maastricht conditions were entry requirements). Therefore, our aim is to see whether, the adoption of a common fiscal framework makes taxation and expenditure measures become growth-enhancing or growth-reducing in a similar way across countries, or whether their impact on growth have still been different across countries.

In our pooled data, an individual observation describes a country and a year, which we call "an episode" of growth rate of real GDP. Our fiscal variables are taken from the functional

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[8] Other methodologies have been proposed in the literature to deal with endogeneity bias in quantile regressions. For instance, Chernozukov and Hansen (2006, 2008) have suggested an instrumental variable quantile regression estimator. However, the latter is computationally demanding when applied to our case since it is based on a grid search procedure on the coefficients of all the variables which are suspected to be endogenous. Their method is well suited to models where there are few endogenous variables among the explanatory variables of a regression.

[9] The countries are the following: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Slovak Republic, Sweden and the United Kingdom.

classification of public administration expenditure (COFOG) as set by the OECD and by considering the disaggregated taxes. This yields the fiscal categories described in Table 1. The set of endogenous and conditioning variables includes those described in Section 2.2. The GDP, the long-run and short-run interest rates, as well as the inflation and unemployment rates are from the OECD statistics. Private investment is measured by the gross capital formation of corporations and comes from the European Commission AMECO dataset. Data on labor markets were obtained from the OECD: employment, working-age population, population, hours worked per employee, labor force (the latter are used as instruments in our regressions).

All the variables in the regressions are in logarithm, except the budget surplus, the inflation rate and the interest rate term structure defined as the long-run minus the short-run interest rates. The fiscal variables are measured as share of GDP.

4 The results

4.1 The conditional distribution of growth episodes

We consider both measures of the growth rate: the simple growth rate of the real GDP and the growth rate of per capita GDP. The policy recommendations regarding the design of tax structure and composition of expenditure in the EU are usually made by considering the real GDP growth (not deflated by the population size). The second indicator, the growth rate of the real GDP per capita, is helpful for evaluating how economic growth feeds into welfare (a rough measure of income distribution).

In order to contrast the different growth episodes with each others, we first examined how the countries and years are shared across the main percentiles of the conditional distribution of the growth rate of the real GDP. In this view, we ran different regressions corresponding to different percentiles from the 10^{th} to 90^{th} percentiles (each percentile estimate is obtained using the pooled panel). Then, we examined the regressions for which the coefficients measuring the impact of the fiscal variables on growth were quite similar. We computed the fitted value of growth and consider that two fitted values belonged to the same group if they were obtained from regressions in which the coefficients of the fiscal variables were quite similar in magnitude. Again, we stress that this classification is made *after* running quantile regressions with the pooled data. In terms of the growth impact of changes in taxation and expenditure, we observed that the estimated coefficients of the explanatory variables were rather similar for four "subgroups" of percentiles as described in Table 2a.

At the left-hand side of the distribution, below the 40th percentile, the real GDP growth rate is less than or equal to 2.6 per cent. This corresponds to times of crisis. Indeed, the intervals up to the 40th percentiles contain the data for all the countries corresponding to the years 2008 and 2009. In addition, these intervals also include the growth episodes of the most ancient members of the EU corresponding to the years 2002, 2003 and 2010. The percentiles up to the 40th are therefore refereed as low growth episodes in times of crisis. At the higher end of the distribution, above the 70th percentile, the real GDP growth is driven by a catch-up dynamics. Indeed, the group of years and countries is made of the new member states between 2002 and 2007 (Central and Eastern Europe) and some former member countries belonging geographically to the periphery of Europe, for instance Ireland, Portugal, Spain in the earlier 2000's. Their growth rate is greater than 4.3 per cent per annum. There is a broad consensus in the literature that these countries' very fast growth was an illustration of a catch-up dynamics to the standard of living of the richest members of the EU from 2000 onwards. We therefore consider the percentiles above the 70th as illustrating transitional growth rate. Then we have medium growth episodes, between 2.6 and 3.3 per cent (from the 40th to the 50th percentile) and high growth not corresponding to transitional growth, between 3.3 and 4.3 per cent, (from the 50th to the 70th percentiles).

Table 1

Classification of Fiscal Variables

Theoretical Classification	Classification in the Data Source
Taxes	
Direct taxation	Direct taxes on business
	Direct taxes on households
Payroll taxes	Social security contributions received by governments
Indirect taxation	Taxes on production and imports
Other government revenues	General Government total receipts minus direct and indirect taxation
Expenditure	
Sovereign expenditure	Defence expenditure
	Security expenditure
	Economic affairs
	General public service expenditure
Human capital	Education expenditure
	Health expenditure
	Social security expenditure
	Recreation and culture
	Environment
Other expenditure	General government total disbursements minus productive and unproductive expenditure
Budget surplus	Government total revenues minus Government total disbursements

Table 2a

Classification of Countries According to the Results of Quantile Regressions
(real GDP growth)

Low-growth episodes: <2.6% [0^{th}-40^{th}]	All countries Most ancient members	Crisis episodes (2008-09) Years: 2002, 2003, 2010
Medium low growth episodes: 2.6%-3.3% Medium high growth episodes: 3.3%-4.3% [50^{th}-70^{th}]	Most ancient members Most ancient members New members	2000, 2001 and 2004 to 2007 2000, 2001 and 2004 to 2007 2000, 2001, 2010
High-growth episodes: >4.3% [70^{th}-100^{th}]	New member states Periphery	Period 2002 to 2007 (catch-up growth) Early 2000's

An interesting feature of the data is that the more industrialized members of the EU move in the distribution over different years (all the intervals of the different percentiles are "visited"), which is not the case of the Central and Eastern emerging countries. For the latter we indeed have few observations between the 40^{th} and 70^{th} percentiles, which could be explained by the fact that they are still converging to the other countries and therefore they experience a higher growth rate (catch-up dynamics).

Comparing the cases of two leading economies of the EU, France and Germany, we observe an unhooking of the former with regard to the latter from 2006 onwards. Indeed, from Table 2b, it is seen that France's growth rates systematically lies in lower percentile intervals.

For purpose of comparison, a classification was also done by considering the regressions with the growth rate of per capita GDP. The conditional distribution of per capita GDP growth led us to classify the growth episodes in three intervals. The first group was composed of countries and years for which the conditional growth rate is below 3.2 per cent (which correspond to the following interval of percentiles: [0^{th} – 40^{th}]), the second group for countries and years for which the growth rate lies between 3.2 and 5 per cent (the interval of percentiles is [40^{th} – 70^{th}]) and finally the third group consisted of countries and years characterized by a growth rate above 5 per cent in the interval [70^{th} – 100^{th}].

4.2 Tax and expenditure effects on real GDP growth across percentiles

Tables 3 till 5 report the estimation results of equation (4). The reported coefficients are cumulative sums over the two years following the initial changes in taxation and expenditure. We report the cumulative sum of the coefficients over the two years. This corresponds to the length of time usually required for changes in investment to fully affect growth in Europe. Further, we

assume that the implementation of fiscal policy requires a delay before impacting the economy and that short-run effect are completely dissipates after two years.

Table 2b

Classification of Growth Episodes Across Quantile Intervals for France and Germany
(real GDP growth)

France		Germany	
2000	70^{th}-80^{th}	2000	50^{th}-60^{th}
2001	30^{th}-40^{th}	2001	30^{th}-40^{th}
2002	20^{th}-30^{th}	2002	10^{th}-20^{th}
2003	40^{th}-50^{th}	2003	20^{th}-30^{th}
2004	40^{th}-50^{th}	2004	30^{th}-40^{th}
2005	30^{th}-40^{th}	2005	20^{th}-30^{th}
2006	50^{th}-60^{th}	2006	70^{th}-80^{th}
2007	40^{th}-50^{th}	2007	60^{th}-70^{th}
2008	10^{th}-20^{th}	2008	20^{th}-30^{th}
2009	0^{th}-10^{th}	2009	0^{th}-10^{th}
2010	20^{th}-30^{th}	2010	60^{th}-70^{th}

The different coefficients must be interpreted in light of our discussion in Section 2.2. In Table 3, first regression, the coefficients indicate the effect on growth of changes in the different variables (two years after the initial change) when these changes are accompanied by changes of similar amount in welfare expenditure. For instance the estimate –0.05 of direct taxation says that a 1 per cent increase in direct taxation, used to finance a 1 per cent increase in welfare expenditure, reduces growth by 0.05 per cent two years after the initial change in direct taxation. In Table 4, second regression, the coefficients measure the impact of changes in the variables on growth, when there are changes of equal amount in the budget surplus. For instance, the coefficient –0.09 of social security contributions says that a 1 per cent increase in social security spending, entirely reflected in the budget balance (which means that neither other spending, nor taxes are modified) reduces growth by 0.09 per cent, two years after the initial change. All the regressions in Tables 3 till 6 must be interpreted in a similar way.

We report the results of the regressions based on the 40^{th}, 50^{th}, 60^{th} and 70^{th} percentiles. The reader must keep in mind that for the different choices of percentiles, we do not split the data into different sub-samples. We use the whole pooled observations. The difference with the classical "mean-based" estimations is that, instead of the conditional mean, the representative observation to which the others are compared is the reported percentile.

Instead of commenting on all the estimated coefficients, we focus on the variables related to the ongoing debate in Europe on the fiscal tools that are viewed as growth-enhancing instruments: the improvement of competitiveness on the labor cost which may imply a reform of the social security systems, optimal taxation and in particular the trade-off between direct and indirect taxes, the rationalization of public expenditure by reducing unproductive public spending, fiscal devaluation.

Table 3

Growth Equation. Two-stage Quantile Regression with Bootstrapped Standard Errors

(t-ratios in parentheses)

Omitted Variable	Welfare Expenditure				Direct Taxation			
	0.4	0.5	0.6	0.7	0.4	0.5	0.6	0.7
Constant	–2.61*** *(–4.51)*	–2.87*** *(–5.04)*	–0.60*** *(–5.58)*	–0.45** *(–2.49)*	–4.74*** *(–4.70)*	–3.17*** *(–4.57)*	–2.96*** *(–5.61)*	–1.30*** *(–3.58)*
Business investment	0.04** *(2.34)*	0.04** *(2.13)*	–0.007 *(–0.26)*	0.07*** *(2.99)*	0.09*** *(4.94)*	0.005 *(0.185)*	–0.025 *(–0.84)*	0.008 *(0.39)*
Employment growth	–0.15 *(–1.51)*	0.14 *(1.51)*	0.04 *(0.55)*	0.003 *(0.03)*	–0.009 *(–0.108)*	–0.09 *(–0.97)*	0.03 *(0.39)*	0.004 *(0.053)*
Hum. capital expenditure	–0.02 *(–0.44)*	–0.04 *(–1.06)*	–0.003 *(–0.09)*	–0.148*** *(–4.60)*	–0.005 *(–0.54)*	–0.07 *(–0.73)*	–0.28*** *(–4.06)*	–0.32*** *(–3.41)*
Welfare expenditure	-	-	-	-	–0.02 *(–0.42)*	0.074 *(1.27)*	0.11* *(2.20)*	0.102 *(1.58)*
Sovereign expenditure	–0.08 *(–0.37)*	–0.004 *(–0.02)*	0.36* *(1.88)*	0.24 *(1.08)*	–0.04 *(–0.66)*	–0.001 *(–0.02)*	0.16** *(2.55)*	0.122*** *(2.10)*
Direct taxation	–0.05*** *(–3.20)*	–0.08*** *(–4.66)*	–0.27*** *(–6.16)*	–0.11 *(–1.50)*	-	-	-	-
Soc. Sec. contributions	0.22 *(1.08)*	–1.66*** *(–3.56)*	0.08 *(0.53)*	–0.04 *(–0.176)*	–0.69* *(–1.87)*	–1.51*** *(–4.16)*	0.05 *(0.28)*	0.06 *(0.21)*
Indirect taxation	–1.22*** *(–4.34)*	0.34 *(0.70)*	0.16 *(1.09)*	–0.11 *(–0.51)*	–1.59*** *(–4.84)*	0.297 *(1.17)*	–1.31*** *(–5.15)*	–0.45*** *(–2.33)*
Other taxes	–0.03 *(0.35)*	0.05 *(0.29)*	–0.19 *(–1.25)*	–0.46*** *(–2.64)*	–0.16 *(–0.96)*	0.04 *(0.18)*	–0.12 *(–0.70)*	–0.18 *(–0.96)*
Budget surplus	0.03 *(0.35)*	–0.01 *(–0.22)*	–0.20*** *(–3.73)*	–0.407*** *(–4.98)*	–0.03 *(–0.36)*	–0.19** *(–1.99)*	–0.19*** *(–2.92)*	–0.32*** *(–3.63)*
Pseudo R^2	0.62	0.61	0.66	0.56	0.63	0.58	0.65	0.58

Note: *, **, *** mean statistical significance at 10, 5 and 1 per cent respectively.

Table 4

Growth Equation. Two-stage Quantile Regression with Bootstrapped Standard Errors
(t-ratios in parentheses)

Omitted Variable	Indirect Taxes				Budget Surplus			
	0.4	0.5	0.6	0.7	0.4	0.5	0.6	0.7
Constant	–2.59*** *(–3.38)*	–3.90*** *(–5.00)*	–0.54*** *(–5.48)*	–0.75*** *(–4.94)*	–2.87*** *(–4.35)*	–3.85*** *(–5.43)*	–0.57*** *(–4.82)*	–1.00*** *(–6.29)*
Business investment	0.09*** *(4.94)*	0.05** *(2.29)*	–0.025 *(–0.842)*	0.008 *(0.39)*	0.08*** *(4.15)*	0.04 *(1.59)*	–0.004 *(–0.15)*	–0.02 *(–1.19)*
Employment growth	–0.009 *(–0.108)*	0.06 *(0.70)*	0.03 *(0.39)*	0.004 *(0.05)*	–0.02 *(–0.28)*	–0.009 *(–0.11)*	–0.003 *(–0.04)*	–0.06 *(–0.64)*
Hum. capital expenditure	0.22* *(1.91)*	0.38*** *(2.97)*	–0.001 *(–0.014)*	–0.38*** *(–4.56)*	0.27*** *(2.64)*	0.34*** *(3.25)*	–0.05 *(–0.58)*	–0.24*** *(–2.78)*
Welfare expenditure	–0.21*** *(–2.84)*	–0.24*** *(–3.39)*	–0.03 *(–0.51)*	0.13** *(2.05)*	–0.24*** *(–3.49)*	–0.21*** *(–3.62)*	–0.07 *(–0.83)*	–0.15* *(–1.86)*
Sovereign expenditure	–0.07 *(–1.29)*	–0.15* *(–1.81)*	0.05 *(0.84)*	0.15*** *(2.77)*	–0.07 *(–1.24)*	–0.11 *(–1.60)*	0.138** *(2.41)*	0.31*** *(6.09)*
Direct taxation	–0.09*** *(–4.84)*	–0.10*** *(–5.28)*	–0.26*** *(–5.15)*	–0.14** *(–2.33)*	–0.09*** *(–4.96)*	–0.09*** *(–5.03)*	–0.24*** *(–4.63)*	–0.19*** *(–3.53)*
Soc. Sec. contributions	–1.31*** *(–3.29)*	–2.06*** *(–4.88)*	0.05 *(0.28)*	–0.31 *(–1.36)*	–1.45*** *(–4.24)*	–2.01*** *(–5.25)*	0.51** *(2.03)*	0.63** *(2.28)*
Indirect taxation	-	-	-	-	0.14 *(0.60)*	0.17 *(0.74)*	0.33 *(1.52)*	1.05*** *(4.10)*
Other taxes	–0.165 *(–0.96)*	0.01 *(0.05)*	–0.12 *(–0.71)*	–0.06 *(–0.31)*	–0.02 *(–0.12)*	0.05 *(0.28)*	0.02 *(0.09)*	0.28 *(1.34)*
Budget surplus	–0.03 *(–0.36)*	–0.02 *(–0.21)*	–0.195*** *(–2.93)*	–0.32*** *(–3.63)*	-	-	-	-
Pseudo R^2	0.63	0.61	0.65	0.58	0.62	0.62	0.65	0.58

Note: *, **, *** mean statistical significance at 10, 5 and 1 per cent respectively.

Table 5

Growth Equation. Two-stage Quantile Regression with Bootstrapped Standard Errors
*(*t*-ratios in parentheses)*

Omitted Variable	**Sovereign Expenditure**			
	0.4	0.5	0.6	0.7
Constant	–3.37***	–3.05***	–0.76	–0.53***
	(–4.74)	*(–5.53)*	*(–1.60)*	*(–3.08)*
Business investment	0.05**	0.05**	–0.01	0.06***
	(2.54)	*(2.24)*	*(–0.43)*	*(3.01)*
Employment growth	–0.07	0.06	0.09	0.002
	(–0.76)	*(0.65)*	*(1.26)*	*(0.02)*
Hum. capital expenditure	0.10	–0.09	0.07	–0.15*
	(1.27)	*(–0.52)*	*(0.97)*	*(–1.80)*
Welfare expenditure	–0.134*	0.03	–0.06	0.03
	(–1.98)	*(0.24)*	*(–0.77)*	*(0.37)*
Sovereign expenditure	-	-	-	-
Direct taxation	–0.077***	–0.10***	–0.29*	–0.15**
	(–3.90)	*(–5.31)*	*(–1.74)*	*(–2.34)*
Soc. Sec. contributions	0.35	–1.97*	0.28	0.16
	(1.54)	*(–1.82)*	*(0.99)*	*(0.67)*
Indirect taxation	–1.59***	0.61	0.40*	–0.04
	(–4.51)	*(0.49)*	*(1.70)*	*(–0.17)*
Other taxes	0.12	0.01	–0.03	–0.55***
	(0.65)	*(0.05)*	*(–0.16)*	*(–2.81)*
Budget surplus	–0.03	–0.017	–0.18**	–0.32***
	(–0.40)	*(–0.21)*	*(–2.50)*	*(–3.65)*
Pseudo R^2	0.63	0.61	0.66	0.57

Note: *, **, *** mean statistical significance at 10, 5 and 1 per cent respectively.

4.2.1 Social security contributions

Social security contributions have the strongest influence among the different fiscal variables (greatest coefficients) but their effect on growth varies across percentiles. Their expected total effect is ambiguous. Indeed, on the one side, they have a negative impact on growth (due to higher labor costs). On the other side, they may have a positive impact due to second round demand effects (in Europe, higher income transfers are usually the counterpart of higher social security spending). From the tables, we see that augmenting social security taxes had the potential for reducing growth during medium low growth episodes. Indeed, we recall from Table 2a, that the 40th and 50th percentiles correspond to medium low growth episodes (growth rates between 2.6 and 3.3 per cent). In Tables 3 till 5 it is seen that we obtain a negative and statistically significant coefficient of social security contributions for these two percentiles. Therefore, in the European economies that have been growing moderately (with a real growth rate between 2.6 and 3.3 per cent), increases in social security contributions have been detrimental for growth. This

happened when the increases in social security contributions were not followed by any changes in public spending or taxes (we obtain negative coefficients in Table 4, when the budget surplus is the omitted variable), or when the governments decided to compensate the increase in social security contributions by lower direct or indirect taxes (see the negative coefficients in Table 3, when the omitted variable is direct taxation and in Table 4, when indirect taxation is omitted from the regressions).

In countries with a fast growth rate, we find that the total impact on growth of an increase in social security contribution has been positive (always for the 60th percentile and sometimes for the 70th percentile), though they are not found to be significantly related to growth, except when the omitted variable is the budget surplus (Table 4). Therefore, the estimates suggest that in the European emerging countries (whose growth episodes are located in the percentiles above the 60th), the negative growth effects of social security revenues are cancelled out by their positive demand effects.

Therefore, from these results, we can conjecture that a reduction in the employers and employees' contribution to social security would have no effect in the fast growing countries (Southern and Eastern European countries) , while they may be growth-enhancing in those countries experiencing a moderate growth (the industrialized countries). For instance, if the governments in Hungary, Poland, or Spain would like to raise growth by improving the competitiveness on labor costs and decide to reduce the social contribution revenues, this policy would be ineffective on growth. But, it would work in countries like Sweden, Germany or UK. One reason may be that in the latter countries social security contributions account for a high proportion of the total labor costs. Another reason is that in these countries, the supply effects of a reduction in social security contribution more than outweigh the negative demand effects (since the contribution finances unemployment benefits). In the eastern European countries social benefits are rather financed by taxes.

4.2.2 Direct and indirect taxation

We first consider the growth impact of a mix between direct and indirect taxation, looking at the respective coefficients of these variables in Tables 3 and 4 when the other variable is omitted from the regression. In Table 3, the coefficients corresponding to the line "indirect taxation" and columns 6 till 9 measure the impact on growth of a shift from indirect to direct taxation. In Table 4, the coefficients in the line labeled "direct taxation" and columns 1 till 4 indicate the impact on growth of a shift from direct to indirect taxation. Indirect taxes can be considered as taxes on consumption, while direct taxes are taxes on production (labor and capital revenues). It is seen that a shift from direct to indirect taxes (Table 4), that is a fall of the former followed by an increase in the latter, is growth-augmenting. Indeed the estimated coefficients are negative, thereby indicating that growth moves in the opposite direction of direct taxes. Table 3 yields a similar conclusion if one considers instead a shift from indirect to direct taxation (higher direct taxes substituted for lower indirect taxes). However, the impact of direct taxation in Table 4 is much smaller than the impact of indirect taxation in Table 3 (compare the coefficients for the different percentiles). This suggests that a reduction of direct taxes compensated by higher indirect taxes is more efficient for growth than a decrease in indirect taxes followed by an increase in direct taxes. One reason may be that direct taxation is more distortionary than indirect taxation.

Now, what happens if the governments rely on either one or the other form of taxation (when none of them is considered as an omitted variable)? Higher indirect taxes reduce growth mainly in times of crises or during low-growth episodes (in Tables 3,4,5, we find a statistically significant coefficient for the 40th percentile, while the coefficient is often non-significant for the other percentiles). Recall that, in Table 2a, the 40th percentile refers growth rates less than 2.6 per cent

and includes years of crisis. Higher direct taxes significantly reduce growth in all the countries. But the negative effect is stronger in the fastest growth countries (compare the coefficients in Tables 3 till 5 between the 40^{th}, 50^{th} percentiles and the 60^{th}, 70^{th} percentiles). Therefore, increases in direct taxation have been more detrimental for the economies which were experiencing a catching-up dynamics.

4.2.3 The impact of public spending

On the expenditure side, our results point to different effects of sovereign and welfare expenditure across the percentiles and the way in which they affect growth depends upon the financing variables in the government budget constraint. When an increase in welfare or sovereign expenditure is financed by an equivalent increase in taxes (direct or indirect), these expenditures boost growth in the countries that are growing fast (the coefficients for the 60^{th} and/or 70^{th} percentiles are positive and statistically significant in Tables 3 and 4), but they are be neutral or even detrimental in the countries with a low growth rate (we obtain negative coefficients for the 40^{th} and 50^{th} percentiles in Tables 3 and 4). The coefficients of welfare expenditure are statistically significant when higher welfare spending is financed by higher indirect taxes). The reported coefficients capture the influence on growth of recreation, culture, and environment spending, social security benefits, sovereign spending. Our results suggest the following interpretation. Although the literature usually classifies these spending as unproductive, they may have a demand effect on growth that cancel out the negative effects of the accompanying tax increases, specifically in the European emerging countries that experience a catch-up growth.

Table 5 also suggests that welfare expenditures have usually no significant impact on growth, if a trade-off is made with other spending items, for instance sovereign expenditure. Finally, if a government raises welfare expenditures and maintain the other spending and taxes at their current level, the increase results in a negative impact irrespective in all countries (in Table 4, when the omitted variable is budget surplus, the coefficients of welfare expenditure is negative for all the percentiles and statistically significant in most cases). In the same context (no changes in the structure of taxes and spending), sovereign expenditures appear to have significant positive effects on growth only in those countries growing fast (the estimated coefficient are statistically significant for the 60^{th} and 70^{th} percentiles).

The empirical evidence regarding the growth effect of human capital spending (health and education expenditure) is mixed. These expenditures, when their coefficient is statistically significant, contribute positively to economic growth in times of crisis or during low-growth episodes in the richest European countries (see the coefficients in Table 4 for 40^{th} and 50^{th} percentiles). However, any increase in this category of spending reduces growth during high-growth episodes (see the coefficients, in Tables 3 till 5, for the 60^{th} and 70^{th} percentile). The positive sign is intuitive, since such expenditure is expected to enhance labor productivity. The negative sign reflects the fact that, in the European emerging economies, educational and health expenditure seem to have been inefficient in generating a positive growth rate, which could be explained by a weaker linkage between public education and wealth outlays. As reported in the literature, there may be several causes of ineffective human capital spending, among which the inefficient role of institutions and governance in mediating the nexus between social spending indicators and growth. Incorporating institutions indicators as additional control variables in the model would be interesting in assessing the negative link. We let this for a further study.

An important policy consequence of our findings is that we would be unable to draw recommendations regarding the composition of public expenditure in the EU countries in connection with growth, without considering two groups of countries, namely the most ancient members and the recent members that are still in a catch-up growth process. For instance, the usual

suggestion of reducing welfare expenditure would be a good thing for growth efficiency in the industrialized countries, but would have doubtful effects on growth in the emerging countries. A reallocation of welfare expenditure to sovereign expenditure (which mean reducing the former while increasing the latter) would be a good thing in the low-growth European countries, but would certainly not be a mean of enhancing growth in the countries with a fast growth rate (as is seen in Table5, the coefficient of welfare expenditure, when sovereign expenditure is the omitted variable, carries a statistically negative sign only for the 40^{th} percentile).

4.2.4 Fiscal devaluation

The principle of a fiscal devaluation is to reduce social security contributions (essentially payroll tax) and to increase in VAT. Such a policy is expected to work through both a demand channel and a supply channel by inciting firms to reduce their prices more or less in proportion to the decrease in unit labor costs. Our results lead mixed conclusions. The estimations suggest that such a policy could lead to a sizeable positive effect on growth, but only in the countries that experience a low growth rate (the most industrialized countries of Europe, like France, the UK, Germany, Finland, etc). Conversely, the impact would be neutral for growth in the emerging high-growth countries (see Table 4, the coefficients in the regressions where indirect taxation are the omitted variable. They are negative and statistically significant for the 40^{th} and 50^{th} percentiles, but non-significant for the 60^{th} and 70^{th} percentiles). Therefore, a transfer of fiscal revenues from payroll taxes to indirect taxes can either drive growth downwards or boost it. In the most industrialized countries (a majority of which have their growth episodes located below the median), one may expect the shift in the tax schedule to result in a higher growth. One reason may be that, in the EU, when growth is low, the price channel (domestic goods are sold at a reduced price) plays more intensively than the tax channel on domestic demand (the elasticity of domestic demand with respect to relative prices may be higher than the elasticity with respect to indirect taxes). Conversely, a reason why a measure like a fiscal devaluation would be neutral in the emerging EU countries facing a fast growth rate may be that the fall consumption fall following the rise in indirect taxation outweigh its increase due to higher real wage.

4.3 Impact of fiscal policy on per capita growth rate under alternative financing hypotheses

We now test the robustness of the above results to different changes in the specification. First, we consider the growth rate of per capita GDP as has been done in previous papers. We are no longer reasoning from a growth efficiency point of view, but we want to see whether different fiscal policies can raise or jeopardize the growth rate of the standard of livings across years and countries. As said before, working with per capita growth rate means that we assume that a shift in GDP modifies the average income per individuals.

We further add one additional lag to the explanatory variables since the annual macroeconomic programs transmitted by the countries to the EU Commission are evaluated over a period of three years. We also consider an alternative classification of spending. As shown in Table 6, we now consider three groups of expenditure: social spending, economic and sovereign expenditure, and, other public expenditure. Direct taxation now incorporates a third component, namely other government revenues. These include for instance taxes on property transactions. Another difference with the preceding section is that, instead of omitting variables from our specifications one by one, we also consider the case where several fiscal variables are omitted. Finally, we add inflation and the initial growth rate of per capita GDP to the list of control variables.

Tables 7a and 7b report the results for the 25th, 50th and 75th quantiles. The reported coefficients are cumulative sums over the three years following the initial changes in taxation and expenditure. Regression (1) assumes that changes in taxes and expenditure are fully reflected by changes in the budget surplus. In regression (2), it is assumed that changes in taxation and public spending are not entirely reflected in budget deficit/surplus, because the government modifies the structure of spending by modifying social expenditure. Similar interpretations apply to regressions (3) till (5).

Table 6

An Alternative Classification of Fiscal Variables

Theoretical Classification	Classification in the Data Source
Direct taxation	Direct taxes on business Direct taxes on households Other direct taxes (total direct taxes minus direct taxation on business and households)
Indirect taxation	Taxes on production and imports
Other government revenues	General Government total receipts minus direct and indirect taxation
Economic and sovereign expenditure	Defense expenditure Security expenditure Education expenditure Health expenditure General public service expenditure Economic affairs expenditure
Social expenditure	Expenditure on recreation and culture Social security and welfare expenditure
Other expenditure	General government total disbursements minus productive and unproductive expenditure
Budget surplus	Government total revenues minus Government total disbursements

Table 7a

Growth Equation (per capita). Two-stage Quantile Regression with Bootstrapped Standard Errors
(t-ratios in parentheses)

Regression No.	**(1)**			**(2)**			**(3)**		
Omitted Variable	**Budget Surplus**			**Budget Surplus and Social Expenditure**			**Budget Surplus, Indirect Taxes and Social Expenditure**		
	0.25	0.50	0.75	0.75	0.50	0.75	0.25	0.50	0.75
Constant	0.17 *(1.51)*	0.02 *(0.18)*	0.27** *(2.39)*	–0.009 *(–0.09)*	–0.09 *(–0.94)*	–0.11 *(–1.29)*	0.11 *(1.29)*	–0.08 *(–1.00)*	0.10 *(1.32)*
Growth (–1)	0.12 *(1.07)*	0.35*** *(3.34)*	0.20* *(1.94)*	0.28** *(2.84)*	–0.05 *(–0.66)*	0.05 *(0.62)*	0.23** *(2.24)*	0.24** *(2.60)*	0.07 *(0.90)*
Inflation	–1.48*** *(–4.63)*	–1.87*** *(–6.84)*	–1.39*** *(–4.35)*	–1.14*** *(–3.93)*	–1.13*** *(–4.88)*	–1.09*** *(–4.12)*	–1.69*** *(–5.72)*	–0.80*** *(–3.11)*	–0.87*** *(–3.83)*
Business investment	0.74*** *(3.56)*	0.45** *(2.14)*	0.71*** *(3.43)*	0.44** *(2.17)*	0.37** *(2.11)*	0.33** *(2.02)*	0.92*** *(4.58)*	0.29 *(1.48)*	0.29* *(1.70)*
Employment growth	0.58** *(2.51)*	0.54** *(2.32)*	0.51** *(2.07)*	0.72*** *(2.82)*	0.70*** *(3.26)*	0.62*** *(2.89)*	0.43* *(1.73)*	0.69** *(2.94)*	0.68*** *(3.26)*
Direct taxation	–0.39 *(–0.85)*	–0.15 *(–0.32)*	–0.66 *(–1.55)*	–0.19 *(–0.43)*	–0.84** *(–2.27)*	–0.79** *(–2.18)*	–1.21*** *(–2.71)*	–0.42 *(–0.99)*	–0.99** *(–2.58)*
Indirect taxation	–1.05 *(–1.54)*	–0.52 *(–0.76)*	–1.46** *(–2.34)*	–0.77 *(–1.21)*	1.28* *(2.24)*	1.37** *(2.51)*	-	-	-
Other taxation	0.10 *(0.24)*	0.30 *(0.94)*	–0.05 *(–0.14)*	0.21 *(0.55)*	–0.19 *(–0.63)*	0.11 *(0.34)*	0.11 *(0.28)*	0.33 *(0.92)*	–0.30 *(–0.93)*
Economic and sovereign expenditure	0.07 *(0.28)*	0.52** *(2.11)*	–0.26 *(–1.07)*	0.43* *(1.91)*	0.32* *(1.88)*	0.51** *(2.68)*	–0.26 *(–1.11)*	0.45** *(2.09)*	0.28 *(1.49)*
Social expenditure	–0.65 *(–0.65)*	–0.77* *(–1.89)*	–0.67** *(–2.20)*	-	-	-	-	-	-
Budget surplus	-	-	-	-	-	-	-	-	-
Pseudo R^2	0.53	0.38	0.53	0.39	0.45	0.45	0.66	0.57	0.45

Note: *, **, *** mean statistical significance at 10, 5 and 1 per cent respectively.

Table 7b

Growth Equation (per capita)
Two-stage Quantile Regression with Bootstrapped Standard Errors
*(*t*-ratios in parentheses)*

Regression No.	**(4)**			**(5)**		
Omitted Variable	**Budget Surplus and Indirect Taxes**			**Indirect Taxes, Other Taxes and Social Expenditure**		
	0.25	0.50	0.75	0.25	0.50	0.75
Constant	0.10 *(1.12)*	–0.08 *(–0.97)*	0.09 *(1.13)*	0.02 *(0.31)*	–0.03 *(–0.42)*	0.11 *(1.47)*
Growth (–1)	0.04 *(0.39)*	0.22** *(2.37)*	0.06 *(0.65)*	–0.09 *(–0.82)*	0.07 *(0.72)*	–0.07 *(–0.69)*
Inflation	–1.60*** *(–5.18)*	–1.34*** *(–5.04)*	–1.25*** *(–5.26)*	–1.79*** *(–5.30)*	–0.74** *(–2.32)*	–1.44*** *(–5.81)*
Business investment	0.96*** *(4.93)*	0.37* *(1.83)*	0.36** *(2.00)*	1.09*** *(5.19)*	0.31 *(1.49)*	0.51** *(2.53)*
Employment growth	0.76*** *(3.18)*	0.79*** *(3.25)*	0.62** *(2.87)*	0.62** *(2.56)*	1.01*** *(4.79)*	0.39* *(1.80)*
Direct taxation	–0.97** *(–2.19)*	–0.39 *(–0.87)*	–0.88** *(–2.29)*	–0.84* *(–1.77)*	–0.54 *(–1.19)*	–1.12** *(–2.50)*
Indirect taxation	-	-	-	-	-	-
Other taxation	0.04 *(0.12)*	0.46 *(1.16)*	–0.34 *(–1.02)*	-	-	-
Economic and sovereign expenditure	0.18 *(0.64)*	0.68** *(2.62)*	0.63*** *(2.85)*	–0.14 *(–0.55)*	0.37 *(1.59)*	0.24 *(1.18)*
Social expenditure	–0.94** *(–2.45)*	–0.62 *(1.63)*	–0.60* *(–1.89)*	-	-	-
Budget surplus	-	-	-	–0.04 *(–0.18)*	–0.04 *(–0.21)*	0.36* *(1.69)*
Pseudo R^2	0.54	0.40	0.44	0.54	0.41	0.46

Note: *, **, *** mean statistical significance at 10, 5 and 1 per cent respectively.

We begin with a brief comment of the results obtained for the conditioning variables (the variables other than the fiscal variables). Their coefficients have the expected signs. Both the business investment ratio and the employment growth enter the regressions with a positive sign and they are mostly statistically significant, irrespective of the quantiles. This seems better than in our previous regression where the ratio of business investment to GDP was positive and statistically significant for the low-growth countries only and the growth rate of the employment rate was rarely significant across the different regressions. Inflation negatively affects per capita GDP growth, which is not a surprised given that price stability has been set up as a prerequisite for sustainable growth in the EU.

Higher direct taxation significantly reduces growth if a country is experiencing either a low-growth or a high-growth rate (in Regressions 3 till 5) while the effect is statistically insignificant for middle-growth countries. Therefore, an increase in direct taxation financed by an equivalent decrease in indirect taxes, social expenditure, or which results in a higher budget surplus, is growth-reducing when growth is below 1.14 or above 3 per cent (these are the average growth rates in the intervals of percentiles shown in Table 2c). In Tables 3 till 5, we see that the coefficients of direct taxations are statistically negatively significant for the 25^{th} and 75^{th} quantiles. When indirect taxation is excluded from the list of omitted variables (regressions 1 and 2), higher direct taxes are growth-reducing only for the high-growth countries (with a growth rate above 3 per cent).

The regressions also report that sometimes, higher indirect taxes can have a negative growth effect in the low-growth economies but a positive effect in the high-growth countries (Regression 2). A reduction of public deficit by higher indirect taxes, or the financing of additional social spending by a higher indirect taxation has several theoretical effects. In principle, deficits and indirect taxes imply a shift in growth in opposite directions. The effect of the former is either positive or negative depending upon whether one observes strong or weak Keynesian multipliers (this depends upon crowding out effects, Barro-Ricardo effects, etc). Indirect taxes are expected to be growth-reducing. The total impact is thus either positive or negative depending upon the effects which is predominant. If we look at Regression 2, it seems that the taxation effect is larger in low-growth countries, while the negative effects of higher budget surpluses dominates in high-growth economies. Therefore, an indirect taxation used to finance social expenditure has the benefit of shifting growth upward if an economy evolves on its transition growth path to its long-run per capita GDP level. Otherwise, once the transition phase is achieved, indirect taxation is likely to result in a lower growth. This finding can be explained by our previous observation that social spending are growth-enhancing in the European emerging countries, but growth-reducing in the industrialized countries (see Section 4.2.4).

Interestingly, the results report a positive effect on growth of economic and sovereign expenditure in high-growth countries, while they are neutral for the group of low-growth countries. Indeed in Regressions 1, 2 and 4, we obtain statistically significant positive coefficients for the median and the 75^{th} quantile only. Economic and sovereign expenditure are therefore beneficial for per capita growth above 3 per cent, when the initial composition of taxes and spending remains unchanged (Regression 1), when their increase is substituted for social expenditure (Regression 2), or even if they are partially financed by higher indirect taxation (Regression 4).

Finally, we can see that social expenditure, when included in the list of explanatory variables, has a negative effect on growth irrespective of the quantile (Regression 4). This contrasts with our findings in the preceding section, since we saw that such spending had strong demand effects in the fast-growth countries.

5 Conclusion

Can we apply common fiscal policies in Europe to boost growth in Europe? The answer seems to be negative.

While using taxes and public spending to foster growth, the EU governments also use their fiscal policy to keep their finance sustainable. Our results cast some doubts on a widespread idea in the policy circles according to which a higher growth rate in the EU could be achieved with the same fiscal mix in all member countries. Against this view, the quantile estimates strongly illustrate heterogeneous reactions across the EU economies.

In light of our findings, we favor the idea of distinguishing among the ancient member countries and the recent emerging countries which adhered to the EU in the early 2000's. On the differences discussed in this paper, social security spending, direct taxation, welfare and sovereign expenditure and human capital expenditure have strikingly different effects on the growth rate of the real GDPs. Increases in human capital spending are growth-enhancing in the industrialized EU countries, while welfare and sovereign expenditure play a more important role in fostering growth in the emerging economies. Direct taxation exerts a much more detrimental impact in the countries that are growing rapidly than in those that experiment a slow growth. When the growth rate is considered in per capita terms, indirect taxes appear to exert an asymmetric effect on the EU economies: they are harmful in the low-growth countries, but not inconsistent with a stronger growth dynamics in the economies that grow rapidly. Direct taxation is growth-enhancing if an economy has either a slow or fast growth rate. Direct taxes are neutral at moderate growth rates.

One implication of the above results is that, in analyzing the fiscal policies which could act friendly to growth in the EU, using average fiscal multipliers could be of very little use. One needs to consider the different growth impacts in times of crises and normal times and to acknowledge the different ways in which the same policies can affect the growth rates in different countries. This rules out the use of a single fiscal/growth model for the EU economies.

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AN ASSESSMENT OF STABILITY AND GROWTH PACT REFORM PROPOSALS IN A SMALL-SCALE MACRO FRAMEWORK

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This paper contributes to the debate on fiscal governance for the European Monetary Union. We simulate a small scale macroeconomic model with forward looking agents, augmented with a public finance block. We account for both positive (output stabilization) and negative (via risk premia) effects of debt and deficit. By the appropriate choice of the exogenous fiscal variables in the fiscal block, we replicate the working of the rule embedded in the so-called "fiscal compact". We compare this rule with the Maastricht 3 per cent deficit limit (status quo), and with an "investment" rule leaving room for public investment. We evaluate the performance in terms of output and inflation during a fiscal consolidation, as well as following demand and supply shocks at the steady state. All rules guarantee long run sustainability. The investment rule emerges robustly as the one guaranteeing the lowest output loss, followed by the status quo. The "fiscal compact" rule appears to be the most recessionary and deflationary.

1 Introduction

This paper assesses the macroeconomic impact of a number of fiscal rules that have been or could be implemented by countries belonging to the European Union. The European fiscal crisis, and the ensuing requirement to reduce public debt levels, paved the way for a set of reforms of the European fiscal rules. On March 2nd 2012, 25 of the 27 EU countries (the UK and the Czech Republic did not sign) adopted the *Treaty on Stability, Coordination and Governance in the Economic and Monetary Union,* that is currently (November 2012) under ratification. This so-called "Fiscal Compact" complemented the provisions of the Maastricht Treaty and of the Stability and Growth Pact (SGP): the limit of public deficit at 3 per cent of GDP has been supplemented with a limit on structural deficit at 0.5 per cent of GDP, and an average yearly reduction by 1/20th of the difference between the debt to GDP ratio and the 60 per cent of GDP Maastricht limit. The limit on structural deficit goes beyond the 3 per cent Maastricht provision, in that it aims at introducing balanced budget constraints at the Constitutional level of each euro zone member state.

It is somewhat paradoxical that rules aimed at constraining the capacity of governments to run countercyclical policies are discussed precisely after the worldwide financial crisis required large public deficits to dampen shocks ensuing from market failures. Thus, the introduction of the above-mentioned rules raises the question of their incidence on the usual objectives of economic policies, namely the output gap and the inflation rate.

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The contribution of this paper is to simulate the macroeconomic effects of the adoption of these rules in a structural small scale New-Keynesian model, in which we introduce a public finance block and a yield curve embedding risk premia. We aim at shifting the attention back from the objective of *fiscal* stabilization to the one of *macroeconomic* stabilization. As the proposed rules stand, public deficit and debt are not instruments to smooth the cycle. European authorities – governments, the ECB, or the Commission – seem to consider them as objectives of policy action rather than what they should be, namely *instruments* for obtaining the final objective of stabilizing output gap and inflation. This reversal of targets and instruments is equivalent to *a priori* denying any role to macroeconomic (in particular fiscal) policy. With this exercise we intend to account for the negative impact of excessive deficit and debt, while emphasizing their role as instruments for attaining the *final objective* of aggregate welfare maximization.

Medium or large scale New-Keynesian models have often been used to assess the impact of fiscal policy on real GDP and inflation rates. Coenen *et al*. (2012) for instance review the fiscal properties of nine dynamic stochastic general equilibrium (DSGE) models in which Keynesian features like price and wage rigidities are introduced. Most models use rule-of-thumb fiscal rules by which taxes respond to deficits or debts (as in the seminal specification of Barro, 1986). Hence, public finance sustainability is always met. In this study and in contrast with these models, we specify the fiscal rules which governments have to abide by.

While in a number of occasions fiscal rules have not been respected, we assume governments to follow the fiscal rules which have been decided at the EU level. We wish to investigate the real consequences of sticking to the rules. We assess these consequences under two different assumptions regarding the initial levels of public deficits and debts. In the first scenario – initial deficits and debts are at their current level, *i.e.*, above their steady-state values – we evaluate the effect of fiscal consolidation under the regimes corresponding to each fiscal rule. In the second scenario we assume that the economy starts at steady-state, and we investigate in our small-scale model the different consequences of supply or demand shocks under the different fiscal rule regimes. Most standard DSGE models deal with the second scenario, while the scenario of fiscal consolidation is specific to our paper. In both cases, our value-added stems from the comparison of the specific EU fiscal rules.

We assess the macroeconomic impact of the fiscal rules on four economies that we take as representative of the euro zone: a large (relatively) low-debt economy (France), a small high-debt one (Belgium), a large high-debt one (Italy) and a small-low debt one (the Netherlands). The size of nations – large or small – relates to the size of their fiscal multiplier. The four countries also differ in terms of the size and sign of their primary structural balance: France and the Netherlands have a large deficit, whereas Belgium has a low one, and Italy holds a large surplus.

We simulate the effect of the rules on the level and variability of the output gap, the inflation rate and the structural deficit, and the impact on the level of public debt. This is done in a framework in which on the one hand, the evolution of deficit is countercyclical, but on the other hand, excessive debt feeds back into the economy through increasing risk premia. Among the nine large-scale DSGE models reported in Coenen *et al.* (2012), only one, the, European Commission's QUEST III, embeds a government debt risk premium. Finally, we simulate the different rules over a 20-year horizon, consistently with the target of the one twentieth debt reduction rule.

The rules we simulate are (a) the Fiscal Compact, with its balanced (at 0.5 per cent of GDP) structural budget and the 1/20th yearly debt reduction rule; (b) the 3 per cent total deficit cap (status quo). We also evaluate the effect of (c) adopting an investment rule in the vein of the UK golden rule of public finances, that imposes budget balance over the cycle only for current

spending, while allowing public investment to be financed through debt.[1] The simulations are carried out starting from a structural New-Keynesian model, where the IS and Phillips curves have hybrid specifications with backward and forward expectation terms. Moreover, our specification of the economy also takes into account the nonlinearity of the risk premium and the zero lower bound.

It is worth emphasizing that the macroeconomic framework is partly biased against the use of an investment rule, because we rule out the endogeneity of potential output, which could be positively affected by public investment. On the opposite, the investigation is partly biased in favor of the Fiscal Compact because we simulate the less restrictive rule among the two embedded in the Fiscal Compact.

Results are manifold. First, the adoption of the rules produces a short-run recession, even in a small country with a low multiplier and relatively low initial public debt like the Netherlands. Second, recessions sometimes foster deflation. Although we do not model deflation differently from inflation in this framework, the former is very difficult to reverse in presence of a binding fiscal constraint and of a zero lower bound for the interest rate (Woodford, 2001). Third, the investment rule performs better than the other two rules: recessions are shorter and milder; hence the average loss of output over a 20-year horizon is smaller, all the more so when the fiscal multiplier is large. Fourth, this result is strongly robust to changes in the parameters' values. Fifth, when the economy is hit by demand and supply shocks at the steady state, none of the rules emerges as superior in coping with them.

The paper is structured as follows: Section 2 introduces and discusses our model. In Section 3 we simulate the two scenarios of a fiscal consolidation and of different types of shocks starting from the steady state, and give a quantitative assessment of the macroeconomic performance for the different fiscal rules. Section 4 is devoted to a robustness check of the main results, and Section 5 concludes.

2 An augmented New-Keynesian model

The economy is characterized by a standard framework with the aggregate demand side described by a dynamic IS curve and the aggregate supply side by a hybrid Phillips curve, in the vein of Clarida *et al.* (1999). By hybrid, we mean that expectations are forward and backward-looking. In order to study the different fiscal rules, we add to this core a public finance block to simulate the differences between the rules. To take into account the effect of debt and deficit on private agents' behavior, we explicitly model the equations for government and central bank interest rates.

2.1 The model

The AD bloc is described by a dynamic hybrid IS curve, detailing the determinants of the output gap x_t, *i.e.*, the percentage difference between real GDP (y) and potential GDP ($\bar{y}$):

$$x_t = \alpha_1 \cdot x_{t-1} + (1-\alpha_1) \cdot E_t x_{t+1} + \alpha_2 \cdot (r_t - E_t \pi_{t+1} - rr^*) + \alpha_3 \cdot (dsp_t - \overline{dsp}) + \varepsilon_t^d \qquad (1)$$

where α_1 stands for the incidence of backward-expectations on demand behavior, r_t and π_t are the nominal long-term interest rate and the inflation rate respectively, both in percent; rr^* is the long-term real interest rate in percent; dsp_t is structural primary balance (*i.e.*, deficit net of interest

[1] Introduced in the 1997, the UK golden rule of public finance excludes public investment from the budget limits over the cycle. See Buiter (2001) for a comprehensive discussion.

payments and of cyclical components) as a percentage of GDP, and we define as the fiscal impulse, or fiscal stimulus, its deviation from the steady-state value $(dsp-\overline{dsp})$. $\alpha_2<0$ and $\alpha_3>0$ are parameters.

The introduction of the fiscal impulse in the expectational IS curve stems from the linearised Euler equation of a closed economy with consumption and government expenditure. Considering a simplified budget constraint for the government, with transfers and proportional taxation, public expenditure has to be considered as net of cyclical components and interest payments; its deviation from steady state is therefore captured by the deviation of the structural primary balance.[2] The introduction of backward-looking expectations in the Euler equation, on the other hand, has an empirical justification (see, e.g., Fuhrer and Rudebusch, 2004).

The aggregate supply block is represented by a standard hybrid Phillips curve, where λ_1 captures the incidence of backward-expectations on supply behavior; λ_2 is the elasticity of inflation to the output gap and is a positive parameter:

$$\pi_t = \lambda_1 \cdot \pi_{t-1} + (1-\lambda_1) \cdot E_t \pi_{t+1} + \lambda_2 \cdot x_t + \varepsilon_t^s \tag{2}$$

The third equation describes the behavior of nominal government bonds' interest rates r_t along the yield curve, where i stands for central bank nominal interest rate, and γ represents the risk premium associated with upwards debt variation over the target b^*:

$$1 + r_t = (1+i_t) \cdot [1 + (\gamma \cdot \max(0, b_t - b^*)] + \varepsilon_t^f \tag{3}$$

Monetary policy is described through a usual Taylor rule. The central banker sets the nominal interest rate in response to expected future inflation and current output gap. We explicitly introduce a close-to-zero bound on the nominal rate (here at 0.25 per cent):

$$i_t = \max(0.25,\ rr^* + E_t \pi_{t+1} + \Phi_1 \cdot (E_t \pi_{t+1} - \pi^*) + \Phi_2 \cdot x_t + \varepsilon_t^m) \tag{4}$$

In equations (1) to (4) the error terms ε capture exogenous shocks. Hence ε^d and ε^s represent a demand and a supply shock respectively.

We develop the public finance block to enable the introduction of different fiscal rules in the model. Total government deficit can be decomposed into a cyclical component and a structural component, all expressed as a percentage of GDP:

$$dt_t \equiv dc_t + ds_t \tag{5}$$

As commonly assumed in the literature (see, e.g., Buti *et al.*, 1998; and Girouard and André, 2005), the cyclical component, or cyclical deficit, depends linearly on the output gap, hence characterizing automatic stabilizers:

$$dc_t = \psi_1 \cdot x_t \tag{6}$$

The structural deficit is by construction the sum of interest payments ip and structural primary deficit dsp, interpreted as the discretionary part of fiscal policy:

$$ds_t = ip_t + dsp_t \tag{7}$$

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[2] The government budget constraint can be written as $T(Y_t) + P_t G_t + (1+i_{t-1})B_t = \tau Y_t + B_{t-1}$, where we interpret T and τY as the components of public deficit related to automatic stabilizers (net transfers, affected by the business cycle, and proportional taxation). Under the assumption that the tax rate is given, there is no discretionary tax policy. Thus, G is the (real) amount of discretionary expenditure of the government, net of net transfers and interest payments, and its variation translates into variations of the primary structural balance.

Public debt, expressed in percentage of GDP, follows the usual law of motion, where everything else equal, a higher nominal growth rate mechanically reduces the debt to GDP ratio:

$$b_t = \frac{b_{t-1}}{1+\pi_t + x_t + \overline{y}} + dt_t \tag{8}$$

2.2 Fiscal rules

The medium-to-long term performance of European economies depends on the macroeconomic governance tools put in place by the EU. Three main options are before policy makers: (a) a *status quo* where the ratio of public deficit to GDP must be maintained below the 3 per cent limit. (b) The "investment rule" that allows to finance an increase in net public assets by public debt issuance. (c) The "Fiscal Compact", that embeds the double requirement of a balanced (at 0.5 per cent of GDP) structural deficit and a constant rate of reduction of debt bringing it asymptotically to the 60 per cent-of-GDP ratio (*i.e.*, a 5 per cent reduction per year of the difference between the current debt and its reference level). These rules differ on the criteria and on the type of constraints imposed to countries. Specifically, each rule imposes different constraints on the choice of endogenous and exogenous variables in the fiscal block of the model.

a) For the status quo, we impose that total deficit is exogenously given at 3 per cent:

$$dt = 3$$

We assume in other words that countries use the entire margin given by the rule, and never breach it. The other fiscal variables adapt to this exogenous constraint.

b) The "investment rule" allows increasing public investment inv^g, expressed in percentage of GDP, up to a threshold equal to the inflation depreciation of steady-state debt. Thus, all else equal, the "investment rule" keeps the debt-to-GDP ratio constant. Higher investment may produce higher net interest charges; the rule forces the government to compensate them with a lower cyclically-adjusted primary deficit, *i.e.*, with lower current expenditures $dcur$, also expressed in percentage of GDP. The "investment rule" is described as follows:

$$dsp = inv^g + dcur$$

$$inv^g = \pi\, \overline{b}$$

$$dcur = -\delta\cdot(inv^g + (ip - \overline{ip})) + (1 - \delta)\cdot dcur_{t-1}$$

where the last equation assumes that the current surplus needed to finance interest payments is spread over a $1/\delta$ year period. δ represents the smoothing of expenditure over future periods, and it may have a strong impact on the restrictiveness of the rule. In the benchmark simulations below, we set δ=1 with all the cost of consolidation borne in the current period, whereas in alternative simulations, we show the effect of setting δ equal to 0.5, 0.2 and 0.1 (spreading over 2, 5 and 10 years respectively). Note that this is a severe version of the rule, first because investment is accepted only up to the limit that keeps the debt ratio on a stationary path; second, because public investment has no impact on potential growth (that we assume exogenous and constant), so that it is analytically equivalent to current spending. This puts us in a "worst-case scenario", in which we artificially shut off the long-run positive effects of the investment rule.

c) The Fiscal Compact has two arms. As regards the debt reduction advocated by the Treaty, the exogenous variable is the yearly change in the debt ratio, supposed to be reduced each year by 5 per cent of the difference with its reference rate (60 per cent). In order to simulate this rule, we need to make three assumptions, not explicit in the Treaty. First, we assume the rule to be symmetric around its reference level of 60 per cent; second, we assume it to be asymptotic, as

debt is reduced of 5 per cent of the difference between the ratio in the previous period and the reference level.[3] Finally, we assume that the debt reduction is net of the cyclical balance. Taken together, these three assumptions allow convergence to the Maastricht steady state. Moreover, the third assumption designs a mild version of the debt reduction rule, which minimizes its recessionary impact. Hence, the one twentieth rule runs as follows:

$$ds_t = -0.05 \cdot (b_{t-1} - \bar{b}) + (\pi_t + x_t + \bar{y}) \cdot b_t$$

$$\Rightarrow$$

$$dsp_t = -0.05 \cdot (b_{t-1} - \bar{b}) + (\pi_t + x_t + \bar{y}) \cdot b_t - ip_t$$

The structural balance can be decomposed into the surplus needed to reduce debt by one twentieth of its difference to its steady state value, and the room for maneuver obtained from debt depreciation.

The second arm of the Fiscal Compact concerns the limit to structural deficit. The Treaty states that general government budgets shall be balanced or in surplus, a criterion that "*shall be deemed to be respected if the annual structural balance of the general government is at its country-specific medium-term objective, as defined in the revised Stability and Growth Pact, with a lower limit of a structural deficit of 0.5 per cent of the gross domestic product at market prices*". This amounts to simulating the model with structural deficit exogenously constrained at $ds_t = 0.5$.

The Fiscal Compact implicitly assumes that once the 60 per cent debt threshold is attained the structural balance rule becomes binding. This would imply that the debt ratio keeps decreasing until it stabilizes at 10.5 per cent of GDP, converging to a steady state different from the other rules. More substantially, whether the one twentieth rule or the structural balance rule is more binding depends on the nominal growth of the economy and the level of debt. If the nominal growth rate g (with $g = x_t + \bar{y} + \pi$) is above 5 per cent, then the structural balance rule is always more restrictive. If the nominal growth rate *g* is below 5 per cent, the level of debt under which the structural balance rule is more restrictive is 120 per cent of GDP for *g*=3%, 82 for *g*=2% and 50 for *g*=0%. Therefore by deciding to focus on the one twentieth rule which is consistent with the Maastricht steady-state, we can reasonably argue that countries follow the least restrictive arm of the Fiscal Compact.

2.3 The steady-state

We use a Newton algorithm to compute the simultaneous solution for the equations of the model for every period, and compute a numerical simulation of the trajectory of the model's solution. The solution technique is described in Juillard (1996).

The model has a steady state with a potential real growth rate y^* of the economy exogenously set at 3 per cent, in accordance with the underlying hypotheses of the European Union Treaty. The real natural interest rate rr^* also equals 3 per cent, the debt target b^* is 60 per cent and the inflation target π^* is 2 per cent, for a nominal growth rate in steady state of 5 per cent. At the steady-state, public deficit is therefore equal to interest payments ($\overline{dt} = \overline{ip} = 3\%$), and primary structural balance is achieved ($\overline{dsp} = 0$).

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[3] The letter of the Treaty is ambiguous, (TSCG, 2012; and Whelan, 2012) and it is usually associated with the requirement to reach the level of 60 per cent in 20 years. Nevertheless discussions with Commission officials and economists lead to interpret the rule as asymptotic convergence.

Table 1

Steady State Values for Endogenous Variables

$\overline{x}$	0
$\overline{\pi}$	π^*
$\overline{r}$	$rr^* + \pi^*$
$\overline{i}$	$rr^* + \pi^*$
$\overline{dt}$	3
$\overline{dc}$	0
$\overline{ds}$	3
$\overline{ip}$	3
$\overline{dsp}$	0
$\overline{b}$	b^*

The three fiscal rules that we assess make the economy converge to the Maastricht steady state, both in the scenario of fiscal consolidation from current debt and deficit levels, and in the scenario of an economy at steady state which is hit by supply and demand shocks.

2.4 Calibration

The output gap and inflation rate in the expectational IS and Phillips curve equations are introduced with both forward and backward components (α_1 = 0.4 and λ_1 = 0.5). For the IS-augmented curve, this seems to be a reasonable hypothesis considering the average results by Fuhrer and Rudebusch (2004) over a wide range of estimations. Estimations by Goodhart and Hofmann (2005), however, point to a relatively lower incidence of forward-looking expectations for the US and Euro area economies, which would put α_1 in the range of [0.2, 0.4]. The parameters of the expectations-augmented-Phillips curve are more controversial (and estimations are more numerous). Galí *et al.* (2005) and Goodhart and Hofmann (2005) find that the coefficient on lagged inflation is rather modest (around 0.2-0.3). Rudd and Whelan (2006), on the contrary, conclude that the forward-looking component is not significant, and a recent evaluation drawing on survey-based expectations concludes that the hybrid Phillips curve (with a backward component) outperforms the New-Keynesian Phillips curve with no inflation persistence, finding that the forward-looking coefficient is close to $\lambda_1 = 0.5$ (see Paloviita, 2008). We decide to follow this road, which is agnostic with respect to a debate that is yet unsettled.

Table 2 reports the parameters in the simulations. The coefficient value of the incidence of the output gap in the hybrid Phillips curve is close to Paloviita's (2008) estimate. The parameters in the monetary rule are taken from Taylor (1993). The targets are consistent with the Maastricht Treaty and the Stability and Growth Pact's requirements, and with the model's steady state. We introduce two different values for the coefficient of the fiscal impulse in the expectational IS equation, in order to take into account the larger external leakage of domestic fiscal policy in a small open economy. It is worth noticing that even for large countries the fiscal multiplier in this calibration is significantly smaller than recent estimates (e.g., IMF, 2012) and is in line with the modeling literature for the euro zone (Smets and Wouters, 2003; Dieppe *et al.*, 2005; Adolfson *et al.*, 2007; Coenen *et al.*, 2008; Christoffel *et al.*, 2009; Ratto *et al.*, 2009; Cogan *et al.*, 2010; Gelain, 2010; and Cwik and Wieland, 2011). Our choice of the fiscal multiplier is well below the value that risks triggering the vicious circle of austerity and economic contraction that some European peripheral countries have been experiencing since early 2010s. In other words, our estimates of the output cost of fiscal consolidation, are based on a conservative fiscal multiplier, and therefore can be interpreted as a lower bound.

The theoretical and empirical uncertainty about many of these parameters (especially α_1 and λ_1) requires thorough robustness checks. The results of Monte Carlo simulations are reported in Section 4.

Table 2

Calibration Parameter Values

α_1	0.4
α_2	–0.2
α_3	0.8 (large country / 0.2 (small country)
λ_1	0.5
λ_2	0.2
γ	0.02
Φ_1	0.5
Φ_2	0.5
Δ	1
ψ_1	–0.5
y^*	3%
r^*	3%
b^*	60%
π^*	2%
discount rate	0.95 [=1/1.05]

3 Simulations

To our knowledge, there are very few examples of papers attempting at the evaluation of different fiscal rules in the EU context. Most recent papers dealing with this issue focus on one type of rule, like an expenditure rule (e.g., Hauptmeier *et al.*, 2011), whereas those which study different rules use the classification by Kopits and Symansky (1998) (see, e.g., Creel and Saraceno, 2010; and Schuknecht *et al.*, 2011). In contrast, Creel *et al.* (2012) performed a comparison between various fiscal rules within a simple estimation exercise in the vein of Eichengreen and Wyplosz (1998) and Monperrus-Veroni and Saraceno (2005). These exercises start from a simple reduced form VAR system and the estimation results are the basis for a counterfactual assessment of the effect of alternative fiscal rules. While not exempt from a number of methodological problems, the paper by Eichengreen and Wyplosz and the followers using a similar methodology retained a remarkable interest because they give a measure of the magnitude of costs and benefits of the SGP and of other rules. Our analysis completes these results; instead of relying on an estimated model, it builds on a theoretical model, and the differences among countries are given by the value of the fiscal multiplier in the output gap equation and by the initial conditions of public finance variables.

We first discuss the application of the different fiscal rules to a consolidation occurring in the four countries starting from current conditions; and then we examine the case of supply and demand shocks hitting an economy at the Maastricht steady state.

3.1 Fiscal consolidation

The economy starts from 2011 levels of deficit and debt, and is tracked for a time span of 20 years. We decided to focus on fiscal consolidation abstracting from the *initial* size of the output gap and inflation which, as a consequence, in the simulations are set at their steady state values

(0 for the output gap and the 2 per cent central bank target for inflation).[4] Initial debts and deficits for the four countries under study are 2011 OECD figures. They are reported in Table 3 below. France and Italy are larger countries than Belgium and the Netherlands; hence, by assumption, the fiscal multiplier is equal to 0.8 for the former and 0.2 for the latter.

Figures 1 and 2 show output gap and inflation, together with interest rates and the public finance variables, for France. The figures for the other countries are qualitatively similar and are presented in the Appendix.

Table 3

Initial Debt and Deficit Values, 2011

Country	Initial Debt	Initial Structural Primary Deficit	Fiscal Multiplier*
France	86	1.45	0.8
Italy	120	–2.34	0.8
Belgium	98	0.78	0.2
Netherlands	65	2.53	0.2

* Authors' assumption.
Source: OECD.

The economy starts outside the steady state equilibrium to capture the effects of a fiscal consolidation. The initial impulse stems from how fiscal rules applied in period one constrain the primary structural deficit which therefore impacts the economy. For instance, in the case of the status quo, the initial impulse brings total deficit back to 3 per cent of GDP at period one when the rule is set up. Before discussing the outcome of each rule, it is worth pointing out two things. First, all the rules yield long run convergence of output gap, inflation, and public finance variables, towards their steady state levels. Furthermore, debt dynamics are comparable: the debt ratio steadily decreases albeit at different rates. The second feature that is common to all the rules is the deep recession induced by fiscal consolidation in the short run, which may even be deflationary and results in a sharp drop of interest rates.

Looking at the rules in detail, the Fiscal Compact yields the larger initial drop of output (Figure 1, upper panel), which causes deflation in the medium run (lower panel). The status quo's output drop is larger than the one of the investment rule, whereas inflation dynamics are quite similar for these two rules. On the other hand, the long run reduction of debt is more substantial with the Fiscal Compact than for the other rules (Figure 2, upper-left panel). The central bank interest rate drops below two percent, and as a consequence interest payments are lower than in the two other rules. This in turn yields faster debt reduction in the medium to long run.

To compare the different rules, we computed for each country (*i.e.*, with different initial public finances values) the average of the discounted variables of interest (assuming a discount rate of 5 per cent). They are reported in Table 4. The table shows that for the four countries the average

[4] If we began with the current values of the (negative) output gap and inflation, the initial drop of output would be larger, and the interest rate would hit the zero lower bound earlier.

loss of output is lower in the case of the investment rule. For the small countries the status quo also minimizes discounted cumulative loss, which can be explained by the assumption of a smaller fiscal multiplier. In addition, the investment rule is associated with lower output variability for all countries except the Netherlands. As can be guessed from Figures 1 and 2, this can most probably be attributed to the lesser recessionary impact in the early phase of the consolidation process. In all cases, the visual impression of Figure 1 for France is confirmed, and the Fiscal Compact fares worse than the other rules.

As regards inflation, the investment rule yields a lower inflation gap to its target on average, and the status quo exhibits lower variability. As expected, on the other hand, the Fiscal Compact yields substantially lower debt levels at t=20. One additional remark refers to the application of the Fiscal Compact in Italy. Setting the γ parameter on the risk premium in the government bonds' interest rates equation to 0.02 as for other simulations prevents the economy to converge back to the steady-state, possibly because of the high initial level of debt. The

Figure 1

Fiscal Consolidation Under Different Rules: France

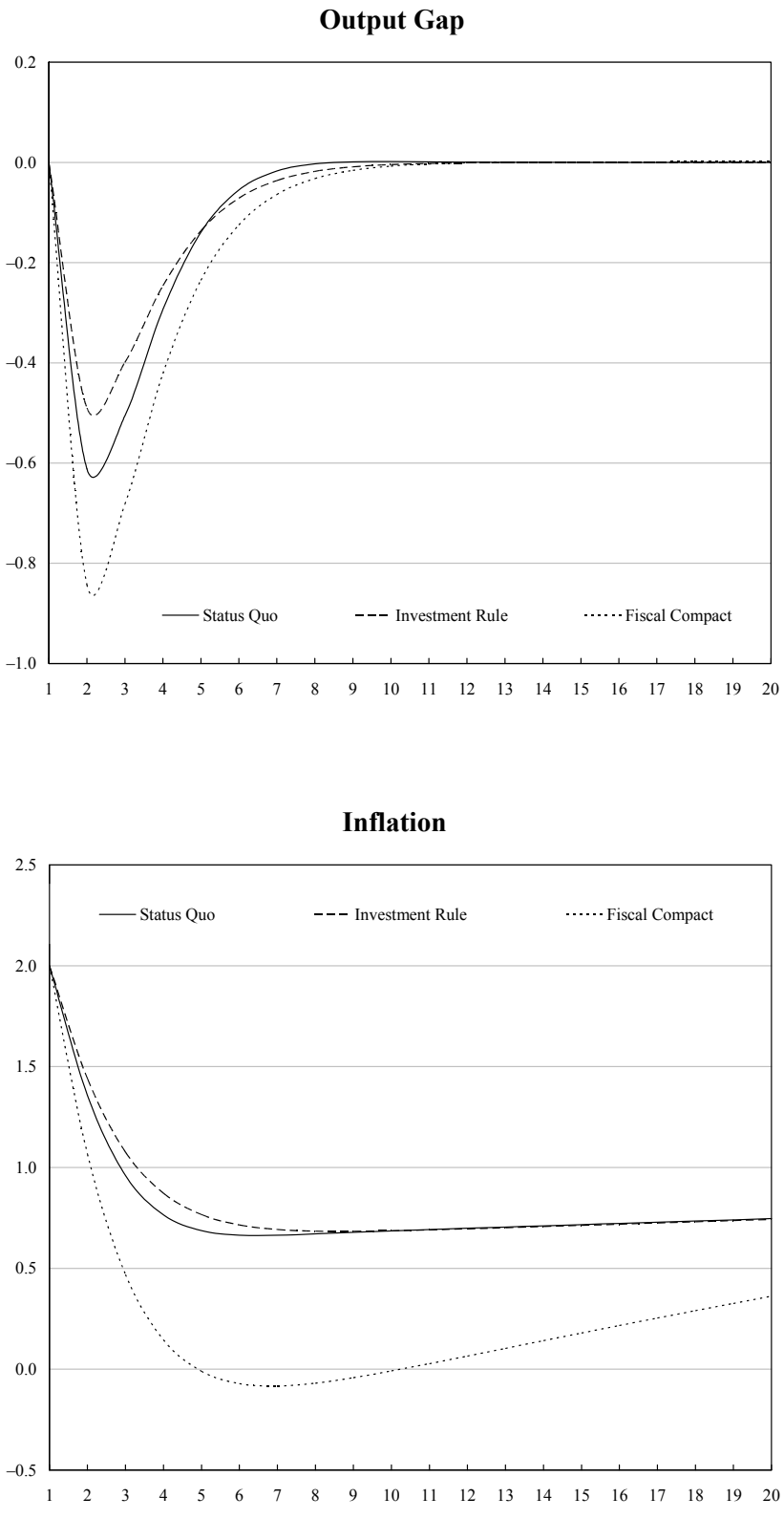


Figure 2

Fiscal Consolidation Under Different Rules: France (Fiscal Variables)

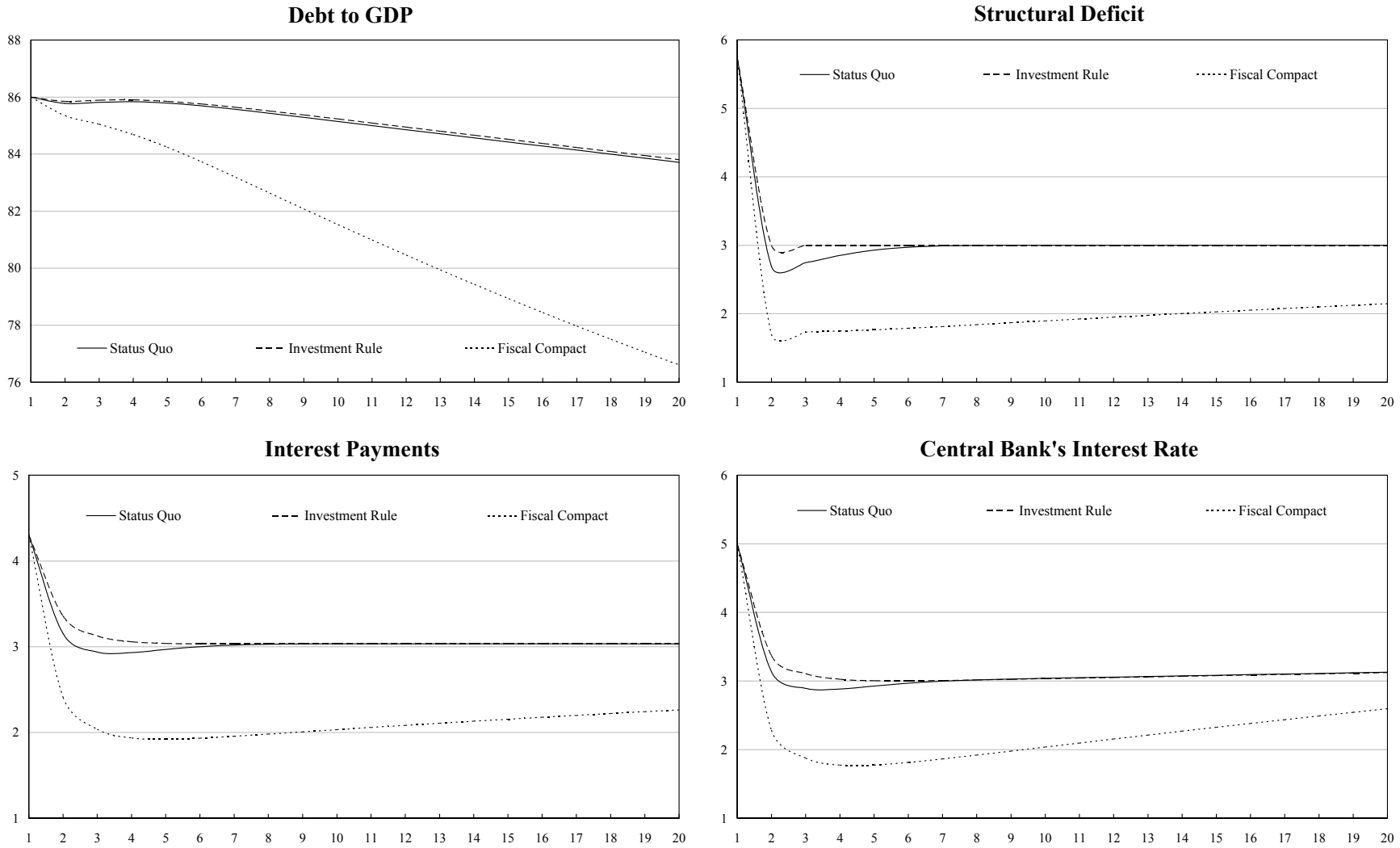


Table 4

Discounted Average Values of the Rules for 20 Years

France

	Status Quo	Inv. Rule	Fiscal Compact
mean(x)	–0.07	–0.06	–0.10
s.d.(x)	0.16	0.13	0.22
mean(π)	0.54	0.56	0.20
s.d.(π)	0.39	0.40	0.46
mean(ds)	1.97	2.00	1.36
s.d.(ds)	0.93	0.95	0.99
b (t=20)	83.71	83.80	76.60

Italy

	Status Quo	Inv. Rule	Fiscal Compact*
mean(x)	–0.13	–0.11	–0.15
s.d.(x)	0.30	0.25	0.32
mean(π)	–0.09	–0.07	–0.18
s.d.(π)	0.53	0.53	0.57
mean(ds)	1.84	1.90	0.55
s.d.(ds)	0.55	0.61	0.71
b (t=20)	120.59	120.75	90.21

Belgium

	Status Quo	Inv. Rule	Fiscal Compact
mean(x)	–0.07	–0.07	–0.10
s.d.(x)	0.13	0.12	0.19
mean(π)	0.38	0.38	0.11
s.d.(π)	0.44	0.45	0.50
mean(ds)	1.96	2.00	1.13
s.d.(ds)	0.92	0.94	1.01
b (t=20)	93.83	94.20	80.40

Netherlands

	Status Quo	Inv. Rule	Fiscal Compact
mean(x)	–0.01	–0.01	–0.02
s.d.(x)	0.02	0.02	0.03
mean(π)	1.11	1.11	1.07
s.d.(π)	0.35	0.36	0.34
mean(ds)	2.00	2.00	1.89
s.d.(ds)	0.95	0.96	0.95
b (t=20)	63.86	63.92	62.30

* The fiscal compact enables convergence back to the steady-state in Italy only if gamma = 0. The simple average values are presented in Table 9 in the Appendix.

convergence in the Italian case thus required to set γ to zero. Even in this case, with no market penalty for large debt, the Fiscal Compact yields a larger output loss than alternative rules.

Setting aside the investment rule, which is currently not an option in the policy debate, we can observe that the status quo performs considerably better than the 5 per cent debt reduction rule in terms of macroeconomic performance.

To conclude, for all possible initial situations (large and small countries; high and low initial debt), the model yields the unequivocal result that implementing the investment rule would minimize the average loss of output, and would also prove less deflationary than the different EU fiscal rules. Among these, the status quo is largely to be preferred if we use the output gap as a metrics, while the debt reduction rule is less inflationary and yields faster debt reduction. The simulations show that relatively larger structural deficits are not necessarily inconsistent with output stabilization and public finances sustainability. Because of depressed growth, debt ratios may actually decrease less than actually planned during fiscal consolidation.

Table 5

Response to Demand and Supply Shocks Starting from Steady State
(average discounted values over 20 years)

Small Countries – Fiscal Multiplier = 0.2

Negative Demand Shock			
	Status Quo	**Inv. Rule**	**Fiscal Compact**
mean(x)	–0.05	–0.05	–0.05
s.d.(x)	0.21	0.19	0.19
mean(π)	1.14	1.13	1.12
s.d.(π)	0.29	0.29	0.29
mean(ds)	1.84	1.87	1.83
s.d.(ds)	0.50	0.54	0.53
b (t=20)	61.27	61.53	60.93

Positive Supply Shock			
	Status Quo	**Inv. Rule**	**Fiscal Compact**
mean(x)	0.07	0.07	0.07
s.d.(x)	0.14	0.12	0.12
mean(π)	1.12	1.11	1.11
s.d.(π)	0.30	0.29	0.29
mean(ds)	1.91	1.87	1.87
s.d.(ds)	0.59	0.54	0.53
b (t=20)	60.39	60.03	60.01

Large Countries – Fiscal Multiplier = 0.8

Negative Demand Shock			
	Status Quo	**Inv. Rule**	**Fiscal Compact**
mean(x)	–0.04	–0.03	–0.03
s.d.(x)	0.19	0.14	0.13
mean(π)	1.17	1.18	1.16
s.d.(π)	0.31	0.32	0.32
mean(ds)	1.85	1.87	1.85
s.d.(ds)	0.51	0.54	0.53
b (t=20)	60.90	60.92	60.65

Positive Supply Shock			
	Status Quo	**Inv. Rule**	**Fiscal Compact**
mean(x)	0.10	0.08	0.08
s.d.(x)	0.23	0.17	0.17
mean(π)	1.19	1.15	1.16
s.d.(π)	0.31	0.30	0.30
mean(ds)	1.92	1.87	1.88
s.d.(ds)	0.61	0.54	0.53
b (t=20)	59.62	59.50	59.64

3.2 Supply and demand shocks at the steady-state

The previous section dealt with the performance of the different rules during a fiscal consolidation process, starting from high debt ratios. Our next question is how these rules would affect the dynamics of the economy if it were hit by a demand shock (in the output gap equation) or by a supply shock (in the Phillips curve equation) when at the steady state. Both shocks are temporary shocks with the value of each exogenous variable namely ε^d and ε^s being equal to minus one during one period. The results are summarized in Table 5, where we distinguish between "small" countries (with a low fiscal multiplier) and "large" ones (with a large fiscal multiplier).

The table shows first that the differences between the fiscal rules are very marginal, a result that is not surprising given that we are studying adjustments close to the steady state. When the economy is hit by demand and supply shocks at the steady state, none of the rules emerges as

Table 6

Smoothing Over the Business Cycle

Investment Rule				
Fiscal Consolidation – France				
	1y	**2y**	**5y**	**10y**
mean(x)	–0.06	–0.04	0.01	0.09
s.d.(x)	0.13	0.08	0.21	0.55
mean(π)	0.56	0.57	0.63	0.74
s.d.(π)	0.40	0.43	0.52	0.80
mean(ds)	2.00	2.03	2.14	2.32
s.d.(ds)	0.95	1.00	1.23	1.84
b (t=20)	83.80	83.76	83.53	82.99

Average discounted values over 20 years. δ equals 0.5, 0.2 and 0.1 for 2, 5 and 10 years respectively.

superior. The status quo seems slightly worse than the two others regarding the variance of output, while the Fiscal Compact appears better, at the margin, regarding the debt level. The reader should bear in mind, however, that as this is a rule designed to come back to the debt reference level of 60 per cent of GDP, its rationale seems quite limited for policymakers when debt is close to the steady state.

Although not surprising, the outcome of these simulations is important. Two interpretations are possible. On the one hand, the Maastricht rule – the status quo – is not worse than alternative rules, which vindicates the claim that in normal times this rule gives sufficient fiscal margins for maneuver (see, e.g., Buti and Giudice, 2002). On the other hand, the rule is not superior to the two others despite the fact that the simulation takes place exactly at the Maastricht steady state. The lack of enforcement of the Maastricht rule by EU governments has certainly had to do with the costly convergence path that we described in the previous section as well as with the absence of relative advantage of this rule at the steady state.

3.3 The lower bound of the investment rule

It is worth recalling that our simulations are partly biased against the use of the investment rule, since we rule out the endogeneity of potential output, which could be positively affected by public investment. Indeed, we consider the negative effect of public investment on output and public debt – through the interest rate and risk-premia. The crowding-out effect of public debt and deficit *via* interest rates (implicitly) on capital accumulation and (explicitly) on output is included in the model, in contrast with the probable effects of public investment as education, health or infrastructures on the potential of the economy.

Moreover, we deliberately set the smoothing parameter of expenditures δ in the investment rule to 1 which is equivalent to assuming that interest payments are not spread over many years but financed by a current surplus. Relaxing this assumption and smoothing the financing of interest

payments and the cost of consolidation over different periods of time yields very different outcomes. Table 6 shows the macroeconomic performance of the investment rule in France for different values of δ. As expected, smoothing the consolidation over several years reduces the restrictiveness of the rule: the output loss is smaller over 2 years or even turns to an output gain over 5 or 10 years. The inflation gap to the target is smaller when the smoothing horizon increases. On the other hand, output and inflation volatility increases. This is not the more interesting result, however. One would expect that a more gradual financing of interest charges, driven by higher and more persistent deficits, would come at the expense of a higher debt ratio. However, there is no such tradeoff: the debt ratio at t=20 is smaller, for all three longer horizons, than in the 1-year case. This result mirrors the situation where debt ratios may actually decrease less than actually planned because of depressed growth during fiscal consolidation; here debt ratios may actually decrease more rapidly thanks to preserved growth when fiscal consolidation is smoothed.

4 Robustness

The results of our simulations show that the investment rule fares better in terms of output performance than the two other rules in the fiscal consolidation scenario. That results was obtained with a particular set of parameter values, as described in Section 2.4. While these values are all reasonable, we need to check for the robustness of this result, performing a Monte Carlo experiment over the space of the most relevant parameters. The objective is to make sure that the comparison between the three rules has not been dependent on the particular set of parameter chosen in Table 2.

We investigate the most representative parameters, *i.e.*, the ones capturing the degree of backward looking expectations in the IS and Phillips curves (α_1 and λ_1 respectively); the impact of real interest rates (α_2) and of the fiscal impulse (α_3) on the output gap (IS curve); the impact of the output gap on inflation in the Phillips curve (λ_2); the risk premium in the government bonds' interest rates equation (γ), and the initial levels of debt (b_{init}) and structural primary deficit (dsp_{init}).

The simulation is conducted as follows:

a) we make random draws of the parameters, within a certain range chosen to be consistent with most of the existing literature;
b) for each draw, we simulate the model for the three rules and select the run only if they all converge;
c) we record the average of discounted output gap and inflation values for each rule, and each parameter draw, over 20 periods.

The range of the 8 parameters random draws is reported in Table 7. We ran 11,000 simulations, and for about 96 per cent of them (10,591), the solution algorithm converged for the three rules. Non-convergence was most of the time due to the Fiscal Compact rule and to high values of γ the parameter capturing the risk premium in the government bonds' interest rates equation.

The 10591 converging iterations form our dataset. In Table 8, we report the descriptive statistics for the average of discounted output gap and inflation over the twenty years following the adoption of each of the three rules.

The results are remarkably stable and insensitive to large changes in parameters. The standard deviation of the average of the discounted output gap and inflation is higher for the one twentieth rule than for the two other rules. This confirms that the debt reduction rule, even if it converges, is more sensitive than the others to parameter variations.

Turning at the analysis of the results, we show that the investment rule fares significantly better than the others (the difference is significantly different from zero). The investment rule always provides the lowest output loss and inflation gap *vis-à-vis* the inflation target. Were the investment rule applied during the consolidation process, then the cost in terms of output gap would be of approximately one half lower than for the Fiscal Compact rule, over the parameters range. The sensitivity analysis run with this Monte Carlo experiment therefore confirms that the result according to which the investment rule outperforms the others in term of output loss is strongly robust to large parameters changes.

Table 7

Parameter Ranges for the Monte Carlo

Parameter	Range
α_1	[0.1 , 0.8]
α_2	[–0.9 , –0.1]
α_3	[0.2 , 0.8]
λ_1	[0.2 , 0.8]
λ_2	[0.1 , 0.5]
γ	[0 , 0.03]
b_{init}	[60 , 100]
dsp_{init}	[–1 , 4]

5 Conclusion

This paper evaluates the macroeconomic impact of a set of different fiscal rules that were, will, or might be implemented in Europe. We simulate a small-scale New Keynesian model with both forward- and backward expectations. The calibration draws on the existing literature and on the 2011 values of public finance data of 4 eurozone countries which we take as representative of the different types of eurozone member states. The three fiscal rules are: the status quo 3 per cent limit on public deficit, a debt reduction scheme and an investment rule in the vein of the UK golden rule of public finances.

Table 8

Monte Carlo Simulation

	Output Gap			Inflation		
	Status Quo	**Inv. Rule**	**Fiscal Compact**	**Status Quo**	**Inv. Rule**	**Fiscal Compact**
mean	–0.037	–0.035	–0.059	0.819	0.826	0.658
s.d.	0.040	0.039	0.052	0.256	0.253	0.349
min	–0.407	–0.399	–0.500	0.132	0.133	–0.278
max	0.000	0.000	0.000	1.246	1.246	1.246

Average over the 10591 simulations of the discounted sum of output gap and inflation.

We focus on two different scenarios. The first involves assessing the path followed by the four economies under each fiscal rule under fiscal consolidation from 2011 debt and deficit levels, towards the Maastricht steady state. The second assesses the impact of demand and supply shocks affecting the economy at the steady state.

The main results are first that abiding by the rules produces in all cases a short-run recession, even in a country with a small fiscal multiplier and a low initial public debt like the Netherlands. Second, during a consolidation phase, the investment rule performs better than the other rules: the recession is milder and shorter, thus leading to a substantially lower average loss of output over a 20-year horizon. Third, if the economy is hit by a demand or supply shock at the steady state, none of the rules emerges as superior in coping with them.. Finally, the Fiscal Compact, with its constant debt reduction rule, generally imposes large costs to the economy, while not necessarily performing better in terms of public finances' sustainability. These results are robust to parameters changes.

This leads to a general concluding remark. The Fiscal Compact requires a constant debt reduction, together with a "semi-balanced" (at 0.5 per cent) structural deficit. This implies that, once the target level of 60 per cent is reached, the debt ratio will continue to decrease, led by the structural deficit balance. Our results show that these rules are extremely costly, in terms of output loss, if compared to the investment rule or even the status quo. Such a drastic consolidation strategy embedded into EU constitutional laws threatens future macroeconomic performances of eurozone countries.

APPENDIX

Table 9

Simple Average Values of the Rules for 20 Years Fiscal Consolidation Scenario

France

	Status Quo	Inv. Rule	Fiscal Compact
mean(x)	–0.08	–0.07	–0.12
s.d.(x)	0.18	0.14	0.24
mean(p)	0.82	0.84	0.27
s.d.(p)	0.32	0.33	0.48
mean(ds)	3.10	3.14	2.11
s.d.(ds)	0.63	0.61	0.87
b (t=20*)*	83.71	83.80	76.60

Italy

	Status Quo	Inv. Rule	Fiscal Compact*
mean(x)	–0.15	–0.13	–0.18
s.d.(x)	0.34	0.28	0.37
mean(p)	–0.26	–0.23	–0.35
s.d.(p)	0.62	0.63	0.66
mean(ds)	2.96	3.03	0.91
s.d.(ds)	0.23	0.15	0.78
b (t=20*)*	120.59	120.75	90.21

Belgium

	Status Quo	Inv. Rule	Fiscal Compact
mean(x)	–0.08	–0.08	–0.12
s.d.(x)	0.15	0.14	0.22
mean(p)	0.53	0.53	0.11
s.d.(p)	0.43	0.43	0.55
mean(ds)	3.09	3.13	1.77
s.d.(ds)	0.61	0.60	0.95
b (t=20*)*	93.83	94.20	80.40

Netherlands

	Status Quo	Inv. Rule	Fiscal Compact
mean(x)	–0.01	–0.01	–0.02
s.d.(x)	0.02	0.02	0.03
mean(p)	1.78	1.78	1.72
s.d.(p)	0.06	0.07	0.09
mean(ds)	3.13	3.14	2.97
s.d.(ds)	0.62	0.62	0.66
b (t=20*)*	63.86	63.92	62.30

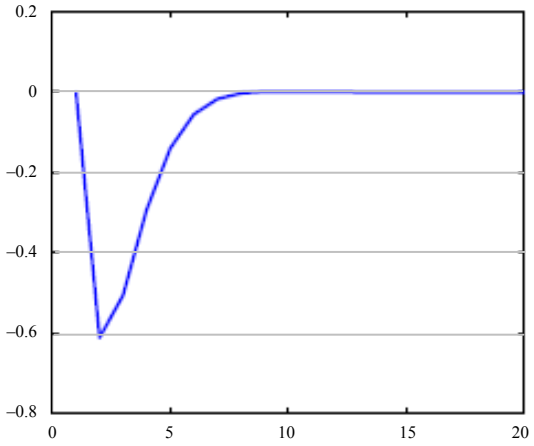
Average discounted values over 20 years.

* The fiscal compact enables convergence back to the steady-state in Italy only if gamma = 0.

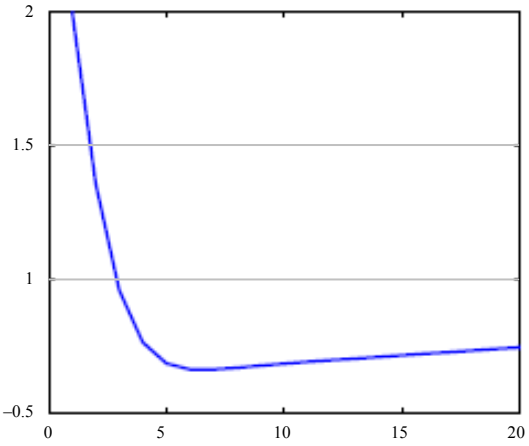
FRANCE

Status Quo

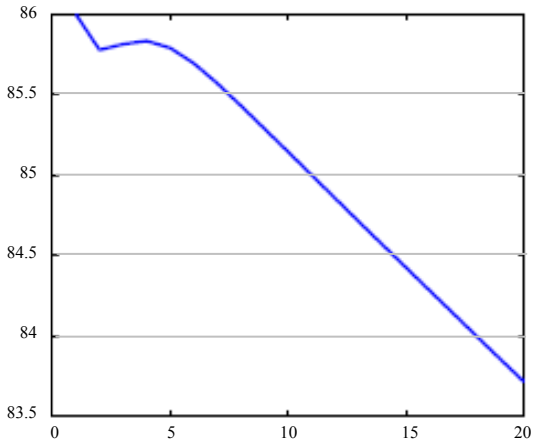
Output Gap



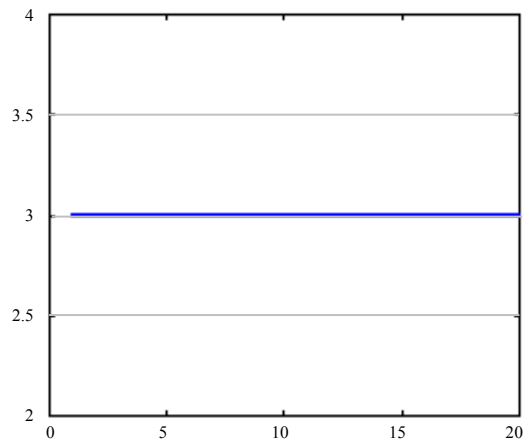
Inflation



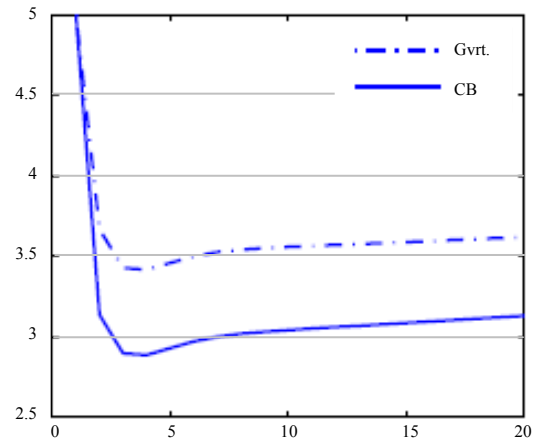
Debt to GDP



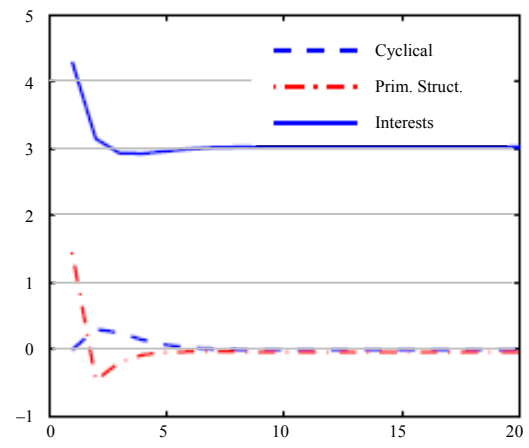
Total Budget Deficit



Nominal Interest Rates



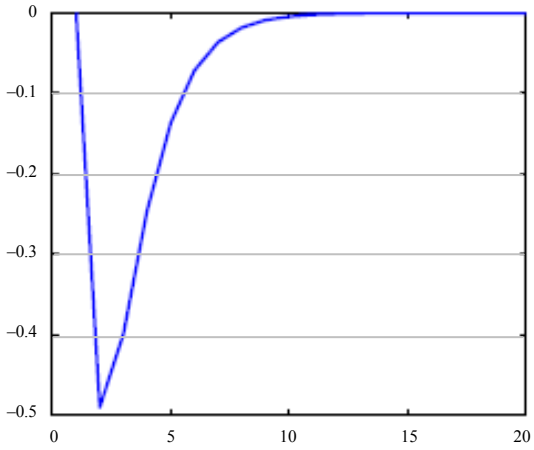
Other Budget Deficits



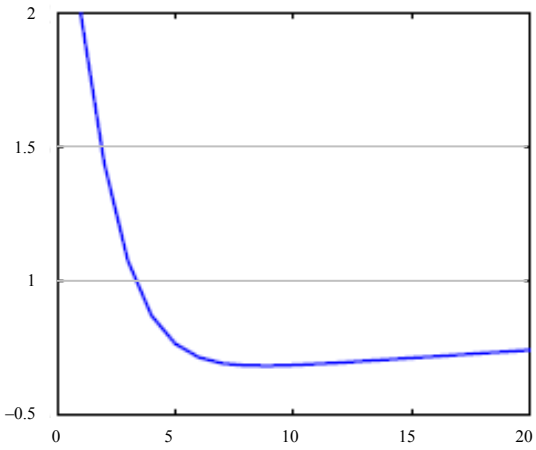
FRANCE

Investment Rule

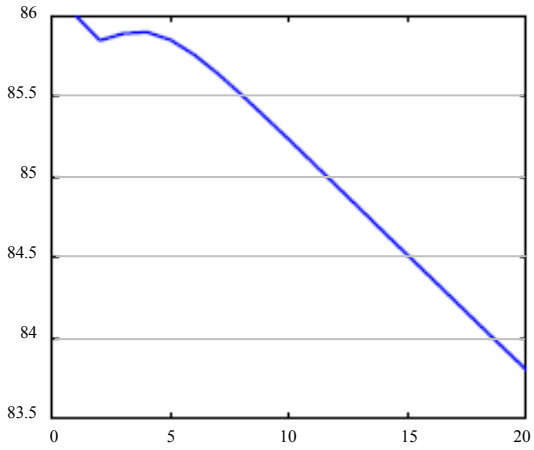
Output Gap



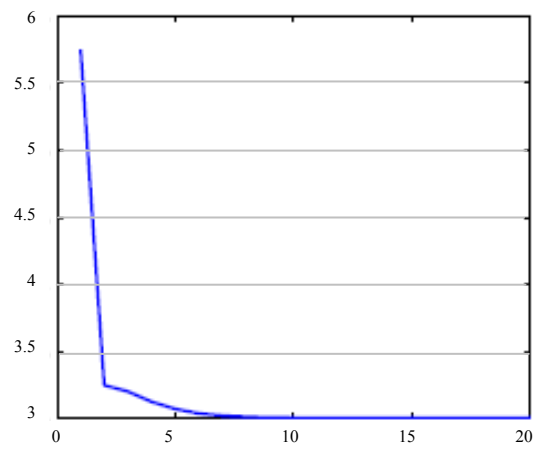
Inflation



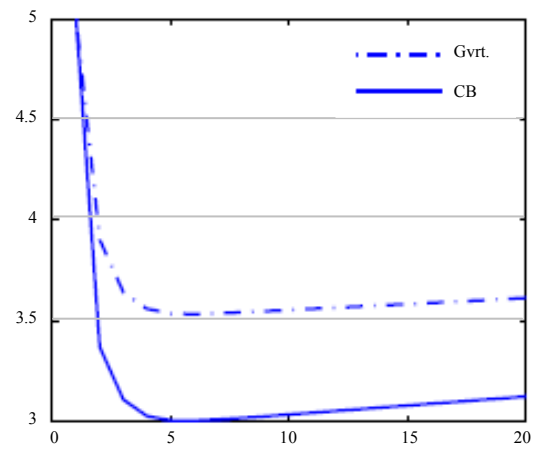
Debt to GDP



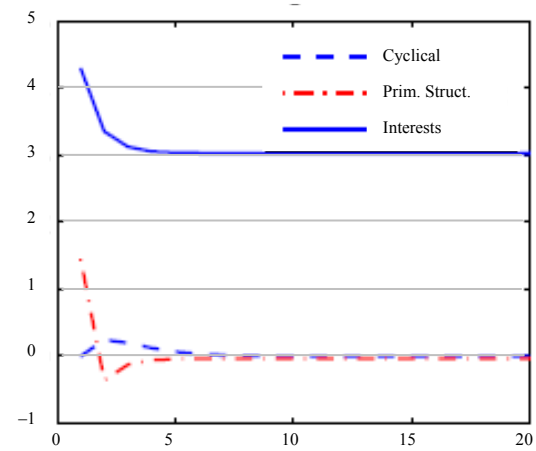
Total Budget Deficit



Nominal Interest Rates



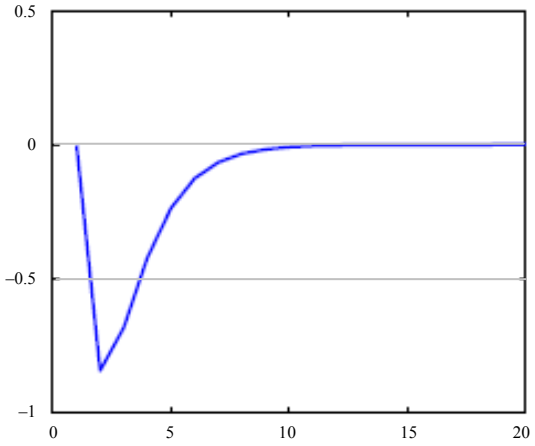
Other Budget Deficits



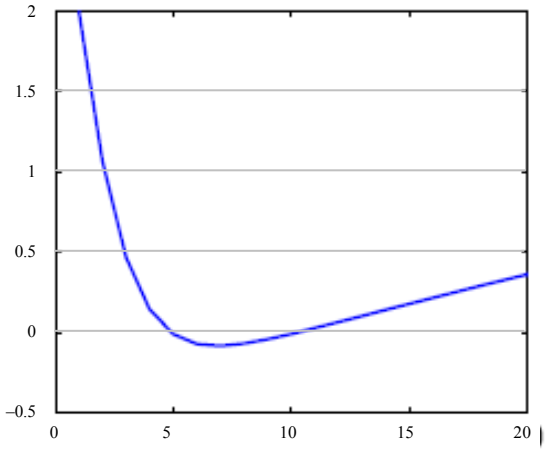
FRANCE

Fiscal Compact

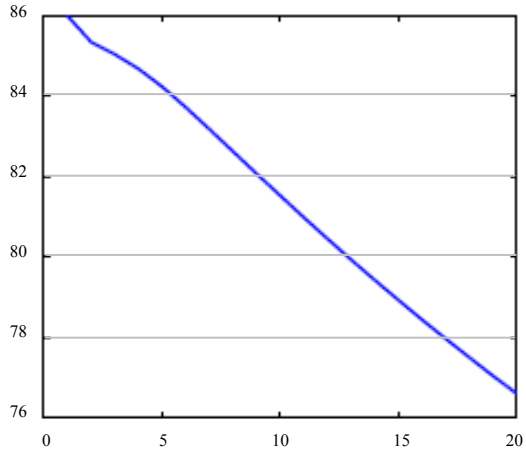
Output Gap



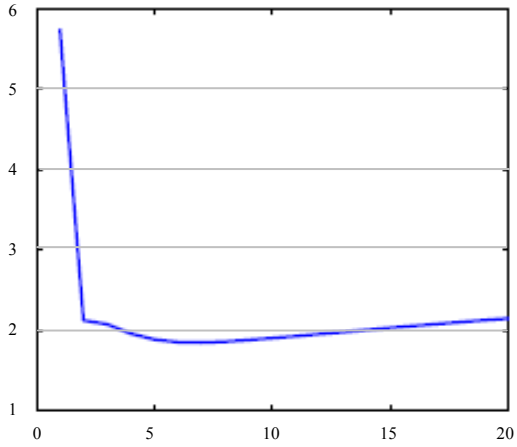
Inflation



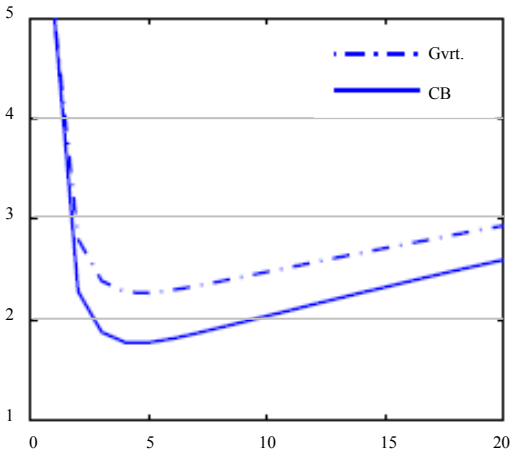
Debt to GDP



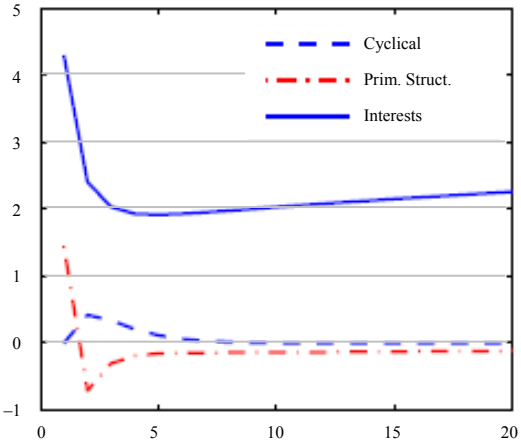
Total Budget Deficit



Nominal Interest Rates



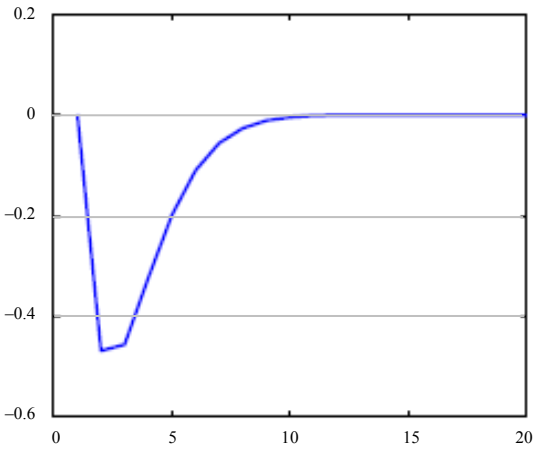
Other Budget Deficits



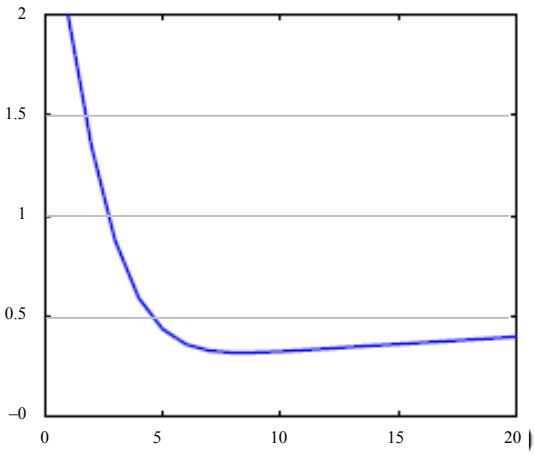
BELGIUM

Status Quo

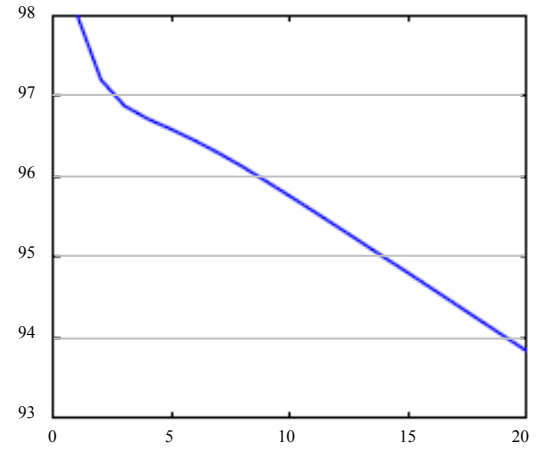
Output Gap



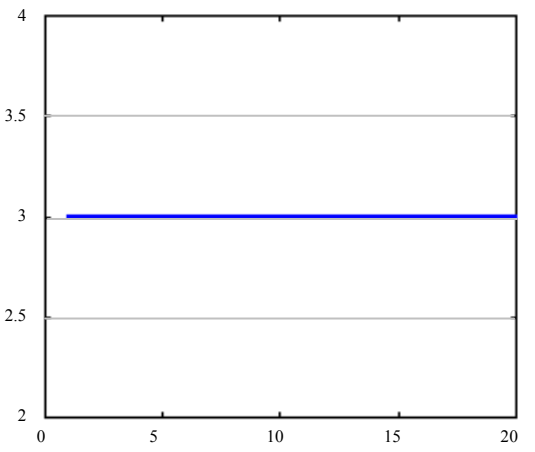
Inflation



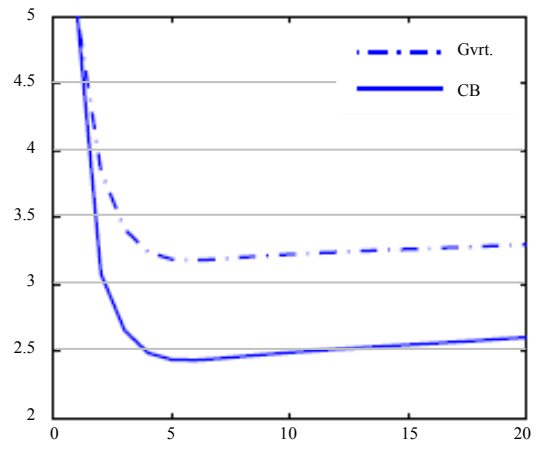
Debt to GDP



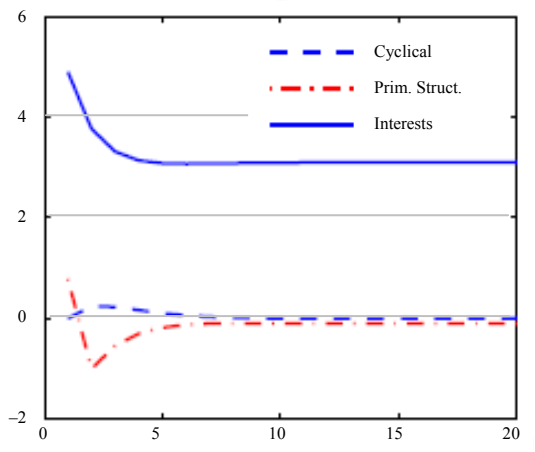
Total Budget Deficit



Nominal Interest Rates



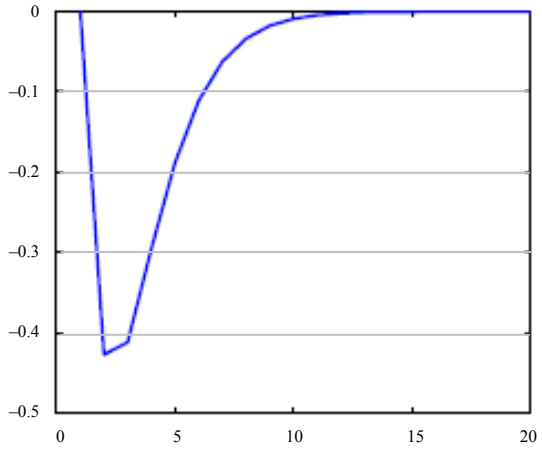
Other Budget Deficits



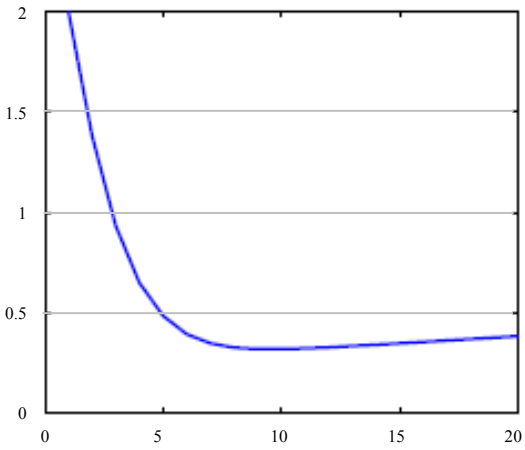
BELGIUM

Investment Rule

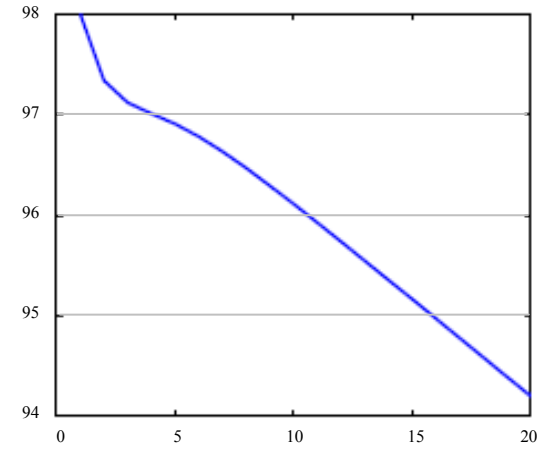
Output Gap



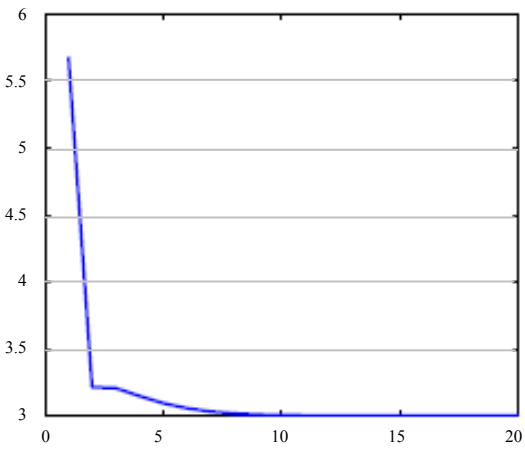
Inflation



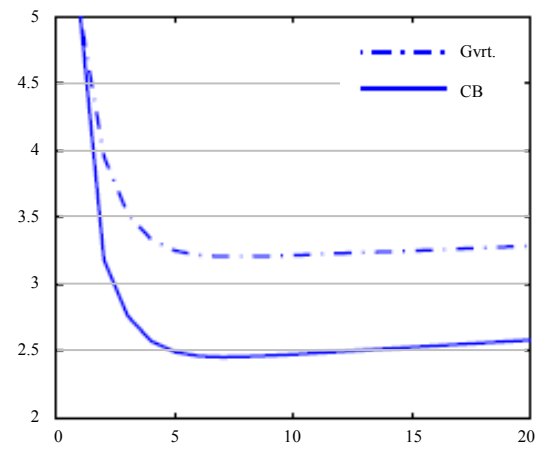
Debt to GDP



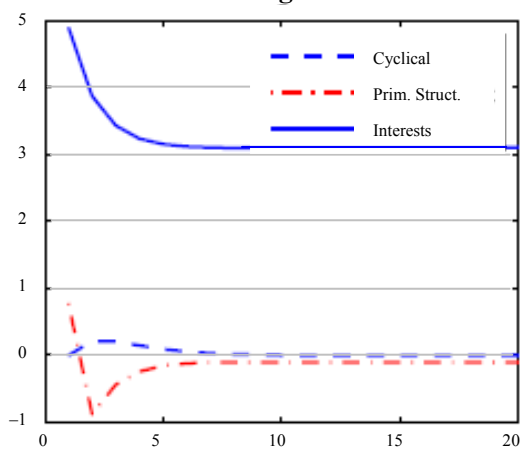
Total Budget Deficit



Nominal Interest Rates



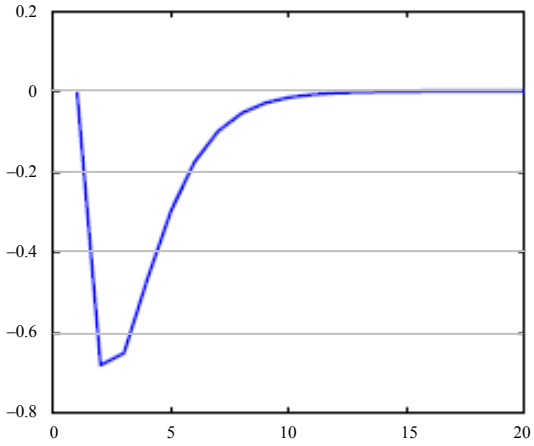
Other Budget Deficits



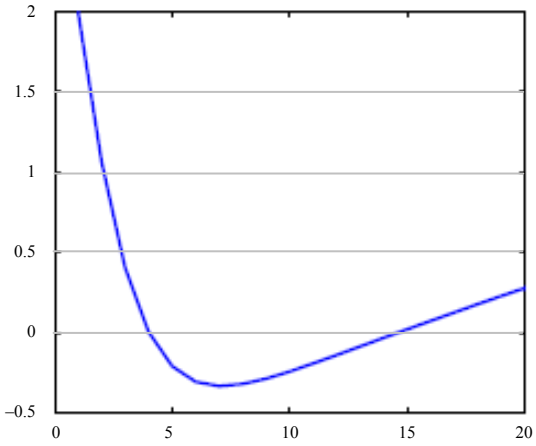
BELGIUM

Fiscal Compact

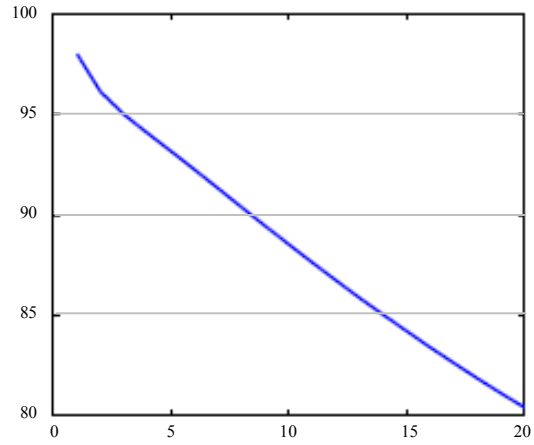
Output Gap



Inflation



Debt to GDP



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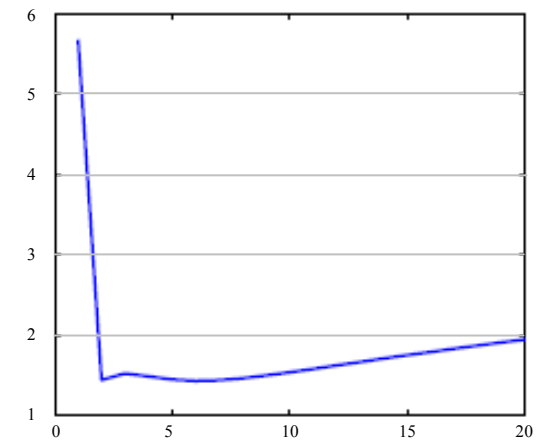
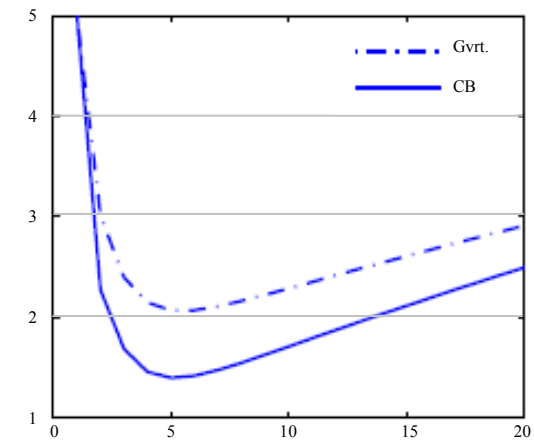
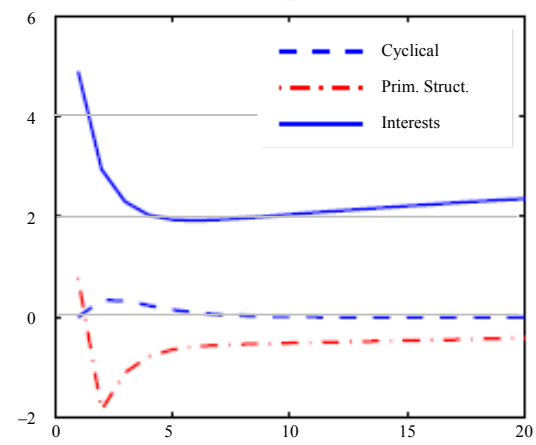


Nominal Interest Rates



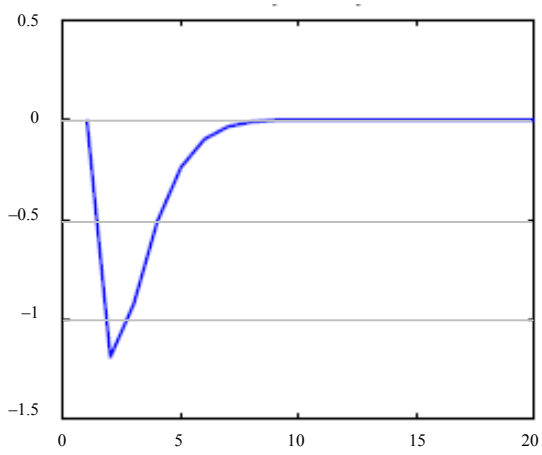
Other Budget Deficits



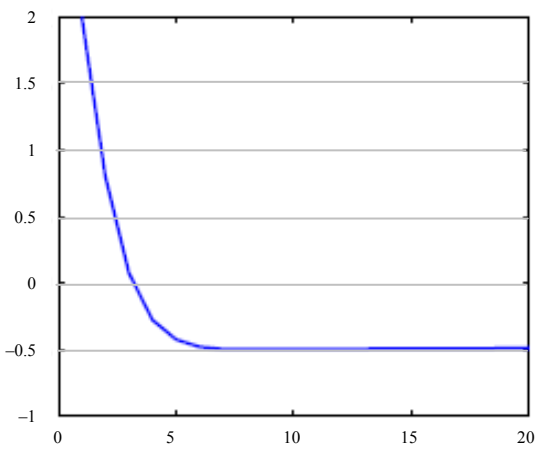
ITALY

Status Quo

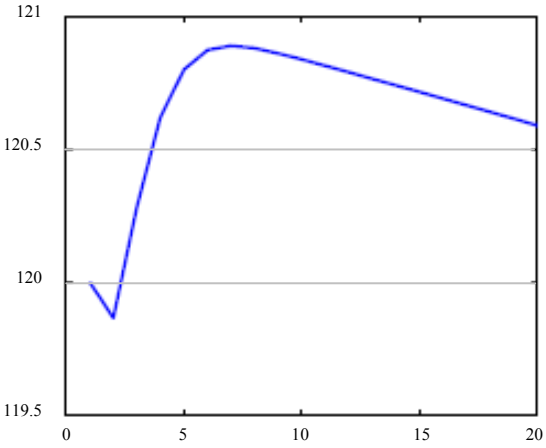
Output Gap



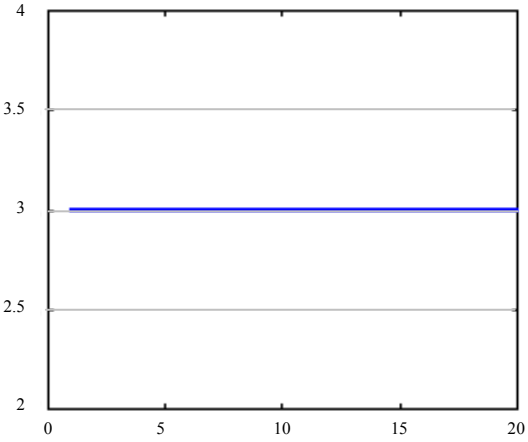
Inflation



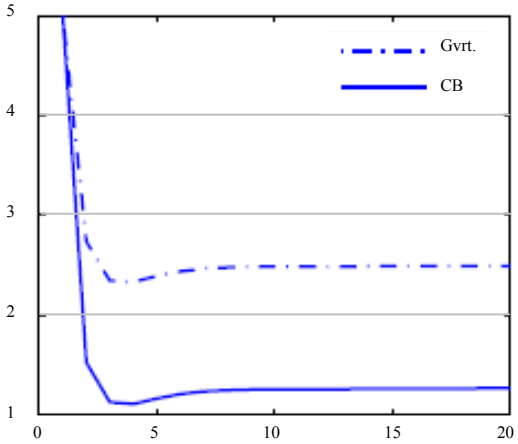
Debt to GDP



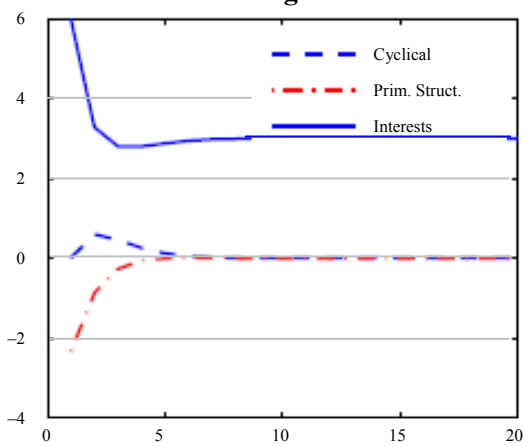
Total Budget Deficit



Nominal Interest Rates



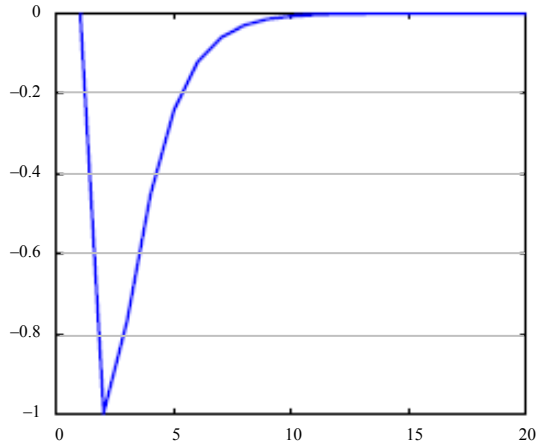
Other Budget Deficits



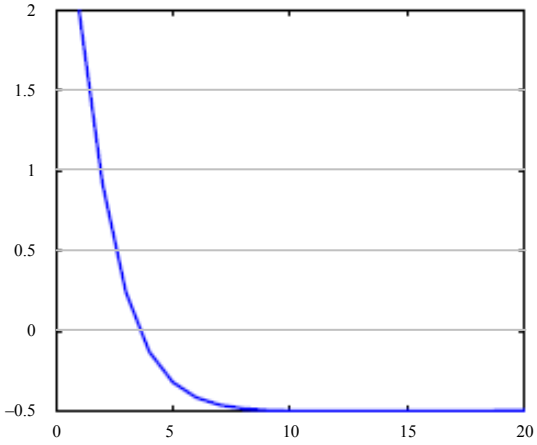
ITALY

Investment Rule

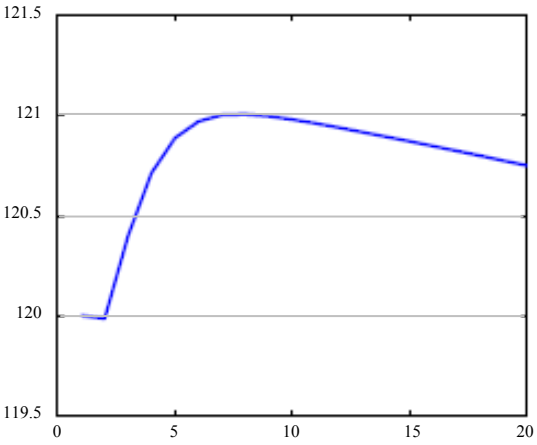
Output Gap



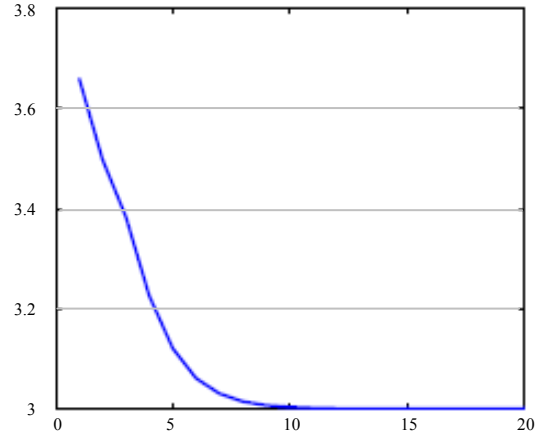
Inflation



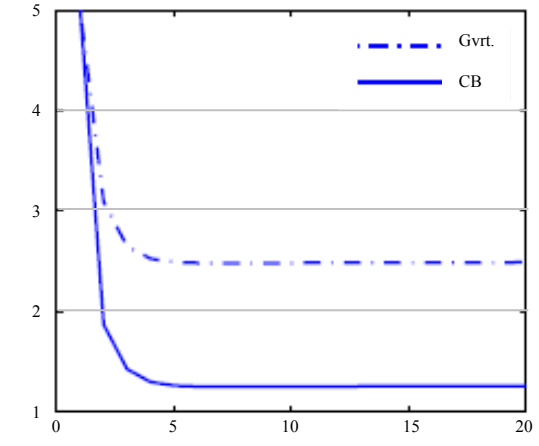
Debt to GDP



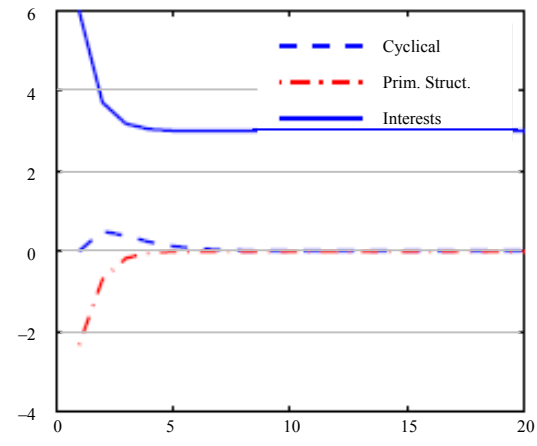
Total Budget Deficit



Nominal Interest Rates



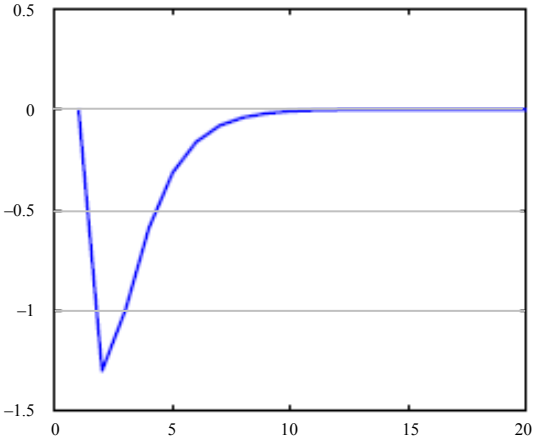
Other Budget Deficits



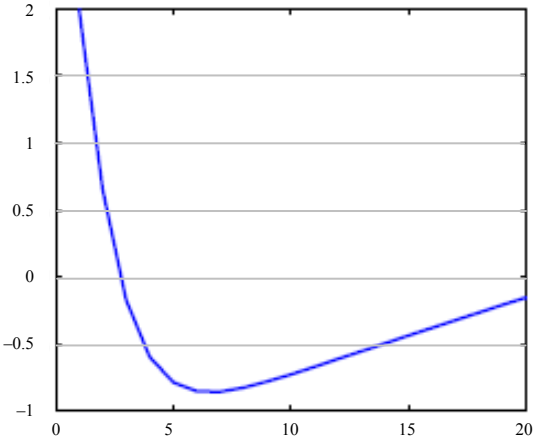
ITALY

Fiscal Compact, with $\gamma = 0$

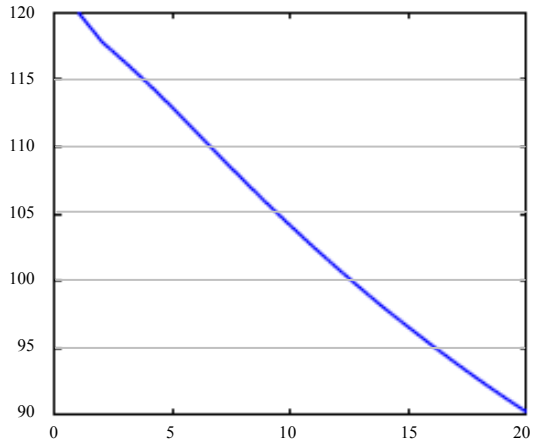
Output Gap



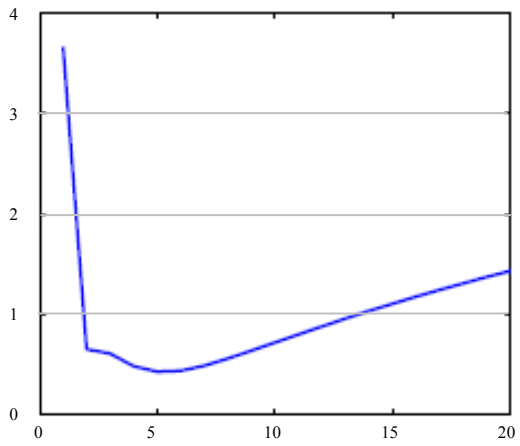
Inflation



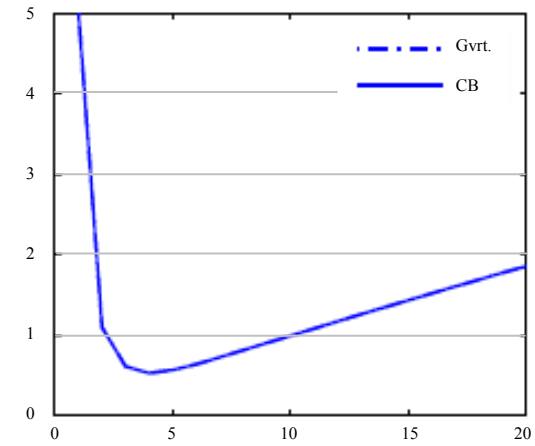
Debt to GDP



Total Budget Deficit



Nominal Interest Rates



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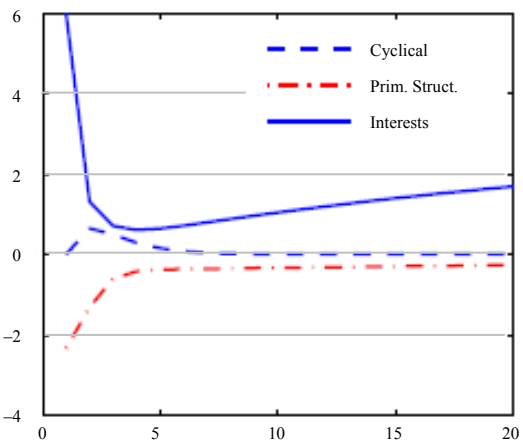
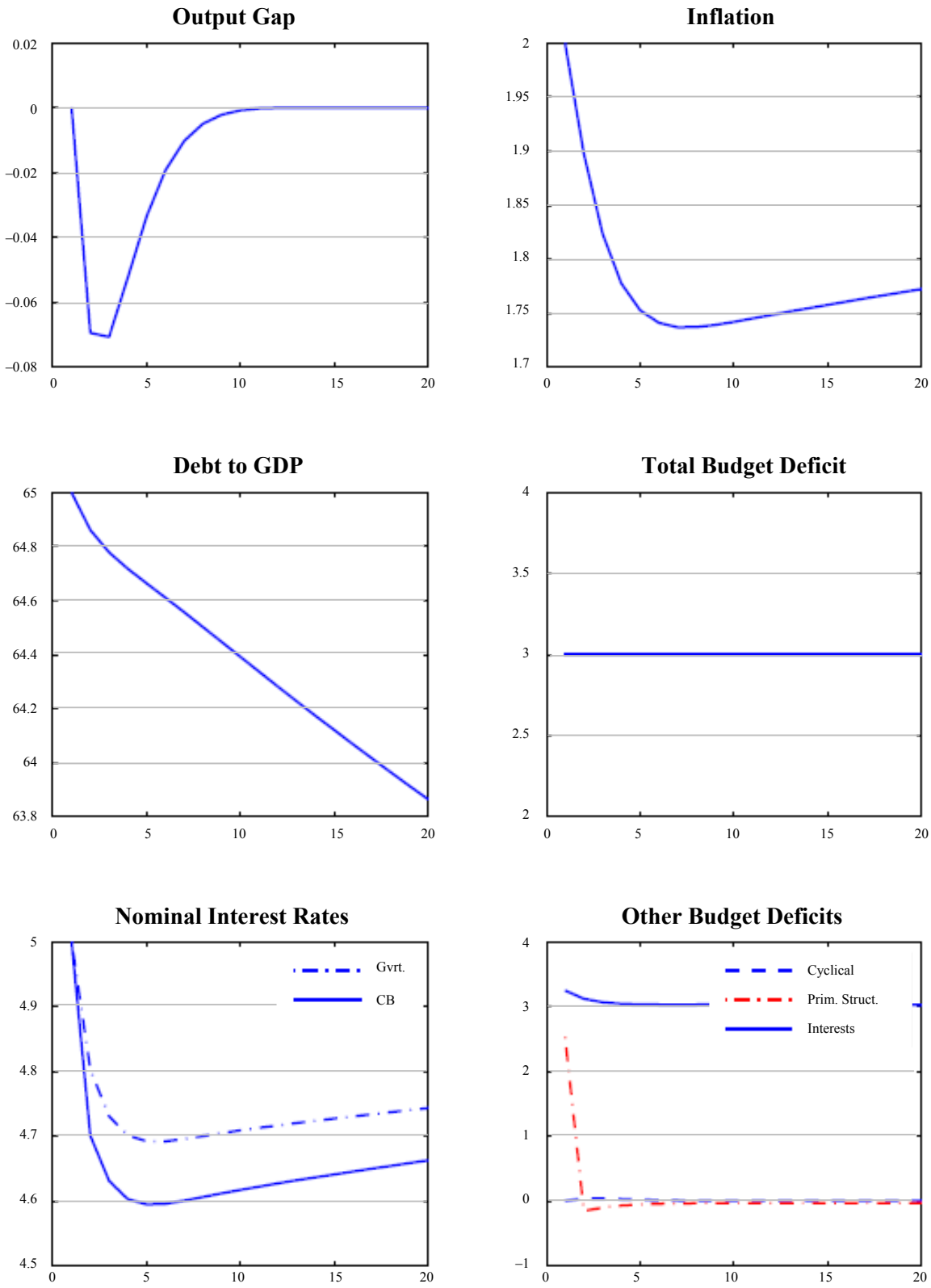


NETHERLANDS

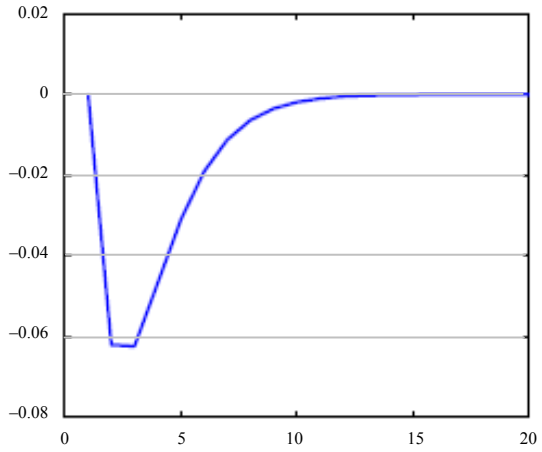
Status Quo



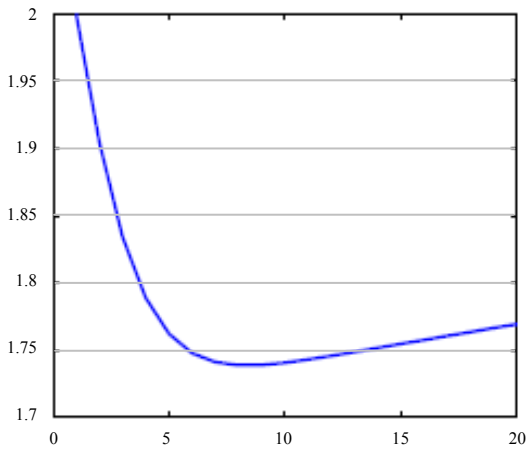
NETHERLANDS

Investment Rule

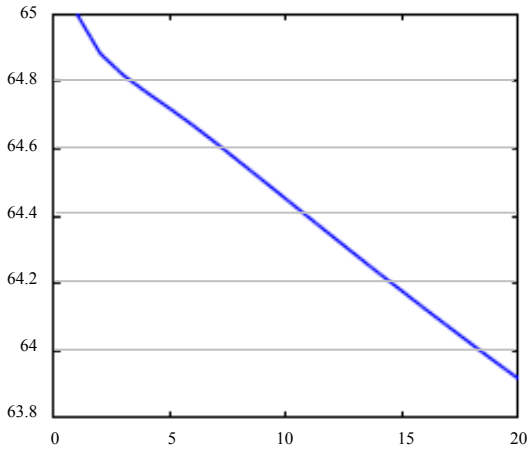
Output Gap



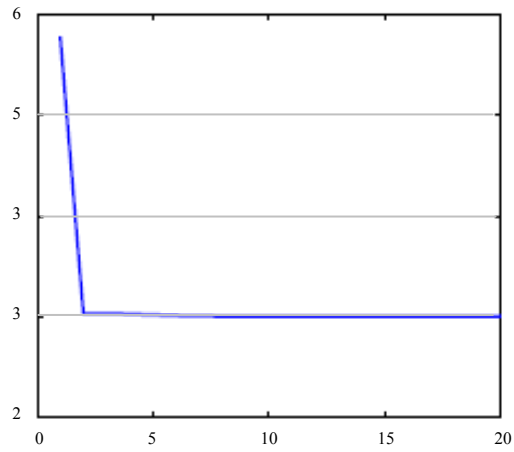
Inflation



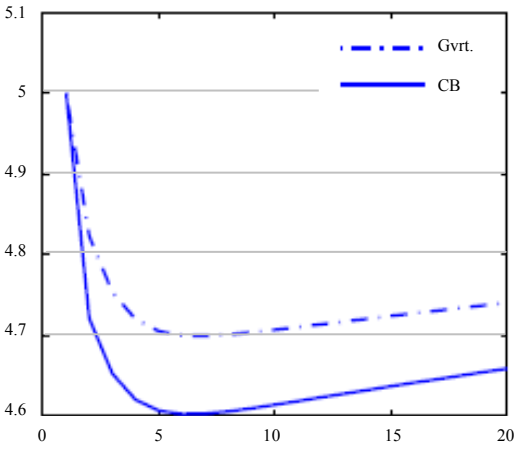
Debt to GDP



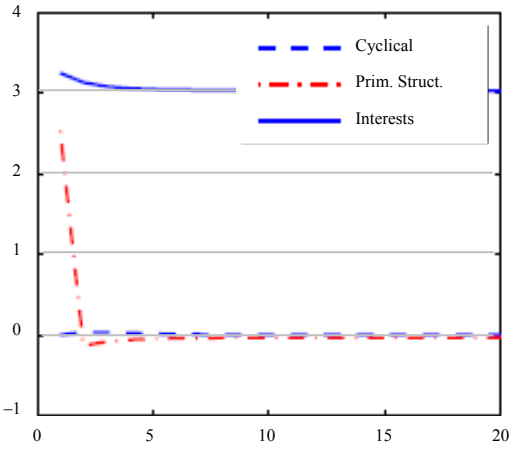
Total Budget Deficit



Nominal Interest Rates



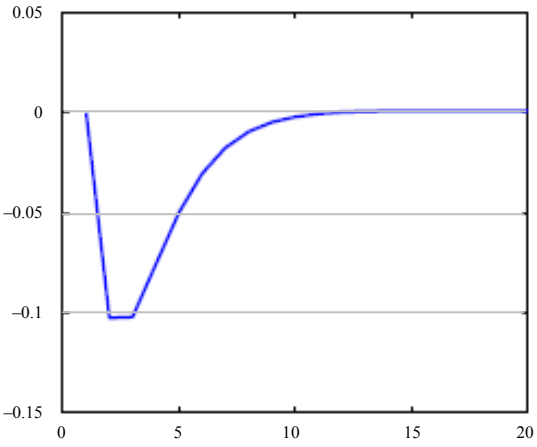
Other Budget Deficits



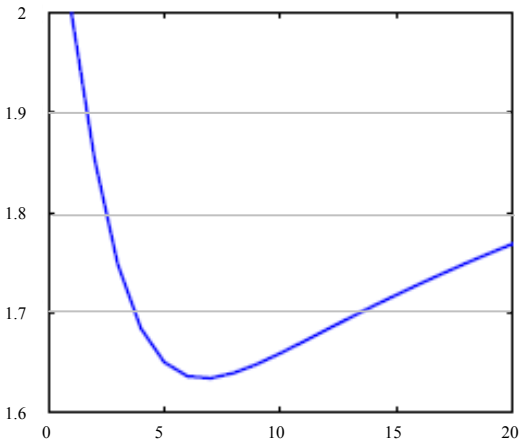
NETHERLANDS

Fiscal Compact

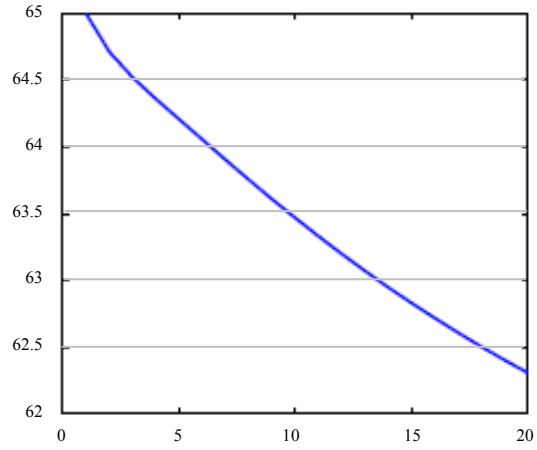
Output Gap



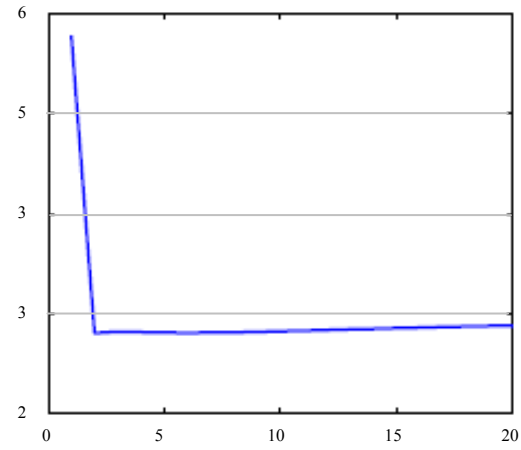
Inflation



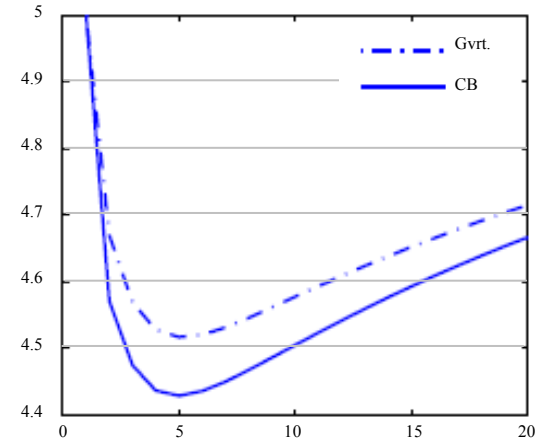
Debt to GDP



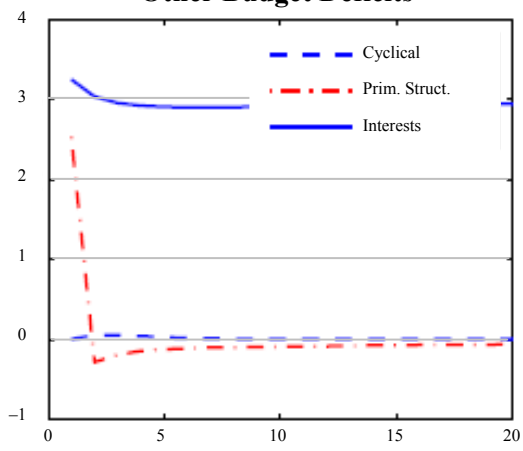
Total Budget Deficit



Nominal Interest Rates



Other Budget Deficits



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FISCAL POLICY, STRUCTURAL REFORMS AND EXTERNAL IMBALANCES: A QUANTITATIVE EVALUATION FOR SPAIN

Angel Gavilán,[*] Pablo Hernández de Cos,[*] Juan F. Jimeno[*] and Juan A. Rojas[*]

This paper builds a large overlapping generations model of a small open economy featuring imperfect competition in the labor and product markets to understand i) which were the main determinants of the large expansionary phase experienced in Spain from the mid-1990s until the arrival of the global financial crisis in 2007-2008, ii) what role fiscal policy and structural reforms could have played to avoid the build-up of large external imbalance over this period, and iii) how these policies could affect the recovery of economic activity in Spain after the crisis. Our results indicate that falling interest rates and demographic changes were the main drivers of the Spanish expansionary phase and that, over this period, a tighter fiscal policy or structural reforms designed to foster competition in the labor and product markets could have not avoided the build-up of a large external imbalance. As for the macroeconomic behavior of the Spanish economy after the crisis our model highlights the trade-off faced by tighter fiscal policies: they may reduce the output losses induced by the crisis in the medium-term but at the expense of a mild output loss in the years immediately after the crisis. Instead, structural reforms do not face this trade-off and they may contribute to reduce output losses in the short- and medium-term, while inducing a positive long-run effect on the level of output.

1 Introduction

From the mid-1990s to 2008, the Spanish economy enjoyed a phase of sustained economic growth in which real convergence with the core EMU member countries advanced notably. This expansionary phase was mostly driven by two factors. First, by a significant expansion of credit, that was induced by the fall in interest rates that followed Spain's adhesion to the EMU and, more broadly, by a pervasive relaxation in the conditions of access to credit. And second, by the large immigration inflows into Spain over the period that substantially modified the demographic structure of the Spanish population.[1]

Yet significant imbalances built up in the process. On the one hand, the Spanish economy became increasingly more dependent of external financing over the period. The fall in interest rates and the overall expansion of credit led to an investment boom, much of which materialized in the housing sector, that increased the share of investment in GDP from around 22 in 1995 to 29 per cent in 2008. Thus, despite a move toward fiscal consolidation by the public sector, the Spanish current account deficit, that was close to zero in 1998, increased nearly monotonically over the period, reaching almost 10 per cent of GDP by 2008. On the other hand, price-competitiveness of the Spanish economy also deteriorated significantly, due to very low productivity growth and to the existence of important distortions in the domestic labor and product markets.

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[*] Banco de España.

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[1] For a recent account of the evolution of the Spanish economy during this period, see Estrada, Jimeno and Malo de Molina (2009).

When the global financial crisis struck and the very favorable international credit conditions suddenly disappeared, the Spanish economy began an inevitable adjustment process, with a substantial reduction in consumption and investment by 2008q4, when housing investment plummeted. This adjustment, that has helped to correct the excessive indebtedness of the private sector, has led however to a large decrease in economic activity, with GDP growth in 2009 at around -3.6 per cent. At the same time, the work of automatic stabilizers and the expansionary fiscal programs put in place by the government to mitigate the effects of the crisis, have led to a very rapid deterioration of public accounts, that have moved from a surplus of around 2 per cent of GDP in 2007 to deficits of around 4 and 11 per cent in 2008 and 2009, respectively. All together, the Spanish economy has very quickly reduced its need for external financing as its current account deficit has decreased from around 10 per cent of GDP in 2008 to around 6 per cent in 2009, being now mostly driven by fiscal deficits rather than by private indebtedness as in the expansionary phase.

With this evidence in mind, several questions arise: i) to what extent are the fall in interest rates and the profound demographic changes witnessed in the Spanish economy over the last decade responsible for the expansionary phase and the build-up of imbalances?, ii) could have fiscal policy contributed more to avoid the build-up of these imbalances?, iii) how would structural reforms increasing competition in the product and labor markets have diminished the saving-investment gap and the loss of price-competitiveness of that period?, and iv) looking ahead, once the economy has been hit by the global financial shock in 2008, how would alternative fiscal policies and reforms in the labor and product markets may affect the expected macroeconomic evolution of the Spanish economy?

In order to address these questions, this paper constructs and calibrates a small open economy model for Spain. The model economy is composed by households, firms and a government. To properly incorporate the intense demographic changes that the Spanish economy experienced over the last decade, and those expected to happen in the future, this paper considers a large scale overlapping generations model.[2] In each period, households take consumption, labor and savings decisions to maximize their lifetime utility. There are four types of firms in the economy, that produce a final consumption good, intermediate goods, labor services and capital services. As the Spanish economy is characterized by rigid labor and product markets, the model incorporates distortions in these markets via monopoly power of intermediate goods and labor services producers. This approach, relatively standard in the new Keynesian literature, is less common in the large scale OLG literature, that typically considers perfect competition in all markets. The government in the model consumes, gives lump-sum transfers, runs a social security system, levies taxes (on consumption and on labor and capital income) and issues debt. The description of the social security system in the model is particularly rich. This is very relevant since, undoubtedly, one needs to take into account the pressures on the social security system generated by the aging of the Spanish baby-boom generation in the near future in order to properly analyze the role played by fiscal policy in the recent and future macroeconomic developments of the Spanish economy.

The model is calibrated to match the main macroeconomic features of the Spanish economy in 1998 and then its performance of over the period 1998-2008 is analyzed under different scenarios concerning interest rates, demographic developments, fiscal policies and labor and product market distortions. Our results indicate that, in line with Izquierdo, Jimeno and Rojas (2010), interest rates and demographic changes are the main responsible for the investment boom and the build-up of a sizable external imbalance (measured as the ratio of net foreign assets to

[2] In this sense, the model is an extended version of the general equilibrium model with overlapping generations used in Izquierdo, Jimeno and Rojas (2010) to evaluate the impact of immigration on the Spanish economy, and in Jimeno, Rojas and Puente (2008) and Rojas (2005) to analyze the consequences of population ageing in Spain.

GDP) witnessed in the Spanish economy during the expansionary phase. In this context, we find a very limited role for fiscal policy in reducing the external imbalance accumulated in Spain over the period 1998-2008. In particular, our results show that a temporary reduction of government expenditure over the expansionary phase would have reduced the size of the Spanish external imbalance by 2008 only very slightly. A more permanent tightening of fiscal policy could have even increased this imbalance. With respect to the effects of structural reforms in product and labor markets pursuing an increase in competition in these markets, we find that, although they would have not helped in reducing the external imbalance of the Spanish economy over the period 1998-2008, they would have led to a short- and long-run expansion of output, employment and investment, and to a substantial improvement in competitiveness and in public accounts. It is precisely due to these positive effects on the economy that these structural reforms may naturally induce in the short-run an increase in the external indebtedness of the economy, as forward-looking households anticipate lower taxes and a more efficient economy in the future and try to smooth their consumption.

As for the macroeconomic behavior of the Spanish economy beyond 2008, our model suggests that, even without the arrival of the crisis, in the short-run the Spanish economy would have entered into a phase of lower GDP growth where the external imbalance of the economy would have been reduced but where public accounts would have deteriorated. The arrival of the global financial crisis has accentuated the aforementioned dynamics. Furthermore, the model highlights the trade-off faced by tighter fiscal policies in the post-crisis scenario: they may reduce the output losses induced by the crisis in the medium-term but at the expense of a more intense output loss in the years immediately after the crisis. In contrast, structural reforms do not face this trade-off and may contribute to reduce output losses in the short- and medium-term, while inducing a positive long-run effect on the level of output.

The rest of the paper is organized as follows. Section 2 lays down the main facts with respect to the macroeconomic evolution of the Spanish economy during the expansionary phase. Then, Section 3 describes the model and Section 4 its calibration. Departing from the model economy calibrated to 1998, Section 5 quantifies the role played by demographic developments and interest rates in shaping the Spanish macroeconomic evolution over the period of analysis and performs counterfactual exercises regarding alternative fiscal policies and labor and product markets reforms. Then, Section 6 introduces into our model economy the global financial crisis that hit the economy in 2008 and shows the predictions of the model beyond that date. Finally, Section 7 concludes.

2 The expansion: driving factors and imbalances

The expansionary phase that the Spanish economy enjoyed from the mid-1990s to 2008 was characterized, among other things, by a process of fiscal consolidation in the public sector and by the build-up of a sizable external imbalance, with large and increasing current account deficits over the period that significantly deteriorated the international investment position of the country. This expansionary process was mostly fuelled by two factors: the fall in interest rates and the expansion of credit, and the large immigration inflows into Spain over the period. This section lays down the evolution of these variables for the period 1995-2008.[3]

Interest rates – In terms of the evolution of ex-post real long-term and short-term interest rates in Spain, despite a slight increase after 2005, the fall in these rates during the period was truly

[3] In this section, data come from the OECD Economic Outlook, except that of the Spanish current account balance and international investment position (Banco de España). Population data is from Instituto Nacional de Estadstica (INE).

remarkable: between 1995 and 2005 long-term (short-term) rates fell by around 7 (6) percentage points.[4] Nominal convergence in the run-up to EMU, lax monetary policy since the early 2000s, anchoring of inflation expectations, and a positive inflation differential in Spain are behind that large decrease. As already mentioned above, this cheaper access to credit, joint with a relaxation in credit standards, that allowed for a wider access to credit, were one of the main push factors behind the Spanish economic expansion during the 1995-2008 period.

I*mmigration inflows* – Immigration inflows were another important factor behind the last expansionary process in the Spanish economy. In Spain, traditionally an out-migration country, these inflows reached a significant scale in the years immediately before the creation of EMU and, since then, they have intensively transformed the Spanish population. Thus, foreign population residing in Spain has increased from 0.35 millions (1 percent of total population) in 1995 to 5.22 millions (11 per cent of total population) in 2008. In addition, these inflows have modified the age distribution in the Spanish population reducing its dependency ratio since, as usual, the age distribution of the immigrants that have entered into Spain has been younger than that of natives.

Fiscal consolidation – Up to 2007, fiscal consolidation in Spain was achieved both through a reduction in expenditures and through an increase in revenues. Thus, public deficit, which was around 6.5 per cent of GDP in 1995, gradually disappeared, to reach a surplus of almost 2 per cent of GDP in 2007. In 2008, however, with the arrival of the global financial crisis, government disbursements increased again, revenues fell and public deficit reached 4 per cent of GDP. Overall, the process of fiscal consolidation over this period contributed to a considerable reduction of public debt, that decreased from 63.3 per cent of GDP in 1995 to 39.7 per cent in 2008. In this sense, Spain significantly over-performed other EMU countries on this account.

External imbalance – The Spanish current account balance as a percentage of GDP fell almost monotonically during the 1995-2008 period and led to a very intense deterioration in the share of net foreign assets in GDP, that decreased from around –22 per cent in 1995 to around –80 per cent in 2008. The increase in current account deficits over this period, despite the process of consolidation of public accounts, clearly points to the rise in private indebtedness as the main origin of this external imbalance. In a cross-country comparison, it is evident that the Spanish increasing dependence on external financing over this period is truly remarkable, only comparable to that of Portugal and Greece and more intense than that of the U.S. It also contrasts with the situation of other countries in the EMU. Thus, while Germany and Finland exhibited sizeable current account surpluses, France and Italy showed a considerable less intense deterioration in their current account balance than that of Spain.

3 The model

This section describes the model used to perform the quantitative experiments reported on the following sections on the macroeconomic effects of interest rates, demographic changes, fiscal policy and product and labor market reforms. In essence, it is a model for a small open economy within a monetary union that combines, on the household side, the large scale overlapping generations structure of Auerbach and Kotlikoff (1987) and, on the supply side, the now standard framework in the new Keynesian literature with firms producing final and intermediate goods, labor and capital services in the presence of monopolistic competition in the intermediate goods

[4] It is somehow controversial, however, to what extent this fall truly resembles a reduction in the cost of financing. For some (see, for instance, Blanco and Restoy (2007) and Gimeno and Marques (2008)) the reduction in inflation uncertainty explains a great deal of the decline in real interest rates, so that the actual real cost of financing might have decreased significantly less than that indicated by ex-post real rates.

and labor markets.[5] The model economy is completed by a government that has a wide range of fiscal instruments at its disposal.

3.1 Households

Demographics – The economy has overlapping generations of agents who live a maximum of I periods. The agents differ in their age, $i \in \{1,2,...,I\}$, and in their place of birth, $n \in \{1,2,...,I\}$, where n=1 identifies a *native* and n=$n_0 \geq 2$ denotes an *immigrant* who first entered the economy with age n_0.[6] We use $N_{i,n,t}$ to denote the total number of agents of type (i, n) in the economy at period t and $\mu_{i,n,t}$ to denote the share of these agents over the total population at that period. The former evolves over time in the following fashion:

$$N_{1,1,t} = \sum_{i} \sum_{n} N_{i,n,t-1} f_{i,t-1} \qquad (Births) \tag{1}$$

$$N_{i,1,t} = N_{i-1,1,t-1} s_{i-1,t-1}, \forall i \geq 2 \qquad (Natives) \tag{2}$$

$$N_{i,n,t} = N_{i-1,n,t-1} s_{i-1,t-1} + NI_{i,n,t}, \forall i \geq 2, \forall n \geq 2 \qquad (Immigrants) \tag{3}$$

where $s_{i-1,t-1}$ denotes the conditional probability of surviving from age $i-1$ to age i at period $t-1$, $f_{i,t-1}$ is the probability of an agent of age i of having an offspring at that period, and $NI_{i,n,t}$ is equal to 0 when $i \neq n$ and to the number of immigrants of age i exogenously entering the economy at the beginning of period t when $i = n$. We assume that the survival and fertility probabilities are common to natives and immigrants, since there is no independent data readily available for these two population groups, and we consider the offspring of immigrants as natives.

Decision problem – At an exogenous age I_A agents start taking decisions. At that time they have no assets, besides transfers emanating from accidental bequests. In each period, agents take consumption and labor decisions in order to maximize lifetime utility. At period t an agent of type (v,n) solves the following problem:

$$Max \sum_{i=v}^{I} \beta^{i-v} \psi_{v,t}^{i} U(c_{i,n,t+i-v}, h_{i,n,t+i-v}) \tag{4}$$

subject to:

$$\begin{aligned} (1+\tau_t^c) c_{i,n,t} + a_{i+1,n,t+1} \leq (1-\tau_t^l - \tau_t^{ss}) w_{i,t} h_{i,n,t} + (1 + r_t(1-\tau_t^a))(a_{i,n,t} + b_t) + \\ + ss_{i,n,t} + tr_t + div_t \quad \forall t \end{aligned} \tag{5}$$

In the expression above, c is consumption, a denotes beginning of period assets and h is time spent at work. Agents are endowed with one unit of time per period. Between ages I_A and $I_R - 1$ this unit of time must be allocated between labor and leisure. Afterwards, agents are forced to retire. Only then, they receive social security benefits, ss, and devote their entire time endowment

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5 Unlike the new Keynesian literature we do not consider price rigidities.

6 We need to keep track of the age at which immigrants entered the economy because we assume that they arrive with no assets (as in, for instance, Storesletten (2000, 2003) and Razin and Sadka (1999)). Thus, conditional on age, two immigrants arriving to the economy at different ages take different consumption and labor decisions because they do not have the same wealth level.

to leisure. In each period, regardless of their type, agents receive lump transfers, *tr*, accidental asset bequests, *b*, and dividends from the different firms operating in the economy, *div*. Regarding prices and taxes, we normalize the price of the final good consumed by households to one, w is the age-dependent wage (in units of c) agents receive for their working time, r is the net real interest rate paid on savings, τ_t^l and τ_t^{ss} are labor income taxes (the latter being the social security tax), and τ_t^c and τ_t^a denote proportional taxes on consumption and capital income, respectively. Finally, β is the discount parameter and $\psi_{v,t}^i$ is the unconditional probability of reaching age i for an individual that has age v at period t. Thus, $\psi_{v,t}^i = \prod_{k=v+1}^{i} s_{k-1,t+k-v-1}$ with $\psi_{v,t}^v = 1$.

3.2 Firms

Final good firm – In each period, a final consumption good, Y_t, is produced within the small open economy by a perfectly competitive firm. The firm does so by combining a continuum of domestic intermediate goods, $y_{H,j,t}$, $j \in (0,1)$, and a continuum of foreign intermediate goods, $y_{F,z,t}$, $z \in (0,1)$, using the following technology:

$$Y_t = \left[(\alpha_C)^{\frac{1}{\eta_C}} Y_{H,t}^{\frac{\eta_C - 1}{\eta_C}} + (1-\alpha_C)^{\frac{1}{\eta_c}} Y_{F,t}^{\frac{\eta_C - 1}{\eta_C}} \right]^{\frac{\eta_C}{\eta_C - 1}} \tag{6}$$

where $Y_{H,t}$ and $Y_{F,t}$ are composites of the continuum of domestic and of foreign intermediate goods, respectively, and follow the constant elasticity of substitution functions:

$$Y_{H,t} = \left[\int_0^1 y_{H,j,t}^{\frac{1}{\lambda_t^i}} dj \right]^{\lambda_t^i}, 1 \le \lambda_t^i < \infty \tag{7}$$

$$Y_{F,t} = \left[\int_0^1 y_{F,z,t}^{\frac{1}{\lambda_t^{i^*}}} dz \right]^{\lambda_t^{i^*}}, 1 \le \lambda_t^{i^*} < \infty \tag{8}$$

In the expressions above, $(1-\alpha_c)$ is the share of imports in consumption, η_c is the elasticity of substitution between the domestic and foreign composite goods, and λ_t^i ($\lambda_t^{i^*}$) denotes the time-varying substitutability of domestic (foreign) intermediate goods in the production of $Y_{H,t}$ ($Y_{F,t}$). Let $p_{H,j,t}$ ($p_{F,z,t}$) denote the price (in units of c) of the domestic (foreign) intermediate good $j(z)$ in period t. Profit maximization by the final good firm implies the following demands for the composite goods $Y_{H,t}$ and $Y_{F,t}$, and for each intermediate good $y_{H,j,t}$ and $y_{F,z,t}$:

$$Y_{H,t} = \alpha_C p_{H,t}^{-\eta_C} Y_t, \qquad y_{H,j,t} = \left(\frac{p_{H,j,t}}{p_{H,t}} \right)^{\frac{\lambda_t^i}{1-\lambda_t^i}} Y_{H,t} \tag{9}$$

$$Y_{F,t} = (1-\alpha_C) p_{F,t}^{-\eta_C} Y_t, \quad y_{F,z,t} = \left(\frac{p_{F,z,t}}{p_{F,t}} \right)^{\frac{\lambda_t^{i^*}}{1-\lambda_t^{i^*}}} Y_{F,t} \tag{10}$$

where prices are related in the following fashion:

$$1 = \left[\alpha_C p_{H,t}^{1-\eta_C} + (1-\alpha_C) p_{F,t}^{1-\eta_C} \right]^{\frac{1}{1-\eta_C}} \tag{11}$$

$$p_{H,t} = \left[\int_0^1 p_{H,j,t}^{\frac{1}{1-\lambda_t^i}} dj \right]^{1-\lambda_t^i} \tag{12}$$

$$p_{F,t} = \left[\int_0^1 p_{F,z,t}^{\frac{1}{1-\lambda_t^{i^*}}} dz \right]^{1-\lambda_t^{i^*}} \tag{13}$$

Intermediate good firms – Each domestic intermediate good, $y_{H,j,t}$, $j \in (0,1)$, is produced within the small open economy by a monopolist who rents capital, K, and labor, L, in the market and uses the technology:

$$y_{H,j,t} = K_{H,j,t}^{\xi} \left(A_t L_{H,j,t} \right)^{1-\xi} \tag{14}$$

where $0 < \xi < 1$ and A_t denotes economy-wide labor augmenting technological change. As in Christiano *et al.* (2005), we rule out entry and exit into the production of intermediate goods. Profit maximization by these monopolists implies that, in each period, they set the price for their differentiated goods with a markup over their marginal costs. Namely:

$$p_{H,j,t} = \lambda_t^i MC_{H,j,t} \tag{15}$$

where the marginal cost, $MC_{H,j,t}$, depends on the rental price of the labor and capital inputs, W_t and $p_{K,t}$, respectively, according to:

$$MC_{H,j,t} = \left(\frac{\xi}{1-\xi} \right)^{-\xi} \left(\frac{W_t}{p_{K,t}} \right)^{-\xi} \frac{W_t}{A_t (1-\xi)} \tag{16}$$

At the end of each period, the profits of these monopolists, $\pi_{H,j,t}$, $j \in (0,1)$ are distributed to the households in the form of dividends.

Firms producing labor services – In each period, a representative competitive firm buys labor hours of households of different ages and transforms them into an aggregate labor input, L_t, which then sells to the domestic intermediate producers, using the following technology:

$$L_t = \left[\sum_{i=I_A}^{I_R-1} \left(\frac{1}{I_R - I_A} \right)^{\frac{\lambda_t^l - 1}{\lambda_t^l}} \left(e_i L_{i,t} \right)^{\frac{1}{\lambda_t^l}} \right]^{\lambda_t^l}, 1 \leq \lambda_t^l < \infty \tag{17}$$

where $L_{i,t}$ is the total number of labor hours supplied by age-i households, e_i is an age-specific index which transforms those raw labor hours into efficient units of labor, and λ_t^l measures the time-varying substitutability of labor hours of households of different ages in the production of the aggregate labor input. Profit maximization by this representative firm in the labor market implies that its demand for labor hours of age-i households is equal to:

$$L_{i,t} = \left(\frac{1}{I_R - I_A} \right) \left(\frac{\widetilde{w}_{i,t}}{W_t} \right)^{\frac{\lambda_t^l}{1-\lambda_t^l}} \left(e_i \right)^{\frac{1}{1-\lambda_t^l}} L_t \tag{18}$$

where $\widetilde{w}_{i,t}$ denotes the price that this firm pays for one hour of labor of an age-i household and W_t is the unit price of the aggregate labor input. These are related via:

$$W_t = \left[\sum_{i=I_A}^{I_R-1} \left(\frac{1}{I_R - I_A} \right) \left(\frac{\widetilde{w}_{i,t}}{e_i} \right)^{\frac{1}{1-\lambda_t^l}} \right]^{1-\lambda_t^l} \tag{19}$$

In Erceg, Henderson and Levin (2000), among others, each household is considered to be a monopoly supplier of a differentiated labor service implying that they can set their own wage. In this paper, due to the overlapping generations nature of our model, we follow a slightly different route to incorporate this friction in the labor market. Namely, we consider that, for each age $i \in I_A, I_R - 1]$, there is a monopoly who buys labor hours directly to the households of age i at price $w_{i,t}$, and sells them to the representative firm producing the aggregate labor input at price $\widetilde{w}_{i,t}$. As usual, these monopoly suppliers set their price with a markup over their marginal cost which, in this case, implies that $\widetilde{w}_{i,t} = \lambda_t^l w_{i,t}$, $i \in I_A, I_R - 1]$. At the end of each period, these firms distribute their profits, $\pi_{L,i,t}$, $i \in I_A, I_R - 1]$, to the households in the form of dividends.

The monopoly power of these firms comes from the fact that, as considered in (17), labor hours of households of different ages are imperfect substitutes in the production of the aggregate labor input. In this set up, as opposed to Erceg, Henderson and Levin (2000), households do not have any monopoly power because their labor hours are perfect substitutes in the production of the aggregate labor input with those of all the other households in the economy with the same age. Nevertheless, for the purposes of this paper, the relevant issue is that there exists a distortion in the labor market that leads to a misalignment between prices and marginal costs and not whether the monopoly power is held by the households or by these intermediate labor producers.

Investment firm – In this small open economy, all capital is owned by a representative firm which rents it to the domestic intermediate producers at a unit price $p_{K,t}$ and takes investment decisions. Investment is assumed to be given by a CES aggregate of domestic and imported goods. Namely:

$$I_t = \left[(\alpha_I)^{\frac{1}{\eta_I}} I_{H,t}^{\frac{\eta_I - 1}{\eta_I}} + (1-\alpha_I)^{\frac{1}{\eta_I}} I_{F,t}^{\frac{\eta_I - 1}{\eta_I}} \right]^{\frac{\eta_I}{\eta_I - 1}} \tag{20}$$

where $(1-\alpha_I)$ is the share of imports in investment, I_H and I_F are the same composites of the continuum of domestic and of foreign intermediate goods as in (7) and (8), respectively, and η_I is the elasticity of substitution between these composite goods in investment. Thus, the unit price of this investment aggregate is given by:

$$p_{I,t} = \left[\alpha_I p_{H,t}^{1-\eta_I} + (1-\alpha_I) p_{F,t}^{1-\eta_I} \right]^{\frac{1}{1-\eta_I}} \tag{21}$$

and the demands of the domestic and foreign composites of the continuum of domestic and foreign intermediate goods, respectively, are given by:

$$I_{H,t} = \alpha_I \left(\frac{p_{H,t}}{p_{I,t}} \right)^{-\eta_I} I_t \tag{22}$$

$$I_{F,t} = (1-\alpha_I) \left(\frac{p_{F,t}}{p_{I,t}} \right)^{-\eta_I} I_t \tag{23}$$

We follow Christiano *et al.* (2005) and assume that this firm's investment decisions are conditioned by the existence of quadratic investment adjustment costs. As argued in Lucca (2007), these adjustment costs are equivalent, up to a first order linearization, to a time-to-build representation of the investment process. Furthermore, along the lines of Garrett and Priestley (2000), among others, we also consider that this firm faces costs of changing the amount of dividends it distributes to households at the end of each period. Thus, in each period t this representative firm chooses an investment sequence to maximize, given prices, its discounted flow of future dividends, net of the dividends adjustment costs:

$$\max_{\{I_s\}_{s=t,\, t+1,..}} \sum_{s=t}^{\infty} \left(\prod_{j=t+1}^{s} \frac{1}{1+r_j} \right) \left[d_s - \frac{\varsigma}{2} \left(\frac{d_s}{d_{s-1}} - 1 \right)^2 \right] \tag{24}$$

subject to:

$$d_s = (1-\tau_s^k) p_{K,s} K_s - p_{I,s} I_s \left(1 + S\left(\frac{I_s}{I_{s-1}} \right) \right) \tag{25}$$

$$K_{s+1} = (1-\delta) K_s + I_s \tag{26}$$

where $\varsigma > 0$ gives a measure of the dividends adjustment costs, τ^k is a proportional tax rate on this firm's capital rents, and, as usual, the investment adjustment cost function, $S(\cdot)$, satisfies that $S(1) = S'(1) = 0$ and $S''(1) \equiv \chi > 0$.

3.3 Government

The government of this small open economy consumes, gives lump-sum transfers, runs a social security system, levies taxes and issues debt. In each period, the government devotes an exogenously given amount of resources to consume, G_t, and to give lump-sum transfers to the households, $TR_t = tr_t\left(\sum_n \sum_{i=I_A}^{I} N_{i,n,t}\right)$. It is assumed that the government consumes the same final consumption good as households.[7] The government also spends resources in social security benefits $SS_t = \sum_n \sum_{i=I_R}^{I} N_{i,n,t}\ ss_{i,n,t}$. For each retired worker these benefits are assumed to represent a fraction ϖ of its average labor earnings in the last I_{SS} periods before retirement. In order to finance these expenditures, the government may issue debt, D_{t+1}, or levy proportional taxes on households' consumption (τ_t^c), labor income (τ_t^l and τ_t^{ss}) and capital income (τ_t^a), and on the investment firm's capital rents (τ_t^k). Thus, the government's budget constraint in period t is:

$$G_t + TR_t + SS_t + (1+r_t)D_t = D_{t+1} + \tau_t^c C_t + \left(\tau_t^l + \tau_t^{ss}\right)\sum_n \sum_{i=I_A}^{I_R-1} N_{i,n,t} w_{i,t}\ h_{i,n,t} + \\ + \tau_t^a r_t A_t + \tau_t^k p_{K,t} K_t \qquad (27)$$

where $C_t = \sum_n \sum_{i=I_A}^{I} N_{i,n,t} c_{i,n,t}$ and $A_t = \sum_n \sum_{i=I_A}^{I} N_{i,n,t}(a_{i,n,t} + b_t)$ denote aggregate households' consumption and financial assets, respectively, D_t is the stock of public debt outstanding at the beginning of period t, and r_t is the exogenous interest rate in the small open economy.

As usual in models like this, a fiscal rule is needed so as to avoid explosive dynamics of public debt. We follow Kilponen *et al.* (2006) and, for the simulation exercises described in Section 5, we consider that the proportional labor income tax rate τ^l adjusts in each period to accommodate deviations of this rate and of the debt to GDP ratio from corresponding target levels according to the following rule:[8]

$$\tau_t^l = \tau_{t-1}^l - \kappa_1(\tau_{t-1}^l - \bar{\tau}^l) + \kappa_2\left(\frac{D_t}{GDP_t} - \overline{\frac{D}{GDP}}\right) \qquad (28)$$

where $\kappa_1 > 0$ and $\kappa_2 > 0$ measure the sensitivity of τ^l to deviations of τ^l and $\frac{D}{GDP}$, respectively, from their targets.

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[7] Aggregate household consumption (C_t) involves consuming domestic ($C_{H,t}$) and foreign goods ($C_{F,t}$). Given equation (6), which defines the final consumption good, it is possible to derive that $C_{H,t} = \alpha_C\left(p_{H,t}\right)^{-\eta_C} C_t$ and $C_{F,t} = \left(1-\alpha_C\right)\left(p_{F,t}\right)^{-\eta_C} C_t$. The same applies to G_t, which can be divided into $G_{H,t}$ and $G_{F,t}$.

[8] As it will be clear in Section 4, for the calibration of the model we do not use this fiscal rule. We simply fix the ratio of public debt to GDP to a target level and obtain a labor income tax rate τ^l endogenously so as to balance the government budget.

In our simulation exercises below, we use (28) looking for a compromise between long-term and short-term dynamics in the following sense. On the one hand, from a long-term perspective, it seems reasonable to consider, as in (28), that excessive debt scenarios need to be corrected via tax rate adjustments. For instance, there is a general consensus that the pressure on public accounts that will be induced in the near future by the aging of the Spanish baby-boom generation would require significant tax reforms. On the other hand, in the short run, in line with the small changes in tax rates typically observed in the data, it seems more reasonable to assume that (28) does not apply. Thus, in order to accommodate these long- and short-term perspectives, in the simulation exercises presented in Section 5 we assume that (28) only operates beyond 2008, so that τ^l stays constant at its value in the calibration exercise prior to that date. Beyond 2008, when the rule is at work, we consider that $\overline{\frac{D}{GDP}} = 0.60$, in line with the Stability and Growth Pact in the euro area, that $\bar{\tau}^l$ is equal to its value in the calibration exercise and, following Kilponen *et al.* (2006), that $\kappa_1 = 0.3$ and $\kappa_2 = 0.1$.

3.4 Foreign economy

As already mentioned above, in this small open economy a fraction $(1-\alpha_I)$ of aggregate investment and a fraction $(1-\alpha_C)$ of aggregate private and public consumption correspond to imports of foreign goods. By a symmetric argument, a fraction of the domestic production of intermediate goods is exported abroad in each period to become part of foreign aggregate consumption (private and public) and investment. In this sense, in terms of the composite good defined in (7), which aggregates all domestic intermediate goods, we assume that, in each period t, domestic exports abroad equal X_t, defined as:

$$X_t = \left(\frac{p_{H,t}}{p_{F,t}} \right)^{-\eta_X} Y_t^* \tag{29}$$

where η_X is the elasticity of substitution in the world economy between the domestic and foreign composite goods, and Y^* is a measure of the total demand in that economy, which is completely exogenous to the domestic economy. Equation (29) closes the model. See the Appendix for a formal definition its equilibrium.

4 Calibration

An initial goal of this paper is to evaluate, in the context of the model described in the previous section, the role played by interest rates, demographic developments, fiscal policy and market distortions in explaining the macroeconomic performance of the Spanish economy over its last expansionary phase. To carry out this quantitative exercise we first need to set the values of the parameters, the initial conditions and the exogenous sequences of the model. This section describes our calibration strategy and Table 1 summarizes our parameter choices.

Target year – We choose 1998 as our calibration target year, so as to focus on the post-Euro performance of the Spanish economy. In this sense note that, although the expansion of economic activity in Spain began some years before the creation of the EMU, this process and the build-up of imbalances in the economy clearly accelerated after 1998.

Initial distributions – A complete characterization of the model requires initial distributions of financial assets and of social security entitlements across households to be specified. Rather than setting those initial distributions arbitrarily in 1998, we set them for the year 1950, which then becomes the first year in our computations. By starting our numerical analysis in 1950, we are able to obtain (initial) distributions of financial assets and of social security entitlements across households in 1998 which are optimally derived from the model and, given that 1950 is far from 1998, do not depend on the initial distributions assumed in 1950.[9]

Demographics – A period in the model corresponds to 1 year. Agents start taking economic decisions at age 16, they are forced to retire at age 65, and die with probability 1 at age 100. We take the age structure of the population in 1950 from the UN World Population Prospects. For the period 1951-98 we propagate that population according to equations (1) and (2) using age-specific fertility and survival probabilities consistent with the evolution of average fertility and life-expectancy in the data. Thus, we consider the 1950-98 calibration period as a non-immigration period (only *native* households are active). In this sense note that it was after 1998, when immigrants represented less than 3 per cent of the Spanish population, when the largest immigration inflows into Spain took place.[10] Beyond 1998, we propagate the population under the assumption that households expect constant (at their 1998 levels) fertility and survival probabilities and do not anticipate the immigration inflows happening after 1998. These flows will be described and incorporated into the analysis in Section 5.

Preferences – We assume a standard CRRA specification of the per period utility function:

$$U(c,h)=\frac{\left(c^{\theta}(1-h)^{(1-\theta)}\right)^{1-\sigma}}{1-\sigma} \tag{30}$$

where σ and θ determine households' risk aversion and the relative importance of consumption over leisure, respectively. We set $\sigma=3$, which falls within the standard range of this parameter in the literature, and choose θ so that in 1998 households in the model economy spend on average one-third of their time endowment at work.

Technology, foreign economy and discount factor – From households' point of view, in order to generate an empirically plausible age profile of asset holdings, it is necessary to account for the fact that earnings grow with experience. In this sense, the standard practice in the literature is to endow agents with an age-specific profile of productivity which in our model is represented by e_i. We have obtained this profile by computing average age-specific hourly wages from the Structural Earnings Survey (SES) in Spain in 2002.

The depreciation rate of capital δ, the discount parameter β and the exogenous world interest rate and output, r and Y^* respectively, are chosen simultaneously to reproduce the following targets in 1998: i) a ratio of investment to GDP of 23.5 per cent, ii) a ratio of international investment position to GDP of –31.7 per cent, iii) a ratio of net exports to GDP of –0.22 per cent and iv) a ratio of exports to GDP of 26.7 per cent. The values generated by these targets are δ=9.95 per cent, β=0.9964, $r=3$ per cent and $Y^*=0.0197$.[11]

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[9] An additional reason to start our analysis in 1950 is that the demographic information provided by the UN World Population Prospects also starts in that year.

[10] Furthermore, if we were to consider the presence of immigrants in Spain before 1999, we would not have information available about the years in which those immigrants first entered in the country.

[11] In 1998, the calibrated model exhibits a ratio of current account to GDP of –1.04 per cent and a capital-output ratio of 2.25. The values of these non-targeted variables are reasonably close to those observed in the data (–0.11 per cent and 2.42, respectively).

We set $\alpha_C = 0.60$, $\alpha_I = 0.40$, $\lambda^l = 1.20$ and $\lambda^i = 1.10$. This implies a 60 per cent (40 per cent) share of domestic goods in consumption (investment) and a 20 per cent (10 per cent) markup in the labor (product) market. These values fall within the typical range for these parameters considered in the literature for the Spanish economy. Following Domenech and Taguas (1995) we also set $\xi = 0.375$. Finally, regarding the elasticities of substitution between domestic and foreign goods, we follow the work of Adolfson *et al.* (2007) and consider that $\eta_C = 5$ and $\eta_I = 2.5$. Furthermore, we assume that $\eta_X = \eta_C$.

Government – In 1998, government consumption, government transfers and public debt represented 17.3 per cent, 5 per cent and 64.1 per cent of the Spanish GDP, respectively. In line with this evidence, in the calibration exercise we choose sequences of government consumption, government transfers and public debt such that, in each period, the model economy replicates those ratios. As for taxes, the ratios of consumption taxes to private consumption, of social security contributions to labor income and of capital taxes to GDP observed in Spain in 1998 were equal to 18 per cent, 25.7 per cent and 5.2 per cent, respectively. Consequently, in the calibration, we consider a constant proportional consumption tax rate, τ_t^c, equal to 18 per cent, a constant proportional social security tax rate, τ_t^{SS}, equal to 25.7 per cent, and set constant capital income tax rates $\tau_t^a = \tau_t^k = 14.8\%$ such that the model economy replicates the latter ratio.[12]

Regarding to the social security system, the Spanish Regimen General de la Seguridad Social considers the last 15 years of contributions prior to retirement to compute the pension. Thus, we choose $I_{SS} = 15$ in our numerical exercises. As for the pension replacement rate, ϖ, we set this parameter such that in 1998 our model economy matches the ratio of social security expenses to GDP observed in the Spanish economy in that period (9.5 per cent). Finally, in each period of the calibration exercise we determine τ_t^l endogenously so that the government budget constraint (27) is met. The value of the labor income tax that satisfies this restriction is 10.3 per cent in 1998 (its counterpart in the data is 12.1 per cent).

5 Findings: the expansion

In Section 4, the model economy described in Section 3 was calibrated to replicate the main features of the Spanish economy in 1998. In this section we analyze the quantitative performance of this model economy beyond 1998 with a two-fold purpose. First, we want to evaluate to what extent the large decline in interest rates and the intense demographic changes observed in the Spanish economy after 1998 may explain the evolution of the main macro-aggregates in this country over the period 1998-2008. And second, we aim to quantify how this evolution could have changed under different scenarios concerning fiscal policy and labor and product markets distortions.

5.1 The role of demographic changes

After 1998 the Spanish economy has experienced a profound demographic change. This has been induced, not only by the large immigration inflows into the economy, but also by a change in the survival and fertility probabilities. To evaluate the macroeconomic impact of these developments

[12] Data on tax revenues are available at http://www.meh.es. National accounts data is available at http://www.ine.es.

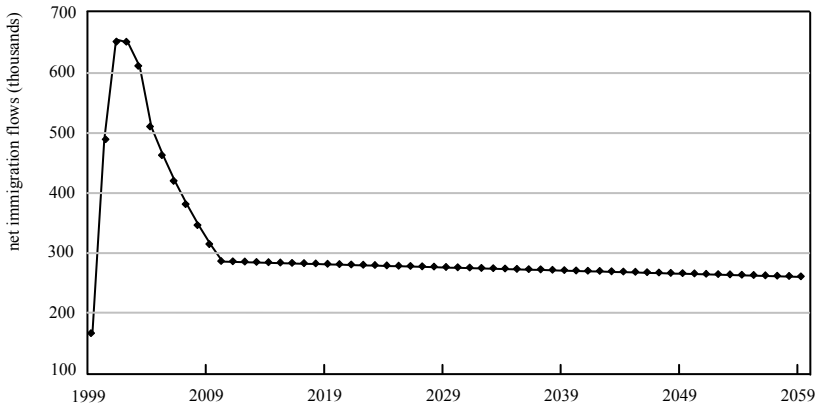
Table 1

Calibrated Parameters

Parameter	Value	Target
Demographics		
I_A	16	Assumed
I_R	65	Assumed
I	100	Assumed
si,t and fi,t	UN Population Prospects	Data
Preferences		
σ	3	Assumed
θ	0.5	Average labor hours = (1/3)
Tech. and foreign ec.		
e	Structural Earnings Survey	Data
δ	0.0995	Investment ratio=23.5%
β	0.9964	IIP over GDP=-31.7%
r	0.03	Net Exports over GDP=–0.22%
Y^*	0.0197	Exports over GDP=26.7
α_C	0.60	Assumed
α_I	0.40	Assumed
λ^l	1.20	Assumed
λ^i	1.10	Assumed
ξ	0.375	Domenech and Taguas (1995)
η_C	5	Adolfson *et al.* (2007)
η_l	2.5	Adolfson *et al.* (2007)
η_X	5	Assumed
χ	2	Christiano *et al.* (2005)
ς	15	Assumed
Government		
G/GDP	0.173	Data
TR/GDP	0.05	Data
D/GDP	0.641	Data
τ^c	0.18	Data
τ^{ss}	0.257	Data
$\tau^a=\tau^k$	0.148	Capital taxes/GDP=5.2%
I_{SS}	15	Data
ϖ	0.56	S.S. expeditures/GDP=9.5%

Figure 1

Net Immigration Flows in Spain, 1999-2059



in the context of our model, we depart from our economy calibrated to 1998 and assume that demographic variables evolve as follows:

Immigration inflows – We assume that, beginning in 1999, immigration flows behave according to Scenario 1 of the long-term demographic projections of the Instituto Nacional de Estadstica (Figure 1).[13] The age distribution of these immigration inflows is assumed to be constant over time and equal to that of new immigrants entering in Spain in 1999 according to the Estadistica de Variaciones Residenciales.[14] For computational reasons, we also assume that immigrants can only enter the country with ages between 16 and 44. In 1999, the immigrants who entered in Spain with these ages accounted for 60 per cent of the total.

Survival and fertility probabilities – Rather than assuming that these probabilities stay constant beyond 1998, as in the calibration exercise, we assume that they change over time in order to match the average fertility and life-expectancy data in the UN World Population Prospects for Spain. These projections end in 2050. Afterwards, we assume that the survival and fertility probabilities stay constant at their 2050 levels.

Findings – The response of our calibrated model economy to the demographic developments described above over the period 1998-2008 is summarized in Table 2. A first implication of these demographic changes is a fall in the dependency ratio of the economy. This can be seen in Figure 2, which compares, for the period 1998-2008, the dependency ratio in the calibration exercise (Baseline) and the associated to the demographic changes witnessed in Spain after 1998. In the model, this expansion of working-age population leads to a rise in aggregate employment, in aggregate investment and, consequently, in GDP. In this sense, according to the model, the observed demographic changes in Spain would have been responsible, on its own, for 60 per cent of the observed expansion in aggregate investment (Table 2).

The impact of these demographic changes is also strong in terms of public accounts. In particular, in the model the share of public debt in GDP gets significantly reduced from 64.1 per cent in 1998 to 53.8 per cent in 2008 (Table 2). This corresponds to 42 per cent of the improvement observed in this variable in the data and it has to do mostly with the increase in tax revenues associated to the expansion of economic activity.[15] Also note that the fall in the dependency ratio further contributes to a reduction in public debt via improving the balance of the social security system.

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[13] Projections end in 2059. Afterwards, we assume that net immigration inflows stay constant at the 2059 level.

[14] These data refer to 10-years age groups. We make it annual by fitting a second order polynomial to the available age distribution.

[15] In this exercise we are keeping the share of government spending in GDP constant at a 17.3 per cent, as in the calibration exercise.

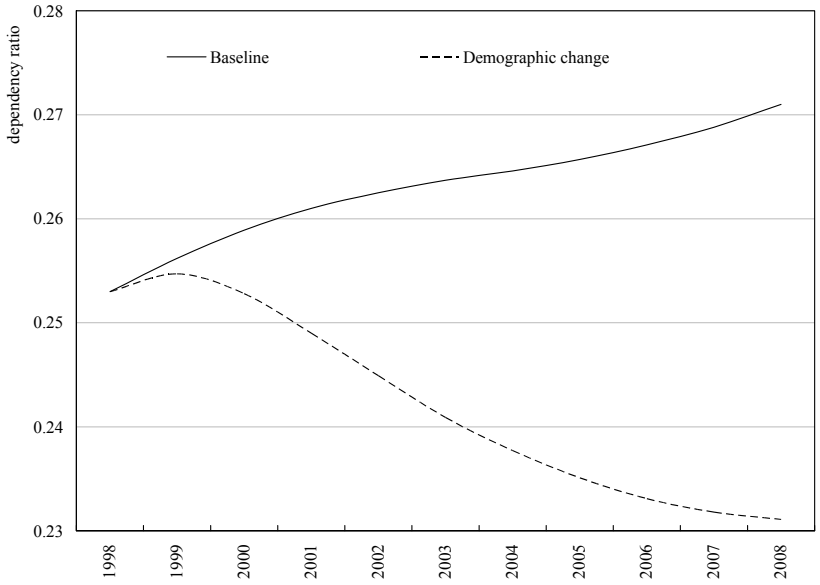
Table 2

Role of Demographic Changes

	Data		Model	
	1998	**2008**	**1998**	**2008**
Investment/GDP	23.5%	29.3%	23.4%	26.9%
Public Debt/GDP	64.1%	39.5%	64.1%	53.8%
Foreign Assets/GDP	–31.7%	–80.6%	–31.7%	–44.9%

Figure 2

The Dependency Ratio in the Short Run



As for impact of demographic developments on the external imbalance of the economy (measured as the ratio of net foreign assets to GDP) the aforementioned increase in investment in the model, together with minor changes in aggregate savings, impacts negatively on the current account and leads to a deterioration in the economy's international investment position. Thus, according to the model, 27 per cent of the deterioration in the ratio of net foreign assets to GDP observed in Spain over the period 1998-2008 could be explained by the demographic changes hitting the economy. However, a better accounting of these observed dynamics requires incorporating additional elements into the model economy. We do this next.

5.2 The role of interest rates

As illustrated in Figure 4, real interest rates in the Spanish economy fell significantly during its last expansionary phase. To evaluate the macroeconomic impact of this interest rate evolution, in this section we depart from our model economy calibrated to 1998 and consider, together with the demographic developments described above, two alternative interest rate scenarios.

Scenarios – To construct these scenarios we take the smoothed evolution of the *ex post* real short-term interest rate (measured as the one year Euribor) in Spain over the period 1998-2008 and consider two possibilities. In the first scenario we assume that the fall in interest rates observed over the period 1998-2008 is transitory, so that by 2010 the interest rate gets back to its 1998's

Figure 3

The Dependency Ratio in the Long Run

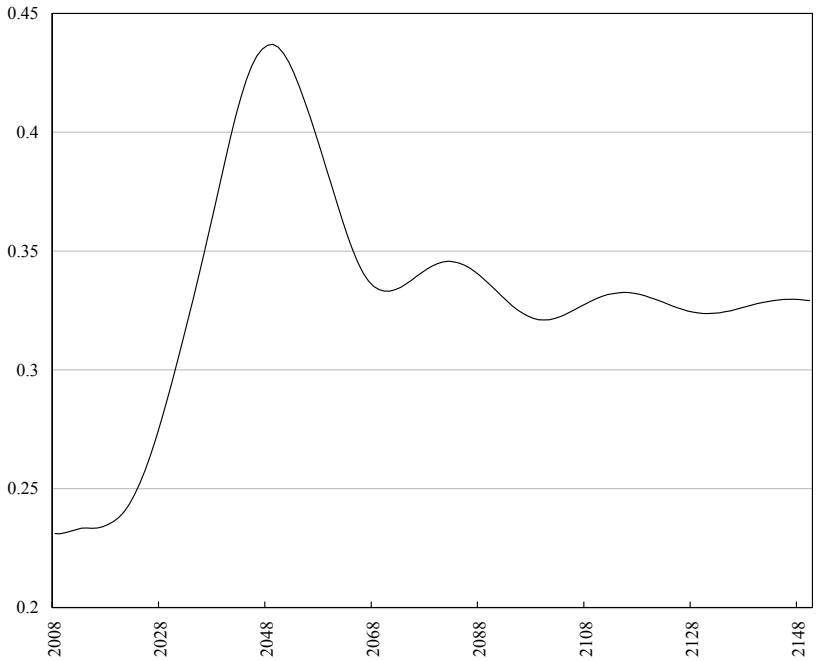
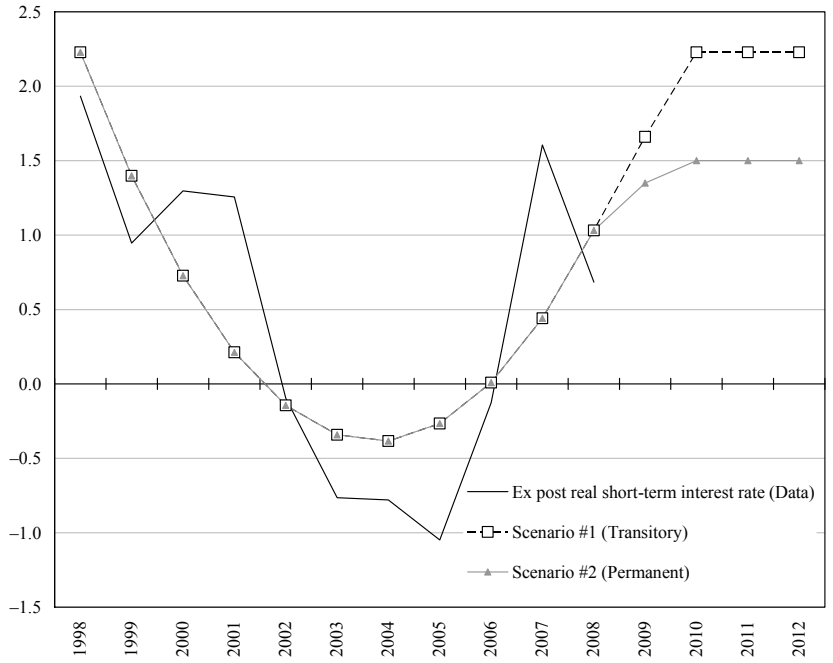


Figure 4

The Interest Rate Shock
(percent)



level, staying constant afterwards. In the second scenario, instead, we consider that the fall in interest rates is permanent. Namely, rather than returning to their 1998's levels, interest rates increase slightly between 2008-10 and stay constant at a 1.5 per cent level afterwards. These scenarios are depicted in Figure 4.

Findings – Departing from our initial state in 1998, we now incorporate into our model economy both the demographic changes described in Section 5.1 and the interest rate scenarios in Figure 4. In addition to the macroeconomic effects discussed above induced by demographic changes, the fall in interest rates (in both scenarios) has two main effects in the economy. Very intuitively, it contributes to a further expansion in aggregate investment and, via a reduction in the debt burden, to a more intense improvement in public debt (Table 3). It turns out that the former effect dominates so that the fall in interest rates leads to a further deterioration of the economy's international investment position. Naturally, all these effects are larger when the fall in interest rates is permanent (Scenario No. 2) rather than transitory (Scenario No. 1).

Table 3

Role of Interest Rates and Demographic Changes

	Data		Model (year 2008)	
	1998	**2008**	**Scenario No. 1**	**Scenario No. 2**
Investment/GDP	23.5%	29.3%	27.4%	30.1%
Public Debt/GDP	64.1%	39.5%	41.3%	40.1%
Foreign Assets/GDP	–31.7%	–80.6%	–63.9%	–77.3%

Not surprisingly, by adding the observed interest rate developments, the model delivers a better description of the evolution of the ratios of public debt and of net foreign assets to GDP in the Spanish economy over the period 1998-2008. Thus, according to the model, the developments in interest rates and demographic variables observed in the Spanish economy over this period would have been responsible for much of the observed improvement in public accounts in Spain (93 per cent in Scenario No. 1 and 97 per cent in Scenario No. 2) and of the deterioration of its external imbalance (66 per cent in Scenario No. 1 and 93 per cent in Scenario No. 2).

5.3 The role of fiscal policy

The previous section showed that much of the investment boom, the consolidation of public accounts and the increase in external indebtedness observed in the Spanish economy over the period 1998-2008 can be rationalized, in the context of our model economy, as the natural reaction of the economy to the observed developments in interest rates and demographic variables. This section analyzes to what extent this macroeconomic behavior would have changed if a different fiscal policy would have been in place. In particular, we study whether a more restrictive fiscal policy, involving a reduction in government consumption, could have attenuated the dramatic deterioration of the Spanish external position over the 1998-2008 period.

Thus, rather than assuming, as in the simulation exercises described above, that government consumption represents a constant fraction of GDP (17.3 per cent) in each period, we now consider two alternative fiscal policy scenarios. In these scenarios government consumption stays constant, in per capita terms, at its 1998's level for 10 (Scenario No. 1) and 20 (Scenario No. 2) years. Beyond 2008 in Scenario No. 1, 2018 in Scenario No. 2, government consumption represents again a 17.3 per cent of GDP in each period. Given that, as mentioned above, GDP increases in the model over the period of analysis in response to interest rate and demographic developments, these fiscal policy scenarios imply, in practice, a temporary reduction in the share of government expenditure to GDP, being this more permanent in Scenario No. 2. Namely, in Scenario No. 1 (Scenario No. 2) this share decreases smoothly from 17.3 per cent in 1998 to 15.8 per cent (14.8 per cent) in 2008 (2018).

Table 4 shows the results of these counterfactual exercises using as a benchmark the exercise described in Section 5.2 that incorporates demographic changes and a transitory fall in interest rates (Scenario No. 1). Intuitively, the model predicts that in both fiscal scenarios less government consumption over the period 1999-2008 would have led to a more intense improvement in public accounts by 2008 than that in the benchmark case. This fiscal tightening, however, would have

Table 4

Role of Fiscal Policy

	Model (Year 2008)		
	Benchmark	**Fiscal Scenario No. 1**	**Fiscal Scenario No. 2**
Investment/GDP	27.4%	27.5%	28.0%
Public Debt/GDP	41.3%	36.7%	36.9%
Foreign Assets/GDP	–63.9%	–63.0%	–75.9%

helped very little in attenuating the build-up of the economy's external imbalance over this period. In particular, the transitory tightening of government consumption in Scenario No. 1 would have only reduced the size of this imbalance by 2008 by 1 percentage point. The more permanent tightening of fiscal policy in Scenario No. 2 would have even increased that imbalance.

The intuition behind this little effectiveness of fiscal policy in addressing the economy's external imbalance lies on the forward-looking behavior of households in the model. Certainly, a reduction in government consumption leads to an improvement in public accounts and this, by itself, attenuates the economy's need for external financing. However, to the extent that households anticipate that the reduction in the share of public debt to GDP is going to imply a reduction in labor income taxes in the future (once the fiscal rule operates), they immediately modify their labor and consumption profiles so that current private borrowing increases. This increase therefore counteracts the fall in public financing needs and, depending on the temporal dimension of the fiscal tightening, it may even imply a more intense deterioration in the economy's external imbalance.

5.4 The role of labor and product market distortions

The Spanish economy is characterized by the existence of important distortions in the labor and product markets, which hinder productivity growth, a proper allocation of resources and, more broadly, damage the external competitiveness of the economy. In this section we explore how structural reforms on these markets could have affected the macroeconomic performance of the Spanish economy over the period 1998-2008. In particular, we study the reaction of our model economy to a 2 percentage points decrease in the labor and product markets markups. Christopoulou and Vermeulen (2008) report that the markup in the U.S. manufacturing sector was, on average over the period 1993-2004, 6 percentage points greater than in the Euro Area. In a similar vein, Andres, Ortega and Valles (2008) argue that a 5 percentage points differential in the product market markup is a conservative estimate of the importance of markup differences across European markets. In this sense, our simulated reduction in markups would entail closing around one third of these differences in the competitive environment. A number of papers in the literature have conducted quantitative exercises similar to ours. For instance, Gomes *et al.* (2009) show the macroeconomic implications of a decline in German markups in the product and labor markets of 5, 10 and 15 percentage points Moreover, Kilponen and Ripatti (2006) show the effects for the Finnish economy of a reduction of 5 percentage points in the labor market markup and of 2 percentage points in the product market markup.

As in the previous section, we use the exercise described in Section 5.2 that incorporates demographic changes and a transitory fall in interest rates (Scenario No. 1) as a benchmark.

Departing from that benchmark, we first consider a labor market reform setting λ^l= 1.18 (rather than 1.20) and then a product market reform setting λ^i = 1.08 (rather than 1.10). Not surprisingly, reducing the inefficiencies in these markets leads, compared to the benchmark, to an expansion of economic activity, with increases in aggregate investment and employment, and to an improvement in external competitiveness. According to the model, the positive effects of the same 2 percentage points reduction in the markup are larger if the reform is carried out in the product market rather than in the labor market. Namely, with a product market reform, GDP, employment and the terms of trade would have been, by 2008, 1.5 per cent higher, 0.7 per cent higher and 0.3 per cent lower, respectively, than with a labor market reform. On the long run, these differences persist: GDP, employment and the terms of trade would have been 1.6 per cent higher, 0.6 per cent higher and 0.3 per cent lower, respectively, with a 2 percentage points decrease in the product market markup than with the same decrease in the labor market markup.

The impact that these structural reforms would have had on Spanish publics accounts and on the economy's external imbalance over the period 1998-2008 is summarized in Table 5. Due to the aforementioned expansion of economic activity, the consolidation of public accounts over this period would have been more intense with the reforms. The external imbalance of the economy, however, would have been higher by 2008 if the reforms had been carried out. The reason for this result is that, as in the case of fiscal policy, households anticipate lower taxes and a more efficient economy in the future. Thus, in order to smooth consumption, they increase current private borrowing what, together with the increase in aggregate investment, dominate the improvement in public accounts and then lead to a more intense external indebtedness.

Table 5

Role of Labor and Product Market Distortions

	Model (Year 2008)		
	Benchmark	**Labor Market Reform**	**Product Market Reform**
Investment/GDP	27.4%	27.6%	28.4%
Public Debt/GDP	41.3%	38.0%	36.6%
Foreign Assets/GDP	–63.9%	–65.0%	–68.4%

Fiscal policy vs. structural reforms – According to the model, an structural reform in the product market (like the one considered in this section) could achieve a short-run reduction (over the 1998-2008 period) in the ratio of public debt to GDP similar to that achieved with the fiscal tightening exercises presented in Section 5.3. This, together with fact that the long-term positive effects of structural reforms on GDP, employment, investment and competitiveness are absent with alternative fiscal policy experiments, strongly point to structural reforms as a powerful instrument to pursue improvements in the economy's public accounts, not only for the period 1998-2008 but for the future. In this sense, as mentioned above, the fact that these reforms may lead to a deterioration in the economy's external imbalance in the short run should not be worrisome. It naturally comes from i) increased investment (once inefficiencies have been reduced) and ii) households' smoothing behavior (as the economy will be wealthier in the future with less distortions).

6 Beyond the financial crisis

The previous section showed the performance of the model over the period 1998-2008 under alternative scenarios. This section, instead, studies its implications beyond 2008. To do that in a meaningful way, we first introduce several shocks into the model economy in 2008 that aim to capture the arrival of the global financial crisis to the Spanish economy. Once these shocks have been incorporated, we address two questions: i) how the macroeconomic evolution predicted for the Spanish economy beyond 2008 has changed due to the global financial crisis and ii) to what extent that predicted evolution may be altered by fiscal policy and structural reforms.

6.1 The global financial crisis

In order to incorporate into our model economy the arrival of the global financial crisis in 2008 we take, as a benchmark, the exercise described in Section 5.2 including demographic changes and a transitory fall in interest rates (Scenario No. 1), and assume that the economy is hit by the following shocks in 2008:

(S1) Between 2008 and 2009 capital depreciates an additional 10 per cent and the depreciation rate goes back smoothly to its initial calibrated level ($\delta = 0.0995$) in 5 years.

(S2) Beyond 2008, during 20 years, TFP growth is 1 percentage point smaller than in the benchmark.

(S3) In 2009, the age-specific index, e_i, which transforms households' raw labor hours into efficient units of labor, decreases by 10 per cent and it goes back to its initial level after 5 years.

(S4) In 2009, the share of government consumption plus government transfers in GDP increases by 5 percentage points with respect to the benchmark and it goes back smoothly to its calibrated level ($\frac{G+TR}{GDP} = 0.223$) in 10 years.[16]

Certainly, the global financial crisis has hit the Spanish economy in many different dimensions, some of which can not be incorporated into the framework developed in this paper. Consequently, the aim of this exercise is not to perform a full account of the quantitative implications of the crisis, but to broadly incorporate its main consequences. In this sense, shock (S1) tries to capture the view that much of the investment made in Spain during the last expansionary phase was not as productive as initially thought so that its value will need to adjust gradually. The second shock (S2) we consider is a fall in TFP growth. This could be justified on two grounds: as a revision of households' expectations about future growth prospects (maybe too optimistic before the crisis) and/or as a way of capturing the real effects of the financial turmoil. The recent crisis has also led to a very rapid and intense increase in unemployment, that rose from around 9 per cent in 2007 to around 19 per cent in 2009, whose future reduction is expected to be very gradual. Shock (S3) incorporates into our model economy the effects of this fall in the workforce. Finally, with the arrival of the crisis public accounts in Spain have experienced a quick and intense deterioration. This has been mostly due to the work of automatic stabilizers and to the expansionary programs put in place by the government to mitigate the effects of the crisis. In our model, this is captured by shock (S4). It should be noted that, although the magnitude of these shocks has not been chosen to replicate the observed deterioration of macroeconomic aggregates

[16] In each year, the increase in $\frac{G+TR}{GDP}$ with respect to the benchmark is split evenly between government consumption and transfers.

over the crisis period, they are able to generate a contraction of real GDP between 2008 and 2009 of –1.7 per cent, which is in line with the HP-filtered growth rate observed in the data (–1.66 per cent). Furthermore, in terms of the dynamics of public accounts, the model generates an increase in public deficit of 6 percentage points (7 percentage points in the data).

6.2 *The effects of the crisis*

Departing from our benchmark in 2008, Figure 5, 6 and 7 show the short-run behavior of our model economy beyond that date with and without the arrival in 2008 of the global financial crisis, represented by the shocks described in Section 6.1.

Two main conclusions can be extracted from this figure. First, even without the arrival of the crisis, in the short-run the Spanish economy would have entered into a phase of lower, even negative, GDP growth where the external imbalance of the economy would have been reduced but where public accounts would have deteriorated. In this non-crisis scenario, that already incorporates an increase in interest rates

Figure 5

GDP During the Crisis

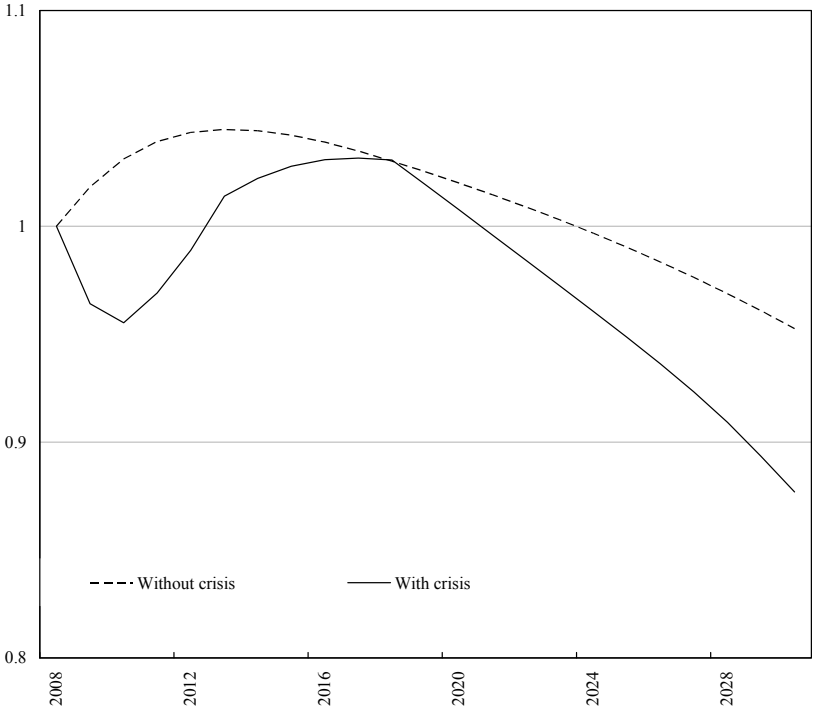


Figure 6

Public Debt During the Crisis

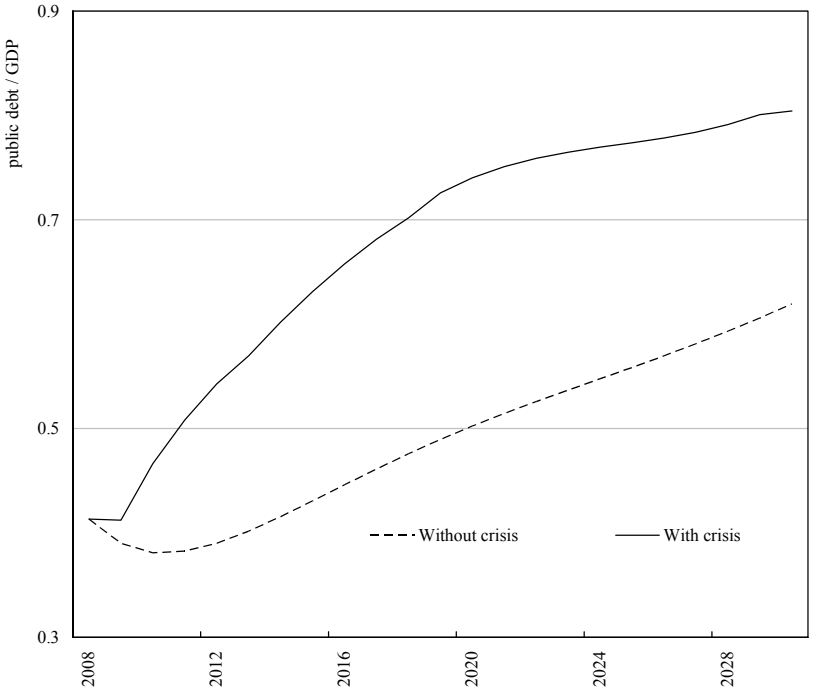
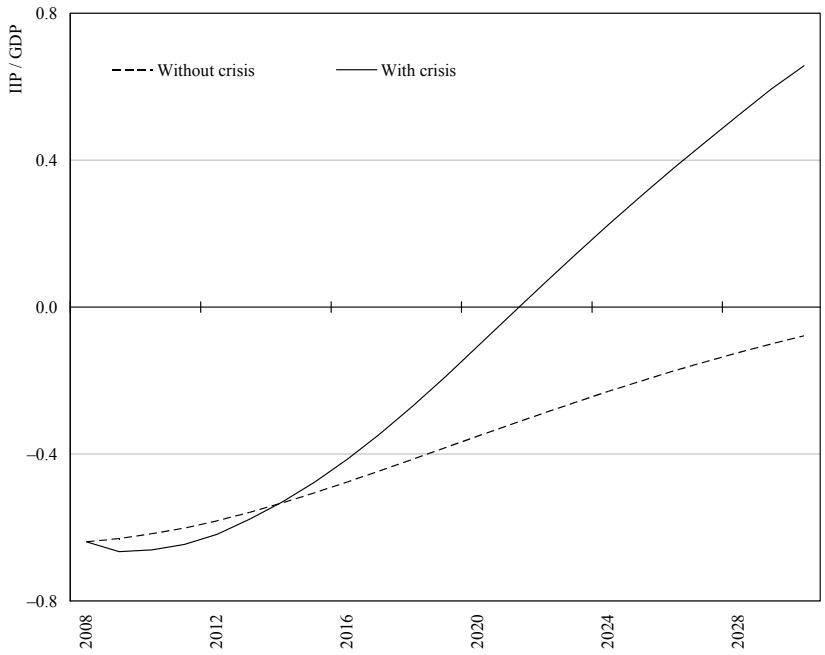


Figure 7

International Investment Position During the Crisis



beyond 2008, these dynamics are driven to a large extent by demographic changes. Namely, by the behavior of the dependency ratio in Spain that, after decreasing over the period 1998-2008 due to immigration inflows, increases again in 2009 and especially over the period 2020-50 with the aging of the Spanish baby boom generation. In the short-run, this reduction of the working-age population has an obvious negative effect on GDP and investment (which helps to correct the external imbalance of the economy) and, due to social security expenditures, on public accounts.

And second, in the short-run, the arrival of the global financial crisis accentuates the aforementioned dynamics that would have taken place without the crisis. Namely, the deterioration of GDP growth and public accounts and the improvement of the economy's external imbalance. To the extent that the crisis constitutes a negative wealth shock for the economy, households' consumption reduces substantially with respect to the non-crisis scenario, what explains the more intense improvement in the economy's the external imbalance. In addition, the shock increasing government consumption and transfers clearly leads to a deeper deterioration in public accounts. Finally, the negative shocks to the capital stock and to the age-specific index, e_i, cause an immediate fall in GDP after the crisis, which only recovers gradually. In this sense, the model predicts that by 2018 the economy is able to get back to the GDP level that would have had without the arrival of the crisis. At that moment, however, GDP starts deviating again from the non-crisis scenario. The reason is that in 2018 the fiscal rule begins to operate in the crisis scenario and, given the increase in the debt to GDP ratio over the period 2009-18, it leads to a substantial increase in labor taxes. Intuitively, this tax increase improves the dynamics of public accounts beyond 2018 but cause a fall in aggregate labor what has an adverse effect on GDP. Note, however, that the global financial crisis does not have any long-term effect on the economy and, in particular, on GDP. This is a natural consequence of the way in which we have modelled the crisis in Section 6.1, exclusively through temporary shocks.

6.3 The role of structural reforms and fiscal policy

Product market reform – Figures 8 and 9 show the short-run behavior of our model economy beyond 2008 when, besides the shocks coming from the global financial crisis, in 2009 the economy experiences a permanent fall in the markup in the intermediate goods market of

2 percentage points (λ^i falls from 1.10 to 1.08). Very intuitively, with respect to a non-reform scenario (*With crisis*), in the short-run this structural reform mitigates the deterioration in output and in public accounts caused by the global financial crisis without significantly affecting the economy's external imbalance. The effect of the reform on GDP is particularly strong. Namely, with the reform the economy, not only is able to get back to the GDP level that it would have had without the arrival of the crisis before compared to a non-reform scenario (2014 vs. 2018), but it may even enjoy for some time (over the period 2014-25) of greater output levels compared to a non-crisis scenario. In addition to these short-term effects, as mentioned in Section 5.4, this structural reform also has important long-term effects. In particular, as shown in Figure 14, with a reduction in the distortions in the product market output is higher and public debt is lower in the long-run.

Fiscal policy – In the crisis scenario (*With crisis*) considered so far the arrival of the global financial crisis was accompanied by a shock to the share of government consumption plus government transfers in

Figure 8

The Role of Product Market Reform During the Crisis: GDP Dynamics

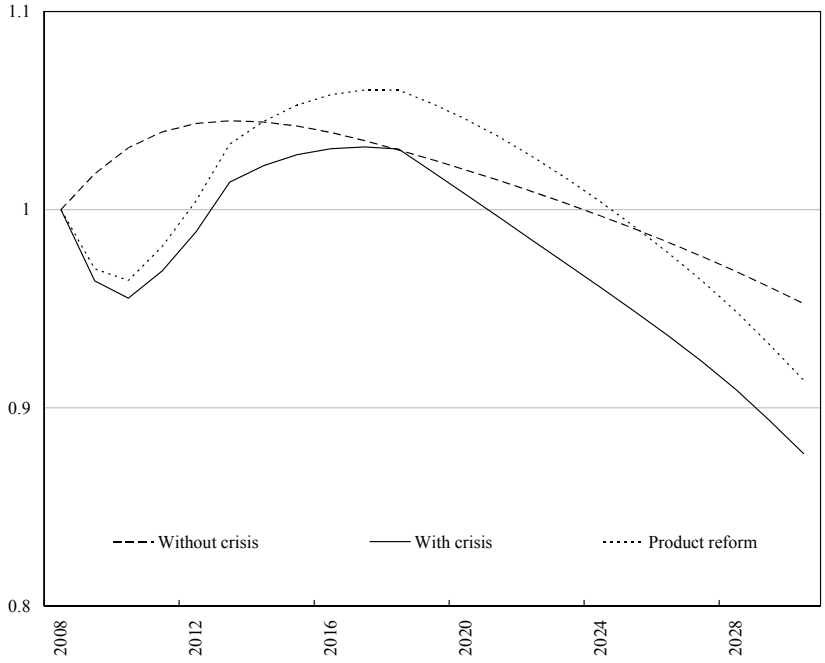
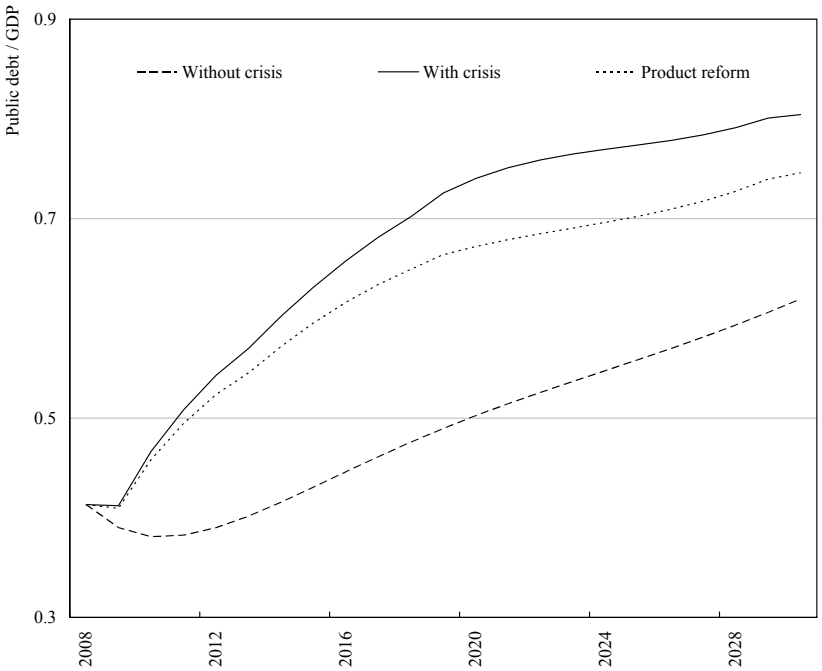


Figure 9

The Role of Product Market Reform During the Crisis: Public Debt Dynamics



GDP. In particular we have assumed that in 2009 this share increases by 5 percentage points with respect to the non-crisis scenario and it goes back smoothly to its calibrated level ($\frac{G+TR}{GDP}=0.223$) in 10 years. In order to evaluate how fiscal policy can modify the macroeconomic evolution of the Spanish economy beyond 2008, we now consider two alternative fiscal scenarios: Scenario No. 1, in which the initial size of the shock is smaller ($\frac{G+TR}{GDP}$ increases by 2.5 percentage points with respect to the benchmark in 2009) and it takes 10 years to get back to the benchmark, and Scenario No. 2, in which the initial size of the shock is the same but it reverts to the benchmark in 5 years rather than 10. In this context, a tighter fiscal policy leads to a less intense deterioration in public accounts and, for the reasons detailed in Section 5.3, it has very little effects on the economy's external imbalance. In terms of output, however, a tighter fiscal policy causes a slightly more intense deterioration of GDP in the years immediately after the arrival of the crisis, but more importantly, it substantially mitigates the output loss predicted beyond 2018 compared to the *With crisis* scenario. With a less expansive fiscal policy the debt to GDP ratio increases less over the period 2009-18 so that the increase in taxes needed afterwards to correct this imbalance is smaller, what has a less adverse effect on aggregate labor and output. Therefore, there is trade-off: while a more expansive fiscal policy helps mitigating the immediate output losses caused by the crisis, it has a negative effect on output recovery in medium-term.

Fiscal policy vs. structural reforms – Summing up, as pointed out in Section 5, the model predicts a very little role for fiscal policy and structural reforms to modify the behavior of the economy's external imbalance in the short-run. In terms of limiting the deterioration of public accounts, however, both tighter fiscal policies and structural reforms may help substantially. More importantly, in terms on output, the model predicts a different reaction of the economy to these alternative policies and structural reforms seem to outperform tighter fiscal policies. Thus, while structural reforms help in reducing output losses in the short- and medium-term and have a positive long-run effect on the level of output, tighter fiscal policies, which do not exhibit long-term effects, face a trade-off: they may reduce the output losses caused by the crisis in the medium-term but at the expense of a more intense output loss in the years immediately after the arrival of the crisis.

7 Concluding remarks

The emergence of a huge current account deficit was one of the main characteristics marking developments in the Spanish economy during the period of robust economic growth prior to the current crisis. This paper tries to disentangle the main drivers behind this upswing. To this end, we calibrate a small open-economy model for Spain that replicates relatively well the main features of the Spanish economy during the last decade. According to this model two main factors arise as particularly relevant in explaining these developments. First, the decline in interest rates derived from Spain's participation in the European Monetary Union; and further, the far-reaching demographic change brought about by huge immigration flows.

Apart from the role of these two factors, which have already been emphasized by the existing literature, our paper investigates the role played by economic policies in the build-up of the Spanish external imbalance. First, considerable attention has been given in the related literature to the potential role fiscal policy might play in the reduction of this imbalance. In this paper, the role of fiscal policy is analyzed by means of two counterfactual scenarios that try to measure what the external imbalance would have been if significantly tighter fiscal policies had been applied during the last decade. This restrictive fiscal policy is simulated through lower public expenditure growth than that observed in the data. Our results show that the role that a tightening of fiscal policy could

have played in the reduction of the Spanish external imbalance would have been very limited and would have depended on the temporal dimension of this tightening. A transitory change in fiscal policy would have reduced the economy's external imbalance only very slightly, by affecting public savings without significantly distorting private ones. Instead, a permanent fiscal tightening would have had a negative effect on the economy's net foreign assets as it would have distorted optimal decisions by forward looking agents and reduced private savings.

These results need to be put in a new perspective under the current economic conditions, where the Spanish budget deficit has increased dramatically over the past two years, causing a significant increase in public debt, and where financing conditions for private agents are considerable tighter. Under these conditions, the situation is closer to the classical "twin deficits" scenario in which the current account imbalance is in close relation with public deficit. In this scenario, fiscal consolidation is needed to correct the external imbalance.

Second, we investigate the role played by labor and product market reforms in the correction of this imbalance. This is relevant insofar as the Spanish economy experienced a progressive increase in its prices and costs relative to those of its main competitors during the economic boom, which may have had an effect on net exports, and there is evidence that this rise in relative prices and wages is related to labor market rigidities and insufficient competition in some markets. Our results show that, if structural reforms in labor and product markets had been adopted in the Spanish economy over the period 1998-2008, the expansion of economic activity, investment and employment would have been more intense than the one observed over that period. The external competitiveness of the economy would have also improved relative to a non-reform scenario and the improvement in public accounts would have been larger. These reforms, however, would have implied a further deterioration of the Spanish external imbalance over the 1998-2008 period. Increased investment, once market distortions had been reduced, and reduced private savings, as households try to smooth their consumption anticipating lower taxes and a more efficient economy in the future, would be responsible for this further deterioration. Nevertheless, it is worth mentioning that, despite this short-run effect on the economy's external imbalance, according the model structural reforms, besides improving GDP, employment, investment and competitiveness in the long-run, constitute a very effective policy instrument to achieve fiscal consolidation.

The framework set out in this paper has also been used to analyze the different policy options faced by the Spanish economy after the crisis. Several results are worth mentioning. First, even without the arrival of the crisis, in the short-run the Spanish economy would have entered into a phase of lower GDP growth where the external imbalance of the economy would have been reduced but where public accounts would have deteriorated. The arrival of the global financial crisis has accentuated the aforementioned dynamics. Second, the model highlights the trade-off faced by tighter fiscal policies in the post-crisis scenario: they may reduce the output losses induced by the crisis in the medium-term but at the expense of a more intense output loss in the years immediately after the crisis. In contrast, structural reforms do not face this trade-off and may contribute to reduce output losses in the short- and medium-term, while inducing a positive long-run effect on the level of output. In light of the potential benefits of those policies aimed at improving competition, it would be interesting to further explore their interactions with total factor productivity growth.

APPENDIX

Definition of equilibrium

The equilibrium of the model is a list of sequences of:

- prices $\{r_t, p_{H,t}, p_{H,j,t}, p_{F,t}, p_{F,z,t}, p_{K,t}, p_{I,t}, W_t, \widetilde{w}_{i,t}, w_{i,t}\}$,
- taxes $\{\tau_t^c, \tau_t^l, \tau_t^{ss}, \tau_t^a, \tau_t^k\}$,
- transfers $\{b_t, ss_{i,n,t}, tr_t, SS_t, TR_t\}$,
- and quantities $\{N_{i,n,t},\ c_{i,n,t},\ C_t,\ C_{H,t},\ C_{F,t},\ a_{i,n,t},\ A_t,\ h_{i,n,t},\ Y_t,\ Y_{H,t},\ y_{H,j,t},\ Y_{F,t},\ L_t,\ L_{i,t},\ L_{H,j,t},\ K_t,\ K_{H,j,t},\ I_t,\ I_{H,t},\ I_{F,t},\ G_t,\ G_{H,t},\ G_{F,t},\ D_t,\ X_t,\ Y_t^*\}$,

such that, at each point in time t:

- the age structure of the population follows the law of motions (1)-(3),
- agents maximize lifetime utility (4) subject to the period by period budget constraints (5),
- all firms maximize profits,
- accidental bequests are given by:

$$b_t = \frac{\sum_n \sum_{i=I_A}^{I} \mu_{i-1,n,t-1} a_{i,n,t} (1 - s_{i-1,t-1})}{(1 + np_{t-1}) \sum_n \sum_{i=I_A}^{I} \mu_{i,n,t}} \tag{31}$$

where np_{t-1} is the population growth rate between periods $t-1$ and t,

- dividends received by households are equal to:

$$div_t = \frac{\int_0^1 \pi_{H,j,t} dj + \sum_{i=I_A}^{I_R - 1} \pi_{L,i,t} + d_t}{\sum_n \sum_{i=I_A}^{I} N_{i,n,t}} \tag{32}$$

- the budget constraint of the government (27) is satisfied,
- labor markets clear:

$$L_{i,t} = \sum_n \mu_{i,n,t} h_{i,n,t} \tag{33}$$

$$L_t = \left[\sum_{i=I_A}^{I_R - 1} \left(\frac{1}{I_R - I_A} \right)^{\frac{\lambda_t^l - 1}{\lambda_t^l}} \left(e_i L_{i,t} \right)^{\frac{1}{\lambda_t^l}} \right]^{\lambda_t^l} \tag{34}$$

$$\int_0^1 L_{H,j,t} dj = L_t \tag{35}$$

- the market for physical capital clears:

$$K_t = \int_0^1 K_{H,j,t} dj \tag{36}$$

- the market for the composite of domestic intermediate goods clears:

$$Y_{H,t} = C_{H,t} + I_{H,t}\left(1 + S(\cdot)\right) + G_{H,t} + X_t \tag{37}$$

- and the aggregate budget constraint of the economy holds:

$$C_t + p_{I,t} I_t \left(1 + S(\cdot)\right) + G_t + DAC_t + FA_{t+1} - (1 + r_t) FA_t = p_{H,t} Y_{H,t} \tag{38}$$

where $FA_{t+1} = A_{t+1} - D_{t+1}$ denotes the net foreign asset position of the country at the end of period t and DAC_t is the dividends adjustment cost.

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EQUITY ASPECTS OF VAT IN EMERGING EUROPEAN ECONOMIES: THE CASE STUDY OF SERBIA

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Studies of VAT incidence in developed European economies reveal a regressive distribution in any particular year, but mildly progressive lifetime incidence. Micro-simulation analysis of Serbian expenditure survey data yields similar conclusions. However it is important to clearly recognize two distinctive features of emerging European economies when analyzing the VAT incidence. Firstly, we show that significant presence of own-source small farming production in many emerging European countries, including Serbia, presents an additional progressivity-enhancing buffer compared to VAT incidence in developed economies. Secondly, the high level of shadow economy and evasion of direct income taxes in many emerging European countries suggests that household expenditures are a more meaningful indicator of the living standard and ability to pay taxes than the registered income. Overall, we conclude that common beliefs of regressive VAT taxation, often encountered in the general public, are vastly overstated and poorly founded in economic reality of emerging European countries.

Introduction

Tax systems around the world are continuously changing in response to economic, political and administrative developments. Rapid globalization during the last couple of decades introduced unprecedented international mobility of capital, goods and services, and (to a certain extent) labor, consequently causing a world-wide trend of reducing custom duties, corporate income taxes and tax wedges on labor. Significant reductions in corporate and personal tax rates on capital and labor incomes have been especially stark in emerging European countries, which experienced a fierce (income) tax competition during the last decade in order to attract foreign investors – the so called "race to bottom" phenomenon.

Faced with reduced revenues from other sources, EU countries are increasingly relying on consumption taxation. European Commission (2009) notes that reliance on consumption taxes, and VAT in particular, has been continually increasing in EU member states in the 2000-07 period. Policy importance of consumption taxation is also highlighted by the renewed attention to the optimal tax-mix issues, due to strong theoretical and empirical evidence that consumption taxes are less disruptive to economic growth than direct income taxes (Johansson *et al.*, 2008). Some European countries have already implemented efficiency-driven tax reforms which shift the burden from income to consumption taxation – Germany in 2007 and Hungary in 2008 being the most obvious examples, with France and Croatia being the most recent ones. Similar efficiency-driven tax reforms are being analyzed in other European countries, both developed (Belgium, Netherlands) and emerging ones (Serbia, Czech Republic).

Implementing aforementioned reforms which shift the burden from income to consumption taxation is challenging in practice due to political considerations and common (mis)belief in the general public that VAT is a regressive tax that causes adverse distributional effects by creating disproportionate tax burden on the poor households. Public perception of regressive consumption taxation has been reinforced by the early empirical tax incidence analysis, including the classical work of Pechman (1985). However, more recent research has unambiguously shown that much of

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the estimated extremely regressive incidence of consumption taxes against annual income originates from measurement errors inherent in expenditure surveys. Furthermore, the theoretical basis for assessing the VAT incidence against annual income instead of annual expenditures or lifetime income is rather weak (Caspersen and Metcalf, 1994; Creedy, 1998). Recent empirical estimates in EU member states, based on the lifetime tax incidence approach, reveal slightly progressive VAT incidence (DeCoster *et al.*, 2010).

We will use micro-level data for Serbia to investigate equity aspects of value added taxation in a typical emerging European country. Compared to developed European countries, many emerging European countries, especially Poland, Romania and Serbia, feature a significant presence of own-source small farming production and associated in-kind consumption. As we will show, this feature tangibly enhances the progressivity of VAT systems in these countries. Furthermore, significant presence of shadow economy and evasion of direct income taxes in many emerging European countries suggests that household expenditures are a more meaningful indicator of the living standard and ability to pay taxes than the registered income. We conclude that common beliefs of regressive VAT taxation, often encountered in the general public, are vastly overstated and poorly founded in economic reality of emerging European countries.

This paper is organized as follows: Section 1 presents basic results from the existing literature, highlighting the difference between annual and lifetime tax incidence analysis and noting the inherent presence of income measurement errors in expenditure surveys. Section 2 describes features of the existing Serbian VAT system and explains the estimation methodology used in our analysis. Section 3 presents empirical estimates of annual and lifetime VAT incidence in Serbia. Section 4 quantifies the poor redistributive performance of the reduced VAT rate mechanism and highlights the fact that government transfer policies are the optimal tool for achieving social redistribution goals. Section 5 simulates three alternative approaches to increasing the VAT burden and compares their distributional effects. Concluding remarks are presented in Section 6.

1 Theoretical background and literature survey

Consumption taxes, and VAT in particular, are often deemed to be inherently regressive by the general public. Throughout the years, this point of view has been shared by a tangible number of economic practitioners and tax experts. The argument most often quoted in the general public in support of the regressive consumption taxation hypothesis is the observation/belief that poor individuals spend most or all of their incomes, while rich individuals are able to save significant shares of their income. Thus, one is led to believe that consumption taxation is inherently regressive – since it burdens poor individuals more heavily than it does the rich ones.

1.1 Empirical evidence

Early empirical evidence, such as the seminal study of Pechman(1985), seemed to be fully supportive of the general public beliefs. Namely, using annual income and expenditure data from a survey of US households, Pechman shows the sales tax incidence to be distinctively regressive, representing a higher share of income for poor households that for the rich ones. Similar results, based on annual data from expenditure surveys, have been obtained in many countries throughout the years. The most recent analysis with respect to EU member states is Decoster et al (2010), which also confirms the belief that VAT incidence is regressive, when measured against annual income.

When conducting empirical analysis of VAT incidence, *ex ante* one would expect to obtain results such that the effective VAT rate faced by any household lies in the range from 0 per cent to

Table 1

Effective VAT Rates in Selected EU Member States Across Annual Income Deciles

Decile	Belgium	Hungary	UK	Greece	Ireland
Poorest	26.7%	28.2%	16.1%	33.2%	46.4%
2	13.4%	20.2%	11.2%	22.1%	16.6%
3	13.0%	18.1%	10.3%	19.6%	13.6%
4	12.4%	17.1%	9.4%	18.5%	11.6%
5	12.0%	16.0%	8.8%	18.5%	12.2%
6	11.2%	15.6%	8.2%	16.7%	11.4%
7	11.0%	15.2%	8.2%	15.3%	10.3%
8	10.3%	14.7%	7.5%	15.1%	9.5%
9	10.1%	14.3%	7.1%	13.4%	8.5%
Richest	8.8%	12.5%	5.8%	11.6%	6.3%
Legal VAT rate	21%	25%	17.50%	19%	21%

Source: Rearranged from Decoster *et al.* (2010) by the authors.

the (standard) legal VAT rate. Namely, very rich households might be able to save most or virtually all of their annual income – thus facing an effective VAT rate of 0 per cent in a given year. On the other extreme, a poor household that is forced to spend all of its annual income on goods and services taxed at the standard VAT rate would face the maximum possible effective VAT rate, which equals the legally prescribed standard VAT rate in a given country. However, existing empirical studies most often present VAT burden as a percentage of (disposable) income across different deciles, ie on the tax-inclusive basis. Since VAT is legally charged on the tax-exclusive, we believe it is more meaningful to present VAT incidence results on the tax-exclusive basis. The two approaches of representing research results are completely equivalent, but representing results on the tax-exclusive basis clearly shows the effective VAT rates and allows us to easily validate our *ex ante* research expectations – that estimated effective VAT rates should lie in the range from 0 per cent to the legal VAT rate.[1]

Empirical evidence from five EU member states in Table 1 seems to confirm the entrenched belief in the general public that VAT is regressive – effective VAT rates faced by the poor households in lower income deciles are significantly higher than the effective tax rates faced by the rich households in higher income decile. However, it should be stressed that in four out of five countries analyzed – the estimated effective VAT faced by the poorest households in the lowest decile are significantly higher than the legally prescribed standard VAT in respective countries. These results are opposite to our *ex ante* research expectations! Extraordinarily high estimates of effective VAT rates in the lowest income deciles are encountered in most empirical studies based on annual income and expenditure data. For example, O'Donoghue *et al.* (2004) investigate VAT

[1] If VAT burden is estimated to equal x per cent of disposable household income, than effective VAT rate on the tax-exclusive basis is easily calculated as $y = x / (1–x)$.

Table 2

Saving Rates and Estimated VAT Rates Excluding the Dissaving Effect

Decile	Belgium		Hungary		Greece	
	Saving	Corrected VAT rate	Saving	Corrected VAT rate	Saving	Corrected VAT rate
Poorest	–63.4%	16.4%	–50.4%	18.8%	–117.3%	15.3%
2	–17.5%	11.4%	–14.3%	17.7%	–62.8%	13.6%
3	–8.1%	12.0%	–3.9%	17.4%	–36.3%	14.4%
4	–2.1%	12.1%	1.6%	17.1%	–3.2%	17.9%
5	3.8%	12.0%	6.4%	16.0%	–26.2%	14.6%
6	9.3%	11.2%	10.1%	15.6%	–14.3%	14.6%
7	13.3%	11.0%	12.1%	15.2%	–8.5%	14.1%
8	18.0%	10.3%	14.4%	14.7%	–5.0%	14.4%
9	22.7%	10.1%	17.6%	14.3%	1.6%	13.4%
Richest	33.3%	8.8%	27.1%	12.5%	15.8%	11.6%

Source: Rearranged from Decoster *et al.* (2010) and expanded by the authors.

incidence in twelve EU member states and their estimates of effective VAT rate in the lowest income deciles are tangibly higher than the legally prescribed VAT rates in ten out of the twelve countries being analyzed.[2]

Unrealistically high effective VAT rate estimates in most countries are caused by the extremely high dissaving rates estimated from expenditure survey data. Decoster et al (2010) describe the dissaving rates in the lowest deciles in Table 2 as "unbelievably high" and resulting from under-reporting bias of income data – a phenomenon reported by most authors dealing with data from expenditure surveys, including Sebelhaus and Groen (2000) and Meyer and Sullivan (2003). If we correct for unrealistically high dissaving rates by assuming that incomes in the lowest deciles have to equal the recorded expenditures, we can observe that estimated VAT incidence in Table 2 is still regressive, but significantly less than the estimates in Table 1 imply.[3]

Overall, we can conclude that the abundance of empirical evidence from many countries over the years, which shows extremely regressive VAT incidence over annual income deciles – only partially supports the general public's beliefs regarding the inherently regressive VAT taxation. Namely, while general public beliefs are driven by regressive incidence of saving, the empirical results are mostly driven by the regressive incidence of dissaving, stemming from measurement errors and under-reporting of income bias inherent in expenditure surveys.

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[2] Interestingly enough, while Decoster *et al.* (2010) estimate effective VAT rate for the lowest decile to be lower than standard VAT rate in UK, O'Donoghue *et al.* (2004) estimate the opposite situation – effective VAT rate for the lowest decile was higher than standard VAT rate in this study. This points to the instability of empirical results that underlie common belief that VAT is a regressive tax.

[3] VAT estimates corrected for dissaving in Table 2 are obtained by dividing estimates in Table 1 *by (1 – the dissaving rate rate)*, for deciles which exhibiting the dissaving behavior.

1.2 Theoretical considerations

Correcting for income measurement errors significantly reduces the regressive character of VAT incidence estimates, but they remain invariably regressive when compared against annual income. However, one can rightfully question whether annual income represents the relevant measure of well-being against which VAT incidence should be assessed? In their seminal paper, Caspersen and Metcalf (1994) explain that low-annual-income households may include four very different kinds of individuals: those with volatile annual income who merely had a bad year, those that are young and just beginning a high-income career, those that are old and have just finished a high-income career, and those who are truly long-term poor. The identification of households that are truly poor requires that we look at the longer time horizon – moving from annual income framework to the entire lifetime income framework.

Permanent income theory (Friedman, 1957) suggests that annual income is not the relevant measure of well-being when assessing the VAT incidence, since households engage in consumption smoothing over their lifetime, saving temporary incomes in "good" years and dissaving accumulated funds in "bad" years. Similarly, the *lifecycle hypothesis* (Modigliani, 1986) implies that a typical individual moves from one income group to another during his lifetime, dissaving in youth and old-age and saving in the most productive middle-ages.[4] As a result, a typical individual is expected to face high VAT burden against annual income in some years, but low VAT burden in others. Overall, if we exclude the effects of inheritances and bequests, the average VAT rate an individual faces throughout his lifetime is exactly equal to the legally prescribed VAT rate – since the individual is assumed to spend all his lifetime earnings, although with certain temporal reallocations.[5] Thus, based on this theoretical consideration, one would expect consumption taxation (at uniform rate) to have proportional lifetime incidence. Furthermore, since most European VAT systems feature reduced VAT rates applicable to basic necessities, we could even expect to observe a degree of progressivity when analyzing lifetime incidence. This indeed is the case, as most research undertaken in the last couple of decades suggests somewhat progressive lifetime VAT incidence estimates, for example Caspersen and Metcalf (1994) for the United States and Decoster *et al.* (2010) for selected EU member states.

Empirical studies mostly support the lifecycle hypothesis and permanent income theory. Two approaches are most often relied upon when estimating lifetime VAT incidence – either using panel data to estimate the lifetime income (Fullerton and Rogers, 1991, Caspersen and Metcalf, 1994) or using current household consumption as a proxy for appropriate lifetime income (Caspersen and Metcalf, 1994; Decoster *et al.*, 2010; Slintakova and Klazar, 2010). Due to lack of appropriate panel data in most countries other than the United States, most of the research on VAT incidence in Europe thus far has relied on approximating the lifetime income with some form of non-durable household expenditures from expenditure surveys.[6] This is the approach we will follow in this study.

2 Data and methodological background

Serbian VAT system broadly follows the "EU model" and requirements laid-out in the

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[4] Lifetime income represents the present value of all incomes earned throughout individual's life plus any inheritance (s)he might receive.

[5] Caspersen and Metcalf (1994) explain that empirical evidence suggests bequests to be U-shaped with respect to lifetime income. Thus, ignoring inheritances and bequests has the effect of overestimating progressivity for the richest households and underestimating progressivity for the majority of poor and medium-income households.

[6] Current (non-durable) expenditures share many characteristics with the permanent or lifetime income, being rather stable from year to year, unlike current income which is very volatile over the years.

European Commission Sixth Directive. Standard VAT rate equals 18 per cent while the reduced rate is 8 per cent. Financial, postal, health and education services are tax-exempt, without the right to deduct the input-VAT (VAT Law Article 25). No domestic turnover of goods and services is zero-rated and basically only exports and services related to international trade and travel are zero-rated with the right to deduct the input-VAT (VAT Law Article 24). The list of goods subject to the reduced VAT rate (VAT Law Article 23) is somewhat long compared to best international practices, and includes food, medicines, utilities, textbooks, newspapers, hotel accommodation, fertilizers, firewood, natural gas, computer equipment, newly built apartments, utility services and tickets for cultural events (detailed list is given in the Appendix).

In order to estimate VAT incidence in Serbia, we will use the annual 2009 data from the Serbian Statistics Office Household Budget Survey (HBS). HBS is conducted in line with practices suggested by EuroStat, and the data from this source can be considered comparable to data obtained from expenditure surveys in other European countries. HBS 2009 data contains detailed expenditure information on 4592 representative households. HBS information is detailed enough so that particular households' expenditures can be identified as being subject to standard VAT rate, reduced VAT rate, being exempt from VAT or representing natural in-kind consumption due to own-source farming production. However, there are two limitations to be noted when using HBS data to estimate the VAT incidence:

1) Sale of food (fruit, vegetables, meat) on greenmarkets is legally exempt from VAT in Serbia. However, HBS data (and most expenditure surveys in general) does not allow differentiating between purchases of food on greenmarkets (VAT exempt) and purchases of food in grocery stores (subject to reduced VAT rate). Since poor households purchase more food from greenmarkets than rich households, using HBS data as the basis of VAT incidence overstates the actual VAT burden for the poor households.[7]
2) HBS surveys in general cover household consumption and don't include purchases of newly built apartments, which formally represent investment spending. However, since purchases of newly built apartments are subject to VAT, HBS data understates VAT incidence of rich households – which save for many years in order to afford one-time high cost of buying an apartment.

Aforementioned limitations of the HBS data cause a systematic regressivity-bias in VAT incidence estimates, by overstating the actual regressivity or understating the actual progressivity. These limitations should be kept in mind when discussing empirical VAT incidence estimates.

In what follows, we will assume full forward-shifting of VAT to consumer prices and will use HBS data to conduct a micro-simulation static analysis of VAT incidence (which assumes no behavioral responses). Although rather restrictive, these assumptions and this modeling framework are most often utilized when assessing incidence of consumption taxes in practice.[8]

We will analyze VAT incidence of the existing system and perspective reforms based on the estimated average effective VAT rate by income and expenditure groups (deciles). Average effective VAT rate in income group i is calculated as the ratio of total estimated VAT burden and total income for the income group i. In particular, average effective VAT rate in income group i (i = 1, 2 … 10) will be calculated as the weighted average of tax rates t_j (j = 1, 2, 3, 4) which

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[7] Jenkins *et al.* (2006) argue that "in developing countries the commodities on which poor households spend most of their income, even if they are included in the legal tax base, are administratively impractical to tax." Based on the detailed information on expenditure patterns and types of establishments from which items are purchased, they estimate effective (annual) VAT burden in the Dominican Republic to be progressive. Similar detailed information is not available for Serbia, but one should keep in mind this source of tangible regressivity-bias in our estimates.

[8] Warren (2008) states some of the drawbacks of this approach and recommends use of input-output tables as the preferred approach to modeling incidence of consumption taxes. However, he notes that only a handful of most developed OECD countries are currently able to provide comprehensive information required to properly calibrate this type of models.

correspond to four different legal VAT rates present in the Serbian system – standard rate, reduced rate, exempt services and natural in-kind consumption due to own-source farming production. Weighting will be done according to the structure of consumption in each income group. Thus, we will use the formula:

$$\bar{t}_i = \sum_{j=1}^{4} t_j C_j \tag{1}$$

where t_j stands for four different tax rates possible under the Serbian VAT system and C_j represents the share of consumption in income group i subject to the tax rate t_j. Alternatively, average effective tax rates will also be estimated for different groups according to the expenditure ranking.

Average effective VAT rates by income and expenditure groups informally indicate whether the system is progressive or regressive. However, we will compliment these statistics with formal global progressiveness indices. Gini coefficient is the most often quoted index with respect to the (in)equality of income and expenditure distributions:

$$G = \frac{\sum_{i=1}^{n}\sum_{r=1}^{n}\left|y_i - y_r\right|}{2n^2\bar{y}} \tag{2}$$

where $\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$, n is number of individual households in the sample, y_i is the income of the individual household i, and y_r is the income of individual household r. We will be measuring the difference between inequality of income distribution before and after taxation by the difference of respective Gini coefficients (also known as the Reynolds-Smolensky index).

The Gini coefficient is focused on the middle portion of the distribution, mostly ignoring the developments in the tails of the distribution. Thus, it is usefully to complement the Gini statistics with General Entropy statistics that can assign higher weight to any particular portion of a distribution (Litcfield, 1999):

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\bar{y}}\right)^{\alpha} - 1\right] \tag{3}$$

We will calculate General Entropy index with the alpha parameter 0.2 to investigate the behavior in the lower distribution tail and General Entropy index with alpha parameter 2.0 to investigate developments in the upper tail of income and expenditure distributions.[9] We will be investigating how Gini and General Entropy statistics change after imposing the VAT burden on before-tax distributions. Lower values of these statistics associated with after-tax distributions indicate progressive VAT incidence, while higher values of Gini and General Entropy statistics indicate regressive VAT incidence.

3 Estimates of VAT incidence in Serbia

This section estimates annual and lifetime VAT incidence in Serbia and compares the results with the existing literature on VAT incidence in other countries. Due to the lack of any relevant

[9] Both Gini and General Entropy statistics with a value of 0 indicate perfectly equal distribution of income, while increasing values of these statistics indicate increasingly unequal income distribution.

Table 3

Cross-referencing Annual and Lifetime Income Rankings
(percent)

		Deciles by Expenditure Ranking									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Deciles by Income Ranking	1	**41.8**	16.1	10.5	8.9	7.4	4.6	2.2	3.5	3.1	2.0
	2	23.1	**21.8**	13.7	11.1	8.9	7.4	5.9	3.7	2.8	1.5
	3	12.6	16.6	**18.3**	14.6	9.4	7.8	7.6	5.7	4.4	3.1
	4	10.5	16.6	13.5	**15.3**	10.5	6.5	10.5	7.8	4.6	4.4
	5	5.0	12.2	15.3	11.3	**12.9**	14.4	10.0	9.8	6.3	2.8
	6	2.6	5.4	10.9	15.0	15.5	**14.4**	12.0	10.5	8.9	4.8
	7	2.0	5.0	5.9	9.4	15.0	13.5	**14.4**	13.7	11.8	9.4
	8	0.7	2.8	5.4	7.6	11.5	15.3	14.6	**15.5**	15.7	10.9
	9	0.7	2.8	5.0	4.1	6.3	8.9	13.3	17.0	**21.4**	20.5
	10	1.1	0.7	1.5	2.6	2.6	7.2	9.6	12.9	21.1	**41.2**

panel data on household income and consumption behavior over time, VAT incidence analysis for Serbia will be based on annual income and expenditure data from the HBS. Annual income data will be used as the relevant measure of living standard in assessing the annual VAT incidence. We will use annual expenditure data as a proxy for permanent income in assessing the lifetime VAT incidence. Since Serbian HBS basically ignores household investment expenditures, we will use total recorded expenditures as a proxy for current (non-durable) household expenditures.[10] Annual income and expenditure rankings of households are cross-referenced in Table 3 in order to investigate how different are the results from these two alternative indicators of the living standard and ability-to-pay taxes.

We can observe that only about 42 per cent of households in the lowest decile by income ranking are also classified in the lowest decile according to expenditure ranking. On average, 21.7 per cent of households (along the main diagonal) are given the same ranking according to income and expenditure criteria. Information in Table 3 closely resembles original calculations by Caspersen and Metcalf (1994), although the data for Serbia in 2009 seems to be more dispersed than the original data for United States in 1988. Both cross-reference tables imply a significant difference between income and expenditure rankings, ie between annual and lifetime VAT incidence.

We have used HBS data to divide total expenditures of each representative household into four categories – expenditures subject to the standard VAT rate, those subject to reduced VAT rate, expenditures that are VAT exempt and expenditures due to natural in-kind consumption of

[10] In order to check the robustness of our results, we have also performed simulations which exclude vehicle purchases from total expenditures, in line with the Caspersen and Metcalf (1994) modeling approach. The results obtained were virtually identical and thus we have opted for the simplest approach of using total household expenditures – which facilities simple cross-country comparison of our results.

own-source farming production. Households were then sorted according to the two alternative indicators of the living standard: registered income and registered expenditures. In both cases, OECD equivalence scale was used to account for different sizes of households.[11] Summary results, by income and expenditure deciles, are presented in Tables 4a and 4b.

We can observe that existing VAT system in Serbia creates a tangibly progressive structure of the tax burden, especially when we consider expenditure ranking of households. Namely, reduced rate goods represent a higher share of expenditures in case of poor households than for the rich households. The progressive structure is somewhat diminished by regressive incidence of VAT exempt services. Besides the well known issue of exempting financial services, Serbian VAT system (like most other European systems) exempts health and education services. Due to the existence of public health and education system, mostly rich households can afford additional expenditures on these services – thus yielding a distinctively regressive incidence.[12]

It is important to note that natural in-kind consumption due to own-source farming production significantly increases the effective progressive layout of the Serbian VAT system by providing a tangible VAT-exempt buffer to poor households. This is a distinctive characteristic of VAT incidence in Serbia compared to other developed European countries where agricultural production and small scale own-source farming is only marginally present. Namely, agricultural production accounts for only 1.3 per cent of GDP in the European Union, while it accounts for 13 per cent of GDP in Serbia. Furthermore, agricultural employment accounts for 20 per cent of total employment in Serbia – compared to about 5 per cent in the European Union. As mentioned, own-source small farming production is also tangibly present in other emerging European countries, foremost Poland and Romania, where agricultural employment also accounts for 20 per cent of the overall employment.

In order to estimate average effective VAT burden for each household, we apply appropriate tax rates to each expenditure category. Effective 0 per cent VAT rate is applied to VAT exempt and natural in-kind consumption categories.[13] The results of annual and lifetime VAT incidence estimates are given in Tables 5a and 5b.

Despite broadly progressive structure of the Serbian VAT system in Tables 4a and 4b, we can see that annual VAT incidence in Table 5a is distinctively regressive, especially in the lower tail of income distribution. As in other countries, this is caused by the distinctively regressive estimated incidence of household (dis)saving. The estimated effective VAT rate in the lowest decile of 21.2 per cent is tangibly higher than the legally prescribed VAT rate of 18 per cent, indicating that under-reporting of income bias is present in the Serbian HBS data, as is the case in virtually all expenditure surveys analyzed in the existing literature.[14] After correcting for unrealistically high dissaving rates in the lowest deciles, which we know not to be realistic nor sustainable in economic reality, we can observe that regressive character of annual VAT incidence is significantly reduced.

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[11] Since Serbia is significantly less developed than OECD countries, using OECD equivalence scale might not be a most suitable choice. For a detailed discussion on this topic, and alternative approaches to measuring income inequality in Serbia, see Jovičić and Milojević (2010).

[12] Possible legal improvements in this area are limited by the EU Sixth Directive which prescribes that VAT cannot be charged on publicly provided health and education services. However, taxing private provision of these services is not forbidden, which could, if introduced, eliminate a significant portion of these regressive effects.

[13] Although most VAT incidence studies assume 0 per cent rate for VAT exempt services, this is not a completely appropriate assumption since VAT exempt entities do bear a certain tax burden due to inability to reclaim VAT on business inputs. For this reason, a sensitivity analysis has been conducted by assuming different non-zero tax rates on VAT exempt services in Serbia. Main conclusions of the study remained valid even after assuming non-zero rate on exempt services.

[14] In fact, if we also recognize that 17.8 per cent of income in the first decile represents implicit in-kind income which can not possibly be saved, since it corresponds to in-kind consumption of own-source small farming production, we can conclude that effective VAT rate on monetary income equals 27 per cent in the first decile.

Table 4a

Expenditure Patterns by Annual Income Deciles
(percent)

Decile	Standard VAT Rate	Reduced VAT Rate	VAT Exempt	Natural Consumption
Poorest	46.4	40.8	2.4	10.3
2	48.7	39.0	2.6	9.7
3	49.5	40.3	2.1	8.1
4	50.0	38.9	2.1	9.0
5	51.4	39.5	2.0	7.1
6	51.7	39.8	2.0	6.5
7	54.5	39.1	2.2	4.3
8	52.9	39.7	3.5	4.0
9	55.5	36.9	3.8	3.9
Richest	58.1	34.6	3.4	3.9

Table 4b

Expenditure Patterns by Annual Expenditure Deciles

Decile	Standard VAT Rate	Reduced VAT Rate	VAT Exempt	Natural Consumption
Poorest	43.5	42.5	0.6	13.4
2	48.6	38.5	1.0	11.8
3	48.2	39.6	1.0	11.2
4	49.3	41.6	1.4	7.8
5	49.1	41.6	1.4	7.9
6	51.5	40.4	1.9	6.2
7	51.7	40.5	2.6	5.2
8	52.8	38.8	3.1	5.3
9	54.7	38.6	3.0	3.7
Richest	59.5	32.5	5.4	2.5

Table 5a

Annual VAT Incidence and VAT Incidence Excluding the Dissaving Effects

Decile	Effective VAT Rate	Saving	Corrected VAT Rate
Poorest	21.2%	–73.1%	12.3%
2	14.9%	–25.5%	11.9%
3	13.9%	–15.8%	12.0%
4	12.3%	–4.0%	11.8%
5	11.2%	6.7%	11.2%
6	11.0%	8.6%	11.0%
7	11.2%	9.9%	11.2%
8	10.0%	17.3%	10.0%
9	9.5%	22.4%	9.5%
Richest	7.9%	36.0%	7.9%
Global Progressiveness Indices			
	Before Tax	**After Tax**	**Difference**
Gini Coeff.	0.299338368	0.312989058	0.045602873
GE(0.2)	0.154817719	0.205870445	0.329760219
GE(2.0)	0.182480671	0.212404149	0.163981633

Table 5b

Lifetime VAT Incidence Statistics

Decile	Effective VAT Rate	
Poorest	10.8%	
2	11.5%	
3	11.5%	
4	11.8%	
5	11.8%	
6	12.2%	
7	12.2%	
8	12.3%	
9	12.6%	
Richest	13.0%	
Global Progressiveness Indices		
	Before Tax	**After Tax**	**Difference**
Gini Coeff.	0.27899635	0.27636354	–0.00263281
GE(0.2)	0.12826570	0.12590617	–0.00235953
GE(2.0)	0.16318280	0.16008532	–0.00309748

Information in Table 5b indicates a slightly progressive lifetime VAT incidence.[15] Global progressiveness indices indicate that lifetime VAT effects seem to be more progressive in the tails of the distribution than in the middle portion. Our estimate of lifetime VAT incidence in Serbia is in line with other empirical studies that indicate slightly progressive lifetime VAT incidence in other European countries (Decoster *et al.*, 2010). We can also notice that within the lifetime framework, estimated effective VAT rates are in the 10 to 13 per cent range, which is in line with our *ex-ante* expectation of the results that a VAT incidence study should yield.

We can notice from table 5b that the Gini coefficient associated with after-tax distribution of expenditures is lower than the Gini coefficient associated with the before-tax distribution of expenditures, which confirms progressive lifetime VAT incidence. It is instructive to decompose this total reduction in the Gini coefficient of 0.26328 per cent into two components – the effect of the structure of the VAT system itself and the effect due to significant presence of small scale own-source farming production in the Serbian economy. Our estimates show that the structure of the Serbian VAT system, which features taxation of necessities under the reduced VAT rate, is responsible for reducing the Gini coefficient by 0.11935 per cent. On the other hand, progressive incidence of own-source farming production reduces the Gini coefficient by 0.14375 per cent. Thus, we can conclude that more significant redistribution effects are achieved due to the presence of own-source farming production than due to the introduction of reduced VAT rate for taxing necessities.[16]

In order to reach the definite answer whether effective VAT incidence is regressive or mildly progressive, one needs to decide what is the most reliable indicator of the standard of living in Serbia – is it household annual income, or household expenditures? It is our belief that one should opt for household expenditures, both on theoretical and practical grounds. From theoretical point of view, it is widely recognized that household engage in consumption smoothing over the lifetime, implying that the lifetime VAT incidence, which can be decently approximated using annual household expenditures, represents a more suitable framework than the annual tax incidence analysis. Furthermore, Creedy (1998) explains that when analyzing distributional effects of consumption taxes in isolation, ignoring the remaining tax and benefit system – one should not mix apples and oranges and assess the incidence of consumption taxes against household incomes, but against their prescribed tax base – the household expenditures.

From practical point of view, it should be stressed that the transition process in emerging European countries has been accompanied with a large surge in shadow economy and tax evasion. In particular, Schneider(2005) approximates that shadow economy averages about 16.3 per cent of GDP in developed OECD countries, compared to 40.1 per cent of GDP in transitional European countries. He estimates the shadow economy in Serbia to be approximately 39 per cent of GDP in 2003.[17] Tax evasion is most pronounced in the case of direct income taxation, since undeveloped judiciary and tax administration capacities in many emerging European economies limit the possibilities for effective identification and effective prosecution of income tax evasion cases. On the other hand, the VAT system is the best available tool for combating tax evasion – evasion has to be organized throughout the entire production and distribution chain, since identification of unregistered invoices at any stage of production implies the collection of VAT corresponding to the

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[15] Lifetime VAT incidence estimates based on expenditure data in Table 5b basically eliminate the effects of dissaving in lower deciles and saving in upper deciles. Corrected annual VAT rates presented in Table 5a had been obtained by basically correcting only for the dissaving effect in the lowest deciles. Remembering regressivity-bias from Section 2, we can conclude that actual lifetime progressivity of VAT incidence is somewhat higher than observed in Table 5b.

[16] It should be noticed that progressive effects of the reduced VAT rate are diminished by the regressive incidence of VAT-exempt services.

[17] Replacing sales tax with VAT in 2005 reduced the extent of tax evasions and shadow economy in Serbia. However, tax compliance in Serbia seems to have deteriorated as the result of 2008-09 economic crisis.

entire value added since the beginning of the production process.[18] Thus, we believe that in Serbia, and many other emerging European countries, household expenditures represent a more meaningful and more reliable indicator of the standard of living and ability-to-pay taxes.[19] In the remainder of this paper, we will focus on analyzing the (lifetime) VAT incidence against household expenditures.

4 Targeting of reduced rate VAT subsidies

Due to social considerations, VAT systems in basically all European countries feature reduced rates for certain basic necessity goods. The idea behind reduced rates is to try to introduce redistributive social elements into the VAT structure. By subjecting basic necessities, such as food or medicine, to a reduced tax rate – the VAT system basically subsidizes the consumption of these goods by the difference between the standard and the reduced VAT rate. Since these necessities represent a higher share of expenditures for poor households than for rich hoseholds, it is hoped that poor households would capture most of the economic benefit associated with the consumption of goods under the reduced VAT rate. Implicit tax subsidies associated with the reduced VAT rate totaled about one quarter of total VAT revenues actually collected.

Slightly progressive lifetime VAT incidence estimated by Decoster et al (2010) for EU member states is driven by the consumption of goods under the reduced VAT rate. As discussed, progressive VAT incidence in Serbia is further reinforced by the significant presence progressive own-source farming production and in-kind consumption. However, it is important to acknowledge that poor households spend more on necessities in relative terms (relative to their total income or total expenditure), but not in absolute terms. For example, we can see from the Appendix that consumption of bread, milk or medicine products is distinctively progressive across expenditure deciles. Milk and dairy products account for 7.3 per cent of monetary expenditures in the lowest decile and 3.5 per cent of expenditures in the highest decile. However, in absolute terms, monetary expenditures for milk and dairy products are about three times larger in the highest decile than in the lowest decile. Thus, households in the highest expenditure decile are receiving a tax subsidy that is in absolute terms three times larger than the amount of subsidy going to the lowest expenditure decile. This difference is even more pronounced in the case of reduced-rate goods whose consumption pattern is not very progressive, such as meat, hotel accommodation or utility services, see Table 6.

We may ask whether the reduced VAT rate is the most suitable approach for achieving redistribution objectives? It seems that it might be more efficient to have a uniform-rate VAT system and to use additional revenues (from eliminating reduced VAT rate subsidies) to fund government programs that are better targeted at poor households. Ebril *et al.* (2001) stresses this point of poor redistributive performance with reduced VAT rates and highlights that best practice strongly suggests that VAT systems should have a single uniform tax rate – leaving the redistribution role to other segments of the tax and benefit system.[20] However, this is the "first-best" result which assumes government transfer policies are properly targeted and appropriately funded. Unfortunately, this is not the case in many emerging European countries. Thus, in the case of "second-best" result, Bird and Gendron (2007) argue that reduced VAT rate on

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[18] Jimenez *et al.* (2010) based on empirical data from Latin America economies show that tax evasion in emerging economies is much higher in the area of direct income taxes than with indirect consumption taxes.

[19] In fact, due to concerns regarding quality of income measurements from sample surveys, poverty levels in developing countries, such as Serbia, are mostly assessed based on expenditure data.

[20] Atkinson and Stiglitz (1976) show that if utility function is weakly separable in leisure and consumption, preferences for goods do not depend on ability and progressive labor income tax is available, then differential commodity tax cannot improve social welfare, *i.e.*, uniform taxation of final goods is optimal in this case.

Table 6

Annual VAT Subsidies per (Equivalence Scales) Household Across Expenditure Deciles
(dinars)

Deciles	Bread and Baked Products	Milk and Dairy Products	Meat and Fish	Medicines	Utility Services
Poorest	1,237	1,125	1,547	765	325
2	1,375	1,538	2,292	792	641
3	1,355	1,789	2,933	906	832
4	1,496	2,010	3,546	995	1,156
5	1,634	2,264	4,259	1,082	1,188
6	1,637	2,410	4,645	1,272	1,462
7	1,738	2,553	5,290	1,447	1,631
8	1,787	2,736	5,883	1,506	1,759
9	1,802	3,117	7,299	1,835	2,114
Richest	2,097	3,650	9,614	2,350	2,501

certain most basic necessities might serve a useful redistributive purpose in developing countries where welfare transfer programs and progressive income taxation are not well developed.

5 Distributional effects of prospective increase of the VAT burden

Increasing the VAT burden in Serbia could create additional budget revenues that could finance a growth-enhancing (revenue-neutral) tax reform aimed at reducing the tax wedge on labor (Arsić et al., 2010). However, alternative approaches to increasing VAT burden will have different distributional effects. In this section we will use lifetime VAT incidence framework to analyze distributional effects of three alternative approaches that yield same budget revenues.

Existing VAT system in Serbia is structured so that about 40 per cent of taxable consumption is subject to the reduced VAT rate of 8 per cent while 60 per cent of taxable consumption is subject to the standard VAT rate of 18 per cent. This implies that average effective VAT rate in Serbia currently stands at 0.4 * 8% + 0.6 * 18% = 14%.[21] We will analyze three alternative scenarios that all increase average effective VAT rate to 18 per cent. In revenue terms, this should yield additional tax revenues of about 2.5 per cent of GDP per year.

- Scenario 1: Transferring all goods from the current reduced rate of 8 per cent to the standard VAT rate of 18 per cent and basically introducing a uniform-rate VAT system.

[21] 14 per cent average VAT rate is not with respect to total household expenditures, but with respect to the taxable portion of expenditures, ie excluding tax-exempt services and in-kind consumption.

Table 7

Effective VAT Rates Relative Changes Under Alternative Reform Scenarios

Decile	Current System	Relative Changes to Current System		
		Scenario 1	Scenario 2	Scenario 3
Poorest	10.8%	4.6%	3.5%	2.9%
2	11.5%	4.1%	3.6%	3.1%
3	11.5%	4.3%	3.6%	3.3%
4	11.8%	4.5%	3.7%	3.6%
5	11.8%	4.5%	3.7%	3.6%
6	12.2%	4.4%	3.8%	3.6%
7	12.2%	4.4%	3.8%	3.7%
8	12.3%	4.2%	3.8%	3.7%
9	12.6%	4.2%	3.8%	3.8%
Richest	13.0%	3.5%	3.8%	3.6%
Gini Coeff.	0.27636	0.00162	–0.00029	–0.00079
GE(0.2)	0.12591	0.00160	–0.00022	–0.00067
GE(2.0)	0.16009	0.00362	0.00005	0.00004

- Scenario 2: Maintaining the existing VAT structure and increasing the tax rate by 4 per cent – reduced rate from 8 to 12 per cent and standard rate from 18 to 22 per cent.
- Scenario 3: Increasing the VAT rate by 2 per cent (reduced rate to 10 per cent and standard rate to 20 per cent) and transferring certain goods from the reduced rate to the standard rate, so that about 20 per cent of taxable consumption remains subject to the reduced rate, while 80 per cent of taxable consumption becomes subject to the standard rate.[22]

Table 7 presents information on the absolute incidence of the existing VAT system and relative incidence increments for each scenario. Looking at the VAT incidence according to expenditure deciles, we can notice that Scenario 1 causes slightly regressive effects, while Scenarios 2 and 3 cause slightly progressive effects. This conclusion is supported by Gini and General Entropy statistics, which indicate higher income inequality in Scenario 1 and lower income inequality in Scenarios 2 and 3.

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[22] There are many different ways in which Scenario 3 could be designed, depending on which goods are chosen to be transferred from the reduced-rate to standard-rate status. In reality, this process would be driven by social and political preferences, subject to the constraint that only 20 per cent of taxable consumption should be left at the reduced VAT rate. For the purpose of this study, in order to achieve best distributional effects, we have decided to transfer to the standard VAT rate those goods with the least progressive (or even regressive in some cases) consumption patterns. Thus, we have implemented Scenario 3 by transferring fruit, meat, fish, computer equipment, hotel accommodation, firewood, natural gas, utility services and tickets for cultural events from the reduced-rate to standard-rate status.

Ebril *et al.* (2001) recommendation of a single uniform-rate VAT system might not be most suitable for the current Serbian environment characterized with low coverage of major welfare transfer programs (such as material family support or child allowance) and basically proportional system of income taxes. Thus, authors believe that Scenario 1 should be accompanied with progressivity-enhancing reforms in other segments of the tax and benefit system – such as expanding welfare transfer programs or increasing the progressivity of income taxation. Scenarios 2 and 3 do not cause regressive effects and could be implemented as standalone measures. Best distributional effects are achieved with Scenario 3. However, implementing this scenario in practice might be politically challenging since it includes significant tax increase on such basic items as meat or fruit.

6 Concluding remarks

The belief that consumption taxes, and VAT in particular, are inherently regressive is entrenched with a significant number of individuals in the general public. This belief, which seemed to had been supported with strong empirical evidence, presents a significant political challenge to implementing growth-enhancing tax reforms which shift tax burden from income to consumption. However, in their classical public finance textbook, Rosen and Gayer (2007) state that the final verdict on the incidence of consumption taxes and VAT is still undecided, despite seemingly strong empirical evidence from annual incidence studies.

We have shown that existing results from annual incidence studies only partially confirm the common belief regarding consumption taxation, since most of the estimated regressive VAT incidence stems from measurement errors and not from regressive savings incidence. From theoretical point of view, the annual VAT incidence approach suffers from many drawbacks and it is thus more meaningful to analyze lifetime tax incidence. When analyzing the VAT incidence in isolation, disregarding the other components of the tax and benefit system, it is particularly inappropriate to mix apples and oranges and compare VAT incidence against annual income and not against household expenditures – which is the prescribed tax-base for VAT assessment (Creedy, 1998).

Overall, it is authors' conclusion that claims regarding inequitable and regressive VAT taxation are vastly overstated and poorly founded in theoretical and empirical evidence. Similarly to the demise of common acceptance of the simple Keynesian consumption function few decades ago, the authors believe that contemporary evidence points to the demise of common beliefs regarding regressive consumption taxation. The case for regressive VAT claims is particularly weak in emerging European economies, due to large scale evasion of direct income taxes and significant presence of own-source farming production which enhances the progressive layout of the VAT burden in these countries.

APPENDIX

Following goods and services are currently subject to the reduced VAT rate of 8 per cent: food (bread and other baked products, milk and other dairy products, flour, sugar, eggs, edible oils and fats, honey, fruit, vegetables, meat, fish), medicines, fertilizers, textbooks, newspapers, computer equipment, hotel and motel accommodation, natural gas, firewood, utility services (including water), tickets for cultural events and newly built apartments.

This Appendix shows VAT incidence for reduced-rate goods, except for newly built apartments whose sales are not recorder in the Serbian HBS. VAT incidence is given across expenditure deciles, as a percentage of monetary expenditures. Data on natural consumption of own-source farming production have been purposely excluded, to highlight the fact that natural consumption of food would not be affected if certain food items are transferred from the reduced-rate to the standard-rate status.

Table 8

Incidence of Reduced Rate Goods
(percent of monetary expenditures, by expenditure deciles)

Deciles	Bread and Baked Products	Milk and Dairy Products	Flower, Sugar, Eggs, Oil, Honey	Fruit	Vegetables	Meat & Fish	Medicines
1	7.9	7.3	5.4	1.8	3.9	10.1	4.8
2	6.0	6.8	4.6	2.0	3.6	10.2	3.4
3	5.0	6.7	4.4	2.1	3.5	11.0	3.2
4	4.6	6.3	4.4	2.2	3.3	11.1	3.0
5	4.4	6.2	4.0	2.0	3.2	11.8	2.9
6	3.9	5.8	3.7	2.0	3.1	11.3	2.9
7	3.6	5.4	3.4	1.9	3.1	11.3	2.9
8	3.2	5.0	3.4	2.0	3.1	10.9	2.7
9	2.7	4.7	3.0	1.9	2.7	11.0	2.6
10	2.0	3.5	2.0	1.6	2.2	9.3	2.2

Deciles	Textbooks and Newspapers	Utility Services	Fertilizers	Natural Gas and Firewood	Hotel Accommodation	Tickets for Cultural Events	Computer Equipment
1	0.8	2.0	3.2	1.5	0.3	0.0	0.2
2	1.0	2.7	1.1	1.7	0.4	0.0	0.2
3	1.1	2.9	1.5	2.7	0.5	0.0	0.1
4	1.0	3.3	1.6	3.4	0.6	0.0	0.2
5	1.3	3.0	2.0	3.3	0.7	0.0	0.2
6	1.2	3.3	1.7	2.8	1.1	0.0	0.2
7	1.1	3.2	1.6	4.0	0.7	0.0	0.3
8	1.2	3.0	1.1	4.3	0.8	0.1	0.2
9	1.0	2.9	1.3	3.6	2.1	0.1	0.4
10	1.0	2.2	0.7	3.0	3.0	0.3	0.4

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COMMENTS ON SESSION 4
POLICIES TO PROMOTE SUSTAINABLE GROWTH

DOES FISCAL POLICY MATTER?

Werner Ebert[*] *and Sarah Ciaglia*[*]

In the context of the current EMU debate on austerity and stimulus, the papers by Bouthevillain and Dufrénot and Gavilán *et al.* address important questions. As fiscal policy is the only policy area which instruments affect growth very differently the question on how heterogeneous growth patterns in the euro area can be shaped by fiscal policy measures compared to structural reforms is topical.[1] Coming from a finance ministry, our perspective is necessarily more practical than academic. Hence, we focus on the question: Does fiscal policy matter? That includes a discussion of the possible use of the results of these papers for the discussion on shaping the institutional context of the EU and the euro area.

1 Common motivation: need for disaggregation

When addressing the "fiscal policy and growth" issue,[2] historical experience with fiscal policy measures shows that a "one-size-fits-all" approach does not work well, particularly in a common currency area. Although aggregate models undisputedly have their merits, concerning these policy issues it is wise to disaggregate and to be more country-specific in order to derive practical policy conclusions. Therefore, both papers follow a quite sensible approach of explicitly taking heterogeneity into account: Bouthevillain and Dufrénot do so by disaggregating public expenditures and revenues and by selecting different growth periods, Gavilán *et al.* by following a country-specific long-term approach including open economy and external imbalances variables. The first paper concentrates on fiscal policy and growth while the second one focuses on structural policies with a specific view on macroeconomic imbalances and growth.

2 Models and main findings

Bouthevillain and Dufrénot raise the following question: does a common fiscal policy (taxation and expenditure measures) become growth enhancing or reducing in a similar way across countries? They run a double quantile fixed effects regression on the effects of fiscal variables on growth. Using the period between 2000 and 2010, they look at real and per capita GDP as that allows differentiating between fiscal policies' effects that are different by country and time. For the analysis of growth effects of social expenditure vs. "economic" spending, taxation vs. social security contributions and direct vs. indirect taxation, they make use of COFOG data. Concerning practical economic policy, their basic assumption is that the "recipes" for generating growth by

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The views expressed here represent their personal opinion, and not necessarily the view of the Ministry.

[1] One could refer to the recent research on growth in the EMU by the EU COM.

[2] Refer to the work by the EU COM (Pench *et al.*), the EU Economic Policy Committee with its Working Group on the Quality of Public Finances, the OECD (Heady on tax issues) and also by the ECB (Afonso and his team on efficiency and effectiveness of public spending). We are delighted that new literature on this topic is being provided at this conference in Perugia (e.g., by WIFO Austria, Afonso).

fiscal policies are very different in high and low growth countries. In their specific model they come to mixed and partly counterintuitive results:

1) welfare expenditure can foster growth in general while human capital expenditure can foster growth only in low-growth countries and can be even harmful for growth in high-growth countries;
2) the effect of a social VAT (replacing social security contributions) on growth is mixed, in low-growth countries positive, in high-growth countries neutral;
3) replacing direct by indirect taxation has a significant impact in high growth countries, not so in low-growth countries.

Gavilán *et al.* use an overlapping generations model of a small open economy characterized by imperfect competition. They focus on three periods, one between the mid-late nineties until the beginning of the crisis in Europe in 2008, the crisis years and a simulated post-crisis period. The basic question they try to answer is: How did external imbalances (in Spain and the euro area) evolve? As the main drivers of the performance of growth and external imbalances they identify demography and immigration causing changes in the work age population and the interest rate channel (permanent nominal convergence). The counterfactual question is what potential role fiscal policy could play to avoid imbalances and to foster growth. They conclude that a continuous tight fiscal policy does not reduce imbalances because of the forward looking behavior of households. Even structural reforms via reducing markups are not considered to help reducing imbalances. However, beyond the crisis the scenario changes as negative wealth shocks on consumption materialize, external imbalances decrease while public deficits increase. During the scenario, GDP falls first and recovers gradually. In that scenario structural reforms and frontloading of fiscal consolidation help mitigating the short-term drop of output and avoiding the medium-term output loss.

3 Possible extensions

Concerning Gavilán *et al.*, while the overlapping generations model nicely captures the effect of demography on external imbalances in principle it is indeed a surprising result that fiscal policy would have no correcting impact on imbalances in the "normal times" period before the (post) crisis scenario. Maybe more differentiation is needed and the impact on imbalances needs to be considered in more detail. In fact, we are confronted with the issue of reversed causality between demography and imbalances. There is an economic intuition that the built-up of the house price bubble triggered immigration, particularly of low-skilled labor. Extending the causal chain, one could expand the model by incorporating the other side of the coin, which is capital flows. And one could check where capital inflows came from. One hypothesis could be that capital flows have been starting after the German reunification (big open economy). Capital released due to the German consolidation process in the Nineties and the beginning of the 2000s complemented or may even have triggered the imbalances in south European countries. Recent OECD analyses support that hypothesis since they show a strong correlation between taxes on housing and the house price bubble in Spain possibly affecting the external current account balance. Therefore, somehow fiscal policy influenced imbalances also before the crisis and the question is if such an effect can be integrated in the model. The sound rational behavior assumption of private borrowing replacing public borrowing might be challenged by introducing myopic behavior of households as an alternative assumption. Bouthevillain and Dufrénot differentiate between high growth countries showing Keynesian behavior and low growth countries showing Ricardian behavior. This could be introduced in the model by Gavilán *et al.*, too.

Concerning the paper by Bouthevillain and Dufrénot, the model could differentiate further regarding the conflict between output and efficiency, basically asking: Do public expenditures, e.g. education, health, and R&D, improve efficiency? The authors indeed point to possible inefficiencies in high growth countries. Therefore, the question is if the analysed countries lie on the 'efficiency frontier' and if there is a systematic link between effectiveness of public spending and its impact on growth. That in principle is an invitation to combine the work by Gavilán *et al.* and also Afonso with country samples regarding their growth level. Nevertheless, it is very difficult to separate productive and unproductive expenditures (see Brender's intervention in this session).

Concerning the data used, we would encourage the authors to disaggregate the dataset further. The current dataset only differentiates between 10 categories displaying functions of government expenditures, whereas the Eurostat dataset knows around 70 subcategories which can be assigned to productive or unproductive spending (COFOG 2 digit structure). This data structure makes it possible to better assess those subcategories that gather growth enhancing policies and this could render the model's results more specific. With respect to the structure of public expenditures one could refer to a German case study by FiFo Köln which tries to assess the effects on growth of different types of expenditures in Germany using the disaggregated COFOG l/2 digit level. Additionally, one should differentiate between several growth indicators and what they should measure: either short-term growth (GDP or GDP per capita) or long-term sustainable growth. The latter one is difficult to assess. A well-known indicator to describe medium-term growth is the potential GDP. Nonetheless, there are more ways to describe sustainable growth as for example environmental accounting or accounting considering ageing and demography. Using "growth potential" could help to take supply side effects into account. These seem to be neglected in the presented models since they are incorporated only tentatively. This may cause the model's result that fiscal policy does not affect imbalances, and, hence, this result might be misleading. Furthermore, one could control for fiscal institutions and measure the effect of changes in debt rules for example. This would be especially interesting with regard to the current developments in the euro area regarding the enhanced Stability and Growth Pact (SGP) and the Fiscal Compact.

4 Lessons for the EU governance

From the point of view of a ministry, it is especially interesting to ask for the "practical" relevance of these papers. Do they provide useful information to improve policies? The reformed SGP 3.0 that now focuses on fiscal sustainability has a very limited view on growth. On the other hand, the new macroeconomic surveillance process (Macroeconomic Imbalance Procedure, MIP) focuses on internal and external imbalances and hence looks at growth, although only indirectly. Also, the strategy 'Europe 2020' as a follow-up to the Lisbon Strategy, referred to in the paper by Bouthevillain and Dufrénot (Guideline 3 of the Integrated Guidelines), is diluted and has a very imprecise focus on 'sustainable' growth. All three processes are quite isolated although the EU Commission tried to gather them under an integrated framework, the European Semester.

What can we learn from the papers for strengthening the governance in the euro area? The approach by Bouthevillain and Dufrénot calls for a renewed agenda on the quality of public finances which should be integrated in 'Europe 2020' and the SGP. The approach of Gavilán *et al.* could help to analyse the links between the MIP and fiscal policy observation under the SGP. While currently no "one-size-fits-all" approach for EU member states' fiscal policies is possible or desired, one could think of alternative measures:

- the medium-term objectives (MTO) could be country-specific differentiating with respect to the country's business cycle, growth rate or effectiveness of public finances;

- the SGP thresholds could be made country-specific, modified with respect to the country's sustainability of public finances and MIP variables;
- "Europe 2020" should be redefined with regard to structural policies enhancing potential growth and be linked to the Euro Plus Pact.

In general, the institutional link between different fiscal policy measures and growth is weak and the impact of structural reforms on fiscal sustainability is widely neglected in the current framework. Therefore, both papers are highly relevant for the current debate on the EU and euro area governance architecture. We encourage the EU COM and the member states to have a close look at these different channels of fiscal policies and to make use of the general ideas of the two papers.

COMMENTS ON SESSION 4
POLICIES TO PROMOTE SUSTAINABLE GROWTH

David A. Heald[*]

I have three papers to discuss, and I will not pretend that there are common themes. The first is the paper by Balázs Égert about debt thresholds, then the paper by Jérôme Creel, Paul Hubert and Francesco Saraceno about the effects of alternative fiscal rules, and finally the paper by Ernesto Rezk, María de los Ángeles Mignon and Agustín Ramello De la Vega about human capital growth, with particular reference to Argentina. I am not an econometrician; my interest is on the public policy side. There are people here who know far more about the econometric methodology and are better able to argue about that than I am. So, other than asking one or two questions, I am not going to talk about that aspect.

Turning to the Égert paper from OECD, I think that is very interesting because there does seem to be something of a policy demand for evidence that there are thresholds. I sense that, given how high debt ratios are now, there is a policy demand for saying that they are now too high: above 90%, that is damaging. The Égert paper convinced me that the Reinhart and Rogoff (2010) results are not robust. I am not quite sure whether the argument is that there are no thresholds or whether the endogenous thresholds around 20% and 50% ought to be taken seriously.

The paper makes clear its counter-intuitive result that, beyond 90 per cent, the effects on growth become less negative or neutral; that is obviously extremely worrying in terms of making intuitive sense. And the question I would throw out to the author, and other people working in the field, is to what extent that is a result of the particular data or of the particular econometric techniques that are used. As a user of this kind of research, when the results are counter-intuitive, one needs to understand what exactly is driving those results.

It is not heavily emphasised in the paper but one of the points I noticed was the fact that the Reinhart and Rogoff data are not publicly available, and there has had to be a reconstruction which makes this paper not an exact replication of their work. The Égert data analysis looks at two time series; a long series from 1790 to 2010 that looks at central government debt; and a shorter time series from 1960 to 2010 that looks at general government debt rather than central government debt. The results are not substantially different. But that provoked a number of reflections on my part, very much about whether one ought to be thinking about central government debt or general government debt or public sector debt.

I am a Professor of Accountancy and one of the things that I have very much noticed is arbitrage techniques using accounting rules, particularly in the context of Public-Private Partnerships (Heald and Georgiou, 2010 and 2011a) and also exploiting the difference between general government and public sector (Heald, 2012). As fiscal austerity bites and with fiscal consolidation generally, one should start watching for arbitrage mechanisms. These might damage value for money; they are also going to contaminate the macroeconomic data.

The second point is that net debt misses lots of things, pension liabilities having been mentioned several times in this Workshop.

The third point I would make is that, in public debate, there is remarkable neglect of the assets side of the public sector balance sheet. In accruals-based government financial reports, the focus is on the net assets figure or in national accounts the net worth figure. Now I recognise that the data often are not very good but, when one is thinking about what kind of policy response there

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should be to particular levels of government debt, I would want to have some idea what the assets side of the government balance sheet looks like. You could be a country with very good infrastructure assets and a relatively high level of debt, but might well be in a better position than a country with very poor infrastructure assets and a lower level of debt. As an accountant, I want to think about both sides of the balance sheet. The United Kingdom has now produced Whole of Government Accounts and that is one of the issues that academically I have been working on (Heald and Georgiou, 2011b).

So my questions about the Égert paper are:

a) to what extent do the different results from Reinhart and Rogoff (2010) depend on the data used or on the econometric techniques used?
b) particularly with regard to the data, are the results driven by certain countries and certain years or certain periods within those very long time series?
c) is the policy conclusion that there is not an obvious threshold? I will come back to the debt issue during the discussion of the Creel *et al.* paper.

Francesco Saraceno presented the paper extremely well, so I am not going to talk about what he and his colleagues did (*Creel et al.*, 2012); other than make the point that this is modelling, from outside the official institutions, of the new European Union fiscal rules. The paper chooses four formulations of possible fiscal rules.

This raises in my mind two questions. First of all, do the modelling assumptions, which are described as New Keynesian, determine the results? To what extent do the judgements made behind the model building prejudge the results that are going to be achieved? Secondly, given the fact that this is unofficial modelling, it makes me interested in what official modelling has been done within the European Commission or elsewhere. The Creel *et al.* results favour the old UK-style golden rule (where investment is outside the golden rule) rather than the new European fiscal compact. Would alternative modelling, which can be defended on technical economic grounds, generate different results? I worry that sometimes economic and political judgements can become obscured by modelling complexities. Would differences in results – between the Creel *et al.* model on a New Keynesian basis and an alternative official model that may lie behind the European Commission and Council decisions – be driven just by different assumptions on how the economy works? A far broader range of people can become involved in discussions about how the economy works than in the econometric arguments.

Table 3 shows what Creel *et al.* (2012) call the investment rule leads to higher debt ratios than the new golden rule. A fundamental aspect of the present debate is uncertainty about the reaction of financial markets to much bigger debt ratios, which is what following their favoured rule would involve. Leaving aside the doubts created by the previous paper I was discussing, let us assume for the time being that higher public net debt does damage growth. The issue that would influence my policy view, probably more than anything else, is the question about how big a cushion economies need in the context of another collapse of the financial sector. The United Kingdom tends to talk about net debt; that was 35.8 per cent (31 March 2007) but has reached 66.2 per cent (31 March 2012), even when "excluding financial interventions" (139.9 per cent with them) (Office for National Statistics, 2012, Table PSF1). So there has been a remarkable increase in UK net debt. My policy instinct is to want as big a cushion as I can possibly have, if you do not have confidence that the financial sector has really changed.

Moving on to Rezk *et al.* (2012) paper, which has two parts. The printer did not work properly but Ernesto very kindly annotated my copy for me, so I could work through it again. The expositional part, on the theory, I found very helpful. Some of the things I had read before; some I just did not know. The way it developed successive models, about how human capital might influence growth, was very helpful and I found it very informative.

The second part of the paper is the empirical results and I think there is evidence of haste in the way that these are reported. I found Ernesto's presentation more helpful than the actual paper, in terms of interpretation and of giving me some idea of which of the various results he placed more confidence in. The paper brought home to me the issue of finding good data for human capital. In no sense am I going to criticise the data that have been used, but years of schooling does seem a fairly limited measure. It also emphasises the importance of good social statistics, as well as good economic statistics. If one thinks that there is a complete separation between the social data and the economic data, you can concentrate on securing good economic data. But, as soon as you start arguing that human capital development is important in a growth context, it is very important to emphasise good social statistics and making sure that national statistics and social statistics do not themselves become a casualty of fiscal consolidation.

A final point on issues that came up in the previous papers in this Session of the Workshop. I become very worried about this discussion of "productive" and "non-productive" public expenditure. Hence I very much like the way that the Banque de France paper (Bouthevillain and Dufrénot, 2012), which I am not commenting on, went to the COFOG data. In my own country, when people talk about productive public expenditure, some of what they want to call productive does not strike me as particularly productive at all; some of it is just industrial subsidies. So I think that one has to be careful about the language of productive and non-productive. The more that you stress human capital development, as Ernesto does, the effect that public spending has on human capital may well come from diverse types of spending. This is an important area for research and that research is going to depend on securing better data, as well as protecting existing sources of data.

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COMMENTS ON SESSION 4
POLICIES TO PROMOTE SUSTAINABLE GROWTH

Sergey Vlasov[*]

The two papers on which I would like to comment, prepared by OECD and Serbian colleagues, cover very different topics. So, let me take these papers up in turn.

1 Comments on "Fiscal Consolidation Needs and Implications for Growth" by Jørgen Elmeskov and Douglas Sutherland

The paper prepared by Elmeskov and Sutherland studies the instruments of public debt levels adjustment with the implications for growth in OECD area. It is a very accurate, well-built paper, mainly descriptive, but supported with the corresponding calculations made by authors themselves or their OECD colleagues.

The motivation of the paper is the dramatic increase in the public debt in the OECD area that has trended upwards since early 1970s and passed annual GPD in 2011 both because of the pro-cyclical fiscal policy during the expansion before the crisis and severe crisis consequences. High public debt, in its turn, has adverse effects on economic growth by raising the costs of capital – reducing productivity and leading to a level shift in potential output in the short run and reducing investment in research and development in the long run – and by crowding out effect – the real interest shock. So, there is a clear necessity to reduce debt overhangs, including creating some room to react to possible future shocks.

Now let me turn to the main findings as well as to make some comments. Talking about the size of adjustment in OECD area the authors present the calculations of what has already been done or is under way as well as what should be done in the long run. What is interesting to note is that Greece, Portugal, Spain and Ireland, the countries associated with possible debt crisis in Euro area, not just make the largest cumulative fiscal tightening between the deficit trough and 2012 (as we can see in Figure 4) but also have the modest adjustment needs on a period till 2050 under conditions of bringing down gross financial liabilities to 50 per cent of GDP (with the only exception for Ireland – see Figure 5). First, how big is the risk that in 2012 the reporting figures would not correspond to those planned? For example, the situation in Greece – I mean considerable public protest against fiscal consolidation measures adopted by the government – allows to suppose that the expected effect will not be fully achieved (directly or indirectly). Second, how do the authors' estimations correlate with the low sovereign ratings given to these countries by international rating agencies and, for instance, the speech of the head of the World Bank, R. Zoellick, who told relatively not long ago that Greece will inevitably default and it is just a matter of time? Possibly there is a preliminary estimation on 2012 to support authors' calculations?

The debt overhang can be worked off in two ways. The first is by primary balance tightening and the second is by using the real growth and real interest rate effects. Let me start from the latter one by looking at first at the Russian experience. Following the Asian financial crisis and the deterioration of external conditions the Russian government had to declare a sovereign default and to allow the depreciation of the Russian ruble. The federal government debt increased dramatically to 137.4 per cent of GDP by the end of 1998. But only about half a decade later GDP growth effect,

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Figure 1

Components of the Russian Federal Government Debt Dynamics in 1996-2000 (left axis) and 2001-2011 (right axis)
(percent of GDP)

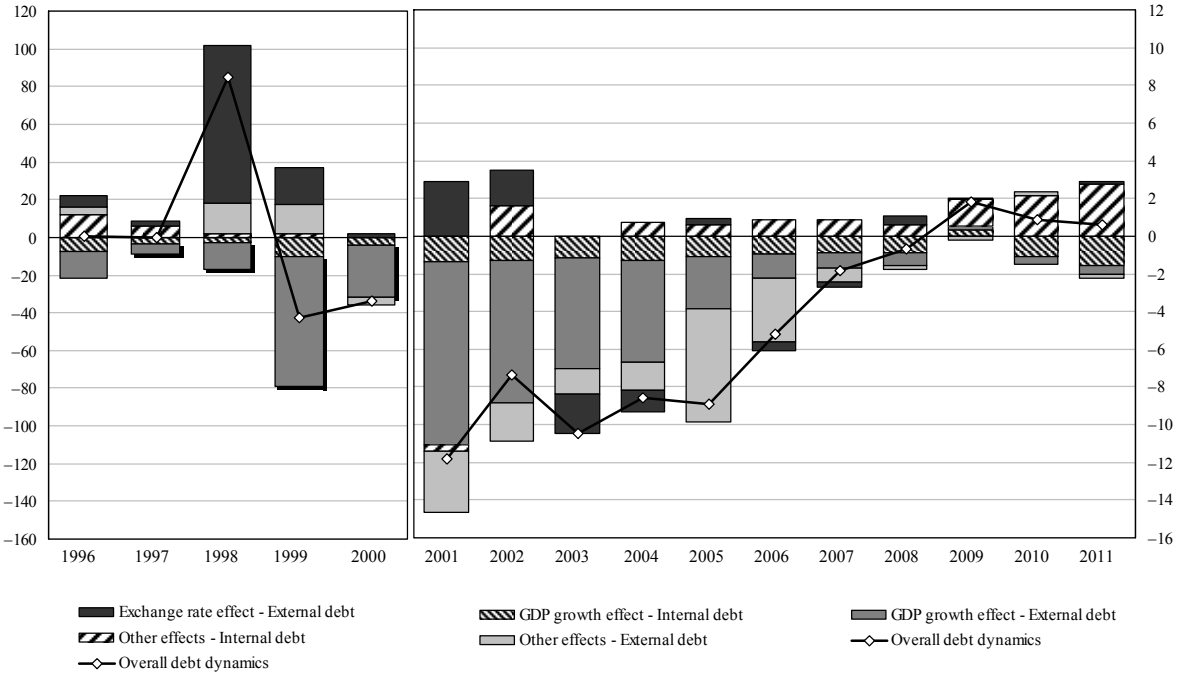
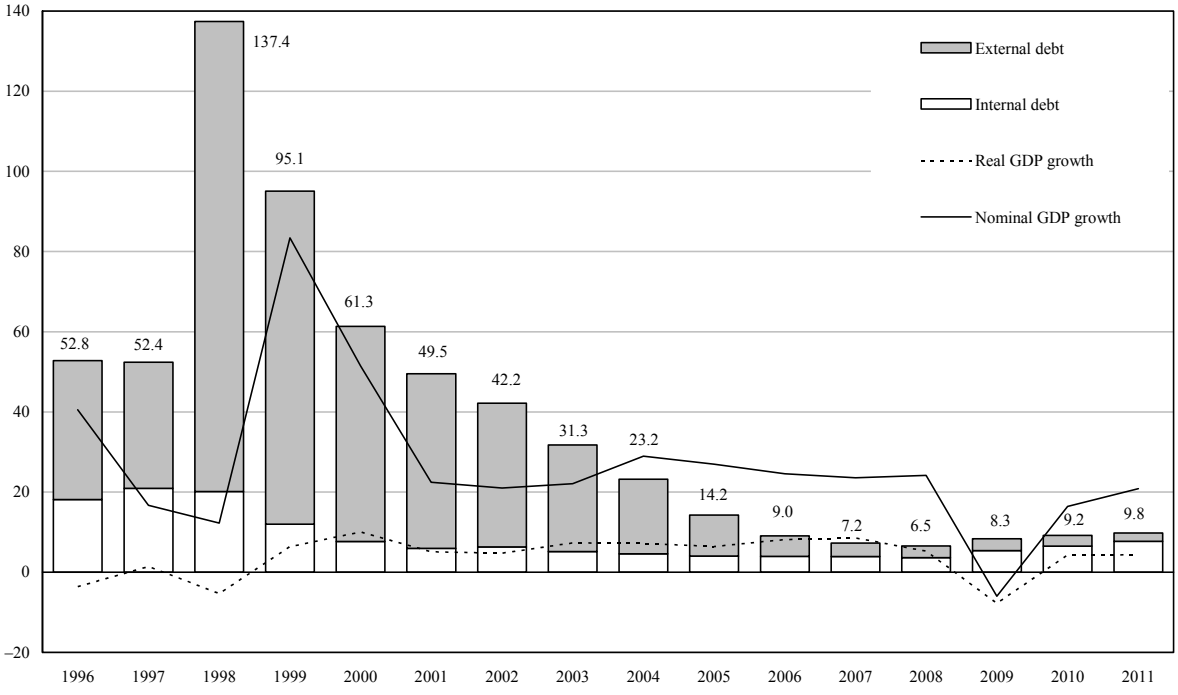


Figure 2

Dynamics and Structure of the Russian Federal Government Debt
(percent of GDP and nominal and real GDP growth rates in 1996-2011)



supported by favourable external conditions and prudent fiscal policy, allowed to reduce the public debt level from one of the highest in the world to one of the lowest ones (see Figures 1 and 2).

Probably this is not the case for the OECD countries and authors' calculations fully support this idea (see Table 2 for the corresponding calculations of real growth effect). So, the authors analyze a wide range of possible instruments of fiscal consolidation and quantify their contribution to primary balance tightening for each country (see Table 3). While implementation of the most of them seems reasonable there are some risks and limitations that have to be taken into account. Also several general comments could be made.

First, I have some doubts about the possibility to use OECD average as a target value for a set of instruments, e.g. social transfers, subsidies, tuition fees, as countries' peculiarities seem worthwhile to be taken into account. For instance, high values of social indicators in the Scandinavian region is a distinctive feature of the policy in these countries, partly concerned with their tax system.

Second, the level of discontent among the population as a result of possible employees' layoffs, social spending cuts and even increase in so-called "sin" taxes should be taken into account.

Third, it seems worthwhile to pay more attention in the paper to the pension reform: how it should be carried out and the corresponding calculations. This issue is very complicated and should become an important contribution to the fiscal tightening. For example, the Russian government, in contrast to the most of the countries, has an intension to avoid retirement age rise and find the required financial resources by reviewing the pension system components. This decision reflects possible political costs as the share of pensioners in the electorate is more than a third at present and presumably will rise gradually in the long run.

Fourth, it should be interesting to see how substantially can the primary balance be improved through the of automatic stabilizers operation. Although the model that is used to calculate fiscal gaps (see Appendix) implies the use of automatic stabilizers while the economy moves back to potential output, the paper does not present the corresponding calculations of their size for OECD and/or individual countries.

Finally, the paper contains the discussion of the choice of instruments based on their possible effect on long-term growth, e.g. that the differences in multipliers make tax increases more attractive than the government spending cuts. But it would be a nice contribution to the paper if the authors could estimate (at least make rough calculations of) the effect of fiscal consolidation (measures) on GDP growth rates for OECD and/or individual countries.

2 Comments on "Equity Aspects of VAT in Emerging European Economies: The Case Study of Serbia" by Nikola Altiparmakov and Milojko Arsić

The paper by Altiparmakov and Arsić is rather specific and aimed at proving VAT progressiveness in Serbia by investigating the VAT system in very details.

The motivation of this paper is the existence of the world-wide trend, aimed specifically at boosting the economic growth, of shifting the tax burden from income to consumption taxation, in particular VAT. At the same time there is common belief in the general public that VAT is a regressive tax that has an adverse distributional effects by creating disproportionate tax burden on the poor households. So, using the micro-level data the authors investigate equity aspects of VAT in Serbia as a typical emerging European country to prove its progressiveness.

Let me turn to the main findings of the paper. In order to determine whether the VAT is progressive or regressive the authors make calculations of the effective VAT rate for ten deciles of the population: from the poorest to the richest. Following the common practice the authors first investigate VAT burden by household annual income. It yielded unreasonable results indicating that the poorest group's of population effective VAT rate lies outside the range from 0 per cent the standard VAT rate (see Table 5a). These results show VAT regressiveness and are explained by the significant presence of the shadow economy and the evasion of direct income taxes in emerging market economies and by relying on annual income framework instead of lifetime income framework.

On the contrary, investigating VAT burden by looking at household annual expenditure leads to reasonable results and allows disclosing VAT progressiveness (see Table 5b). In about 60 per cent of the effect of progressivity is explained by taxation under reduced rate, while the remaining by progressive incidence of own-farming production, which is widely used in Serbia.

Finally, the authors investigate the prospective increase in VAT burden in Serbia by examining three possible scenarios. They conclude that introducing the uniform rate by eliminating the reduced rate contributes to regressivity and should be chosen only if accompanied with progressivity-enhancing reforms (see Table 7 for results).

There are three comments that I would like to make.

First, as a representative of another typical emerging European country which is very close to Serbia in many aspects, including those close to the topic of the paper (significant presence of the shadow economy and the evasion of direct income taxes, widely used own-farming production and VAT system as a whole), and basing on the Russian experience, let me express some doubts about the common (mis)belief in general public in Serbia that VAT is a regressive tax. I believe that scientists or politicians care about this issue, in particular the latter ones can use it in their political activity. At the same time I guess common people resist the prospective increase in VAT burden not because they believe that this tax burdens poor individuals more but because they resist the increase in tax burden at all.

Second, it would be a good contribution to the paper if authors would present their proposals how to modify VAT system in Serbia basing on such aspects as offering special consumption incentives, boosting economic growth, improving fiscal sustainability etc. They may include not only the suggestions of eliminating reduced rate or exemption from VAT for certain goods but any tax relief as well. For instance, in accordance with the Russian VAT system goods for children are a subject to the reduced VAT rate. It allows to promote their consumption and, therefore, to increase fertility rate.

Finally, is there any effective VAT rate for achieving the most of redistributive objectives, e.g., as the share of the standard VAT rate, especially for the poorest households? May be some literature on this issue exists?