Session 2

FISCAL IMPULSE

FISCAL POLICY AND MACROECONOMIC STABILITY: NEW EVIDENCE AND POLICY IMPLICATIONS

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The paper revisits the empirical link between fiscal policy and macroeconomic stability. Our basic presumption is that by definition, the operation of automatic stabilizers should always and everywhere contribute to greater macroeconomic stability (output and consumption). However, two stylized facts seem at odds with that prediction. First, the moderating effect of automatic stabilizers appears to have weakened in advanced economies between the mid-1990s and 2006 (the end of our main sample). Second, automatic stabilizers do not seem to be effective in developing economies. Our analysis addresses these apparent puzzles by accounting for the government's ambivalent role as a shock absorber and a shock inducer for determinants of macroeconomic volatility over time. Results provide strong support for the view that fiscal stabilization operates mainly through automatic stabilizers.

1 Introduction

Recent developments in macroeconomic modeling and pressing policy challenges have revived the classic debate on the effectiveness of fiscal policy as an instrument of macroeconomic stabilization (Van der Ploeg, 2005). On the theory side, the rapid development of micro-founded general equilibrium models with non-Ricardian features has allowed researchers to assess the benefits of fiscal stabilization in a coherent and rigorous analytical framework (see Botman *et al.*, 2006, for a survey). These studies confirm the conventional wisdom that a timely countercyclical response of fiscal policy to demand shocks is likely to deliver appreciably lower output and consumption volatility (Kumhof and Laxton, 2009). However, well-intended fiscal activism can also be undesirable, when shocks are predominantly affecting the supply side (Blanchard, 2000), or squarely destabilizing, when information, decision and implementation lags unduly lengthen the transmission chain. On the policy side, a growing number of countries turned to fiscal policy as their primary stabilization instrument either because of changes in their monetary regime (currency board, hard peg, participation in a monetary union) or because financial conditions deteriorated to the point of making monetary policy ineffective (Spilimbergo *et al.*, 2008).

Fiscal policy can contribute to macroeconomic stability through three main channels. The first is the automatic reduction in government saving during downturns and increase during upturns, cushioning shocks to national expenditure (Blinder and Solow, 1974). Such *automatic stabilization* occurs because tax revenues tend to be broadly proportional to national income and expenditure, whereas public spending reflects government commitments independent of the business cycle and entitlement programs specifically designed to support spending during

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downturns, including unemployment benefits.[1] Also, to the extent that government consumption is less volatile than other components of GDP, the public sector contributes to output stability through a mere composition effect of domestic expenditure. Second, governments can deliberately change public spending and tax instruments to offset business cycle fluctuations. Finally, the structure of the tax and transfer system can be designed to maximize economic efficiency and market flexibility, thereby enhancing the resilience of the economy in the face of shocks. The notion of fiscal stabilization pertains to the first two channels.

The public's demand for government-induced stability reflects a number of factors that may vary over time and across countries, including the inherent resilience of the economy and the existence of alternative stabilizers, such as an effective monetary policy and unrestricted access of individual agents to financial instruments. During the recent crisis, the perceived need for fiscal stabilization has been unquestionably high: the resilience of national economies was impaired by the depth and the global nature of the shock, agents faced either limited access to or high cost of self-insurance through credit markets and financial institutions, and the firepower of monetary policy was constrained by the zero-bound on nominal interest rates. In the short term, the stabilizing role of fiscal policy relies on effective automatic stabilizers and on the capacity of governments to engineer (and credibly phase out) a fiscal stimulus in a timely fashion.

This paper puts the current revival of fiscal stabilization policies in a broader perspective by revisiting the contribution of fiscal policy to macroeconomic stability in both industrial and developing economies over the last 40 years. The study builds on earlier work by Galí (1994), Van den Noord (2002), and Fatás and Mihov (2001, 2003), who investigate directly the cross-country relationship between fiscal policy indicators and output volatility. That approach has the advantage to incorporate in simple statistical tests various determinants of the stabilizing effect of fiscal policy, including policymakers' "reaction functions" and the actual impact of fiscal measures on output and private consumption. The resulting, reduced-from empirical relations thus provide useful information on the effectiveness of fiscal policy, while avoiding the methodological issues related to the estimation of fiscal "multipliers." Indeed, multipliers' estimates highly sensitive to the identification procedure of exogenous fiscal impulses (structural VARs, narratives, or DSGE model simulations), the nature of the shock (tax cuts, spending increases), and the behavior of monetary policy (Blanchard and Perotti, 2002; Perotti, 2005; Romer and Romer, 2008; and Horton, Kumar and Mauro, 2009, for a survey).

Existing analyses of fiscal stabilization tend to focus on the role of automatic stabilizers in industrial economies. Many of those draw on the seminal insights of Galí (1994) and revolve around the negative relationship between output volatility and government size, used as a proxy for the cyclical sensitivity of the budget balance. While the literature generally confirms the countercyclical impact of automatic stabilizers, the relationship appears to be a complex one. First, non-linearities seem to exist,[2] suggesting that the adverse effect of high tax rates on an economy's resilience could more than offset the action of automatic stabilizers. Second, the relationship may be changing over time as structural changes moderating output volatility could be faster in economies with leaner governments.[3] Finally, the relationship does not seem to hold beyond a narrow sample of industrial OECD countries.[4] Debrun, Pisani-Ferry and Sapir (2008) addressed the

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[1] Darby and Mélitz (2008) and Furceri (2009) show that social spending – including health and retirement benefits – is more countercyclical than generally acknowledged. For instance, early retirement and sick leave – which often protects employees against involuntary separation – are more likely to be used during downturns.

[2] Examples include Silgoner, Reitschuler and Crespo-Cuaresma (2002), and Martínez-Mongay and Sekkat (2005).

[3] Debrun, Pisani-Ferry and Sapir (2008) and Mohanty and Zampolli (2009) document an apparent breakdown of the relationship between government size and output volatility in the 1990s.

[4] Fatás and Mihov (2003) find that government size actually increases output volatility in a cross-section of 91 countries. Viren (2005), using an even larger cross-section of 208 countries and territories, concludes that "*the relationship between government size*

(continues)

first two concerns, introducing a time-dimension in the Fatás-Mihov sample to control for potential determinants of the "great moderation", (*i.e.* the steady decline in output volatility observed between the mid-1980s and the recent past). Their results confirm the effectiveness of automatic stabilizers in reducing output volatility.

This paper looks further into the robustness of the results described above. Our contribution rests on 4 elements. First, our sample includes 49 industrial and developing countries for which reasonably long time series exist for fiscal data covering the general government. Second, we take into account the potentially destabilizing impact of fiscal policy, as public finances are used to attain other goals than macroeconomic stability. Should bigger governments produce larger fiscal shocks, estimates of the impact of automatic stabilizers would be biased. Third, we account for the role of potential substitutes to fiscal policy as a macroeconomic insurance mechanism, including financial development, improved monetary policy credibility, and better economic policy governance. These variables may account for the decline in output volatility observed until the recent crisis and may prove important to properly identify the causal relation between automatic stabilizers and volatility (see Debrun, Pisani-Ferry, and Sapir, 2008, and Mohanty and Zampolli, 2009). Fourth, we investigate the extent to which fiscal policy contribute to lower private consumption volatility, as the latter is more closely related to welfare.

The main results can be summarized as follows. First, automatic stabilizers strongly contribute to output stability regardless of the type of economy (advanced or developing), confirming the effectiveness of timely, predictable and symmetric fiscal impulses in stabilizing output. The impact on private consumption volatility is quantitatively weaker and statistically less robust. Second, countries with more volatile cyclically-adjusted budget balances also exhibit more volatile output and private consumption. However, the result could be tainted by a reverse causality problem that we could not satisfactorily address with instrumental-variables techniques due to a weak-instrument problem. Third, access of individual consumers to credit appears to exert a stabilizing influence on output and private consumption. A weaker contribution of credit supply to smooth cyclical fluctuations could thus increase the public's appetite for fiscal stabilization.

The rest of the paper is structured as follows. Section 2 discusses data issues and reviews stylized facts. Section 3 develops the econometric analysis, while Section 4 discusses the results and draws policy implications.

2 Data and stylized facts

2.1 Governments as shock absorbers and shock inducers

The size of automatic stabilizers is commonly approximated by the ratio of general government expenditure to GDP. Using a rule of thumb according to which the elasticity of government revenues and expenditure (both in levels) to the output gap is 1 and 0 respectively, the expenditure-to-GDP ratio is indeed equal to the semi-elasticity of the overall budget balance (in percent of GDP) to the output gap.[5]

However, if size matters for automatic stabilization, it could also prove harmful for macroeconomic stability if bigger governments tend produce larger fiscal shocks than their leaner counterparts. To avoid an omitted-variable bias, it is important to control for this possibility in the econometric analysis. The rest of this sub-section constructs a set of mutually-consistent fiscal

and output volatility is either nonexistent or very weak at best." Mohanty and Zampolli (2009) find that even among OECD countries government size only has a modestly negative impact on output volatility.

[5] See equations (1) and (2) below.

indicators capturing three relevant dimensions of fiscal policy: automatic stabilizers, systematically stabilizing discretionary policy, and non-systematic policy (which can be stabilizing or not).

2.1.1 Three dimensions of fiscal policy

To look at the cyclical properties of the overall budget balance, it is common to split it in two components: the cyclical balance and the cyclically-adjusted balance (see for instance, Galí and Perotti, 2003). Changes in the cyclical balance give an estimate of the budgetary impact of aggregate fluctuations through the induced changes in tax bases and certain mandatory outlays. By construction, the cyclical balance is zero when the output gap is closed (actual output is on trend), and its variations are thought to be outside the immediate control of the fiscal authorities. Subtracting the cyclical balance from the overall balance yields the cyclically-adjusted balance (CAB), or the hypothetical overall balance one would observe if output was on trend (or "potential") level. Changes in the CAB are generally interpreted as resulting mostly[6] from discretionary actions by policymakers.

The CAB itself reflects two dimensions of fiscal policy relevant for our analysis. The first is the effect of policy decisions systematically related to changes in the actual or expected cyclical conditions of the economy. For instance, governments wishing to actively pursue a countercyclical policy could reduce taxes or increase government consumption whenever the economy is in a recession, while withdrawing the stimulus during the recovery and reducing public spending during booms. The response of the CAB to the cycle can either be pro-cyclical (running against automatic stabilizers) or countercyclical (augmenting the effect of automatic stabilizers). The second source of variations in CABs arises from budgetary changes that are not the result of the average response of fiscal authorities to the business cycle. This "exogenous" CAB can either reflect extraordinary fiscal stabilization efforts—such as those adopted in response to the recent crisis—or destabilizing fiscal impulses associated with other objectives of public finances (redistribution and efficiency), or non-economic considerations (e.g., electoral budget cycle).

Thus, from now, fiscal policy will be discussed in light of those three dimensions of the overall balance, namely:

(i) automatic stabilizers;

(ii) the "cyclical fiscal policy", reflecting the *systematic* response of the CAB to the business cycle;

(iii) and the "exogenous discretionary fiscal policy" capturing CAB changes that are not systematically related to current macroeconomic conditions.[7]

2.1.2 Quantifying the three dimensions

Data analysis alone does not allow disentangling the impact of automatic stabilizers from that of systematic discretionary stabilization. To solve that identification problem, we simply *assume* that automatic stabilizers are adequately measured by the ratio of public expenditure to GDP. That assumption enhances the comparability of our results with related studies and provides a simple and transparent metric applicable to all countries. But it entails a potential measurement error that we will need to keep in mind when interpreting the results (see further discussion below).

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[6] Studies of the fiscal stance often exclude interest payments, as they reflect past policies (public debt) and financial conditions.

[7] This is the terminology used by Fatás and Mihov (2009). For a more detailed discussion of cyclical adjustment, see Fedelino, Ivanova and Horton (2009).

A CAB consistent with our assumption is needed to derive indicators of the "cyclical" and exogenous policies defined above. As indicated earlier, government size is an exact measure of the sensitivity of the budget balance to the business cycle if revenue and expenditure elasticities to output are 1 and 0 respectively. To see this, define the CAB (in percentage of trend output Y^*) as:

$$\begin{aligned} CAB &\equiv \frac{R\left(Y^*/Y\right)^{\eta_R}}{Y}\frac{Y}{Y^*} - \frac{G\left(Y^*/Y\right)^{\eta_G}}{Y}\frac{Y}{Y^*} \\ &= r\left(Y^*/Y\right)^{\eta_R - 1} - g\left(Y^*/Y\right)^{\eta_G - 1} \end{aligned} \tag{1}$$

where r is total revenue as a ratio of GDP (Y), Y^* is the trend level of output, η_R is the elasticity of revenue to the output gap, g is the expenditure to GDP ratio, and η_G is the elasticity of expenditure to the output gap. Setting $\eta_R = 1$ and $\eta_G = 0$ and denoting by b the overall budget balance (in percent of GDP) yields:

$$\begin{aligned} CAB &= r - g\left(Y^*/Y\right)^{-1} \\ &= b - g\left(Y^*/Y\right)^{-1} + g \\ &= b - g(Y/Y^* - 1) \\ &= b - gy\,, \end{aligned} \tag{2}$$

where y is the output gap in percentage of trend output ($y \equiv (Y - Y^*)/Y^*$), and gy is the cyclical balance. This formally establishes that the public expenditure ratio is the semi-elasticity of the budget balance (in percent of GDP) to the output gap.[8]

Indicators of the cyclical and exogenous/discretionary fiscal policies can then be estimated for each country in our sample, using a simple time-series regression:[9]

$$CAB_t = \alpha + \beta y_t + \gamma CAB_{t-1} + \mu_t \tag{3}$$

where the output gap y_t is calculated as the relative deviation of actual GDP from an HP trend. The first-order autoregressive term on the right-hand side of (3) accounts for persistence in budget balances, and effectively eliminates the severe first-order serial correlation of residuals observed in static regressions.

The cyclical fiscal policy is captured by β, the short-term response of the CAB to the output gap. A negative value implies that a cyclical upturn (downturn) tends to deteriorate (improve) the CAB, indicating that government actions are systematically destabilizing and offset – at least partly – the impact of automatic stabilizers on the economy. On the other hand, a positive coefficient on y_t implies that on average, the government seeks to increase the counter-cyclical bent of fiscal policy through discretionary measures.

The effectiveness of fiscal policy entails reverse causality from CAB to y, introducing a downward bias in OLS estimate of β. Also, equation (3) is parsimonious by necessity (time series are short in some countries), which could create an omitted variable bias. To alleviate potential

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[8] Of course, this does not mean that automatic stabilizers arise from the expenditure side since we assumed η_G=0.

[9] Galí and Perotti (2003), Wyplosz (2006) and Fatás and Mihov (2009) use a similar specification to study the cyclical features of fiscal policy. Fatás and Mihov (2003) and Afonso, Agnello and Furceri (2009) also rely on a regression-based method to distinguish between cyclicality, persistence, and the volatility of public expenditure.

biases in the estimated β's, instrumental variable (IV) techniques are used. Instruments for the output gap include its own lagged value, log-differenced terms of trade and oil prices, and energy use per capita.[10] A priori, these are adequate instruments – especially for small open economies – as cyclical fluctuations are correlated with terms of trade shocks, oil prices and energy use per capita, without being directly influenced by the fiscal stance. For oil exporters, however, we used the lagged value of the output gap, the output gap of the United States, and its lagged value.[11]

The exogenous discretionary policy is calculated as the variability (standard deviation) of a residual $\hat{\zeta}_t = CAB_t - \hat{\alpha} - \hat{\beta} y_t - \hat{\gamma}(CAB)_{t-1}$, where $\hat{\alpha}, \hat{\beta}, \text{and } \hat{\gamma}$ are obtained from IV estimation. This differs from the standard error of residuals in equation (3), $\sigma_i^{\mu} = \sqrt{\text{var}_i(\hat{\mu}_t)}$. The reason is that, having instrumented the output gap, the residual of (3) would incorporate the non-instrumented part of the output gap ($\hat{\beta}(y_t - \hat{y}_t)$), introducing co-movement between our measure of discretionary policy and output gap volatility. This would in turn create a simultaneity bias in the regressions performed to estimate the effect of fiscal policy on output gap variability. By their very nature, these residuals capture more than discretionary policy decisions, including measurement errors, and the direct budgetary impact of certain shocks over and above their influence on economic activity (for instance, exchange rate fluctuations affecting interest payments and commodity-related revenues, the influence of asset prices on certain revenue categories, and inflation shocks). The notion of "exogenous discretionary policy" should therefore be interpreted with caution. While equation (3) could be augmented to account for some of these effects, the measurement of pure shocks raises other issues that would ultimately alter the transparency of our simple approach.

2.1.3 Caveats

In interpreting our empirical results, one should keep in mind that government size is only an approximation of the cyclical sensitivity of the budget balance. To assess the likelihood of any bias introduced by that proxy, we look at the relation between the public expenditure to GDP ratio and the semi-elasticities of the budget balance to the output gap estimated by the OECD for most of its member countries (Figure 1). These estimates partly take into account the impact of tax progressivity and cyclically-sensitive expenditure.[12] The regression line is statistically indistinguishable from a 45-degree line, indicating that government size is a reliable proxy of automatic stabilizers in OECD countries.

Outside the OECD, however, lower output sensitivities may prevail. On the revenue side, a greater share of indirect taxes in revenues and a lower degree of progressivity in direct taxes tend to weaken the responsiveness of tax revenues to income. On the expenditure side, unemployment insurance and other social safety nets are generally less developed. Given this, we may overestimate the size of automatic stabilizers in developing countries, while underestimating their impact on output and consumption volatility. We would correspondingly overestimate the

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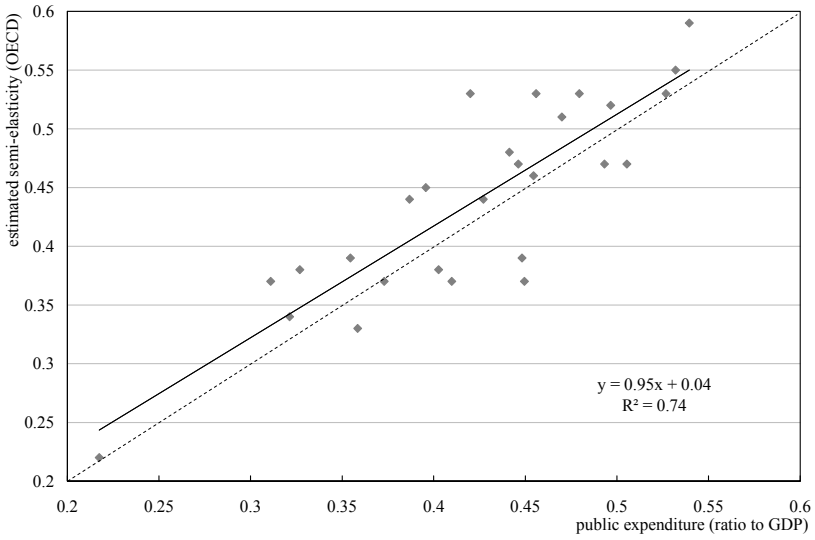
[10] Lee and Sung (2007) estimate the responsiveness of fiscal policy to cyclical fluctuations, taking the average of GDP growth rates in neighboring countries, weighted by the inverse of the distance between the two countries, as an instrument.

[11] There are five oil producing countries in the sample. Ideally, the non-oil fiscal balances should be used in the regression. However, no sufficiently long time series were available to obtain meaningful estimates of *β*. Dropping these countries from the sample does not alter the results.

[12] Some ad-hoc assumptions remain, however, including a unit-elasticity of indirect taxes and a zero-elasticity for expenditure except unemployment benefits. The latter may be a strong assumption in light of Darby and Mélitz (2009) who show that social spending other than unemployment benefits exhibits a significant countercyclicality, including health and pension expenditure. Building on these results, Furceri (2009) estimates that social spending alone is able to offset about 15 percent of output shocks.

Figure 1

Government Size and Cyclical Sensitivity of the Budget Balance



Sources: Girouard and André (2005) and authors' calculations.

stabilizing influence of cyclical fiscal policy, as $\hat{\beta}$ would capture any measurement error in the size of automatic stabilizers. Another issue is that short time series limit our ability to test for the presence of structural breaks in the relation between the CAB and the output gap. In general, tests conducted for OECD countries – for which we have time-series starting in 1970 – do not allow to reject the null hypothesis that β is stable between two sub periods (1970-89 and 1990-2006).

2.2 Output volatility and automatic stabilizers: stylized facts

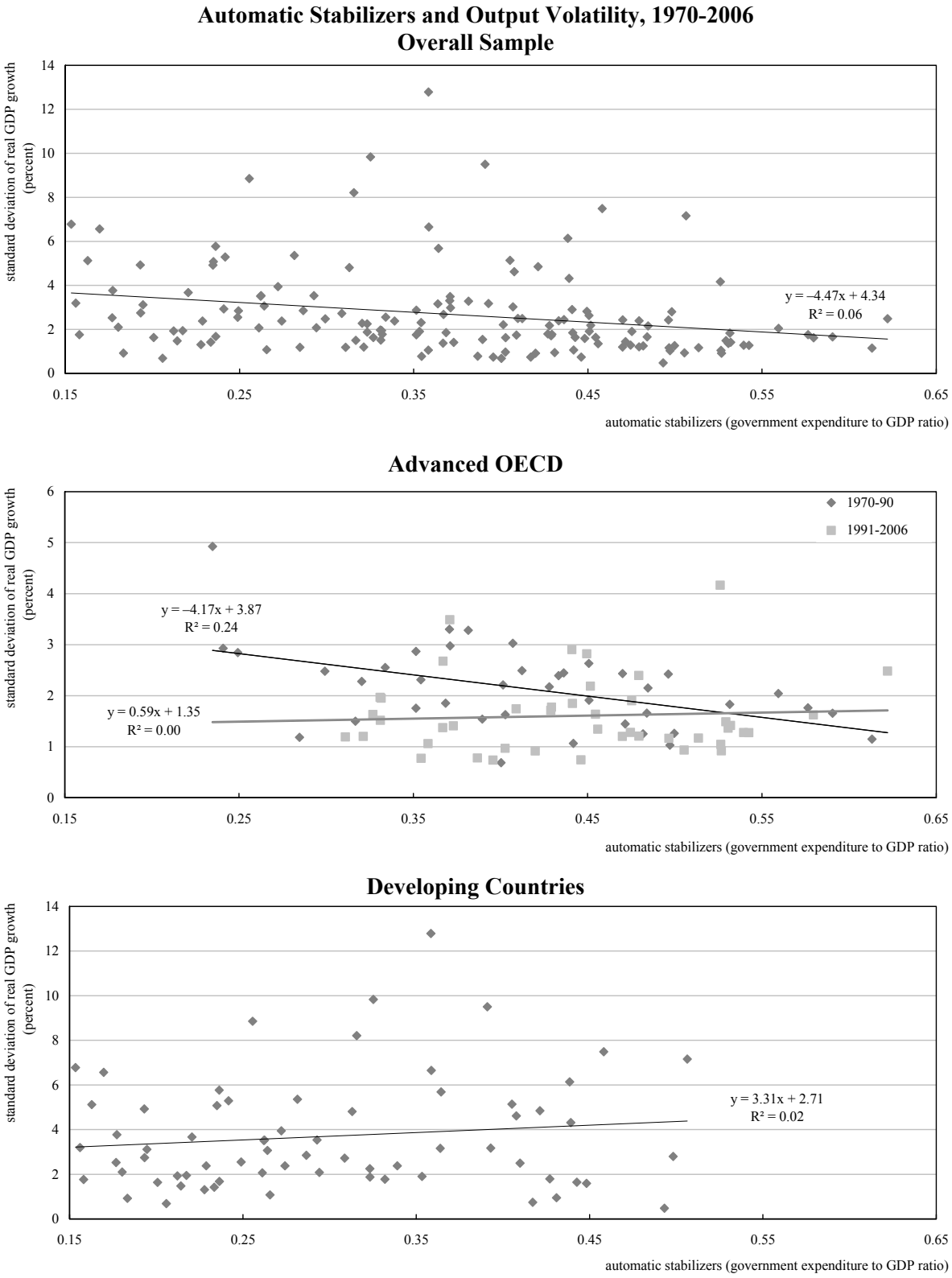
The seminal studies by Galí (1994) and Fatás and Mihov (2001) suggest that the effectiveness of automatic stabilizers is already evident from the negative unconditional correlation between real GDP growth variability and the size of government, and they show this for a sample of selected OECD countries between 1960 and the early 1990s. Our broader sample, which covers selected developing economies and ends in 2006, exhibits a similar correlation (Figure 2, top panel). Subsequent analyses qualified this result, suggesting that the relation is likely to be non-linear and unstable over time. Using the same set of countries as Fatás and Mihov (2001), Debrun, Pisani-Ferry and Sapir (2008) document a dramatic weakening of the negative relation after the mid 1990s, a stylized fact present in our sample for advanced OECD countries (Figure 2, center panel). Econometric analysis by the same authors also revealed non-linearities in this relation, implying strongly decreasing returns in automatic fiscal stabilization beyond a certain threshold of government size. Silgoner, Reitschuler and Crespo-Cuaresma (2002), and Martínez-Mongay and Sekkat (2005) found similar non-linearities in a sample of EU member states.

Although the literature generally supports the effectiveness of automatic stabilizers in OECD countries, some have suggested that the result may not hold in developing economies. In particular, Viren (2005) finds that the negative relation between government size and GDP volatility does not exist when developing economies are included in the sample. Using our sample, scatter plots indeed depicts a weakly *positive* correlation for the subset of developing countries (Figure 2, bottom panel).

These stylized facts raise two questions. First, it is unclear why automatic stabilizers per se would be subject to strong "decreasing returns".[13] Second, even if government size exaggerates the

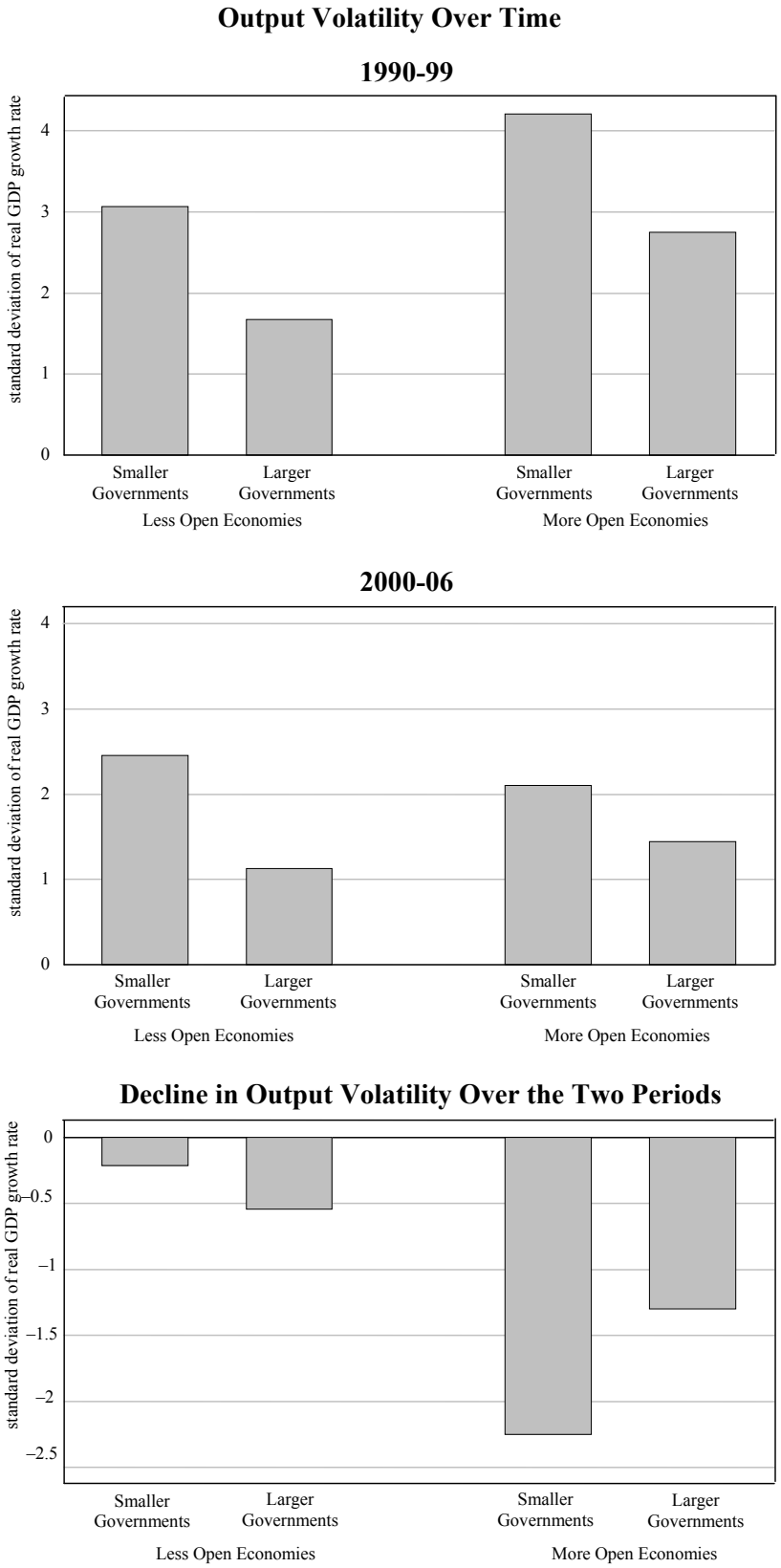
[13] That said, in a reduced-form IS-curve, the relation between output and the size of automatic stabilizers is log-linear because the fiscal impulse stemming from the operation of stabilizers itself depends on output (see the Appendix).

Figure 2



Note: Each observation represents a combination of government size and real GDP growth volatility observed in one country over a given decade.
Source: Authors' calculations.

Figure 3



Source: Authors' calculations.

magnitude of automatic stabilizers in developing countries, the existence of a positive relationship remains counterintuitive. Both puzzles are consistent with the need to take into account the shock-inducing aspect of fiscal policy. The appearance of decreasing returns could indeed result from the fact that bigger governments generate more destabilizing fiscal shocks, as documented in Debrun and Kapoor (2010). Likewise, the apparent ineffectiveness of automatic stabilizers in developing countries may have to do with more pervasive institutional weaknesses and political economy constraints in these countries that magnify the shock-inducing part of fiscal policy to the point of overcoming automatic stabilizers.

Another interesting characteristic of the relation between output volatility and government size is that it seems to be evolving over time, stressing the importance to examine possible causes for such evolution. Debrun, Pisani-Ferry and Sapir (2008) show that the factors driving the trend decline in output volatility until the recent crisis – the so-called great moderation – were more powerful in countries with smaller government sectors than

others. We can verify this in our broader sample and divide countries into 4 categories along 2 dimensions: trade openness and government size (cut-off levels are the median values). We consider only the last two periods of our sample 1990-99 and 2000-06 to cover all the countries.

For both sub-periods, output volatility is on average larger in countries with smaller governments, regardless of trade openness (Figure 3). Rodrik's (1998) observation that more open economies are generally more volatile is verified for 1990-99, but not for the more recent period. Indeed, the bottom panel of Figure 3 shows that the decline in average output volatility between the two subperiods has been more pronounced in more open economies, and among the latter in countries with smaller governments. This suggests that open economies with smaller government took better advantage of the factors driving the great moderation, such as improved access to financial instruments, credit and external financing, allowing economic agents to better smooth consumption and plan investment. Also, openness tends to raise the economic cost of policy mistakes, contributing to better macroeconomic management, including more countercyclical macroeconomic policies.

3 Econometric analysis

3.1 Testing the effectiveness of automatic stabilizers

Following Fatás and Mihov (2001), the empirical test is based on the *cross-country* relation between government size and output volatility. As we also take into account time-varying factors that may affect the public's demand for fiscal stabilization or the government's incentives to provide such stabilization (Debrun, Pisani-Ferry and Sapir, 2008), the baseline empirical model is a panel regression with period-fixed effects: [14]

$$Y_{i,t} = \alpha + \sum_{t=2}^{t=4} \lambda_t P_t + \phi_1 G_{i,t} + \phi_2 Cyc_i + \phi_3 Discr_{i,t} + \sum_{j=1}^{J} \theta_j X_{j,i,t} + \nu_{i,t} \quad (4)$$

with $i = 1,...49$ (countries) and $t = 1,...4$ (10-year period). $Y_{i,t}$ is a measure of real GDP volatility, the P_t's symbolize period fixed effects, $G_{i,t}$ denotes the size of automatic stabilizers (logarithm of public expenditure in percent of GDP), Cyc_i and $Discr_{i,t}$ are the cyclical and discretionary dimensions of fiscal policy discussed in Section 2, the X_j's are control variables, and $\nu_{i,t}$ is the error term. As the cyclicality indicator is an estimated coefficient, it is sometimes not statistically different from zero. To reduce the noise stemming from such uncertainty, we set Cyc_i equal to zero for countries where the $\hat{\beta}_i$ is statistically insignificant at the 10 percent confidence level. The discretionary dimension $Discr_{i,t}$ is calculated for each subperiod to capture any change in the average magnitude of fiscal policy shocks non-systematically related to the business cycle.

By default, we calculate output volatility as the standard deviation of real GDP growth over each period t. However, since this measure is sensitive to variations in potential growth (over time and across countries), we systematically checked the robustness of our results using the standard deviation of the first differenced output gap (calculated by us for all countries as the relative difference between actual real GDP and its HP-filtered series). The focus on aggregate output

[14] The time dimension comprises 4 periods over which annual data have been averaged (1970-79, 1980-89, 1990-99 and 2000-06). The panel is unbalanced because of data limitations for developing and emerging market economies. The Appendix reports data sources. Input from auxiliary regressions can be found in Debrun and Kapoor (2010).

volatility – instead of privately-generated GDP, for instance – is justified by the fact that the contribution of fiscal policy to macroeconomic stability also operates through composition effects of national expenditure (Andrés, Doménech and Fatás, 2008). Although there is no evident theoretical reason for rejecting these effects, we also investigated the relationship between our fiscal indicators and the variability of private consumption because the latter is more directly related to welfare.

A rejection of the null hypothesis that $\phi_1 = 0$ against the alternative $\phi_1 < 0$ is consistent with the effectiveness of automatic stabilizers. The Appendix formally illustrates that, given a sample average of 0.38 for government size, plausible values of ϕ_1 lie between –0.5 and –2.6. As we have more observations than most comparable studies, we are better placed to deal with the omitted-variables and reverse causality issues inherent to a single-equation approach. More specifically, we introduce determinants of volatility that have been related to the "great moderation" episode and are suspected to have weakened the relation between government size and output volatility. We then we assess the robustness of our results, and expand the analysis to private consumption volatility.

3.2 Fiscal policy: shock-absorbing or shock-inducing?

We first estimate a parsimonious model deliberately omitting discretionary and cyclical dimensions of fiscal policy as well as time-series determinants of output volatility (Table 1). The results are consistent with two stylized facts noted earlier. First, non-OECD-20 countries are both more volatile and have smaller governments, explaining why the standard stabilization result holds for the whole sample but not for the non-OECD-20 subset. Second, among the OECD-20 group, the effectiveness of automatic stabilizers seems to have decreased substantially over the last two decades.

We conjectured earlier that omitting $Discr_{i,t}$ could entail a serious upward bias in estimates of ϕ_1 if bigger governments also tended to induce larger shocks. The results summarized in Table 2 – which now include all dimensions of fiscal policy and the time-series controls – lend support to that hypothesis: the size of government now has a negative and statistically significant impact on output volatility, and this regardless of whether we restrict the sample to certain economies or sub-periods. The absolute values of $\hat{\phi}_1$ are higher than previously estimated, and the confidence intervals are narrower. They are also quantitatively similar to Fatás and Mihov (2001) – around 2 – despite a very different sample.

These results differ from Fatás and Mihov (2003) who find that government size has a positive effect on volatility in a cross-section of 91 countries. Their model is similar to (4) except that (i) they have no measure of Cyc_i, (ii) the time dimension is missing, and (iii) their measure of $Discr_{i,t}$ is based on public consumption only. Two important reasons for the difference are that our approach allows for a richer set of relevant determinants of volatility (e.g., financial development) and that it uses measures of automatic stabilizers, cyclical policy and discretionary policy that are mutually consistent and based on a broad coverage of the government sector.

While we fail to find any significant stabilizing impact of the cyclical dimension (a sign that this series may be too noisy), the coefficient $\hat{\phi}_3$ on the discretionary dimension is positive and significant for the unrestricted sample and for the sub-sample excluding the OECD-20. In contrast, $\hat{\phi}_3$ is not significantly different from zero in the OECD-20. Also, the fit of the model increases

Table 1

A Parsimonious Model

Dependent Variable	Standard Deviation of Real GDP Growth Rate			
	All	Non-OECD	OECD (1970-89)	OECD (1990-2006)
	1	2	3	4
Openness	1.143 (1.32)	0.150 (0.11)	1.617* (1.87)	0.720 (1.17)
Automatic Stabilizers	–1.614*** (–4.45)	1.038 (1.35)	–2.224*** (–2.78)	–0.244 (–0.41)
Constant	0.728 (1.21)	5.614*** (3.19)	–0.418 (–0.48)	0.675 (0.99)
Observations *R* -squared	152 0.14	75 0.15	37 0.33	40 0.32

Note: Robust *t*-statistics in parentheses. Time effects are not reported. Stars denote statistical significance at conventional levels (* for 10 per cent, ** for 5 per cent, and *** for 1 per cent).

Table 2

Introducing Cyclical and Discretionary Dimensions of Fiscal Policy

(dependent variable: standard deviation of real GDP growth rate)

Dependent Variable	OECD-20	Non OECD-20	All	All	All	All
				1970-89	1990-2006	
	1	2	3	4	5	6
Openness	0.717 (1.56)	0.462 (0.48)	0.507 (0.79)	–0.389 (-0.33)	0.684 (1.00)	0.519 (0.86)
Automatic Stabilizers	–1.409*** (–2.93)	–1.605* (–1.79)	–2.013*** (–5.00)	–1.290** (–2.30)	–2.257*** (–3.89)	–1.680*** (–4.21)
Central Bank Independence	–0.117 (–0.27)	0.715 (0.47)	1.096* (1.79)	0.138 (0.18)	1.404 (1.63)	–2.728*** (–2.62)
Financial Development	–0.446* (–1.98)	–0.01 (–0.02)	–0.788*** (–3.01)	–0.577 (–1.08)	–0.770** (–2.56)	–0.550** (–2.20)
Cyclical Fiscal Policy	–0.065 (–0.27)	0.209 (0.15)	0.114 (0.38)	–0.214 (–0.51)	0.030 (0.07)	0.026 (0.09)
Discretionary Fiscal Policy	0.016 (0.16)	0.911*** (4.62)	0.672*** (4.64)	0.186 (1.19)	0.877*** (4.66)	–0.451* (–1.79)
Interaction: Discretion x CBI	…	…	…	…	…	2.118*** (3.83)
Constant	1.013** (2.13)	–2.501 (–1.17)	–1.134 (–1.51)	0.992 (0.42)	–2.617** (–2.42)	…
Observations *R* -squared	77 0.40	56 0.52	133 0.50	47 0.35	86 0.57	133 0.58

Note: Robust *t*-statistics in parentheses. Time effects are not reported. Stars denote statistical significance at conventional levels (* for 10 per cent, ** for 5 per cent, and *** for 1 per cent).

substantially. These results suggest that discretionary fiscal policy is likely to be an important contributor to output volatility outside the core OECD economies covered in previous studies. This is in line with Fatás and Mihov (2003), although our measure of discretionary policy – based on budget balance volatility – is quite different from theirs – volatility of GDP-growth-adjusted public consumption.

An interesting observation is that the degree of central bank independence has a significantly positive impact on volatility, a result largely driven by the presence of the non-OECD-20 countries in the sample. This could suggest that anti-inflationary credentials take time to build up despite rising degrees of legal independence, or that productivity shocks and decision lags entail a meaningful trade-off between real and nominal stability.

Another possibility is that coordination failures in the policy mix could be more frequent when monetary and fiscal authorities independently pursue different objectives. Specifically, fiscal impulses unrelated to routine stabilization are more likely to lead to costly conflicts with monetary authorities when the latter are politically independent than when they are forced to accommodate fiscal shocks. To explore that conjecture, we added to the model an interaction term between the index of central bank independence (CBI) and our measure of exogenous fiscal policy. In the presence of the interaction term, the estimated coefficient of CBI turns negative and significant – as one would expect if CBI induces improvements in the quality of monetary policy – whereas the interaction term is positive and highly significant. One interpretation is that fiscal impulses not systematically related to output stabilization undermine the benefits of central bank independence, reflecting possible coordination failures in the policy mix. The fact that $\hat{\phi}_3$ also turns negative when the interaction term is present could indicate that such conflicts would be the main reason for the positive conditional correlation between fiscal discretion and output volatility.

Finally, we see that the moderating impact of financial development on output volatility is robust to the introduction of our fiscal controls although that effect is mainly driven by more recent (post-1990) observations.

3.3 Robustness checks

We now check the robustness of our results to common econometric issues, first examining the possibility of reverse-causality, and then assessing the risk of an omitted-variable bias.

3.3.1 Endogeneity

Equations (4) and (5) are potentially subject to reverse causality problems. For instance, governments concerned with output stability could arguably adjust their fiscal behavior and the size of automatic stabilizers to the intensity of exogenous disturbances affecting the economy (Rodrik, 1998). Reverse causality could also bias estimated coefficients on CBI and financial development if more volatile economies are more inclined to delegate monetary policy to an independent agency with a clear stabilization mandate, and if private agents take better advantage of financial services to self-insure against the income effect of aggregate fluctuations.

Following Fatás and Mihov (2001, 2003), we selected instruments capturing institutional and structural characteristics of countries likely to be correlated with our explanatory variables but presumably orthogonal to output volatility itself. Institutional instruments include the electoral rule (proportional vs. majoritarian), the type of political system (presidential vs. parliamentary), the presence of political constraints (number of veto points in the government), and the distribution of

Table 3

Two-Stage-Least-Squares (2SLS) Estimates
(dependent variable: standard deviation of real GDP growth rate)

Instrumented Variable	Automatic Stabilizers	Cyclical Fiscal Policy	Discretionary Fiscal Policy	Financial Development	Central Bank Independence
	1	2	3	4	5
Openness	0.528	0.472	0.491	0.539	0.566
	(0.83)	(0.75)	(0.74)	(0.85)	(0.79)
Automatic stabilizers	–2.271***	–2.169***	–1.948***	–2.144***	–2.802***
	(–4.17)	(–5.11)	(–4.07)	(–5.00)	(–4.31)
Central Bank Independence	1.096*	1.050*	0.790	1.084*	3.873*
	(1.69)	(1.75)	(1.23)	(1.80)	(1.85)
Financial Development	–0.817***	–0.814***	–0.971***	–1.083***	–0.902***
	(–3.21)	(–3.14)	(–3.45)	(–2.61)	(–3.25)
Cyclical Fiscal Policy	0.125	0.012	–0.225	0.166	0.099
	(0.44)	(0.01)	(–0.75)	(0.57)	(0.29)
Discretionary Fiscal Policy	0.671***	0.659***	0.322	0.650***	0.734***
	(4.22)	(3.64)	(0.87)	(4.15)	(4.92)
Constant	–1.201	–1.037	–0.063	–0.896	–3.070*
	(–1.31)	(–1.32)	(–0.06)	(–1.24)	(–1.86)
Observations	127	127	127	127	127
R-squared	0.49	0.49	0.44	0.48	0.39
Wu-Hausman Test (p-value)	0.79	0.92	0.05	0.31	0.11
Hansen J Test (p-value)	0.24	0.25	0.41	0.38	0.37
Weak Identification (F-stat)	27.76**	3.4	7.65	24.41**	2.55
Exogeneity Tests (p-value):					
Automatic Stabilizers	…	0.9	0.72	0.75	0.53
Central Bank Independence	0.3	0.1	0.64	0.1	…
Financial Development	0.26	0.15	0.16	…	0.07
Discretionary Fiscal Policy	0.13	0.07	…	0.34	0.26
Cyclical Fiscal Policy	0.04	…	0.26	0.1	0.25

Note: Robust t-statistics in parentheses. Time effects are not reported. Stars denote statistical significance at conventional levels (* for 10 per cent, ** for 5 per cent, and *** for 1 per cent).

ideological preferences. Other instruments are GDP per capita (at PPP, in log), the dependency ratio, the rate of urbanization, and a dummy variable identifying oil producers.

The specification used for 2SLS estimation is column 3 of Table 2. We instrumented potentially endogenous explanatory variables one by one, each time testing for the endogeneity of other suspicious instruments.[15] Formal exogeneity tests (Wu-Hausman, WH) only rejected the null

[15] Instrumenting multiple right-hand-side variables did not yield any meaningful result, in large part reflecting the weak-instrument issue discussed below.

hypothesis that OLS estimates are consistent for $Discr_{i,t}$ (strongly) and the index of central bank independence (marginally), suggesting that 2SLS should be preferred over OLS (column 3 and 5 of Table 3). Testing for the orthogonality between each non-instrumented explanatory variable (*i.e.*, the *included* instruments) and the error term broadly support the conclusions of the WH tests.

Two-stage least-squares estimates confirm the effectiveness of automatic stabilizers (column 1 of Table 3) and the stabilizing impact of financial development (column 4), although the coefficient for the latter is somewhat higher in absolute value. The other results are difficult to interpret because instruments appear to be weak, meaning that the explanatory power of the excluded instruments in the first stage regression is too low to provide reliable identification. Hence 2SLS estimators are biased and inefficient, especially in small samples such as ours (Stock, Wright and Yogo, 2002). It is nevertheless notable that our indicator of fiscal policy discretion does not appear to significantly raise volatility when it is instrumented. This could be a sign that this indicator also reflects other sources of output volatility not captured by the statistical model, but with potentially significant budgetary consequences (e.g., commodity or asset prices, exchange rates, inflation shocks…).

3.3.2 Omitted variables

The omission of relevant explanatory variables could also entail a correlation between the error term and the independent variables. We thus further examine the possibility of a bias by adding potential determinants of output volatility to the baseline specification. Keeping our focus on the effectiveness of automatic stabilizers, we follow Fatás and Mihov (2001) and select controls likely to be correlated with both government size and output volatility.[16] None of the added explanatory variable turns out being statistically significant (neither individually nor together, as shown in Table 4), and estimates of the coefficients of interest (automatic stabilizers, discretionary fiscal policy and financial development) are not statistically different across regressions.

In a panel context, a natural test for the robustness of our results to omitted variables is to add country fixed-effects. The limited size of our sample limits our investigation to the parsimonious specifications in columns 8 and 9, which exclude the cyclical policy indicator because it has no time-series variance. The stabilizing impact of financial development does not survive this "acid test", pointing to the possibility that some underlying, country-specific variables – perhaps "deep" institutional determinants[17] – jointly determine the level of financial development and macroeconomic volatility. In contrast, automatic stabilizers and discretionary policy still exhibit respectively stabilizing and destabilizing impacts on GDP growth. The interaction between CBI and discretionary fiscal policy passes the test as well, adding support to the possibility that coordination failures in the policy mix could be a key channel through which fiscal discretion increases output volatility.

3.3.3 Fiscal policy and private consumption volatility

While macroeconomic stabilization aims at reducing the volatility of output, welfare gains are often thought to be more closely associated with the stability of real private consumption.[18] Although output and consumption (real growth) volatilities are strongly correlated (unconditional

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[16] These authors discuss in detail the motivation for each of those controls.

[17] See Acemoglu *et al.* (2002).

[18] The argument is not so clear-cut, however, because output fluctuations are likely to be more tightly related to employment, and thereby leisure.

Table 4

Adding Control Variables
(Dependent variable: standard deviation of real GDP growth rate)

Item	1	2	3	4	5	6	7	8	9
Openness	0.450	0.807	0.862	0.910	0.923	0.844	0.881	–1.924	–3.081
	(0.66)	(1.08)	(1.21)	(1.28)	(1.30)	(1.24)	(1.34)	(–0.91)	(–1.31)
Automatic Stabilizers	–2.067***	–2.428***	–2.574***	–2.439***	–2.426***	–2.421***	–2.326***	–2.867**	–2.738**
	(–4.94)	(–5.14)	(–4.60)	(–4.37)	(–4.47)	(–4.17)	(–3.93)	(–2.48)	(–2.56)
Central Bank Independence	1.115*	1.031*	0.984	1.065*	0.885	1.382*	–1.931*	0.423	–1.689
	(1.85)	(1.69)	(1.58)	(1.67)	(1.33)	(1.84)	(–1.66)	(0.66)	(–1.26)
Financial Development	–0.782***	–0.820***	0.920**	–0.874**	–0.914***	–0.640**	–0.560*	0.005	0.066
	(–2.92)	(–3.03)	(–2.52)	(–2.57)	(–2.75)	(–1.95)	(–1.63)	(0.01)	(0.14)
Cyclical Fiscal Policy	0.117	0.046	0.013	0.039	0.051	0.126	–0.015	…	…
	(0.39)	(0.15)	(0.04)	(0.13)	(0.16)	(0.36)	(–0.04)		
Discretionary Fiscal Policy	0.676***	0.642***	0.639***	0.623***	0.711***	0.831***	–0.187	0.489***	–0.224
	(4.65)	(4.14)	(4.17)	(4.20)	(4.55)	(5.32)	(–0.49)	(2.73)	(–0.54)
Country Size (Log of GDP)	–0.018	–0.007	–0.006	–0.008	0.004	–0.027	–0.033	…	…
	(–0.28)	(–0.11)	(–0.09)	(–0.13)	(0.06)	(–0.44)	(–0.59)		
Mean Real GDP Growth	…	–0.131	–0.132	–0.117	–0.113	–0.081	–0.105	…	…
		(–1.44)	(–1.46)	(–1.21)	(–1.22)	(–0.83)	(–1.11)		
GDP per capita (PPP, in Log)	…	…	0.075	0.077	0.118	–0.015	0.032	…	…
			(0.39)	(0.41)	(0.68)	(–0.08)	(0.17)		
Terms-of-trade Volatility	…	…	…	0.020	0.023	0.015	0.010	…	…
				(0.96)	(1.12)	(0.91)	(0.71)		
Oil Dummy	…	…	…	…	–0.844	–0.792	–0.385	…	…
					(-0.98)	(–0.85)	(–0.46)		
Government Stability	…	…	…	…	…	–0.121	–0.078	…	…
						(–0.85)	(–0.63)		
Interaction: Discretion x CBI	…	…	…	…	…	…	1.783***	…	1.328**
							(2.63)		(2.11)
Country Fixed Effects (*F*-test)	…	…	…	…	…	…	…	2.94**	3.41**
Constant	–0.722	–0.852	–1.666	–1.722	–2.432	–0.571	0.854	–1.05	0.435
	(–0.41)	(–0.48)	(–0.64)	(–0.65)	(–1.01)	(–0.22)	(0.32)	(–0.56)	(0.21)
Observations	133	133	133	133	133	111	111	133	133
R-squared	0.50	0.51	0.51	0.51	0.52	0.58	0.63	0.35	0.35

Note: Robust *t*-statistics in parentheses. Time effects are not reported. Stars denote statistical significance at conventional levels (* for 10 per cent, ** for 5 per cent, and *** for 1 per cent).

correlation coefficient of 0.69 in our sample), the determinants of private consumption reflect individual choices that may be more directly responsive to opportunities to smooth consumption than to fiscal aggregates. Variance-decomposition exercises performed by Debrun, Pisani-Ferry and Sapir (2008) provide some support to that presumption, showing that automatic stabilizers – income tax payments and transfers – have not contributed to the decline in consumption volatility observed since the mid-1980s.

To model private consumption volatility, we follow equation (4). The results are qualitatively comparable to those found for output volatility, but with important nuances (Table 5).

Table 5

Fiscal Policy and Consumption Volatility
(dependent variable: standard deviation of real GDP growth rate)

Estimator:	**OLS**		**2SLS**			
Instrumented Variable:	**…**	**…**	**Automatic Stabilizers**	**Cyclical Fiscal Policy**	**Discretionary Fiscal Policy**	**Financial Development**
	1	**2**	**3**	**4**	**5**	**6**
Openness	1.032	1.059	1.417	1.050	1.227	1.348
	(1.11)	(1.19)	(1.59)	(1.10)	(1.28)	(1.43)
Automatic Stabilizers	–1.140*	–0.772	–2.046***	–1.307**	–1.091*	–1.263**
	(–1.94)	(–1.36)	(–2.61)	(–2.08)	(–1.63)	(–1.99)
Central Bank Independence	0.944	–2.886*	1.637	1.289	0.958	1.375
	(1.08)	(–1.86)	(1.62)	(1.51)	(1.08)	(1.58)
Financial Development	–1.429***	–1.196***	–1.394***	–1.384***	–1.633***	–2.228***
	(–2.94)	(–2.42)	(–3.15)	(–3.13)	(–3.23)	(–2.91)
Cyclical Fiscal Policy	–0.511	–0.606	–0.387	–1.11	–0.875*	–0.318
	(–1.15)	(–1.43)	(–0.87)	(–0.88)	(–1.81)	(–0.70)
Discretionary Fiscal Policy	0.525***	–0.606*	0.611***	0.526**	0.162	0.521**
	(2.51)	(–1.89)	(2.84)	(2.04)	(0.39)	(2.39)
Interaction: Discretion x CBI	…	2.118***	…	…	…	…
		(2.76)				
Constant	0.307	2.575**	–1.028	0.168	1.210	0.514
	(0.28)	(2.25)	(–0.80)	(0.13)	(0.78)	(0.44)
Observations	131	131	126	126	126	126
R-squared	0.35	0.39	0.35	0.35	0.33	0.34
Wu-Hausman Test (*p*-value)	…	…	0.24	0.65	0.14	0.06
Hansen J Test (*p*-value)	…	…	0.16	0.12	0.17	0.34
Weak Identification (*F*-stat)	…	…	27.14**	3.37	7.44	23.49**

Note: Robust *t*-statistics in parentheses. Time effects are not reported. Stars denote statistical significance at conventional levels (* for 10 per cent, ** for 5 per cent, and *** for 1 per cent).

First, the stabilizing effect of financial development is quantitatively large and statistically significant, confirming the important role of access to credit in providing consumption-smoothing opportunities to consumers. Second, automatic stabilizers continue to play a stabilizing role, although it is quantitatively smaller than for output (by roughly ½ in most regressions) and less precisely estimated. Instrumenting government size yields quantitatively similar results to the output volatility equation. However, these results are not robust to the introduction of additional control variables, even though the latter remain non-significant. Third, the discretionary dimension of fiscal policy is generally destabilizing; but simultaneity concerns remain. Fourth, the cyclical dimension of fiscal policy now consistently has the expected negative impact on consumption volatility although large estimation errors[19] remain. Still, the contrast with the output equations is

[19] Running the same regressions with the unrestricted indicator of cyclical policy indeed reduces $\hat{\phi}_2$ and increases errors.

striking enough to suggest that systematic stabilizing actions by fiscal policymakers seem to be more effective at stabilizing private consumption, possibly because they are better targeted. Alternatively, this could indicate that our indicator of cyclical fiscal policy also captures automatic stabilizers on the expenditure side, which are by design targeted at smoothing individual consumer income. Finally, the interaction between the CBI index and our measure of the discretionary dimension of fiscal policy remains strong and statistically significant.

4 Conclusions

This paper revisits the empirical link between fiscal policy and macroeconomic volatility (output and private consumption). Our analysis is based on a sample of 49 developing and advanced economies spanning the last 40 years. Results generally provide strong support for the view that fiscal stabilization operates mainly through automatic stabilizers. By contrast, fiscal policies systematically linked to cyclical conditions – be they pro- or counter-cyclical – do not appear to have a meaningful impact on output volatility. Finally, fiscal variability not systematically related to the business cycle generally seems to increase output and consumption volatility, possibly due in part to conflicts with monetary authorities. However, these latter two results may suffer from a simultaneity bias because certain sources of budgetary volatility (e.g., exchange rate, or inflation) are correlated with output volatility. Outside fiscal policy, financial development seems to exert a moderating influence on income and, even more so, on consumption growth, but robustness analysis indicates that it may proxy the role of other country-specific features not included in our analysis. As regards monetary policy, central bank independence is associated with lower volatility, provided that the interaction between monetary and fiscal policies is taken into account.

The analysis contributes to the relevant literature in two ways. First, we show that the effectiveness of automatic stabilizers extends well beyond the narrow sample of 20 OECD countries explored by Fatás and Mihov (2001) and apply with equal strength to a broader set of highly heterogeneous countries, including developing economies. Second, our robustness tests strike a note of caution on the causal nature of the relationship between discretionary policy activism and output volatility (Fatás and Mihov, 2003).

Broader policy implications emerge. First, fiscal policy is unambiguously effective at durably stabilizing the economy when it operates in the same way as automatic stabilizers (in a timely, reasonably predictable and symmetric way). Second, governments could also contribute to macroeconomic stability by subjecting the pursuit of other objectives (redistribution or efficiency) to a "stability test." Our results indeed suggest that a conscious effort to reduce conflicts among public finance objectives and between monetary and fiscal policies could reduce output volatility. One practical way to do so is to subject budget preparation to quantitative objectives or even binding constraints defined in terms of a structural balance or expenditure ceilings.

That said, an exclusive reliance on automatic stabilizers as the channel of fiscal stabilization has limits and potential drawbacks. In terms of the limits, recent experience suggests that government revenues endogenously respond to asset price cycles not necessarily synchronized with the business cycle. The induced swings in commonly estimated structural budget balances may be difficult to sustain politically, leading to pro-cyclical fiscal expansions when structural surpluses appear substantial (Alesina, 2000). Also, automatic stabilizers may be insufficient in case of acute crises, or when other policy instruments or consumption smoothing opportunities are constrained.

In terms of the drawbacks, the fact that large stabilizers come with large government sectors may adversely affect potential growth and the economy's resilience to shocks; and as our analysis suggests, it could also increase the likelihood of destabilizing fiscal shocks. In light of these limits

and drawbacks, a number of proposals to enhance fiscal stabilizers without increasing the size of government have been made. For instance, given the difficulty to design effective fiscal stimulus plans and the incomplete credibility of subsequent consolidations, automatic adjustments in selected tax rates or expenditure programs could be envisaged (see Baunsgaard and Symansky, 2009, for a survey and an assessment).

Looking forward, further research will need to address a number of pending issues. First, we see a need to explore more systematically the apparently strong impact of monetary-fiscal conflicts on macroeconomic volatility, as this could have important implications for the design of macro-fiscal frameworks. In particular, alternative measures of the quality of monetary policy should be envisaged. Second, we ignored the impact of expenditure and revenue composition on the size of fiscal stabilizers, possibly introducing measurement errors. Third, and related, more work is needed to improve measures of automatic stabilizers – particularly to have a better grasp of the role of expenditure composition – and of fiscal discretion.

APPENDIX

Data Sources

Data on government size (general government expenditure as a percentage of GDP), GDP per capita, openness to trade, public debt (percentage of GDP), private consumption, dependency ratio and urbanization rates are obtained from the IMF World Economic Outlook Database. Financial development, which is captured by the total stock of credit by deposit money banks to private sector as percentage of GDP, and indices of oil prices are obtained from the IMF International Financial Statistics. Data on political and electoral systems is from the Database of Political Institutions (Beck *et al.*, 2001). The political constraint index is from the POLCON database (Henisz, 2006). The index of government stability is from the International Country Risk Guide database. The index of Central Bank Independence is from Crowe and Meade (2008).

Automatic stabilizers, fiscal multipliers and $\hat{\phi}_1$

It is useful to illustrate the link between our estimates of the impact of automatic stabilizers and conventional measures of fiscal policy effectiveness. For simplicity, the starting point is a log-linear, backward-looking IS equation:

$$y = \lambda y_{-1} + \gamma_0 d - \gamma_1(i-\pi^e) - \gamma_2(e+\pi-\pi^*) + \gamma_3 y^* + \varepsilon \qquad \text{(A.1)}$$

$$\text{with } 0 < \lambda < 1 \text{ and } \gamma_{0,\ldots,}\gamma_3 > 0$$

where the output gap[20] y depends on the government budget deficit d, the real interest rate, the real exchange rate, external demand, and a random disturbance (all these with obvious notations). The decomposition between the cyclical and the cyclically-adjusted deficit (d^S) can be written as: $d = d^S - \alpha y$, where $\alpha > 0$ denotes the sensitivity of the budget deficit to the output gap. The cyclically-adjusted deficit itself reflects the cyclical policy and a residual: $d^S = -\beta y + \mu$, with $\beta > 0$. Hence, $d = -(\alpha+\beta)y + \mu$. Substituting for the budget deficit, we can write the long-run relationship ($y = y_{-1}$) as follows:

$$y = \frac{1}{(1+\gamma_0(\alpha+\beta)-\lambda)}\left[\gamma_0\mu - \gamma_1(i-\pi^e) - \gamma_2(e+\pi-\pi^*) + \gamma_3 y^* + \varepsilon\right] \qquad \text{(A.2)}$$

Clearly, greater automatic stabilizers, a more countercyclical discretionary fiscal policy and a greater fiscal multiplier all contribute to offset IS shocks:

$$\frac{\partial y^2}{\partial \in \partial \alpha} = \frac{\partial y^2}{\partial \in \partial \beta} = \frac{-\gamma_0}{(1+\gamma_0(\alpha+\beta)-\lambda)^2} < 0, \quad \frac{\partial y^2}{\partial \in \partial \gamma_0} = \frac{-(\alpha+\beta)}{(1+\gamma_0(\alpha+\beta)-\lambda)^2} < 0$$

To illustrate how these fiscal policy parameters relate to the estimated impact of automatic stabilizers on output volatility in the empirical model, let us write the variance of the output gap as:[21]

$$Var(y) = \left(\frac{1}{(1+\gamma_0(\alpha+\beta)-\lambda)}\right)^2 Var(\xi)$$

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[20] A similar relationship can be assumed to hold for the log of output.

[21] The same expression applies to the first difference of the output gap.

$$\text{with } \xi = [\gamma_0 \mu - \gamma_1 (i - \pi^e) - \gamma_2 (e + \pi - \pi^*) + \gamma_3 y^* + \varepsilon]$$

This implies:

$$\frac{\partial Sd(y)}{\partial \alpha} = \frac{-y_0}{(1+\gamma_0(\alpha+\beta)-\lambda)^2} Sd(\xi) < 0, \text{ and } \frac{\partial Sd(y)^2}{\partial^2 \alpha} = \frac{2y_0^2}{(1+\gamma_0(\alpha+\beta)-\lambda)^3} Sd(\xi) > 0$$

Stronger automatic stabilizers thus reduce the standard deviation of the output gap, but at a decreasing rate because stabilizers themselves run against the potency of exogenous fiscal impulses. This second-round effect likely explains why using the logarithm of government size (instead of its level) generally yields better statistical results. The link between $\hat{\phi}_1$ and the fiscal policy parameters can be written as:

$$\phi_1 = \frac{\partial Sd(y)}{\partial \log(\alpha)} = \frac{\partial Sd(y)}{\frac{1}{\alpha}\partial \alpha} = \frac{-\alpha y_0}{(1+\gamma_0(\alpha+\beta)-\lambda)^2} Sd(\xi) \tag{A.3}$$

Using equation (A.3), we can determine a range of values for $\hat{\phi}_1$ consistent with plausible calibration of the various parameters. As $Sd(\xi)$ is not observable, we simply assume – in line with recent empirical estimates[22] – that fiscal policy can stabilize about one third of shocks to ξ. We thus set $Sd(\xi)$ equal to 1.5 times our sample's measure of output variability. Assuming[23] that $\lambda = 0.6$, that γ_0 spans over [0.1; 1.5] and that government size can be anywhere between 0.2 and 0.6, the implied values for ϕ_1 lies between –2.64 and –0.48. We can also use equation (A.3) to calculate, for given government size, the range of values of fiscal policy multipliers implicit in our estimates of ϕ_1 Taking the sample average of government size of 0.38 and assuming that discretionary fiscal policy is acyclical ($\beta > 0$), the 95 percent confidence interval of ϕ_1 (*i.e.* [–2.81; –1.22])[24] maps into "fiscal multipliers" $((\gamma_0) (1+ \gamma_0 (\alpha+\beta) - \lambda)^{-1}$ between 0.4 and 1.5. Replicating this exercise for the 95 percent confidence interval of ϕ_1 using the standard deviation of the output gap as the measure of volatility (*i.e.* [–2.29; –0.92]), we obtain somewhat lower multipliers (between 0.4 and 1.0).

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22 For recent evidence, see Dolls, Fuest and Peichl (2009).

23 The value for the persistence parameter was set on the basis of the average value obtained in straightforward OLS estimations of equation (A.1) for a variety of advanced countries in our sample.

24 This refers to the regression (3) in Table 2 of the main text.

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FISCAL STABILISATION PLANS AND THE OUTLOOK FOR THE WORLD ECONOMY

Patrick Van Brusselen[*]

The topic of counter-cyclical fiscal policies has been put squarely under the spotlights since the outbreak of the current world-wide financial and economic crisis in September 2008. As governments have devised billion dollar stimulus packages, debates have raged in both the media and academia surrounding the effectiveness of such measures. This paper brings together material written on fiscal stabilisation plans in 2009 and a more recent macroeconomic projection for the world economy, which was made in early 2010. It attempts to provide an overview of the theory and empirical evidence on the effects of fiscal policies, placed in the current context of global recession and financial distress. It then goes on to address the question of where the world economy is headed given the now generally unsustainably high levels of public sector deficits and debt and given the possibility that the global financial crisis will have lasting adverse effects on potential output levels. This text is a very much abridged version of the full paper (80 pages in length) that was presented at the Bank of Italy's Fiscal Policy Workshop, held in Perugia on 25-27 March 2010. The full paper can be obtained upon simple email request sent to the author.

1 Economic stabilisation policies in theory

1.1 The basic fiscal policy setup

During the Great Depression years of the 1930s, John Maynard Keynes explained that the cause of the high unemployment was insufficient demand. Aggregate demand had fallen to a level below that necessary to ensure the full and optimal utilisation of the economy's productive capacities, in terms of both labour and capital utilisation. Left to themselves, economies could remain in such a state of insufficient demand indefinitely. The answer to this deficiency was for the government to boost demand and bring the level of aggregate demand up to the level of optimal aggregate supply, thus ensuring full employment and stable inflation.

Government intervention in the economy happens through both the expenditure side and the income side. On the expenditure side, government outlays are, in part, linked to mechanisms laid down in laws. These public expenditures are commonly referred to as non-discretionary or entitlement spending. Other spending items are called discretionary, because governments can decide to change the level of spending on these items without going through changes in legislation. Most income is usually raised through taxation rates, which are usually laid down in laws and are thus non-discretionary.

Changes in the business cycle have a direct influence on government income and expenditure levels, even without any changes in discretionary spending. Indeed, in a recession, unemployment levels rise and lead to automatic increases in unemployment benefits paid out. This in turn tends to mitigate the effect of the cyclical downturn on income and employment. Similarly, a recession can lead to a decline in household incomes and push households into lower average tax brackets. This tends to increase after-tax incomes and mitigate the effect of the cyclical downturn on income and employment, while leading to reduced tax receipts for the government.

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However, alongside the working of the government's automatic fiscal stabilisers, a government can also intervene directly in the economy through discretionary fiscal policy, enhancing or counterbalancing the effects of automatic stabilisers.

1.2 Insights from the Hicksian IS-LM analysis

In discussing the effectiveness of monetary and fiscal policy, two polar cases can be analysed in the standard Hicksian IS-LM framework. In this framework, recall that the IS curve or schedule represents the combinations of interest rates and aggregate output levels for which the goods market is in equilibrium. It is negatively sloped because a higher level of the interest rate reduces investment spending. The LM curve represents the combinations of interest rates and aggregate output levels for which real money balances (and the bond market) are in equilibrium. It is positively sloped because a higher level of the interest rate reduces the demand for real money balances and an increase in aggregate income raises the demand for real money balances.

First, there is the *classical case* in which the LM curve becomes vertical. A vertical LM schedule signals that demand for real money balances is completely insensitive to the interest rate. This is called the classical case because it represents the situation corresponding to the *quantity theory of money*, which states that for a given price vector, the level of real output is completely determined by the supply of nominal money balances. In this situation, fiscal policy is completely ineffective in stimulating the economy while monetary policy can have a maximum effect on output. Indeed, an increase in the money supply shifts the LM schedule out to the right, leading to a strong increase in output and a parallel decline in the interest rate. An increase in government expenditure, which shifts the IS curve up and to the right, would lead to a complete crowding out of private spending, thus pushing up the interest rate and leaving the output level unchanged.

Second, there is the case of the *liquidity trap*, in which the LM curve becomes horizontal and where changes in the quantity of money are unable to shift it. In this case, households are prepared to hold any amount of real money balances rather than increase their portfolio balance of less liquid bonds. Changes in the stock of money in circulation have no effect on the LM curve, implying that monetary policy no longer affects the interest rate, no longer affects investment and savings decisions, and no longer affects output and income. This is the situation that presents itself when nominal interest rates fall to their zero lower bound. Households then prefer to hold cash balances rather than invest in less liquid bonds that yield zero interest. Note that an economy can also find itself in a liquidity trap with a positive interest rate, as in the case of a seizing up of credit linked to increased perceptions of market or counterparty risk. If this situation leads to lower private final demand, fiscal policy can be relatively potent, as an increase in government spending will not lead to any significant crowding out of private consumption and investment.

Having reviewed the potential for economic stimulus through fiscal policy in the case of the *classical model* and in the case of a *liquidity trap*, we now turn to a summary analysis of fiscal policy in the usual IS-LM framework. An increase in government spending or a decline in taxation brings about an increase in both output and in the interest rate. For any rise in public spending, equilibrium output must rise by the change in spending multiplied by the value of the fiscal spending multiplier. In an open economy operating in a flexible exchange rate regime, the rise in the interest rate would lead to a rise in the external value of the country's currency and to a deterioration in the country's current account balance. In the absence of any crowding out and upward pressure on the interest rate, the economy's equilibrium output would rise unambiguously.

1.3 Bridging the divide with the New Keynesian perspective

In a noteworthy attempt to breach the divide that has appeared between various strands of macroeconomic approaches since the beginning of the global financial crisis, recent literature has indicated that though differences do exist between more traditional Keynesian and the New Keynesian approaches, these differences can often be largely explained in terms of modelling assumptions.

Indeed, recent research indicates that even in the framework of a modern, state-of-the-art New Keynesian macroeconomic model, the basic findings of the more traditional Keynesian perspective on the usefulness of public stabilisation policies still hold (Woodford, 2010). This research indicates that both monetary and fiscal policies are essential policy tools, but that their effectiveness is state-dependant, that it changes with their degree of coordination, and that timing and expectations matter. The New Keynesian macroeconomic models would produce government spending multipliers of around unity when monetary policy is coordinated with fiscal policy, ensuring that real interest rates do not rise. If monetary policy does not stabilise real interest rates and if the economy is operating around its potential output level, real interest rates would rise and the public spending multiplier would fall below one, possibly even becoming nil or negative. The multiplier can however be significantly larger than one in these models, inasmuch as the economy is operating below potential and if monetary authorities act to reduce real interest rates. The research finds that a large public multiplier is to be expected in the case where the nominal interest rate falls to the zero lower bound, as the higher inflation generated by public spending would reduce the real interest rate.

The research also attempts to shed light on the question of the optimal size of discretionary public spending plans in the face of a recession, supporting the view that the optimal size of a public stabilisation plan depends on the output loss relative to the economy's potential and on perceptions as to the timing and duration of the increase in public spending. Indeed, confirming other recent findings (Krugman, 2008), the research indicates that the larger the negative output gap, the larger the optimal policy response: the fiscal stabilisation package should go a long way in closing the output gap if the gap is large, but should remain much more limited in the case of a less pronounced or cyclical downturn. At the same time, the effectiveness of a public spending programme depends on the duration of the rise in spending. If the increase in public spending is expected to persist even after a recovery in private sector output, the expected increase in real interest rates would once again reduce the potency of the fiscal stabilisation plans.

2 Optimal design of fiscal stabilisation programmes

Standard economic theory indicates that in situations where there exist developed and functioning financial markets and an independent central bank with the appropriate know-how, monetary policy is usually the best response to an effective or anticipated downturn in economic activity, due to the speed with which monetary authorities can modify market interest rates. Even though it may take several quarters before the full impact of a change in the monetary policy stance is felt in the economy, the first effects materialise quite rapidly and implementation lags are, in any case, shorter than those usually associated with budgetary processes.

In all cases, an economic downturn will also lead to an autonomous counter-cyclical fiscal policy through the working of the automatic fiscal stabilisers. However, if the expected downturn appears to be particularly sudden and large, there is a case that can be made for an accompanying expansionary and discretionary fiscal policy. This is particularly relevant in situations where monetary authorities have all but exhausted the scope for conventional monetary policy intervention through reductions in policy interest rates. It has also been shown to be the optimal

response in the face of uncertainty as to the true impact of monetary and fiscal policy options. Furthermore, recent research indicates that an active discretionary fiscal policy based on counter-cyclical public spending can be more important for growth than a fiscal policy based only on automatic fiscal stabilisers.

When monetary policy is deemed insufficient to stabilise the economy on its own, or in the case of a liquidity trap, an expansionary fiscal policy should be devised so as to correspond to a number of basic principles. There are the now well-known three "Ts": an expansionary fiscal policy should be timely, targeted and temporary (Elmendorf and Furman, 2008). Then, there are the three "Cs": an expansionary fiscal policy should also be contingent, credible and coordinated.

All in all, poorly crafted fiscal stabilisation packages might result in too little economic boost coming too late, and lead only to rising interest rates and increased public borrowing and debt. In this case, having no fiscal stimulus could be better than a badly thought-out stimulus plan, in limiting the present value of the sum of current and future output losses.

3 Empirical evaluations of fiscal multipliers

The following section presents the values of fiscal multipliers that are found through the historical narrative record method, through the analysis of the impulse-responses of variable auto regressive models and through macroeconomic model simulation experiments.

Evidence on multipliers from empirical macroeconomic models leads to a number of important conclusions. Looking at all the results compiled from narrative records, VAR impulse-responses, econometric models and general equilibrium models, the range of multipliers is very wide indeed. Government spending multipliers vary between –3.8 and +3.8; tax cut multipliers vary between –4.8 and +3.0.

Results vary most widely for multiplier estimates derived from VAR models. However, it has been shown that estimates are very sensitive to specifications and assumptions in all types of empirical models. Studies have highlighted the important role of the monetary policy reaction function in multiplier evaluations, underscoring the necessity of coordination between fiscal and monetary policies.

Results also indicate that exchange rates play a crucial role in open-economy models, underscoring here the importance of international policy coordination. Finally, another set of model features or assumptions are found to be crucial in deriving multiplier estimates; these are linked to the way the model handles liquidity constraints, credibility issues regarding long-term fiscal balance, forward-looking behaviour and rationality issues.

4 An evaluation of the effects of the euro area recovery plan of 2008

This section presents a tentative evaluation of the national Recovery Plans put forward by individual EU governments in the wake of the European Commission's Recovery Plan proposal. The macroeconomic effects of the effective implementation of these plans have been evaluated with the NIME model. The main effects of the implied Euro area Recovery Plan are presented in terms of deviations from a baseline scenario that does not include these measures.

The European Commission's *European Economic Recovery Plan* of 26 November, 2008, called for the swift implementation of a public spending and/or tax cut programme of roughly 1.5 per cent of the EU's GDP (Commission, 2008). This would come in the form of various types of aid for business investments (e.g., through direct aid and loan guarantees), other public works

Table 1

Range of Fiscal Multiplier Estimates for the US

Item	Narrative Record Models		VAR/SVAR models		Econometric Models		GE / DSGE Models	
	Low	High	Low	High	Low	High	Low	High
Public spending multipliers	1.0	1.4	–3.77	3.68	–0.6	1.6	0.0	3.9
Tax cut multipliers	-	3.0	–4.75	2.64	–0.4	1.3	–2.63*	–0.23*

* Results for a large economy from the IMF's Global Fiscal Model (see Botman *et al.*, 2006).

programmes, tax cuts aiming to boost consumption expenditure, and cuts in social security contributions aiming to boost labour demand. The recovery plans could allow EU Member States to engage in temporary fiscal stabilisation (deficit spending) and increase their budget deficits without violating the terms of the EU's revised Stability and Growth Pact, as the Pact's "exceptional circumstances" clause allows countries to post temporary and limited budget deficits[1] as long as their medium-term cyclically-adjusted budgetary position is projected to return to balance or surplus.

On 2 December, 2008, the EcoFin Council approved the Commission's proposed Recovery Plan, based on a proposal of an overall 1.5 per cent of GDP, EU-wide fiscal stimulus package. By late February 2009, the sum of fiscal stimulus (public spending and tax cut) measures put forward by EU governments was estimated to reach 106 billion euros at the level of the 27 EU Member States (Saha and Von Weisäcker, 2009). If one adds to this figure the 263.8 billion euros in measures put forward in the form of government loan and credit guarantees for non-financial enterprises, one comes up with a total EU-wide commitment of 369.8 billion euros. For the euro area[2] (Euro-12), direct fiscal measures are estimated to total 73 billion euros. Additional credit and loan guarantees to non-financial corporates could provide another 169.85 billion euros, leading to a grand total of 271.6 billion euros or 3 per cent of the estimated nominal GDP of 2008 at the Euro-12 level.

Though the total figure of 369.8 billion euros budgeted in the framework of the economic recovery plans of the 27 EU Member States is impressive, a large part of this sum consists of credit and loan guarantees extended by national governments to the non-financial corporate sector. These guarantees and credit lines constitute large contingent liabilities for governments; however, a figure for an effective fiscal stimulus which includes this support most likely overestimates the true impact of the stimulus plans in terms of their potential impact on real economic output and employment.

In view of assessing the potential real output effects of these plans, we assume that the effective stimulus consists of the announced fiscal spending and tax cut measures, to which we add half of the amount budgeted under the heading of credit lines and loan guarantees to the

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1 See Article 1 of Council Regulation (EC) No 1056/2005 on exceptional excessive deficits.

2 The NIME model's "euro area" comprises the following twelve countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Spain and Portugal.

Table 2

Main Effects of the Euro Area Economic Recovery Plan
(deviations from baseline level in percent, except where otherwise noted)

Item	2009	2010	2011	2012	2013	2014	2015
Real GDP	0.77	0.62	0.45	0.31	0.19	0.11	0.06
Real private consumption	0.23	0.18	0.10	0.05	0.00	–0.04	–0.08
Employment	0.14	0.11	0.06	–0.02	–0.07	–0.10	–0.10
Employment *(difference, thousands of persons)*	200	163	84	–25	–107	–150	–149
Consumer price inflation rate *(difference, percent)*	0.00	0.22	0.50	0.76	0.99	1.19	1.35
Nominal short term Interest rate *(difference, percent of GDP)*	0.17	0.34	0.44	0.47	0.44	0.39	0.33
Nominal effective exchange rate	–0.20	–0.58	–1.00	–1.49	–1.90	–2.18	–2.35
Fiscal position *(difference, percent of GDP)*	–0.60	–0.67	–0.75	–0.85	–0.92	–0.98	–1.03
Current account position *(difference, percent of GDP)*	–0.19	–0.21	–0.28	–0.37	–0.46	–0.53	–0.58

No international fiscal policy coordination: fiscal stimulus is simulated within the Euro-12 area only.
Short-term interest rates are endogenously determined by a Taylor-type rule.
Exchange rates are endogenously determined by an uncovered interest parity condition; a minus (–) sign indicates currency appreciation.
No long-run fiscal solvency rule is imposed.

non-financial business sector. For the Euro-12 area, this leads to a total effective economic stimulus package of 157.93 billion euros, representing 1.7 per cent of the Euro-12's nominal GDP of 2008.

In evaluating the macroeconomic effects of the euro area economic recovery package, we assume the presence of both inside and outside implementation lags, leading to a spend-out schedule in which one half of the package impacts the economy in 2009 and the remaining half affects the Euro-12 economy in 2010. For the sake of simplicity, we assume that the entire increase in public spending comes in the form of increased consumption of goods and services and that the reductions in taxes take the form of temporarily lower taxes on labour income. In both cases, we opt for policy measures that are associated with what can be viewed as relatively high short-run multiplier effects; the simulation thus arguably provides an upper bound on the macroeconomic effects that can be expected from the NIME model for the Euro-12 economic stabilisation plan.

Finally, the recovery plans are simulated using a baseline projection that corresponds to a projection of the world economy in the current economic environment. This allows the macroeconomic effects of the stimulus plan to capture possible state-dependant effects from prevailing low inflation, low – but still positive – nominal short-term interest rates, rising unemployment, and rising household saving rates in the Euro-12 area.

The main macroeconomic effects of the euro area fiscal stabilisation plan are presented in Table 2. In the first year of its implementation, the plan would raise Euro-12 GDP by 0.77 per cent with respect to the baseline. The initial effect of the euro-12 recovery plan would be to increase private sector output, creating about 200 thousand jobs in response to the rise in public consumption. The ensuing rise in household income then goes on to raise private consumption expenditure.

The second half of the stimulus package affects the economy in 2010, raising GDP by 0.62 per cent. This lesser impact is due to a number of factors. First, the somewhat higher inflation reduces the size of the real amount of stimulus in 2010. Secondly, a larger part of the stimulus package leaks out in the form of higher real imports, which produce a deterioration in the area's current account balance. Finally, the fiscal stimulus leads to a slight increase in nominal interest rates as the area's negative output gap is reduced and as inflation picks up.

Over the period 2011-15, the effects of the stimulus package on output decline, and real GDP gradually falls back toward its baseline level. As of 2012, higher inflation, higher interest rates and import leakages reverse the initial employment gains. The area's fiscal position deteriorates by a full percentage point of GDP while the area's current account deteriorates by 0.58 percentage points of GDP.

5 Where is the world economy headed? Insights from a model-based medium-term projection

In this section, a tentative projection for the world economy is proposed for the period 2010-18. Though there are an unusually high number of risks and uncertainties surrounding the unwinding of the global financial and economic crises, the NIME model is used to project a baseline scenario for the world economy over the coming years, conditional to a number of technical assumptions. NIME is a macroeconometric model with microeconomic foundations for consumption and investment decisions, short-run wage and price stickiness, stock-flow interactions and a long-run supply-driven "steady-state" equilibrium. The projection indicates that although fiscal stimulus plans will undoubtedly provide a temporary boost to world output, they will also most likely prove to be insufficient to prevent a sharp decline in real GDP growth rates and will not allow the major economies of the world to escape falling into a period of very low rates of inflation.

5.1 Evolution of the structural variables underlying the euro area economy

The results of the macroeconomic projection are determined in part by the model's reactions to past cyclical conditions, and in part by the model's long-run structural trends. While the short run is mainly determined by cyclical movements, the fundamental determinants of the projection's medium-term results are to be found in such variables as the evolution of an area's demographics, the evolution of hours worked per person, the evolution of trend hourly labour productivity and structural unemployment.

Table 3 presents the evolutions of the structural variables underlying the projection results for the euro area. Strikingly, it indicates that all of the core determinants of trend real private sector output are projected to lead to reduced growth rates of real output and GDP over the 2010-18 period.

Over the 1997-2007 period, demographics made a positive contribution to euro area growth. Indeed, over that period, total population increased at an annual average rate of 0.5 per cent.

Table 3

The Euro Area: Main Structural Developments Underlying the Projection Results

Item	Average 1997-2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average 2010-18
1. Population	**0.5**	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	**0.2**
2. Working-age population	**0.3**	0.4	0.3	0.1	0.0	–0.1	–0.2	–0.2	–0.2	–0.2	–0.2	–0.2	**–0.1**
3. Trend labour supply *(persons)*	**0.9**	0.8	0.6	0.5	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.1	**0.2**
4. Trend hours worked per person, private sector	**–0.5**	–0.4	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	**–0.5**
5. Trend total hours worked, private sector	**0.7**	0.5	–0.3	–0.9	–1.0	–0.2	0.1	0.1	0.2	0.1	0.0	–0.1	**–0.2**
6. Trend hourly labour productivity, private sector	**2.0**	1.2	–2.0	2.0	1.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**0.8**
7. Trend private sector potential output	**2.7**	1.6	–2.4	1.1	0.5	0.3	0.6	0.6	0.7	0.6	0.5	0.4	**0.6**
8. Trend inflation rate (consumption deflator)	**1.8**	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	**1.7**
9. Structural rate of unemployment *(level)*	**8.2**	8.1	8.1	8.5	9.0	8.8	8.6	8.5	8.4	8.3	8.2	8.2	**8.5**

All figures reported are year-on-year growth rates of yearly averages, unless otherwise specified.

Population growth temporarily reached 0.7 per cent in 2004 but has since been in steady decline. Population is expected to have increased by just 0.4 per cent in 2009 and growth rates are projected to fall to no more than 0.1 per cent per annum by 2015. The working-age population fared worse that total population: the working-age population increased on average by 0.3 per cent per year over 1997-2007, but growth is expected to have fallen to just 0.3 per cent in 2009. The level of the working-age population should remain more or less flat in 2010-11 and decline as of 2012. The area's labour supply fared somewhat better over the recent past, rising at an annual average rate of 0.9 per cent over 1997-2007. The labour supply is expected to have increased by 0.8 per cent in 2008 and 0.6 per cent in 2009 and is projected to expand at an annual average rate of 0.2 per cent over 2010-18.

Figure 1

Euro Area Private Sector Hourly Labour Productivity
(index of trend, year 2000=100)

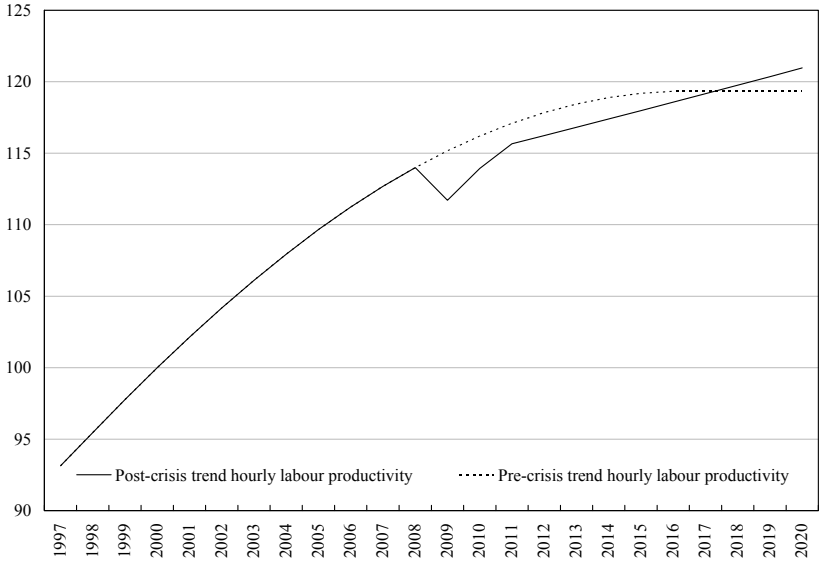
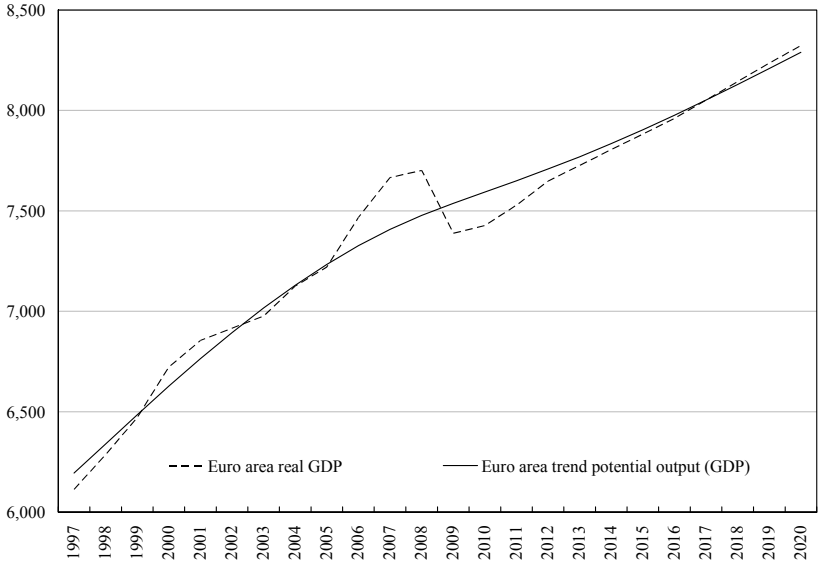


Figure 2

Euro Area Output Gap Projection
(levels, billions of chained (2000) euros)



Total hours worked per person employed in the private sector followed a marked trend decline of –0.5 per cent per year over the 1997-2007 period. This steadily declining trend has been apparent since at least the early 1970s and is assumed to persist through 2018.

As for private sector trend labour productivity growth,[3] Table 3 indicates that trend productivity increased at an annual average rate of 2 per cent over 1997-2007. However, this average figure hides the fact that trend private sector labour productivity growth was gradually declining, from 2.6 per cent growth in 1997 to just 1.3 per cent in 2007. Labour productivity growth is estimated to have subsequently fallen to 1.2 per cent in 2008. Then, due to the specific effects that the global financial crisis[4] (GFC) is thought to have had on such factors as investment, capital utilisation rates and government-backed labour hoarding schemes in 2009, productivity is expected to have declined by 2 per cent in 2009. After 2009, it is assumed that labour

[3] Private sector labour productivity, measured in terms of units of real output per hour of labour services, is our preferred indicator of the evolution of euro area labour productivity, due to the methodological and practical difficulties involved in attempts to arrive at an economically relevant and accurate measure of deflated non-market public sector output and productivity.

[4] The term "global financial crisis" refers to the difficulties that the world economy faced as of August 2007, linked to the outbreak of global financial market turmoil and world-wide downturns in economic activity.

productivity will regain some of the lost ground, rising by 2 per cent in 2010 and 1.5 per cent in 2011, as the private sector cuts costs and rationalises its production processes in order to expand output and increase profit margins. However, these relatively robust increases in labour productivity are assumed to be only a short-term burst, as labour productivity is further assumed to settle on a new trend growth rate of 0.5 per cent per year over the 2012-18 period. As shown in Figure 2, this positive, albeit historically low, rate of trend labour productivity growth, in combination with the trends that are assumed for the labour supply and for hours worked per person, will, however, ensure that the euro area's output gap closes by the end of the projection period.

The subject of the trend rate of labour productivity growth after the onset of the GFC continues to be the object of much debate, but it seems that a relatively wide consensus has formed around the notion that labour productivity in the euro area will have declined significantly in the immediate aftermath of the global financial crisis. The line of reasoning is that the crisis will durably affect the cost and availability of private funds for investment, thus reducing the number of investment projects that remain profitable and that are effectively financed. This could then affect the area's overall rate of technological progress and innovation, leading to lower rates of output growth than would have been observed had capital been more easily available.

Furthermore, it is thought that the GFC will also have significant and persistent effects on the labour market, as college graduates face greater difficulties in finding first-time jobs and as workers lose their positions, thus letting valuable human capital depreciate. The loss in human capital is expected to persist throughout the projection period, as relatively low GDP growth through 2018 pushes up unemployment and leads to longer spells of unemployment, which are typically associated with a loss of skills and an increase in structural unemployment. Table 3 indicates that the current economic crisis is expected to raise the structural rate of unemployment from 8.1 per cent of the labour force in 2008 to 9 per cent in 2011. The structural unemployment rate should then gradually decline, reaching 8.2 per cent by 2018, thanks to a steady decline in the working-age population and a slower expansion of the labour supply.

5.2 The outlook for the euro area over the 2011-18 period

Over the 2011-18 period, the euro area's potential real GDP is projected to rise at a yearly average rate of about 0.8 per cent. As indicated in Table 3, this should come mainly from a rise in trend hourly labour productivity, with a marginal contribution from an increase in the labour supply, while the declining trend of hours worked per person per year will continue to weigh negatively on potential output, as it has done at least since the early 1970s.

Real GDP growth is projected to pick up significantly in 2011 and 2012, progressing by respectively 1.4 per cent and 1.6 per cent over the year. At the same time, total final domestic demand should fall, led by significant declines in both private consumption expenditure and household investment in residential buildings. Hence, the rise in real GDP can only be attributed to the strong upswing in real net exports.

Though private consumption levelled out in 2010 thanks to the massive support for final demand from both fiscal and monetary policy, household expenditure is projected to resume its decline as of 2011; this decline should then extend right through to the end of the projection period. Household consumption is negatively affected by the massive decline in the volume of labour services demanded over the 2009-11. This reduction in the demand for labour combines with a significant decline in hours worked per person and, at best, modest increases in real wage rates to limit the rise in household real disposable income and to raise the household saving rate.

Figure 3

Contributions to Real GDP Growth in the Euro Area
(percent)

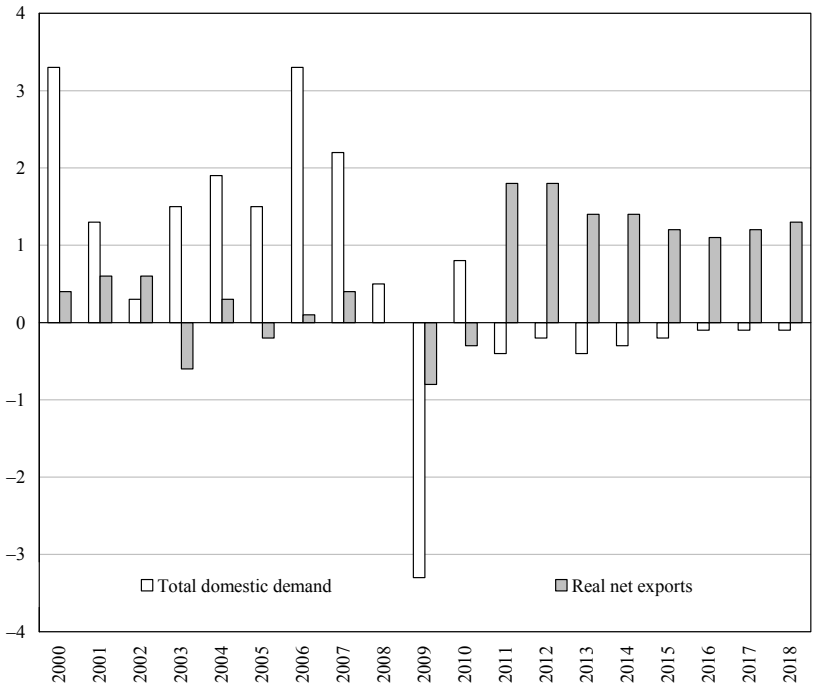
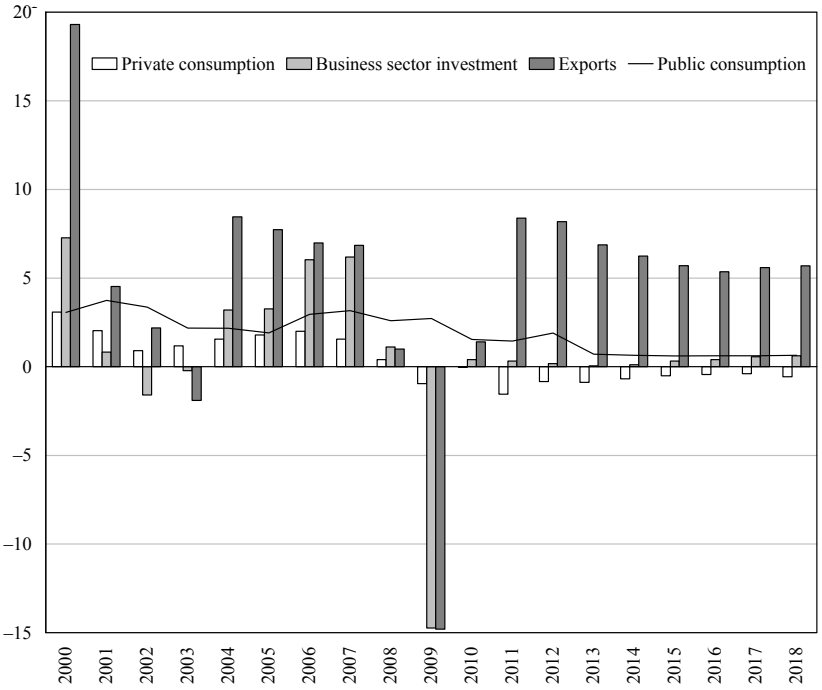


Figure 4

Selected Components of Demand in the Euro Area
(y-o-y, percent change)

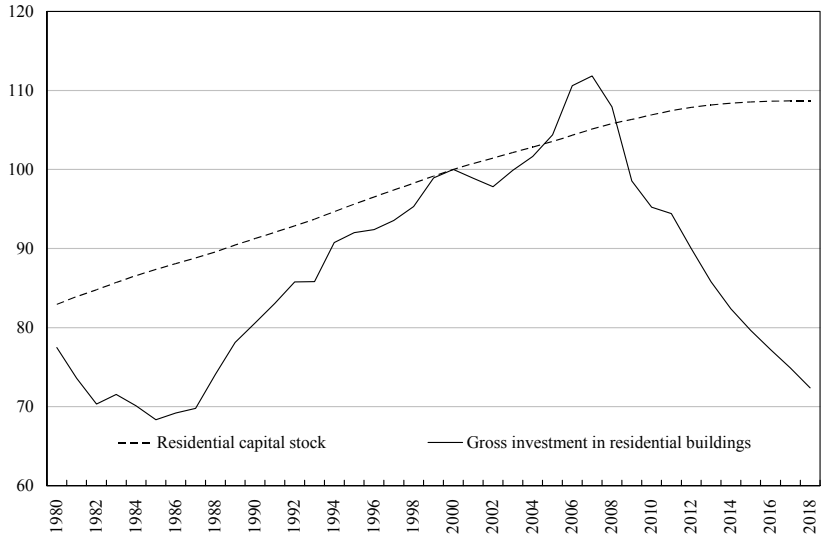


Tepid growth in household take-home wage rates stems largely from an expected slowdown in trend labour productivity growth. Indeed, real wage growth is indexed on the evolution of long-run labour productivity, which will tumble from a growth rate of 1.2 per cent in 2008 to a growth rate of just 0.5 per cent after 2011. This lower expected rate of trend labour productivity growth reflects the historical long-run trend of the euro area's real GDP growth rate, as well as the current widely held view that the GFC will lead to a one-off decline in the level of labour productivity and a slight permanent decline in the growth rate of labour productivity (see Table 3, item 6). The GFC is expected to have a negative effect on human capital – knowledge and skills – through an increase in the structural unemployment rate. It could also weigh on the other determinants of total factor productivity by curtailing business expenditure on research and development, by reducing innovation and investment, by generating generally less buoyant "animal spirits" and by reducing entrepreneurial tolerance to risk-taking. Figure 1 shows how the global financial and

economic crisis led to a revision in the assumptions we make for trend hourly labour productivity, leading to a decline in the level of the euro area's potential real GDP to below what it was expected to have been previous to the GFC.

Figure 5

Residential Investment and the Housing Stock
(index, year 2000=100)



Household investment in residential buildings is also projected to decline significantly over the 2011-18 period. This decline comes on the back of a steady decline in population growth, and marks the return of investment levels back towards what they were previous to their massive rise over 1990-07. As shown in Figure 5, the projected growth rates of gross residential investment should lead to a decline in the growth of the stock of residential buildings, which is expected to fall to about nil by 2018.

Business sector investment is projected to recover only very slowly from its precipitous decline of nearly 15 per cent in 2009. After a first small rise of 0.4 per cent in 2010, growth in business sector investment should remain very subdued, picking up only weakly and towards the end of the projection horizon as the euro area's output gap is closed and as rising output and depreciation push capacity utilisation rates back up to more normal levels. Hence, over the 2011-18 period, business gross fixed capital investment is projected to increase at an average rate of no more than 0.3 per cent per year.

With household income and consumption straining to progress over the 2011-18 period, with high unemployment rates and a rise in structural unemployment, and with private sector capacity utilisation rates still below normal levels over the first years of the projection period, pricing power and upward price pressure is projected to be mild in the euro area. After a 0.8 per cent yoy rise in 2010, consumer prices are projected to pursue a very gradual rise back towards the ECB's preferred range of inflation, slightly below the 2 per cent mark.

We already noted that euro area GDP growth over the 2011-18 period is projected to be underpinned by the area's real net exports, while domestic demand should recover only painstakingly slowly from the "Great Recession" of 2009. After plunging 14.8 per cent in 2009, export volumes are forecast to begin to recover in 2010, rising by 1.4 per cent on the year. Exports are then projected to increase significantly over the next two years, rebounding first from the low level to which they had fallen, and then rising moderately as the euro area's foreign effective demand increases.

Export growth is not projected to be underpinned by favourable exchange rate developments. Indeed, while the euro currency is projected to depreciate against the US dollar and the Japanese yen over the projection period, it should appreciate against other world currencies. This would then translate into a moderate nominal effective exchange rate appreciation over 2011-18.

Table 4

Baseline Projection Results for the Euro Area

Item	Average 1997-2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average 2010-2018
I. Real aggregate demand and supply												
1. Private consumption	**2.0**	–0.9	–0.0	–1.5	–0.8	–0.9	–0.7	–0.5	–0.4	–0.3	–0.4	**–0.6**
2. Government consumption	**1.9**	2.4	1.1	2.0	2.2	1.2	0.8	0.6	0.6	0.7	0.9	**1.1**
3. Gross fixed capital formation	**3.2**	–10.2	–0.7	0.1	–1.0	–1.1	–0.8	–0.5	–0.3	–0.1	–0.1	**–0.5**
- of which: residential buildings	**1.8**	–8.7	–3.4	–0.9	–4.7	–4.7	–3.9	–3.2	–2.8	–2.6	–2.8	**–3.2**
- of which: business sector	**4.2**	–14.7	0.4	0.3	0.2	–0.0	0.0	0.2	0.3	0.5	0.5	**0.3**
4. Exports	**6.7**	–14.8	1.4	8.4	8.2	6.4	5.4	5.0	4.8	4.9	5.0	**5.5**
5. Imports	**6.8**	–12.5	3.2	–0.9	–0.4	0.2	0.2	0.6	0.8	0.9	0.9	**0.6**
6. Gross Domestic Product	**2.3**	–3.9	0.5	1.4	1.6	0.9	0.8	0.9	0.9	1.0	1.1	**1.0**
7. Output gap *(deviation of GDP from trend GDP, percent)*	**0.5**	–2.0	–2.1	–1.5	–0.6	–0.4	–0.4	–0.3	–0.2	–0.1	0.1	**–0.6**
8. Contributions to real GDP growth												
a) Total domestic expenditure	**2.2**	–3.3	0.8	–0.4	–0.2	–0.4	–0.4	–0.2	–0.1	–0.0	–0.0	**–0.1**
b) Net exports	**0.1**	–0.8	–0.3	1.8	1.8	1.4	1.2	1.1	1.0	1.0	1.1	**1.1**
II. Deflators												
1. Private consumption	**1.7**	0.0	0.8	0.6	0.7	1.0	1.1	1.2	1.2	1.4	1.5	**1.1**
2. Exports	**0.6**	0.3	0.2	–0.0	–0.2	–0.5	–0.7	–0.9	–1.1	–1.3	–1.5	**–0.7**
3. Imports	**1.0**	–5.1	2.8	–0.0	0.1	0.1	0.3	0.4	0.4	0.6	0.6	**0.6**
4. Gross domestic product	**1.7**	1.5	0.0	0.1	0.2	0.4	0.6	0.7	0.7	0.7	0.7	**0.4**
III. Financial Markets												
1. Short-term interest rate *(level)*	**3.4**	1.2	1.2	1.1	1.3	1.6	1.8	2.0	2.2	2.5	3.0	**1.9**
2. Long-term interest rate *(level)*	**4.6**	3.6	2.9	2.9	3.0	3.1	3.2	3.4	3.5	3.6	3.9	**3.3**
3. Spot exchange rate, euro/USD *(level x 100)*	**90.8**	71.8	76.3	79.8	82.7	84.2	84.8	84.6	83.9	82.9	81.8	**82.3**
4. Spot exchange rate, euro/USD *(+: depreciation)*	**–0.3**	5.6	6.3	4.5	3.8	1.8	0.7	–0.2	–0.9	–1.1	–1.4	**1.5**
5. Nominal effective exchange rate *(+: depreciation)*	**–3.4**	–9.1	0.4	–0.8	–1.1	–2.3	–2.9	–3.6	–4.2	–4.2	–4.1	**–2.5**
6. Real effective exchange rate *(+: depreciation)*	**1.1**	–5.8	2.1	1.2	1.3	0.4	0.2	–0.0	–0.2	0.1	0.6	**0.6**

Table 4 (continued)

Baseline Projection Results for the Euro Area

Item	Average 1997-2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average 2010-2018
IV. Labour Market												
1. Labour supply	**1.1**	0.2	0.2	0.2	0.0	0.4	0.4	0.4	0.4	0.3	0.2	**0.3**
2. Employment, in hours	**0.9**	–3.5	–0.9	–0.9	0.6	1.0	1.0	0.8	0.5	0.2	–0.1	**0.2**
. of which private sector	**0.9**	–3.9	–1.2	–1.3	0.7	1.3	1.2	1.0	0.6	0.2	–0.2	**0.3**
3. Unemployment rate *(percent of civilian labour force)*	**8.7**	9.4	10.4	11.3	10.4	9.4	8.4	7.5	7.0	6.6	6.5	**8.6**
4. Nominal wage rate, private sector	**2.7**	0.9	1.6	1.0	0.4	0.5	0.9	1.2	1.4	1.6	1.6	**1.1**
5. Real take-home wage rate, private sector	**0.9**	2.9	0.9	0.1	–0.4	–0.5	–0.2	0.0	0.2	0.2	0.1	**0.0**
6. Real producer wage rate, private sector	**1.2**	–0.1	1.4	0.9	–0.3	0.1	0.3	0.6	0.8	0.9	1.0	**0.6**
7. Contemporaneous labour productivity, private sector	**1.4**	–0.6	1.5	2.3	1.0	–0.1	–0.1	0.1	0.4	0.8	1.2	**0.8**
V. Household sector												
1. Total real means	**3.4**	2.8	0.3	–0.7	–0.5	–0.7	–0.5	–0.4	–0.3	–0.3	–0.4	**–0.4**
- of which: real disposable income	**1.8**	–0.8	–0.1	–1.7	–1.0	–0.9	–0.7	–0.5	–0.4	–0.4	–0.5	**–0.7**
2. Net saving by households *(percent of disposable income)*	**9.6**	9.3	9.7	9.5	9.3	9.2	9.2	9.2	9.2	9.2	9.1	**9.3**
VI. Fiscal sector												
1. Net lending (+) or borrowing (–) *(percent of GDP)*	**–2.0**	–6.1	–7.2	–7.3	–7.3	–7.1	–7.0	–6.9	–6.9	–7.0	–7.2	**–7.1**
2. General government gross debt *(percent of GDP)*	**69.9**	78.4	85.2	91.3	96.9	102.7	108.2	113.5	118.6	123.6	128.6	**107.6**
VII. International environment												
1. Foreign effective output	**5.2**	–8.4	3.4	4.9	4.7	4.0	4.0	4.1	4.2	4.2	4.1	**4.2**
2. Current account balance *(percent of GDP)*	**0.5**	–0.4	–0.8	1.2	3.1	4.4	5.5	6.3	7.0	7.5	8.1	**4.7**
VIII. Miscellaneous												
1. Real GDP per capita	**1.8**	–4.5	0.2	1.0	1.4	0.7	0.7	0.7	0.8	0.9	1.0	**0.8**
2. Total population	**0.5**	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	**0.2**

All figures are year-on-year growth rates of yearly averages, unless otherwise specified.
Real variables are in chained (2000) euro; price indexes are also chain-type measures.
The NIME bloc for the euro area represents the 12 Member States that composed the euro area up to 2007.
The real effective exchange rate of the euro area is defined here as the ratio of the euro area's foreign effective output price to its export price, measured in the euro area's own currency.

Table 5

Main Results for the World Economy

Item	Average 1997-2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average 2010-2018
I. World nominal GDP												
1. Level *(trillions of current euro)*	**33.4**	39.5	41.5	44.0	46.2	48.0	49.6	51.0	52.2	53.7	55.1	**49.0**
- *percent change, in euro*	**5.0**	–3.0	5.2	5.9	5.1	4.0	3.3	2.8	2.4	2.7	2.7	**3.8**
2. Level *(trillions of current USD)*	**37.6**	55.0	54.4	55.1	55.9	57.1	58.7	60.7	62.9	65.5	68.4	**59.9**
- *percent change, in USD*	**5.7**	–8.1	–1.0	1.3	1.4	2.3	2.8	3.3	3.7	4.1	4.5	**2.5**
II. World real GDP												
1. Real GDP *(euro)*	**3.5**	–2.2	3.4	4.9	4.4	4.2	3.9	3.7	3.7	3.5	3.5	**3.9**
- *per capita*	**2.2**	–3.3	2.2	3.7	3.2	3.1	2.8	2.6	2.6	2.5	2.5	**2.8**
2. Real GDP *(USD)*	**4.6**	–7.4	–2.7	0.4	0.7	2.5	3.4	4.2	5.0	4.9	5.3	**2.6**
- *per capita*	**3.3**	–8.5	–3.8	–0.7	–0.4	1.4	2.3	3.1	3.9	3.9	4.3	**1.5**
III. World export volumes												
1. *percent change, in euro*	**6.5**	–14.6	2.9	0.7	1.6	2.0	2.2	2.5	2.8	2.9	3.0	**2.3**
2. *percent change, in USD*	**6.5**	–19.2	–3.1	–3.6	–2.0	0.4	1.7	3.0	4.0	4.3	4.8	**1.1**
3. exports *(percent of World GDP)*	**18.4**	17.9	18.5	18.1	17.9	17.9	17.8	17.8	17.8	17.8	17.8	**17.9**
IV. Price of world exports *(percent change)*												
1. *at euro exchange rates*	**–6.6**	–4.2	5.4	2.7	2.7	1.5	0.9	0.2	–0.4	–0.1	–0.2	**1.4**
2. *at USD exchange rates*	**–5.7**	–9.3	–0.8	–1.7	–0.9	–0.1	0.4	0.7	0.8	1.3	1.5	**0.1**
V. Price of oil *(bbl, Brent crude)*												
1. *level, in USD*	**35.2**	61.6	82.5	79.2	76.1	73.3	70.9	68.5	66.1	64.4	62.7	**71.5**
2. *level, in euro*	**30.4**	44.3	63.0	63.2	62.9	61.7	59.9	57.6	54.9	52.7	50.5	**58.5**
3. *percent change, in USD*	**15.4**	–36.4	33.9	–4.0	–4.0	–3.6	–3.3	–3.3	–3.5	–2.6	–2.5	**0.8**
4. *percent change, in euro*	**15.4**	–32.9	42.3	0.3	–0.4	–2.0	–2.9	–3.8	–4.7	–3.9	–4.2	**2.3**
VI. World population												
1. *in billions*	**6.2**	6.8	6.8	6.9	7.0	7.1	7.2	7.2	7.3	7.4	7.5	**7.2**
2. *percent change*	**1.2**	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	**1.1**

All figures are year-on-year growth rates of yearly averages, unless otherwise specified.
Real aggregates are in chained (2000) currency units; price indexes are also chain-type measures.

This overall nominal effective exchange rate appreciation would then impose downward price pressures on exports, so as to ensure a slight depreciation of the area's real effective exchange rate.

Finally, relatively stable public spending on goods and services, on investment, stable public sector employment and the unconstrained working of the area's automatic fiscal stabilisers, should all tend to underpin euro area domestic demand, but lead also to a continued build-up of public sector debt. The euro area's consolidated public deficit is projected to rise to 7.3 per cent of GDP in 2011 and 2012, and then to edge down to 6.9 per cent of GDP in 2016. However, as of 2017, deficits are projected to resume their upwards course once again, as fiscal positions are negatively impacted by the costs of ageing and as population growth grinds to a halt.

5.3 Main projection results for the world economy

Table 5 provides basic aggregate results for the world economy. These results are produced by computing appropriately weighted averages of macroeconomic variables of the six fully-specified economic areas (the euro area, the United States, Japan, the Western non-euro EU MS, the Central and Eastern EU MS and the Rest of the World) of the model.

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FISCAL POLICY MULTIPLIERS IN THE EU DURING THE CREDIT CRISIS: A DSGE ANALYSIS

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This paper uses a multi region DSGE model with collateral constrained households and residential investment to examine the effectiveness of fiscal policy stimulus measures in a credit crisis. The paper explores alternative scenarios which differ by the type of budgetary measure, its length, the degree of monetary accommodation and the level of international coordination. It is found that an increase in households facing credit constraints and the fact that the zero lower bound on nominal interest rates has become binding both increase the effectiveness of temporary fiscal stimulus measures.

1 Introduction

The depth of the global recession has led to a revival of interest in discretionary fiscal policy. The current recession has proved to be the deepest and longest since the 1930s and recovery remains uncertain and fragile. But the general policy response to the downturn has been swift and decisive. Aside from government interventions dealing with the liquidity and solvency problems of the financial sector, including unconventional measures in the form of quantitative easing, the European Economic Recovery Plan (EERP) was launched back in December 2008. The objective of the EERP was to restore confidence and bolster demand through a coordinated injection of purchasing power into the economy complemented by strategic investments and measures to shore up business and labour markets. Governments across the world have implemented large fiscal stimulus packages. In the European Union, the overall discretionary fiscal stimulus over 2009 and 2010 amounts to more than 2 per cent of GDP, and this is further enhanced by the workings of automatic stabilisers.

There exists widespread scepticism on the effectiveness of fiscal policy as a general instrument for stabilisation purposes, and it is frequently argued that it is best to let fiscal policy have its main countercyclical impact through the operation of automatic stabilisers. But with limited room for a stronger monetary policy response, the effectiveness of temporary fiscal measures in stabilising the economy needed reexamination. There are several reasons why a temporary fiscal stimulus can be more powerful in the current financial crisis. First, to the extent that this recession is purely demand driven, fiscal policy can be more effective than in previous recessions that were to a large extent caused by supply side factors (e.g., oil price shocks). When the economy is hit by supply shocks there is little active discretionary fiscal policy can do. A second factor that justified earlier scepticism on fiscal policy was the rapid financial liberalisation. When more and more households acquired access to financial markets and were able to smooth their consumption, fiscal policy became less powerful. The financial crisis has had a profound effect on credit conditions and led to a sharp tightening in lending practices. With the sharp increase in the share of credit constrained households, fiscal policy has become more effective. Third, for those economies where interest rates are near their zero lower bound, monetary policy can be accommodative to the fiscal expansion and the resulting increase in inflation and decrease in real interest rates form an additional indirect channel through which growth can be supported. Fourth, as the financial crisis has long-lasting consequences and the recovery is expected to be

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The views expressed in this paper are those of the authors and should not be attributed to the European Commission.

fragile and feeble, the often argued disadvantage of fiscal policy that it is not timely due to long implementation lags, seems less relevant at the current juncture.

This paper examines the effectiveness of fiscal policy measures. In many of the euro area countries, fiscal multipliers are larger than under "normal" circumstances due to the presence of credit constrained households and nominal interest rates at the zero lower bound. This not necessarily holds in the Member States in Central and Eastern Europe. One particular aspect in which these economies differ from the old member states is that a larger share of household debt is denominated in foreign currencies (like, e.g., in Latvia and Hungary). This can have a profound effect on household spending when the domestic currency depreciates *vis-à-vis* the currency in which debt is denominated. A second aspect in which many of these countries differ from the old EU15 is that monetary policy had less space to be accommodative.

We use a modern dynamic stochastic general equilibrium (DGSE) model in which collateral constraints play an important role. The main transmission channels of the financial crisis into the real economy are thought to be through higher risk premia and credit rationing for households and firms. By disaggregating households into credit constrained and a non-constrained group, along the lines suggested by the recent literature on collateral constraints,[1] we can examine the importance of tighter credit constraints on the effectiveness of discretionary fiscal policy. The presence of credit constrained households raises the marginal propensity to consume out of current net income and makes fiscal policy a more powerful tool for short run stabilisation. A second reason why fiscal policy can be more powerful with deflationary shocks like the current financial crisis is that credit constrained consumers react even more strongly to a fall in real interest rates, which as argued above can occur when monetary policy can be accommodative towards the fiscal stimulus, and allow real interest rates to fall.

The rest of the paper is structured as follows. The next section starts with a brief overview of the fiscal measures that have been undertaken by the governments in the European Union. This is followed by a brief description of the QUEST III model, with particular emphasis on the household sector and collateral constrained households. The next section gives a review of the size of fiscal multipliers in this model for a range of fiscal instruments and under alternative assumptions. The following section then presents simulation results of a credit crisis and shows how a temporary fiscal stimulus can mitigate the output losses associated with the crisis.

2 Fiscal stimulus packages in the New Member States of the EU

The EU has combined structural reforms with active fiscal stimulus to address the economic downturn. Large fiscal stimulus packages have been implemented across the EU in 2009 and 2010.[2] The packages have broadly followed desirable general principles, *i.e.*, they were differentiated according to the available fiscal room for manoeuvre and relied on measures that were targeted, timely and temporary. Tables 1 and 2 give an overview of the fiscal stimulus measures implemented in the EU Member States, using a classification of measures in four broad categories: measures aimed at supporting household purchasing power, labour market measures, measures aimed at companies, and measures aimed at increasing/bringing forward investment. The dispersion of package sizes is considerable. On average in the EU, the fiscal stimulus in 2009 amounted to more than 1 percent of GDP and slightly less than that in 2010, with generally a strong emphasis on measures supporting household income. Many of the countries most affected by the

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[1] See, e.g., Kiyotaki and Moore (1997), Iacoviello (2005), Iacoviello and Neri (2008), Monacelli (2007), Calza, Monacelli and Stracca (2007), Darracq Pariès and Notarpietro (2008).

[2] The European Economic Recovery Programme (EERP) is estimated to total around 2 per cent of GDP over 2009-10, including EUR 20 billion (0.3 per cent of EU GDP) through loans funded by the European Investment Bank.

Table 1

Fiscal Stimulus Measures in EU Member States: 2009 and 2010
2009

Country	Total Stimulus Measures *(percent of GDP)*	A Supporting Household Purchasing Power *(percent of GDP)*	B Labour Market Measures *(percent of GDP)*	C Measures Aimed at Companies *(percent of GDP)*	D Increasing/ Bringing Forward Investment *(percent of GDP)*
BE	0.94	0.38	0.03	0.20	0.00
BG	0.00	0.00	0.00	0.00	0.00
CZ	1.99	0.65	0.56	0.68	0.10
DK	–0.08	0.00	0.00	–0.08	0.00
DE	1.71	0.62	0.22	0.46	0.41
EE	0.00	0.00	0.00	0.00	0.00
IE	0.54	0.40	0.00	0.14	0.00
EL	0.19	0.12	0.05	0.01	0.00
ES	0.79	0.33	0.11	0.35	0.00
FR	0.65	0.14	0.11	0.27	0.14
IT	0.57	0.20	0.16	0.21	–0.01
CY	1.22	0.89	0.04	0.29	0.01
LV	1.76	1.73	0.00	0.04	0.00
LT	0.05	0.00	0.05	0.00	0.00
LU	1.90	1.50	0.34	0.06	0.00
HU	0.01	0.00	0.01	0.00	0.00
MT	0.56	0.00	0.00	0.48	0.09
NL	0.88	0.00	0.11	0.27	0.16
AT	1.39	1.09	0.23	0.02	0.04
PL	0.92	0.01	0.75	0.16	0.00
PT	0.29	0.00	0.16	0.09	0.03
RO	1.81	0.16	0.02	1.63	0.00
SI	0.86	0.04	0.18	0.30	0.34
SK	0.34	0.23	0.05	0.05	0.02
FI	1.29	1.04	0.02	0.23	0.00
SE	0.73	0.17	0.56	0.00	0.00
UK	1.72	1.35	0.07	0.28	0.02
EU27	1.06	0.46	0.16	0.29	0.12
EUR16	0.98	0.36	0.14	0.29	0.15

Table 1 (continued)

Fiscal Stimulus Measures in EU Member States: 2009 and 2010
2010

Country	Total Stimulus Measures (percent of GDP)	A Supporting Household Purchasing Power (percent of GDP)	B Labour Market Measures (percent of GDP)	C Measures Aimed at Companies (percent of GDP)	D Increasing/ Bringing Forward Investment (percent of GDP)
BE	0.75	0.42	0.03	0.00	0.00
BG	0.00	0.00	0.00	0.00	0.00
CZ	1.37	0.74	0.00	0.57	0.00
DK	0.11	0.00	0.00	0.11	0.00
DE	2.42	1.30	0.23	0.35	0.54
EE	0.00	0.00	0.00	0.00	0.00
IE	0.68	0.45	0.00	0.24	0.00
EL	0.00	0.00	0.00	0.00	0.00
ES	0.59	0.00	0.03	0.08	0.48
FR	0.25	0.01	0.00	0.17	0.07
IT	0.49	0.00	0.22	0.15	0.12
CY	0.98	0.67	0.01	0.29	0.02
LV	0.30	0.26	0.00	0.05	0.00
LT	0.01	0.00	0.01	0.00	0.00
LU	1.65	1.44	0.00	0.22	0.00
HU	0.02	0.00	0.02	0.00	0.00
MT	1.23	0.00	0.14	0.84	0.26
NL	0.83	0.00	0.10	0.20	0.17
AT	1.61	1.33	0.23	0.04	0.00
PL	0.81	0.02	0.70	0.09	0.00
PT	0.12	0.00	0.00	0.12	0.00
RO	0.00	0.00	0.00	0.00	0.00
SI	0.47	0.00	0.37	0.10	0.00
SK	0.45	0.32	0.06	0.06	0.00
FI	2.06	1.51	0.02	0.52	0.00
SE	1.32	0.73	0.59	0.00	0.00
UK	0.61	0.39	0.16	0.04	0.01
EU27	0.95	0.42	0.15	0.17	0.19
EUR16	1.05	0.45	0.12	0.20	0.25

crisis, particularly among the new Member States, have had very limited room to implement stimulus measures (and have often predominantly adopted consolidation measures with a view to avoiding a further fall-out from the crisis).

3 The model

The model used in this exercise is an extended version of the QUEST III model (Ratto *et al.*, 2009) with collateral constrained households and residential investment (see Röger and in 't Veld, 2009).[3] We use a 6 region version of this model, calibrated for the euro area, the New Member States not part of the euro area, the old member states outside the euro area, the US, emerging Asia, and the rest of the world.

There are three production sectors in each region, namely a sector producing tradables, non tradables and houses. We distinguish between Ricardian households which have full access to financial markets, credit constrained households facing a collateral constraint on their borrowing and liquidity constrained households which do not engage in financial markets. And there is a monetary and fiscal authority, both following rules based stabilisation policies. Behavioural and technological relationships can be subject to autocorrelated shocks denoted by U_t^k, where *k* stands for the type of shock. The logarithm of U_t^k [4] will generally be autocorrelated with autocorrelation coefficient ρ^k and innovation ε_t^k.

3.1 Firms

There is a tradable and a non tradable sector, and there is a housing sector.

3.1.1 Producers of tradables and non tradables

Firms operating in the tradable and non tradable sector are indexed by *T* and *NT* respectively *j=(T,NT).* Each firm produces a variety of the domestic good which is an imperfect substitute for varieties produced by other firms. Because of imperfect substitutability, firms are monopolistically competitive in the goods market and face a demand function for goods. Domestic firms in the tradable sector sell consumption goods and services to private domestic and foreign households and the domestic and foreign government and they sell investment and intermediate goods to other domestic and foreign firms. The non tradable sector sells consumption goods and services only to domestic households and the domestic government and they sell investment and intermediate goods only to domestic firms including the residential construction sector. Preferences for varieties of tradables and non tradables can differ resulting in different mark ups for the tradable and non tradable sector.

Output is produced with a CES production function nesting a Cobb Douglas technology for value added using capital K_t^j and production workers $L_t^j - LO_t^j$, augmented with public capital

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[3] See Röger, W. and J. in 't Veld (2009), "Fiscal Policy with Credit Constrained Households", *European Economy*, Economic Paper, No. 357, January, available at: http://ec.europa.eu/economy_finance/publications/publication13839_en.pdf

[4] Lower cases denote logarithms, *i.e.* $z_t = log(Z_t)$. Lower cases are also used for ratios and rates. In particular we define $p_t^j = P_t^j / P_t^{GDP}$ as the relative price of good j w. r. t. the GDP deflator

K_t^G, and a CES function for domestically produced (*INTD)*, imported (*INTF)* and non-tradable intermediates *INTNT* .

$$O_t^j = \left\{ (1-s_{\text{int}})^{\frac{1}{\sigma in}} . Y^{j\,(\frac{\sigma in-1}{\sigma in})} + s_{\text{int}}^{\frac{1}{\sigma in}} . INT^{j\,(\frac{\sigma in-1}{\sigma in})} \right\}^{\frac{\sigma in}{\sigma in-1}} \tag{1}$$

where:

$$Y_t^j = (ucap_t^j K_t^j)^{1-\alpha} (L_t^j - LO_t^j)^{\alpha} U_t^{Y\,\alpha} \left(K_t^G\right)^{\alpha_G}, \qquad \text{with} \quad L_t^j = \left[\int_0^1 L_t^{i,j\,\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}} \tag{2}$$

and:

$$INT_t^j = \left\{ s_T^{1/\sigma tnt} \left[\left\{ sdom^{\frac{1}{\sigma}} INTD^{\left(\frac{\sigma-1}{\sigma}\right)} + (1-sdom)^{\frac{1}{\sigma}} INTF^{\left(\frac{\sigma-1}{\sigma}\right)} \right\}^{(\frac{\sigma}{\sigma-1})} \right]^{(\frac{\sigma tnt-1}{\sigma tnt})} + \right.$$
$$\left. + (1-s_T)^{1/\sigma tnt} INTNT^{(\frac{\sigma tnt-1}{\sigma tnt})} \right\}^{(\frac{\sigma tnt}{\sigma tnt-1})} \tag{3}$$

The term LO_t^j represents overhead labour. Total employment of the firm L_t^j is itself a CES aggregate of labour supplied by individual households *i.* The parameter $\theta > 1$ determines the degree of substitutability among different types of labour. Firms also decide about the degree of capacity utilisation ($UCAP_t^j$). There is an economy wide technology shock U_t^Y. The objective of the firm is to maximise profits *Pr*:

$$\text{Pr}_t^j = p_t^j Y_t^j - w_t L_t^j - i_t^K p_t^{K,j} K_t^j - (adj^P(P_t^j) + adj^L(L_t^j) + adj^{UCAP}(ucap_t^j)) \tag{4}$$

where i^K denotes the rental rate of capital. Firms also face technological and regulatory constraints which restrict their price setting, employment and capacity utilisation decisions. Price setting rigidities can be the result of the internal organisation of the firm or specific customer-firm relationships associated with certain market structures. Costs of adjusting labour have a strong job specific component (e.g., training costs) but higher employment adjustment costs may also arise in heavily regulated labour markets with search frictions. Costs associated with the utilisation of capital can result from higher maintenance costs associated with a more intensive use of a piece of capital equipment. The following convex functional forms are chosen:

$$adj^{L}(L_t^j) = w_t(L_t^j u_t^L + \frac{\gamma_L}{2}\Delta L_t^{j\,2})$$
$$adj^{P}(P_t^j) = \frac{\gamma_P}{2}\frac{(P_t^j - P_{t-1}^j)^2}{P_{t-1}^j} \tag{5}$$
$$adj^{UCAP}(ucap_t^j) = PI_t K_t(\gamma_{ucap,1}(ucap_t^j - 1) + \frac{\gamma_{ucap,2}}{2}(ucap_t^j - 1)^2)$$

The firm determines labour input, capital services and prices optimally in each period given the technological and administrative constraints as well as demand conditions. The first order conditions are given by:

$$\frac{\partial \Pr_t^j}{\partial L_t^j} => \left(\frac{\partial O_t^j}{\partial L_t^j}\eta_t^j - w_t u_t^L - w_t\gamma_L\Delta L_t^j + E_t(w_{t+1}\frac{\gamma_L}{(1+r_t)}\Delta L_{t+1}^j)\right) = w_t \tag{6a}$$

$$\frac{\partial \Pr_t^j}{\partial K_t^j} => \left(\frac{\partial O_t^j}{\partial K_t^j}\eta_t^j\right) = i_t^K p_t^{K,j} \tag{6b}$$

$$\frac{\partial \Pr_t^j}{\partial ucap_t^j} => \left(\frac{\partial O_t^j}{\partial ucap_t^j}\eta_t^j\right) = \frac{P_t^{K,j}}{P_t^j}K_t^j(\gamma_{ucap,1} + \gamma_{ucap,2}(ucap_t^j - 1)) \tag{6c}$$

$$\frac{\partial \Pr_t^j}{\partial O_t^j} => \eta_t^j = 1 - 1/\sigma^d - \gamma_P\left[\frac{1}{(1+r_t)}E_t\pi_{t+1}^j - \pi_t^j\right] \quad \text{with} \quad \pi_t^j = P_t^j / P_{t-1}^j - 1 \tag{6d}$$

Where η_t is the Lagrange multiplier of the technological constraint and r_t is the real interest rate. Firms equate the marginal product of labour, net of marginal adjustment costs, to wage costs. As can be seen from the left hand side of equation (6a), the convex part of the adjustment cost function penalises in cost terms accelerations and decelerations of changes in employment. Equations (6b-c) jointly determine the optimal capital stock and capacity utilisation by equating the marginal value product of capital to the rental price and the marginal product of capital services to the marginal cost of increasing capacity. Equation (6d) defines the mark up factor as a function of the elasticity of substitution and changes in inflation. The average mark up is equal to the inverse of the price elasticity of demand. We follow the empirical literature and allow for additional backward looking elements by assuming that a fraction (*1–sfp*) of firms index price increases to inflation in *t*–1. Finally we also allow for a mark up shock. This leads to the following specification:

$$\eta_t^j = 1 - 1/\sigma^d - \gamma_P\left[\beta(sfpE_t\pi_{t+1}^j + (1-sfp)\pi_{t-1}^j) - \pi_t^j\right] - u_t^\eta \qquad 0 \le sfp \le 1 \tag{6d'}$$

3.1.2 Residential construction

Firms *h* in the residential construction sector use new land (J_t^{Land}) sold by (Ricardian) households and non tradable goods ($J_t^{inp,H}$) to produce new houses using a CES technology:

$$J_t^H = \left(s_L^{\frac{1}{\sigma L}} J_t^{Land\,\frac{(\sigma L-1)}{\sigma L}} + (1-s_L)^{\frac{1}{\sigma L}} J_t^{inp,H\,\frac{(\sigma L-1)}{\sigma L}}\right) \tag{7}$$

Firms in the residential construction sector are monopolistically competitive and face price adjustment costs. Thus the mark up is given by:

$$\eta_t^H = 1 - 1/\sigma^H - \gamma_H \left[\beta(sfpE_t\pi_{t+1}^H + (1-sfp)\pi_{t-1}^H) - \pi_t^H\right] - u_t^H \qquad 0 \le sfp \le 1 \qquad (8)$$

New and existing houses are perfect substitutes. Thus households can make capital gains or suffer capital losses depending on house price fluctuations.

3.2 Households

The household sector consists of a continuum of households $h \in [0,1]$. There are $s^l \le 1$ households which are liquidity constrained and indexed by *l*. These households do not trade on asset markets and consume their disposable income each period. A fraction s^r of all households are Ricardian and indexed by *r* and s^c households are credit constrained and indexed by *c*. The period utility function is identical for each household type and separable in consumption (C_t^h), leisure ($1 - L_t^h$) and housing services (H_t^h). We also allow for habit persistence in consumption and leisure. Thus temporal utility for consumption is given by:

$$U(C_t^h, 1 - L_t^h, H_t^h) = \log\left(C_t^h - hC_{t-1}\right) + \vartheta\left(1 - L_t^h\right)^{1-\kappa} + \omega\log\left(H_t^h\right) \qquad (9)$$

All three types of households supply differentiated labour services to unions which maximise a joint utility function for each type of labour *i*. It is assumed that types of labour are distributed equally over the three household types. Nominal rigidity in wage setting is introduced by assuming that the household faces adjustment costs for changing wages. These adjustment costs are borne by the household.

3.2.1 Ricardian households

Ricardian households have full access to financial markets. They hold domestic government bonds ($B_t^{G\,r}$) and bonds issued by other domestic and foreign households ($B_t^r, B_t^{F,r}$), real capitals (K_t^j) of the tradable and non tradable sector as well as the stock of land ($Land_t$) which is still available for building new houses and cash balances (M_t^r). The household receives income from labour, financial assets, rental income from lending capital to firms, selling land to the residential construction sector plus profit income from firms owned by the household (tradables, non tradables, residential construction). We assume that all domestic firms are owned by Ricardian households. Income from labour is taxed at rate t^w, rental income at rate t^k and investors can receive an investment subsidy (itc_t). In addition households pay lump-sum taxes T^{LS}. We assume that income from financial wealth is subject to different types of risk. Domestic bonds yield risk-free nominal return equal to i_t. Domestic and foreign bonds are subject to (stochastic) risk premia linked to net foreign indebtedness. Current spending is allocated to consumption (C_t^r), investment in equipment and structures (I_t^j) as well as residential investment ($I_t^{H,r}, I_t^{HLC,r}$). An equity premium on real assets arises because of uncertainty about the future value of real assets. The Lagrangian of this maximisation problem is given by:

$$
\begin{aligned}
&Max \quad V_0^r = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^{rt} U(C_t^r, 1-L_t^r, H_t^r) \\
&-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \beta^{rt} \left(\begin{array}{l} (1+t_t^c) p_t^C C_t^r + \sum_j p_t^{K,j} (1-itc_t) I_t^j + p_t^H (1+t_t^c) I_t^{H,r} + p_t^H (1+t_t^c) I_t^{HLC,r} + (B_t^{G,r} + B_t^r) \\ + rer_t B_t^{F,r} - (1+r_{t-1})(B_{t-1}^{G,r} + B_{t-1}^r) - (1+r_{t-1}^F)(1-risk(.)) rer_t B_{t-1}^{F,r} \\ - \sum_j ((1-t_t^k) i_{t-1}^{K,j} + t_t \delta^{k,j}) p_{t-1}^{K,j} K_{t-1}^j - (1-t_t^W) w_t L_t^r + \frac{\gamma_W}{2} \frac{\Delta W_t^2}{W_{t-1}} - \\ ((1-t^k) i_{t-1}^H + \delta^H) p_t^H H_{t-1}^{LC,r} - p_t^L J_t^{Land} - \sum_{j=1} \mathrm{Pr}_t^j - \mathrm{Pr}_t^H + T_t^{LS,r} \end{array} \right) \\
&-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \beta^{rt} \left(\sum_j \xi_t^j (K_t^j - J_t^j - (1-\delta^{K,j}) K_{t-1}^j) \right) \\
&-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \zeta_t^r \beta^{rt} \left(H_t^r - J_t^{H,r} - (1-\delta^H) H_{t-1}^{H,r} \right) \\
&-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \vartheta_t^r \beta^{rt} \left(H_t^{LC,r} - J_t^{HLC,r} - (1-\delta^H) H_{t-1}^{LC,r} \right) \\
&-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^r \xi_t^r \beta^{rt} \left(Land_t + J_t^{Land} - (1+g_t^L) Land_{t-1} \right)
\end{aligned} \tag{10}
$$

The investment decisions w.r.t. physical capital and housing are subject to convex adjustment costs, therefore we make a distinction between real investment expenditure (I_t^j, I_t^H) and physical investment (J_t^j, J_t^H). Investment expenditure of households including adjustment costs is given by:

$$I_t^j = J_t^j \left(1 + \frac{(\gamma_K^j + u_t^j)}{2} \left(\frac{J_t^j}{K_t^j} \right) \right) + \frac{\gamma_I^j}{2} (\Delta J_t^j)^2 \tag{11a}$$

$$I_t^{H,r} = J_t^{H,r} \left(1 + \frac{(\gamma_H + u_t^H)}{2} \left(\frac{J_t^{H,r}}{H_t^r} \right) \right) + \frac{\gamma_{IH}}{2} (\Delta J_t^{H,r})^2 \tag{11b}$$

The budget constraint is written in real terms with all prices expressed relative to the GDP deflator (*P*). Investment is a composite of domestic and foreign goods. From the first order conditions we can derive the following consumption rule, where the ratio of the marginal utility of consumption in period *t* and *t*+1 is equated to the real interest rate adjusted for the rate of time preference:

$$\frac{\mathrm{E}_t (C_{t+1}^r - hC_t)}{C_t^r - hC_{t-1}} = \beta^r (1+r_t) \tag{12}$$

From the arbitrage condition of investment we can derive an investment rule which links capital formation to the shadow price of capital.

$$\left((\gamma_K^j + u_t^j)\left(\frac{J_t^{K,j}}{K_{t-1}^j}\right) + \gamma_I^j \Delta J_t^{K,j}\right) - E_t\left(\frac{1}{(1+r+\pi_{t+1}^{GDP} - \pi_{t+1}^{K,j})} \Delta J_{t+1}^{K,i}\right) = \frac{\xi_t^j}{p_t^K (1 - itc_t)} - 1 \tag{13}$$

where the shadow price of capital is given as the present discounted value of the rental income from physical capital:

$$\frac{\xi_t^j}{p_t^{K,j}} = \mathrm{E}_t\left(\frac{1}{(1+r_t+\pi_{t+1}^{GDP} - \pi_{t+1}^{K,j})} \frac{\xi_{t+1}^j}{p_{t+1}^{K,j}} (1-\delta^K)\right) + ((1-t_t^K) i_t^K + t_t^K \delta^{K,j}) = 0 \tag{14}$$

From the FOC for housing investment we can derive a housing investment rule, which links investment to the shadow price of housing capital:

$$\left((\gamma_H + u_t^H)\left(\frac{J_t^{H,r}}{H_{t-1}^r}\right) + \gamma_{IH} \Delta J_t^{H,r}\right) - E_t\left(\frac{1}{(1+r_t+\pi_{t+1}^{GDP} - \pi_{t+1}^{H} - \Delta t_{t+1}^c)} \Delta J_{t+1}^{H,r}\right) = \frac{\zeta_t^r}{p_t^H (1+t_t^c)} - 1 \tag{15}$$

The shadow price of housing capital can be represented as the present discounted value of the ratio of the marginal utility of housing services and consumption:

$$\frac{\zeta_t^r}{p_t^H (1+t_t^c)} = \omega^r \frac{(C_t^r - hC_{t-1})(1+t_t^c) p_t^C}{H_t^r (1+t_t^c) p_t^H} + \mathrm{E}_t\left(\frac{1}{(1+r_t+\pi_{t+1}^{GDP} - \pi_{t+1}^{H} - \Delta t_{t+1}^c)} \frac{\zeta_{t+1}^r}{p_{t+1}^h (1+t_{t+1}^c)} (1-\delta^H)\right) \tag{16}$$

For the price of land we one obtain a (quasi) Hotelling rule:

$$p_t^{Land} = \mathrm{E}_t\left(\frac{1}{(1+r_t)} p_{t+1}^{Land} (1+g_L)\right) \tag{17}$$

The growth rate of the price of land must guarantee a rate of return which can be earned by other assets, *i.e.*, the growth rate of the price of land must be equal to $r_t - g_L$.

3.2.2 Credit constrained households

Credit constrained households differ from Ricardian households in two respects. First they have a higher rate of time preference ($\beta^c < \beta^r$) and they face a collateral constraint on their borrowing. They borrow B_t^c exclusively from domestic Ricardian households. Ricardian households have the possibility to refinance themselves via the international capital market. The Lagrangian of this maximisation problem is given by:

$$\begin{aligned}
&Max \quad V_0^c = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^{c\,t} U(C_t^c, 1 - L_t^c, H_t^c) \\
&-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^c \beta^{c\,t} \left((1+t_t^c) p_t^C C_t^c + p_t^H (1+t_t^H) I_t^{H,c} - B_t^c + (1+r_{t-1}) B_{t-1}^c - (1-t_t^W) w_t L_t^c + \frac{\gamma_W}{2} \frac{\Delta W_t^{\,2}}{W_{t-1}} + T_t^{LS,c}\right) \\
&-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^c \zeta_t^c \beta^{c\,t} \left(H_t^c - J_t^{H,c} - (1-\delta^H) H_{t-1}^c\right) \\
&-\mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^c \psi_t \beta^{c\,t} \left(B_t^c - (1-\chi) p_t^H H_t^c\right)
\end{aligned} \tag{18}$$

From the first order conditions we can derive the following decision rules for consumption:

$$\frac{\mathrm{E}_t(C_{t+1}^c - hC_t)}{C_t^c - hC_{t-1}} = \beta^c \frac{(1+r_t)}{(1-\psi_t)} \tag{19}$$

and housing investment:

$$\left((\gamma_H + u_t^H)\left(\frac{J_t^{H,c}}{H_{t-1}^c}\right) + \gamma_{IH}\Delta J_t^{H,c}\right) - E_t\left(\frac{(1-\psi_t)}{(1+r_t+\pi_{t+1}^{GDP}-\pi_{t+1}^H-\Delta t_{t+1}^c)}\Delta J_{t+1}^{H,c}\right) = \frac{\zeta_t^c}{p_t^H(1+t_t^c)} - 1 \tag{20}$$

where, again, the shadow price of housing capital is the present discounted value of the ratio of the marginal utility of housing services and consumption:

$$\frac{\zeta_t^c}{p_t^H(1+t_t^c)} = \omega^c \frac{(C_t^c - hC_{t-1})(1+t_t^c)p_t^C}{H_t^c(1+t_t^c)p_t^H} + \psi_t(1-\chi) + \mathrm{E}_t\left(\frac{(1-\psi_t)}{(1+r_t+\pi_{t+1}^{GDP}-\pi_{t+1}^H-\Delta t_{t+1}^c)}\frac{\zeta_{t+1}^c}{p_{t+1}^H(1+t_{t+1}^c)}(1-\delta^H)\right) \tag{21}$$

The major difference between credit constrained and Ricardian households is the presence of the Lagrange multiplier of the collateral constraint in both the consumption and the investment rule of the former. The term ψ_t acts like premium on the interest rate which fluctuates positively with the tightness of the constraint.

One specific feature in many of the Member States in Central and Eastern Europe is that many households are indebted in foreign currency. For example, it is estimated that in Latvia more than 90 per cent of mortgage debt is denominated in euros, while in Hungary household debt is predominantly in Swiss francs. Poland and Romania have similarly high shares of foreign currency denominated debt. To capture this feature we include an alternative specification of the budget constraint:

$$e_t B_t^c - (1+r_{t-1}^*)e_t B_{t-1}^c + (1-t_t^W)w_t L_t^c + TR_t^{LS,c} = (1+t_t^c)p_t^C C_t^c + p_t^H(1+t_t^H)I_t^{H,c} \tag{18'}$$

where B_t^c is now denominated in the foreign currency and *e* is the exchange rate (domestic currency per unit of foreign currency) and a star indicates foreign variables. The collateral constraint in this case takes the following form

$$e_t B_t^c = (1-\chi)p_t^H H_t^c \tag{18''}$$

3.2.3 Liquidity constrained households

Liquidity constrained households do not optimize but simply consume their entire labour income at each date. Real consumption of household *k* is thus determined by net wage income plus transfers minus a lump-sum tax:

$$(1+t_t^c)P_t^c C_t^l = (1-t_t^w)W_t L_{tt}^l + TR_t^l - T_t^{LS,l} \tag{22}$$

It is assumed that liquidity constrained households possess the same utility function as Ricardian households.

3.2.4 Wage setting

A trade union is maximising a joint utility function for each type of labour *i* where it is

assumed that types of labour are distributed equally over constrained and unconstrained households with their respective population weights. The trade union sets wages by maximising a weighted average of the utility functions of these households. The wage rule is obtained by equating a weighted average of the marginal utility of leisure to a weighted average of the marginal utility of consumption times the real wage, adjusted for a wage mark up:

$$\frac{s^c U^c_{1-L,t} + s^r U^r_{1-L,t} + s^l U^l_{1-L,t}}{s^c U^c_{c,t} + s^r U^r_{c,t} + s^l U^l_{c,t}} = \frac{(1-t^W_t)}{(1+t^C_t)} \frac{W_t}{P^C_t} \eta^W_t \tag{23}$$

where η^W_t is the wage mark up factor, with wage mark ups fluctuating around $1/\theta$ which is the inverse of the elasticity of substitution between different varieties of labour services. The trade union sets the consumption wage as a mark up over the reservation wage. The reservation wage is the ratio of the marginal utility of leisure to the marginal utility of consumption. This is a natural measure of the reservation wage. If this ratio is equal to the consumption wage, the household is indifferent between supplying an additional unit of labour and spending the additional income on consumption and not increasing labour supply. Fluctuation in the wage mark up arises because of wage adjustment costs and the fact that a fraction (*1–sfw*) of workers is indexing the growth rate of wages π^W_t to inflation in the previous period:

$$\eta^W_t = 1 - 1/\theta - \gamma_W/\theta \left[\beta(\pi^W_{t+1} - (1-sfw)\pi_t) - (\pi^W_t - (1-sfw)\pi_{t-1}) \right] \qquad 0 \le sfw \le 1 \tag{24}$$

Combining (23) and (24) one can show that the (semi) elasticity of wage inflation with respect to the employment rate is given by (κ/γ_W), *i.e.*, it is positively related to the inverse of the labour supply elasticity and inversely related to wage adjustment costs.

3.2.5 Aggregation

The aggregate of any household specific variable X^h_t in per capita terms is given by $X_t = \int_0^1 X^h_t dh = s^r X^r_t + s^c X^c_t + s^l X^l_t$ since households within each group are identical. Hence aggregate consumption is given by:

$$C_t = s^r C^r_t + s^c C^c_t + s^l C^l_t \tag{25a}$$

and aggregate employment is given by:

$$L_t = s^r L^r_t + s^c L^c_t + s^l L^l_t \quad \text{with } L^r_t = L^c_t = L^l_t \tag{25b}$$

Since liquidity constrained households do not own financial assets we have $B^l_t = B^{lF}_t = K^l_t = 0$. Credit constrained households only engage in debt contracts with Ricardian households, therefore we have:

$$B^c_t = \frac{s^r}{s^c} B^r_t \tag{26}$$

3.3 Trade and the current account

So far we have only determined aggregate consumption, investment and government purchases but not the allocation of expenditure over domestic and foreign goods. In order to

facilitate aggregation we assume that households, the government and the corporate sector have identical preferences across goods used for private consumption, public expenditure and investment. Let $Z^i \in \{C^i, I^i, C^{G,i}, I^{G,i}\}$ be demand of an individual household, investor or the government, and then their preferences are given by the following utility function:

$$Z^i = \left[(1 - s^M - u_t^M)^{\frac{1}{\sigma^M}} Z^{d\,i\,\frac{\sigma^M - 1}{\sigma^M}} + (s^M + u_t^M)^{\frac{1}{\sigma^M}} Z^{f\,i\,\frac{\sigma^M - 1}{\sigma^M}} \right]^{\frac{\sigma^M}{(\sigma^M - 1)}} \tag{27a}$$

where the share parameter s^M can be subject to random shocks and $Z^{d\,i}$ and $Z^{f\,i}$ are indexes of demand across the continuum of differentiated goods produced respectively in the domestic economy and abroad, given by:

$$Z^{d\,i} = \left[\sum_{h=1}^{n} \left(\frac{1}{n}\right)^{\frac{1}{\sigma^d}} Z_h^{d\,i\,\frac{\sigma^d - 1}{\sigma^d}} \right]^{\frac{\sigma^d}{\sigma^d - 1}}, \quad Z^{f\,i} = \left[\sum_{h=1}^{m} \left(\frac{1}{m}\right)^{\frac{1}{\sigma^f}} Z_h^{f\,i\,\frac{\sigma^f - 1}{\sigma^f}} \right]^{\frac{\sigma^f}{\sigma^f - 1}} \tag{27b}$$

The elasticity of substitution between bundles of domestic and foreign goods $Z^{d\,i}$ and $Z^{f\,i}$ is σ^M. Thus aggregate imports are given by:

$$M_t = (s^M + u_t^M) \left[\rho^{PCPM} \frac{P_{t-1}^{\ C}}{P_{t-1}^{\ M}} + (1 - \rho^{PCPM}) \frac{P_t^C}{P_t^M} \right]^{\sigma^M} (C_t + I_t^{inp} + C_t^G + I_t^G) \tag{28}$$

where P^C and P^M is the (utility based) consumer price deflator and the lag structure captures delivery lags. We assume similar demand behaviour in the rest of the world, therefore exports can be treated symmetrically and are given by:

$$X_t = (s^{M,W} + u_t^X) \left(\rho^{PWPX} \frac{P_{t-1}^{\ C,F} E_{t-1}}{P_{t-1}^{\ X}} + (1 - \rho^{PWPX}) \frac{P_t^{C,F} E_t}{P_t^X} \right)^{\sigma^X} Y_t^F \tag{29}$$

where P_t^X, $P_t^{C,F}$ and Y_t^F are the export deflator, an index of world consumer prices (in foreign currency) and world demand. Prices for exports and imports are set by domestic and foreign exporters respectively. The exporters in both regions buy goods from their respective domestic producers and sell them in foreign markets. They transform domestic goods into exportables using a linear technology. Exporters act as monopolistic competitors in export markets and charge a mark-up over domestic prices. Thus export prices are given by:

$$\eta_t^X P_t^X = P_t \tag{30}$$

and import prices are given by:

$$\eta_t^M P_t^M = E_t P_t^F \tag{31}$$

Mark-up fluctuations arise because of price adjustment costs. There is also some backward indexation of prices since a fraction of exporters (*1–sfpx*) and (*1–sfpm*) is indexing changes of prices to past inflation. The mark-ups for import and export prices are also subject to random shocks:

$$\eta_t^k = 1 - 1/\sigma^k - \gamma_{Pk}\left[\beta(sfp^k \cdot_t \pi_{t+1}^k + (1-sfp^k)\pi_{t-1}^k) - \pi_t^k\right] + u_t^{P,k} \qquad k = \{X, M\} \tag{32}$$

Exports and imports together with interest receipts/payments determine the evolution of net foreign assets denominated in domestic currency:

$$E_t B_t^F = (1+i_t^F) E_t B_{t-1}^F + P_t^X X_t - P_t^M M_t \tag{33}$$

3.4 Policy

We assume that monetary policy is partly rules based and partly discretionary. Policy responds to an output gap indicator of the business cycle. The output gap is not calculated as the difference between actual and efficient output but we try to use a measure that closely approximates the standard practice of output gap calculation as used for fiscal surveillance and monetary policy (see Denis *et al.*, 2006). Often a production function framework is used where the output gap is defined as deviation of capital and labour utilisation from their long run trends. Therefore we define the output gap as:

$$YGAP_t = \left(\frac{ucap_t}{ucap_t^{ss}}\right)^{(1-\alpha)} \left(\frac{L_t}{L_t^{ss}}\right)^{\alpha} \tag{34}$$

where L_t^{ss} and $ucap_t^{ss}$ are moving average steady state employment rate and capacity utilisation:

$$ucap_t^{ss} = (1-\rho^{ucap}) ucap_{t-1}^{ss} + \rho^{ucap} ucap_t^j \tag{35}$$

$$L_t^{ss} = (1-\rho^{Lss}) L_{t-1}^{ss} + \rho^{Lss} L_t \tag{36}$$

which we restrict to move slowly in response to actual values.

Monetary policy is modelled via the following Taylor rule, which allows for some smoothness of the interest rate response to the inflation and output gap:

$$\begin{aligned} i_t = {} & \tau_{lag}^{INOM} i_{t-1} + (1-\tau_{lag}^{INOM})[r^{EQ} + \pi^T + \tau_{\pi}^{INOM}(\pi_t^C - \pi^T) + \tau_{y,1}^{INOM} ygap_{t-1}] \\ & + \tau_{y,2}^{INOM} ({}_t ygap_{t+1} - ygap_t) + u_t^{INOM} \end{aligned} \tag{37}$$

The Central bank has a constant inflation target π^T and it adjusts interest rates whenever actual consumer price inflation deviates from the target. The central bank also responds to the output gap. There is also some inertia in nominal interest rate setting. There is no active fiscal policy.

In the government budget constraint, we distinguish on the expenditure side government consumption, government investment, transfer payments to households and investment subsidies. Revenue consists of taxes on consumption as well as capital and labour income, and lump-sum taxes. Government debt (B_t) evolves according to:

$$B_t = (1+i_t) B_{t-1} + P_t^C C_t^G + P_t^C I_t^G + TR_t + itc_t P_t^I I_t - t_t^w W_t L_t - t_t^c P_t^c C_t - t_t^K i_t^K P_t^I K_{t-1} - T_t^{LS} \tag{38}$$

The labour income tax rate is used for controlling the debt-to-GDP ratio according to the following rule:

$$\Delta t_t^w = \tau^B \left(\frac{B_{t-1}}{Y_{t-1}P_{t-1}} - b^T\right) + \tau^{DEF} \Delta\left(\frac{B_t}{Y_t P_t}\right) \tag{39}$$

where b^T is the government debt target.

4 Model calibration

The model used in this exercise consists of six regions: the Euro area, the new member states not participating in the euro, the rest of the EU, the US, emerging Asia and the rest of the world. The regions are differentiated from one another by their economic size and the model is calibrated on bilateral trade flows. Although the calibration incorporates some of the main stylised differences between the regions, it relies heavily on estimates of this model on euro area and US data (see Ratto *et al*., 2009a and 2009b). Table 2 summarises the main differences between the blocks, which are, for the EU countries, generally higher transfers and unemployment benefits, higher wage taxes, higher price rigidities and labour adjustment costs, and a lower elasticity of labour supply.

In terms of nominal and real rigidities, our estimates reveal differences which are largely consistent with prior expectations and other empirical evidence. This is most clear when it comes to price adjustment rigidities. European firms keep prices fixed for more quarters than US firms. However, our estimates suggest that the duration of wage spells in the US is similar to those in the EA. There are significant differences in the labour supply elasticity. A significantly higher elasticity in the US translates into a smaller response in US wages to changes in employment. Higher labour adjustment costs in the EU reflect higher employment protection in the EU. We assume similar capital adjustment costs in all regions. Concerning financial market frictions, we assume 30 percent of households to be liquidity-constrained, which corresponds closely to our estimates, and we keep this share unchanged. When we include collateral constrained households in the model we assume their share is 30 percent of households, and the remainder are all unconstrained "Ricardian" households (when for comparison in section 5 we exclude collateral constraints the share of Ricardian households is 70 percent). The loan-to-value ratio ($1-\chi$) is set at 0.75 in all regions, calibrated to fit a mortgage debt ratio as share of GDP on the baseline of around 50 percent. Estimated Taylor rules do not point to sizeable differences in monetary policy behaviour and we set these parameters identical. Other important stylised difference between regions are the size and generosity of the transfer system.

5 Fiscal instruments and their multipliers

There is no single fiscal multiplier but the size depends on a number of factors. Table 3 shows the fiscal multipliers of various fiscal instruments in 1) a model without collateral constraints, 2) in the model with collateral constrained households, and 3) in a model with collateral constrained households and with monetary accommodation. The multipliers reported in this table are for the EU as an aggregate region. Single country results will be somewhat smaller as the degree of openness of the economy also plays a significant role. In a small open economy more of the fiscal stimulus will leak abroad through higher imports. The duration is also important and the impact of a fiscal stimulus depends crucially on whether the shock is credibly temporary or perceived to be permanent. In the latter case, economic agents will anticipate higher tax liabilities and increase their savings, leading to stronger crowding out and smaller GDP effects. We only consider temporary fiscal stimulus here and focus on one year shocks of 1 per cent of baseline GDP.

In general, GDP effects are larger for public spending shocks (government consumption and

Table 2

Model Calibration

Item	EA	NE	REU	US	AS	RW
Nominal rigidities						
Avg. duration between price adjustments *(quarters)*	5.5	5.5	5.5	5	5	5
Avg. wage contract length *(quarters)*	4.5	4.5	4.5	4.5	4.5	4.5
Real rigidities						
Labour adjustment cost *(percent of total add. wage costs)* (γ_L)	13	13	13	10	10	10
Labour supply elasticity ($1/\kappa$)	1/5	1/5	1/5	1/3	1/3	1/3
Semi-wage elasticity w.r.t. employment rate (κ/γ_w)	0.33	0.33	0.33	0.20	0.20	0.20
Capital adjustment cost (γ_K)	20	20	20	20	20	20
Investment adjustment cost (γ_I)	75	75	75	75	75	75
Consumption						
Share of liquidity-constrained consumers s^l	0.3	0.3	0.3	0.3	0.3	0.3
Share of credit-constrained consumers s^c	0.3	0.3	0.3	0.3	0.3	0.3
Share of non-constrained consumers s^r	0.4	0.4	0.4	0.4	0.4	0.4
Downpayment rate χ	0.25	0.25	0.25	0.25	0.25	0.25
Habit persistence h	0.7	0.7	0.7	0.7	0.7	0.7
Monetary policy						
Lagged interest rate τ_{lag}^{INOM}	0.82	0.82	0.82	0.82	0.82	0.82
Consumer price inflation τ_{π}^{INOM}	1.5	1.5	1.5	1.5	1.5	1.5
Output gap τ_{Y}^{INOM}	0.05	0.05	0.05	0.05	0.05	0.05
National accounts						
Consumption	0.59	0.59	0.59	0.64	0.64	0.64
Investment tradedables	0.06	0.06	0.06	0.05	0.05	0.05
Investment non-tradables	0.07	0.07	0.07	0.06	0.06	0.06
Investment residential	0.06	0.06	0.06	0.06	0.06	0.06
Government consumption	0.18	0.18	0.18	0.15	0.15	0.15
Government investment	0.04	0.04	0.04	0.04	0.04	0.04
Exports	0.18	0.45	0.30	0.15	0.15	0.40
Imports	0.18	0.45	0.30	0.15	0.15	0.40
Transfers to households	0.16	0.16	0.16	0.13	0.13	0.13

investment) than for tax reductions and transfers to households. Increasing *investment subsidies* yields sizeable effects especially if it is temporary since it leads to a reallocation of investment spending into the period the purchase of new equipment and structures is subsidised. *Government investment* yields a somewhat larger GDP multiplier than *purchases of goods and services*. However, it is mainly the long run GDP multiplier which shows a significant difference because of the productivity enhancing effects of government investment. An increase in *government transfers* has a smaller multiplier, as it goes along with negative labour supply incentives. However, transfers targeted to liquidity constrained consumers provide a more powerful stimulus as these consumers have a larger marginal propensity to consume out of current net income.

Temporary reductions in *value added* and *labour taxes* show smaller multipliers, but in these cases it is nearly entirely generated by higher spending of the private sector. A temporary reduction in consumption taxes is more effective than a reduction in labour taxes as also forward looking households respond to this change in the intertemporal terms of trade.[5] A temporary reduction of taxes is attractive from a credibility point of view, since the private sector is likely to believe in a reversal of a temporary tax cut more than into a reversing of a temporary spending increase. Temporary *corporate tax* reduction would not yield positive short run GDP effects since firms calculate the tax burden from an investment project over its entire life cycle.

The presence of credit-constrained agents raises the multiplier as these agents have a larger marginal propensity to consume out of current net income. The multiplier increases especially for those fiscal measures which increase current income of households directly, such as labour taxes and transfers, while the increase is less strong for government consumption and investment. The reason for this is that credit constrained households not only have a higher marginal propensity to consume out of current income but their spending is also highly sensitive to changes in real interest rates (see Röger and in 't Veld, 2009). This is because the collateral constraint requires that spending must be adjusted to changes in interest payments. In other words, the interest rate exerts an income effect on spending of credit constrained households. For realistic magnitudes of indebtedness, the interest sensitivity exceeds the interest elasticity of spending of Ricardian households substantially.

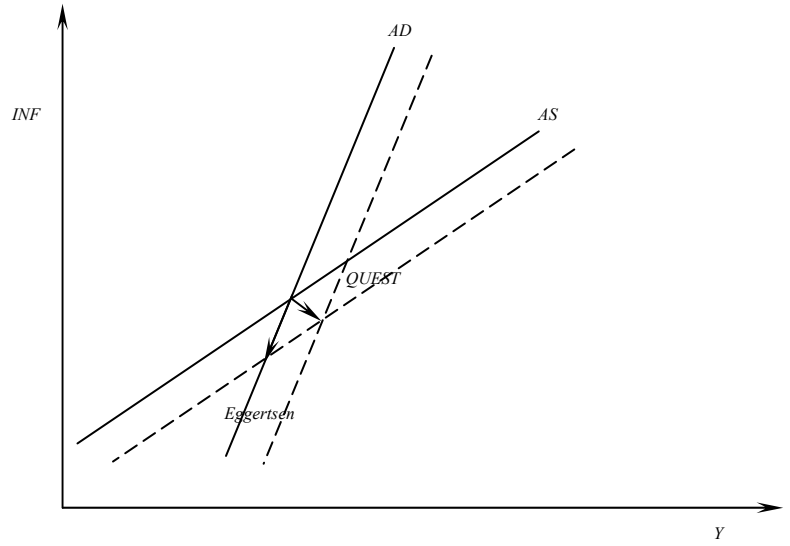
Fiscal policy multipliers become very much larger when the fiscal stimulus is accompanied by monetary accommodation. This is particularly relevant in the current crisis with interest rates at, or close to, their lower zero bound. Under normal circumstances a fiscal stimulus would put upward pressure on inflation and give rise to an increase in interest rates. With monetary accommodation and nominal interest rates held constant, higher inflation will lead to a decrease in real interest rates and this indirect monetary channel amplifies the GDP impact of the fiscal stimulus (Christiano *et al.*, 2009, Erceg and Linde, 2009). As shown in Röger and in 't Veld (2009), under monetary accommodation, both spending and tax multipliers are considerably larger and this effect is amplified in the presence of credit constrained households. For the case where nominal interest rates are kept constant for four quarters, the government consumption multiplier increases by about 40 per cent with collateral constrained households, while it would only increase by about 10 per cent without credit constraints. The latter increase of the multiplier is similar to the change of multiplier obtained by Christiano *et al.* (2009) for the same experiment. This amplification effect of the zero bound multiplier with credit constraints is again due to the strong response of spending of credit constrained households to changes in real interest rates.

The zero bound increases the multiplier substantially for all expenditure and revenue categories, except for labour taxes, where the increase in the multiplier is insignificant. This can easily be explained by the fact that a central mechanism which increases the expenditure multiplier

[5] Note that this assumes the VAT reduction is fully passed through into consumer prices. This intertemporal effect will be strongest in the period just before taxes are raised again (in t+1).

Figure 1

The Effect of Cutting Taxes at the Zero Bound



at the zero bound, namely an increase in inflation is likely not be present in this case, or is even reversed because a reduction in labour taxes will at least partly be shifted onto firms and thus will end up in lower prices. Nevertheless, this result is in sharp contrast to a result obtained by Eggertson (2009), who claims that the labour tax multiplier at the zero bound will be negative. His argument is based on the assumption that a labour tax reduction will only shift the aggregate supply (AS) curve to the right in the inflation-GDP space, while the aggregate demand (AD)curve does not shift and is upward sloping in the case of a zero bound. In contrast to this analysis, in the QUEST model there is also a shift of aggregate demand associated with a tax cut (see Figure 1).

There are at least three important sources for such a shift and two of them are not present in Eggertson's model. First, there is a international competitiveness effect as a result of declining costs, which increases net external demand. Second, there is a shift in corporate investment because of an increase in the marginal product of existing capital because of an increase in employment. Both of them are not present in Eggertson's model. However, a tax reduction also shifts consumer spending either via higher net labour income or higher employment a combination of which must necessarily result from a labour tax cut. These three demand effects taken together make it unlikely that the labour tax multiplier turns negative at the zero bound.

Finally, there are also sizeable positive *spill-over effects* from fiscal stimuli. The effects of a global fiscal stimulus (as in the final three columns in Table 1) are larger than when the EU acts alone. In the current crisis there has been a global fiscal stimulus with large fiscal packages implemented in all G20 countries, and model simulations suggest this resulted in larger multipliers.[6]

The table also indicates the costs of a withdrawal of a stimulus. These also depend on the presence of collateral constraints and on monetary policy accommodation. As long as credit conditions remain tight, and more households face a binding collateral constraint on their borrowing, the larger the costs of a withdrawal of fiscal stimulus. Second, as long as interest rates remain low, monetary policy is less likely to support a fiscal tightening by reducing interest rates. An early withdrawal of fiscal stimulus risks a much sharper contraction in output than when the exit is delayed till monetary conditions have returned to normal.

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[6] In the Annex we provide an assessment of the fiscal stimulus measures by member states for 2009 and 2010, as outlined in Section 2, and calculate the estimated GDP impact according to these multipliers depending on whether the stimulus is temporary or permanent (in the latter case multipliers are lower, see Röger and in 't Veld, 2009), and depending on whether the stimulus is accompanied by monetary accommodation.

Table 3

Fiscal Multipliers

Item	EU Alone			Global Stimulus		
	Without Collat. Constr.	**With Collat. Constr.**	**With Collat. Constr. + Mon. Acc.**	**Without Collat. Constr.**	**With Collat. Constr.**	**With Collat. Constr. + Mon. Acc.**
Investment subsidies	1.29	1.36	2.1	1.8	1.93	2.65
Government investment	0.87	0.89	1.22	1.04	1.07	1.33
Government consumption	0.75	0.77	1.17	0.93	0.98	1.33
General transfers	0.18	0.38	0.59	0.23	0.49	0.65
Transfers targetted to collateral constrained hh.	-	0.63	0.98	-	0.81	1.08
Transfers targetted to liquidity constrained hh.	0.63	0.66	1.02	0.79	0.84	1.12
Labour tax	0.23	0.41	0.47	0.26	0.48	0.52
Consumption tax	0.44	0.5	0.76	0.54	0.64	0.84
Corporate income tax	0.02	0.02	0.03	0.03	0.03	0.04

Note: Effect on EU GDP (percent diff. from baseline) for a temporary one year fiscal stimulus of 1 per cent of baseline GDP.

6 Simulations of fiscal stimulus in a credit crunch

The global recession has hit the various Member States of the European Union to different degrees. Ireland, the Baltic countries, Hungary and Germany have seen the sharpest contractions, while Poland seems to have been the only country that has so far escaped an outright recession (but has also suffered a sharp slowdown in GDP growth). The financial crisis was initially driven by sharp declines in house and asset prices and a tightening of credit conditions. The extent to which the crisis has been affecting the individual Member States of the European Union strongly depends on their initial conditions and the associated vulnerabilities.[7] In particular the role of overvalued housing markets and oversized construction industries is important. Strong real house price increases have been observed in the past ten years or so in the Baltic countries, and in some cases this has been associated with buoyant construction activity. The greater the dependency of the economy on housing activity, including the dependency on wealth effects of house price increases on consumption, the greater the sensitivity of domestic demand to the financial market shock. Some Member States in Central and Eastern Europe have been particularly hard hit through this wealth channel, notably the Baltic countries.

In order to illustrate the role of fiscal policy in this crisis, we first create a "recession scenario". This credit crunch scenario is driven by a combination of domestic shocks, existing of a reduction in the loan to value ratio and shocks to arbitrage equations which explain business fixed investment and residential investment (Q-equations) that capture the bursting of a bubble in these asset prices. These shocks to arbitrage equations can be interpreted as non-fundamental shocks or as "bubbles", as they are shocks to the optimality conditions for investment and house prices. As a declining risk premium in the Q equation for investment indicates the building up of a bubble, a

[7] For a discussion, see European Economy (2009), Economic Crisis in Europe: causes, consequences and responses.

rapid rise in the risk premium indicates the bursting of a bubble. The shocks start in 2008Q1 and are calibrated such that GDP falls by about 2 per cent in 2009.[8]

Figure 2 shows the profile for GDP and the main macroeconomic components, both in the case of debt denominated in domestic currency as well as the case when debt is denominated in foreign currency. The shocks lead to sharp declines in corporate investment and in consumption and residential investment of in particular collateral constrained households. When household debt is denominated in foreign currency, the further tightening of the collateral constraint caused by the depreciation (for new member states *vis-à-vis* the euro) leads to an even sharper decline in spending by these constrained households, even though the depreciation is relatively small. This negative effect on domestic demand is stronger than the boost given to export growth from the devaluation and the decline in GDP is larger. The shocks have a negative impact on tax revenues and raise unemployment benefit spending, leading to an increase in government deficits and debt.

We can now illustrate what fiscal policy can do to mitigate the output losses of this "crisis" scenario. Figure 3 shows the effect of fiscal stimulus measures in this recession scenario. In order to avoid unnecessary duplication, we only show here results for the NE block in the model, representing the Member States in Central and Eastern Europe, and assume household debt is denominated in foreign currencies (euros). The results for the other regional blocks in the model are comparable. We consider first a one year increase in government consumption of 1 per cent of GDP. The stimulus starts in 2009q1 and is announced as a one year shock which is believed to be credible. As the NE block in the model representing the New Member States in Central and Eastern Europe is a smaller and more open economy than the EU aggregate block for which multipliers are reported in Table 2, the fiscal multiplier is significantly smaller here (0.57 compared to 0.77). Nevertheless, the fiscal stimulus helps to cushion the impact of the recession and boost output at least for the duration of the year of the stimulus. In the following year, output falls to slightly below where it would have been in the pre-stimulus recession scenario. The temporary fiscal stimulus worsens the government budget balance and raises the debt-to-GDP ratio further.

Fiscal multipliers are considerably larger when interest rates are near their zero bound as monetary policy can then accommodate the fiscal stimulus by keeping nominal interest rates unchanged and allowing real interest rates to fall due to the increase in inflationary pressures. Monetary policy in the euro area has been able to accommodate the fiscal impulse in this way but in many of the new member states monetary policy has not been able to play this supportive role as interest rates have remained (with the exception of the countries in the euro area – Slovenia and Slovakia). Figure 4 shows the much larger effects when monetary policy can accommodate the fiscal stimulus. Note that the higher growth impact also helps to lessen the impact on government deficits and debt.

While temporary fiscal stimulus can be effective in supporting output in the short run, a more prolonged stimulus package lasting many more years does not become more powerful. Collateral constrained consumers react strongly to temporary increase in disposable income, but react more like Ricardian households to permanent income shocks, smoothing their income intertemporally.[9] Figure 5 shows the impact of a more prolonged stimulus lasting for three years and then gradually phased out. The impact of this stimulus in the first quarter of the expansion is actually smaller then the impact of a one year stimulus and output falls in the medium term to a lower level. The government deficit now increases for a duration of more than 3 years, and the debt-to-GDP ratio increases by an additional 3 percentage points.

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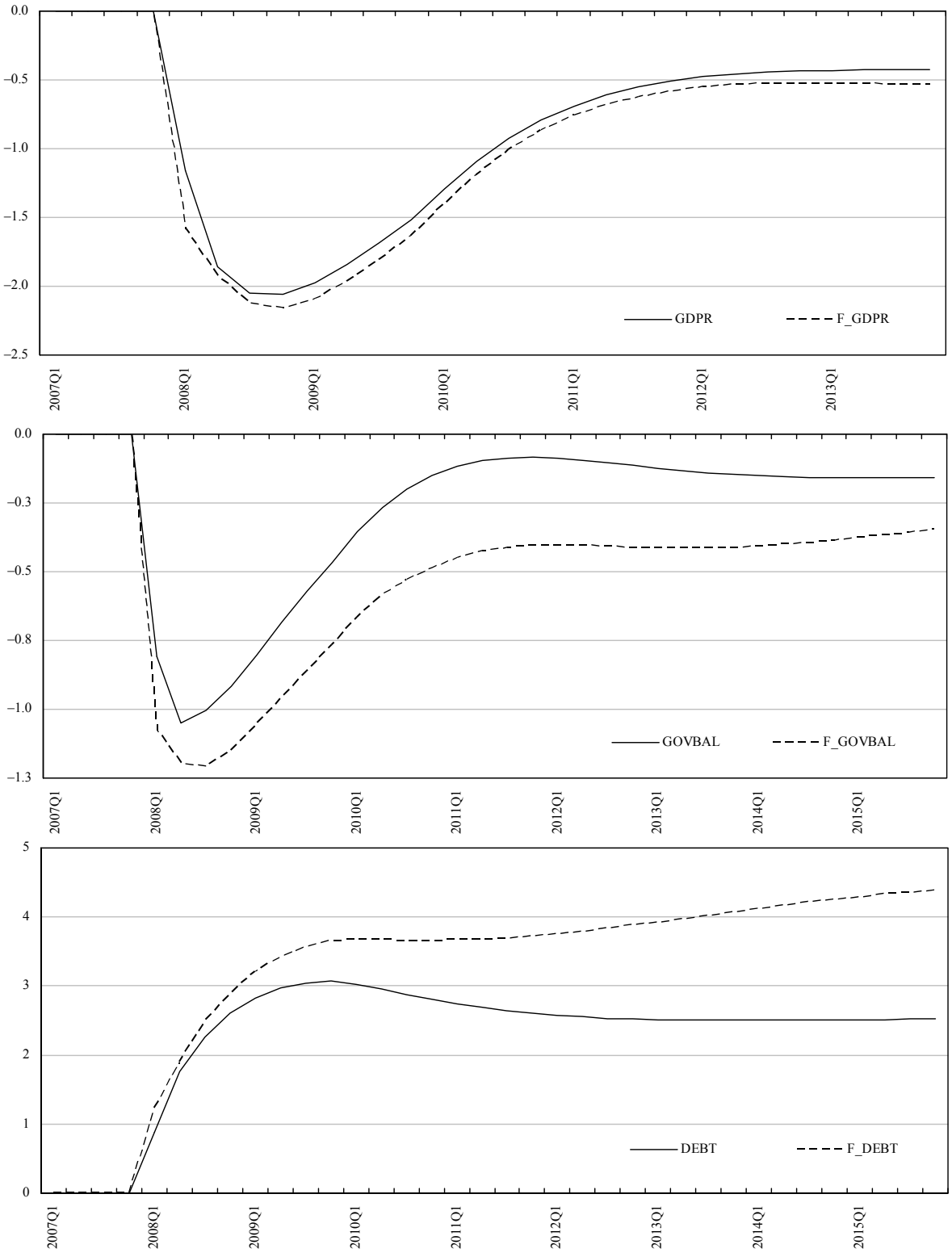
[8] This scenario merely serves as an illustrative baseline against which to show the effects of fiscal policy stimulus, and the scenario is a relatively mild recession, where the slowdown in growth is dampened by higher exports growth due to the depreciating currency. The sharp fall in world growth in 2009 which prevented this cushioning channel from operating is not simulated here.

[9] The differences between temporary and permanent fiscal shocks are shown in Röger and in 't Veld (2009).

Figure 2

Domestic Credit Crunch Scenario: GDP, Deficit/GDP Ratio, Debt/GDP Ratio



Note: GDP percentage difference from baseline, Govbal and debt as percent of GDP.
Dashed line F_: debt denominated in foreign currency.

Figure 3

Temporary Fiscal Expansion

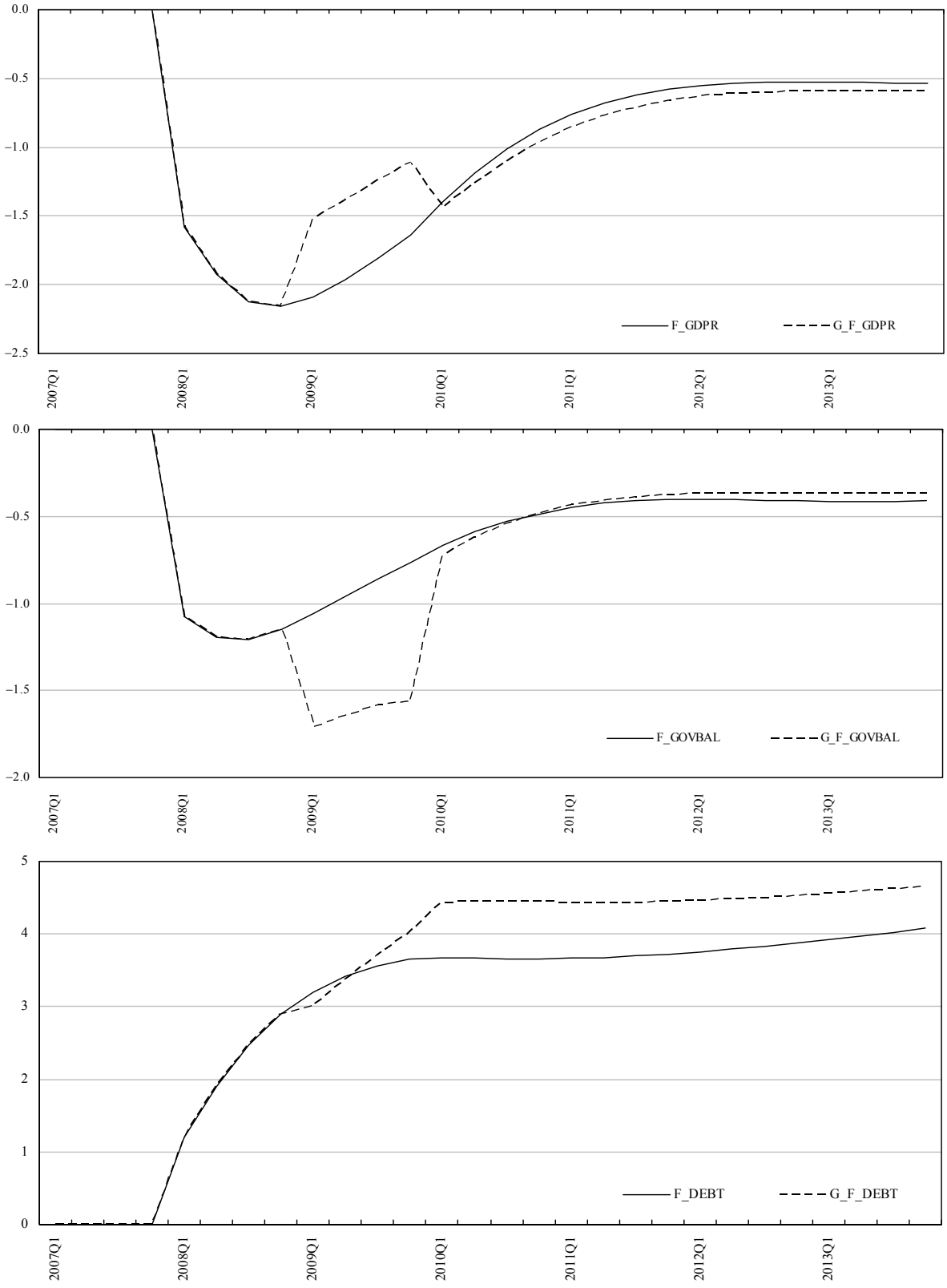


Figure 4

Temporary Fiscal Expansion with Monetary Accommodation

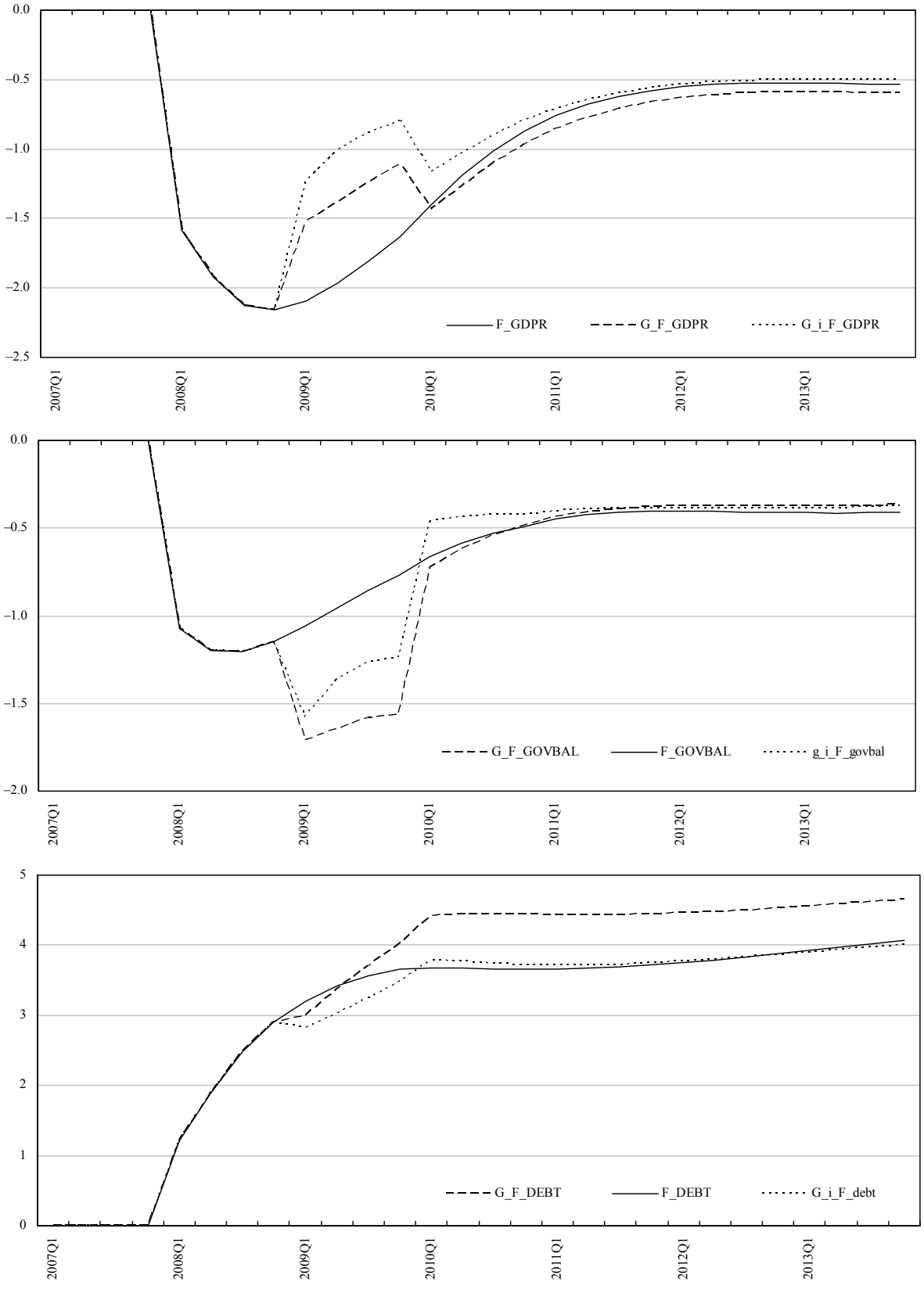


Figure 5

Temporary vs. Prolonged Fiscal Expansion

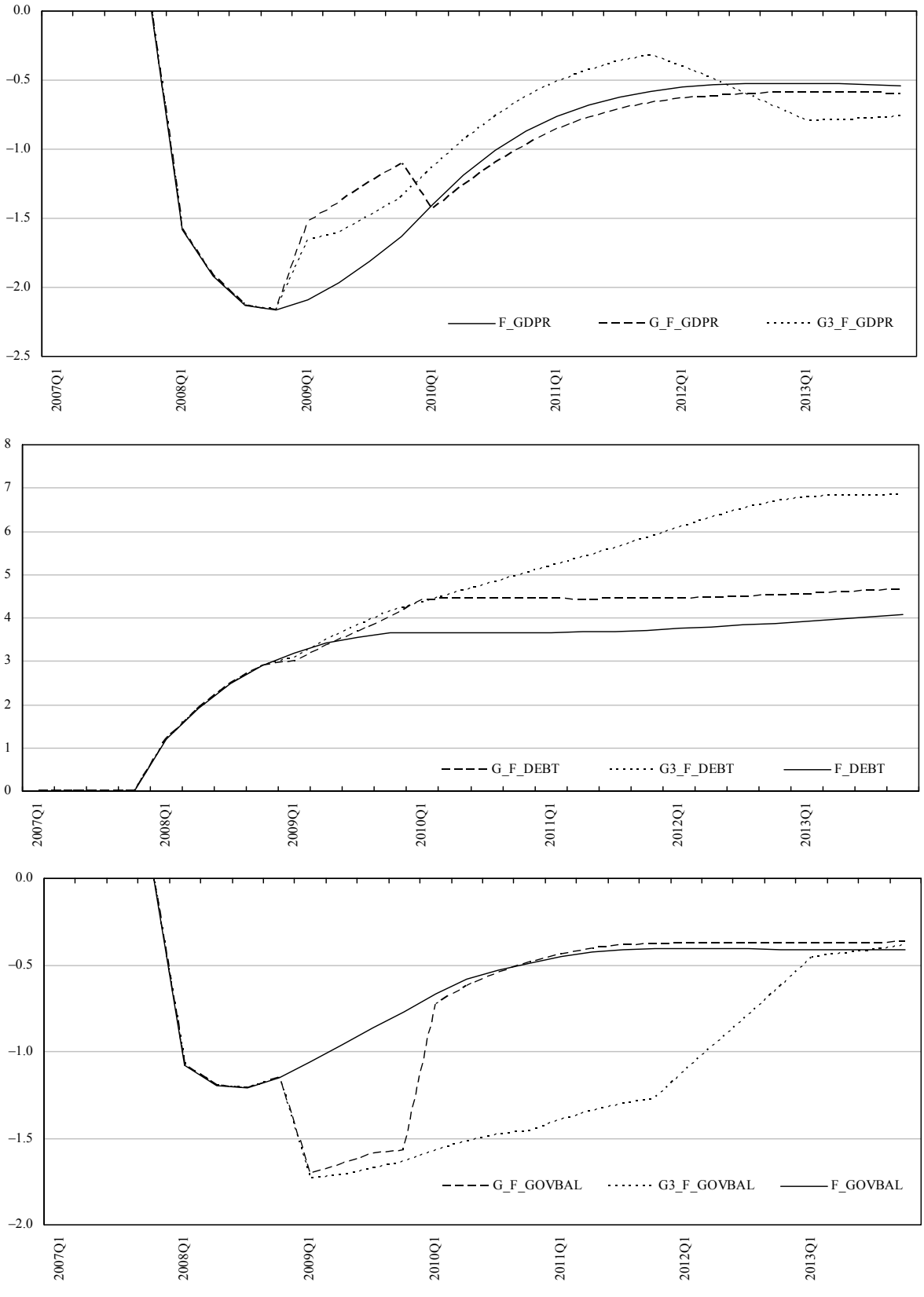
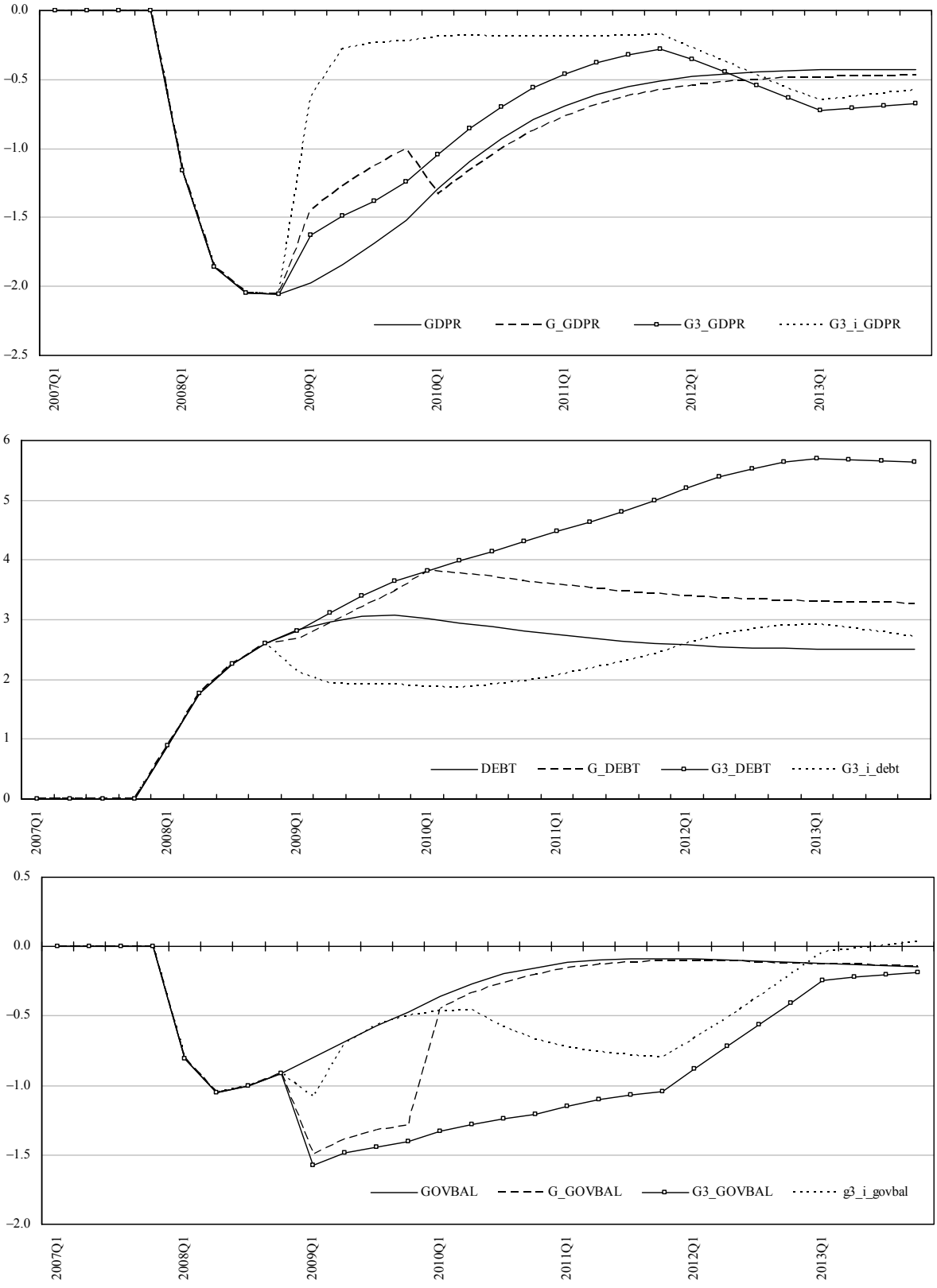


Figure 6

Temporary vs. Persistent Fiscal Expansion with Monetary Accommodation



However, a longer lasting fiscal stimulus can be significantly more effective if it is accompanied by an accommodative monetary policy. Figure 6 shows the results for this case, when nominal interest rates are kept unchanged. As the fiscal stimulus is longer lasting, more inflationary pressures build up and with unchanged nominal interest rates, real interest rates decline by more. This additional real interest rate effect has a strong impact on output and the combination of the fiscal and monetary stimulus helps to almost offset the effect of the credit crunch shocks. This real interest rate channel is effective in the euro area and the US, where interest rates are at or close to their lower zero bound, and central banks can keep nominal interest rates unchanged. Note also that at least in the short run the strong growth effects in this scenario also help to reduce the deterioration in government balances.

7 Conclusions

The paper has described a DSGE model with collateral constrained households and housing investment and used this to examine the effectiveness of fiscal stimulus measures in a credit crisis. The financial accelerator mechanism in the model allows it to be used for an analysis of falling asset prices and tightening credit conditions on the economy. The presence of credit constrained households and the fact that the zero lower bound on nominal interest rates became binding in the crisis, meant that fiscal multipliers were higher than in normal circumstances.

While the above suggests a larger role for fiscal policy in the euro area, in many of the Member States in Central and Eastern Europe interest rates were generally higher. As it is less likely that monetary policy in these countries can accommodate the fiscal impulse, fiscal policy is less effective than in countries where nominal interest rates can be kept unchanged and real interest rates are allowed to fall. However, even when monetary policy cannot accommodate the fiscal impulse, well-designed fiscal stimulus measures can still help to soften the impact of the crisis and mitigate the detrimental effects on (potential) growth.

A further analysis should shed light on the appropriate exit strategy. As noted, many of the countries most affected by the crisis, particularly among the new Member States, have had very limited room to implement stimulus measures. To the contrary, they often have predominantly adopted consolidation measures with a view to avoiding a further fall-out from the crisis. How such consolidation efforts are best designed according the DSGE modelling framework used in this paper, would be the subject of future research.

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FISCAL AND MONETARY POLICY INTERACTION: A SIMULATION-BASED ANALYSIS OF A TWO-COUNTRY NEW KEYNESIAN DSGE MODEL WITH HETEROGENEOUS HOUSEHOLDS

Marcos Valli Jorge[*] *and Fabia A. de Carvalho*[*]

This paper models a fiscal policy that pursues primary balance targets to stabilize the debt-to-GDP ratio in an open and heterogeneous economy where firms combine public and private capital to produce their goods. The model extends the European NAWM presented in Coenen et al. (2008) and Christoffel et al. (2008) by broadening the scope for fiscal policy implementation and allowing for heterogeneity in labor skills. The domestic economy is also assumed to follow a forward looking Taylor-rule consistent with an inflation targeting regime. We correct the NAWM specification of the final-goods price indices, the recursive representation of the wage setting rule, and the wage distortion index. We calibrate the model for Brazil to analyze some implications of monetary and fiscal policy interaction and explore some of the implications of fiscal policy in this class of DSGE models.

1 Introduction

DSGE models are now part of the core set of tools used by major central banks to assess the widespread effects of policy making. Building mostly on the recent New Keynesian literature (Monacelli, 2005, Galí and Monacelli, 2008, Smets and Wouters, 2003, Adolfson *et al.*, 2007, among others), these models have been further enriched in several aspects by the inclusion of alternative pricing assumptions, imperfect competition in distinct economic sectors, international financial linkages, and financial frictions. However, as Ratto *et al.* (2009) argue, "so far, not much work has been devoted towards exploring the role of fiscal policy in the *(DSGE)* New-Keynesian model".[1]

DSGE models are a promising tool to understand the outcome of interactions between fiscal and monetary policies. The recent trend in modeling the fiscal sector in New Keynesian DSGE models is to include non-Ricardian agents and activist fiscal policies (Gunter and Coenen, 2005; Mourougane and Vogel, 2008; and Ratto *et al.*, 2009) mostly to assess the effects of shocks to government consumption on the aggregate economy, as well as the distributional effects of fiscal policies. However, the practice of fiscal policy usually goes beyond the decisions on consumption expenditures. The government often intervenes in the economy through public investment with important externalities upon private investment.

Ratto *et al.* (2009) are a recent attempt to account for the strategic role of public investment in policy decisions in a DSGE setup. They introduce a rule for public investment that responds to the business cycle and assume that public capital interferes in the productivity of private firms, but does not belong to factor decisions.

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[1] Rato, Röger and in 't Veld (p. 222). The italics are ours.

In this paper, we depart from the assumption that public investment is a type of externality. We assume that firms can rent capital services from a competitive market of private and public capital goods. The optimal composition of capital services will depend on the elasticity of substitution between both types of capital goods and on a parameter that captures the economy's "dependence" on public infrastructure. Households and the government have different investment agenda, and are faced with distinct efficiency in the transformation of investment to capital goods.

The reasoning for introducing public capital goods in this manner can be rationalized as follows. In our model, intermediate goods firms are the entities that actually use public capital. In the real world, there are both (mixed-capita) firms and government agencies utilizing capital owned by the government. By letting public capital enter firms' decisions, we believe we are approximating our model to the reality of a mixed-capital economy. The production technology distinguishes between the quality of each type of capital, and as such, the demand for public capital reacts to deviations of its rental rate to the calibrated value, which we assume to be subsidized in the steady state. In the real world, the government makes decisions on investment, and the efficiency with which such investment is transformed into capital goods can differ from the efficiency of the private sector's investment. In our model we empowered our government to decide on its public investment.

Our model builds on ECB's New Area Wide Model (NAWM) presented in Coenen *et al.* (2008) and Christoffel *et al.* (2008), hereinafter referred to as CMS and CCW respectively. However, there are important distinctions. First, we change the fiscal set-up. In the ECB NAWM, government consumption and transfers follow autoregressive rules. In our model, we introduce a fiscal policy rule that tracks primary surplus targets, that responds to deviations on the debt-to-GDP ratio and that also portrays an anti-cyclic response to economic conditions. In addition, we let fiscal transfers to be biased in favor of one of the household groups, and also introduce government investment through an autoregressive rule that also pursues an investment target. With a rule for the primary surplus, for government transfers and for public investment, government consumption thus becomes endogenous. This framework better approximates the theoretical setting of these models to the current practice of fiscal policy in a number of countries, including Brazil.

Second, we augment the labor market by introducing heterogeneity in labor skills. In Brazil, labor contracts are not usually flexible as to adjustments in daily hours worked. The most usual contracts set an 8-hour workday. Therefore, it seems reasonable to allow for the possibility that members of different social classes in average earn different wages for the same amount of hours worked.

Third, we correct some equations shown in CMS and CCW. The first refers to the specification of consumer and investment price indices, which we correct to guarantee that the producers of final consumption and investment goods operate under perfect competition. These modifications yield a representation of the economy's resource constraint that also differs from the one presented in CMS and CCW. We also correct the recursive representation of the wage setting rule and the wage distortion index.

Fourth, we introduce a deterministic spread between the interest rates of domestically and internationally traded bonds to account for the risk premium that can be significant in emerging economies.

Finally, monetary policy in the domestic economy is modeled with a forward looking rule to better approximate the conduct of policy to an inflation targeting framework.

We calibrate the structural parameters of our model for the Brazilian economy and the rest of the world (USA+EURO), leaving the monetary and fiscal policy rules of the rest of the world as specified in CMS and CCW. We assess the impulse responses to arbitrary magnitudes of the shocks

and analyze the implications of the interaction between fiscal and monetary policies. In particular, we assess the macroeconomic and distributional effects of shocks to government investment, primary surplus, transfers, and monetary policy, and analyze the effects of concomitant shocks to the fiscal and monetary policy rules. We proceed with a sensitivity analysis of the impact of varying degrees of rigor in the implementation of the fiscal rule, of fiscal commitment to a sustainable path of the public debt, and of the commitment of the monetary policy to the inflation target.

The adopted calibration of fiscal and monetary policy rules lies in a region of monetary activeness and fiscal passiveness. However, the model also shows stable equilibria under alternative calibrations where, in contrast, monetary policy is passive and fiscal policy is active. Apart from the specifications where the fiscal rule has a mute response to the public debt, active fiscal policies bring about strong cyclicality in the impulse responses.

One of the important contributions of this paper is to show that an expansionist shock to the primary surplus is not equivalent to a shock to government consumption, as the former attains with a mix of cuts in both government consumption and investment. We also show that each one of the fiscal shocks – primary surplus, government investment and government transfers – has a distinct impact on the model dynamics.

Under the calibrated model, a shock that reduces the primary surplus has very short lived expansionist effects on output growth. A government investment shock, on the other hand, initially depresses output growth, since compliance with the fiscal rule requires government consumption to reduce. However, the government investment shock enables output growth expansion still within the first year after the shock. The inflationary effects of the shocks to the primary surplus and to government investment are mild, yet relatively long-lived. Shocks to government transfers have very short lived effects on economic growth. With the fiscal rule in place, an increase in government transfers induces some reduction in government consumption, which presses down production. Under our calibration, the distributional effects of all fiscal shocks end up being small, contrary to the findings of CMS and CCW likely due to the specification we adopted for labor heterogeneity.

We also experiment with different specifications of monetary and fiscal policy rules, and show that they have important effects on the models' dynamic responses and predicted moments.

Higher commitment to the stabilization of the public debt strengthens the contractionist impact of the monetary shock. The volatility of consumer price inflation increases, as does the correlation between inflation and output growth. Strongly (and negatively) correlated policy shocks also dampen the contractionist effect of the monetary policy shock.

We find a degree of fiscal rigor that jointly minimizes the influence of the primary surplus shock on inflation and of the monetary policy on GDP growth. As expected, a more rigorous implementation of the primary surplus rule implies lower variance of inflation and output growth, and significantly increases the influence of the monetary policy shock onto the variances of consumer price inflation and output growth.

Increasing the monetary policy commitment to the inflation target significantly reduces the volatility of inflation and its correlation with output growth. The variance of output growth poses a mild reduction.However, a higher commitment to the inflation target results in a higher stake of the variance of inflation being explained by the fiscal shock.

The model is also simulated under alternative monetary policy rules. Augmenting the rule to include an explicit reaction to the exchange rate variability or the output growth adds sluggishness to the reversal of inflation to the steady state after a monetary policy shock. However, the initial impact of the shock onto the economic activity is milder (yet more persistent). By activating the

policy shocks only, the response to the exchange rate volatility reduces the variance of inflation, output growth and the exchange rate. The monetary policy shock has a smaller effect on output variation and gains influence on the volatility of inflation.

On the other hand, a monetary policy rule that responds to output growth reduces output growth volatility, but increases the variance of consumer price inflation and the exchange rate. Under this policy rule, a shock to monetary policy loses influence over inflation variance, but also reduces its stake in the variance of output growth and the exchange rate.

The paper is organized as follows. Section 2 provides an overview of the model, focusing on the extensions proposed to the NAWM. Section 3 details the calibration strategy and the normalization to attain stationary representations of the aggregated variables. Section 4 analyses the impulse responses of the model and experiments with distinct types of policy orientation. The last section concludes the paper.

2 The model

In the model, there are two economies of different sizes that interact in both goods and financial markets. Except for monetary and fiscal policy rules, both economies are symmetric with respect to the structural equations that govern their dynamics, but the structural parameters are allowed to differ across countries.

Each economy is composed of households, firms, and the government. Households are distributed in two continuous sets that differ as to their access to capital and financial markets, and also to their labor skills. Families in the less specialized group, hereinafter referred to as group $I = [1-\omega,1]$, can smooth consumption only through non-interest bearing money holdings, whilst the other group of households in group $I = [0,1-\omega]$, with more specialized skills, has full access to capital, and to domestic and international financial markets. The differentiation in households' ability to smooth consumption over time, a feature adopted in CMS and CCW, allows for breaking the Ricardian Equivalence in this model. Within their groups, households supply labor in a competitive monopolistic labor market to produce intermediate goods. There are Calvo-type wage rigidities combined with hybrid wage indexation rules.

Firms are distributed in two sets. The first produces intermediate goods for both domestic and foreign markets, and operates under monopolistic competition with Calvo-type price rigidities combined with hybrid price indexation. The other set is composed of three firms, each one of them producing one single type of final good: private consumption, public consumption, or investment goods. Final goods firms are assumed to operate under perfect competition.

The government comprises a monetary authority that sets nominal interest rates and issues money, and a fiscal authority that levies taxes on most economic activities, and endogenously adjusts its consumption expenditures to comply with its investment, distributional transfers, and primary surplus rules.

A detailed derivation of the model is available in Appendix H. In the remaining of this section, we correct important equations in CMS and CCW and model a fiscal sector that is more in line with the current practice of fiscal policy in a wide number of countries. Public investment has spillover effects over private investment and affects the market for capital goods.

2.1 Wage setting

Household $i \in I = [0,1-\omega]$ chooses consumption $C_{i,t}$ and labor services $N_{i,t}$ to maximize the separable intertemporal utility with external habit formation:

$$E_t\left\{\sum_{k=0}^{\infty}\beta^k\left[\tfrac{1}{1-\sigma}\left(C_{i,t+k}-\kappa.C_{I,t+k-1}\right)^{1-\sigma}-\tfrac{1}{1+\zeta}\left(N_{i,t+k}^{1+\zeta}\right)\right]\right\} \tag{1}$$

subject to the budget constraint:

$$\begin{aligned}&\left(1+\tau_t^C+\Gamma_v(v_{i,t})\right)P_{C,t}C_{i,t}+P_{I,t}I_{i,H,t}+R_t^{-1}B_{i,t+1}\\&+\left(\left(1-\Gamma_{B^F}(B_{I,t}^F)\right).rp.R_{F,t}\right)^{-1}S_tB_{i,t+1}^F+M_{i,t}+\Xi_{i,t}+\Phi_{i,t}\\=\;&\left(1-\tau_t^N-\tau_t^{W_h}\right)W_{i,t}N_{i,t}+\left(1-\tau_t^K\right)\left[u_{i,t}R_{K,H,t}-\Gamma_u(u_{i,t})P_{I,t}\right]K_{i,H,t}+\tau_t^K.\delta.P_{I,t}.K_{i,H,t}\\&+\left(1-\tau_t^D\right)D_{i,t}+TR_{i,t}-T_{i,t}+B_{i,t}+S_tB_{i,t}^F+M_{i,t-1}\end{aligned} \tag{2}$$

where $W_{i,t}$ is the wage earned by the household for one unit of labor services, $I_{i,H,t}$ is private investment in capital goods, $B_{i,t+1}$ are domestic government bonds, $M_{i,t}$ is money, $B_{i,t+1}^F$ are foreign private bonds, S_t is the nominal exchange rate, $R_{F,t}$ is the interest rate of the foreign bonds, rp is the steady state spread between interest rates of domestically and internationally traded bonds, $\Gamma_{B^F}\left(B_{I,t}^F\right)$ is an extra risk premium when the external debt deviates from the steady state, $\Gamma_v(v_{i,t})$ is a transaction cost on consumption, $v_{i,t}$ is the money-velocity of consumption, $D_{i,t}$ are dividends, $K_{i,H,t}$ is the private capital stock, $u_{i,t}$ is capital utilization, $\Gamma_u(u_{i,t})$ is the cost of deviating from the steady state rate of capital utilization, $R_{K,H,t}$ is the gross rate of the return on private capital, $TR_{i,t}$ are transfers from the government, $\Xi_{i,t}$ is a lump sum rebate on the risk premium introduced in the negotiation of international bonds, and $\Phi_{i,t}$ is the stock of contingent securities negotiated within group *I*, which act as an insurance against risks on labor income. Taxes are τ_t^C (consumption), τ_t^N (labor income), $\tau_t^{W_h}$ (social security), τ_t^K (capital income), τ_t^D (dividends) and $T_{i,t}$ (lump sum, active only for the foreign economy). The parameter κ is the external habit persistence, β is the intertemporal discount factor, $1/\sigma$ is the intertemporal elasticity of consumption substitution, $1/\zeta$ is the elasticity of labor effort relative to the real wage, and δ is the depreciation of capital. Price indices are $P_{C,t}$ and $P_{I,t}$, the prices of final consumption and investment goods, respectively. Cost functions are detailed in Appendix A.

Households in group *J* maximize a utility function analogous to (1), but constrained on their investment choices, allowed to transfer wealth from one period to another only through non-interest bearing money holdings.

Within each group, households compete in a monopolistic competitive labor market. By setting wage $W_{i,t}$, household *i* commits to meeting any labor demand $N_{i,t}$. Wages are set *à la* Calvo, with a probability $(1-\xi_I)$ of optimizing each period. Households that do not optimize

readjust their wages based on a geometric average of realized and steady state inflation $\overline{W}_{i,t} := \left(\frac{P_{C,t-1}}{P_{C,t-2}}\right)^{\chi_I} \pi_C^{1-\chi_I} W_{i,t-1}$. Optimizing households in group *I* choose the same wage $\widetilde{W}_{i,t}$, which we denote $\widetilde{W}_{I,t}$.

Household *i*'s optimization with respect to the wage $\widetilde{W}_{i,t}$ yields the first order condition, which is the same for every optimizing household:

$$E_t\left\{\sum_{k=0}^{\infty}\left[(\xi_I\beta)^k N_{i,t+k}\left(\begin{array}{l}\Lambda_{i,t+k}\left(1-\tau_{t+k}^{N}-\tau_{t+k}^{W_h}\right)\frac{\widetilde{W}_{I,t}}{P_{C,t+k}}\left(\frac{P_{C,t+k-1}}{P_{C,t-1}}\right)^{\chi_I}\pi_C^{(1-\chi_I)k} \\ -\frac{\eta_I}{\eta_I-1}\left(N_{i,t+k}\right)^{\zeta}\end{array}\right)\right]\right\}=0 \tag{3}$$

where $\frac{\Lambda_{i,t}}{P_{C,t}}$ is the Lagrange multipliers for the budget constraint, and $\eta_I/(\eta_I-1)$ is the after-tax real wage markup, in the absence of wage rigidity (when $\xi_I \to 0$), with respect to the marginal rate of substitution between consumption and leisure. The markup results from the worker's market power to set wages.

Equation (3) can be expressed in the following recursive form, which corrects the one presented in CMS after including the multiplicative constant $(1-\omega)^{\zeta}$ on the left hand side. This constant arises from the labor demand equation:

$$(1-\omega)^{\zeta}.\left(\frac{\widetilde{W}_{I,t}}{P_{C,t}}\right)^{1+\eta_I.\zeta} = \frac{\eta_I}{\eta_I-1}.\frac{F_{I,t}}{G_{I,t}} \tag{4}$$

where:

$$F_{I,t} := \left(\left(\frac{W_{I,t}}{P_{C,t}}\right)^{\eta_I} N_t^I\right)^{1+\zeta} + \xi_I.\beta.E_t\left\{\left(\frac{\pi_{C,t+1}}{\pi_{C,t}^{\chi_I}.\pi_C^{1-\chi_I}}\right)^{\eta_I(1+\zeta)}.F_{I,t+1}\right\}$$

$$G_{I,t} := \Lambda_{I,t}\left(1-\tau_t^N-\tau_t^{W_h}\right)\left(\frac{W_{I,t}}{P_{C,t}}\right)^{\eta_I} N_t^I + \xi_I.\beta.E_t\left\{\left(\frac{\pi_{C,t+1}}{\pi_{C,t}^{\chi_I}.\pi_C^{1-\chi_I}}\right)^{\eta_I-1}.G_{I,t+1}\right\}$$

and N_t^I is households group *I* aggregate labor demanded by firms, and $W_{I,t}$ is household group *I*'s aggregate wage index. Superscripts in the labor variable represent demand. Subscripts represent supply.

The derivation of equation (4) is detailed in Appendix B.

2.2 Production

There are two types of firms in the model: producers of tradable intermediate goods and

producers of non-tradable final goods.

2.2.1 Intermediate goods firms

A continuum of firms, indexed by $f \in [0,1]$, produce tradable intermediate goods $Y_{f,t}$ under monopolistic competition. We depart from the set-up in CMS by introducing mixed capital as an input to the production of these goods. We assume that firms competitively rent capital services from the government, $K^S_{G,f,t}$, and from households in group *I,* $K^S_{H,f,t}$, and transform them into the total capital input $K^S_{f,t}$ through the following CES technology:

$$K^S_{f,t} = \left[(1-\omega_g)^{1-\eta_g} . \left(K^S_{H,f,t}\right)^{\frac{\eta_g - 1}{\eta_g}} + (\omega_g)^{1-\eta_g} . \left(K^S_{G,f,t}\right)^{\frac{\eta_g - 1}{\eta_g}} \right]^{\frac{\eta_g}{\eta_g - 1}} \tag{5}$$

where ω_g is the economy's degree of dependence on government investment, and η_g stands for the elasticity of substitution between private and public goods, and also relates to the sensitivity of demand to the cost variation in each type of capital.

In addition to renting capital services, intermediate goods firms hire labor $N^D_{f,t}$ from all groups of households to produce the intermediate good Y_t using the technology:

$$Y_{f,t} = z_t . \left(K^S_{f,t}\right)^{\alpha} . \left(zn_t . N^D_{f,t}\right)^{1-\alpha} - \psi . zn_t \tag{6}$$

where $\psi . zn_t$ is a cost, which in steady state is constant relative to the output. The constant ψ is chosen to ensure zero profit in the steady state, and z_t and zn_t are respectively (temporary) neutral and (permanent) labor-augmenting productivity shocks that follow the processes:

$$\ln(z_t) = (1-\rho_z).\ln(z) + \rho_z . \ln(z_{t-1}) + \varepsilon_{z,t} \tag{7}$$

and:

$$\frac{zn_t}{zn_{t-1}} = (1-\rho_{zn}).gy + \rho_{zn} . \frac{zn_{t-1}}{zn_{t-2}} + \varepsilon_{zn,t} \tag{8}$$

where z is the stationary level of total factor productivity, gy is the steady state growth rate of labor productivity, ρ_z and ρ_{zn} are parameters, and $\varepsilon_{z,t}$ and $\varepsilon_{zn,t}$ are exogenous white noise processes.

In equilibrium, $K^S_{f,t} = u_{I,t} K_{f,t}$, where $K_{f,t}$ is the stock of capital used by firm *f*.

For a given total demand for capital services, the intermediate firm minimizes the total cost of private and public capital services, solving:

$$\min_{K^S_{H,f,t}, K^S_{G,f,t}} R^H_{K,t} K^S_{H,f,t} + R^G_{K,t} K^S_{G,f,t} \tag{9}$$

subject to (5).

The rental rate on private capital services results from the equilibrium conditions in the private capital market. The rental rate on government capital services also results from equilibrium conditions, this time in the market for government capital goods, but, in steady state, we calibrate ω_g in order to have the rental rate of public capital goods exclusively covering expenses with capital depreciation, so as to portrait the idea that public capital is usually subsidized.

First order conditions to this problem yield the average rate of return on capital and the aggregate demand functions for each type of capital goods services:

$$R_{K,t} = \left((1-\omega_g).\left(R^{H}_{K,t}\right)^{1-\eta_g} + \omega_g.\left(R^{G}_{K,t}\right)^{1-\eta_g}\right)^{\frac{1}{1-\eta_g}} \tag{10}$$

$$K^{S}_{G,t} = \omega_g\left(\frac{R_{G,t}}{R_{K,t}}\right)^{-\eta_g} K^{S}_{t} \tag{11}$$

$$K^{S}_{H,t} = \left(1-\omega_g\right)\left(\frac{R_{H,t}}{R_{K,t}}\right)^{-\eta_g} K^{S}_{t} \tag{12}$$

All firms are identical since they solve the same optimization problem. The aggregate composition of capital services rented by intermediate goods firms can be restated by suppressing the subscript "*f*" from (5), using (10), and aggregating the different types of capital services across firms:

$$K^{S}_{t} = \left((1-\omega_g)^{1/\eta_g}\left(K^{S}_{H,t}\right)^{\frac{\eta_g-1}{\eta_g}} + \omega_g^{1/\eta_g}\left(K^{S}_{G,t}\right)^{\frac{\eta_g-1}{\eta_g}}\right)^{\frac{\eta_g}{\eta_g-1}} \tag{15}$$

We also depart from CMS by introducing differentiated labor skills in the model. We reason that individuals with a lower degree of formal education are usually more constrained on their ability to analyze more sofisticated investment possibilities. In addition, it also seems reasonable to hypothesize that individuals with a lower degree of education will also have lower level of labor skills. Therefore, we make the assumption that the group of households that is investment-constrained in our model also has lower labor skills. This modeling strategy allows for a steady state where skillful workers can earn more yet working the same amount of hours as the less skilled. In addition to the labor differentiation arising from the assumption of monopolistic competition in the labor market, the non-homogeneity that we introduce here within household groups generates important differences in the impulse-responses of the model compared to CMS, as we show in Section 4.

The labor input used by firm *f* in the production of intermediate goods is a composite of labor demanded to both groups of households. In addition to the population-size adjustment (ω) that CMS add to the firm's labor demand, we add the parameter $v_\omega \in \left[0, 1/\omega\right]$ to introduce a bias in favor of more skilled workers. The resulting labor composite obtains from the following transformation technology:

$$N^{D}_{f,t} := \left((1-v_\omega\omega)^{1/\eta}\left(N^{I}_{f,t}\right)^{1-1/\eta} + \left(v_\omega\omega\right)^{1/\eta}\left(N^{J}_{f,t}\right)^{1-1/\eta}\right)^{\eta/(\eta-1)} \tag{14}$$

where:

$$N_{f,t}^{I} := \left[\left(\frac{1}{1-\omega} \right)^{1/\eta_I} \int_{0}^{1-\omega} \left(N_{f,t}^{i} \right)^{1-1/\eta_I} di \right]^{\eta_I/(\eta_I-1)} \tag{15}$$

$$N_{f,t}^{J} := \left[\left(\frac{1}{\omega} \right)^{1/\eta_J} \int_{1-\omega}^{1} \left(N_{f,t}^{j} \right)^{1-1/\eta_J} dj \right]^{\eta_J/(\eta_J-1)} \tag{16}$$

and where η is the price-elasticity to demand for specific labor bundles, η_I and η_J are the price-elasticities for specific labor varieties. The special case when $v_\omega = 1$ corresponds to the equally skilled workers assumption, as in CMS.

Taking average wages ($W_{I,t}$ and $W_{J,t}$) in both groups as given, firms choose how much to hire from both groups of households by minimizing total labor cost $W_{I,t}N_{f,t}^{I} + W_{J,t}N_{f,t}^{J}$ subject to (14). It follows from first order conditions that the aggregate wage is:

$$W_t = \left[(1 - v_\omega.\omega).W_{I,t}^{1-\eta} + v_\omega.\omega.W_{J,t}^{1-\eta} \right]^{\frac{1}{1-\eta}} \tag{17}$$

and the aggregate demand functions for each group of households are:

$$N_t^{I} = (1 - v_\omega.\omega).\left(\frac{W_{I,t}}{W_t} \right)^{-\eta}.N_t^{D} \tag{18}$$

$$N_t^{J} = v_\omega.\omega.\left(\frac{W_{J,t}}{W_t} \right)^{-\eta}.N_t^{D} \tag{19}$$

2.2.2 Final goods firms

As in CMS, there are three firms producing non-tradable final goods. One specializes in the production of private consumption goods, another in public consumption goods, and the third in investment goods. Except for the firm that produces public consumption goods, all final goods producers combine domestic and imported intermediate goods in their production. The differentiation of public consumption goods stems from the evidence that usually the greatest share of government consumption is composed of services, which are heavily based on domestic human resources.

The existence of an adjustment cost to the share of imported goods in the production of final goods invalidates the standard result that the Lagrange multiplier of the technology constraint equals the price index of final goods. In this new context, we derive below the price index of private consumption goods and investment goods to ensure that final goods firms operate under perfect competition The pricing of public consumption goods is exactly the same as in CMS.

2.2.2.a Private consumption goods

To produce private consumption goods Q_t^C, the firm purchases bundles of domestic H_t^C and foreign IM_t^C intermediate goods. Whenever it adjusts its imported share of inputs, the firm

faces a cost, $\Gamma_{IM^C}(IM_t^C / Q_t^C)$, detailed in Appendix A. Letting ν_C denote the bias towards domestic intermediate goods, the technology to produce private consumption goods is:

$$Q_t^C := \left\{ \begin{array}{l} (\nu_C)^{1/\mu_C} \left[H_t^C\right]^{1-1/\mu_C} + \\ (1-\nu_C)^{1/\mu_C} \left[\left(1-\Gamma_{IM^C}(IM_t^C / Q_t^C)\right) IM_t^C\right]^{1-1/\mu_C} \end{array} \right\}^{\mu_C/(\mu_C-1)} \tag{20}$$

where:

$$H_t^C := \left(\int (H_{f,t}^C)^{1-1/\theta} df \right)^{\theta/(\theta-1)}$$

$$IM_t^C := \left(\int_0^1 (IM_{f^*,t}^C)^{1-1/\theta^*} df^* \right)^{\theta^*/(\theta^*-1)}$$

The firm minimizes total input costs:

$$\min_{H_t^C, IM_t^C} P_{H,t}.H_t^C + P_{IM,t}.IM_t^C \tag{21}$$

subject to the technology constraint (20) taking intermediate goods prices as given.

The price index that results from solving this problem is:[2]

$$P_{C,t} = \left(\Omega_t^C\right)^{1-\mu_C} \left(\lambda_t^C\right)^{\mu_C} \tag{22}$$

where:

$$\lambda_t^C = \left[\nu_C P_{H,t}^{\ 1-\mu_C} + (1-\nu_C)\left(P_{IM,t} / \Gamma^{\Im}{}_{IM^C}(IM_t^C / Q_t^C)\right)^{1-\mu_C}\right]^{\frac{1}{1-\mu_C}} \tag{23}$$

$$\Omega_t^C = \left\{ \begin{array}{c} \nu_C \left(P_{H,t}\right)^{1-\mu_C} + (1-\nu_C)\left(\dfrac{\Gamma^{\Im}{}_{IM^C}(IM_t^C / Q_t^C)}{\left(1-\Gamma_{IM^C}(IM_t^C / Q_t^C)\right)} \right) \\ \times \left(P_{IM,t} / \Gamma^{\Im}{}_{IM^C}(IM_t^C / Q_t^C)\right)^{1-\mu_C} \end{array} \right\}^{\frac{1}{1-\mu_C}} \tag{24}$$

In CMS, the multiplier λ_t^C is assumed to be the price index for one unit of the consumption good. However, this result is not compatible with their assumption that final goods firms operate with zero profits.

Notice that only when $\Omega_t^C = \lambda_t^C$ do we obtain $P_{C,t} = \lambda_t^C = \Omega_t^C$. This requires $\left(\dfrac{\Gamma^{\Im}{}_{IM^C}(IM_t^C / Q_t^C)}{\left(1-\Gamma_{IM^C}(IM_t^C / Q_t^C)\right)} \right) = 1$, a very specific case.

In general, when this equality does not hold, first order conditions and equation (22) can be combined to yield the following demand equations:

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[2] Details of the derivation of (22) are shown in Appendix D.

$$H_t^C = \nu_C \left(\frac{P_{H,t}}{\Omega_t^C} \right)^{1-\mu_C} \left(\frac{P_{H,t}}{P_{C,t}} \right)^{-\mu_C} Q_t^C \tag{25}$$

$$IM_t^C = (1-\nu_C) \left(\frac{P_{C,t}}{\Omega_t^C} \right)^{1-\mu_C} \left(\frac{P_{IM,t} / \Gamma^{\Im}{}_{IM^C}(IM_t^C / Q_t^C)}{P_{C,t}} \right)^{-\mu_C} \frac{Q_t^C}{1-\Gamma_{IM^C}(IM_t^C / Q_t^C)} \tag{26}$$

These demand equations are different from the ones in CMS, and, as we show in subsequent sessions, they also result in important differences in the market clearing equations. In particular, the equation for the aggregate resource constraint of the economy now resembles the usual representation of national accounts.

2.2.2.b Investment goods

The pricing problem of investment goods is analogous to that of consumer goods. The investment goods price index, which also differs from CMS, is:

$$P_{I,t} = \left(\Omega_t^I \right)^{1-\mu_I} \left(\lambda_t^I \right)^{\mu_I} \tag{27}$$

where:

$$\Omega_t^I = \left\{ \begin{array}{l} \nu_I \left(P_{H,t} \right)^{1-\mu_I} + (1-\nu_I) \left(\dfrac{\Gamma^{\Im}{}_{IM^I}(IM_t^I / Q_t^I)}{\left(1-\Gamma_{IM^I}(IM_t^I / Q_t^I)\right)} \right) \times \\ \left(P_{IM,t} / \Gamma^{\Im}{}_{IM^I}(IM_t^I / Q_t^I) \right)^{1-\mu_I} \end{array} \right\}^{\frac{1}{1-\mu_I}} \tag{28}$$

and:

$$\lambda_t^I = \left[\nu_I P_{H,t}{}^{1-\mu_I} + (1-\nu_I) \left(P_{IM,t} / \Gamma^{\Im}{}_{IM^I}(IM_t^I / Q_t^I) \right)^{1-\mu_I} \right]^{\frac{1}{1-\mu_I}} \tag{29}$$

2.3 Fiscal authorities

The domestic fiscal authority pursues a primary surplus target *(sp)*, levies taxes on consumption, labor, capital and dividends, makes biased transfers, and adjusts expenditures and budget financing accordingly.

The primary surplus SP_t is defined as:

$$\begin{aligned} SP_t = {} & \tau_t^C P_{C,t} C_t + (\tau_t^N + \tau_t^{W_h} + \tau_t^{W_f}).W_t.N_t^D \\ & + \tau_t^K \left(R_{H,t}.u_{I,t} - (\Gamma_u(u_{I,t}) + \delta).P_{I,t} \right).K_{H,t} + \tau_t^D.D_t \\ & + u_{I,t}.R_{G,t}.K_{G,t} - P_{G,t} G_t - TR_t - P_{I,t}.I_{G,t} \end{aligned} \tag{30}$$

where τ_t^C, τ_t^N, $\tau_t^{W_h}$, $\tau_t^{W_f}$, τ_t^K, and τ_t^D are rates of taxes levied on consumption, labor income, social security from workers, social security from firms, capital and dividends. $P_{G,t} G_t$ stands for aggregate expenditures with government consumption, TR_t stands for government transfers, and $P_{I,t}.I_{G,t}$ stands for aggregate expenditures with government investment.

Table 1

Empirical Estimate of the Primary Surplus Rule in Brazil

Dependent Variable: PRI_SUR_PIB_SA
Method: Least Squares
Sample (adjusted): 1996Q3 2009Q1
Included observations: 51 after adjustments
Convergence achieved after 1 iteration
PRI_SUR_PIB_SA = C(2)*PRI_SUR_PIB_SA(–1) + C(4)*PRI_SUR_PIB_SA(–2)
+ (1 – C(2) – C(4))*(C(1) + C(3)*(DLSP_PIB_SA(–1)–2.1214))
+ C(5)*(PIB_TRIM_SA(–1)/100 – 0.004962932)

Variable		**Coefficient**	**Std. Error**	***t*-statistic**	**Prob.**
C(2)	ρ_1	0.248161	0.094789	2.618042	0.0119
C(4)	ρ_2	0.167091	0.083178	2.008836	0.0504
C(1)	sp	0.041899	0.004038	10.37669	0.0000
C(3)	ϕ_b	0.040928	0.012266	3.336770	0.0017
C(5)	ϕ_{gy}	**0.269544**	0.107748	2.501619	**0.0160**

R-squared 0.710078
Adjusted *R*-squared 0.684868

The realization of the primary surplus is affected by deviations of the public debt and economic growth from their steady-states (B_y and g_y, respectively):

$$sp_t = \rho_{1,sp}.sp_{t-1} + \rho_{2,sp}.sp_{t-2} + (1-\rho_{1,sp}-\rho_{2,sp}).\{sp + \phi_{B_Y}(b_{Y,t} - b_Y)\} + \phi_{gy}(g_{Y,t-1} - g_Y) + \varepsilon_{sp,t} \quad (31)$$

where $sp_t = \frac{SP_t}{P_{Y,t}.Y_t}$, $b_{Y,t} = \frac{B_t}{P_{Y,t-1}Y_{t-1}}$, $g_{Y,t} = \frac{Y_t}{Y_{t-1}}$, the unindexed counterparts are steady-state ratios, and $\varepsilon_{sp,t}$ is a white noise shock to the primary surplus.

For industrialized economies, Cecchetti *et al.* (2010) do not find evidence of a response of the primary balance to economic conditions. For Brazil, our empirical estimates for the primary balance rule show a significant anti-cyclic component (Table 1), which is also addressed, yet in a different manner, in Ratto *et al.* (2009). Estimations of the rule with only one lag in the primary balance do not show well-behaved residuals.

In our calibrations, the foreign economy is represented by the USA and the Euro area. Therefore, for the foreign economy, we adopt CMS's assumption that the fiscal authority does not follow a primary surplus target, and government expenditures with consumption, $g_t = \left(\frac{P_{G,t}}{P_{Y,t}}\right).\left(\frac{G_t}{Y_t}\right)$, follow an autoregressive process:

$$g_t = (1-\rho_g).g + \rho_g.g_{t-1} + \varepsilon_{g,t} \quad (32)$$

where *g* is the steady state value of government expenditures as a share of GDP and $\varepsilon_{g,t}$ is a white noise shock to government expenditures. Specifically for the foreign economy, we assume that lump sum taxes exist and follow an autoregressive process of the type:

$$\left(\frac{T_t}{P_{Y,t}.Y_t}\right) := \phi_{B_Y}\left(\left(\frac{R_t^{-1}.B_{t+1}}{P_{Y,t}Y_t}\right) - B_Y\right) \tag{33}$$

where B_Y is the steady state value of government bonds.

For both economies, government transfers follow the autoregressive process:

$$\left(\frac{TR_t}{P_{Y,t}.Y_t}\right) = (1-\rho_{tr}).tr + \rho_{tr}.\left(\frac{TR_t}{P_{Y,t}.Y_t}\right) + \varepsilon_{tr,t} \tag{34}$$

where *tr* is the steady state value of government transfers, and $\varepsilon_{tr,t}$ represents a white noise shock to government transfers.

Total transfers are distributed to each household group according to:

$$TR_{I,t} := \frac{(1-\omega.v_{tr})}{1-\omega} TR_t \tag{35}$$

$$TR_{J,t} := v_{tr}.TR_t \tag{36}$$

where v_{tr} is the bias in transfers towards group *J*.

Government investment follows an autoregressive rule of the form:

$$ig_t = (1-\rho_{ig}).ig + \rho_{ig}.ig_{t-1} + \varepsilon_{ig,t} \tag{37}$$

and public capital accumulation follows the rule:

$$K_{G,t+1} = (1-\delta).K_{G,t} + \left(1 - \Gamma_I\left(\frac{I_{G,t}}{I_{G,t-1}}\right)\right) I_{G,t} \tag{38}$$

The government budget constraint is thus:

$$\begin{aligned} &\tau_t^C P_{C,t} C_t + (\tau_t^N + \tau_t^{W_h} + \tau_t^{W_f}).W_t.N_t^D \\ &\quad + \tau_t^K \left(R_{K,t}.u_{I,t} - (\Gamma_u(u_{I,t}) + \delta).P_{I,t}\right)K_t \\ &+ \tau_t^D.D_t + T_t + R_t^{-1}.B_{t+1} + M_t + u_{I,t}.R_{G,t}.K_{G,t} \\ &- P_{G,t}G_t - TR_t - B_t - M_{t-1} - P_{I,t}.I_{G,t} = 0 \end{aligned} \tag{39}$$

with $T_t = 0$ for the domestic economy, which, using the primary surplus definition, can be stated as:

$$SP_t = (B_t - R_t^{-1}.B_{t+1}) - (M_t - M_{t-1}) \tag{39'}$$

This equation makes clear that, in this model, money not only has an effective role in real decisions, but also matters for the adjustment of fiscal accounts. Increased money supply can alleviate the financial burden from public debt, a feature that approximates the theoretical model to the real conduct of economic policy.

2.4 Monetary authorities

The domestic monetary authority follows a forward-looking interest rate rule that is compatible with an inflation targeting regime:

$$R_t^4 = \phi_{R1}.R_{t-1}^4 + \phi_{R2}.R_{t-2}^4 + (1-\phi_{R1}-\phi_{R2}).\left[R^4 + \phi_{\Pi}\left(\frac{P_{C,t+3}}{P_{C,t-1}} - \Pi\right)\right] + \phi_{g_Y}\left(g_{Y,t-1} - g_Y\right) + \varepsilon_{R,t} \tag{40}$$

where Π is the annual inflation target, R^4 is the annualized quarterly nominal equilibrium interest rate, which satisfies $R^4 = \beta^{-4}.\Pi$, g_Y is the steady state output growth rate, and $\varepsilon_{R,t}$ is a white noise shock to the interest rate rule. Empirical evidence in Brazil suggests the presence of two lags in the policy instrument.[3]

For the foreign economy we adopt the representation in CMS:

$$R_t^4 = \phi_R.R_{t-1}^4 + (1-\phi_R).\left[R^4 + \phi_{\Pi}\left(\frac{P_{C,t}}{P_{C,t-3}} - \Pi_t\right)\right] + \phi_{g_Y}\left(\frac{Y_t}{Y_{t-1}} - g_Y\right) + \varepsilon_{R,t} \tag{41}$$

2.5 Aggregation and market clearing

Any aggregated model variable Z_t denoted in per capita terms results from the aggregation $Z_t := \int_0^1 Z_{h,t}dh = (1-\omega).Z_{I,t} + \omega.Z_{J,t}$ where $Z_{I,t}$ and $Z_{J,t}$ are the respective per capita values of Z_t for families *I* and *J*. Details on the aggregation that do not substantially differ from CMS are not shown.

There are important distinctions in the aggregate relations that obtain from this model as compared to those in CMS. The first refers to the wage dispersion index, and the second to the economy's resource constraint, which are detailed below.

2.5.1 Wage dispersion

The equilibrium conditions between supply ($N_{i,t}$) and demand (N_t^i) for individual labor are:

$$N_{i,t} = N_t^i := \int_0^1 N_{f,t}^i df \tag{42}$$

$$N_{j,t} = N_t^j := \int_0^1 N_{f,t}^j df \tag{43}$$

Aggregating the demand of all firms for labor services yields:

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[3] See Minella and Souza-Sobrinho (2009).

$$N_{i,t} = \frac{1}{1-\omega}\left(\frac{W_{i,t}}{W_{I,t}}\right)^{-\eta_I} N_t^I \tag{44}$$

$$N_{j,t} = \frac{1}{\omega}\left(\frac{W_{j,t}}{W_{J,t}}\right)^{-\eta_J} N_t^J \tag{45}$$

which can also be represented, using the group-wise aggregated labor demand equations, as a function of total demand for labor by the intermediate firms:

$$N_{i,t} = \frac{1-\nu_\omega.\omega}{1-\omega}.\left(\frac{W_{i,t}}{W_{I,t}}\right)^{-\eta_I}\left(\frac{W_{I,t}}{W_t}\right)^{-\eta}.N_t^D \tag{46}$$

$$N_{j,t} = \nu_\omega.\left(\frac{W_{j,t}}{W_{J,t}}\right)^{-\eta_J}\left(\frac{W_{J,t}}{W_t}\right)^{-\eta}.N_t^D \tag{47}$$

The aggregate supply of labor from each household group, $N_{i,t}$ and $N_{j,t}$, relates to the labor demand as:

$$N_{I,t} := \frac{1}{1-\omega}\int_0^{1-\omega} N_{i,t}di = \frac{\psi_{I,t}}{1-\omega}.N_t^I \tag{48}$$

$$N_{J,t} := \frac{1}{\omega}\int_{1-\omega}^{1} N_{j,t}dj = \frac{\psi_{J,t}}{\omega}.N_t^J \tag{49}$$

where $\psi_{I,t} := \int_0^{1-\omega}\frac{1}{1-\omega}\left(\frac{W_{i,t}}{W_{I,t}}\right)^{-\eta_I} di$ and $\psi_{J,t} := \int_{1-\omega}^{1}\frac{1}{\omega}\left(\frac{W_{j,t}}{W_{J,t}}\right)^{-\eta_J} dj$ are the dispersion indices.

We show in Appendix E that the wage dispersion indices $\psi_{I,t}$ and $\psi_{J,t}$ can be stated in a recursive formulation that differs from the working paper version of CMS as to the term of current consumer-price inflation that does not show in our equation:[4]

$$\psi_{I,t} := (1-\xi_I).\left(\frac{\widetilde{W}_{I,t}}{W_{I,t}}\right)^{-\eta_I} + \xi_I.\left(\frac{\pi_{C,t-1}^{\chi_I}\pi_C^{1-\chi_I}}{\pi_{W_I,t}}\right)^{-\eta_I}.\psi_{I,t-1} \tag{50}$$

$$\psi_{J,t} := (1-\xi_J).\left(\left(\frac{\widetilde{W}_{J,t}}{P_{Y,t}.Y_t}\right).\left(\frac{W_{J,t}}{P_{Y,t}.Y_t}\right)^{-1}\right)^{-\eta_J} + \xi_J.\left(\frac{\pi_{C,t-1}^{\chi_J}\pi_C^{1-\chi_J}}{\pi_{W_J,t}}\right)^{-\eta_J}.\psi_{J,t-1} \tag{51}$$

where $\pi_{W_I,t}$ and $\pi_{W_J,t}$ stand for household *I* and *J* wage inflation rates.

Aggregating the labor supply from household groups *I* and *J,* using equations (48) and (49), results in:

$$N_{S,t} := \psi_{I,t}.N_t^I + \psi_{J,t}.N_t^J$$

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[4] Equation A.9, WPS 747/ECB.

which relates to the aggregate labor demand and the total wage dispersion index as:

$$N_{S,t} = \psi_t . N_t^D \tag{52}$$

where total wage dispersion is $\psi_t := \left\{ (1-\omega).\left(\frac{W_{I,t}}{W_t}\right)^{-\eta} \psi_{I,t} + \omega.\left(\frac{W_{J,t}}{W_t}\right)^{-\eta} \psi_{J,t} \right\}$.

2.5.2 Aggregate resource constraint

The price indices derived in the previous sessions entail representations for the aggregate resource constraint of the economy that are importantly different from the ones presented in CMS and CCW. Aggregating household and government budget constraints, and substituting for the equations of external financing and optimality conditions of firms, we obtain the aggregate resource constraint of the economy:

$$P_{Y,t}.Y_t = P_{C,t}.Q_t^C + P_{I,t}.Q_t^I + P_{G,t}Q_t^G + S_t.P_{X,t}.X_t - P_{IM,t}IM_t \tag{53}$$

which, using the price indices derived above, can also be restated as:

$$P_{Y,t}.Y_t = P_{H,t}.H_t^C + P_{H,t}.H_t^I + P_{H,t}.H_t^G + S_t.P_{X,t}.X_t \tag{54}$$

Despite the fact that these representations are standard for national accounts, they differ from the respective equations derived in CMS[5] and CCW, as we detail in Appendix F.

3 Model transformation and steady state calibration

In this section we describe the transformation of variables that render the model stationary, and detail the steady state calibration.

As we assume a technology shock that permanently shifts the productivity of labor, all real variables, with the exception of hours worked, share a common stochastic trend. Besides, as the monetary authority aims at stabilizing inflation, rather than the price level, all nominal variables share a nominal stochastic trend.

The strategy consists of three main types of transformation. Real variables are divided by aggregate output (Y_t), nominal variables are divided by the price of aggregate output ($P_{Y,t}$) and the variables expressed in monetary terms are divided by $P_{Y,t}.Y_t$.

Although most transformations are straightforward, some are not trivial. Predetermined variables, such as capital, are scaled by dividing their lead values by Y_t; wages, domestic bonds, and internationally traded bonds are scaled by $P_{Y,t}.Y_t$. In addition, in order to make the Lagrange multipliers compatible with the adopted scaling strategy, we multiply them by Y_t^σ, resulting in $Y_t^\sigma.\Lambda_{I,t}$ and $Y_t^\sigma.\Lambda_{J,t}$ for households *I* and *J*, respectively.

[5] Equation (38) in CMS.

Table 2

Steady State Ratios

Ratio	Value		Description
	Brazil	**Rest of the World**	
$TB/P_Y Y$	0.012	0.00	Trade balance
X/Y	0.128	0.00	Exports
IM/Y	0.122	0.00	Imports
$M/P_Y Y$	0.205	1.24	Money
$ROG/P_Y Y$	0.000	0.0	Government budget
$P_I I_G/P_Y Y$	0.019	0.02	Government investment
$T/P_Y Y$	0.000	0.00	Lump-sum taxes
$B/P_Y Y$	2.121	2.79	Public Debt
$SP/P_Y Y$	0.036	–0.005	Primary Surplus
$D/P_Y Y$	0.0	0.0	Dividends
$P_I I_H/P_Y Y$	0.162	0.25	Private Investment

The permanent technology shock, zn_t, should also be divided by the aggregate output. Re-scaling the production function for the intermediate goods results in:

$$\left(\frac{zn_t}{Y_t}\right)^{-1} = z_t.\left(u_{I,t}.\frac{K_t}{Y_{t-1}}\right)^{\alpha}.\left(N_t^D\right)^{1-\alpha}.\left(\frac{Y_t}{Y_{t-1}}\right)^{-\alpha}.\left(\frac{zn_t}{Y_t}\right)^{-\alpha} - \psi$$

From the above, we can conclude that $\frac{zn_t}{Y_t}$ is a stationary variable whenever the ratios $\frac{K_t}{Y_{t-1}}$ and $\frac{Y_t}{Y_{t-1}}$ are both stationary.

We now turn to the steady state calibration. For the domestic economy, we calibrate the model to reproduce historical averages of the Brazilian economy during the inflation targeting regime (Table 2). For parameters that are not directly derived from the historical averages in these series, we took the agnostic stance of using the same parameters adopted in the literature for Brazil, or, in its absence, we replicated the parameters in CMS.[6] The rest of the world is calibrated using an average of the values presented in CMS for the United States and the Euro Area.

Calibration and simulations are performed under the assumption of log-linear utility ($\sigma = 1$). The steady state calibration starts by normalizing the stationary prices of intermediate goods at 1.

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[6] An alternative strategy would be to calibrate the parameters to reproduce empirical moments of the endogenous series. We leave this for a companion paper with an estimated version of the model.

This normalization ensures that the steady state values of some variables are one, as is the case of final goods prices and Lagrange multipliers associated with the optimization problem of final goods firms. The steady state rate of capital utilization is also fixed at one for both economies. The remaining steady state ratios are calibrated accordingly, as shown in Table 3.

We calibrate the population size using LABORSTA[7] data on the economically active population in the world for the year 2007. The size of household's group *J* in the domestic economy was set to equal the share of households in Brazil that earn less than two minimum wages according to the PNAD 2007 survey. Also according to this survey, relative wages for household group *I* were set in our calibrations at 2.86.

The share of fixed costs in total production was set so as to guarantee zero profits in the steady state. The labor demand bias, ν_{ω}, was calibrated to ensure that households' groups *I* and *J* work the same amount of hours. For the stationary labor productivity growth rate, we set 2 per cent for Brazil and the rest of the world using data on GDP growth from the World Bank for the period 2000-07.

For Brazil, we calibrated the price elasticity $\mu_C = 0.33$ according to Araújo *et al.* (2006). For the price elasticity μ_I, we repeated the value set for μ_C. The home biases ν_C and ν_I are obtained from the demand equations of imported goods using the steady state value for the supply of consumption and investment goods, and the import quantum.

The steady state primary surplus to output ratio, sp, was calibrated as the mean value of the primary surplus in the period 1999-2008. For the rest of the world, the value for sp was obtained implicitly from the NAWM calibration. The public debt ratio B_Y was set to be consistent with *sp*.

Government expenditures, g, for both Brazil and the rest of the world were set residually from the aggregate resource constraint. Government transfers, tr, for both Brazil and the rest of the world, were obtained so that household budget constraints close.

With the exception of consumption taxes, τ^C, which were calibrated following Siqueira *et al.* (2001), Brazilian tax rates were calibrated based on the current tax law. The lump-sum tax bias, υ_{tp}, which is active only for the foreign economy, was set to one, whilst the transfer bias, υ_{tr}, was implicitly calculated from households *I* and *J* budget constraints.

We calibrated the price-elasticity to demand of government investment goods, η_g, to a value that is close to 1, arbitrarily approximating it to a Cobb-Douglas technology. This enabled us to calibrate υ_g from the rental rate on government capital, which we assumed to be just enough to cover expenditures with depreciation.

The inflation target and the respective steady state nominal interest rate in the domestic economy were set according to historical Brazilian averages. The reaction coefficients in the monetary policy rule were calibrated according to Minella and Souza-Sobrinho (2009), where they show that the monetary policy in Brazil has in average shown an insignificant direct reaction to output.

The parameter $\gamma_{v,2}$ that appears in the functional form of the consumption transaction for the domestic economy was set at the same value calibrated in CMS. The parameter $\gamma_{v,1}$ follows from

[7] http://laborsta.ilo.org/

Table 3

Calibrated Parameters and Steady State Variables

Parameter	Value		Description
	Brazil	Rest of the World	
A) Households			
s	0.00478	0.99522	Population size
β	0.98183	0.99756	Subjective discount factor
σ	1.00000	1.00000	Inverse of the intertemporal elasticity of substitution
κ	0.23280†	0.60000	Degree of habit persistence
ζ	1.59000‡	2.00000	Inverse of the Frisch elasticity of labor supply
δ	0.02500	0.02500	Depreciation rate
ω	0.59260	0.25000	Size of household *J*
ξ_I, ξ_J,	0.48660†	0.75000	Fraction of household members not setting wages optimally each quarter
χ_I,χ_J	0.75000	0.75000	Degree of wage indexation for household members
B) Intermediate-good firms			
α	0.30000	0.30000	Share of capital income in value added
ψ	0.14909	0.41200	Share of fixed cost in production
z	1.00000	1.00000	Stationary total productivity level
ρ_z	0.89000‡	0.90000	Productivity parameter
η	6.00000	6.00000	Price elasticity of demand for labor bundles
η_I	6.00000	6.00000	Price elasticity of demand for labor of household *I*
η_J	6.00000	6.00000	Price elasticity of demand for labor of household *J*
ξ_H	0.90000	0.90000	Fractions of firms not setting prices optimally each quarter
ξ_N	0.30000	0.30000	Fractions of firms not setting prices optimally each quarter
χ_H,χ_N	0.50000	0.50000	Degree of price indexation
g_Y	1.00500	1.00500	Stationary labour productivity growth rate
ρ_{zn}	0.90000	0.90000	Labor productivity parameter
v_ω	0.00438	1.00000	Labor demand bias

Table 3 (continued)

Calibrated Parameters and Steady State Variables

Parameter	Value		Description
	Brazil	Rest of the World	
C) Final-good firms			
υ_C	0.87500	0.99650	Home bias in the production of consumption final goods
υ_I	0.74999	1.00750	Home bias in the production of investment final goods
μ_C , μ_I	3.33000	1.50000	Price elasticity of demand for intermediate-goods
θ	7.60000‡	6.00000	Price elasticity of demand for a specific intermediate-good variety
D) Fiscal authority			
B_Y	2.12140	2.78840	Government debt as a share of quarterly GDP in the steady state
ϕ_{B_Y}	0.0409	0.10000	Primary surplus reaction to debt-to-output in the domestic economy and sensitivity of lump-sum taxes to debt-to-output ratio in the foreign economy
ϕ_{g_Y}	0.2695	n/a	Primary surplus reaction to output growth
g	0.1992	0.11099	Government consumption of public goods in the steady state
ρ_g	n/a	0.90000	Parameter governing public consumption
tr	0. 1526	0.29231	Public transfers-to-GDP in steady state
ρ_{tr}	0.37717	0.90000	Parameter governing public transfers
τ^C	0.16200	0.18300	Consumption tax rate
τ^D	0.15000	0.00000	Dividend tax rate
τ^K	0.15000	0.18400	Capital income tax rate
τ^N	0.15000	0.14000	Labour income tax rate
τ^{W_h}	0.11000	0.11800	Rate of social security contributions by households
τ^{W_f}	0.20000	0.21900	Rate of social security contributions by firms
sp	0.03600	(0.00541)	Stationary primary surplus to output ratio
$\rho_{1,sp}$	0.2481	0.90000	Parameter of the first autoregressive term in the primary surplus rule
$\rho_{2,sp}$	0.1671	n/a	Parameter of the second autoregressive term in the primary surplus rule
υ_{tr}	1.01300	0.42668	Household J transfers bias
υ_{tp}	1.00000	1.00000	Household J lump-sum tax bias
υ_g	0.05198	0.05590	Government investment bias
η_g	1.00100	1.00100	Elasticity of substitution between government and private investment goods
ig	0.01860	0.02000	Government investment-to-output ratio target
ρ_{ig}	0.90000	0.90000	Parameter governing government investment-to-output ratio

Table 3 (continued)

Calibrated Parameters and Steady State Variables

Parameter	Value		Description
	Brazil	Rest of the World	
E) Monetary Authority			
Π	1.04500	1.02000	Inflation target
ϕ_{R1}	1.13‡	0.95000	Degree of interest-rate inertia
ϕ_{R2}	–0.51‡	0.00000	Degree of interest-rate inertia
ϕ_{Π}	1.57000‡	2.00000	Interest-rate sensitivity to inflation gap
ϕ_{g_Y}	0‡	0.10000	Interest-rate sensitivity to output-growth gap
R	1.03490	1.01240	Equilibrium nominal interest-rate
π_H	1.01110	1.00500	Steady state domestic prices inflation
π_X	1.00500	1.01110	Steady state export prices inflation
π_C	1.01110	1.00500	Steady state consumption prices inflation
F) Adjustment and transaction costs			
γ_{B1}	0.01545	0.47073	Parameter of transaction cost function
γ_{B2}	0.15000	0.15000	Parameter of transaction cost function
γ_{u1}	0.05271	0.03409	Parameter of capital utilization cost function
γ_{u2}	0.00700	0.00700	Parameter of capital utilization cost function
γ_I	3.00000	3.00000	Parameter of investment adjustment cost function
γ_{IM^C}	2.50000	2.50000	Parameter of import adjustment cost function
γ_{IM^I}	0.00000	0.00000	Parameter of import adjustment cost function
γ_{BF}	0.01000	0.01000	Parameter of intermediation cost function

Notes: Areosa, Areosa and Lago (2006): †, Minella and Souza-Sobrinho (2009): ‡

the equation that defines the consumption transaction cost, the calibrated values for money and consumption, and the equation that defines the money velocity. Finally, some autoregressive coefficients $(\rho_{zn}, \rho_{sp}, \rho_{ig})$ were set at 0.9 following the NAWM calibration for ρ_z. For autoregressive coefficients referring to government consumption and transfers, ρ_g and ρ_{tr}, we used estimated coefficients obtained from isolated econometric regressions for Brazil.

4 Simulations and policy analysis

In this session, we show impulse responses for shocks to: monetary policy, primary surplus, government transfers and investment.[8] The intention here is to understand how this model responds to shocks under the adopted calibration. We compare the model's predictions for alternative types of primary surplus and monetary policy rules. All simulations were done using the function "stoch_simul" of DYNARE at MATLAB.

4.1 Impulse responses of the calibrated model

Figure 1 shows the impulse responses of a 1 percentage point shock to the nominal interest rate. With this calibration, the shock affects inflation and output in the expected direction, but we do not obtain a hump-shaped response.[9] The trough in inflation and output growth occurs already in the first quarter. Inflation reverts back to the steady state in the third quarter, while the nominal interest rate remains above the steady state for about one year. Output levels return to the steady state in about 6 quarters.

Despite the fact that each policy rule responds to a different set of variables, in equilibrium the fiscal response intertwines with monetary conditions, the key linking element being the public debt. The interest rate hike puts pressure on the public debt, which rises above its steady trend and takes very long to revert to the steady state. Notwithstanding, the anti-cyclic component of the fiscal rule forces the primary surplus to initially react to the economic downturn, and the fiscal rule loosens through a reduction in the primary surplus of about 0.05 percentage points of GDP from its steady state. This reaction is enabled by an increase in government consumption that should also offset the reduction in expenditures with government investment. In the third quarter, public debt to GDP reaches a peak, and the output growth surpasses its stationary rate. This development puts pressure on the fiscal rule for a rise in the primary surplus of up to 0.10 percentage points of GDP, through a reduction in government consumption and levels of government investment below the steady state for longer than private investment. Consequently, the debt initiates a downward path, yet still above its steady state for a long time afterwards.

The economy decelerates in the aftermath of a monetary policy shock. Capital utilization is below the steady state and firms pay lower nominal wages to households. The amount of labor and consumption also drops. The impact on private investment and the stock of capital is almost negligible. The distributional effects, although very small, are less favorable to less specialized and more constrained households.

The dynamics of endogenous variables after the shock affects GDP composition. Although private consumption to GDP falls in the first quarter, it immediately bounces upwards after the second quarter mostly to replace investment and public consumption.

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[8] The standard deviations of all shocks were arbitrarily set at 100bps. Their values are not meant to reflect their empirical counterpart.

[9] Minella (2003) and Silveira (2008) also report impulse responses of inflation and output after a monetary policy shock that lack the "hump shapeness" that is observed in other countries.

Figure 1

Impulse Responses to a Contractionist Shock to Monetary Policy

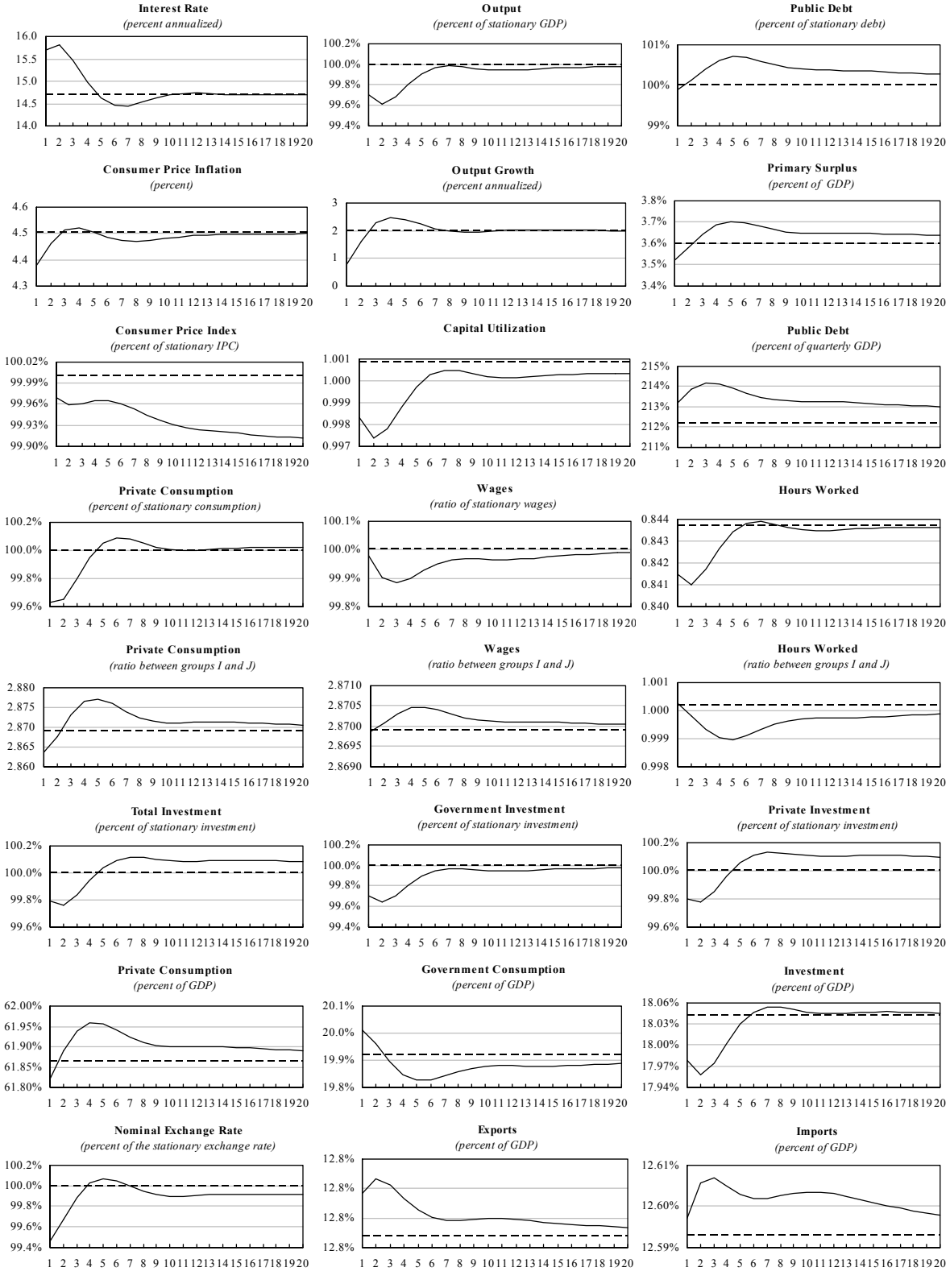


Figure 2 shows the impulse responses of a 1 percentage point reduction in the primary surplus. The shock initially increases government consumption by about 0.4 percentage points of GDP and raises public investment by 1 per cent from its steady state. Such expansionist effect initially boosts output growth to around 7 per cent per year, but in the second quarter, output growth falls to levels below steady state, where it reverts to afterwards. This shock has a smaller impact on the levels of private consumption and labor as compared to their steady state trends. The monetary effects of the fiscal shock comprise an increase of up to 0.2 percentage points in consumer price inflation, and, in spite of the contractionist stance of monetary policy, inflation remains above its steady state for a prolonged period.

The shape of the responses of inflation and public debt varies according to which shock is activated. For each shock, there is a distinct transmission mechanism. When the shock comes from the monetary policy, the response of the debt is more hump-shaped as the fiscal rule reacts to economic conditions. On the other hand, when the shock stems from the fiscal sector, the response of inflation becomes more hump-shaped, as the monetary policy rule reacts to the inflationary conditions imposed by the fiscal loosening.

To account for the fact that transfers are usually an instrument used for income distribution, the shock to government transfers (Figure 3) is biased towards less specialized and more constrained households. The hike in government transfers is enabled by a reduction in government consumption and public investment. These choices of cuts in government expenditures initially result in a significant downturn in economic activity. The fall in private consumption that could follow from depressed conditions stemming from the production side of the model does not occur possibly because of the direct injection of financial resources to households by the transfers (income effect) and also because monetary policy reacts to poor economic conditions and to the drop in inflation by keeping interest rates slightly below the steady state. Net public expenditures that result from the shock to transfers are not financed through debt issuance above steady state trends. In addition, the distributional effect of the shock vanishes after about 5 quarters.

A shock to government investment (Figure 4), of about 1 percentage point of GDP, crowds out private investment, as the rental rate of public capital is cheaper in the steady state. The rise in expenditures with public investment is financed through cuts in government consumption, driving the primary surplus down to levels below the steady state, and through debt issuance. Afterwards, the rise in public debt exerts a contractionist pressure on the fiscal rule, and the primary surplus rises after the third quarter. The initial inflationary spike results in a contractionist monetary policy reaction, and the final outcome is a drop in economic dynamism, with output below its steady state path for about 5 quarters. After the third quarter, the shock to government investment boosts output growth to above its steady state for a very prolonged time span. After the contractionist stance imposed by the fiscal and monetary adjustment unwinds, private consumption and wages rise a little above the steady state and remain there for a long time.

4.2 Policy analysis

To understand how the interaction of fiscal and monetary policy affects the model's predictions, we analyze impulse responses, variances and variance decompositions after policy shocks under a number of different specifications for the policy rules.

4.2.1 Sensitivity analysis

Figure 5 shows the impulse responses of a monetary policy shock with varying degrees of fiscal commitment with the stationary path of public debt. Greater commitment to the debt-to-GDP

Figure 2

Impulse Responses to an Expansionist Shock to the Primary Surplus

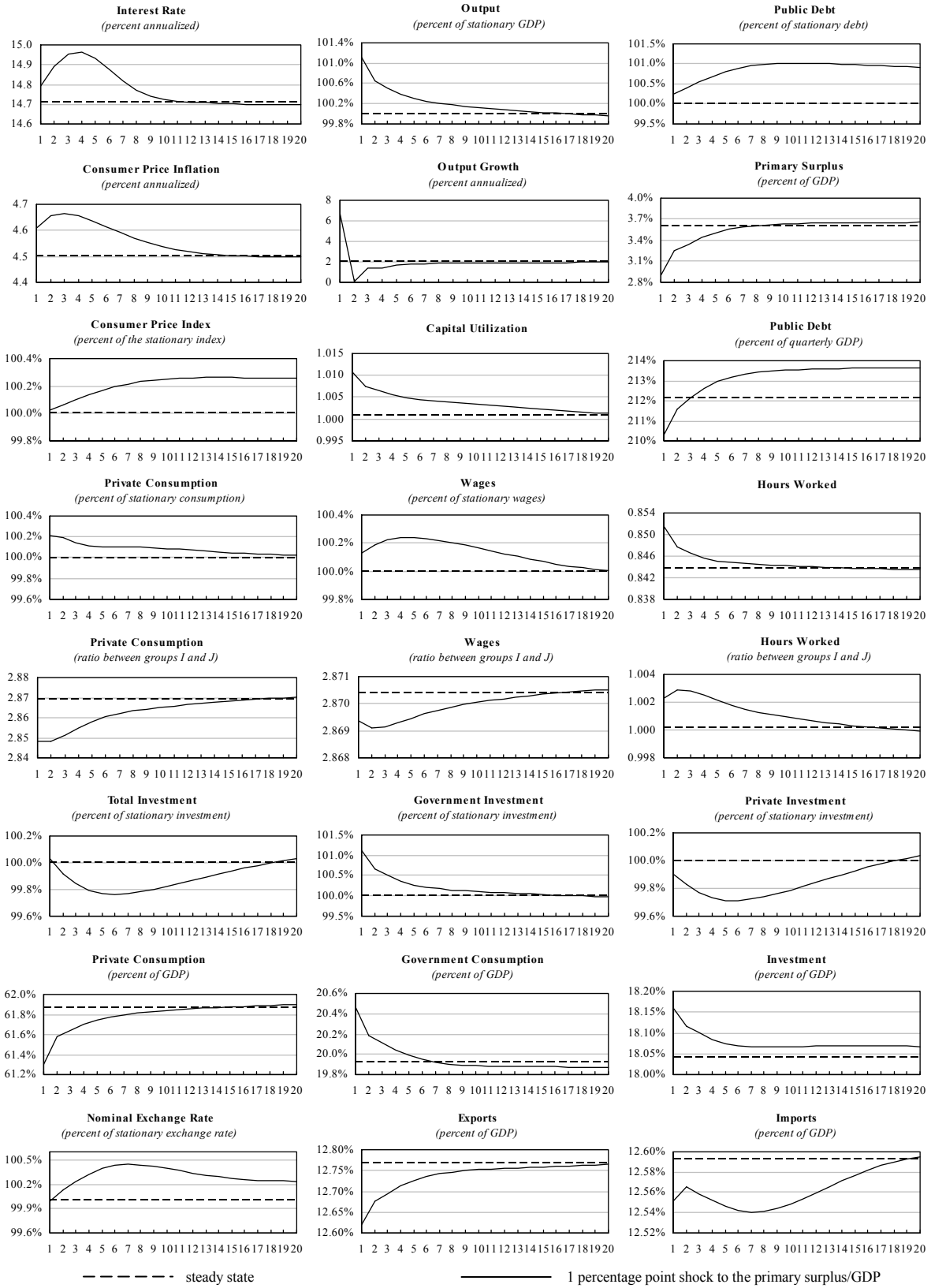


Figure 3

Impulse Responses to a Shock to Government Transfers

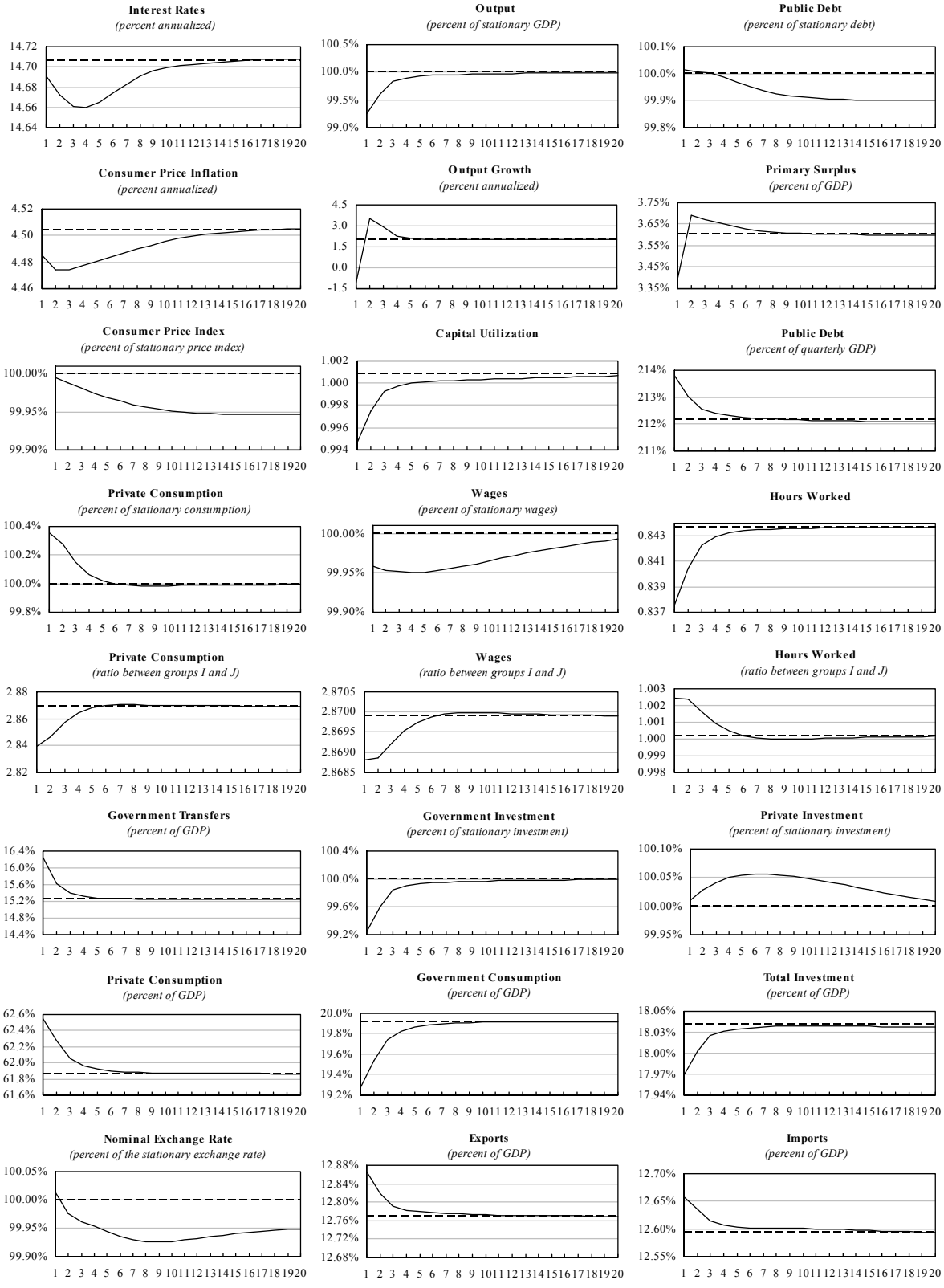


Figure 4

Impulse responses to a shock to government investment

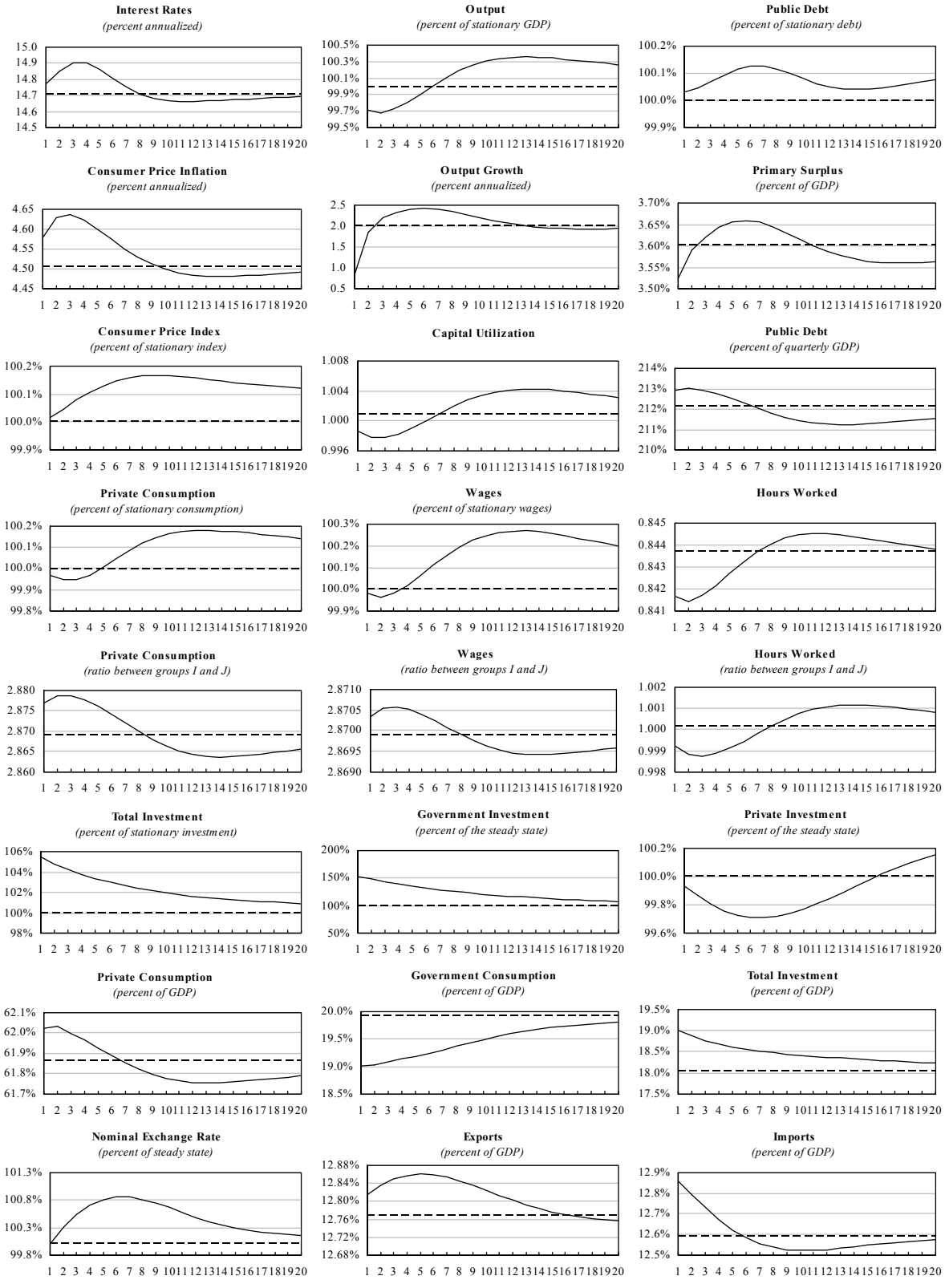


Figure 5

Fiscal Commitment to the Steady State Level of the Public Debt: Impulse Responses of a Monetary Policy Shock

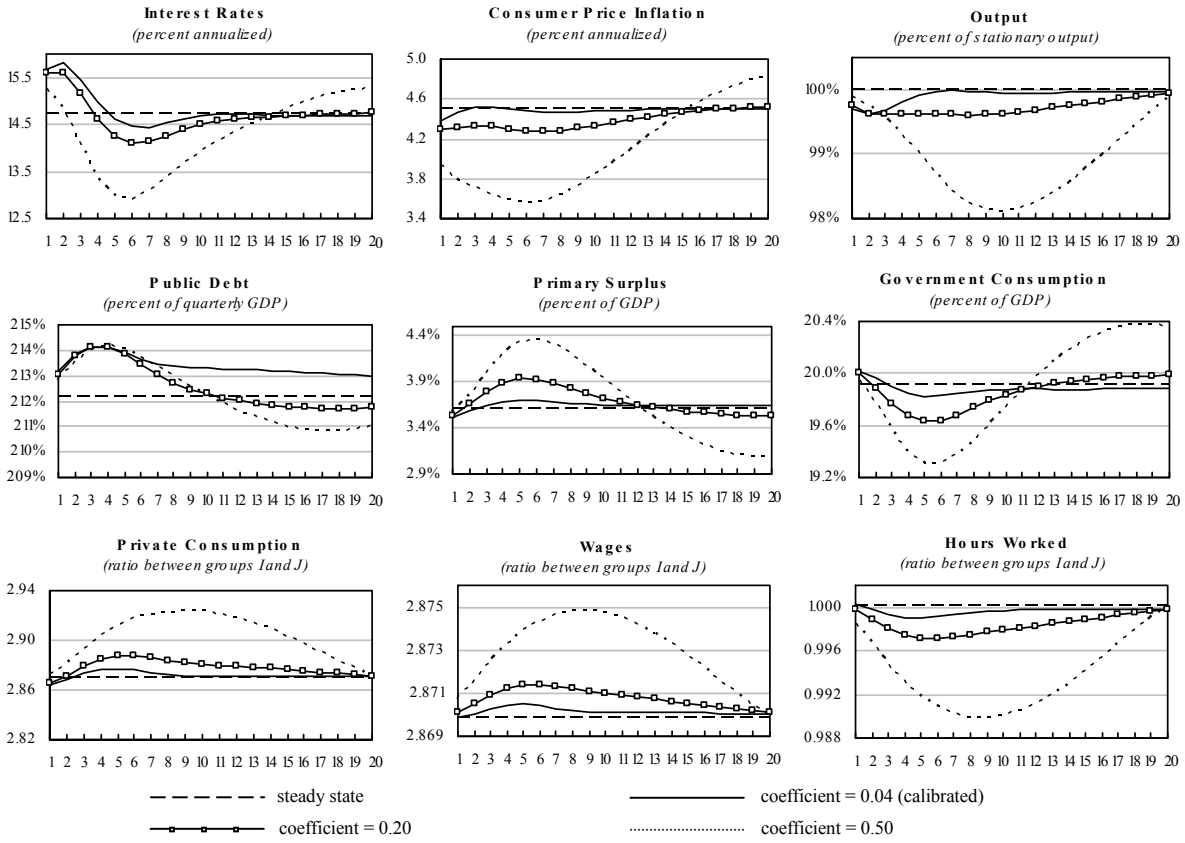
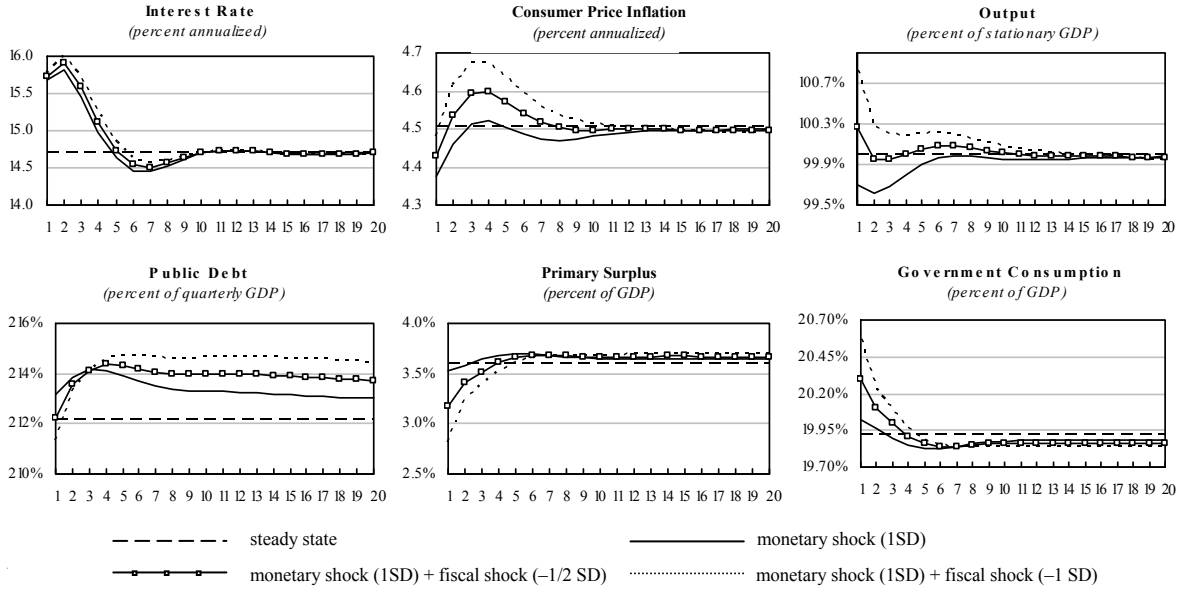


Figure 6

Combination of Policy Shocks: Impulse Responses to a Monetary Policy Shock Varying the Rigor in the Implementation of the Fiscal Rule



ratio implies that the government will post a stronger reaction to events that drive the public debt as a share of GDP away from its stationary trajectory. A contractionist monetary policy[10] increases interest rates and thus the service of the debt, which then triggers a reaction from the fiscal policy to stabilize the debt-to-GDP ratio. The stronger the reaction of the fiscal policy to the debt, the stronger the impact on output and inflation. The monetary policy rule then reacts to the effects on inflation from these economic conditions, lowering interest rates. The extreme case presented in the first plot, which corresponds to the case where the fiscal response to the debt is the greatest, illustrates that the initial increase in interest rates should be promptly reversed followed by an intense expansionist reaction in the medium-run to contain the excessive contractionist impact from the fiscal feedback. This calls for some sort of coordination between fiscal and monetary policy to attain the best policy combination to reduce the volatility that arises in inflation and output when both policies are in place. The plots also show that a stronger reaction to the debt-to-GDP ratio skews the distributive effects of the monetary policy shock a little more in favor of the group of more specialized households (group *I*) who also have more investment alternatives.

Table 4 shows variances and variance-decomposition when only the fiscal and monetary policy shocks are active. Under varying degrees of commitment to the stationary level of the debt, an increase in the coefficient of the fiscal rule associated with the deviation of the debt from its steady state increases the volatility of consumer price inflation and the correlation between inflation and output growth. As to the volatility of the output growth, the effects are non-linear. The shock decomposition shows that the influence of the monetary shock on output growth variance attains its least value with a coefficient of 0.18, a level that also grants the least variance of output growth.[11] On the other hand, the greatest influence of the monetary policy shock onto inflation variance obtains with a coefficient of 0.31.

Assuming that it is desirable to have the monetary policy affecting inflation more than the fiscal shock and conversely for the case of the output growth, we sought for a standard deviation of the fiscal shock that could jointly minimize the influence of the primary surplus shock on inflation and of the monetary policy shock on GDP growth. For a 1 percentage point standard deviation of the monetary policy shock and for a degree of fiscal commitment that minimized the unconditional volatility of output growth, the degree of fiscal rigor in the execution of the fiscal rule that implements this outcome is 0.47. The moments and variance decomposition that result are portrayed in Table 5. In the following figures and tables, the 0.47 standard deviation of the fiscal shock is used as benchmark. Figure 6 shows the impulse responses to a combination of a contractionist monetary policy shock and expansionist fiscal policy shocks, varying the rigor with which the fiscal rule is implemented. In the short run, the fiscal policy shock nullifies the impact of the monetary policy shock on inflation, and in the medium run, it actually generates some inflation, the more so the greater the rigor in the implementation of the fiscal rule. As to the public debt, as the fiscal policy shock increases in magnitude, there is additional pressure on the debt, and its initial increase gets steeper, accompanied by a higher persistence to revert back to the steady state.

Table 6 shows the effects on the variances, co-variances and variance decompositions of different degrees of correlation between policy shocks. In this exercise we start from one of the specifications of the fiscal rule shown in Table 4, corresponding to the one (coefficient of 0.18) where output growth attains its lowest volatility and is least impacted by a monetary policy shock. When a contractionist monetary policy jointly occurs with a loosening fiscal shock, which in the table is represented in the columns of negative correlations, the unconditional volatility of inflation

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[10] Notice that in the benchmark calibration of the monetary policy rule, the direct reaction of the monetary policy to output is null. As a result, the exercises shown in the subsections that follow are conditional on the adopted parameterization.

[11] This could be suggestive of a region where optimal fiscal policy may lie on, but to be conclusive on this, we would need to conduct optimal policy analysis, which is beyond the scope of this paper.

Table 4

Higher Commitment with the Stationary Path of the Public Debt in the Fiscal Rule

Moments of the shocks *(percent)*								
SD of the monetary policy shock[1] = 1.00 SD of the fiscal shock = 1.00								
Corr. between shocks[1] = 0.00								
Fiscal commitment to the public debt								
Coefficient in the fiscal rule	0.04[2]		**0.18**		**0.31**		0.50	
Moments of endogenous variables *(percent)*								
SD of cons. price inflation	0.10		0.20		0.44		1.04	
SD of GDP growth	1.30		**1.28**		1.37		1.93	
Corr. between variables	4.78		9.68		29.41		58.85	
Variance decomposition *(percent)*								
↓variance / → shock	MS[3]	FS[3]	MS	FS	MS	FS	MS	FS
Consumer price inflation	15.63	84.37	47.98	52.02	58.48	**41.52**	45.16	54.84
GDP growth	7.86	92.14	**5.22**	94.78	10.85	89.15	25.53	74.47

[1] SD = standard deviation / Corr. = correlation.
[2] Calibrated value.
[3] MS = monetary shock / FS = fiscal shock (to the primary surplus).

Table 5

Greater Rigor in Implementation of the Primary Surplus Rule

Moments of the shocks *(percent)*								
SD of the monetary policy shock[1] = 1.00 SD of the fiscal shock = **0.47**								
Corr. between shocks[1] = 0.00								
Fiscal commitment to the public debt								
Coefficient in the fiscal rule	0.04[2]		**0.18**		**0.31**		0.50	
Moments of endogenous variables *(percent)*								
SD of cons. price inflation	0.06		0.16		0.36		0.79	
SD of GDP growth	0.69		**0.66**		0.76		1.25	
Corr. between variables	24.41		14.81		39.12		65.23	
Variance decomposition *(percent)*								
↓variance / → shock	MS[3]	FS[3]	MS	FS	MS	FS	MS	FS
Consumer price inflation	45.12	54.88	80.36	19.64	86.21	**13.79**	78.51	21.49
GDP growth	27.45	72.55	**19.64**	80.36	35.06	64.94	60.34	39.66

[1] SD = standard deviation / Corr. = correlation.
[2] Calibrated value.
[3] MS = monetary shock / FS = fiscal shock (to the primary surplus).

Table 6

Varying the Correlation Between Monetary and Fiscal Policy (Primary Surplus) Shocks

Moments of the shocks *(percent)*										
SD of the monetary policy shock[(1)] = 1.00 SD between fiscal shocks = **0.47**										
Corr. between policy shocks	0.80		0.50		0.00		**–0.50**		**–0.80**	
Fiscal commitment to the public debt										
Coefficient in the fiscal rule = **0.18**										
Moments of the variables *(percent)*										
SD of cons. price inflation	0.19		0.18		0.16		0.13		**0.11**	
SD of output growth	0.80		0.75		0.66		0.55		**0.47**	
Corr. between variables	18.44		17.40		14.81		9.95		**4.25**	
Variance decomposition *(percent)* – when the 1st shock is in monetary policy										
↓variance / → shock	MS[(3)]	FS[(3)]	MS	FS	MS	FS	MS	FS	MS	FS
Consumer price inflation	95.27	4.73	88.74	11.26	80.36	19.64	78.70	21.30	86.04	13.96
GDP growth	80.49	19.51	53.70	46.30	19.64	80.36	**13.68**	86.32	44.07	55.93
Variance decomposition *(percent)* – when the 1st shock is in the fiscal rule										
↓variance / → shock	MS[(3)]	FS[(3)]	MS	FS	MS	FS	MS	FS	MS	FS
Consumer price inflation	80.63	19.37	53.94	46.06	19.64	80.74	**12.83**	87.17	42.86	57.14
GDP growth	95.23	4.77	88.68	11.32	80.36	19.64	78.90	21.10	86.33	13.67

(1) SD = standard deviation / Corr. = correlation.
(2) Calibrated value.
(3) MS = monetary shock / FS = fiscal shock (to the primary surplus).

and output growth falls. This result was in line with what the previous discussion on Figure 6 implied. Economic stimuli from expansionist fiscal and monetary shocks add variance to both inflation and output, and also expand the correlation between these two variables.

Table 7 shows the impact of monetary policy rules that react more to deviations of expected inflation from the target. Notice that the coefficient of reaction to output growth is null under all monetary policy rules that we experiment with here. In this exercise, we used the same specification for the fiscal rule in Table 6. Under these assumptions, a more hawkish monetary policy enacts a reduction in the variances of inflation and output growth. It also reduces the correlation between these two variables. However, as monetary policy becomes more hawkish, the fiscal shock gains some power to explain the variance of consumer price inflation. When the coefficient attached to inflation targets is set at 2.44, the monetary policy shock has the smallest influence on the variance of the output growth.[12]

We find an specific combination of monetary and fiscal commitment that grants the lowest volatility in output growth, bearing in mind that the benchmark monetary policy rule does not react

[12] This result is not indicative of an optimal reaction of monetary policy to stabilize output, as it is conditioned on the fact that the calibrated monetary policy rule does not react directly to output growth, while the fiscal rule does.

Table 7

Varying the Monetary Policy Commitment to the Inflation Target

Moments of the shocks *(percent)*								
SD of the monetary policy shock[(1)] = 1.00 SD of the fiscal shock = **0.47**								
Corr. between shocks[(1)] = 0.00								
Fiscal commitment to the public debt								
Coefficient in the fiscal rule = **0.18**								
Monetary policy commitment to the inflation target								
Coefficient in the mon. policy rule	1.20		1.57[(2)]		**2.44**		5.2	
Moments of endogenous variables *(percent)*								
SD of cons. price inflation	0.82		0.16		0.07		0.04	
SD of GDP growth	0.73		0.66		0.63		0.61	
Corr. between variables	25.52		14.81		8.40		0.00	
Variance decomposition *(percent)*								
↓variance / → shock	MS[(3)]	FS[(3)]	MS	FS	MS	FS	MS	FS
Consumer price inflation	93.01	6.99	80.36	19.64	64.72	35.28	60.37	39.63
GDP growth	29.57	70.43	19.64	80.36	**18.13**	81.87	22.08	77.92

(1) SD = standard deviation / Corr. = correlation.
(2) Calibrated value.
(3) MS = monetary shock / FS = fiscal shock (to the primary surplus).

directly to output conditions. Such combination is shown in the second column of Table 8. It increases the share of inflation variance that is attributed to the monetary policy shock, although the highest stake is still with the fiscal shock.

4.2.2 Fiscal and monetary policy activeness

In Dynare, the model shows a unique solution for time paths of endogenous variables under two regions of policy activeness[13] (Figure 7), maintaining the remaining parameters as they were originally calibrated. Under active monetary policy ($\phi_{\Pi} > 1.1$), the equilibrium is unique if the response of the fiscal rule to deviations of the public debt to its steady state ratio (ϕ_{B_Y}) remains in the positive interval of [0.03,∞) , where the original calibrated parameter belongs, or in the interval (–∞, –1.21). In the former interval, the stronger the reaction of the fiscal rule to the debt-to-GDP ratio, the more cyclical are the responses of the output (Figure 8).

The model also shows a unique solution (in Dynare) in regions where monetary policy is passive (5th to 8th columns of Figure 8).[14] Again, the greater the magnitude of the reaction of the

[13] Active and passive policies are used here in the sense described in Schmidt-Grohé and Uribe (2006) and Leeper (1991). Woodford (2003) uses the term "locally Ricardian" for active policies.

[14] Schmidt-Grohé and Uribe (2006) also obtain regions of implementable policy with Taylor coefficients lower than 1.

Table 8

Policy Rules That Minimize Output Volatility

Moments of the shocks *(percent)*				
SD of the monetary policy shock[(1)] = 1.00 SD of the fiscal policy shock = 1.00				
Corr. between shocks[(1)] = 0.00				
Fiscal commitment to the public debt				
Coefficient in the fiscal rule	0.04[(2)]		**0.27**	
Monetary policy commitment to the inflation target				
Coefficient in the mon. policy rule	1.57[(2)]		**4.50**	
Moments of endogenous variables *(percent)*				
SD of cons. price inflation	**0.10**		**0.10**	
SD of output growth	1.30		**1.17**	
Corr. between variables	4.78		–15.58	
Variance decomposition *(percent)*				
↓variance / → shock	MS [(3)]	FS [(3)]	MS	FS
Consumer price inflation	15.63	84.37	25.31	**74.69**
GDP growth	7.86	92.14	**3.88**	96.12

(1) SD = standard deviation / Corr. = correlation.
(2) Calibrated value.
(3) MS = monetary shock / FS = fiscal shock (to the primary surplus).

fiscal rule to the debt-to-GDP ratio, the stronger the cyclicality of the responses. However, for practically null responsiveness of the fiscal rule to the debt and of the monetary policy rule to the inflation target, the model reestablishes lower cyclicality.

4.2.3 Alternative types of monetary policy rules

The model can also be used to analyze the effects of adopting a distinct monetary policy rule. Table 9 compares the moments and shows a variance decomposition of key endogenous variables under alternative types of monetary policy rules. If the monetary policy rule directly reacts to changes in the exchange rate,[15] the volatility of inflation and output growth reduces. The absolute magnitude of the correlation between economic growth and inflation drastically reduces.

If the monetary policy rule reacts to the gap in output growth,[16] the variance in output growth reduces, albeit with an increase in the variance of consumer price inflation and the exchange rate. The monetary policy shock also contributes less to the variances of inflation, output growth and the exchange rate.

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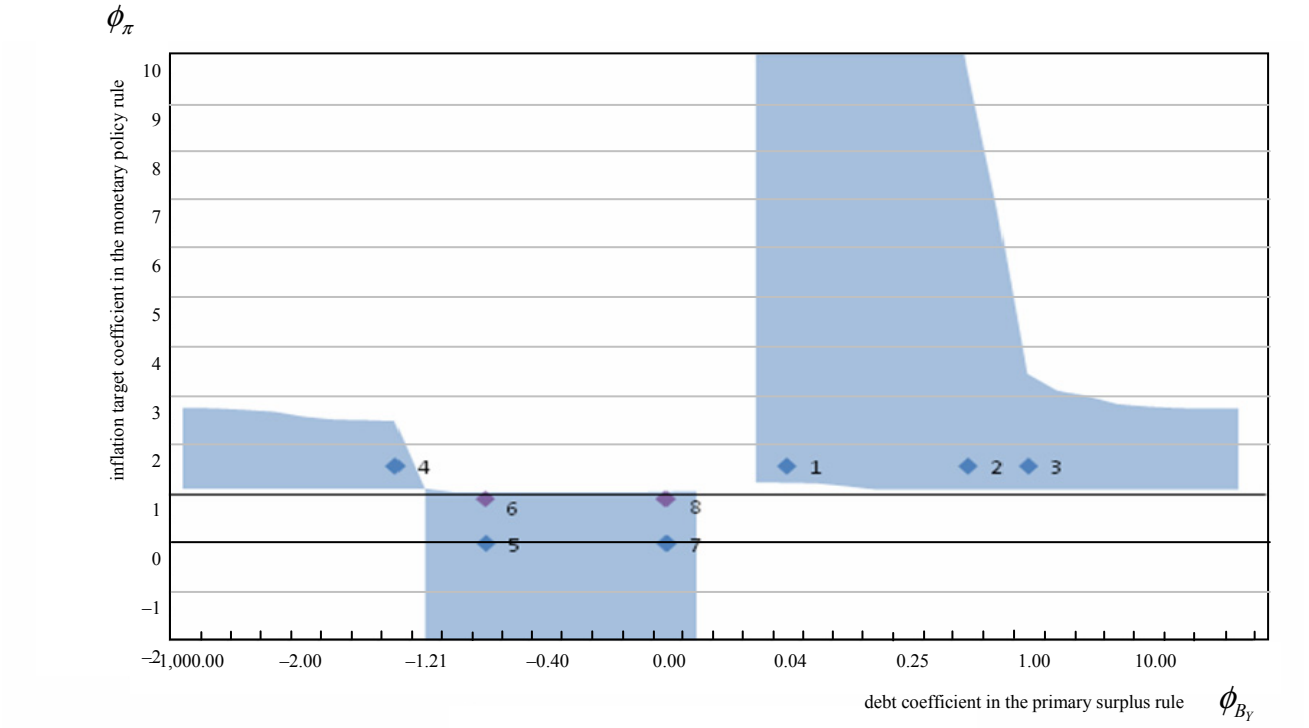
[15] The coefficient of reaction to the deviation of changes in the exchange rate from its steady state was arbitrarily set at 1 in this exercise.

[16] The coefficient of reaction to the deviation of output growth from its steady state was arbitrarily set at 0.79 in this exercise.

Figure 7

Regions Where the Model Converges to a Unique Solution in Dynare[1]



[1] The regions of convergence were plotted only for the interval $\phi_{B_Y} \in (-1000, 100)$ and $\phi_\pi \in (-2, 10)$. The colored region continues in the area beyond the plotted limits.
The numbered dots represent the points selected to draw impulse responses in Figure 8.

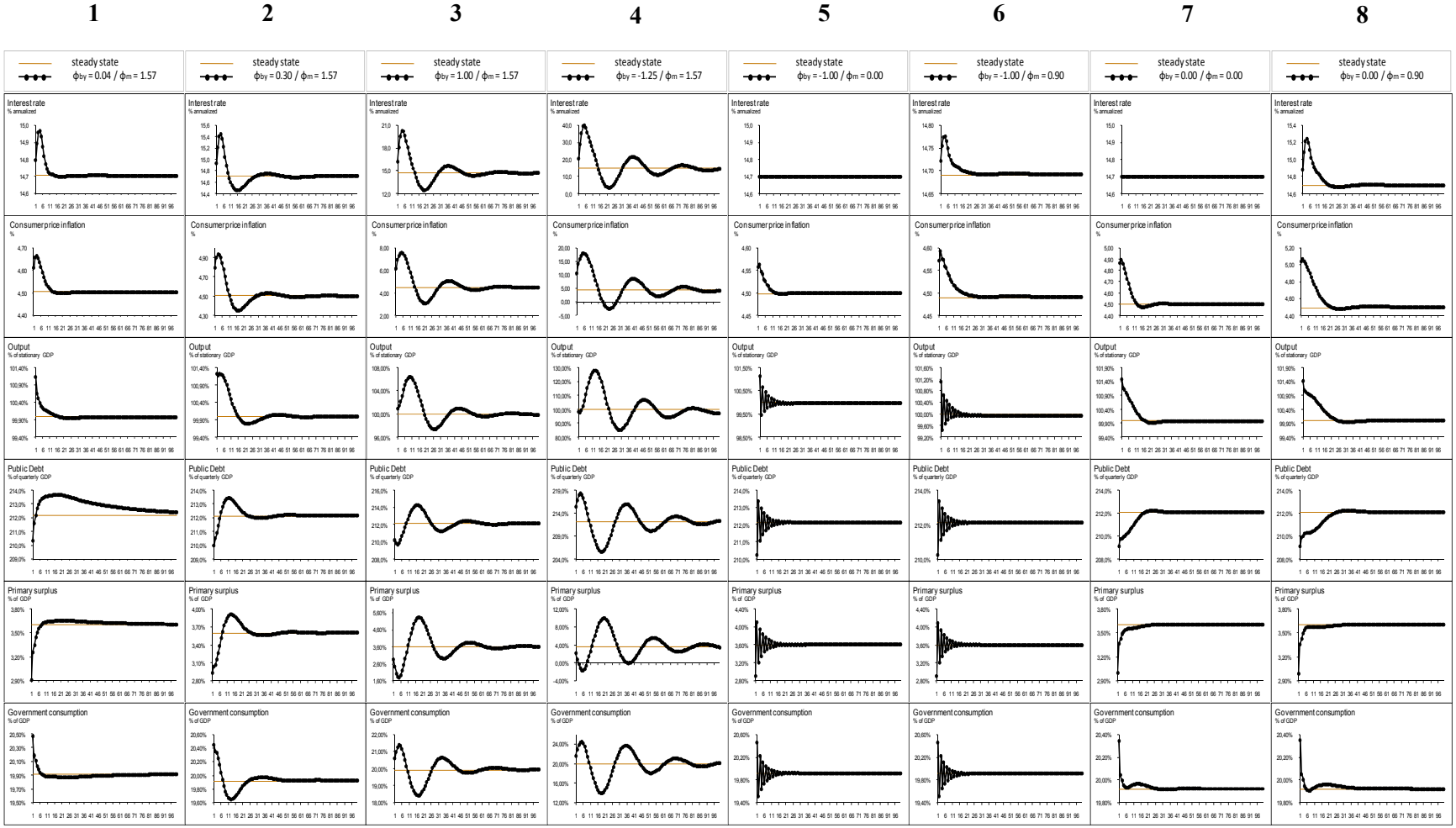
Impulse responses to different types of monetary rules have distinct shapes. Figure 9 shows that the introduction of an explicit reaction of the monetary policy to either output growth or to changes in the exchange rate brings about greater persistence to the drop in inflation. The initial impact on output growth is a little milder, yet the persistence is also more pronounced. Backward looking rules, on the other hand, do not substantially alter the dynamics of the main macroeconomic variables after a monetary policy shock.

5 Conclusion

In this paper we revised the work in CMS and CCW, correcting important equations relating to prices, wages and the aggregate resource constraint of the economy. In addition, in order to better approximate the modeled economy to the current practice of fiscal policy in a number of countries, including Brazil, we introduced a different modeling strategy of the fiscal sector. We let the government track a primary surplus and a debt-to-GDP target, using its instrument also as a response to economic conditions, and allowed the government to invest and the private sector to decide upon the utilization of public and private capital. We also extended the model to introduced labor specialization in order to allow for wage heterogeneity amongst households that supply the same amount of worked hours.

Figure 8

Some Plots of Impulse Responses to a Fiscal Policy Shock Under Distinct Combinations of Policy Parameters in the Regions Where the Model Converges to a Unique Solution in Dynare(1)



(1) The numbers in each column of graphs indicate the combinations of policy reactions plotted (and equally numbered) in Figure 7.

Table 9

Alternative Monetary Policy Rules

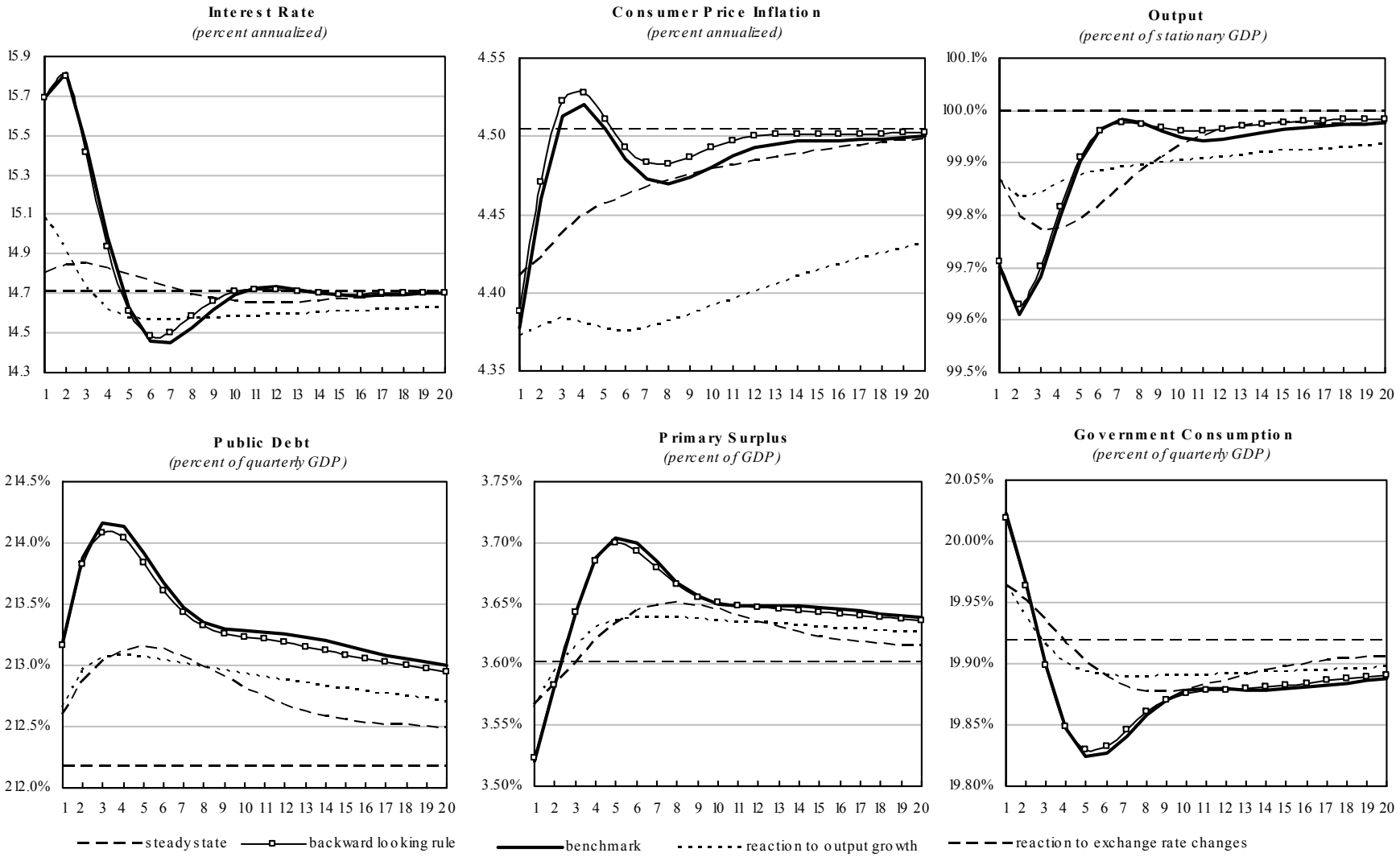
Moments of the shocks *(percent)*						
SD of the monetary policy shock[(1)] = 1.00 SD of the fiscal policy shock = 1.00						
Corr. between shocks[(1)] = 0.00						
Monetary policy rules						
	calibrated model		calibrated rule + reaction to the exchange rate		calibrated rule + reaction to the output growth	
Moments of endogenous variables *(percent)*						
SD of inflation	0.10		**0.04**		0.41	
SD of GDP growth	1.30		1.27		**0.85**	
SD of exchange rate variation	0.68		**0.22**		1.28	
Corr. between consumer price inflation and GDP growth	4.78		0.46		–7.51	
Corr. between consumer price inflation and exchange rate variation	48.84		40.25		46.36	
Corr. between GDP growth and exchange rate variation	8.58		-25.58		–78.61	
Variance decomposition *(percent)*						
	MS[(3)]	FS[(3)]	MS	FS	MS	FS
Consumer price inflation	15.63	84.37	97.67	**2.33**	10.14	89.86
GDP growth	7.86	92.14	**1.75**	98.25	2.80	97.20
Exchange rate variation	89.4	10.6	86.16	13.84	**5.1**	94.9

(1) SD = standard deviation / Corr. = correlation.
(2) Calibrated value.
(3) MS = monetary shock / FS = fiscal shock (to the primary surplus).

Under the adopted calibration, the model responses to monetary policy shocks are short-lived. The simulations show an important endogenous interaction of monetary policy conditions with fiscal policy responses, although policy rules are not directly responsive to one another. Expansionist primary surplus shocks can boost economic activity, yet with significant implications to inflation. Shocks to government investment also put pressure on inflation, and, although the immediate response of output growth is negative, it soon reverses to a prolonged economic expansion. On the other hand, the simulations show that fiscal transfer shocks, aimed at redistributing income, negatively affect general economic conditions as consequence of the fiscal rule.

Figure 9

Impulse Responses to a 1 Percentage Point Monetary Policy Shock Under Alternative Monetary Policy Rules



Different specifications for the policy rules significantly affect the results implied by the model. The simulations with different degrees of fiscal commitment to the stationary path of the public debt and with greater rigor in the implementation of the primary surplus rule make explicit that the strength of one policy affects the impact of the other on important variables such as output and inflation. Increasing fiscal commitment to the stationary debt-to-GDP ratio enhances the contractionist impact of a monetary policy shock upon inflation, albeit at the cost of a higher impact on output growth in the medium-run. The volatility of inflation and output growth increases, as does the correlation between them. On the other hand, a more rigorous implementation of the primary surplus rule implies, as expected, lower variance of inflation and output growth, but the correlation between them increases with the degree of rigor.

Simultaneous shocks to the primary surplus rule and to monetary policy make explicit the contrasting objectives of these policies. Primary surplus shocks dampen the contractionist effect of the monetary policy shock onto inflation and output, and also reduce the variance of inflation and output growth.

A higher commitment to the inflation target in the monetary policy rule reduces the variance of inflation and output growth, and their correlation, with the drawback that the fiscal shock gains importance in affecting the variance of inflation.

Different specifications of monetary policy rules also yield qualitatively distinct predictions. Rules that directly react to changes in the exchange rate or to the output gap reduce the variance of output growth. However, an explicit reaction to the output growth increases the variance of inflation. A monetary policy reaction to the exchange rate holds the following outcomes: the variance of inflation and the correlation between inflation and output growth reduce, and the monetary policy shock gains a much greater stake at the variance of inflation.

Our model finds stable equilibria in regions where the fiscal policy rule is active and the Taylor principle does not hold. Impulse responses with some combinations of policy reactions in the region of fiscal-activeness show that the responses can be either well-behaved or strongly cyclical. For these cases, the model reestablishes lower cyclicality for practically null responsiveness of the fiscal rule to the debt and of the monetary policy rule to the inflation target.

APPENDIX

Please contact the authors to request a copy of the Appendix, or download a complete version of the working paper at http://www.bcb.gov.br/pec/wps/ingl/wps204.pdf

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SHORT-TERM MACROECONOMIC EFFECTS OF THE FISCAL STIMULUS MEASURES IN AUSTRIA

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Like most industrialized countries and many developing countries, Austria has taken measures to stabilise financial markets and to mitigate the sharp decrease in economic activity caused by the recent financial crisis. These measures amount to 4.2 per cent of 2008 GDP. Model simulations show that, together with fiscal measures adopted in the 10 major trading partner countries, the national stimulus packages may have slowed the decrease in Austrian real GDP by a cumulative 2.1 percentage points in 2010, preserving 41,500 jobs.

1 Introduction

The financial crisis of 2008 has triggered the deepest recession since the Great Depression of 1930s. The Austrian economy has been adversely affected by the financial and economic crisis, albeit somewhat less severely than the euro area on average. Other than in the wake of the Great Depression, economic policy responded to the global financial and economic crisis in a determined and timely manner. In November 2008, the Austrian federal government adopted measures to stabilize the banking sector and to cushion the economic downturn, which are gradually being implemented.

Part of the federal government's stabilisation programme is the carrying-forward of income tax cuts into 2009, supplemented by two fiscal stimulus packages, a rescue package for the banking sector, and two labor-market packages. In addition, the Länder have adopted own programmes that focus on infrastructure investment.

This paper presents simulations of the short-term effect of the domestic fiscal stimuli and of those set by Austrian's most important trading partners on output and employment in Austria (Breuss, Kaniovski and Schratzenstaller, 2009). The effect of the national packages is estimated using the Macromod, a macroeconomic model of the Austrian economy developed at WIFO. The spill-over effect of the stimuli adopted by Austria's ten most important trading partners on the Austrian economy is estimated using the Oxford World Macroeconomic Model (OEF). Our discussion of the results focuses on the GDP multipliers of the revenue and expenditure measures. The calculations rest upon the assumption that all measures are actually implemented as planned, *i.e.*, there is no implementation lag. The time horizon for the simulations is 2010.

In most industrialized countries, the fiscal response to the imminent economic recession has been swift and coordinated, which poses the question of the size of spill-over effects on the national economy. This question is especially important for small open economies such as Austria with imports and exports in 2009 being, respectively, 46 and 51 per cent of the nominal GDP. An assessment of spill-over effects for several large industrialized countries has been undertaken in OECD (2009). Model simulations by the OECD (2009, Table 3.7) show that for the USA this effect is about half as high as the effect of the US fiscal measures. For the average of the Euro area the effect is smaller.

In order to obtain the total effect of fiscal packages on the Austrian economy we have linked the OEF World model with a model of the WIFO model of the Austrian economy that is more detailed than the model for Austria supplied with the OEF. In addition to the demand effect, our simulations take account of changes in terms of trade, interest rates and the Euro/US Dollar

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exchange rate that cannot be fully implemented in a national model, and thus would not be fully accounted for. Our simulations for Austria show this effect to be about half as high as the effect of the fiscal measures taken on the national level. This confirms the importance of including the spill-over effects in assessment of the effectiveness of fiscal policy measures taken in response to the recent financial and economic crisis.

2 Stimulus programmes adopted by the main trading partners

In late March 2009, *OECD* (2009) published an overview of volume and timing of stimulus programmes implemented or planned by the 30 OECD member countries as of 24 March 2009. The volume is defined as a cumulated net effect on the general government balance over the period from 2008 to 2010, as percent of 2008 GDP, disaggregated to broad expenditure and revenue measures within the national account framework. The main findings were:

- Fiscal stimuli have been set in almost all OECD countries. The budgetary effect of these programs is typically smaller than that of the automatic stabilisers or other discretionary fiscal measures. The volumes differ markedly across countries. An unweighted average of the stimulus packages in the OECD countries (*i.e.*, those sets of measures giving a positive impulse to growth) cumulated over the period 2008 to 2010 amounts to 2.7 per cent of GDP, of which 1.6 per cent of GDP is due to tax cuts and 1.1 per cent of GDP to spending increases. The largest package has been adopted by the USA (5.6 per cent of GDP), the smallest by Switzerland (0.5 per cent of GDP). In five countries (USA, Australia, Canada, Korea and New Zealand), they exceed 4 per cent of 2008 GDP, while four countries (Italy, Ireland, Iceland and Hungary) assume a neutral or restrictive fiscal policy stance.
- Estimates based on the crisis-induced low fiscal multipliers suggest a growth effect of around 0.5 per cent of GDP in the OECD. The largest US package is expected to raise the US GDP by more than 1 per cent (2009: 1.3 per cent, 2010: 1.5 per cent). This estimate does not include international spillovers.
- The more effective the automatic stabilisers, the smaller are the national discretionary stimulus packages. On average, the impact of the automatic stabilisers is three times as high as that of the discretionary measures.
- Most OECD countries outside the G-7 focus on tax cuts, whereas tax cuts are less dominant among the G-7. Priority is given to cuts in personal income tax against cuts in business taxes. Almost all OECD countries resort to additional public investment or to the carrying-forward of planned projects. In many cases, transfers to private households are being increased, particularly for low-income earners. Some countries also increased subsidies to firms.
- Most OECD countries planned the bulk of their stimulus programmes for the year 2009.

Table 1 gives an overview of the volume and timing of the budgetary effects in Austria's ten major trading partner countries (*OECD,* 2009, p. 111). The measures planned for the period from 2008 to 2010 range from a strong fiscal expansion (5.6 per cent of nominal GDP of 2008) in the USA to a fiscal contraction of 4.4 per cent of GDP in Hungary. Germany, Austria's most important trading partner, has adopted measures totaling 3.0 per cent of nominal GDP. In most countries the measures take effect in 2009. On average of the 11 countries, the stimulus packages for 2008 to 2010 correspond to 1.4 per cent of 2008 GDP; if the comparison is confined to those countries in which fiscal policy is expansionary, the budgetary impact is 2.2 per cent of 2008 GDP. The expenditure-increasing measures account for 0.3 per cent and 0.9 per cent of GDP, respectively, the revenue cuts for 1.1 per cent and 1.3 per cent.

According to the analysis by the OECD, the Austrian package totalling 1.1 per cent of GDP (expenditure increase 0.3 per cent, tax cuts 0.8 per cent) is both below the OECD average and

Table 1

Size and Time Profile of the Stimulus Programmes Adopted by Austria's Main Trading Partners

	Net Impact on General Government Balance			Distribution 2008-10		
	2008-10			2008	2009	2010
	Expenditure	Taxes	Total			
	(percent of 2008 GDP)			*(percent share of net impact)*		
Germany	–1.4	–1.6	–3.0	0	46	54
Italy	–0.3	0.3	0.0	0	15	85
USA	–2.4	–3.2	–5.6	21	37	42
Switzerland	–0.3	–0.2	–0.5	0	68	32
France	–0.4	–0.2	–0.6	0	75	25
Czech Republic	–0.5	–2.5	–3.0	0	66	34
UK	0.0	–1.5	–1.4	15	93	–8
Hungary	4.4	0.0	4.4	0	58	42
Spain	–1.9	–1.6	–3.5	31	46	23
Poland	–0.6	–0.4	–1.0	0	77	23
Austria	–0.3	–0.8	–1.1	0	84	16
OECD 11						
Unweighted	–0.3	–1.1	–1.4	6	61	33
Only positive impact						
Unweighted	–0.9	–1.3	–2.2	7	66	29
G7	–1.6	–2.0	–3.6	17	43	40
OECD total						
Unweighted	–0.7	–1.2	–2.0	10	53	37
Weighted	–1.5	–1.9	–3.4	17	45	39
Only positive impact						
Unweighted	–1.1	–1.6	–2.7	9	53	38
Weighted	–1.7	–2.0	–3.7	17	45	39

Source: OECD, WIFO.

below the average for the 11 countries shown in Table 1. This may be explained by the following factors:

- the OECD study does not include off-budget measures that play an important role in Austria. Investment projects by the road financing agency (Asfinag), the Federal Real Estate Agency (BIG) and the Austrian Railways (ÖBB) belong to this category;
- although the aim of the OECD was to include all measures, the fiscal packages adopted by the Länder were omitted;
- of the permanent tax cuts enacted with the tax reform 2009, only the revenue shortfall for 2009 is taken into account. The OECD argues that the tax cuts for 2010 would have been implemented notwithstanding the crisis;

- lastly, the OECD study includes only some of the measures aimed at lowering the financing costs for businesses.[1]

In quantifying the inputs for model simulations we disaggregate the measures on the revenue side into personal taxes, business taxes, consumption taxes, social security contributions and a residual category of other revenues. On the contrary, we treat the expenditures as one category. While the diversity of the measures on the expenditure side precludes their disaggregation in a manner that is consistent among the countries, their effect is essentially identical in the highly aggregated macroeconomic models used for simulations.

3 Stabilisation measures taken by Austria

3.1 Stabilisation measures adopted by the federal government

In line with efforts at the international level to support aggregate demand, Austria resorts to a fiscal policy mix of tax cuts and spending increases. The measures included in model simulations comprise the stimulus packages I and II, and the tax cuts carried forward from 2010 into 2009. They can be grouped into four categories (total amount 2009-10 in millions of euros):

- increase in infrastructure investment (€ 1,435 million),
- lowering of companies' financing cost (€ 2,080 million),
- increase in private household disposable income (€ 5,953 million),
- increase in public consumption and subsidies (€ 370 million).

Table 2 gives an overview of the volume and timing of these packages.[2] Together the two packages and the tax cuts amount to 3.5 per cent of nominal GDP, rising to 4.2 per cent of GDP if the measures by the Länder are included. This shows that Austria belongs to the group of countries that adopted large stimulus programs relative to their GDP.

The investment initiative of the federal government foresees an increase in building and infrastructure investment by € 1.4 billion in 2009 and 2010, of which € 1,015 million will have a direct budgetary impact. Asfinag and ÖBB will invest € 450 million in transportation networks. Unlike the investment by ÖBB, that by Asfinag will be financed out of current revenues and therefore not burden the federal budget, whereas a small part of the ÖBB investment will have an impact on the budget. Further plans concern investment in energy conservation for buildings owned by the Federal Real Estate Agency (BIG) as well as the construction or renovation of schools, universities and administrative facilities.

The federal government programme sets incentives for private construction investment. Budget outlays of € 50 million for energy conservation in commercial buildings and of another € 50 million for private households are to generate an additional € 300 million in non-residential and residential construction output in 2009 and 2010. In 2009, € 10 million are allocated to investment in broadband technology.

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[1] The difficulty of international comparisons is illustrated by a comparison of the OECD findings with those of Saha and Von Weizsäcker (2009), which cites a budgetary effect of 1.3 per cent of GDP for Austria in 2009. Also the IMF, 2009 estimates of the fiscal cost of discretionary measures by the G-20 differ substantially from those of the OECD. The volume of the Austrian stabilization measures is best reflected in an overview published in June 2009 by the European Commission (European Commission, 2009A and 2009B), according to which the Austrian stimulus measures of 1.8 per cent of GDP are second-largest in the EU. Spain's package was larger in 2009 (2.3 per cent of GDP); Germany's in 2010 (1.9 per cent of GDP).

[2] For the tax measures raising private disposable income of households, Table 2 refers to the respective amounts after full implementation as from the year of introduction, since it is not the budgetary effects that are relevant (which may lag due to conventions of tax collection) but the economic effect. For this reason, the data differ slightly from those presented in Schratzenstaller (2009).

Table 2

Tax Reform and Measures Included in Stimulus Packages I and II

	2009	**2010**	
	(millions of euros)		
Federal level (government programme)	*4,702.5*	*5,135.0*	
Infrastructure investment	690	745	
ÖBB	175	175	Stimulus package I
Asfinag	50	50	Stimulus package I
BIG	355	520	Stimulus package II
Broadband services	10	0	Stimulus package I
Energy-saving renovation	100	0	Stimulus package II
Lowering of corporate financing cost	840	1,240	
Accelerated depreciation	0	250	Stimulus package II
Profit tax allowance	0	150	Tax reform
Third-party credits EIB[(1)]	200	200	Stimulus package I
Interest-subsidised ERP credits	200	200	Stimulus package I
Higher guarantee ceiling aws	400	400	Stimulus package I
Silent participations aws	40	40	Stimulus package I
Increase in private disposable income	2,987.5	2,965.0	
Income tax cuts	2,300	2,300	Tax reform
Family "package"	510	510	Tax reform
Tax deductability of sponsoring	100	100	Tax reform
Subsidised homebuilding	20	20	Stimulus package I
Regional employment "package"	35	35	Stimulus package II
Car scrapping premium	22.5	0.0	
Government consumption	120	120	
Compulsory pre-school year free of charge	70	70	Stimulus package II
Research and development	50	50	Stimulus package II
Subsidies	65	65	
Regional employment "package"	40	40	Stimulus package II
Globalisation "campaign"	25	25	Stimulus package I
Länder	*1,073.2*	*1,007.7*	
Infrastructure investment	876.8	876.8	
Increase in transfers	196.3	130.9	
Total	*5,775.7*	*6,142.7*	

Source: Federal Ministry of Economics, Families and Youth, IHS, WIFO. - Asfinag = Autobahnen- und Schnellstraßen Finanzierungs-Aktiengesellschaft, BIG = Federal Real Estate Agency, ÖBB = Austrian Railways.
[(1)] Small and medium-sized enterprises, research and development.

The measures designed to lower financing cost and strengthen the equity base of Austrian businesses may be summarised into three groups: strengthening of the equity base through silent partnerships, interest-subsidised loans and accelerated depreciation rules.

Among the measures supporting the purchasing power of private households, the tax reform carried forward into 2009 is the most important one. The cut in tax rates will lower the tax burden on households by € 2.3 billion per year. Additional tax concessions for families will increase the disposable income by € 510 million per year. To this category includes several tax rebates that cover charities, homeowner savings and loans, measures from the employment package and the car scrappage premium.

The remaining € 370 million in additional federal spending is included partly as government consumption and partly as subsidies. Included in this category is the funding of a newly-introduced compulsory pre-schooling year and the reinforcement of funds for research by € 70 million and € 50 million for 2009 and 2010, respectively, and € 65 million per year for the regional employment package and measures aimed at increasing exports.

3.2 Measures taken by the Länder

The federal states are planning a series of cyclical stabilisation measures which in the simulations with the WIFO macroeconomic model are captured in a simplified way either as investment or as addition to private disposable income. The measures at the Länder level are predominantly investment programmes, notably construction; of lower importance are commercial subsidies and transfers to households. In 2009 and 2010, the Länder plan additional infrastructure investment of nearly € 880 million, respectively, and an increase in transfer payments by almost € 200 million in 2009 and € 130 million in 2010. In total, the Länder "packages" amount to € 1,073 billion in 2009 and € 1,008 billion in 2010, together € 2,081 billion.

4 Simulation results

For a simulation of the overall effects of the expansionary fiscal measures described above, two macroeconomic models are used: the impact of measures taken by Austria's key trading partners on the domestic economy are estimated on the basis of the Oxford World Macroeconomic Model (OEF, 2005), the effects of the measures taken in Austria by the federal government and the Länder using the WIFO macroeconomic model (Baumgartner, Breuss and Kaniovski, 2004).

WIFO-Macromod is a medium-scale econometric model of the Austrian economy designed for medium term forecasting and economic policy simulations. We use this model to analyze the impact of global economic developments on Austria and explore both the intended and the unintended consequences of domestic fiscal policies such as tax reforms, public spending, and budget cuts. WIFO-Macromod is a structural econometric model that is based on the income-expenditure framework, with supply-side elements used for price and wage determination. We estimate a trend output using a production function and use an output gap as a proxy for the aggregate rate of capacity utilization.

In WIFO-Macromod, Austria is modeled as a small open economy in the European Economic and Monetary Union (EMU). The repercussions of economic activity in Austria on the rest of the world are neglected and variables describing the world economic conditions, including those of European economic policy authorities, are set as exogenous. Specifically, we treat the income of Austria's trading partners, the Euro-U.S. dollar exchange rate, short and long-term interest rates and world prices for tradable goods and services as exogenous. In the simulations of

the spillover effects these variables are borrowed from the OEF Model. In terms of the theoretical underpinning, the OEF model is very similar to the WIFO-Macromod but covers a large number of countries interconnected by trade flows and prices. The results of the simulations are summarized in Table 3.

4.1 Investment initiative

The federal government's investment initiative increases gross fixed capital formation by a cumulated 1.8 per cent above baseline, *i.e.*, a scenario without these government measures. As could be expected, investment in construction will post the strongest increase. Investment in machinery and equipment increases due to an accelerator effect. The imports increase by 0.3 per cent. The resulting cumulated increase in GDP is 0.3 per cent. The positive demand shock leads to an increase of 7,200 jobs and a decline in the unemployment rate by 0.1 percentage points. Labour productivity and real per capita wages will edge up only modestly, such that the increase in the wage bill is mainly due to the job creation. The marginal inflation-enhancing effect can be neglected.

Underlying the calculations is the assumption of timely implementation of the planned investment. In the case of delay, the macroeconomic impulse will materialize only with a lag.

4.2 Increase in private disposable income

The measures taken by the federal government raise real disposable income of households by 1.6 per cent. Since only part of the gain is used for consumption, private consumption grows by a cumulated 1.1 per cent. Because of the relatively low short-term propensity to consume of 0.34, the saving ratio goes up by 0.7 percentage points in 2009. Part of the rise in private consumption is imported. Real GDP increases by 0.4 per cent in 2009 and a further 0.2 per cent in 2010.

As a consequence of the positive demand shock, the number of people in dependent active employment rises by a cumulated 10,900 from baseline, and the jobless rate decreases by 0.2 percentage points. Per capita wages in the private sector continue to increase moderately, therefore the higher wage bill is also in this case largely due to the creation of new jobs.

4.3 The role of multipliers

The macroeconomic effects of a given fiscal policy measure are captured by multipliers, which quantify the impact of variations in government spending or taxes on GDP, employment, investment, private consumption, etc. In the focus of analyses studying the macroeconomic impact of fiscal policy are GDP multipliers. Their magnitude differs for different fiscal policy measures. Generally, the macroeconomic effect of increases in investment in public infrastructure is particularly strong since the respective measures have a direct impact and are relatively labor-intensive (particularly for the building of new structures). Moreover, the import content for construction investment is low. Cuts in income taxes have generally a more limited effect on growth than an increase in government spending, since they do not directly raise demand but rather personal disposable income. Like with most international or national macroeconomic models, the GDP multiplier is markedly higher for government expenditure than for cuts in direct taxes also in the WIFO model (Table 4). GDP increases only if the additional income is spent rapidly for purchases of domestically-produced consumer goods. Decisions on higher government expenditure will, however, exert their full effect only if the measures are implemented as planned.

Table 3

Macroeconomic Effects of the Fiscal Stimulus Programmes

	Stimulus Packages I and II, Tax Reform[1]								Measures by Bund and Länder[1]		Stimulus Programmes of Main Trading Partners		Grand Total	
	Total		Infrastructure Investment		Increase in Private Disposable Income		Lowering of Corporate Financing Cost							
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
	(percent of cumulated deviation from baseline)													
Aggregate demand, volume														
Gross domestic product	+0.9	+1.0	+0.4	+0.3	+0.4	+0.6	+0.0	+0.1	+1.2	+1.4	+0.7	+0.8	+1.9	+2.1
Consumption	+0.8	+1.1	+0.1	+0.1	+0.7	+0.9	+0.0	+0.1	+0.9	+1.2	+0.1	+0.1	+1.0	+1.2
Private households	+1.0	+1.4	+0.1	+0.2	+0.8	+1.1	+0.0	+0.1	+1.0	+1.5	+0.2	+0.1	+1.2	+1.6
Government	+0.5	+0.3	+0.1	+0.0	+0.3	+0.3	+0.0	+0.0	+0.5	+0.4	± 0.0	± 0.0	+0.4	–0.0
Gross fixed investment	+3.1	+3.1	+2.0	+1.8	+0.7	+1.0	+0.4	+0.3	+5.1	+5.1	+0.7	+0.7	+5.7	+5.7
Equipment[2]	+2.4	+2.4	+0.8	+0.7	+1.0	+1.3	+0.5	+0.4	+3.1	+3.1	+1.1	+1.1	+4.1	+4.0
Construction	+3.8	+3.7	+3.0	+2.6	+0.5	+0.8	+0.3	+0.3	+6.7	+6.6	+0.4	+0.5	+7.0	+7.0
Exports	± 0.0	+0.1	± 0.0	+0.0	± 0.0	+0.0	± 0.0	+0.0	± 0.0	+0.1	+1.7	+1.8	+1.7	+1.9
Imports	+0.8	+1.0	+0.3	+0.3	+0.4	+0.6	+0.1	+0.1	+1.1	+1.2	+1.0	+0.9	+2.0	+2.1
Gross domestic product, nominal	+0.8	+1.1	+0.3	+0.4	+0.4	+0.6	+0.0	+0.1	+1.1	+1.5	+0.8	+1.2	+1.9	+2.6
Consumer prices	–0.1	+0.1	–0.0	+0.0	+0.0	+0.1	–0.0	+0.0	–0.1	+0.1	+0.2	+0.7	+0.1	+0.8

Labour market and income														
Dependent active employment[3]	+0.3	+0.6	+0.1	+0.2	+0.2	+0.3	+0.0	+0.0	+0.4	+0.8	+0.3	+0.5	+0.7	+1.3
1,000 persons	+10.7	+19.7	+4.7	+7.2	+5.4	+10.9	+0.6	+1.5	+14.7	+26.6	+9.1	+16.4	+23.5	+41.5
Labour supply	+0.1	+0.2	+0.0	+0.1	+0.1	+0.1	+0.0	+0.0	+0.2	+0.3	+0.1	+0.2	+0.2	+0.4
Unemployment rate in percent of dependent labour force[4]	–0.2	–0.3	–0.1	–0.1	–0.1	–0.2	–0.0	–0.0	–0.3	– 0.5	– 0.2	– 0.3	– 0.4	– 0.7
Real wage per capita of dependent employees	+0.2	+0.3	+0.1	+0.1	+0.1	+0.2	+0.0	+0.0	+0.3	+0.4	+0.0	– 0.0	+0.3	+0.4
Unit labour cost, private sector	–0.4	+0.0	–0.2	+0.1	–0.2	+0.0	–0.0	–0.0	–0.5	+0.1	– 0.2	+0.4	– 0.8	+0.5
Average labour productivity, private sector	+0.5	+0.4	+0.2	+0.1	+0.3	+0.2	+0.0	+0.0	+0.7	+0.5	+0.5	+0.3	+1.2	+0.7
Real disposable income, private households	+1.9	+2.1	+0.3	+0.2	+1.6	+1.6	+0.0	+0.2	+2.1	+2.2	+0.4	+0.1	+2.4	+2.3
Government														
Expenditure	–1.5	–1.3	+0.2	+0.3	–1.8	–1.4	+0.0	–0.2	–1.2	– 0.9	+0.5	+1.1	– 0.7	+0.2
Revenue	+0.5	+0.6	+0.3	+0.4	+0.1	+0.2	–0.0	–0.0	+1.2	+1.3	+0.0	+0.1	+1.2	+1.4
Government balance *(percent of nominal GDP)*	–0.9	–0.9	–0.1	–0.0	–0.9	–0.8	+0.0	–0.1	–1.2	– 1.0	+0.3	+0.5	– 0.9	– 0.5
Saving ratio *(percent)*	+0.8	+0.6	+0.1	+0.0	+0.7	+0.4	+0.0	+0.1	+0.9	+0.6	+0.2	– 0.0	+1.0	+0.6

Source: WIFO.
[1] Including subsidies and government consumption. – [2] Including immaterial investment, other equipment, industrial cattle and plants. – [3] Excluding early child care benefit recipients. – [4] Public Employment Service Austria.

Table 4

Comparative Estimates of Fiscal Multipliers for Austria

	Government Expenditure		Wage and Income Tax	
	First Year	Second Year(1)	First Year	Second Year(1)
	Impact of 1 percent change on GDP *(percent)*			
OECD	0.70	1.10	0.20	0.60
OeNB	0.78	1.40	0.45	0.64
WIFO	1.19	1.31	0.40	0.56
IHS	0.96	0.98	0.29	0.41

Source: WIFO compilation.
(1) Cumulated.

The effectiveness of tax cuts to boost disposable income and thereby private purchasing power largely depends on the readiness of private households to increase consumption. The marginal propensity to consume is the change in consumption in response to a small variation in income. It is to an important extent determined by the overall economic environment. Sluggish income growth and heightened uncertainty may encourage precautionary saving and thus lead to a rise in the saving ratio (e.g., Bartzsch, 2006). The uncertainty about the effectiveness of fiscal measures, as reflected by GDP and employment multipliers, is higher at the present juncture than before the economic crisis or for "normal" cyclical variations. At the same time, however, various recent studies suggest that the impact of government spending may be higher in a severe recession with low/zero interest rates or a recession-induced liquidity trap.[1]

Furthermore, private households' marginal propensity to consume differs substantially by income brackets. Low-income households typically have a higher consumption/lower saving propensity than higher-income earners. Tax cuts will thus have a stronger impact on growth and employment the more they benefit the lower income brackets.

A recent study by Oesterreichische Nationalbank (OeNB) arrives at somewhat higher cumulated multipliers than the present analysis (Köhler-Töglhofer and Reiss, 2009). For government expenditure, the OECD (2009, p. 138) assumes lower multipliers for Austria than those incorporated in the WIFO model. The fiscal multipliers in the LIMA model of the Institute for Advanced Studies (Hofer and Kunst, 2004; Berger *et al.*, 2009) are lower than the other multipliers presented in Table 4. In the WIFO model, the multiplier in the first year is markedly higher than in other models for Austria. Fiscal multipliers in the range between 1.0 and 1.2 are very common in national macroeconomic models. For example, a survey of a large number of national macroeconomic models provided in OECD (2009) quotes the average public consumption multiplier of 1.2 in the first year and 1.3 in the second year. The same survey reports the average multiplies for personal income tax cuts of 0.5 in the first year and 0.8 in the second year. The corresponding multiplier in the WIFO model is slightly lower.

[1] For a short overview of studies determining the multiplier in a liquidity trap see Erceg and Lindé (2010).

The multipliers presented here for Austria are derived from conventional demand-side oriented macroeconomic simulation models. The sizeable stimulus packages many countries have implemented to mitigate the economic downturn caused by the financial market crisis have intensified the academic discussion about the effectiveness of fiscal policy, which has been ongoing for the last two decades.[2] Meanwhile a number of empirical studies exist which are trying to quantify the multipliers for different fiscal policy measures for different countries and are yielding rather diverse results. These studies are mainly based on three types of models (Auerbach and Gale, 2009): (i) large-scale macroeconomic models with several equations for prices and quantities in different sectors of the economy which are trying to identify the impact of fiscal policy measures on these prices and quantities; (ii) structural vector autoregression (VAR) models identifying the macroeconomic effects of fiscal policy shocks; (iii) dynamic stochastic general equilibrium (DSGE) models using equations based on microeconomic theory. The different models used to estimate the magnitude of multipliers are one reason for the inconclusive results brought about by the existing body of literature. According to Freedman *et al.* (2009), further causes are country-specific differences in the marginal propensities to save and to import, in the responses of monetary policy, in financing constraints for the government, as well as in country size and degree of openness.

Table 5 gives an overview over the most important studies published since the beginning of 2009 inspired by the sizeable stimulus programs with which many countries reacted to the crisis. These studies try to identify the magnitude of the multipliers for various fiscal policy measures. Mostly public spending is in the focus, which is somewhat astonishing as tax measures were dominant in the majority of stimulus packages (OECD, 2009). Not surprisingly, the results for the fiscal multipliers vary considerably, depending on the models used. Generally, the more recent, neoclassical or New Keynesian models incorporating rational expectations and forward-looking behavior of firms and households and partly resting on microeconomic foundations produce smaller – and partly even negative – multipliers than the traditional macroeconomic Keynesian models, due to a crowding-out of private investment and consumption by public spending. It is important to note that all papers included in the following overview do not account for cross-border effects, *i.e.*, they only estimate the GDP multipliers for a given country resulting from its own fiscal actions, while leakages abroad or positive impulses from abroad are neglected.

Moreover, the studies reviewed here suggest that the multipliers:

- of spending measures are larger than of variations in taxes are larger in a situation with economic slack
- of contractionary and expansionary spending measures are very similar
- of spending measures are larger at low nominal interest rates or in a liquidity trap, respectively
- of spending measures are larger in traditional Keynesian models without forward-looking behavior of firms and households
- in conventional macroeconomic simulation models increase in the years after the policy shocks, while they tend to decrease in the more recent models
- vary inversely with the degree of openness of the countries regarded.

4.4 Cyclical stimulus from abroad

Particularly in Europe, one issue heavily debated was the necessity of international coordination of national stimulus programs to reinforce their effectiveness given the deep economic

[2] For brief reviews of the most important earlier studies (since 2002) see Giordano *et al.* (2007), Afonso and Sousa (2009) and Christiano *et al.* (2009).

Table 5

Recent Studies on the Size of Multipliers for Various Fiscal Policy Measures

Authors	Sample	Fiscal Policy Measure	Magnitude of GDP Multiplier	Specific Aspects
Barro and Redlick (2009)	US 1917 to 2006	increase in defense spending	0.6 to 0.7 for median unemployment rates 1.0 for high unemployment rates	multipliers depend positively on extent of economic slack spending multipliers smaller than tax multipliers
	US 1950 to 2006	increase in income tax	–1.1	multipliers for spending increases and decreases very close
Cogan *et al.* (2009)	US 2009 to 2012	permanent increase in government purchases	0.4	temporary increase: multiplier turns negative
Cwik and Wieland (2009)	11 largest Euro area countries 2009/10	increase in government spending in forward-looking models	–0.26 to 0.04 short-term –0.455 to –0.11 medium-term	multipliers much larger in traditional macroeconomic model without forward-looking behavior
		increase in government spending in non-forward-looking models	0.37 short-term –0.18 medium-term	
Fair (2009)	US	increase in government purchases	2.0	-
		decrease of personal income tax	1.0	
		increase in transfer payments to households	1.0	
Hall (2009)	US	increase in government purchases	0.7 to 1.0 1.7 at low interest rate	spending multipliers higher with zero nominal interest rate
Ramey (2009)	US	increase in government spending	0.6 to 1.1	-
Romer and Bernstein (2009)	US 2009 to 2012	permanent increase in government purchases	1.6	-
		permanent tax cuts	1.0	
OECD (2009)	Review of macroeconomic simulation models for various OECD countries and Euro area	increase in government purchases	1.2 to 1.3	multipliers vary inversely with degree of openness
		corporate tax cut	0.3 to 0.5	
		personal income tax cut	0.5 to 0.8	
		indirect tax cut	0.2 to 0.4	
		social security contribution cut	0.3 to 0.6	

Source: Own compilation.
(1) Mean values; first and second year multipliers.

integration of national economies. To avoid leakages and thus to reinforce the effectiveness of domestic fiscal measures, and to respond adequately on a global/European level to the global/European crisis, supranational bodies – in particular the IMF and the European Commission – strongly advocated internationally coordinated stimulus measures. Few studies, however, exist to date on the extent of the cross-border impact of fiscal policy. IMF economists themselves (Freedman *et al.*, 2009) undertook simulations with the IMF's Global Integrated Monetary and Fiscal Model (GIMF) to assess the size of GDP multipliers for a global fiscal stimulus, differentiating for a situation with and without monetary accommodation. Not surprisingly, multipliers are considerably higher with monetary accommodation, and there are significant cross-border spillovers. These findings are corroborated by simulations done by the OECD (2009) and by Corsetti, Meier and Müller (2009) who show in addition that cross-border spillovers are particularly large when a credible medium-term consolidation regime is announced simultaneously.

Besides estimating the macroeconomic effects of the domestic stimulus measures on the Austrian economy, the present study also quantifies the impact of stimulus packages adopted by Austria's main trading partner countries on the domestic economy. Therefore the increase in Austria's foreign markets has been estimated using the OEF model. For this purpose, the tax-related measures have been taken into account to the same degree of detail as presented in OECD (2009). The additional government expenditure has entirely been counted as public consumption. Such simplification is deemed warranted since in the OEF model the GDP and employment multipliers are of similar magnitude for public investment and consumption. Both aggregates exhibit rather low import content in comparison with other demand components.

Table 6 shows the impact of fiscal stimulus programs on real GDP of Austria's main trading partners and Japan.[3] Weighted by the each country's export share in Austria's overall exports, demand on Austria's foreign markets is boosted from baseline by 0.8 per cent each for 2009 and 2010.

The spillover effect on the Austrian economy is estimated using the WIFO macroeconomic model (Table 3). The increase in demand abroad leads to a cumulated gain in Austria's exports by 1.8 per cent from baseline in 2010. The higher exports trigger a positive income effect leading to an increase in private consumption and investment mostly in 2009. As imports will rise at the same time, the gain in real GDP is 0.8 per cent from the baseline. These transmission effects are consistent with simulation results in *OECD* (2009, p. 133) for the euro area where a fiscal impulse of the order of 1 per cent of GDP in all industrialized countries lifts euro area real GDP by 0.76 per cent, of which 0.24 percentage points are due to transmission effects from abroad.

Table 7 summarizes the respective size as well as GDP and employment effects of the measures taken by the federal government and the Länder and of the stimulus programs adopted by Austria's main trading partners.

5 Concluding remarks

Model simulations suggest that the fiscal stimulus measures implemented in Austria may have dampened the downturn by a cumulated 2.1 per cent of GDP in 2009 and 2010. Almost half of the fiscal impulse is generated by the fiscal packages I and II and the tax cuts introduced at the federal level, 0.4 percentage points by measures taken by the Länder and 0.8 percentage points by the stimulus programs implemented by Austria's main trading partners. The total impact on GDP secures 41,500 jobs and holds the rise of the unemployment rate by 0.7 percentage points (in each

[3] Japan's fiscal package has been included in order to illustrate more explicitly its effect on the euro/yen exchange rate.

Table 6

Impact of Stimulus Programs Adopted by Austria's Major Trading Partners

	Percentage Share in Austrian Exports 2007	Gross Domestic Product *(volume)*		
		2008	2009	2010
		Cumulated Deviation from Baseline *(percent)*		
Germany	30.0	+0.1	+0.9	+1.0
Italy	8.9	± 0.0	± 0.0	– 0.3
USA	5.0	+0.6	+2.3	+3.6
Switzerland	3.9	+0.1	+0.5	+0.1
France	3.6	± 0.0	+0.2	– 0.2
Czech Republic	3.6	± 0.0	+0.8	+0.6
UK	3.5	+0.1	+0.4	– 0.4
Hungary	3.5	± 0.0	– 0.5	– 1.0
Spain	2.9	+0.8	+1.2	+0.5
Poland	2.6	± 0.0	+0.7	+0.3
Japan	1.0	± 0.0	+0.8	+0.1
Other countries	31.4	+0.2	+1.0	+1.2
Export markets total[(1)]		+0.2	+0.8	+0.8

Source: OECD, WIFO.
[(1)] Impact on GDP, weighted by Austrian export shares.

Table 7

Overall Economic Effects of Stimulus Measures by Category

Item	Size[(1)]		Deviation from Baseline[(1)]	
			GDP *(volume)*	Dependent Active
	(millions of euros)	*(percent of 2008 GDP)*	*(percent)*	*(persons)*
Total		*4.2*	*+2.1*	*41,500*
Measures by Bund and Länder	11,918.4	4.2	+1.4	26,600
Infrastructure investment	1,435	0.5	+0.3	7,200
Lowering of corporate financing cost	2,080	0.7	+0.1	1,500
Increase in private disposable income	5,952.5	2.1	+0.6	10,900
Measures taken by the Länder	2,080.9	0.7	+0.4	6,900
Stimulus programmes of main trading partners			+0.8	16,400

Source: WIFO.
[(1)] Cumulated over 2009 and 2010.

case from a baseline without government measures). Inflation picks up moderately. According to the simulations, the federal government balance weakens in 2010 by an amount of 0.5 per cent of GDP.

Infrastructure investment at the federal level raises GDP by 0.3 per cent and employment in 2010 by a cumulated 7,200 persons. The measures to lower corporate financing cost boost GDP by 0.1 per cent and employment in 2010 by a cumulated 1.500.

The *ex ante* simulation results rest on the assumption of the measures decided being fully implemented in 2009 and 2010. In addition, some measures - such as the introduction of a compulsory pre-school year free of charge - and the active employment policy in general have a direct positive impact on employment which cannot be captured by the kind of models used. Hence, the results presented here should be taken as the lower limit of the overall employment effects generated by the fiscal stimulus programs. A more precise estimate of these effects would require a more sophisticated analysis.

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GETTING IT RIGHT:
HOW FISCAL RESPONSE CAN SHORTEN CRISIS LENGTH AND RAISE GROWTH

Emanuele Baldacci,[*] *Sanjeev Gupta*[*] *and Carlos Mulas-Granados*[**]

1 Introduction

Fiscal measures, such as tax cuts and spending increases, have been central to government responses to the recent global financial crisis. All countries in the Group of Twenty (G-20) have adopted discretionary fiscal packages to fight the economic downturn that was set off in mid-2007 by a financial and banking crisis with roots in the U.S. mortgage market. Those programs, enacted specifically to boost aggregate demand during the economic downturn, cost about 2 per cent of the gross domestic product (GDP) of the G-20 countries in 2009 and are projected at 1.6 per cent of GDP in 2010 (IMF, 2009).

These expansionary fiscal policies are beginning to offset the fall in private demand in G-20 countries, but it is too early to tell if they will help shorten the duration of the recession and promote growth in the medium term. Does it matter for the next three to five years whether governments rely on tax cuts or spending increases to combat the recession? Or whether governments cut consumption taxes or income taxes or spend on current consumption or investment? We examine these questions, using historical data from past banking crises, which have caused more severe and protracted recessions than those with their roots in the real economy.

2 Fiscal balances deteriorate

The discretionary programs enacted to combat the global recession contributed to increased government deficits. In addition, declining economic activity and a drop in asset values both lowered government revenues and increased spending for existing social programs, such as unemployment insurance. On average, fiscal balances in the G-20 nations are projected to deteriorate by about 7 per cent of GDP in 2009, compared to the pre-crisis periods. The discretionary measures account for almost half of the increase in deficits. Discretionary fiscal stimulus was larger in emerging market economies, which have limited social programs and lower revenues. By contrast, in advanced G-20 countries, the bigger deficits were mainly caused by automatic increases in spending on such existing social programs as unemployment insurance and social assistance.

Most of the fiscal stimulus has centered on raising public spending. More than two-thirds of the discretionary stimulus came in spending measures in 2009, with the rest in tax cuts. Investment in infrastructure accounts for almost half of the stimulus in emerging G-20 countries, compared to about one-fifth in advanced G-20 countries. Tax reductions, notably corporate and personal income taxes, are a significant share of fiscal stimulus in advanced economies.

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3 Recessions and fiscal policy

The role of fiscal and monetary policy during recessions has been studied extensively. Fiscal and monetary policies counter the effects of shrinking output during recessions, credit contractions and asset price declines (Claessens, Kose and Terrones, 2008). Fiscal policy appears to be particularly effective in shortening the duration of recessions. That suggests that an aggressive countercyclical fiscal stance – one that leans against the direction in which the economy is moving by cutting taxes or increasing spending – is appropriate during recessions and that fiscal stimulus should be large, sufficiently lasting, diversified, contingent, collective and sustainable (Spilimbergo *et al.*, 2008). However, there is little evidence on the effectiveness of fiscal policy during periods of systemic banking crises. This has limited our understanding of how the current stimulus packages will affect the duration of the crisis.

Several factors could hamper the effectiveness of fiscal expansion during the more severe and long-lasting recessions caused by financial crises:

- The dramatic drop in aggregate demand necessitates a larger fiscal stimulus to support the economy than in a standard recession.
- The implementation of fiscal policy is made difficult because the ability of consumers to spend is hampered by financial distress. This causes capital markets to freeze, limiting the scope for private consumers to access credit against the backdrop of severe income losses.
- Governments find it difficult to finance fiscal expansions in a more risk-averse global environment. While this can be particularly important for countries with high initial levels of debt or high credit risk, the across-the-board increase in the perception that it is riskier to lend to governments can affect sovereign bond issuance even in better-rated economies. However, this effect can be offset in part by lower inflationary pressures and financial markets' flight to quality.

4 Systemic banking crisis and fiscal policy

We used new data on financial crisis episodes compiled by Laeven and Valencia (2008) to study the effectiveness of fiscal policy under systematic banking crises. This database comprises 118 episodes of financial crises that occurred in 99 countries during the period 1980-2008. These crises were different from standard recessions as they originated from severe systemic disruptions in the banking system. Under Laeven and Valencia definition, systemic banking crisis occurs when a country's corporate and financial sectors experience a large number of defaults and financial institutions and corporations face difficulties repaying loans on time. They identify 124 systemic banking crises over the period 1970-2007, and estimate that fiscal costs net of recoveries associated with these crises average about 13.3 per cent of GDP while output losses average 20 per cent of GDP.[1, 2, 3]

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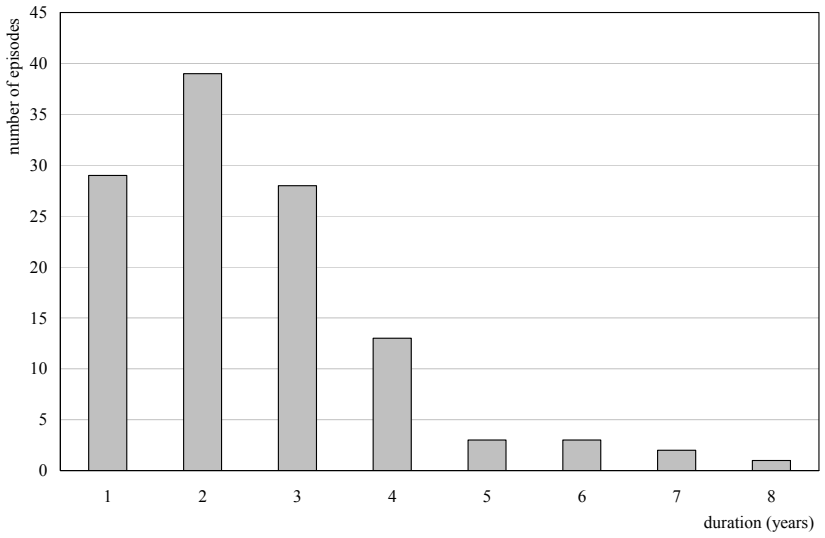
[1] We use the dataset of 124 banking crises and drop 10 of them due to lack of fiscal data. We come up with a sample of 118 cases by adding 4 cases from their other two datasets. These cases were originally classified as other type of financial crisis (currency crisis and debt crisis), but they triggered a banking crisis.

[2] We complement Laven and Valencia's database with additional data from the World Economic Outlook, the Government Financial Statistics, and the Global Financial Database.

[3] This approach differs from the one recently adopted by Reinhart and Rogoff (2009) who define banking crises as two types of events: bank runs that lead to the closure, merger, or takeover by the public sector of one or more financial institutions; and if there are no runs, the closure, merger, takeover, or large-scale government assistance for an important financial institution that marks the start of a string of similar outcomes for other financial institutions. With these criteria, they identify 66 cases that occurred between 1945 and 2007.

Figure 1

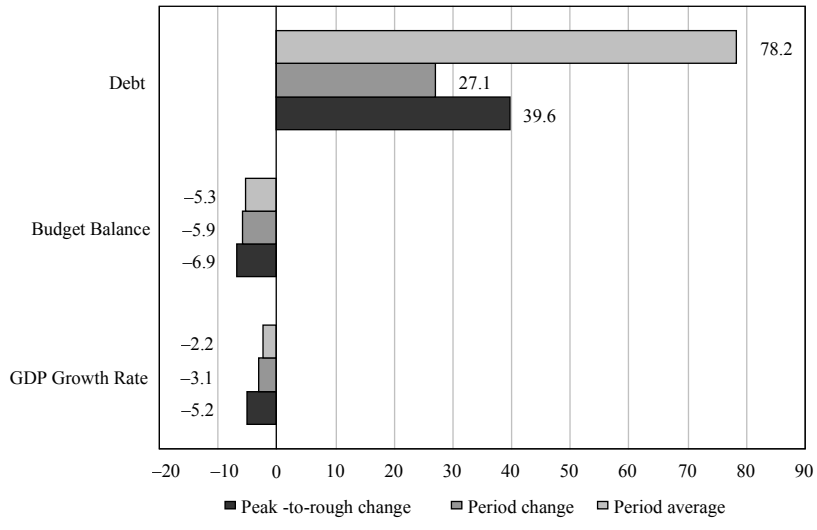
Frequency and Duration of Banking Crises



Source: Author's calculations.

Figure 2

Economic Consequences of Banking Crises
(percent of GDP)



Source: Author's calculations.
Note: Peak-to-trough values are differences between the worst level reached by the variables during the crisis and their pre-crisis value. Period changes denote differences between the last year of the crisis and the pre-crisis year. Period averages show the average value of the variable during the crisis episodes.

Financial crises lasted on average for 2.5 years (Figure 1), with 85 per cent of the episodes lasting between one and four years. One episode, the longest, lasted eight years. These crises also generated large economic costs. Peak-to-trough fall in GDP growth was more than 5 percentage points during the average shock episode. The effects of crises on fiscal aggregates were also significant: during the crisis, public debt increased by about 30 percentage points of GDP (Figure 2) reflecting a significant deterioration in the primary fiscal balance. A drop in revenue collection as well as higher public expenditure contributed to the fiscal deterioration. These results are similar to the estimated impact of the current crisis on output and government debt in G-20 countries and to those reported in other studies on financial crises (Reinhardt and Rogoff, 2009).

To assess the behavior of fiscal variables during crises episodes and in their aftermath, we calculate the overall change in the variables two years prior to the start of the crisis;[4] during the crisis; and in the two years after the crisis. Results are expressed as a percent of GDP (Tables 1 to 3).

[4] As fiscal variables, in particular revenue, may be affected by asset value increase in the run up to the crisis we also estimated the change over a longer time period.

Table 1

Fiscal Aggregates
(percent of GDP)

Item	Before Crisis *(t–2; t–1)*	During Crisis *(t)*	After Crisis *(t+1; t+2)*
Debt	–9.2	27.1	–7.2
Budget balance	–0.1	–5.9	1.5
Primary budget balance	0.3	–4.9	2.8
Total revenues	0.8	–3.7	4.9
Total expenditures	0.9	2.3	2.6

Table 2

Budget Composition: Revenues
(percent of GDP)

Item	Before Crisis *(t–2; t–1)*	During Crisis *(t)*	After Crisis *(t+1; t+2)*
Taxes	0.5	–2.3	4.2
Income, profits, capital gains	0.2	–1.2	3.8
Payroll and workforce	0.1	–0.3	0.0
Property	0.0	0.0	0.0
Goods and services	0.1	–0.5	0.4
International trade	0.1	–0.3	0.0
Other taxes	0.0	0.1	–0.1
Social contributions	0.2	–1.2	0.2
Other revenues	0.1	–0.2	0.5

Table 3

Budget Composition: Expenditures
(percent of GDP)

Item	Before Crisis *(t–2; t–1)*	During Crisis *(t)*	After Crisis *(t+1; t+2)*
Current expenditure	–0.9	2.2	0.1
Goods and services	–0.1	0.6	–0.5
Employee compensation	0.1	0.2	0.1
Transfers	0.1	0.6	0.3
Interest payments	0.4	1.0	2.3
Other expenses	0.4	–0.2	–0.1
Public Investment	0.0	0.1	2.5

For the three tables above:
Source: Author's calculations based on data from WEO and GFS.
Note: Figures in (*t*) show the change in the variables between the last year of the crisis period and the pre-crisis year. Figures in (*t–2; t–1*) show the change in the variables during the two years prior to the start of the crisis. Figures in (*t+1; t+2*) show the change in the variables during the two years following the last year of the crisis.

During banking crises, fiscal deficits increased by more than 2 per cent of GDP per year and public debt worsened by about one-third of the preexisting average debt level of about 80 per cent of GDP. Total revenues fell by about 3.5 percentage points of GDP and government expenditures rose by more than 2 percentage points of GDP. Tax revenue fell by more than 2 per cent of GDP, especially from income and profits taxes (Table 2). Social contributions also fell considerably. After the crisis, revenue collection improved, in particular taxes associated improvement in private income. There was also a significant increase in current expenditure (Table 3). Interest payments, transfers and government's purchase of goods rose most. The rise in public sector salaries was weaker and public investment remained stable during the shock, but rose after the crisis.

Did fiscal expansion help in shortening the length of financial crises? Our results based on regression analysis of the factors that affected crisis duration indicate that it did. We use a dummy-variable indicator of large fiscal expansions during the crisis episode to capture major changes in fiscal policy. We create an "expansionary fiscal policy" dummy that takes value equal to 1 if the budget balance worsens by more than 1.5 per cent of GDP in the first three years following the onset of the crisis. The following model is used to determine the effect of fiscal policy and other accompanying measures on the duration of banking crises:

$$Duration(t) = \alpha + \beta_1 FiscalExpansion_t + \beta_2 CreditBoom_{t-1} + \beta_3 Containment(Dep.Guarantee)_t + \beta_4 \mathrm{Re}solution(N.BanksClosed)_t + \beta_4 \mathrm{Re}solution(GovtIntervention)_t + \varepsilon_t \quad (1)$$

where t refers to the time period during the crisis and t–1 refers to the year preceding the onset of the crisis. *Expansion* is the indicator of fiscal expansion; *Credit Boom* is a dummy variable that takes value equal to 1, when the banking crises was preceded by an abnormal expansion of credit; and *Guarantee* is a dummy variable that takes value equal to 1 when there was a freeze of deposits and/or a blanket guarantee in the first phases of banking crises. We include two measures of resolution policies, captured by the total *Number of Banks Closed* during the episode and the degree of *Government Intervention* in the financial sector.[5]

We estimate a baseline model in a truncated sample of 118 episodes of banking crises, using OLS and Ordered Logit. Results are reported in Table 4 and show that fiscal expansions are a decisive factor for reducing the duration of banking crises. Higher government spending and lower taxes boosted aggregate demand by replacing falling private consumption. Public investment also contributed to offsetting the collapse in private investment. Higher deficits led to shorter crisis durations in our sample. An increase of 1 percent of GDP in the fiscal deficit reduced the duration of the crisis by almost two months. This suggests that fiscal expansion of the size similar to the one adopted on average by G-20 countries during the current global financial crisis may cut the length of the recession by almost one year, compared to a baseline situation in which the budget deficits remained the same as in the pre-crisis period.

5 Fiscal policy composition

We also find that the composition of fiscal expansion – how it is distributed as current spending, investment spending, or tax cuts – matters (Table 5). Higher public consumption – government purchases of goods and services and wages – and lower income taxes shorten the duration of financial crises. For example, a 10 per cent increase in the share of public consumption in the budget reduced the crisis length by three to four months more than would have larger fiscal deficits alone. The same cannot be said for capital expenditures. Why? We believe that implementing capital projects generally takes longer than directly injecting demand through

[5] See Laeven and Valencia (2008) for the derivation of these variables.

Table 4

Fiscal Policy, Resolution Policies and Crisis Length

Item	Duration (OLS)		Duration (Ord.Logit)	
	Model 1	Model 2	Model 3	Model 4
Budget Balance *(percent of GDP)*	0.072***	-	0.122***	-
	(3.73)	-	(3.22)	-
Expansionary fiscal policy	-	–0.626***	-	–1.023***
	-	(–2.86)	-	(–2.62)
Previous credit boom	0.690***	0.637***	1.036***	0.927**
	(3.40)	(3.04)	(2.82)	(2.53)
Deposit freeze or guarantee	–0.522**	–0.610***	–0.814**	–0.806**
	(–2.53)	(–2.94)	(–2.25)	(–2.23)
Number of banks closed	–0.168***	–0.165***	–0.519***	–0.496***
	(–3.53)	(–3.37)	(–4.91)	(–4.72)
Government intervention	–0.721***	–0.825***	–1.207***	–1.329***
	(–3.52)	(–3.94)	(–3.12)	(–3.46)
Constant	3.514***	3.876***	-	-
	(14.76)	(14.31)	-	-
Observations	118	118	118	118
Adj. R-squared / Pseudo R-squared	0.435	0.407	0.211	0.198

*** significant at 1 percent; ** significant at 5 per cent; * significant at 10 per cent.
Dependent variable: length of banking crisis.
Source: Authors' estimates.

government purchases of goods and services. This picture seems consistent with the pace of disbursement of current fiscal packages. Tax cuts and increases in government consumption and transfers were implemented rapidly in many G-20 economies. However, procedures for budget allocation, transfers to subnational governments, procurement and payments to contractors slowed down the disbursement of some capital projects (Horton, Kumar and Mauro, 2009).

The composition of tax measures is also important: cutting consumption taxes was more effective than cutting income taxes. That is because cuts in levies such as a value added or sales taxes quickly stimulate private consumption while income tax reductions can in part be saved. Consumption tax cuts help support domestic demand particularly when dropping asset values, income losses and rising unemployment dent households' ability to spend.

Other factors played a significant role. Crises that were preceded by a credit boom tended to last longer. Those in which a guarantee for bank deposits was provided (or expanded) by the government were shorter than crises in which governments did not provide this financial safety net. Closing failed banks and a strong government intervention in financial markets was also beneficial to resolving crises in the last three decades.

The analysis also found that how fiscal expansion is constructed affects whether it creates conditions that promote economic growth five years after a crisis (Table 6). Fiscal responses that had a greater share of public investment may not have helped shorten the recessions as much as

Table 5

Fiscal Policy Composition, Resolution Policies and Crisis Length

Item	Duration of Crisis (OLS)				Duration of Crisis (Ord. Logit)			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Expansionary fiscal policy	–0.522**	–0.572**	–0.581**	–0.601**	–0.945**	–0.974**	–0.937**	–1.049**
	(–2.45)	(–2.61)	(–2.74)	(–2.85)	(–2.41)	(–2.48)	(–2.39)	(–2.67)
Public consumption *(percent of total expenditures)*	–0.035***				–0.041**			
	(–3.12)				(–2.11)			
Public investment *(percent of total expenditures)*		–0.027*				–0.027		
		(–1.82)				(–1.13)		
Income tax revenue *(percent of total revenues)*			0.076***				0.111**	
			(3.07)				(2.31)	
Goods & services tax revenue *(percent of total revenues)*				0.119***				0.180**
				(3.19)				(2.71)
Previous credit boom	0.568**	0.621**	0.590**	0.592**	0.874**	0.936**	0.927**	0.960**
	(2.80)	(2.99)	(2.91)	(2.93)	(2.37)	(2.55)	(2.51)	(2.58)
Deposit freeze or guarantee	–0.555**	–0.563**	–0.461**	–0.568**	–0.782**	–0.752**	–0.664*	–0.803**
	(–2.76)	(–2.72)	(–2.24)	(–2.84)	(–2.16)	(–2.06)	(–1.81)	(–2.20)
Number of banks closed	–0.137**	–0.152***	–0.143**	–0.135**	–0.459***	–0.480***	–0.449***	–0.440***
	(2.86)	(–3.09)	(–2.99)	(–2.82)	(–4.31)	(–4.54)	(–4.24)	(–4.15)
Government intervention	–0.713***	–0.781***	–0.841***	–0.837***	–1.244***	–1.304***	–1.386***	1.408***
	(–3.48)	(–3.74)	(–4.16)	(–4.16)	(–3.21)	(–3.38)	(–3.56)	(–3.61)
Constant	3.737***	3.854***	3.917***	3.731***				
	(14.12)	(14.36)	(14.98)	(14.12)				
Observations	118	118	118	118	118	118	118	118
Adj. *R*-squared / Pseudo *R*-squared	0.451	0.419	0.449	0.452	0.211	0.202	0.213	0.219

*** significant at 1 percent; ** significant at 5 per cent; * significant at 10 per cent.
Dependent variable: length of banking crisis.

Table 6

Fiscal Policy Composition, Resolution Policies and Post-crisis Growth

Item	Average Growth (*t*–*t*+5) OLS)				Average Growth (*t*–*t*+5) (Robust)			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Expansionary fiscal policy	0.262	0.251	0.144	0.218	0.262	0.251	0.144	0.218
	(0.38)	(0.40)	(0.21)	(0.34)	(0.39)	(0.45)	(0.2)	(0.36)
Public consumption *(percent of total expenditures)*	–0.010				–0.010			
	(–0.28)				(–0.36)			
Public investment *(percent of total expenditures)*		0.229***				0.229***		
		(4.94)				(4.98)		
Income tax revenue *(percent of total revenues)*			–0.177**				–0.177**	
			(–2.20)				(–2.48)	
Goods & services tax revenue *(percent of total revenues)*				0.402***				0.402***
				(3.44)				(3.57)
Previous credit boom	0.033	0.242	0.183	–0.101	0.033	0.242	0.183	–0.101
	(0.05)	(0.40)	(0.28)	(–0.16)	(0.05)	(0.45)	(0.30)	(–0.17)
Deposit freeze or guarantee	1.413**	0.895	1.030	1.529**	1.413**	0.895	1.030	1.529**
	(2.18)	(1.47)	(1.54)	(2.42)	(2.19)	(1.68)	(1.62)	(2.51)
Number of banks closed	0.181	0.094	0.129	0.279*	0.181	0.094	0.129	0.279**
	(1.15)	(0.67)	(0.84)	(1.85)	(1.49)	(0.93)	(1.07)	(2.45)
Government intervention	0.450	–0.004	0.449	0.353	0.450	–0.004	0.449	0.353
	(0.67)	(0.01)	(0.69)	(0.56)	(0.67)	(0.01)	(0.71)	(0.58)
Private investment *(percent of total investment)*	7.530**	4.803*	7.220**	6.557*	7.530**	4.803**	7.220***	6.557***
	(2.50)	(1.75)	(2.47)	(2.31)	(2.76)	(2.14)	(2.87)	(3.14)
Cost of financing (a)	–0.121***	–0.074**	–0.109**	–0.122***	–0.121**	–0.074	–0.109**	–0.122**
	(–2.87)	(–1.95)	(–2.71)	(–3.13)	(–1.81)	(–1.20)	(–1.71)	(–1.99)
Fresh capital injections into financial sector	1.453**	0.866	1.246**	1.415**	1.453**	0.866	1.246**	1.415**
	(2.18)	(1.43)	(1.92)	(2.27)	(2.02)	(1.52)	(1.91)	(2.22)
Constant	1.486	2.145**	1.541*	1.149	1.486	2.145**	1.541*	1.149
	(1.57)	(2.56)	(1.71)	(1.31)	(1.44)	(2.44)	(1.60)	(1.25)
Observations	118	118	118	118	118	118	118	118
Adj. R-squared	0.142	0.299	0.178	0.226	0.208	0.353	0.241	0.286

*** significant at 1 percent; ** significant at 5 per cent; * significant at 10 per cent.
Dependent variable: average GDP growth in the 5 years following the end of the crisis.
Note (a): the cost of financing variable is the difference between the lending interest rates and the interbank interest rates.
Source: authors' estimates.

consumption spending but had a positive effect on output growth in the medium term. A 1 percent increase in the share of capital outlays in the budget raised post-crisis growth by about 1/3 of 1 percent per year in our regression analysis of crisis episodes. It appears that capital investment promotes medium-term growth by removing infrastructure bottlenecks and by enhancing private sector competitiveness. Income tax reductions were also associated with positive growth effects. Trimming income taxes removed distortions that hurt long-run economic performance.

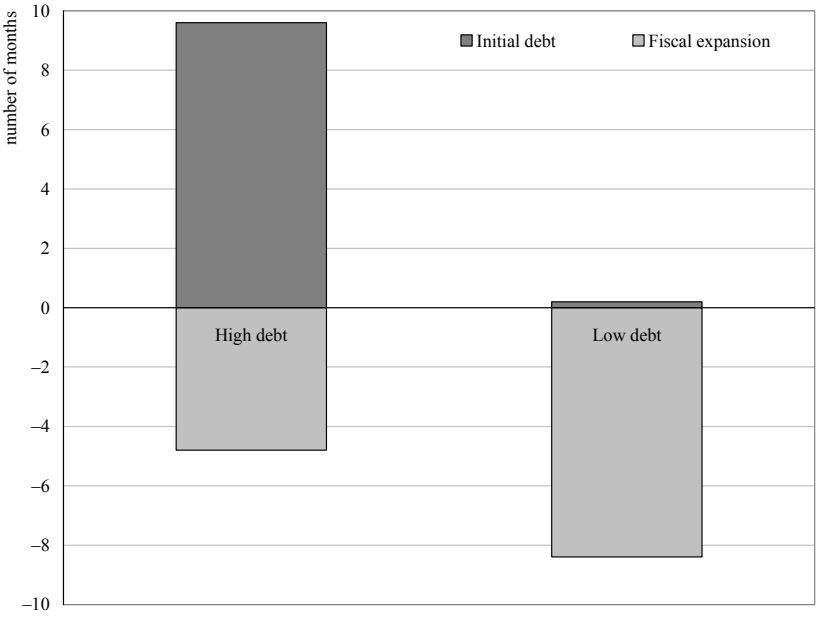
These results highlight the potential trade off between fiscal policy's role in supporting aggregate demand in the short term and its contribution to productivity growth in the medium term. They point to the need to evaluate the composition of fiscal stimulus packages before their implementation, as different short-term and medium-term fiscal multipliers can affect fiscal policy performance during the crisis and in its aftermath.

6 Fiscal policy and debt sustainability

However, insufficient fiscal space – that is, the capacity to spend more – and concerns about the sustainability of public debt along with low initial per capita income can limit the effectiveness of fiscal expansions during crises (Tables 7-10). The lack of fiscal space in countries with high public sector debt-to-GDP ratios before the crisis not only constrains the government's ability to implement countercyclical policies, but also undermines the effectiveness of fiscal stimulus and the quality of fiscal performance. For example, in countries with relatively high debt, crises lasted almost one year longer; the beneficial effects of fiscal expansions were negated by the high public debt. Our simulation (Figure 3) shows that high initial levels of public debt make it more difficult to exit a crisis and also limit the ability of expansionary fiscal policy to support output growth. Similar results are found for countries with lower per capita income, because those nations' limited fiscal space, lower technical capacity to implement fiscal stimulus plans and higher exposure to macroeconomic risks, including to external shocks, reduce the scope and the effects of fiscal expansions during crises.

Figure 3

Impact of Fiscal Expansions on Crisis Length by Level of Debt



Source: Author's calculations.

7 Robustness

The robustness of the above results has been assessed to control for alternative definitions of crisis' length, index of discretionary fiscal policy and endogeneity. In the baseline model, the

Table 7

Explaining Crisis Length Controlling for Initial Fiscal Conditions

Item	Duration of Crisis (OLS)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Expansionary fiscal policy	–0.676**	–0.907***	–0.791**	–0.947***
	(–2.20)	(–2.92)	(–2.55)	(–3.13)
Expansionary fiscal policy* Highly Indebted (*t*–1)	0.273	0.564	0.397	0.522
	(0.66)	(1.33)	(0.95)	(1.26)
Public consumption *(percent of total expenditure)*	–0.055***			
	(–3.22)			
Public consumption* Highly Indebted (*t*–1)	0.019			
	(0.84)			
Public investment *(percent of total expenditure)*		–0.029*		
		(1.91)		
Public Investment* Highly Indebted (*t*–1)		–0.010		
		(–0.34)		
Income tax revenue *(percent of total revenues)*			0.110**	
			(2.72)	
Income tax revenue* Highly Indebted (*t*–1)			–0.064	
			(–1.26)	
Goods & services tax revenue *(percent of total revenues)*				0.090*
				(1.88)
Goods &services tax revenue * Highly Indebted (*t*–1)				0.057
				(0.71)
Previous Credit boom	0.420**	0.549**	0.531**	0.504**
	(2.03)	(2.60)	(2.53)	(2.42)
Deposit freeze or guarantee	–0.628***	–0.619***	–0.559***	–0.651***
	(–3.15)	(–2.93)	(–2.63)	(–3.15)
Number of banks closed	–0.145***	–0.162***	–0.157***	–0.145***
	(–3.10)	(3.31)	(–3.28)	(2.96)
Government intervention	–0.737***	–0.801***	–0.876***	–0.896***
	(3.62)	(–3.78)	(–4.25)	(–4.33)
Highly Indebted (*t*–1)	0.798**	0.837**	0.844***	0.672**
	(2.52)	(2.48)	(2.54)	(1.99)
Constant	3.877***	3.907***	3.932***	3.843***
	(11.17)	(10.86)	(11.12)	(11.15)
Observations	118	118	118	118
Adj. *R*-squared	0.503	0.453	0.475	0.471

Table 8

Explaining Crisis Length Controlling for Initial Economic Conditions

Item	Duration of Crisis (OLS)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Expansionary fiscal policy	–0.676**	–0.907***	–0.791**	–0.947***
	(–2.20)	(–2.92)	(–2.55)	(–3.13)
Expansionary fiscal policy* High GDP per Capita (*t*–1)	–0.876**	–0.805***	–0.881***	–0.987***
	(–2.39)	(–3.12)	(–2.99)	(–3.63)
Public consumption *(percent of total expenditure)*	–0.075***			
	(–3.42)			
Public consumption* High GDP per Capita (*t*–1)	0.122***			
	(4.84)			
Public investment *(percent of total expenditure)*		–0.129*		
		(1.92)		
Public Investment* High GDP per Capita (*t*–1)		–0.210***		
		(–2.94)		
Income tax revenue *(percent of total revenues)*			0.122**	
			(2.72)	
Income tax revenue* High GDP per Capita (*t*–1)			–0.264***	
			(–3.26)	
Goods & services tax revenue *(percent of total revenues)*				0.190*
				(1.98)
Goods & services tax revenue * High GDP per Capita (*t*–1)				0.157**
				(2.71)
Previous Credit boom	0.411**	0.439**	0.331**	0.404**
	(2.33)	(2.60)	(2.63)	(2.32)
Deposit freeze or guarantee	–0.618***	–0.619***	–0.629***	–0.621***
	(–3.15)	(–3.02)	(–3.63)	(–3.45)
Number of banks closed	–0.155***	–0.156***	–0.158***	–0.155***
	(–3.14)	(3.39)	(–3.29)	(2.97)
Government intervention	–0.707***	–0.802***	–0.872***	–0.825***
	(3.63)	(–3.79)	(–4.15)	(–4.13)
High GDP per capita (*t*–1)	–0.345***	–0.322***	–0.455***	–0.667***
	(–3.02)	(–4.07)	(–4.19)	(–4.31)
Constant	3.017***	3.008***	3.032***	3.033***
	(11.87)	(11.86)	(11.02)	(11.22)
Observations	118	118	118	118
Adj. *R*-squared	0.501	0.471	0.462	0.485

Table 9

Explaining Post-Crisis Growth Controlling for Initial Fiscal Conditions

Item	Average Growth (*t*–*t*+5) (OLS)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Expansionary fiscal policy	0.363	0.563	0.032	0.201
	(0.44)	(0.86)	(0.14)	(0.29)
Expansionary fiscal policy* Highly Indebted (*t*–1)	–0.845	–0.042	–0.448	–0.772
	(–0.76)	(–0.05)	(–0.43)	(–0.81)
Public consumption *(percent of total expenditure)*	(–0.020)			
	(–0.42)			
Public consumption* Highly Indebted (*t*–1)	0.017			
	(0.27)			
Public investment *(percent of total expenditure)*		0.259***		
		(5.94)		
Public Investment* Highly Indebted (*t*–1)		–0.071		
		(–1.02)		
Income tax revenue *(percent of total revenue)*			–0.237**	
			(–2.28)	
Income tax revenue* Highly Indebted (*t*–1)			0.028	
			(0.22)	
Goods & services tax revenue *(percent of total revenue)*				0.558***
				(4.94)
Goods & services tax revenue * Highly Indebted (*t*–1)				–0.407**
				(2.07)
Previous Credit boom	0.023	0.421	0.466	0.204
	(0.41)	(0.89)	(0.86)	(0.40)
Deposit freeze or guarantee	1.140**	0.631	0.633	1.010
	(2.03)	(1.33)	(1.15)	(2.01)
Number of banks closed	0.187	0.104	0.129	0.320**
	(1.43)	(0.96)	(1.05)	(2.69)
Government intervention	0.063	0.349	0.067	0.146
	(0.11)	(0.74)	(0.13)	(0.29)
Private Investment *(percent of total investment)*	6.647**	3.755*	5.919**	5.220**
	(2.60)	(1.74)	(2.44)	(2.30)
Cost of financing (a)	–0.069**	–0.018	–0.053	–0.059*
	(–1.90)	(–0.59)	(–1.59)	(1.89)
Fresh capital injections into financial sector	0.955*	0.417	0.787	0.612
	(1.68)	(0.88)	(1.45)	(1.22)
Highly Indebted (*t*–1)	–0.188	–0.301	–0.014	–0.965
	(–0.22)	(–0.50)	(.0.02)	(–1.23)
Constant	2.621**	3.332**	2.701**	2.774***
	(2.55)	(3.95)	(2.63)	(3.10)
Observations	112	112	112	112
Adj. *R*-squared	0.298	0.353	0.262	0.342

Table 10

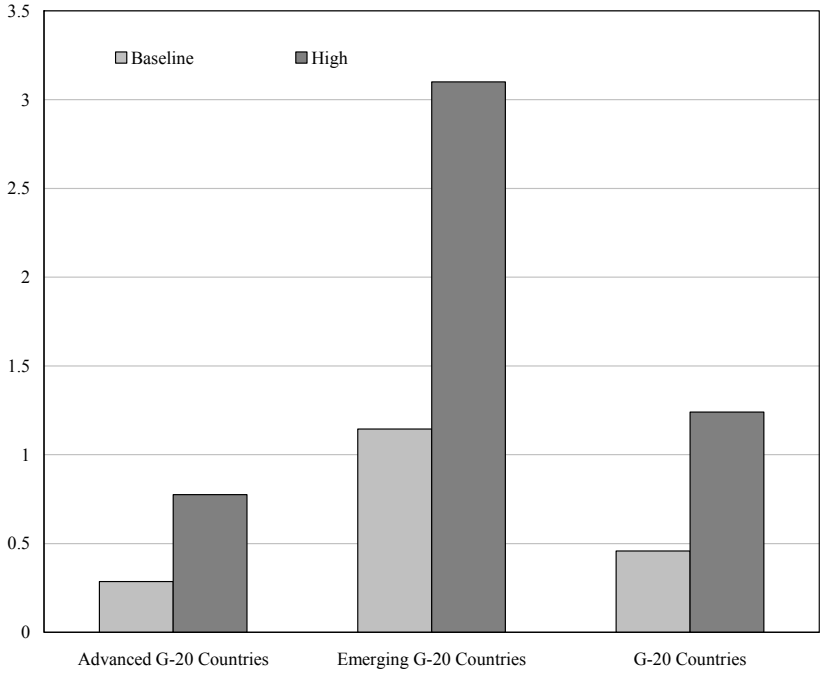
Explaining Post-Crisis Growth Controlling for Initial Economic Conditions

Item	Average Growth (*t*–*t*+5) (OLS)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Expansionary fiscal policy	0.163	0.463	0.132	0.241
	(0.64)	(0.36)	(0.44)	(0.39)
Expansionary fiscal policy* High GDP per Capita (*t*–1)	0.545*	0.442	0.456	0.572*
	(1.86)	(1.55)	(1.34)	(1.91)
Public consumption *(percent of total expenditure)*	–0.234			
	(–0.52)			
Public consumption* High GDP per Capita (*t*–1)	0.117*			
	(1.57)			
Public investment *(percent of total expenditure)*		0.259***		
		(5.94)		
Public Investment* High GDP per Capita (*t*–1)		0.371***		
		(6.52)		
Income tax revenue *(percent of total revenue)*			–0.037	
			(–0.88)	
Income tax revenue* High GDP per Capita (*t*–1)			0.028***	
			(2.22)	
Goods & services tax revenue *(percent of total revenue)*				0.358***
				(4.94)
Goods & services tax revenue * High GDP per Capita (*t*–1)				0.407***
				(5.07)
Previous Credit boom	0.123	0.321	0.326	0.324
	(0.51)	(0.92)	(0.89)	(0.60)
Deposit freeze or guarantee	0.610**	0.631	0.637	0.910*
	(2.03)	(1.53)	(1.56)	(2.01)
Number of banks closed	0.227	0.214	0.219	0.213**
	(1.43)	(0.96)	(1.05)	(2.69)
Government intervention	0.333	0.359	0.337	0.316
	(0.14)	(0.75)	(0.17)	(0.19)
Private Investment *(percent of total investment)*	4.647**	3.701*	5.034**	5.330**
	(2.64)	(1.94)	(2.24)	(2.20)
Cost of financing (a)	–0.089**	–0.088	–0.083	–0.089*
	(–2.90)	(–1.59)	(–1.62)	(1.99)
Fresh capital injections into financial sector	0.905*	0.407	0.707*	0.602*
	(1.98)	(0.98)	(1.95)	(1.92)
High GDP per capita (*t*–1)	0.237*	0.215*	0.219*	0.233**
	(1.86)	(1.96)	(2.05)	(2.71)
Constant	2.600**	3.302**	2.700**	2.704***
	(2.56)	(3.99)	(2.69)	(3.19)
Observations	112	112	112	112
Adj. *R*-squared	0.382	0.397	0.363	0.373

end of the banking crises is registered when output growth resumes. However, this definition may be inappropriate if the banking sector problems are resolved quickly, but GDP growth lags. As an alternative, the end of the crisis is defined as the first year in which the stock market index returns to its precrisis level. Under this definition, episodes' duration is shorter than in the baseline. Results are robust to alternative definitions of duration.[6]

Figure 4

Impact of the Fiscal Stimulus Composition on Post-crisis Growth
(percent)



Source: Author's calculations.

The index of fiscal expansion used in the baseline model is incapable of differentiating between fiscal expansions which are discretionary and those which are the unintended result of a dramatic collapse of GDP growth. We calculated an indicator of discretionary fiscal policy.[7] Results are are consistent with the baseline. Finally, we controlled for potential endogeneity between crisis duration and fiscal policy: Since fiscal policy and output growth are correlated, baseline results could be biased as GDP growth enters the definition of crisis length. In order to control for this factor, we used a Two-Stage Least Square (TSLS) estimator, employing all other independent variables and a measure of liquidity support as instruments. Results confirm that the main findings hold.

8 Conclusion

This paper has assessed the effects of fiscal policy response during 118 episodes of systemic banking crisis in advanced and emerging market countries during 1980-2008. The results show that timely countercyclical fiscal measures can help shorten the length of crisis episodes by stimulating aggregate demand. Fiscal expansions based on measures to support government consumption are more effective than those based on public investment or income tax cuts. But these results do not

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6 The details are available in Baldacci, Gupta, and Mulas-Granados (2009).

7 We take the value of the primary surplus which would have prevailed, were unemployment at the same value as in the previous year, minus the value of the primary surplus in the previous year. Both variables are expressed as a percent of GDP. When this change was greater than –1.5 per cent of GDP, we labeled the year as a fiscal expansion (value 1), and zero otherwise.

hold for countries with limited fiscal space where fiscal expansions are prevented by funding constraints or limited access to markets. The composition of countercyclical fiscal responses matters also for post-crisis growth recovery, with public investment yielding the strongest impact on growth. These results suggest a potential trade off between short-run aggregate demand support and medium-term productivity growth objectives in fiscal stimulus packages adopted in distress times.

They also suggest that fiscal stimulus packages by G-20 countries may have reduced crisis length by up to one year and could have stimulated post-crisis growth by up 1 percent of GDP, compared to a scenario where fiscal policy response was not implemented. Figure 4 shows that based on the composition of the fiscal stimulus implemented by G-20 countries in 2009 and the regression results presented in the paper, post-crisis real growth rate could be higher by almost ½ percentage point for these countries. Results can be larger for emerging market economies that devoted a higher share of the stimulus to infrastructure. In these countries, the baseline impact is estimated at more than 1 percent, compared to less than ¼ of one percent in advanced economies that made larger use of tax cuts and increases in transfers. These results are higher if one uses the regression coefficients for countries with low initial fiscal vulnerabilities and high per capita income as discussed in the previous sections.

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FISCAL POLICY AND GROWTH: DO FINANCIAL CRISES MAKE A DIFFERENCE?

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In this paper we assess to what extent in the existence of a financial crisis, government spending can contribute to mitigate economic downturns in the short run and whether such impact differs in crisis and non crisis times. We use panel analysis for a set of OECD and non-OECD countries for the period 1981-2007. The fiscal multiplier for the full sample for instrumented regular and crisis spending is about 0.6-0.8 considering the sample average government spending share of GDP of about one third. Altogether, we cannot reject the hypothesis that crisis spending and regular spending have the same impact using a variation of controls, sub-samples and specifications.

> *"The claim that budget deficits make the economy poorer in the long run is based on the belief that government borrowing "crowds out" private investment. (...) Under normal circumstances, there is a lot to this argument. But circumstances right now are anything but normal."* Paul Krugman*, New York Times,* December 1, 2008.
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> *"Fiscal policy is back. (...) Fiscal policy must be more effective at times when credit and liquidity constraints are tighter, because firms and households spending decisions are more dependent on current income."* Giancarlo Corsetti*, VOX EU,* February 11, 2008.

1 Introduction

In 2008-09 the world was hit by what many people now believe is one of the deepest financial crises in modern history. This view relates both to the aggregate volume of non-performing loans (mainly in the housing sector) and to the fact that international financial linkages almost immediately lead to contagion effects around the globe. In the response to these developments, governments around the world initiated huge fiscal stimulus packages. According to the IMF (2009), the US announced the implementation of discretionary fiscal measures of 3.8 per cent of GDP in 2009-10, and the European Union unveiled a European Economic Recovery Plan encompassing a planned two hundred billion Euro fiscal stimulus package. For the OECD, the

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accumulated budget impact of the stimulus package over 2008-10 reaches 2.5 per cent of GDP (OECD, 2009).[1]

Many economists support these measures, including well known scholars such as Paul Krugman or Joseph Stiglitz. But also economists who were previously opposed to active stabilization policies seem to be in support of such policies under the current – exceptional – circumstances.[2]

These new policy measures contrast with the results of recent empirical research on the potential impact of debt-financed fiscal policy measures (such as spending programmes and tax reductions) on economic growth. There is a wide body of literature which carefully studies the size of fiscal multipliers. The common conclusion of this literature is that there are significant effects of fiscal policy on output.[3] Nevertheless, many papers also conclude that the size of these effects is rather small and the estimated multipliers of government spending or tax reduction are below one. Moreover, in many countries the multipliers declined over the 1980s and 1990s. Taking into account that any debt-financed fiscal stimulus package has to be repaid later on (with interest payments) one may have serious doubts in the usefulness of such policy measures.

However, one may argue that times of financial crises are different from normal times. Indeed, there are some good reasons to believe that the economy reacts differently to discretionary fiscal policy in a financial crisis than during normal times. First, there are some theoretical contributions which distinguish between more classical and more Keynesian regimes on output and labour markets (e.g., Malinvaud 1985; Bénassy, 1986). A classical situation would be one, where unemployment is generated by excessive real wages while output markets are in equilibrium. A more Keynesian regime is one where unemployment and excess capacities coexist. There are disequilibria both on labour and on output markets. One can argue that in such a situation a fiscal stimulus may become more effective, replacing declining private demand for goods and so stimulating private demand for labour. One could view the public provision of private goods as a replacement for the private provision of these goods. In this case the state would take consumers' decisions in their place and run a higher deficit that later on would have to be repaid in form of taxes by these consumers. Such a policy might have strong crowding-out effects in a situation where capacities are already exhausted, but this need not be the case when there are excess capacities in the economy.

A second argument in favour of discretionary fiscal policy is that a liquidity trap is associated with financial crises and that "the only policy that still works is fiscal policy" (both Krugman and Stiglitz advocate that).

Most importantly, one can argue that financial crisis cut off many consumers and producers from bank lending. During the current crises, the growth rate of lending to the private sector has fallen significantly. This may have two effects on the effectiveness of fiscal policy measures. First, government transfers or tax reductions may result directly in increased consumption of relatively poor, credit constrained consumers. Along these lines, Galí *et al.* (2007) recently calculated larger fiscal policy multipliers when more consumers spend their current income. Second, government purchases directly affect the survival of some firms.

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1 In addition, the headline support for the financial sector is estimated (IMF, 2009), for instance, at 3.7 per cent of GDP in Germany, 6.3 per cent in the US, and 19.8 per cent in the UK.

2 In 2008, the German council of economic advisors recently proposed to raise government spending by 1 percent of GDP in order to stimulate the economy, a measure that hardly would have found its support in recent years.

3 See, for instance, Fatás and Mihov (2001), Blanchard and Perotti (2002), Perotti (2004), de Arcangelis and Lamartina (2003), Galí *et al.* (2007), Afonso and Claeys (2007), Afonso and Furceri (2010), Afonso and González Alegre (2008), and Afonso and Sousa (2009).

Therefore, it is an interesting question whether the emergence of a systemic financial crisis changes the way in which fiscal policy measures affect the economy. This is the question that we want to address in this empirical research. We assess to what extent in the existence of financial crises, government spending can contribute to reduce observed output losses and to foster economic growth. We employ a panel analysis for a set of OECD and non-OECD countries for the period 1981-2007.

Since causality may run in both directions, from government spending to GDP and from GDP to government spending, we instrument government spending by using a variable that is based on the distance to the next or, respectively, to the last democratic election as an instrument in our analysis. Moreover, we also use the past government budget balance-to-GDP ratio as an additional instrument. We perform each specification and sub-sample with a 1-year and with a 2-year definition of financial crisis, with and without time fixed effects.

Overall, our main result is that we cannot reject the hypothesis that crisis spending and spending in the absence of a financial crisis have the same impact throughout our study using a variation of controls, sub-samples and specifications.

The remainder of the paper is organized as follows. Section two reviews the related literature. Section three briefly presents our empirical methodology. Section four reports and discusses the results of the empirical analysis. Section five concludes the paper.

2 Related literature

A theoretical model that establishes a relationship between credit constraints and the effects of fiscal policy is Galí *et al.* (2007). They develop a sticky price model, in which a certain fraction of households always consume their current income. These "rule-of-thumb consumers" coexist with Ricardian consumers. The larger the share of rule-of-thumb (non-Ricardian) consumers the larger is the effect of fiscal policy on output and consumption. One may think of these consumers as credit constrained individuals – or as individuals with no access to financial markets at all.[4] Therefore, one can view that study as supporting a link between credit market conditions and fiscal policy effectiveness. In addition, a calibration of such a model produces relatively large deficit spending multipliers.

The idea that credit frictions have an impact on the way in which policy shocks affect the economy is also well known in monetary economics. An important earlier contribution that links credit market imperfections with the impact of policy shocks is Bernanke, Gertler and Gilchrist (2000). They consider moral hazard in the lending relationships between financial intermediaries and firms and between households and intermediaries. These imperfections strengthen the impact of macroeconomic shocks on output but also the impact of policy responses. Therefore, the study supports the view that policy interventions work better when credit markets are not working well.

The present paper is related to the empirical literature that studies the effects of fiscal policy on output growth in "normal times". For instance, Blanchard and Perotti (2002) initially applied structured VAR techniques to the measurement of fiscal policy effects on output and private consumption in the U.S., and Perotti (2004) extended their analysis to other OECD countries. Blanchard and Perotti find a fiscal stimulus in the US with multipliers ranging from 0.66 to 0.9. However, they also found that the effects of fiscal policies declined in the 1980s. Some multipliers

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[4] The separation between Ricardian and non-Ricardian households, which have a higher propensity to consume, is quite paramount in the policy discussion, being notably one of the arguments used in support of recent fiscal stimuli packages implemented by the authorities in Europe. For the euro area the share of non-Ricardian households has been estimated around 25-35 per cent by Ratto, Röger and in 't Veld (2008) and Forni, Monteforte and Sessa (2009).

have become insignificant, others even negative. Bénassy-Quéré and Cimadomo (2006) argue that domestic fiscal policy multipliers have been declining in the U.S. (since the 1970s) and in Germany (since the 1980s), and that "cross-border" multipliers (from Germany to seven EU economies) have been diminishing.[5]

There is also an ongoing debate in the empirical literature about the role of exogenous expansion in government spending on consumption and real wages. Ramey and Shapiro (1998) find that, following an expansionary fiscal policy shock, output rises while private consumption falls (crowding out). Blanchard and Perotti (2002) instead find that output and consumption both increase. The main methodological difference is that Ramey and Shapiro use war build-ups as exogenous dates to identify fiscal expansions while Blanchard and Perotti use identifying restrictions which they derive from delays in the response of fiscal policy decisions to the economic development.

Case studies such as Johnson *et al.* (2006) also provide valuable insights into the effect of particular spending programmes on individual consumption.

For the EU, and using panel data for the 15 "old" EU countries for the period 1971-2006, Afonso and González Alegre (2008) identify a negative impact of public consumption and social security contributions on economic growth, and a positive impact of public investment. They also uncover the existence of a crowding-in effect of public investment into private investment that provokes an overall positive effect of public investment on economic growth.

More recently, using a Bayesian Structural Vector Autoregression approach for the U.S., the U.K., Germany, and Italy, Afonso and Sousa (2009) show that government spending shocks, in general, have a small but positive effect on GDP, have a varied effect on private consumption and private investment, reflecting the existence of important "crowding-out" effects, and in general, impact positively on the price level and on the average cost of refinancing the debt.

For the case of the U.S., Cogan *et al.* (2009), find that the government spending multipliers from permanent increases in federal government purchases are lower in new Keynesian models than in old Keynesian models. The differences are quite large regarding estimates of the impact on the future development of U.S. government spending in a fiscal package such as the one of February 2009. On the other hand Spilimbergo *et al.* (2008) argue that the content of the fiscal packages put in place in 2008-09 by the major developed economies, with targeted tax cuts and transfers are likely to have the highest multipliers.

Related to the 2008 financial crisis Blanchard (2008) argued that fiscal expansion must "now play a central role in sustaining domestic demand." A similar argument was previously put forward by Krugman (2005) who argued that fiscal expansion is quite possible when economic downturns last for several years and low interest rates reduce monetary policy effectiveness. Nevertheless, Cerra and Saxena (2008) report that a financial crisis tends to depress long-run growth, which may cast some doubts on the short-term effectiveness of fiscal policies under such circumstances.

For a panel of 19 OECD countries, Tagkalakis (2008) finds that in the presence of liquidity constrained households, fiscal policy is more effective in increasing private consumption in recessions than in expansions. Such effect squares with the fact that usually constrained consumers contemplate short-term horizons in their consumption and saving decisions. This issue of credit

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[5] Van Brusselen (2010) provides a broad overview of the effectiveness of fiscal policy, and an evalutaion of fiscal multipliers in VAR, macroeconometric models and dynamic stochastic general equilibrium models.

constrained households is also related to the possibility of expansionary fiscal consolidations, and the eventuality of ensuing non-Keynesian effects of fiscal policies.[6]

Finally, Baldacci *et al.* (2009) analyse the impact of fiscal policy taken during systemic banking crises, and they show that, if countries are not funding constrained, fiscal measures contribute to shortening the length of crisis episodes by stimulating aggregate demand. Their results can not directly be used to compare the impact of fiscal policies in crisis and non-crisis times. In a related study, Röger, Székely, and Turrini (2010) found that fiscal policy seems to play a role in the impact of banking crises on headline growth, an insight further rationalised with simulation results. Their econometric analysis consists of a set of OLS regressions distinguishing between crisis and non-crisis multipliers.

3 Empirical methodology

The focus of the present paper is on the role of fiscal policies in phases of financial turmoil. Such phases are associated with tighter credit constraints both for firms and for households, leading to pronounced economic downturns.

However, frequent financial crises in single countries are very rare. Hence, if one only looks at GDP in individual countries, there may not be enough data points to run a time series analysis for several countries, and provide meaningful information about the role of fiscal policies during a crisis. In order to overcome this problem we construct an unbalanced panel containing data from the available set of OECD and non-OECD countries.

We test the impact of government spending on economic growth during crises and normal times by interacting the fiscal stimulus variable with a (dummy) variable that indicates the state of the economy, "crisis" or "normal". In addition, we also perform Wald tests with the null-hypothesis that the coefficients of crisis government spending and government spending in the absence of crisis are equal. The following linear panel model for output growth is then specified:

$$Y_{it} = \beta_i + \delta Y_{it-1} + \phi X_{it} + \gamma FC_{it} + \theta Sp_{it} * FC_{it} + \theta' Sp_{it} * (1 - FC_{it}) + u_{it} \quad (1)$$

In (1) the index i (i=1,…, N) denotes the country, the index t (t=1,…, T) indicates the period and β_i stands for the individual effects to be estimated for each country i. Y_{it} is real output growth for country i in period t, Y_{it-1} is the observation on the same series for the same country i in the previous period, X_{it} is a vector of additional explanatory variables, in period t for country i. FC_{it} (FC_{it-1}) is a dummy variable that captures the existence of a financial crisis (in the preceding year), either banking, currency or sovereign debt crisis, and Sp_{it} is real government spending growth for country i in period t. Additionally, it is assumed that the disturbances u_{it} are independent across countries. The interaction term $Sp_{it}*FC_{it}$ denotes government spending in the presence of a financial crisis and $Sp_{it}*(1–FC_{it})$ picks up government spending during normal times. Both interactions terms are also tested using lags.

3.1 Reverse causality

Obviously, the specification above is not immune to reverse causality. Current economic growth may affect the government's spending behaviour. The influence of GDP growth on contemporaneous spending holds true, in particular, for welfare benefits and subsidies, notably via

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[6] The possibility of expansionary fiscal consolidations, notably when triggered by a crisis, was initially discussed by Giavazzi and Pagano (1990), although the empirical evidence is diverse (see, for instance, Afonso, 2010).

the functioning of automatic stabilisers. For instance, higher economic growth reduces expenses for unemployment benefits since more people are likely to find a job during an economic upswing. Lower growth can lead to higher government transfers as well as to discretionary, countercyclical spending such as infrastructure programmes. This negative causal effect from growth on fiscal spending would imply an underestimation of the fiscal stimulus' impact. Due to the large number of countries, data on government spending net of transfers were not available and we need to refer to different methods to address endogeneity.

Also, real economic growth can influence government spending in a positive way if governments follow pro-cyclically economic developments.[7] Under this assumption, politicians do not save (discretionarily) in good times and do not (discretionarily) provide fiscal stimuli in crisis times. Without accounting for endogeneity, this effect would lead to an overestimation of the fiscal multiplier. In our sample, which includes OECD and non-OECD countries, we find evidence of the first assumption, that growth affects spending in a negative way.

A possible way to address endogeneity would be to use time lags of the relevant explanatory variables. Due to data availability we can only use yearly change in spending. As shown by single country time series studies with quarterly data (for instance, Perotti *et al.*, 2004) the positive impact of a government spending shock vanishes approximately after four to five quarters. That is, with one year lagged spending growth as ordinary control variable, instead of current spending growth, we could address the endogeneity problem but we cannot measure the fiscal multiplier properly. Using lagged government spending as an instrument captures spending habits potentially linked to the institutional path of the economy, rather than discretionary changes in spending.[8]

3.2 Instrumenting spending growth

Altogether, to address the endogeneity problem we use two instruments, the *distance to elections* referring to the political budget cycle (Brender and Drazen 2005) and the *lagged budget balance-to-GDP ratio*. *Distance to elections* is a linear distance measure between the current year and the year of the next election. The election years are taken from Pippa Norris' Democracy Time series Dataset (2009). For non-OECD countries, we use the year of legislative elections. For OECD countries, we use legislative elections if the country has a parliamentary system and executive elections if the country is characterised by a presidential system.[9] The distance-to-elections indicator takes on values from 1 to 5.

By using a distance-to-elections indicator, which runs throughout the political budget cycle, we are benefiting from two effects: increase in spending before elections, decrease in spending after elections.[10] We obtain a more robust instrument than only using pre-election, election, and post-election dummies by imposing a parameterised linear relationship.

The parameterised linear relation between distance to elections and spending is not always identical: empirically, the year of elections ("zero distance") does not display the largest spending increase. Changes in government spending in the year of elections depend very much on when elections take place. Elections in spring can trigger spending cuts for the rest of the year while elections in autumn can lead to spending increases. Since our data do not provide information on

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[7] Jaeger and Schuknecht (2004) mention that boom-bust phases tend to exacerbate already existing pro-cyclical policy biases, toward higher spending and public debt ratios.

[8] The results (not shown) for using the lagged crisis spending as an instrument in a basic panel set up are not statistically significant.

[9] Due to data accuracy, we use information on the political system only for OECD countries.

[10] The relations between electoral cycles and government behaviour be traced back to Nordhaus (1975) and Hibbs (1977), respectively regarding opportunistic and partisan cycles.

the month of elections, we test the impact of distance to elections by means of distance year dummies, hence without imposing a parametric structure. The coefficient of the election year dummy is smaller than the coefficients of the one and two year pre-election dummies and more similar to the coefficient of the three year pre-election dummy . Thus, we assume that, on average, the spending behaviour three years before elections[11] is similar to the spending behaviour in the election year. Therefore, we replace the actual value of the distance indicator in the election year (zero) by three.[12] Finally, by the nature of the instrument, we only capture states with regular elections as reported in the dataset. For each specification we report the results of the Kleibergen-Paap test reflecting the validity of our instruments.

As a second instrument we use the one year lagged budget balance-to-GDP ratio, the difference between total revenue and total expenditure of the central government relative to GDP. To avoid that the instrument lagged budget balance-to-GDP ratio is capturing good governance and disciplined political institutions, which is in turn correlated with GDP growth, the budget balance-to-GDP ratio is lagged twice and included in the main regression. Furthermore, to ensure that lagged budget balance to GDP is exogenous, we control for lagged spending growth and lagged revenue growth. The Sargan-Hansen test of over-identifying restrictions (not reported) strongly supports the validity of the above described instruments.

These two instruments capture different aspects of government spending. *Distance to elections* is a good measure for discretionary fiscal activities if politicians act according to the "political budget cycle". The *budget balance ratio* considers the financial leeway provided by last year's government budget to predict current spending. We perform the instrumental variable estimations with one and two (interacted) instruments.

4 Empirical analysis

4.1 Data

Our panel covers 127 countries out of which 98 countries experienced financial crises during the years 1981-2007. The crisis dummy was taken from the IMF dataset on financial crisis. The maximum number of observations used, due to data availability across the panel, is 2867 (3271 observations were initially gathered), and the number of crises years is 218 (encompassing banking, currency and sovereign debt crises). To avoid the influence of outliers, we restrict the dependent variable, GDP growth, as well as the spending variables by excluding the first and last percentile of the sample. Data descriptions and sources are reported in the Appendix.

In our panel, government spending increases on average at 0.76 per cent of GDP per year. Spending decreases on a yearly basis by 0.05 per cent of last period's GDP on average in the starting year of the crisis and by 0.1 per cent of GDP in the next year. Hence, during financial crises governments tend to spend less money, eventually because revenues decline as well. Only during 90 crisis episodes we observe a positive change in government spending relative to GDP the year after the beginning of the crisis.

Real GDP growth is adversely affected by a financial crisis as will be confirmed in our regression results reported in the next sections. While the average real growth rate in our panel is 3.4 per cent, it goes down to 0.1 per cent during a crisis.

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[11] In our sample, the average election cycle is four years. Therefore, three years before the next election corresponds on average to the post election year.

[12] Imposing a missing value in the election year or using the value of two instead of three we obtain similar but less robust results. The actual distance indicator for a country with a 4-year cycle over a period of, for instance, 8 years starting with an election year is accordingly: 3-3-2-1-3-3-2-1.

Table 1

Results for Real GDP Growth (1981-2007), Spending Growth Rates, Instrument: Distance to Elections, 1-year Crisis

	(1)	(2)	(3)	(4)
Spending*(1–*FC*)	0.322*	0.228*	0.180	0.0858
	(1.89)	(1.70)	(1.24)	(0.68)
Spending**FC*	0.642	0.489*	0.428*	0.601
	(1.10)	(1.93)	(1.80)	(1.60)
GDP(–1)	0.197	0.243***	0.242**	0.142*
	(1.58)	(2.66)	(2.49)	(1.73)
FC	–0.0797**	–0.0869***	–0.0909***	(dropped)
	(–2.17)	(–3.89)	(–4.36)	
FC(–1)	0.000166	–0.000828	–0.00112	–0.00618
	(0.03)	(–0.15)	(–0.22)	(–1.20)
Spending(–1)*(1–*FC*(–1))		0.00586	0.00472	0.00541
		(0.33)	(0.26)	(0.33)
Spending(–1)**FC*(–1)		0.0645	0.0583	0.0700
		(1.49)	(1.41)	(1.05)
Revenue(–1)		0.00815	0.0139	0.0246
		(0.33)	(0.54)	(1.33)
Claims on Private Sector				0.0168***
				(2.65)
Inflation				–0.00261**
				(–2.20)
Time Fixed Effects	No	No	Yes	Yes
Observations	2,605	2,516	2,516	1,937
Cross-sections	122	122	122	101
Kleibergen-Paap LM Statistic	6.91	8.10	6.41	5.35
Kleibergen-Paap *p*-value	0.0086	0.0044	0.0113	0.0207
Wald Test Statistic	0.28	0.87	0.80	1.57
Wald Test *p*-value	0.5959	0.3502	0.3719	0.2096

Notes: unbalanced panels with country fixed effects. t-statistics are in brackets. *, ** and *** denote level of significance indicating 10, 5 and 1 per cent respectively. A Wald test is conducted to test whether crisis spending and regular spending are statistically different. The underlying null hypothesis of the test is that the coefficients of the interaction terms between spending and financial crisis are equal. *GDP, Spending, Revenue* and *Claims on Private Sector* are used as growth rates. *FC* – dummy variable for the existence of financial crisis. The Kleibergen-Paap statistic tests the null that the equation is underidentified. Constant as well as fixed effects interactions with crises dummy are partialled out.

We also collected data on claims to the private sector. Indeed, some existing evidence links credit contractions to financial markets distress (see, Claessens *et al.*, 2008), and the hypothesis that increases in credit concession to the private sector can attenuate economic slowdowns is then tested.

4.2 Results and discussion

Table 1 reports the panel estimation results using real GDP growth as the dependent variable as in specification (1), using only the distance to elections as an instrument for real government spending growth, and controlling for the existence of a financial crisis, in which case the dummy variable *FC* assumes the value of one (zero otherwise). We perform each specification with a 1-year definition of financial crisis – *FC* equals one in the starting year of the crisis – and a 2-year definition of financial crisis – where *FC2* equals one in the crisis' starting year as well as in the following year.[13]

From Table 1 we can see that increases in real government spending growth have a positive impact on real GDP growth. In addition, the estimated government spending coefficients are higher when a crisis occurs. However, as shown by the Wald test, we cannot reject the null hypothesis that the estimated coefficients for government spending are equal with and without a financial crisis. The existence of a financial crisis also decreases real growth unequivocally. In this specification government spending coefficients can not directly be interpreted as fiscal multipliers. We have to multiply them by the inverse average share of government spending in GDP.[14] In our data sample, government spending amounts to around 36 per cent of GDP for the full sample, 33 per cent of GDP for non-OECD countries and 46 per cent of GDP for OECD countries. Overall, the above fiscal multipliers (about 0.6-0.8 for regular and crisis spending) are somewhat smaller when compared to multipliers observed in the existing literature.

Similar results can be observed when government spending is instrumented with both the distance to elections and the lagged budget balance (see Table 2). In this case, the fiscal multiplier is around 0.8. In addition, both with one and with two instruments, we can see that claims to the private sector have a positive estimated coefficient, implying that increases in credit concession to the private sector can positively impinge on economic growth (see last columns of Tables 1 and 2).

Our sample comprises observations from a diverse set of countries and thus collects information from very heterogeneous financial crises. To allow for a different severity of crisis across countries and a reaction of economic variables to the occurrence of financial crisis (possibly due, for instance, to institutional differences) we interact country dummies with crisis dummies in each specification.

The above results from the IV regression with "differentiated fixed effects" are similar to the results obtained with a sample split into crises and non-crises observations.[15] By keeping the full sample and introducing a country specific interaction term with crises we benefit from gains in efficiency and instrument validity. Moreover, we can directly test the hypothesis of equality between spending in crises and non-crises times.[16]

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[13] The results using the *FC2* variable can be found in Afonso, Grüner and Kolerus (2010).

[14] With Y=GDP, G=government spending and m=fiscal multiplier, $(Y_t-Y_{t-1})/Y_{t-1}=m(G_t-G_{t-1})/G_{t-1} \Leftrightarrow \Delta Y_t=m\Delta G_t(Y_{t-1}/G_{t-1})$ and $\Delta Y / \Delta G \cong m \times \overline{(Y / G)}$.

[15] Tables are not reported and can be obtained from the authors upon request.

[16] The coefficients of these interaction terms are not reported since they are partialled out in the regressions, together with the constant.

Table 2

Results for Real GDP Growth (1981-2007), Spending Growth Rates, Instrument: Distance to Elections and Lagged Budget Balance, 1-year Crisis

	(1)	(2)	(3)	(4)
Spending*(1–*FC*)	0.151***	0.291**	0.251**	0.192
	(2.95)	(2.48)	(2.20)	(1.36)
Spending**FC*	0.128	0.263**	0.256**	0.140
	(1.60)	(2.13)	(2.12)	(1.09)
GDP(–1)	0.307***	0.226***	0.216***	0.117
	(5.68)	(2.92)	(2.81)	(1.40)
GDP(–2)	0.0190	0.0227	0.0237	0.00771
	(0.53)	(0.64)	(0.69)	(0.22)
FC	–0.111***	–0.104***	–0.105***	
	(–5.79)	(–5.40)	(–5.53)	
FC(–1)	–0.00835**	–0.00418	–0.00427	–0.00747
	(–2.06)	(–0.85)	(–0.92)	(–1.42)
Budget balance ratio(–2)	–0.0315	–0.113	–0.0991	–0.134
	(–1.24)	(–1.48)	(–1.40)	(–1.40)
Spending(–1)*(1–*FC*(–1))		0.0367	0.0310	0.0375
		(1.28)	(1.15)	(1.11)
Spending(–1)**FC*(–1)		0.0533	0.0487	0.00794
		(1.01)	(0.96)	(0.11)
Revenue(–1)		–0.0163	–0.00886	–0.00289
		(–0.66)	(–0.38)	(–0.12)
Claims on Private Sector				0.0165***
				(3.10)
Inflation				–0.00193***
				(–4.13)
Time Fixed Effects	No	No	Yes	Yes
Observations	2,504	2,439	2,439	1,884
No. Clusters	122	122	122	101
Kleibergen–Paap LM Statistic	26.14	13.80	14.31	9.22
Kleibergen–Paap *p*–value	0.0000	0.0032	0.0025	0.0264
Wald Test Statistic	0.07	0.09	0.00	0.14
Wald Test *p*–value	0.7931	0.7691	0.9596	0.7090

Notes: unbalanced panels with country fixed effects. t-statistics are in brackets. *, ** and *** denote level of significance indicating 10, 5 and 1 per cent respectively. A Wald test is conducted to test whether crisis spending and regular spending are statistically different. The underlying null hypothesis of the test is that the coefficients of the interaction terms between spending and financial crisis are equal. *GDP, Spending, Revenue* and *Claims on Private Sector* are used as growth rates. *FC* – dummy variable for the existence of financial crisis. The Kleibergen-Paap statistic tests the null that the equation is underidentified. Equation (4) is over-identified. Constant as well as fixed effects interactions with crises dummy are partialled out.

A direct consequence of this approach is that – as in the case of fixed effects – observations for countries with only one crisis-year (singleton dummies) are not included in the analysis. Since many countries indeed experienced several financial crises, our *FC* dummy variable captures 111 crises years for 45 countries with 2 to 4 crises. The coefficient of the *FC* dummy in the tables has to be interpreted by taking into account that country specific crises reactions of GDP have already been partialled out. For robustness, we run every specification with a 2-year definition of crises, which also includes observations with only one crisis per country (see results in, Grüner, and Kolerus, 2010).

4.2.1 Instrument performance

In Tables 1 and 2 we can reject the null hypothesis that the equation is underidentified. In Table 2, including the lagged budget ratio balance improves the instrument performance in the first stage for crisis spending. Indeed, the Kleibergen-Paap test statistic also passes the critical value of 10 allowing rejecting the null of underidentification.

Therefore, regular distance to elections and regular lagged budget balance ratios are good predictors for regular spending. The closer to elections, the higher is spending growth. The larger the buffer provided by last year's budget balance position relative to last year's GDP, the higher is government spending growth during normal times. The instrument lagged budget balance has a similar performance during financial crises as during regular times: there is a significant and positive correlation between regular spending and regular lagged budget balance. Distance to elections, however, changes the sign such that the political budget cycle during crises is positively correlated with crisis spending and is weakly (1-year crisis) to highly (2-year crisis, see Annex) significant. The further away elections are, the more the government is reacting via spending during crisis.[17]

4.2.2 Fiscal multipliers

According to the results in Table 1 and 2 the fiscal multiplier for instrumented regular spending ranges between 0.6 and 1.1 assuming an average government spending share of GDP of about one third.[18] In addition, reverse causality seems to be stronger in crisis times. Indeed, our results show a somewhat larger marginal impact for crisis spending. Intuitively, this is appealing, implying that social transfers and discretionary spending react stronger during an expected and/or experienced economic downturn than in times of an economic upswing. Overall, albeit the qualitative differences, endogeneity does not influence our findings since the marginal impact of spending is not statistically different in crisis and non-crisis times.

Moreover, government spending in the presence of a financial crisis, when compared to normal times, is clearly larger in Table 1 compared to Table 2. This is likely to be due to a weak instrument bias for crisis spending when using only the distance to elections indicator (see above). Including the lagged budget balance ratio, the coefficients of crisis spending and regular spending are approximately equal.

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[17] Exogeneity tests rejected the hypothesis that a fall in GDP leads to new elections, hence we reject the hypothesis that the instrument is correlated with the dependent variable.

[18] Our estimates based on different instruments yield output multipliers that are close to the ones derived, for instance, in the papers by Baxter and King (1993), Linnemann and Schabert (2003).

4.3 Robustness analysis

4.3.1 OECD and non-OECD economies

Evidence from the related literature points out that (economic) cyclical fiscal behaviour in developed economies is somewhat different from the case of developing economies. The conventional wisdom that emerges from such studies is that fiscal policy is counter-cyclical or a-cyclical in most developed countries, while it is pro-cyclical in developing countries.[19] More specifically, reverse causality could be different in developed and developing economies. It is therefore important to analyse the instrument's performance and instrumented fiscal multipliers in OECD and non-OECD sub-samples.

As Table 3 shows, the results for non-OECD countries are close to the results obtained for the full sample and fiscal multipliers, for both crisis and regular spending, are on average 0.6. In addition, the instruments behave similarly in the first stage and statistical significance is even stronger compared to the full sample regressions.

For OECD countries, however, distance to elections, *i.e.* the political budget cycle, does not perform very well as an instrument during regular times (see Table 4).

Literature on the political budget cycle mostly confirms our results of different fiscal attitudes in OECD and non-OECD countries (see, for instance, Shi and Svensson, 2006). Interestingly, distance to elections matters for crisis spending as we find a significant negative correlation in the first stage. In other words, during financial crisis, fiscal action is required by the electorate in OECD countries. The lagged budget balance-to-GDP ratio is also significant during crisis with a clearly larger coefficient than in the non-OECD countries regressions, while it is not significant in regular times.

Overall, it proved to be difficult to build a significant instrument for regular spending in OECD countries. Therefore, in Table 4 (and Table 4b in the Annex) the under identification test is not passed. The reported value, however, only captures the average validity of instruments over both endogenous variables. The instruments for crisis spending, crisis distance to elections and crisis lagged budget balance, are still highly significant in the first stage. The fiscal multiplier of crisis spending ranges between 0.5 and 0.7 and is therefore slightly larger than in non-OECD countries (the underlying fiscal share is 46 per cent of GDP, as described above).

4.3.2 Banking crisis

The previous analysis showed the impact of government spending on economic growth during up to 141 financial crises, which included banking crises, currency crises, and debt crises. Table 5 reports on to which extent government spending and growth are correlated during 60 banking crises.

Given the limited number of banking crises recorded in the IMF dataset on financial crisis, between 1981 and 2007 and, in particular, the high proportion of only one banking crises per country, we can only use the 2-year definition of crises, which provides us with two observations per crisis and thus allows us to use the singleton crises. Again, country dummies are interacted with banking crisis dummy in specifications (1)-(3) in Table 5, hence the coefficient of *BC2* has to be interpreted taking into account the country specific crises reactions. Without interactions, *BC2* is significantly negative, as in regression (1).

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[19] See, for instance, Galí (1994), Lane (2003), Kaminsky *et al.* (2004), Talvi and Vegh (2005), and Alesina *et al.* (2008).

Table 3

Results for Real GDP Growth (1981-2007), Spending Growth Rates, Instrument: Distance to Elections and Lagged Budget Balance, Non-OECD Countries, 1-year Crisis

	(1)	(2)	(3)	(4)
Spending*(1–*FC*)	0.153***	0.258**	0.218**	0.177
	(3.08)	(2.48)	(2.18)	(1.53)
Spending**FC*	0.137*	0.258**	0.237*	0.170
	(1.65)	(1.97)	(1.90)	(1.33)
GDP(–1)	0.295***	0.229***	0.218***	0.0951
	(5.08)	(2.99)	(2.96)	(1.26)
GDP(–2)	0.0329	0.0376	0.0295	0.0147
	(0.83)	(0.98)	(0.80)	(0.40)
FC	–0.111***	–0.104***	–0.105***	(dropped)
	(–5.72)	(–5.33)	(–5.47)	
FC(–1)	–0.00756*	–0.00301	–0.00337	–0.00579
	(–1.66)	(–0.56)	(–0.68)	(–0.98)
Budget balance ratio(–2)	–0.0324	–0.102	–0.0825	–0.160
	(–0.96)	(–1.20)	(–1.08)	(–1.39)
Spending*(1–*FC*(–1))		0.0332	0.0253	0.0422
		(1.14)	(0.93)	(1.17)
Spending**FC*(–1)		0.0545	0.0476	0.0268
		(1.03)	(0.93)	(0.39)
Revenue(–1)		–0.0121	–0.00362	–0.00673
		(–0.50)	(–0.16)	(–0.26)
Claims on Private Sector				0.0168**
				(2.32)
Inflation				–0.00204***
				(–4.33)
Time Fixed Effects	No	No	Yes	Yes
Observations	1,814	1,750	1,750	1,261
Cross–sections	94	94	94	73
Kleibergen–Paap LM Statistic	26.99	15.79	16.36	12.42
Kleibergen–Paap *p*–value	0.0000	0.0013	0.0010	0.0061
Wald Test Statistic	0.04	0.00	0.04	0.00
Wald Test *p*–value	0.8479	0.9969	0.8329	0.9568

Notes: unbalanced panels with country fixed effects. t-statistics are in brackets. *, ** and *** denote level of significance indicating 10, 5 and 1 per cent respectively. A Wald test is conducted to test whether crisis spending and regular spending are statistically different. The underlying null hypothesis of the test is that the coefficients of the interaction terms between spending and financial crisis are equal. *GDP,* S*pending, Revenue* and *Claims on Private Sector* are used as growth rates. *FC* – dummy variable for the existence of financial crisis. The Kleibergen-Paap statistic tests the null that the equation is underidentified. Constant as well as fixed effects interactions with crises dummy are partialled out.

Table 4

Results for Real GDP Growth (1981-2007), Spending Growth Rates, Instrument: Distance to Elections and Lagged Budget Balance, OECD coUntries, 1-year Crisis

	(1)	(2)	(3)	(4)
Spending*(1–*FC)*	0.784	1.029	0.719	–0.0415
	(1.00)	(0.85)	(1.09)	(–0.15)
Spending**FC*	0.303***	0.327**	0.284*	0.216*
	(2.65)	(1.99)	(1.79)	(1.73)
GDP(–1)	0.121	–0.00886	0.0932	0.411***
	(0.32)	(–0.02)	(0.26)	(4.03)
GDP(–2)	–0.135	–0.141*	–0.0971	–0.0642
	(–1.55)	(–1.65)	(–1.44)	(–1.29)
FC	(dropped)	0.0488***	(dropped)	(dropped)
		(3.87)		
FC(–1)	–0.0314	–0.0379	–0.0336	–0.00437
	(–1.08)	(–0.83)	(–1.05)	(–0.28)
Budget balance ratio(–2)	–0.135	–0.237	–0.167	–0.00491
	(–0.99)	(–0.90)	(–1.20)	(–0.06)
Spending*(1–*FC*(–1))		–0.0234	0.0138	0.0364*
		(–0.46)	(0.32)	(1.78)
Spending**FC*(–1)		–0.0410	0.161	–0.0359
		(–0.10)	(0.43)	(–0.20)
Revenue(–1)		0.0213	–0.00359	0.00969
		(0.26)	(–0.06)	(0.35)
Claims on Private Sector				0.00730
				(1.39)
Inflation				–0.0198*
				(–1.81)
Time Fixed Effects	No	No	Yes	Yes
Observations	690	689	689	623
Cross–sections	28	28	28	28
Kleibergen–Paap LM Statistic	2.69	0.68	1.11	3.68
Kleibergen–Paap *p*–value	0.4423	0.8775	0.7740	0.2977
Wald Test Statistic	0.32	0.37	0.48	1.12
Wald Test *p*–value	0.5702	0.5448	0.4907	0.2907

Notes: unbalanced panels with country fixed effects. t-statistics are in brackets. *, ** and *** denote level of significance indicating 10, 5 and 1 per cent respectively. A Wald test is conducted to test whether crisis spending and regular spending are statistically different. The underlying null hypothesis of the test is that the coefficients of the interaction terms between spending and financial crisis are equal. *GDP, Spending, Revenue* and *Claims on Private Sector* are used as growth rates. *FC* – dummy variable for the existence of financial crisis. The Kleibergen-Paap statistic tests the null that the equation is underidentified. Constant as well as fixed effects interactions with crises dummy are partialled out.

Table 5

Results for Real GDP Growth (1981-2007), Spending Growth Rates, Instrument: Distance to Elections and Lagged Budget Balance, 2-year Banking Crisis

	(1) IV	(2) IV	(3) IV
Spending*(1–BC2)	0.163***	0.195*	0.172
	(2.93)	(1.83)	(1.62)
Spending*BC2	–0.164	–0.116	–0.130
	(–1.25)	(–1.07)	(–1.15)
GDP(–1)	0.278***	0.249***	0.232***
	(4.42)	(3.19)	(2.97)
GDP(–2)	0.0323	0.0417	0.0395
	(0.97)	(1.32)	(1.25)
BC2	0.0571***	0.0550***	0.0531***
	(7.68)	(8.26)	(7.99)
Budget Balance to GDP(–2)	–0.0314	–0.0621	–0.0612
	(–1.24)	(–0.89)	(–0.90)
Spending(–1)		0.00876	0.00805
		(0.33)	(0.31)
Revenue(–1)		0.00749	0.0101
		(0.35)	(0.47)
Time Fixed Effects	No	No	Yes
Observations	2,438	2,375	2,375
Cross–sections	119	119	119
Kleibergen–Paap LM Statistic	22.92	14.42	13.86
Kleibergen–Paap p–value	0.0000	0.0024	0.0031
Wald Test Statistic	5.48	6.69	6.27
Wald Test p–value	0.0193	0.0097	0.0123

Notes: unbalanced panels with country fixed effects. t-statistics are in brackets. *, ** and *** denote level of significance indicating 10, 5 and 1 per cent respectively. A Wald test is conducted to test whether crisis spending and regular spending are statistically different. The underlying null hypothesis of the test is that the coefficients of the interaction terms between spending and financial crisis are equal. *GDP,* S*pending, Revenue* and *Claims on Private Sector* are used as growth rates. *BC2* – dummy variable for the existence of banking crisis. The Kleibergen-Paap statistic tests the null that the equation is underidentified.

Essentially, in the IV estimation spending significantly differs in crises and non-crises times. While there is no impact of a change in spending in the first and second year of a banking crises on GDP growth, the impact of spending in normal times is still positive (and mostly significant) with a multiplier of about 0.5.

Performing the analysis with all remaining financial crises, hence debt and currency crises, supports these results (see Table 5b in the Annex), and the coefficient of crisis spending is larger as for the full set of financial crises. The difference between spending in crisis times and normal times is not significant.

5 Conclusion

In this paper we have studied the impact of government spending on output notably during the occurrence of financial crises, covering 127 countries for the period 1981-2007. We have performed each estimation using a 1-year and a 2-year definition of financial crisis, with and without time fixed effects.

To address the endogeneity issue we have used two instruments: the distance to elections – a linear distance measure between the current year and the year of the next election – and the lagged budget balance-to-GDP ratio. According to the results, the fiscal multiplier for instrumented regular spending ranges between 0.6 and 0.8, considering the average government spending share of GDP of about one third. The multipliers of instrumented government spending are higher than the simple OLS multipliers. However, the differences between the coefficients of government spending in crises and non-crises periods are also insignificant in most of our estimations.

More specifically, the fiscal multiplier for the full sample and for the non-OECD sub-sample, for instrumented regular and crisis government spending, is about 0.6, with an average government spending-to-GDP ratio of one third. For the OECD sub-sample, government spending in the presence of a financial crisis also produces a fiscal multiplier of 0.6 assuming an average fiscal share of GDP of around 40 per cent. Moreover, for the sub-sets of OECD and non-OECD countries our results show, that altogether, we also cannot reject the hypothesis that government spending either in the presence or in the absence of a financial crisis has the same impact. Interestingly, for the cases when a banking crisis occurred, our results do not support the idea that expansionary fiscal policies positively impact on economic growth.

Therefore, the main result of our panel analysis is that that government spending has essentially the same impact on economic growth with or without a financial crisis. This result holds throughout our sample, using a variation of controls, sub-samples and specifications. Consequently, taking into account that larger spending programmes tend to be less targeted, this indicates that they may actually not be particularly helpful.

The present analysis is a first step and these conclusions are tentative. Additional research is needed to further study the relevance of fiscal policies in the context of financial crisis. One way forward would be to use more detailed data on the composition of government spending and to distinguish between budgetary components that react to changes in output and others that don't.

APPENDIX
DATA DESCRIPTION AND SOURCES

Non-performing loans: data available on the website of Luc Laeven, reported as a percentage of GDP at the peak of a crisis. http://www.luclaeven.com/Data.htm

Year of crisis: banking, currency or sovereign debt crisis. Source: IMF database on financial crises, Laeven and Valencia (2008), and at http://www.luclaeven.com/Data.htm

Government spending: general government spending deflated with the GDP deflator. For some countries only central government data are available. Source: IMF World Economic Outlook database.

Budget balance: general government budget balance as percent of GDP. For some countries only central government data are available. Source: IMF World Economic Outlook database.

Government debt: government gross debt as percent of GDP. For some countries only central government data are available. Source: IMF World Economic Outlook database.

Real GDP: Source: IMF World Economic Outlook database.

GDP gap: difference between actual and trend real GDP, as a percentage of trend real GDP. Trend GDP is estimated using an HP-filter on real GDP. The lambda value is chosen as 100.

Inflation rate: Consumer price index. Source: IMF World Economic Outlook database

Long-term nominal interest rate: Data are only available for OECD countries. Source: OECD Economic Outlook database.

Election dates: Legal and Executive Elections taken from Norris, P. (2009), *Democracy Time Series Dataset*, http://www.hks.harvard.edu/fs/pnorris/Data/Data.htm

List of Countries

All Countries			OECD Sub-sample
Albania	Ghana	Oman	Australia
Algeria	Greece	Pakistan	Austria
Antigua and Barbuda	Guinea	Panama	Belgium
Argentina	Guinea-Bissau	Paraguay	Canada
Australia	Guyana	Peru	Czech Republic
Austria	Hungary	Philippines	Denmark
Azerbaijan	Iceland	Poland	Finland
Bahamas, The	India	Portugal	France
Bangladesh	Indonesia	Romania	Germany
Barbados	Iran	Russia	Greece
Belgium	Ireland	São Tomé and Príncipe	Hungary
Belize	Israel	Saudi Arabia	Iceland
Bolivia	Italy	Senegal	Ireland
Bosnia and Herzegovina	Jamaica	Seychelles	Italy
Brazil	Japan	Singapore	Japan
Bulgaria	Jordan	Slovak Republic	Korea
Burkina Faso	Kazakhstan	Slovenia	Luxembourg
Burundi	Kenya	South Africa	Mexico
Cambodia	Korea	Spain	Netherlands
Canada	Kuwait	Sri Lanka	New Zealand
Cape Verde	Kyrgyz Republic	Swaziland	Norway
Chile	Lao	Sweden	Poland
China	Latvia	Switzerland	Portugal
Colombia	Lebanon	Syrian Arab Republic	Slovak Republic
Costa Rica	Lithuania	Taiwan	Spain
Côte d'Ivoire	Luxembourg	Tajikistan	Sweden
Croatia	Madagascar	Thailand	Switzerland
Cyprus	Malaysia	Trinidad and Tobago	United Kingdom
Czech Republic	Mauritania	Turkmenistan	United States
Denmark	Mauritius	Uganda	
Djibouti	Mexico	Ukraine	
Dominican Republic	Moldova	United Arab Emirates	
Ecuador	Mongolia	United Kingdom	
Egypt	Morocco	United States	
El Salvador	Mozambique	Uruguay	
Equatorial Guinea	Namibia	Uzbekistan	
Estonia	Nepal	Venezuela	
Ethiopia	Netherlands	Vietnam	
Fiji	New Zealand	Yemen	
Finland	Nicaragua	Zambia	
France	Niger	Zimbabwe	
Georgia	Nigeria		
Germany	Norway		

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TAX POLICIES TO IMPROVE THE STABILITY OF FINANCIAL MARKETS

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While tax policies did not cause the recent global financial crisis, they almost certainly contributed to key vulnerabilities in the international financial system. In this paper we review existing tax policies identifying a number of channels by which tax distortions increase an economy's vulnerability to financial shocks. In particular, we highlight how current tax policies contribute to excessive leverage, reduced transparency and increased complexity due to unproductive financial innovation. Rather than improving financial stability, some recent tax proposals, such as a Tobin tax or other financial sector taxes and levies, may in fact add to the vulnerabilities of the financial sector.

We identify a number of policy reforms which would reduce the potential for financial shocks to become crises with severe consequences for individual wellbeing. These reforms include, reducing corporate debt biases (such as through an allowance for corporate equity), improving loss offset provisions, eliminating transaction based taxes and moving towards accrual based taxation. These reforms would significantly improve risk allocation in the economy, particularly by reducing the bias towards leverage, improving the price revelation of financial products and the stability of financial markets. Many of these issues were also outlined in the recent Australia's Future Tax System review.

1 Introduction

There appears general agreement among policy advisers and academics that while tax policy did not cause the recent global financial crisis, it may have contributed to it (see, for example, Lloyd, 2009; Slemrod, 2009; Shaviro, 2009, Keen *et al.*, 2009). This paper first discusses the likely causes of the crisis before outlining in more detail the likely role of the tax system. The paper then discusses some potential reforms to the tax system to improve financial market stability, which notably does not include additional taxes on the financial sector. Many of these issues and potential reform options were outlined in the recent Australia's Future Tax System review (Henry, 2010).

2 The impact of the Global Financial Crisis (GFC)

The world has recently progressed through one of the most destructive and dramatic economic events in the era of modern global capital. The financial crisis had significant real world economic effects, with output across the OECD falling 4.5 per cent in the year to 30 June 2009 and potential output being revised down by 2¾ percentage points compared to pre-crisis projections (OECD, 2009); unemployment in advanced economies rising to over 8 per cent in 2009 (IMF, 2009a), and budget deficits in advancing economies rising to 8.9 per cent on average (IMF, 2009a). The effects were by no means universal, with jurisdictions with more sophisticated and extensive financial systems (such as the United States and Europe) suffering proportionately

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The views in this paper are those of the authors and not necessarily those of the Australian Treasury.

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more than others with relatively unsophisticated markets (such as China and India). Countries with more trade exposure and less exposure to the kinds of "toxic" assets originating in the US subprime mortgage market also escaped with relatively better performances.

The GFC also significantly changed the international financial landscape. Indeed, the important financial centres of the world were unrecognisable from what they were just one year before. In late 2010, of the world's one hundred largest banking groups only nine were rated AA or higher (and Australia had four of those) (Swan, 2010). Today, as well as some institutions, some previously ubiquitous financial products – such as mortgage backed securities (assets backed by expected mortgage flows), collateralised debt obligations (assets backed by mortgage backed securities, MBS, and other obligations) and credit default swaps (swaps which improved MBS by having other entities insure the default risk) – have evaporated. For example, global private-label securitization gross issuance (made up of asset-backed securities, collateralized debt obligations and derivates and mortgage-backed securities) soared from almost nothing in the early 1990s to peak at almost $5 trillion in 2006. In 2009 volumes dropped off sharply to around $1 billion, much of this only with government support, while the United States MBS market no longer existed (IMF, 2009a, p. 81).

The GFC also changed the way that many people think about economic management, with the near universal re-emergence of counter-cyclical fiscal policy and pressure for increased regulation to address perceived failures in financial markets. Governments have also shown that they are willing to use less traditional economic responses to perceived economic problems, including equity injections and loans (for example, the US Government support for AIG), guarantees, the purchase of financial assets (such as the US Government's Troubled Asset Relief Program) and even nationalisation (such as the takeover of Northern Rock by the UK Government).

3 What is a "financial crisis"?

One indicator of the path of the progress of the financial crisis is the interest rate spread on inter-bank lending (measured by the London Inter-Bank Offer Rate, or LIBOR). The LIBOR is the interest rate that banks charge each other in the London wholesale market. Since the funds are unsecured, the interest rate spread accounts for both credit and liquidity risk (see Figure 1).

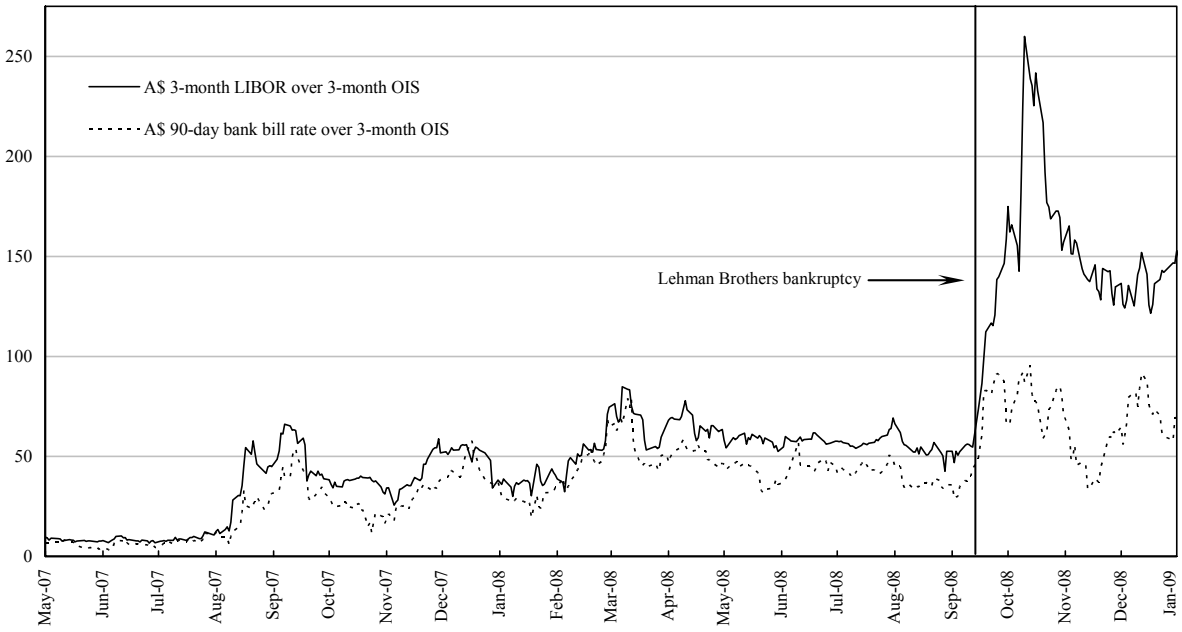
The crisis started in late July 2007 as default rates on United States "sub-prime" loans began to increase. This lead to a slowly building concern in the United States mortgage backed securities markets through the latter part of 2007, events evolved more rapidly in the Autumn of 2008 with the collapse of Lehman Brothers. Soon after the Lehman Brothers collapse, the risk of short-term inter-bank lending rose by more than two percentage points. When a financial shock envelopes the whole financial system, it turns into a crisis, typified by the almost complete ceasing of many private credit markets and a flight towards debt of major economies (but away from the vulnerable, such as Iceland). Credit became unavailable from banks due to the fear that potential borrowers would be unlikely to repay because the businesses and individuals that owed them could not repay. This is a system wide collapse that no individual firm could withstand.

But it was not the losses themselves that lead to this crisis of confidence. The total value of subprime mortgages reported in March 2007 of $1.3 trillion is still less than three per cent of world stockmarket capitalisation at that time.[1] So even if all such mortgages foreclosed and the houses were worth nothing, there should have been a small fall in equity markets, not the 40 per cent that

[1] The value of world stock markets was $52.6 trillion in March 2007, falling to $31.1 trillion in November 2008 (http://www.world-exchanges.org/statistics/ytd-monthly). One contemporary media account quoting $1.3 billion in subprime losses can be found here http://www.msnbc.msn.com/id/17584725 (Associated Press reported, 13 March 2007).

Figure 1

Long-run LIBOR Interest Rate Spread
(basis points)



Source: Australian Treasury.

soon followed. Even today, total defaults in the US mortgage market are only a fraction of the $11 trillion of total outstanding mortgages. The financial markets have withstood other financial shocks without this flowing through to a credit crisis. In the past, share prices have fallen significantly (for example, the Dow Jones industrial average fell 29 per cent on one day in October 1987), the economy weak (in 1982, US unemployment neared 10 per cent and GDP fell by nearly 4 per cent) large firms have gone bankrupt (such as Enron in 2001) and significant parts of the financial system have malfunctioned (such as the US savings and loans crisis of the late 1980s).

Fundamentally, the market struggled to determine the size of potential losses and who actually bore them. The uncertainty flowed from the complex nature of the financial assets and obligations. Existing process for managing and measuring risk had proved themselves unreliable. The major ratings agencies continued to provide Lehman Brothers with at least an "A" rating right up until its collapse (US House of Representatives, 2009). Agency costs – paying for the management and monitoring of investments – are a means of dealing with asymmetries of information.[2] One way of viewing the crisis is that technology advanced so rapidly that agency costs could not keep up with inherent information asymmetries (see Arrow, 2008). Sometimes managers had incentives to hide the extent of such losses, sometimes they themselves may not have known what they were due to the complex nature of the arrangements and malfunctioning technologies for measuring risk. Because of this asymmetry in information and distrust of the agency arrangements for containing them, lenders refused to extend credit in ways they had in the past – first to firms suspected of poor business practices (some mortgage originators), then those

[2] This may not mean financial markets are inefficient. The weak form efficient markets hypothesis recognises that information is not free and trading in it can be costly, but no individual trader can make excess returns from trading on publicly available information (Fama, 1970).

Table 1

Marginal Effective Tax Rates for Plant and Equipment, 2005

	Australia	Canada	Italy	United Kingdom	United States
Statutory tax rate	30.0	35.6	37.3	30.0	39.3
Equity financed	24.3	24.8	19.1	20.3	23.6
Debt financed	–23.1	–37.0	–48.5	–27.6	–45.9

Source: Devereux, Griffith and Klemm (2002) and updated data available at www.ifs.org.uk

with a heavy reliance on short term credit (investment banks) and finally even standard retail banks and businesses in the real economy. The economic purpose of financial markets is to relay information to guide efficient investment. When that information becomes tainted and unreliable, the consequence for markets has proven to be severe.

4 The influence of tax policy

Tax systems around the world did not cause the recent global financial crisis, however it is likely that some elements at least contributed to the turmoil being of greater magnitude and duration than necessary. In that sense, it has a similar type of culpability to financial regulation that is sometimes cited as contributing to the crisis (for example, Cukierman, 2009). In particular, the tax system favours debt financing, investment in housing and assets earning capital gains. It also encourages people towards behaviours to avoid transaction taxes and make use of tax losses. The tax system therefore encourages people to expose themselves to risks that they normally wouldn't, increasing the overall susceptibility of the economy to financial shocks.

4.1 Tax bias towards debt financing and corporate finance

Firms can raise finance in one of three ways, debt, new equity and retaining profits. Corporate tax systems in most countries are based on the full return to equity. Systems based on taxing the full return to equity have a bias towards debt financing over equity at the corporate level and therefore may encourage companies to rely excessively on debt finance. The bias towards debt arises because interest expenses are deductible while the cost of equity capital is not. The debt bias can be seen by comparing Marginal Effective Tax Rates (METRs) in Table 1 for equity and debt financed investments. For example, for Australia the METR for new investment in plant and equipment is estimated to be around 24 per cent, just below the statutory rate of 30 per cent. However, for the same investment financed by debt the METR is around –23 per cent. This suggests that the tax system not only favours debt financing, but subsidises investments that are debt financed.

While the implications of significant leverage are unclear, high levels of leverage can make companies more vulnerable to economic shocks and increase the probability of bankruptcy and therefore create a cost of financial distress. Highly leveraged companies are susceptible to volatility in profits, as they are required to make interest payments irrespective of profitability. As such, they are also more susceptible to volatility in interest rates.

BOX 1
EFFECTIVE TAX RATES – DEBT AND EQUITY

The effective tax burden on capital income can be measured using Marginal Effective Tax Rates (*METRs*) and Average Effective Tax Rates (*AETRs*).[3]

The *AETR* measures the proportion of the value of an investment project which is paid in tax. It is given by the net present value of the tax paid by the investment divided by the present value of the pre-tax profit flows from the investment. As shown in Sørensen (2009) the AETR is given by:

$$AETR = \frac{\tau\left[p - \rho + (1 - A)(\rho + \delta) - \beta(r + \pi)\right]}{p} \tag{1}$$

where τ is the company tax rate, p is the real net rate of return before tax, ρ is the company's real cost of finance, that is, the rate of return required by the investor supplying the funds for the project, A is the net present value of allowances, δ the real rate of economic depreciation, β is the debt-to-asset ratio, and $r+\pi$ is the nominal interest rate.

From equation (1) it can be seen that the AETR can be used to measure the tax burden on inframarginal projects where $p–\rho$ is the pure rent from the project – that is, the difference between the actual pre-tax return and the investor's required return.

In contrast to the *AETR*, the *METR* measures the tax burden on the marginal unit of investment which generates no net profit for the investor. The *METR* is given by:

$$METR = \frac{c - \rho}{c} \tag{2}$$

where c is the real pre-tax rate of return on the marginal investment (user cost of capital). The user cost of capital, as shown in Sørensen (2009), is given by:

$$c = \frac{(1 - \tau A)(\rho + \delta) - \tau\beta(r + \pi)}{1 - \tau} - \delta \tag{3}$$

First, consider the case where investment is financed by equity (β=0 and ρ=r), where tax depreciation is set to reflect the true decline in the nominal value of the asset. The present value of depreciation allowances (A) and the user cost of capital (c) are given by:

$$c = r/(1-\tau)$$

$$A = \frac{\delta - \pi}{r + \delta}$$

Hence:

$$MERT = AETR = \tau \tag{4}$$

That is, the *METR* and *AETR* where the investment is financed by equity are equal to the statutory tax rate.

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[3] The methodology used to calculate *METRs* and *AETRs* in this paper is based on Sørensen (2009).

Now, instead, consider the case where the investment is fully debt-financed (β=1 and ρ=r). The user cost of capital is now given by c=r. From (1) and (3):

$$METR = 0$$

and

$$AETR = \tau\left(\frac{p-r}{p}\right) \quad (5)$$

For a project earning rents, that is $p>r$, the $AETR<\tau$. As such, under a conventional company income tax where debt is deductible, the *METR* and *AETR* will be lower where the investment is funded by debt.

If leverage levels become unsustainable and lead to a credit crunch, firms and households are unable to access credit required for investment and consumption which can result in a collapse in demand. Such concerns are particularly relevant for countries with relatively large current account deficits (such as Australia) that are financed by the international community's willingness to lend in order to rollover existing debt.

Where markets cease to function, financing strategies predicated on the existence of well-functioning markets has serious consequences for individuals as well as nations. The uncertainties and costs associated with bankruptcy are one of the transaction costs that can accentuate financial crises. The International Monetary Fund recently suggested that the bias towards higher leverage increases the vulnerability of the private sector to shocks (IMF, 2009a).

As highlighted previously, the tax bias towards debt may be made worse where the tax system also allows assets to be depreciated at accelerated rates. Where the tax system allows for a deduction for both financing costs and economic depreciation, the tax system would have no impact on investment decisions at the margin. In this case the METR would be equal to zero (see Box 1) as all costs – financing and depreciation – are fully recovered. However, where accelerated depreciation is allowed in addition to debt deductibility, the METR becomes negative, that is the investment is subsidised (see Box 2). As a result, this can distort resource allocation, and may encourage low-productive investment that would not have been viable in the absence of the tax system.

While tax systems based on the return to equity are biased towards debt, there are some factors that may have acted to reduce this bias. Company income tax rates have fallen across OECD countries over the past 30 years (see Figure 2). The unweighted average company income tax rate fell from around 47 per cent in 1982 to around 28 per cent in 2007. The weighted average (which is heavily influenced by the United States, Japan and the United Kingdom) has fallen to a lesser extent, from around 50 per cent in 1982 to 36 per cent in 2006. A lower tax rate increases the cost of debt financing as it reduces the benefit from interest deductibility.

In some circumstances, financial innovation may be reducing the tax bias towards corporate debt. For example, if a financial instrument acts like equity for accounting or regulatory purposes (and has similar economic characteristics), while having the additional benefit of being deductible for tax purposes, then the tax bias is eliminated. For example, in the United States hybrid instruments such as convertible debt obligations are treated as debt for tax purposes, but have equity like characteristics (Shaviro, 2009). Of course, while they may qualify as debt for tax purposes, the securities are likely to be less permanent, and give the investor greater rights to

BOX 2
EFFECTIVE MARGINAL TAX RATES –
DEBT AND ACCELERATED DEPRECIATION

Where an asset is written off at an accelerated rate the required return will fall below *r*. The required return falls below r because accelerated deprecation is effectively allows for tax to be deferred. Where the required return falls below r the METR will be negative, this compares to an *METR* of 0 where tax deprecation is appropriately measured (see Box 1).

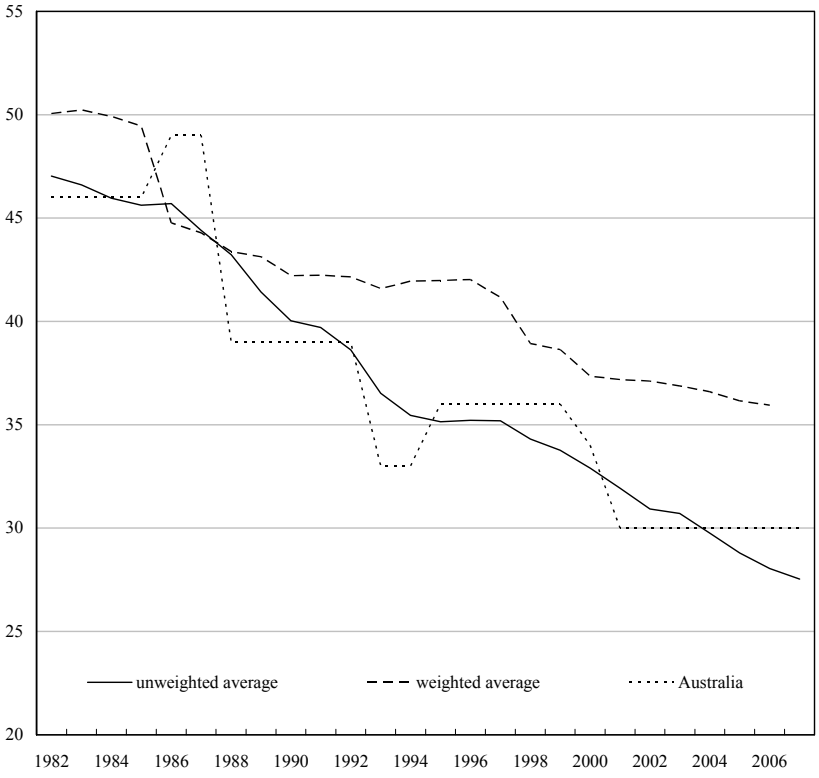
To see this, consider the case where investment is debt financed and the cost of the new investment is immediately expensed. In this case the present value of depreciation allowances (A) would equal 1. Using (3) again, the cost of capital equation for a break even project would be:

$$c = r - \frac{\tau(r+\pi)}{1-\tau} \tag{6}$$

The cost of capital in (6) is less than the discount rate for positive values of r and $r+\pi$, thus yielding a negative *METR*, or a subsidy.

Figure 2

Statutory Corporate Tax Rates in the OECD, 1982-2007
(percent)



Source: Loretz (2008), with additional data from author.

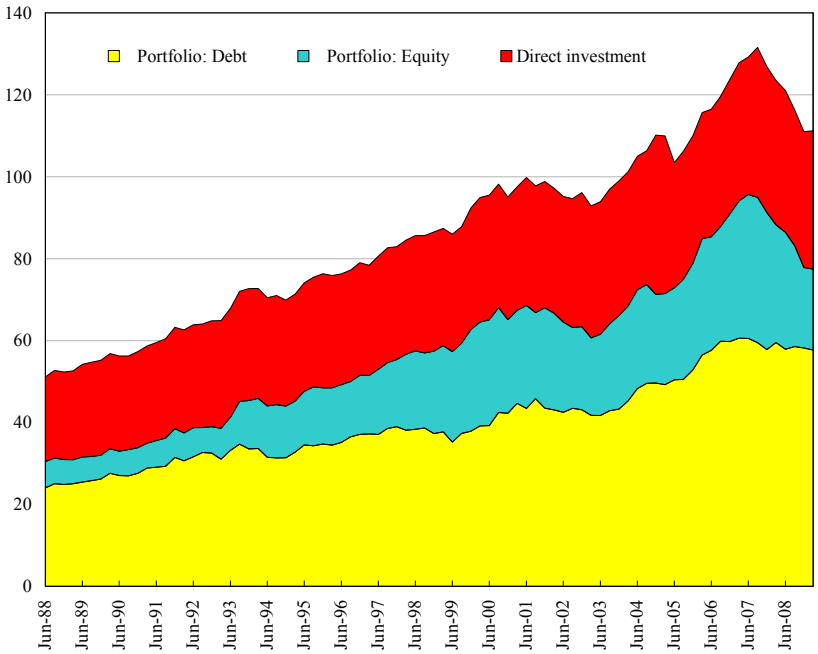
dividends/interest, than ordinary share capital and as such may be a less secure (that is, more risky) form of capital. Global issuance of such hybrids reached $170 billion in 2007 (Lloyd, 2009, p. 8).

One alternative means of accessing debt interest deduction, if you are a multinational, is to take advantage of the tax benefits for debt financing by lending to subsidiaries (and in extreme cases transfer pricing). The use of such tax avoidance mechanisms reduces the corporate debt tax bias, while effectively allowing taxpayers to choose their tax rate. Investors are effectively able to choose whether they wish to be taxed at the

corporate tax rate (through equity finance) or their individual marginal tax rate (though debt finance) (Shaviro, 2009 and Slemrod, 2009). Rather than increasing financial risk, the social cost is the loss in revenue from an optional tax system, valued at the cost of making up the revenue from other distorting taxes (see Slemrod, 2009).

Figure 3

Inbound Foreign Investment in Australia by Type
(percent of GDP)



Australian Bureau of Statistics catalogue 5302.0.

In relation to the regulated financial sector, capital adequacy rules limit the debt component of a company's capital. However, the tax deduction for interest may still provide an incentive for firms to maximise debt financing within the prescribed limits. Furthermore, the tax system may also encourage capital to be issued in the form of hybrid instruments that may be classified as debt at least for tax purposes (Lloyd, 2009).

To the extent that firms cannot access international finance, as may be the case for smaller unlisted companies, financing decisions may also be influenced by taxes at the individual level (such as the taxation of dividends, capital gains and interest). Where tax systems double tax the return to equity, this may also result in a bias towards debt financing. In recent years many European countries have moved away from full imputation systems, which remove the double taxation of equity, towards uniform credits (United Kingdom) or reduced dividend tax rates (Ireland).

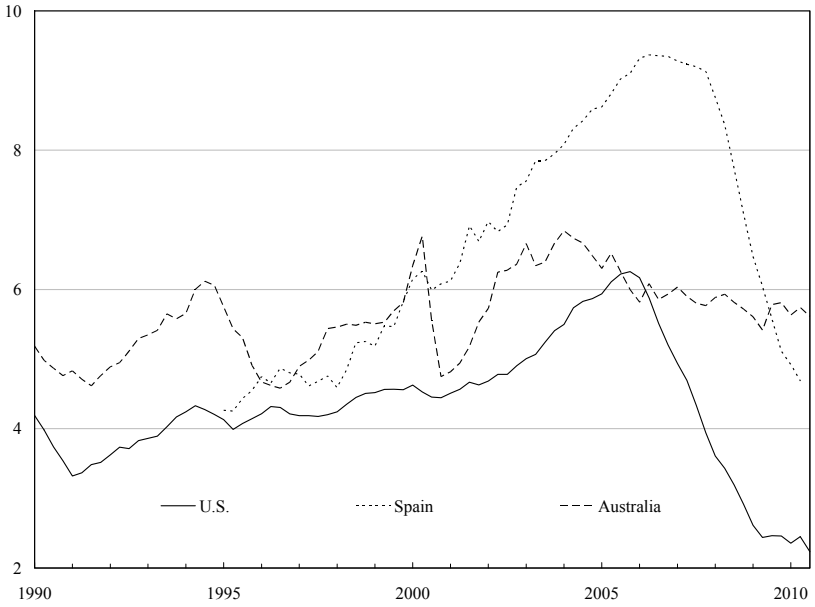
In Australia (and New Zealand) the bias towards debt may be offset to some degree by the full dividend imputation system (introduced in Australia in 1987) and concessional taxation of capital gains. These measures remove the double taxation of equity and result in a bias towards domestic equity for domestic resident savers. However, foreign investors cannot utilise imputation credits and therefore, for foreign investors debt is still preferred and has grown in recent years (Figure 3).

4.2 The tax preference for housing

The accumulation of wealth in the form of home equity is one of the most important forms of household saving in OECD countries. It is also intimately associated with recent financial crisis in a number of ways. In particular, the crisis is generally thought to have begun in the United States subprime mortgage market. Further, the crisis also resulted in substantial falls in housing investment, particularly the United States and Spain (Lowe, 2010).

Figure 4

Dwelling Investment
(percent of nominal GDP)



Source: Australian Bureau of Statistics catalogue 5206, Lowe (2010).

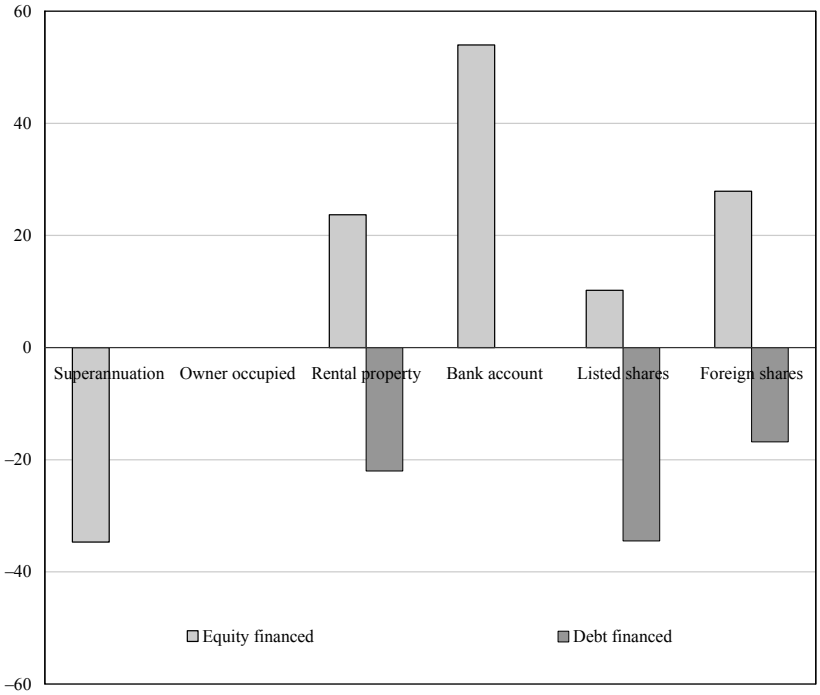
Australia stands out in not having a significant fall in housing investment. Indeed, the IMF recently announced that Australia's house prices may be up to 20 per cent overvalued – and that was before the most recent growth (IMF; 2009b). Many of the curiosities of the Australian housing market reflect the biases that you would expect from the way taxes are levied, although it is difficult to determine how important these effects are. The role of the taxation of housing should not be over-stated, since its role in contributing to the instability in the financial system is inconclusive. In particular, collapses in housing prices occurred in countries with limited preferences to home ownership (Shaviro, 2008, p. 3). However, elements of some countries tax systems may have contributed to housing price booms. For example, until 1985, Australians could earn capital gains tax exempt income from any source, not just housing. As income tax rates have risen for more workers and available tax shelters have been reduced, the remaining tax preferences for housing have become more valuable. Similarly, Fane and Richardson (2005) argue that the 50 per cent CGT discount for rental property introduced in 2000 directly stimulated the increase in debt and housing prices. Other factors could include differential degrees of financial innovations, such as reverse mortgages, which effectively allow investors to make greater use of housing tax preferences as a means of saving. The Productivity Commission (2004) and Reserve Bank of Australia (2003) have suggested that favourable taxation settings in Australia can contribute to volatility of the housing market.

It is worth illustrating some of the features of tax systems around the world which may contribute to less stable housing and financial markets with reference to Australia. First, like most countries, owner occupied housing is exempt from income tax. Few countries tax imputed rents while capital gains are typically tax exempt. Investment properties are also favourably taxed with capital gains typically concessionally taxed, and taxed only on realization. Overall, because housing is a significantly tax preferred, more of the nation's savings is likely to be devoted to housing than under a more neutral diversified national savings portfolio. Indeed, relative to other savings tax preferences, biases to saving in housing may expose domestic economies to greater risk. The owner-occupied tax preference can only be accessed for most through domestic house purchases and few opportunities are available for investing in overseas investment properties. Housing assets are undiversified in many people's portfolios. According to the ABS, the principal assets of Australian households are: their own home (44 per cent of household assets) followed by other property – including rental properties (16 per cent) (ABS 6553.0).

Second, there is a debt bias towards investment housing in Australia, since the interest is fully deductible whereas the capital gains are only taxed at 50 per cent. The impact of these arrangements is highlighted in Figure 5. For rental properties, the effective tax rate will vary depending on the financing choice of the investor. Where the investment is funded by equity, the effective tax rate is small, put positive, reflecting the concessional treatment of capital gains. But, where the investment is financed (at least partially) by debt the effective tax rate is negative, this results in a significant asymmetry. This result also applies to shares.

Figure 5

Real Effective Tax Rates
by Asset Type and Financing Arrangement
(percent)



Source: Henry (2009).

Household mortgage debt has more than tripled in the past ten years to over one trillion dollars. Increasing house prices in Australia have been associated with a substantial increase in household debt, with household debt rising from around 90 to almost 160 per cent of annual household disposable income over the past 10 years (RBA; Statistical Tables). Debt financed housing contributes to a significant amount of Australia's gross borrowing requirements and contributes to a current account deficit, averaging 4.6 per cent of GDP over the same period. Such preferential tax treatment for housing may have higher social costs than corporate preferences for debt because of the relative unsophisticated or liquidity constrained nature of such investors and because the inherent "lumpiness" (non-divisibility) of the purchases reduces the scope for diversification. Corporates have more options for offsetting any debt biases by changing their portfolio (Slemrod, 2009, p. 5).

Third, there are a number of significant transaction costs to turning over houses in Australia, including: the realisation basis of taxing capital gains on investment housing; losing the exemptions from pension means tests when shifting from owner-occupied housing into other investments; and transaction taxes (in the form of stamp duty) twice the OECD average. This increases incentive to overinvest in existing homes. For example, young couples are more likely to buy larger homes than they need in order to not to have to move and retired people may not downsize their accommodation as needed. This may be one reason why even though housing investment has been at historic highs for five years (at 6 per cent of GDP), housing supply has not kept pace. Even though investment in housing is higher than in the past, rental yields have continued to rise and vacancy rates are at record lows. Australians are investing in bigger and more expensive houses –

real expenditure on each new dwelling built is now 60 per cent higher than it was around 15 years ago. The size of the average Australian new home grew 40 per cent between 1984-85 and 2002-03 (ABS, 2005), even as the average household size fell (ABS, 2008). And Australians are upgrading their existing homes, rather than building new ones – a high proportion of dwelling investment is in the form of alterations and additions – that is upgrading existing houses rather than building new ones. Almost half of all dwelling investment has been accounted for by alterations and additions in recent years (Lowe, 2009). Transaction based taxes also reduce the turnover of housing, harming price discovery.

Fourth, a fragmented land tax regime with large thresholds for small investors. This may be one reason why rental properties are almost all held by small (as opposed to institutional) investors. Land tax applies only to investors and due to exemption thresholds, it increases with the number of properties owned, reducing the incentive for institutional investors and appropriate risk diversification.

Overall, the tax system provides incentives for small and relatively unsophisticated buyers that own highly leveraged, large houses that make up a disproportionate part of their financial portfolio.

4.3 The tax preference for capital gains

The Australian income tax system, like that on most other countries, tax returns in the form of capital gains concessionally. The concessional treatment of capital gains results in one of the greatest tax distortions to the savings choices of households.

Capital gains are typically only taxed when they are realised, providing a tax deferral benefit. The conventional justifications for deferring the taxation of gains until the time of realisation is that taxing accrued unrealized gains could lead to valuation and liquidity problems. Deferral however; generates its own problems by reducing the effective tax rate on accrued gains as investors as the payment of tax is deferred until the asset is realised, this effectively gives the taxpayer an interest free loan on their accrued tax liability.

Allowing deferral of taxation of accrued capital gains on shares could open the door to tax avoidance. For example, there is an incentive to construct positions where an investor holds gains and realises losses, thereby using the realisation event for tax arbitrage. Such possibilities lave lead to the introduction of limits in the tax system, such as limitations on loss utilisation even where a taxpayer incurs a true economic loss.

Taxing capital gains on realisation also creates a “lock-in” effect. This is because the tax deferral advantage encourages investors to hold on to assets with accrued capital gains. The lock-in effect impedes the efficient functioning of capital markets and distorts ownership patterns as investors are discouraged from switching assets and paying tax on a realised gain. The lock-in effect can also destabilise the stock market and real property market as shares and property are sold when prices decline (to realise losses) and are held onto when prices rise (to defer realisation of the gain).

In order to address the lock-in effect, most countries, including Australia, concessionally tax capital gains. For example, in Australia only half the capital gain is subject to tax where the asset is held for more than a year. This approach, while going some way to reducing the lock in problem, contributes to a further lowering of the effective tax rate on capital gains. This distorts asset allocation further, and may also distort company financing choice through the decision between distribution and retaining earnings.

The impact of a realisation based tax, combined with the 50 per cent exemption, is more pronounced where an asset is debt financed. Under this system, investors have an incentive to borrow (and deduct the full interest expense at marginal tax rates) and invest in assets that generate capital gains, which are concessionally taxed.

As the tax treatment of capital gains encourages investment in assets where the return can be categorised as capital gains for taxation purposes, to the extent that it easier to convert the returns from a risk asset into capital gains the tax system could encourage more risky investment.

4.4 Taxation and risk taking

The tax system can affect risk taking. It has been well known since the contribution of Domar and Musgrave (1945), than an income tax system may encourage risk taking where full loss offset is provided.

Most countries corporate income tax systems do not however provide full loss offset. Income tax systems typically treat gains and losses asymmetrically. Gains are taxed when they are realised, while losses can only be used to offset future (or in some cases prior) taxable income, typically only under certain tests. While companies can use prior year losses against future income, typically subject to certain tests. While losses can be carried forward, their value erodes over time, and in some cases they can never be used and are wasted. In Australia, the stock of existing losses is over $100 billion and growing with around $30 billion of new losses generated each year, while only $20 billion of losses are utilised (Abhayaratna and Johnson; 2009).

The asymmetric treatment of gains and losses is typically justified as an integrity provision. It reduces the scope for companies to create fraudulent losses in order to get a tax refund. Despite perceived integrity benefits, the asymmetric taxation of profits and losses is likely to lead to a misallocation of resources and risk in the economy.

Imperfect loss offset provisions can bias investment decisions towards safer investments over risky investments. In effect denying full loss offset reduces the expected return from risky investments. In addition, investments with a long lead time may not be undertaken because the present value of deductions diminishes when losses are carried forward and because of concerns that expenditure will fail loss-utilisation tests in future periods (under a partial loss-offset).

Similarly imperfect loss offset provisions may also distort corporate financing decisions towards equity rather than debt, as firms are unable to receive the full tax benefit of interest deductibility.

Limitations on the use of losses may in particular disadvantage entrepreneurial small businesses engaged in risky investments, with start up or closing down expenditure and without other income to offset losses against. The bias against small business may lead to greater market concentration, because larger more diversified businesses may have a higher expected post tax return when they have other income to use against a loss against.

Loss restrictions may also lead to inefficient takeover activity. This is because entities carrying losses forward are valued more highly by entities that can utilise those losses. The impact on takeover activity is likely to be exacerbated by loss utilisation tests which require a degree of continuity of ownership for the loss to be used.

In addition, such restrictions can lead to pressure on the government for concessions to compensate and attract investors to investments which suffer as a result of the restrictions. These concessions are typically targeted towards specific types of investments and therefore further

distort investment decisions. For example, in Australia concessions for research and development, film, and venture capital create a bias toward such investments.

Where losses are not fully refunded or where gains and losses are taxed at different rates, as under a progressive tax rate scale, these asymmetries will tend to discourage risk taking including entrepreneurial activity. The flattening of personal tax rate schedules in recent years may therefore have reduced the bias against risk taking.

In effect while restrictions on loss utilisation and progressive marginal tax rates may reduce risk taking, they may also discourage certain types of risk taking such as entrepreneurial activity, and therefore distort the allocation of, and pattern of risk in the economy.

During the crisis, imperfect loss offset also limited the tax systems effectiveness to serve as an automatic stabiliser. This is because the tax value of deductions is not injected into companies until they have income to offset the loss against. In turn this may have prolonged government deficits beyond the economy's recovery. In order to reduce these effects a number of countries extended (or introduced) loss carry-back provisions. Loss carry-back allows companies to utilise losses in the year they incur them, providing they have paid tax in prior years.

5 Are some of the proposed cures even worse?

The financial sector is one of the most important for a well-functioning modern economy. Today, nearly every real transaction in the economy gives rise (or is guided) in some way by related financial transactions. Governments therefore need to be careful when intervening in financial markets, even (perhaps, most importantly) during crises, given the pervasive effects of financial signals.

Even though tax has not been one of the proximate causes of the crisis, it has recently gained popularity as one of the proposed responses to it, either through a Tobin tax or some kind financial industry levy. However, there are different policy objectives and effects for different types of financial industry levies. Adopting an inappropriate instrument can mean the objective is missed or results in unintended consequences, while the costs associated with using the instrument are nevertheless realised.

5.1 Financial transactions taxes

A persistent policy proposal for addressing financial market instability has been to tax transactions in financial market products. For example, Keynes in 1936 proposed taxing bonds (Keynes, 1964, pp. 159-60), Tobin in 1972 suggested foreign exchange (Tobin, 1974), while more recently Professor Krugman (2009) and, Lord Turner (Turner, 2009) chair of the UK Financial Services Authority canvassed the possibility of a similar tax on all financial transactions.

While there are differences in the reasoning behind such proposals, the common thread is that by placing "sand in the wheels" of the financial system, destabilising trades will be reduced and prices will better reflect market fundamentals. For example, Tobin suggests that because destabilising foreign exchange speculation tend to be high-volume and short-term, they would be disproportionately affected by such a tax.

There are a number of problems with this reasoning, including:

- the mobility of financial markets means trades would still occur, just elsewhere (different jurisdictions) or in different forms (such as options), potentially under less regulation;

- there is no clear link between some of the market and government failures that lead to the crisis, and trading volumes; that is there is no link between trading volumes and the creation of systemic risk (for example, credit default swaps – which effectively transferred a lot of risk up from sub-prime borrowers to more secure financial institutions – are generally done over the counter and not traded in secondary markets);
- the tax would apply equally to stabilising as well as de-stabilising trades (if *ex ante* you could tell the difference, you would simply ban the destabilising trades). The proportion of each may be different at different times (which is why, for example, regulators tend to restrict short selling of financial stocks only at times of financial crises). The tax would apply indiscriminately to transactions that are socially useful – including those that contribute to financial system stability – and those that are costly;
- there is no evidence that destabilising trades are more responsive to tax than stablising trades – to the extent that "raiders" are less responsive to tax than "smoothers", the tax might increase volatility. Indeed, transaction taxes tend to reduce the number of trades,
- there would be real economic distortions. For example, large, vertically integrated businesses use fewer transactions to make the same product and would pay less tax. Even if levied at a low rate, a tax would cause some impediment to real activity (for instance, currency transactions are essential for international trade and investment).

There appears little practical ability to introduce a financial transaction tax that improves financial market stability, not the least because the conceptual case itself is unclear.

5.2 Financial levies

The first step when assessing whether a levy is appropriate is to be clear about its policy purpose. Some objectives of financial levies include:

- reducing systemic risk;
- recovering the costs of government assistance provided after the collapse of financial firms; and
- taxing economic rents due to a heavily regulated and subsidised (either explicitly or implicitly) financial sector.

Policy makers should be clear about the policy purpose because each objective requires a different policy design. Indeed, the objectives can actually be in direct conflict. For example, a levy aiming to reduce systemic risk will provide less revenue the more it "works" in changing behaviour, so it should not be relied on to finance government bailouts. In contrast, a tax on economic rent should leave the incentives in the financial system unaffected, since it explicitly tries to avoid changing marginal behaviour. Finally, a levy used to cost recover government financial assistance could apply to firms with large potential liabilities deemed worthy of covering, but which inherently have no implications for systemic risk.

One problem with using a levy to protect the *system* against a financial shock is that there are a number of potential sources of such risk in financial markets. Some may be generated by markets, such as increasingly complex financial transactions effectively hiding systematic relationships between financial returns from different assets. Agency problems may contribute to this, since financial managers may be more focused on short-term remuneration related returns over more stable investments with long term returns. But it is often difficult to determine *ex ante* what transactions undertaken by profit-seeking individuals improve financial risk management and which are more likely to harm it. Governments can also be sources of systemic risk.

Risk-based fees are used by some regulatory agencies (such as the Australian Prudential Regulatory Authority) to cost recover their expenses. Extending the principle would see these fees

rise proportionate to the social costs of the activities of these financial firms, rather than the regulatory costs. The IMF (2009a, p. 43) and Slemrod (2009, p. 4) have noted the similarity with Pigovian taxes on pollution. However, the recent financial crisis poses a number of problems for such taxes. The source of the systemic risk may not be in the (domestic) regulated financial sector. Taxing the domestic financial sector may actually encourage instability by providing more incentive to use external finance sector. The tax rate needs to be set *ex ante*, when the costs are often only apparent *ex post*. For example, few commentators would have though an insurance company such as AIG was systemically important before the GFC. It is similarly difficult to know what behaviours will cause a future financial shock with sufficient provision to be able to tax it. The externality is unlikely to rise in a consistent way with different types of financial obligations or remain stable through time, making setting the tax rate difficult. There appear other significant difficulties in determining relatively objective measures of systemic risk. One proposal is to measure a financial firms proportionate contribution to stock index falls of more than five per cent (Acharya and Richardson, 2009). Using such a methodology as a basis for taxing systemic risk leads to a peculiar non-linearity where, during such an event, investors will continually bid down the share price of a financial firm by whatever the future levy obligation, leading to more and more significant reductions.

There are likely to be better ways of targeting the social cost of systemic risk than using tax instruments. Instruments which target the marginal behaviours that impose the social costs are likely to be less costly. For example, if agency problems (such as short-termism on asset managers rather than owners) drive the systemic risk, then regulatory reforms targeted at the problem will be less costly (such as greater voting rights on remuneration incentives by shareholders). If the problem is moral hazard by government, it is unrealistic to expect future governments not to intervene in the economy when facing potentially calamitous market failures. But it is not unrealistic for managers to know that they will be fired, shareholder equity extinguished and liabilities severely curtailed should "bail outs" be needed. Clarity about the costs likely to be imposed on managers and owners before a shock may be more effective means of ensuring they do not become a crisis.

Levies that aim to *recover costs* may appear "equitable", particularly following a financial crisis that has seen the commitment of significant government revenues. But it is far from certain that those who pay a financial levy are the same ones who benefit from financial market interventions. First, who actually bears the burden of the levy depends on economic incidence, which may be different during a crisis (when the spending is made) compared to after when the tax is paid. Financial markets also capitalise the benefits and costs of policies into the value of financial asset. The owner of a financial asset when a government support program is announced (or is expected) gains, and they may be different to the owners of the same financial asset when a tax is announced. Second, the beneficiaries of the support also presumably include the wider economy, rather than simply financial asset holders.

More importantly, such levies are likely to be inefficient and may even increase instability. Unless the levy itself reflects the potential risk of default, it is likely to be a high cost way for the government to finance such guarantees – effectively taxing relatively "safe" firms to pay for "risky" ones. The most common form of such a levy is to fund deposit insurance. Deposit insurance may improve financial stability by reducing the incidence of bank runs. However, it is the guarantee, rather than the levy which potentially improves stability. While a single, unexpected capital levy (on any sector) may be efficient, the prospect of ad hoc and recurrent capital levies on the financial sector is likely to harm economic growth in the long run.

Further, by affecting how firms take on risk, the levies can increase financial instability. For example, applying a tax to covered liabilities means financial firms are more likely to rely on alternative financial instruments not subject to the tax. Ironically, this mirrors the regulatory

incentives preceding the crisis, where banks used derivatives to maintain risk while reducing their borrowing costs by ring-fencing liabilities in off-balance sheet subsidiaries (Lloyd, 2009, p. 3). Rather than taxing pollution, the tax may actually be causing more pollution. Further, going into a financial crisis, the prospect of higher taxes on financial firms that survive (in order to finance the bailouts of those that don't) is likely to increase financial market instability. Even a recurrent capital levy is likely to be inefficient since businesses that are systemically risky pay the same rate as those that are not. Instead of targeting the marginal social cost of a firms contribution to systemic risk, levy rate is usually set to recover the cost of interventions (for example, Sweden's prospectively and the US proposal is retrospective). This makes them an inefficient source of financing.[4] In principle, the least cost means of raising the required revenue should be preferred.

One alternative would be to require financial institutions to buy credit default insurance deposits on secondary markets. This would result in more risky financial firms paying higher fees, providing price signals to consumers. Such insurance would only be effective in cases of limited financial system failures (say, for individual firms), rather than for comprehensive global financial collapse.

There may be one area where recent events have increased the case for tax reform. If some form of (implicit and explicit) guarantees persist, along with new financial regulations, financial sectors may be typified as having subsidies and barriers to entry, increasing the potential for excess profits. For example, in Australia, the closing of much of the mortgage origination market has effectively eliminated the competition to the four major banks in providing bank finance. Some options for recouping this economic rent are discussed below.

6 Potential tax policy reforms

The previous sections outlined a number of areas where the tax system may have contributed to the key vulnerabilities in the financial system. In this section we highlight a number of tax policy reforms options that could be used to reduce these issues. Many of these options were also outlined in the recent Australia's Future Tax System review (Henry, 2010).

Rather than financial sector specific taxes, governments could instead consider reforms that address underlying risk misallocation in the economy, many of which relate to the tax system.

6.1 Addressing the corporate debt bias

There are a number of options that could be used to reduce the bias towards debt at the company level. For example, options such as the comprehensive business income tax system business or business level expenditure taxes (such as cash flow taxes and allowance based system) would either eliminate or significantly reduce the current bias towards debt.

6.2 Comprehensive business income tax

The comprehensive business income tax (CBIT) was originally proposed by the U.S. Treasury (1992). The CBIT aims for financial neutrality by abolishing the deductibility of interest. A broadening of the company tax base may allow the company tax rate to be reduced.

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[4] Pre-funding may actually introduce an additional uncertainty into financial markets since governments are likely to face increased incentives to bail out firms, even those for whom the funds are not ear-marked.

Introducing the CBIT would mean denying interest deductibility for existing loans. While it may be possible to phase this in over a number of years, this could further increase the vulnerability of highly leveraged firms, placing them at in further financial distress. In addition, denying interest deductibility could also increase the cost of debt financed from foreign investors.

The CBIT has not been formally adopted in any country, although there have been partial steps taken in some countries to limit interest deductibility (for example, Germany).

6.3 Cash flow taxes

The cash flow taxes, as discussed by the Meade Committee (1978), allow full expensing of investment in the year capital goods are acquired while, like the CBIT interest expenses are not deductible. In effect the government finances a fraction of investment equal to the tax rate. At the same time the government receives a fraction of all future cash inflows from the investment. Like the CBIT, as the cash flow tax is neutral towards debt and equity as the tax liability is independent of how investment s financed. Cash flow taxes only tax the above normal returns and as such are neutral to real investment decisions at the intensive margin.

There are various forms of cash flow tax. They can be imposed on a source base, or destination base (as suggested by Auerbach, Devereux and Simpson, 2009).

However, like the CBIT, because it abolishes interest deductibility, it raises a significant transitional problem for existing debt.

6.4 Allowance for corporate equity

The allowance for corporate equity (ACE) was proposed by the Capital Taxes Group of the Institute of Fiscal Studies (1991). Variants of the system have been tested in Croatia (Keen and King, 2002), Brazil (Klemm, 2007), Italy (Bordignon *et al.*, 2001) and in Austria (OECD, 2007, p. 130). More recently, an ACE system has been introduced in Belgium (Gérard, 2006) and Latvia.

Like the CBIT, the ACE is a sourced-based tax, but while the CBIT denies deductibility for interest the ACE eliminates the tax bias in favour of debt by allowing a company to deduct an imputed normal return on their equity, in addition to the deduction for debt. The ACE therefore only taxes rents, or profits above the required rate of return. The ACE is in effect similar to the "R+F" cash flow tax as outlined by Meade (1978), and therefore, like the cash flow tax, also does not distort real investment decisions at the intensive margin.[5]

As the ACE effectively narrows the company tax base it is often argued that it should be combined with an increase in the company tax rate. However this need not be the case. As highlighted in Sørensen and Johnson (2010), as the incidence of a company income tax is passed onto less mobile factors, such as labour and land through the taxing the normal return, the revenue loss from the introduction of an ACE could be funded by increases in taxes on these factors. In fact, as these factors carry more than the full burden of the company tax on the normal return, they would still be better off.

Furthermore, the immediate revenue impact of moving to an ACE-based system can be mitigated by only providing the allowance for new equity. That is, by setting the initial equity base for which the allowance is calculated to zero. This approach maximises the boost to equity financed investment for each dollar of revenue forgone. However, setting up an ACE-based system in this

[5] Unlike a conventional company income tax system, under the ACE there is no distortion from accelerated depreciation. Any mis-measurement of profit is offset by a corresponding change in future allowances.

way may require complex anti avoidance provisions to prevent entities from re-characterising existing equity as new equity.

6.5 More neutral treatment of savings income

The previous options to reforming the company income tax system would not however address all distortions to financial decisions. There are still considerable distortions at the personal level, particularly in relation to the taxation of capital gains and housing.

Sørensen and Johnson (2010), who consider options for the fundamental reform of Australia's capital tax system, recommend consideration be given to introducing an ACE at the corporate level combined with a broad based dual personal income tax.

Dual income taxes have been introduced in its purest form in the Nordic countries, and combine progressive taxation of labour income with a low flat uniform rate on capital income.

Sørensen (2009) outlines a number of reasons for adopting a dual income tax. A flat tax reduces lock-in effects of a realisation based capital gains tax system under progressive taxation, whereby taxpayers can be pushed into a higher tax bracket when large gains are realised. A flat tax on capital income eliminates tax arbitrage opportunities where individuals exploit differences in marginal tax rates.

A low rate dual income tax may also allow for the tax base to be expanded to include currently exempt or concessionally taxed activities. Where concessions cannot be removed, for example due to political concerns or administrative difficulties, a move towards a dual income tax would reduce the relative attractiveness of the activities outside the system.

Under the model proposed by Sørensen and Johnson, all savings income would be taxed at a low flat rate. Australia's dividend imputation system would be replaced with the ACE, providing double tax relief at the corporate level.[6]

By providing a more symmetric treatment of expenses (such as interest) and capital income would reduce, and possibly eliminate the current biases towards debt financing investments, and consequently the incentive for individuals to take on too much risk. Such arrangements would also reduce concerns that the current arrangements may in fact amplify the volatility of the housing market which could inturn add to macroeconomic instability.

Returns form listed shares, would be taxed under the dual income tax with capital gains taxed on a mark to market basis (eliminating the lock-in effect). Thus the normal return on equity, (which is exempt from tax under the ACE) would be taxed at the dual income tax rate, and any economic rents would be taxed twice once in the company and again under the dual income tax.

6.6 The taxation of housing

The dual income tax could also be applied to housing. Sørensen and Johnson, proposed using the risk free return method (RFRM). Under this method the returns from saving through investment property or owner occupation is deemed on the either the net value of the property or gross value with a deduction for interest expenses.

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[6] This would further reduce the revenue loss from the introduction of an ACE, and reduce the complexity of the tax system.

A deeming approach to taxing property could replace existing transaction based taxes on housing, improving how the tax system impacts on housing, particularly reducing the susceptibility of financial markets to housing lead shocks.

6.7 Improving loss utilisation

In an ideal world losses would be made fully refundable. However, full refundability opens the tax system to increased opportunities for tax evasion.

In Australia, there are a number of options that could be considered to improve loss utilisation, and to reduce distortions arising from the current arrangements which favour particular forms of risk taking.

Many countries currently have loss carry-back arrangements. Under loss carry back firms can offset current year losses against tax paid in a prior year. Loss-carry back, like full refundability but to a lesser extent, would act as a microeconomic stabiliser. While this would free up loss utilisation, on its own it may further distort risk towards larger ongoing firms and away from start-ups and entrepreneurs who are less likely to have paid tax in previous periods.

In response to the GFC a number of countries extended (or introduced) losscarry-back provisions, including the United Kingdom and the United States.

Another option could be to allow losses to be carried forward with interest. This would ensure losses maintain their real value and if combined with a relaxation of utilisation rules would have a similar impact to full refundability. This option would however have a significant cost to revenue, and if the current income tax system is maintained, would increase the debt bias, as the present value of losses arising from interest deductions would be preserved.

7 Conclusion

While tax policies did not cause the global financial crisis they are likely to have at least contributed to key vulnerabilities in financial systems. Introducing new taxes on the financial system appears to some to be one of the main means for addressing financial market instability. This is even more incongruous when one looks at the existing tax biases that distort the allocation of risk and increase the complexity of the financial system. Rather than the “new”, there appears significantly greater chance of success from attempting reforms to the “old”.

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COMMENTS ON SESSION 2
FISCAL IMPULSE

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In this session on Fiscal Impulse it is my task to discuss the two papers "Fiscal Policy and Macroeconomic Stability: New Evidence and Policy Implications", written by Xavier Debrun and Radhicka Kapoor, and "Fiscal Stabilisation Plans and the Outlook for the World Economy" by Patrick van Brusselen. Before I comment on the two papers, I will make three short remarks. A first remark on the definition of fiscal impulse, a second on the fundamental macroeconomic modelling the analyses in the two papers build on, and a last remark on the data used in the two papers.

Definition of fiscal impulse and fiscal impact

What is the definition of *fiscal impulse* and how do we distinguish between *fiscal impulse* and *fiscal impact* (*effects of fiscal policies)*? In the organisations *Interim Economic Outlook in* March 2009, the OECD made an attempt to measure the fiscal impulses member state governments implemented following in the wake of the economic and financial crises. The OECD, in their analyses used a "down-up" approach. The method was to add policy initiatives on the expenditure and income sides of the budgets, that governments put in place to hamper the effects of the crises on growth and employment. However, these measures of fiscal impulse was also open to some criticism. It was not in all cases obvious which policy initiatives that should be included. For instance, policy initiatives that was taken before the crises, for instance in budget proposals early in the autumn 2008, and which had positive effects on growth and employment during 1009 and 2010, should they be included? This became a matter of choice. An alternative way to measure fiscal impulse could be to use a "top-down" method by measuring the effect on structural budget balances of single fiscal instruments or packages.

The *impact* or *effect* of fiscal policies, on the other hand, are the effects a certain fiscal impulse has on GDP or other macroeconomic variables. Such effects could be measured either by econometric methods or by using macroeconomic simulation models. As I see it, the two papers by Debrun and Kapoor and by Van Brusselen more analyse fiscal impact of fiscal policies than fiscal impulse.

Macroeconomic framework

Both papers lean on *best practices* concerning macroeconomic modelling, the *New Neoclassical Synthesis*. These models, for instance highly sophisticated Dynamic Stochastic General Equilibrium models, combine general equilibrium logics with Keynesian rigidities. An important feature is that market forces tend to move model economies towards equilibrium after shocks.

In the aftermath of the recent economic and financial crises these models have been put a bit in question, although, it must be admitted, so far no comprehensive alternatives has been developed. Leijonhufvud (2009)[1] discusses some of these problems and he proposes that "*Within some corridor around an equilibrium time-path, the usual adaptive market mechanism would*

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[1] Leijonhufvud, A. (2009), "Macroeconomics and the Crisis: A Personal Appraisal", CEPR, Policy Insight, No. 41.

operate to coordinate activities (Models building on New Neoclassical Synthesis are adequate to use (The author's remark)). But further away from equilibrium effective demand failures would impair the systems ability to restore to a coordinated state". An interpretation and "application" of such ideas could be that in the current crises situation non-linearities are prevailing and multiple-equilibriums could materialize that could be characterised by high unemployment equilibrium.

One such problem could be related to levels of public debts. Somewhere, there is a limit on how high debt levels could rise and still getting Keynesian effects from discretionary fiscal policy initiatives. Above a critical level, fiscal stimulus could have totally different effects compared to under that level, even effects with opposite sign. In such cases multipliers has turned non-linear.

Data from the great moderation period

Data used in Debrun and Kapoor's analysis, and which is lying behind parameters in Van Brusselen's model, origins partly from the time period of the "Great moderation". It is plausible that the very deep crises will change several economic relationship, also even after new equilibrium-paths have emerged. Increased capital-costs because of on average higher risk premia and long-term interest rates could have such effects. Labour market relationships such as the Okun's law are other candidates for changes. This would also in the end influence effects of fiscal policy. It would be reasonable to be cautious in using estimates of automatic stabilisers and multipliers from earlier periods – but we have no choice. Both Debrun and Kapoor and Van Brusselen are aware of these uncertainties.

Comments on "Fiscal Policy and Macroeconomic Stability: New Evidence and Policy Implications" by Xavier Debrun and Radhicka Kapoor

Having the reservations stated above in mind, it must be underlined that the paper by Debrun and Kapoor is a very competent peace of work. They analyse the empirical link between fiscal policy and macroeconomic volatility. The relationship is complex, especially related to the size of governments, the degree of development of economies and the maturity of financial markets in single economies.

The results are interesting. Debrun and Kapoor find that automatic stabilisers contributes to stability in all types of economies, but stronger so in OECD countries than in non-OECD countries. In earlier empirical work in this area this was not the result for developing countries. Credible monetary policy, and in what extent consumers have access to credit, seem to contribute to stability, according to the results. However, fiscal activism that is not related to the cycle induce cyclical volatility. Improved maturity of financial markets seems to have foster stability, especially concerning consumption.

On the issue of fiscal activism not related to the cycle it would have been interesting if some examples had been discussed. Could that result for instance refer to structural reforms that were not well timed related to the cycle? Another possibility could be policies related to the political cycle. A third possible example are initiatives implemented on the bases of forecast errors.

An interesting result is also that well formulated monetary policy frameworks are stabilising. Such frameworks are in Debrun and Kapoor's empirical analyses approximated by an index of central bank independence.

The result concerning the degree of maturity of financial markets and stability, is of course partly dependant on data from "the Great moderation" period. If this empirical analyses will be

updated in a few years from now, and with data also including the crises period after 2007, I am not so sure this result will prevail.

A possible extension of the analyses would be to test if the introduction of fiscal frameworks and independent fiscal institutions could have had stabilizing effects on economies. These types of frameworks and institutions have been more and more prevalent over the last decade. I believe it would also in the case of fiscal frameworks be possible to construct indices that could be used in the type of econometric analyses Debrun and Kapoor carries out. In construction of such indices there are of course pit falls. For instance, labelling a policy rule "expenditure cap" could have very different interpretations in different countries. Such rules could be tough or soft and of different time spans. The same goes for independent institutions for surveillance of fiscal policy. They are in different countries very different "animals".

A very interesting result is that fiscal impulses, not systematically meant to stabilise output, undermine the benefits of central bank independence. My interpretation of this result is that it is important that fiscal policy, at least in "normal" times, paves the way for monetary policy by keeping fiscal policies prudent. This "policy mix" gives the best effect on stabilisation. I fully support Debrun and Kapoor's conclusion that "*one practical way to do so is subject budget preparation to quantitative objectives or even binding constraints defined in terms of structural balance or expenditure ceilings*." The successful handling of stabilisation policies in Sweden, before and during the current crises, builds on a rather strict fiscal framework.[2]

Comments on "Fiscal Stabilisation Plans and the Outlook for the World Economy" by Patrick Van Brusselen

It his paper Van Brusselen takes a broad grip on the issue of the impact of fiscal stabilisation plans in the crises and longer run prospects of the major economies in the world. The paper starts with a competent discussion of elements underlying the concept of fiscal multipliers. Based in conventional macro theory, the size of multipliers also in extreme situations such as when credit crunch is prevailing (liquidity trap-situations), are discussed. Van Brusselen's first conclusion, drawing on his studies of the literature, is that both monetary and fiscal policies have roles to play and that fiscal policies are more potent in "liquidity trap situations". The task for monetary policy in such situations is to support expectations of positive inflation. His fear is that the US, the UK and the Euro area are all rapidly moving into zero interest rate and, possibly, deflation territory (page 262).

A reference to the failure of fiscal policy in Japan aimed at drawing Japan out of stagnation, should, in my view be a bit qualified. The Japanese stimulative fiscal policies in the 1990s could have been less well targeted. Well targeted public investments and tax reforms could have shown to have been more effective.

On optimal designs of fiscal stabilisation programmes Van Brusselen states that in situations of deep crises, fiscal policies has a role to play to prop up demand. The famous three Ts are the principles to obey to in such cases. Two comments: To begin with, it seems that most governments introduced fiscal stimulus in a timely fashion in 2008/2009, but when it now comes to exit from the stimulus uncertainties make timing and sequencing problematic. Secondly, in many stimulus packages there are elements of permanent measure. This goes especially for tax cuts, which could

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[2] For description and discussion of the Swedish fiscal framework, see Hansson-Brusewitz, U. and Y. Lindh (2005), "Expenditure Ceilings and Fiscal Policy – Swedish Experiences", in *Public Expenditure*, proceedings of the 7th Banca d'Italia's workshop on Public Finances, and Lindh, Y. and G. Ljungman (2007), "Fiscal Rules and Scope for Stabilisation Policy – The Case of Sweden", in *Fiscal Policy: Current Issues and Challenges*, proceedings of the 9th Banca d'Italia's workshop on Public Finances.

be expected to have more of longer term efficiency gains compared to temporary stimulation effects. In the aftermath of the crises it will be interesting to see research on the effects of such measures. Could such measures for instance improve growth rates in the up-turn after the crises?

Van Brusselen's conclusion in this part of the paper is that fiscal packages should be tailored to individual countries depending for instance on conditions such as openness of economies and of initial government debt levels. Such conditions give different room for manoeuvre for governments. This conclusion could only be supported, but it should be added that some coordination in time between countries policies could strengthening the impact of the packages. It must also be added that in some really severe cases, governments must stick to tough, transparent convergence plans, even if basic conditions change. Such examples are Sweden in the 1990s and Greece today.

On the evaluation of the sizes of fiscal multipliers Van Brusselen carries out a very comprehensive overview. He reports on attempts both with what he calls "the narrative record evaluation" which I interpret as "down-up" methods where discretionary and automatic measures are aggregated separately and than together. Other methods are estimations of VAR-models and lastly, simulations by using macroeconomic models and especially DSGE and other general equilibrium models.

In a large part of the paper Van Brusselen reports simulation results carried out with the NIME model, a world model grounded in the "New Neoclassical Synthesis". By using this model Van Brusselen evaluates the size of multipliers in the euro area, effects of fiscal plans in the euro area and in the US and presents macro economic projections for the major world economies up to 2018. This is an impressive peace of work.

However, although the NIME-model is presented in detail in earlier documentations, as a reader I would have appreciated some more of technical descriptions of the model also in this paper, for instance in a technical appendix. That could have made the interpretation of the results a bit easer for the reader. For the analyses of effects of fiscal policies it is important how a model handles variables and relationships such as monetary policy targets and reaction functions, exchange rate/trade elasticities, liquidity constraints, production functions and formation of expectations. These matters are not much discussed in the paper.

Van Brusselen uses the NIME-model for simulations of the effects of the stimulation packages in the Euro area and in the US for the short and medium terms (up to 2015). The results are interesting, In the euro area, there is a positive effect on GDP, compared to a base line scenario, although this effect fades away after some years. Employment, however, decreases somewhat towards the end of the period, which seems to more or less counteract the positive effects in the first years. The fiscal position deteriorates compared to baseline and so does current account. In my view these are reasonable results and points to the need to rise potential output growth in Europe by structural reforms.

For the US, the policy package induce a more negative effect compared to base line than the results for Euro area. However, budget deficits and current account develops closer to base line. In a comparison it is shown that the NIME model gives a somewhat more negative growth path than that projected by the CBO in the US. As Van Brusselen points out, this shows that there are great uncertainty about the results. Not least the different measures of multipliers that are used.

In simulations for the longer term (up to 2018) Van Brusselen finds that the Euro area's growth prospects are bleak (approximately 1 percent per annum), inflation will be positive but low (1 per cent) and public debt will reach almost 130 per cent of GDP. For the US growth prospects are better (approximately 2 per cent), but this is lower than in resent history. The most striking result is the very low inflation in the US, almost close to zero. This seems to be an affect of

increased unemployment, and fall in real private take-home wage. At the same time public debt is projected to reach over 140 per cent of GDP in 2018, but the current account deficit shows a stable path. Policies to avoid these development are of course necessary in both the Euro area and in the US.

In the end of the paper Van Brusselen discusses in an interesting way a range of uncertainties around his results. Uncertainties are related to the timing of exit strategies, to adjustments of balance sheets of banks, households and firms and to possible protectionism. Uncertainties are also related to which economy will be the growth engine of the world economy in the coming years and related to that, to demand policies in the large economies, also to the development of international coordination, to the effects implementation of stricter financial regulations and not least to the development of future potential output in our economies. It is difficult not to support the author on all these uncertainties and also that we are living in a very uncertain phase of economic development of the world economy.

COMMENTS ON SESSION 2
FISCAL IMPULSE

Daniela Monacelli[*]

1 The assessment of fiscal impulse in the recent crisis scenario: A comment

The current debate about discretionary fiscal policy was somewhat stimulated by the fiscal action policy makers put in place to support economic activity during the recent crisis. Action came before theory. *The Economist* describes this situation bluntly: "*It is the biggest peacetime fiscal expansion in history. Across the globe countries have countered the recession by cutting taxes and by boosting government spending. The G20 group of economies ... have introduced stimulus packages worth an average of 2 per cent of GDP this year and 1.6 per cent of GDP in 2010. Coordinated action on this scale might suggest a consensus about the effects of fiscal stimulus.* ***But economists are in fact deeply divided about how well, or indeed whether, such stimulus works***".[1] The last sentence sounds like a slap in the face of the economists for having been unable to get a sense of the policies needed to counteract crisis and for leaving policy makers to play it by ear.

After a dominance of policy advice based on models featuring frictionless markets and inter-temporally optimizing forward-looking agents (where any expenditure expansion would eventually give rise to increases in taxes and therefore to negative wealth effects and decreasing private consumption), to the external observers the revival of fiscal multipliers may actually look like a paramount switch in the profession's perspective or a nostalgic comeback of old-fashioned views.

Past wisdom inherited from the'80s fixed the focus on "normal" and "peacetime" concerns about real business cycle and definitely established the failure of discretionary fiscal policy for stabilisation purposes (due to implementation lags, small multipliers' size, etc.). Policy makers were even warned against possible destabilising pro-cyclical effects from its misuse. The widespread scepticism on the ability of fiscal policy to work as a stabilisation instrument emphasized the role of automatic stabilisers and shifted the focus on long term budgetary outlook.[2] This view has not changed, basically: at the beginning of the recession, when the issue of discretionary fiscal policy re-emerged in the debate, the old concerns were firmly restated: "*Fiscal stimulus is critical but could be counterproductive if it is not timely, targeted and temporary*" (Summers, 2007). The resort to fiscal policy was primarily envisaged as a consequence of the reduced efficacy of monetary policy in low interest conditions and in a liquidity trap situation.[3] What has changed in the meantime is the perception about the seriousness of economic context, particularly the depth and the duration of the crisis (Auerbach and Gale, 2009), and about the nature of the current recession, which – contrary to the previous crises of the '70s and the '90s that were supply side induced – is demand side driven (Röger and in 't Veld, 2009), Under these

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[*] Banca d'Italia.

The views expressed here are those of the author and do not necessarily reflect those of Banca d'Italia.

[1] From *The Economist* (2009a), our bold.

[2] See, for instance, Blanchard, Dell'Ariccia and Mauro (2010), pp. 5-6.

[3] "*If policymakers are able to act quickly and effectively, fiscal policy can work more rapidly than monetary policy, which has about a lag of a year between the change in the federal funds rate and its maximum impact. Moreover, the efficacy of monetary policy may well be diminished by capital constraints that limit the ability of banks to lend or by creditworthiness constraints that limit the ability of businesses to borrow. As important, the extent to which monetary policy can be prudently used in the current environment is limited by concerns about the dollar as well as about the bubble creating effects of very low interest rates. Finally certain problems – such as the impact of mass foreclosures on affected communities – are not easily amenable to monetary policy.*" (Summers, 2007).

circumstances a return to fiscal policy as a macroeconomic tool sounds somewhat less contradictory: *"some of the past problems in using fiscal policy to stimulate demand may be less an impediment in the current circumstances"* (Feldstein, 2009).

As a matter of fact, the disagreement among the economists "*about how well, or indeed whether*" fiscal stimulus may work is more a signal of the **difficulty in reconciling theoretical and empirical results consistently enough**. Such difficulties were already a concern of the economists before the crisis imposed the issue of sustaining the economic activity in the policy agenda, but they were still unsolved. The last wave of New Keynesian models may be interpreted precisely as an attempt to reconcile theoretical predictions with empirical analysis, by neutralising in macroeconomic models the negative response of private consumption to government expenditure shocks as a result of rational expectations and Ricardian behaviours inherited from the micro-foundations. The key mechanisms to this aim are found in real frictions and nominal rigidities, that allow real wages to increase, and devices to obstruct, someway, the working out of negative wealth-effect[4] (e.g., liquidity constraints that prevent at least some agents from optimising their consumption choices).

Some authors depict the current status of the art in macroeconomics as the result of a **philosophical divide between two opposite approaches**, more than a stage in the evolution of macroeconomics.[5] One is a "theory first"/Walrasian approach, which "*sees the macro economy as a system that we can best understand through the lens of formal micro-founded theory*" (Colander, 2009) and "*insists on a complete theoretical model of the phenomena of interest prior to data analyses*" (Campos, Eriksson and Hendry, 2005); it has recently flown into DSGE models. The other is a "reality-first"/VAR family approach, which "*sees the macro economy as more complex than that and does not see a rigid microeconomicly grounded theory as especially helpful in shedding light on most macroeconomic problems*"[6] since the economy is "*a complicated, dynamic, nonlinear, simultaneous, high dimensional, and evolving entity*" due to continuous changes in social systems, laws, technological innovation, etc.[7] The divide, in Colander opinion, opposes US and European schools, with the US "theory-first" approach prevailing, primarily due to a "publish or perish" selection mechanism in journals publication that encourages the profession to invest more in assumptions based modelling and less in complex and judgemental demanding data analysis.[8] One less extreme position could recognise that both approaches are needed and both can provide useful insights. The crucial point when tackling the crisis is that policy receipts may be extremely different. The recent debate about fiscal multipliers seems a long way from end.

Auerbach and Gale (2010) summarise the **evidence on the effects of discretionary fiscal policy on economic activity** considering all main approaches in the literature, from the micro evidence on individual agents behaviour (capturing only direct effects), to the macro evidence on overall economy (capturing both direct and indirect effects). On the macro side, the authors distinguish: the large-scale macroeconomic models, that track all the channels relating prices, quantities, and policy variables and are estimated by regression techniques; reduced form SVAR models, that directly relate changes in output to changes in policy variables and are estimated based on assumptions for the identification of fiscal policy shocks and their effects; dynamic general equilibrium models (like DSGE), with relative small number of equations, that are strictly grounded in microeconomic theory and are partly-estimated and partly-calibrated. Limitations of the three approaches are to be found respectively: in the Lucas critique applying to the estimated

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4 For instance, Hall (2009), par. 5.

5 As, for instance, Woodford (2009).

6 Colander (2009).

7 Campos, Eriksson and Hendry (2005).

8 Colander (2009), pp. 5-7.

parameters of macroeconometric models; in the possibility of SVAR to address policy effects only under the economic conditions prevailing within the sample and if complemented by a "narrative approach"; in the enormously wide spectrum of multipliers DSGE may provide depending on the modelling assumptions (Auerbach and Gale report values ranging from "*the essentially zero estimate provided by Cogan* et al. *(2009) to estimates in the range of 3 or 4 provided by Christiano* et al. *(2009)*"). From the analysis of case studies of previous crises (the US Great Depression and the Japanese Lost Decade) the authors conclude that sustained fiscal policy expansion was not attempted in either case and that was to some extent due to the predominance of concerns about the budget over concerns about the state of the economy.

The debate has therefore shifted on the size of fiscal multipliers. Multipliers size vary with: *non-fiscal factors* like the size, the structure, the frictions, the openness, and the state of the economy, the interactions of fiscal policy with other policies; *fiscal factors* like, the different channels chosen to inject the fiscal stimulus, the fiscal institutional framework affecting the implementation of the policy, the permanent or temporary nature of the fiscal stimulus, the framing/packaging of interventions (via announcement effects, transparency, etc.); households and firms *behavioural assumptions and potential nominal and real rigidities* in the models that are used to estimate the multipliers (reflecting different micro-foundation).[9] As to the last point, it matters in particular whether agents formulate forward or backward-looking expectations, are Ricardian or non-Ricardian, are subject to constraints on liquidity, borrowing, cash flow, (Galí, López-Salido and Vallés, 2004, 2007; Coenen and Straub, 2005). The size of multipliers also reflects the "*fiscal space*" allowed for more aggressive response by policy makers (Blanchard, Dell'Ariccia and Mauro, 2010) and may be dictated by debt and fiscal sustainability conditions (Corsetti, Meier and Muller, 2010). Another factor that recently attracted the attention of the economists, in the light of the coordinated fiscal expansion strategy undertaken by policy makers, is the magnitude of cross-border fiscal policy spillovers due to changes induced by fiscal shocks in imports, exports, exchange rates and interest rates. These channels act both in positive and in negative ways on the multipliers, and the assessment of the net effect varies according to the modelling of domestic and foreign economies and the underlying assumptions (Cwik and Wieland, 2009; Corsetti, Meier and Muller, 2010).

As Blanchard *et al.* (2010) argue, **there is a lot we still need to learn about multipliers**.[10] However, Spilimbergo, Symanski and Schindler (2009) in the IMF Staff Position Note that gives background information to policy makers on fiscal multipliers, correctly stress that the fiscal multipliers available for some countries "*should be carefully re-examined in the light of current events*", but they also advice against reestimating their size in the present situation since structural parameters have changed, violating one of the crucial estimating assumptions. They conclude that "*past research on multiplier estimates ... can provide guidance in developing multiplier estimates, but judgement, based on current conditions, is important*", someway validating the detachment between economists and policy makers in the current situation.

One relevant issue in this debate concerns the **size of fiscal multiplier under zero interest or liquidity trap conditions**. It probably deserve some more attention. The debate on this topic in the economic literature has revived after the Japanese experience of the Nineties and the US experience in the recent financial crisis. However, "*much of this debate was, explicitly or implicitly, within the context of old-fashioned Keynesian models or the frictionless neoclassical growth*

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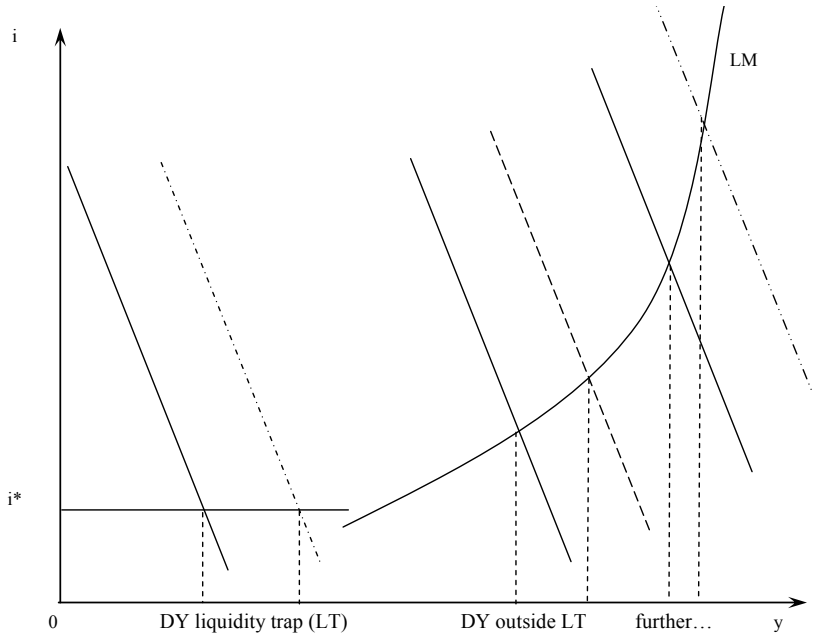
[9] See, for instance, Hall (2009).

[10] " *… the wide variety of approaches in terms of measures undertaken has made it clear that there is a lot we do not know about the effects of fiscal policy, about the optimal composition of fiscal packages, about the use of spending increases versus tax decreases, and the factors that underlie the sustainability of public debts, topics that have been less active areas for research before the crisis*" (Blanchard, Dell'Ariccia and Mauro, 2010, p. 9).

model" (Eggertsson, 2010). The basic idea does not seem to have significantly moved away from Keynes suggestions that fiscal multipliers were likely to be much larger during severe downturns than in normal times (Keynes, 1936). In a simple IS-LM framework, a demand equilibrium occurring in the horizontal (liquidity trap) segment of LM curve implies null effectiveness for monetary policy and maximum effectiveness for fiscal policy and the same shift in the IS curve is associated with decreasing changes in output (Figure 1). The supply side is affected by the choice of fiscal instrument insofar as taxation may interfere with price formation mechanisms, and possibly with expectations.

Figure 1

Liquidity Trap: A Simple IS-LM Representation



Eggertsson observes that "*the principal goal of a policy at zero interest rates should not be to increase aggregate supply by manipulating aggregate supply incentives. Instead, … should be to increase aggregate demand – the overall level of spending in the economy. … At zero interest rates, output is demand-determined. … policy should not be aimed at increasing the supply of goods when the problem is that there are not enough buyers*". A receipt that closely resembles the Keynesian arguments against Say's Law and the explanation of the Paradox of Drift.

However, the use of new Keynesian DSGE models may significantly add to our knowledge of the effects of the specific fiscal instruments. For instance, Eggertsson finds that tax cut are effective only in case of temporary reductions of sales taxes and investment tax credit, whereas cutting taxes on labor or capital may prove to be contractionary. As he argues: "*policies aimed at increasing aggregate supply are counterproductive because they can create deflationary expectations at zero interest rates"*. Erceg and Lindé (2009) find results that "*suggest a somewhat nuanced view of the role of fiscal policy in a liquidity trap*". In studying the effects of expanding government spending in a liquidity trap environment they conclude that by allowing an endogenous duration of the liquidity trap, fiscal multipliers depend on the scale of the fiscal expansion: "*For an economy facing a protracted recession and for which monetary policy seems likely to be constrained by zero bound for a very prolonged period … there is a strong argument for increasing government spending on a temporary basis. … for shorter-lived liquidity traps … the multiplier is larger than under "normal conditions" for small increases in spending, but drops relatively quickly at higher spending levels.. Thus, larger spending programs may suffer from sharply diminishing returns, and may boost government debt significantly*". As for the state of the art of macroeconomics, pictures are not as clear-cut as policy makers would probably like…

Under these circumstances a warning may be particularly useful: "*Convenience, not conviction, often dictates the choices economists make. Convenience, however, is addictive. Economists can become seduced by their models, fooling themselves that what the model leaves out does not matter. ...*".[11]

2 Comment on the papers

The papers presented in Session 2 give a broad overview of state of the art as reported above. They provide us with an interesting insight about the difficulties policy maker must confront in these days when approaching the use of macroeconomics to look for policy guidance. The three papers by Kaniovski and Schratzenstaller, Valli Jorge and De Carvalho, and Röger and in 't Veld differ in many respects (Table 1): the first one uses a medium scale macroeconometric model, while the others use DSGE models; it also simulates the effects of policy packages actually implemented by Austria and its main commercial partners *vis-à-vis* the current crises, while the other two present predictions from different fiscal instruments changes, subject to specific fiscal rules.

All of them, however, try to contextualise their own findings in the present crisis scenario: they address common issues like the role of spill-over effects from cross-border flows (in the light of the significant role policy makers attached to fiscal policy coordination in the international agenda) and the need to take on board somehow the peculiar conditions of the monetary and financial markets in the aftermath of the financial crises.

The **Kaniovski and Schratzenstaller** paper is a typical example of macro model simulation. Results from Macromod (the macroeconomic model of the Austrian economy developed at WIFO) are supplemented by the spillover effects from Austria's ten most important trading partners on the Austrian economy, that are estimated by OEF (the Oxford World Macroeconomic Model). The two models are linked so that simulations can take into account both of changes in terms of trade, interest rates and the Euro/US Dollar exchange rate from the OEF World model and of the much more detailed description of the institutional features of the Austrian economy from the domestic WIFO model.

The richness of details about domestic economy is a classical advantage of macroeconometric models and represents the real value added in using this tool for assessing the impact of fiscal policy. Some more description by the authors of the working through of the macro model would therefore be appreciated (possibly in an appendix). Fiscal multipliers reported in the paper are in line with other macro models: for government expenditure are above 1, while for the personal income are around half percentage point ("slightly below"). Inclusion of the economy openness is the main addition.

The spillover effects from the additional stimulus by foreign fiscal packages is estimated to produce an extra gain in real GDP of almost one percentage point from the baseline scenario. In a more detailed description of WIFO model, it would be interesting to understand how spillover work through the single channels, considered in both directions separately, in order to assess whether the policy mix adopted by the states could have been enhanced by a different composition of the packages. In Kaniovski-Schratzenstaller paper the role of the crisis in affecting fiscal policy effectiveness is simply mentioned as a background issue. It is not clear, however, whether such an issue is taken care of, and how, in the simulation (what is happening to interest rates? Are they set fixed, or shocked or what else?).

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[11] *The Economist* (2009b).

Table 1

Kaniovski and Schratzenstaller, Valli Jorge and De Carvalho, Röger and in 't Veld Compared

Comparison complex. Papers use:	**Röger and in't Veld**	**Valli Jorge and De Carvalho**	**Kaniovski and Schratzenstaller**
different models …	NK, DSGE: Estimated; Multi Country	NK, DSGE: Calibrated; Two Country	Macro model: Estimated; (Exogenously) Multi Country
with different assumptions about fiscal stimulus …	Fiscal Policy reaction function	Fiscal Policy reaction function	Discretionary manouvre simulated
under different complementary policies …	Taylor Monetary Policy Rule	Forward looking Taylor Monetary Policy rule	Short and long term interest rates exogenous
different exercises …			
Consumption Behaviour			
Household heterogeneity	**Three Households types (with ≠ reactions)**	**Two Households types (with ≠ characteristics)**	**No household heterogeneity**
(expectations, constraints, etc.)	Ricardian (RIC) have RE (counter-react to policy)	Ricardian (RIC) have RE with some habit persistence; **also** high skilled in labour mkt	No forward looking expectations (apparently)
	Credit constrained (CC) are RIC + Credit Constraint (optimise but under additional constraint)		
	Liquidity constrained (LC) followpure Rule of Thumb (RoT) (do not optimise just consume)	Liquidity constrained (LC) optimise but cannot access complete financial markets; **also** low skilled in labour mkt	No micro foundation
	Share of each group crucial for multipliers size RIC lowest multiplier; CC higher; LC highest	**Share of each group crucial for multipliers size** RIC earn more for same hours; LC earn less for same hours	
Policy			
Fiscal policy feeds private economy:	directly on *RIC* ← *B, tc, tw, tk, Tls,* ***itc*** *, TR* indirectly on *RIC* ← *CG, IG* (supplied by *FF*) directly on *CC* ← *–B, tc, tw, tk, Tls, itc, TR* directly on *LC* (*RoT*) ← *tc, tw, Tls, TR* directly on *Ffinterm* , *G* ← *KG* (externality)	directly on *RIC* ← *B, tc, tw, tN, tk, tD, Tls, TR* * directly on *LC* ← *tc, tw, tN, Tls, TR* * directly on *FF* (intermediate) ← *KG* (**input** together with K_{PR}) affect output (not only via externality) realistic role for public investment indirectly on *FF* (intermediate) ← *TR, tw* (via *vω* , *i.e.* bias in favour of Skilled *L*)	Demand side channels: On the revenue side: personal taxes, business taxes, consumption taxes, social security contributions and a residual category of other revenues. Expenditure traeted only as one category
Fiscal policy instruments:	Taxes (except *tw*), Investment subsidies (≠ from Govt. investment) Govt. investment → *KG* (generate externalities)	*TR* biased towards constrained *HH* *IG* responds to *I* * *CG* endogenously derived	Actual Govt anti crisis package simulated
Fiscal rule:	t_w responds to debt target *b* *; on all *HH* (no ≠ labour types across *RIC, CC, LC*)	*SP* responds to *B* and output growth deviations from *SS* *(counter-cyclical)*	No fiscal rule mentioned
Spill-over (Cross-border)			
Openess modelling	**6-region version of the model** bilateral calibration of trade flows open economies (trade channel) exchange rates (Euro Area vs. others) symmetrical behaviour of the two sub-regions	**2-country model** Brazil vs. RoW (US+EA) Same structural model but different calibrated parameters Symmetric except for policy rules. RoW: Fiscal policy → *CG* , *TR* tools; t_{LS} adjust to *B* *)	**Multi-countries model** exogenous embed in domestic model no interaction involved (small economy hypothesis) 10 main commercial partners simulate their own packages

The **Valli Jorge and De Carvalho** paper gives an example of policy analysis based on DSGE micro-founded theoretical approach. Their model is very rich, therefore results are complex to interpret and are very restricted by inevitable model-depending. Fiscal policy modelling is particularly articulated. The set of fiscal channels affecting the economy includes several tax instruments (τ^c, τ^N, τ^{W_h}, τ^{W_f}, τ^K, and τ^D, *i.e.* rates of taxes levied on consumption, labour income, social security from workers *h*, social security from firms *f*, capital and dividends, and expenditure from Government consumption *G*, transfers *TR*, and investment I_G).

The authors attribute an interesting role to government capital K_G. It directly enters the intermediate good production function as an input with a weight ω_g in the technology, that is interpreted as an indicator of the economy's degree of dependence on government investment, possibly a relevant policy variable. Fiscal authorities follow a primary surplus rule reacting to deviations of public debt and economic activity from their steady state levels and Government consumption is endogenously determined by this rule.

The model embed standard new Keynesian hypothesis of heterogeneous households, distinguished between Ricardian households (RIC, optimising consumption and investing) and Rule of Thumb households (RoT, who only consume all their disposable income and therefore feature higher multipliers). The novelty is in overlapping this consumption heterogeneity with an analogous heterogeneity in labour supply quality: RoT household consume more out of an increase in their wage, but are also less skilled and are paid less for the same amount of worked hours. Interestingly, these features also interact with the use of government transfers as policy instruments for distributional goals, which advantages less skilled workers. The interaction of these assumptions is complex to follow and to assess on qualitative grounds. It would be interesting to disentangle the impact of each channel on the multiplier and explain whether this interaction ends up by increasing or decreasing the size of fiscal multipliers and under what conditions. It could well be the case that the distributional policy play some relevant role.

It seems from the authors discussion that the constrained fiscal framework reduces the impact of the fiscal instruments (government expenditure on investment and transfers), by the implied adjustment of government consumption to raise primary surplus *vis-à-vis* increases in public debt. If this is so, it is not clear why tax rates are not considered as potential endogenous instrument to be adjusted by the primary surplus rule, as well, or whether there is any reason for this choice other than modelling convenience. Another possibility offered by the richness of the fiscal side of the model could be the use of the degree of dependence from government capital as a policy target to be pursued by the public investment policy. By setting investment in order to fulfil a steady state government capital level that corresponds to a desired degree of dependency, policy makers may decide how much private sector may rely on the public sustain. This seems to be a relevant issue for the Brasilian economy, as it can be inferred by some statement in the paper, and could possibly deserve some thought by the authors.

Much attention is given in the paper to the interactions between fiscal and monetary regimes. Maybe some consideration could be added in order to place the current crisis scenario inside the description of the alternative monetary policy rules.

The **Röger and in 't Veld** paper get on board all the three issues addressed in recent literature: the assessment of different fiscal multipliers, the spillovers from cross-border interactions, the impact of the crisis on fiscal policy effectiveness. They use a 6-region version of Röger and in 't Veld (2009) DSGE model.

The most relevant feature of their model is definitely the household heterogeneity assumption: on top of the usual Ricardian (RIC, with the lowest multiplier) and liquidity constrained (RoT) household type (with the highest), the authors consider a third type represented by credit-constrained households (CC). CC households consume and invest in housing capital; they

optimise as the RIC households, but under an additional constraint due to the collateral requirement on borrowing. The consumption rule of CC households is characterised by a higher sensitivity to interest rate. This is captured by a parameter in the Langrangian multiplier representing the premium on interest rate, related to the degree of tightness from the collateral constraint. The potential effect of this extra constraint on the size of the multipliers is not immediately clear. It presumably depends on the different types of fiscal stimuli an don the way through which they influence the credit conditions and the interest rate. CC multiplier is likely to be higher than Ricardian households' whenever the fiscal impulse may actually generate an extra effect on CC consumption from the loosening of the credit constraint. The authors also assume a higher rate of time preference for CC than for RIC households, *i.e.* more impatience, which presumably helps in raising the consumption multiplier of the overall economy even more. This assumption is not directly related to the credit constraint, but is presumably connected. Some more elaboration on this may help. The relative shares of the different heterogeneous household types, which are crucial variables for the size of multipliers, are calibrated.

Röger and in 't Veld explicitly simulate a crisis scenario by a combination of domestic shocks to the optimality conditions of investment and housing capital through the relevant parameters (for instance in the arbitrage conditions). The set up of the exercise does not involve the share of CC households, which is kept constant; this amounts to distribute the crunch, so to speak, across the same households. One can argue that the simulated scenario would probably ask for a rise in the CC share and that this would presumably produce different results. A higher share of CC households in a crisis scenario would anyway affect the impact of fiscal policy to counteract the downturn, its desired composition, the mix in terms of temporary and permanent measures. Although complex, and probably irrelevant for the equilibrium of the model, the introduction of some link between the share of CC households and the monetary/credit conditions would probably be ppropriate in case one wants to use the model to study the behaviour of the economy in extreme crisis scenarios like the present ones.

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COMMENTS ON SESSION 2
FISCAL IMPULSE

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These three papers make interesting contributions to the discussion of fiscal policy. The papers by Baldacci *et al.* and Afonso *et al.* explore the important topic of whether fiscal policy can be effective in the wake of a financial crisis. The paper by McDonald and Johnson has a somewhat different angle: it explores how tax policies may have contributed to the recent financial crisis and what policy changes could be made to limit this effect.

Comments on "Getting It Right: How Fiscal Response Can Shorten Crisis Length and Raise Growth" by Emanuele Baldacci, Sanjeev Gupta and Carlos Mulas-Granados

This paper examines historical data to determine what type of fiscal stimuli work best in the context of a banking crisis. The authors find that fiscal expansions are a decisive factor in reducing the duration of banking crises. However, they note that different fiscal stimuli have different effects and that there is a trade-off between short-term and medium term objectives. To spur recovery in the short-term, the fiscal stimuli need to be of the sort that can be implemented rapidly. In this regard, tax cuts, particularly consumption tax cuts, as well as government consumption are found to work best. However, some of these instruments are not as effective in contributing to long-term growth. For instance, spending on infrastructure and other capital, which given the lead time for implementation, doesn't have much of an impact on shortening a crisis but was particularly effective in contributing to long-term growth.

The authors also demonstrated empirically that having a sound fiscal position before the crisis hits is important since it provides governments with the flexibility to use fiscal policy to mitigate the effects of a banking crisis. Indeed, the authors find that high-debt, low-income countries have a harder time recovering from the crisis since their ability to resort to fiscal policy is limited.

This paper makes an interesting contribution in exploring the choice of fiscal stimuli to combat the effects of a financial crisis. An interesting extension of this analysis would be to examine the choice of fiscal measures and their effect on long term fiscal sustainability. In this context, time-limited spending may have an advantage over tax cuts, which tend to be more permanent.

Comments on "Fiscal Policy and Growth: Do Financial Crises Make a Difference?", by António Afonso, Hans Peter Grüner and Christina Kolerus

The paper by Afonso *et al.* empirically explores the question of whether fiscal policy works differently in a financial crisis versus a "regular" recession. The authors find that there is no statistical effect to show that fiscal policy is any more effective in a financial crisis than during a non-financial one. Indeed, they find that fiscal multipliers are relatively small.

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The views expressed here are those of the author and do not necessarily reflect those of the Department of Finance, Canada.

While this paper addresses an important question, it is limited by the fact that it does not control for the monetary policy stance at the time of the crisis (indeed, it may not be possible due to data limitations). A key aspect of the current crisis was that monetary policymakers were quickly running out of tools – what we now refer to as the "zero lower bound". Indeed, another paper presented in this session by Röger and Jan in 't Veld suggests that fiscal multipliers are in fact larger during financial crises.

Comments on "Tax Policies to Improve the Stability of Financial Markets" by Jason McDonald and Shane Johnson

The paper by McDonald and Johnson explores how long-standing tax policies common to many countries could have been a factor in the latest financial crisis. These policies include interest deductibility, which leads to a bias towards debt financing, and the preferential treatment of owner-occupied housing, which creates an incentive for individuals to invest in housing versus other investment vehicles. The authors provide a good qualitative summary of the relevant policy issues, and in the last part of the paper, propose some possible reforms. Such reforms may be difficult to achieve, given that they often involve transitional costs or the loss of preferences by certain groups of taxpayers.

The draft of the paper presented at the conference included a middle section discussing financial transaction taxes and their ability to reduce systemic risk, recover the costs of government assistance provided after the collapse of financial firms, and tax economic rents in the financial sector. Given recent proposals concerning the taxation of financial institutions, this discussion is quite timely. The authors provide a good discussion of the issues involved and conclude that proposals to tax financial transactions pose a number of challenges. In particular, some taxes may not achieve their desired outcome.

This paper provides a very good review of tax policies and a reminder of how these rather microeconomic policy instruments can have profound macroeconomic effects. My one comment on this paper this that middle section on financial transaction taxes, while useful, seems out of place with the rest of the paper. Consideration should be given to turning this section into a separate paper or finding a way to better integrate this section into the rest of the paper.