Comparing fiscal multipliers across models and countries in Europe

Working Paper Research

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Abstract

This paper employs fifteen dynamic macroeconomic models maintained within the European System of Central Banks to assess the size of fiscal multipliers in European countries. Using a set of common simulations, we consider transitory and permanent shocks to government expenditures and different taxes. We investigate how the baseline multipliers change when monetary policy is transitorily constrained by the zero nominal interest rate bound, certain crisis-related structural features of the economy such as the share of liquidity-constrained households change, and the endogenous fiscal rule that ensures fiscal sustainability in the long run is specified in terms of labour income taxes instead of lump-sum taxes.

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I. Introduction

Fiscal multipliers vary in many dimensions, as highlighted by the recent academic literature. The disagreement over the size of fiscal multipliers over the last years has not yet been resolved despite voluminous empirical and theoretical analyses of the issue.

This article provides a quantitative assessment of the key factors that determine the GDP effects associated with the use of alternative fiscal instruments. We employ structural macroeconomic models maintained within the European System of Central Banks (ESCB) to document by means of simulations how multipliers depend on the fiscal instruments, the zero lower bound (ZLB) on the monetary policy rate, the duration of the fiscal shock and various country-specific features. In each of the simulated scenarios, we consider the short and – if applicable – the long-run effects of a discretionary change in a single fiscal policy instrument on real GDP. The change in the policy instrument amounts to 1% of baseline GDP and represents a tightening of the fiscal stance. Specifically, we consider a reduction in (unproductive) government consumption and increases in the households' labour income tax rate, the capital income tax rate and the consumption tax rate.

The multipliers are computed assuming that monetary policy is either determined by an endogenous Taylor-type nominal interest rate rule, or alternatively, that interest rates are fixed for a period of two years, which we take as mimicking a binding ZLB condition.

The key findings from our simulations can be summarized as follows. First, short-run multipliers are in general negative and smaller than one in absolute value. This result is quite robust with respect to the fiscal instrument, the considered country and the duration of the fiscal shock. Short-run tax (labour, consumption and capital) multipliers are typically smaller in absolute value than government consumption multipliers.

Second, imposing the ZLB to bind for two years does not greatly affect short-run multipliers associated with a temporary fiscal tightening of individual euro area countries. The reason is that the monetary policy rate stays essentially at

its baseline level even when the monetary authority is free to adjust it, reflecting the limited impact of a country-specific fiscal shock on the euro area economy. In contrast, the ZLB unfolds quite sizeable effects on the size of multipliers if the fiscal shocks are simultaneously implemented in the euro area as a whole. In particular, short-run government consumption multipliers become larger than one. The same holds true for non-euro area countries in which monetary policy is determined domestically.

Third, the short and the long-run effects of permanent fiscal shocks depend on the fiscal instrument that reacts endogenously to stabilise public debt in the long run. Long-run multipliers are in general negative when the budgetary room materialising after the fiscal tightening is used to reduce lump-sum taxes. Instead, long-run multipliers are typically positive if the households' labour income tax rate is reduced in the medium to long term. Since households anticipate these long-run GDP effects at the outset of the simulations, short-run multipliers tend to be more favourable if distortionary taxes are used to stabilise public debt.

Our paper is related to a small set of studies that examine the robustness of fiscal multiplier estimates across structural models. Cwik and Wieland (2011) use five macroeconomic models to estimate multipliers associated with the European Economic Recovery Plan and related national fiscal policy measures in the euro area. They focus on the announced government purchases component of the plan for 2009 and 2010. In the majority of models, private consumption and investment are crowded out by the rise in government spending unless the zero nominal interest rate bound is anticipated to be binding for at least two years. Unlike our paper, they do not consider tax policies. Coenen at al. (2012) employ seven dynamic stochastic general equilibrium models maintained by policymaking institutions to assess the GDP effects of discretionary fiscal stimulus shocks to seven different instruments. They find that fiscal stimulus is most effective if it is temporary and accompanied by an accommodative monetary policy stance. Unlike our paper, they do not focus on European countries. We should also emphasise that both studies investigate multipliers associated with expansionary fiscal

shocks whereas we consider fiscal retrenchments. The sign of the fiscal shocks matter in particular in those situations where the economy is at the zero lower bound.

More broadly, our paper is related to a large and growing set of studies that examine the size of fiscal multipliers within one or two macroeconomic models. Prominent recent examples include Cogan et al. (2010), Christiano et al. (2011), Eggertsson (2011) and Woodford (2011).

The remainder of the paper is structured as follows. Section II summarizes the models used in the simulation exercises. Section III describes the standardised simulations and presents the results. Section IV summarizes the results from the sensitivity analysis. Section V compares the model-based results with standard fiscal multiplier estimates from the empirical literature. Finally, Section VI concludes.

II. Model set-up

a. General features

We use fifteen models from National Central Banks (NCBs) and the ECB in the simulation exercises. Fourteen out of fifteen are New-Keynesian dynamic general equilibrium models, ten out of fifteen are calibrated. A complete list of the models is presented in Table A1 in the Appendix.

The majority of models from NCBs of the euro area are based on multi-country set-ups, namely those of Belgium, Estonia, France, Germany, Italy, Malta, Slovenia and Spain. These models exhibit a “home” country, the rest of the euro area (possibly subdivided) and in some cases the rest of the world. In these models the euro area monetary policy responds to economic fluctuations in the home country only proportionally to its weight in the monetary union.

A second set of models comprises small open economy set-ups, with an exogenous rest of the euro area and/or rest of the world: Czech Republic,

Finland, Greece, Netherlands, Portugal and Sweden. If the corresponding country is part of the euro area, monetary policy is assumed to be exogenous.

Finally, the ECB's New Area-Wide Model (NAWM) has also been used. It is a two-country model of the euro area and the United States. Monetary policy in both model blocks is characterized by standard nominal interest rate rules.

Responses to fiscal shocks can be influenced by the fiscal instrument that, through the fiscal rule, endogenously adjusts to stabilise public debt. In the vast majority of the models, this fiscal instrument reacts to deviations of the government debt-to-GDP ratio from the target, but in a few cases the fiscal instrument reacts also to deviations of the public deficit or public consumption from its long-run target. Typically, either the labour income tax or lump-sum transfers are used as fiscal instrument. In some of the simulations, the choice of the fiscal rule has been left at the discretion of each country modelers. However, whenever the fiscal rule becomes critical for the results, we harmonized the instrument that is specified by the rule across models.

b. Steady state values and calibration

Key parameters and their calibration are listed in Tables A2-A4 in the Appendix. The models differ in various aspects.

In terms of steady state values, the models differ significantly as regards the imports-to-GDP ratio, which to some extent measures the degree of openness of the economy. Lowest import penetration is found for Greece and largest for Estonia. The models differ also substantially in terms of how public expenditures are financed. As an example, in the German model the labour income tax revenues amount to 35% of GDP, while in Spain they account only for 7% of GDP. The steady state values of debt-to-GDP ratio vary from 0% to 120%. The models also vary by the degree of home bias in government consumption. Most of the models assume full home bias, as is typical in this type of set-ups, and only a few feature somewhat lower home bias of around 90%. Finally, the share of liquidity-constrained consumers, i.e. agents that

have at most limited ability to smooth consumption over time, varies between 0 to 40%.

Regarding the calibration of some key parameters, household preferences, investment (or capital) adjustment costs, price and wage stickiness (characterized by a Calvo parameter or, if the value is larger than 1, by a Rotemberg adjustment cost parameter) and the proportion of firms (workers) that index their price (wage) to inflation are quite different across models: The Frisch elasticity of labour supply varies from 0.50 to 11, wage indexation from 0 to 0.90, and investment adjustment costs from 0.20 to about 14.

All these differences can play an important role in explaining differences in fiscal multipliers across the models.

III. Simulation experiments and results

a. Definition of fiscal multipliers and simulated scenarios

In each of the simulation scenarios reported below, we consider the short and – if applicable – the long-run effects of a discretionary change in a single fiscal policy instrument on real GDP. The change in the policy instrument amounts to 1% of baseline (before shock) GDP and represents a tightening of the fiscal stance. Specifically, we consider a reduction in government consumption and increases in the labour income tax rate of households, the capital income tax rate and the consumption tax rate. Fiscal instruments other than the ones subject to discretionary change are held constant for the first two years.[1] Also the social security contributions are held unchanged in the simulations. In the medium to long run, either lump-sum or labour income taxes are allowed to

[1] In the case of the Swedish model, the fiscal rule is implicit: lump-sum transfers make sure that government expenditures and tax revenues are equal in every period. For the simulations carried out in this model, lump-sum transfers are thus allowed to adjust also in the short run.

adjust according to the country-specific fiscal rules to stabilise the public debt-to-GDP or deficit-to-GDP ratio at their target values. In the case of permanent fiscal shocks, the multipliers can be quite sensitive to the fiscal instrument that stabilises the debt or the deficit. Therefore, we conduct these simulations twice with each model, in one case imposing a lump-sum tax rule and in the other a households' labour income tax rule.[2]

Monetary policy is harmonized across models, assuming that the short-term nominal interest rate is determined by the Taylor rule used in Gomes et al. (2012), where the policy rate responds to euro area-wide inflation and output growth.[3] We also assess the role of the ZLB on the monetary policy rate for the fiscal multipliers, assuming that the Taylor rule is deactivated and the short-term nominal interest rate is held constant at its baseline level for 2 years.

All simulations are run under perfect foresight. Therefore, policies are fully anticipated by households and firms.

We first report GDP multipliers for transitory changes in each fiscal instrument implemented unilaterally by a single country. Subsequently we present multipliers associated with permanent changes in each fiscal instrument. In both cases, two years after the initial shock the country-specific fiscal rule starts to operate, slowly bringing the debt-to-GDP ratio or deficit-to-GDP ratio back to its target level (the initial pre-shock level).

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[2] The specification of the country-specific fiscal rule has only very modest effects on multipliers if the fiscal shock is transitory.

[3] The rule is specified as $R_t = \rho R_{t-1} + (1-\rho)[\bar{R} + \theta_\pi(\pi_t - \bar{\pi})] + \theta_y Ygr_t$, where *R* denotes the policy rate, π is the annual euro area inflation rate (excluding the direct effect from changes in consumption taxes) and *Ygr* denotes quarterly euro area output growth. $\bar{R}$ is the equilibrium nominal interest rate and $\bar{\pi}$ is the monetary authority's inflation target. The coefficients are as follows: ρ = 0.87, $\bar{\pi}$ = 1.02, θ_π= 1.70 and θ_y= 0.10.

b. Fiscal multipliers for temporary fiscal shocks

Government consumption

Table 1 shows the government consumption multipliers, i.e. the response of GDP to a temporary change in government consumption. The latter, as a ratio to the baseline GDP, decreases by one percentage point for two years and then returns to the baseline.

In the first case, denoted 'No ZLB', the ZLB is not imposed as a constraint and the nominal interest rate adjusts according to the Taylor rule (see footnote 9). In the second case, denoted '2 year-ZLB', the nominal interest rate is kept constant during the first two years of the simulation and follows the Taylor rule thereafter. Similarly, all the other fiscal instruments are held constant for two years. The fiscal rule kicks in thereafter.

– Table 1 around here –

When the ZLB is not binding all multipliers are below one in absolute terms. In the majority of the models the first year multipliers are between 0.7 and 0.9, but in some cases they are lower. They are close to 0.5 in Germany, Spain, Czech Republic and Sweden.

Multipliers are lower than one in absolute value because the crowding-in effect on private sector spending partially compensates for the reduction in public consumption. In the majority of models, private sector consumption and investment (not reported) increase, as lower public consumption increases the resources available for the private sector. However, the positive wealth effect, i.e. the reduction in the present value of future tax payments required to balance the government's budget, is rather small, as the fiscal retrenchment is temporary.

Multipliers are lower in absolute terms in the second year than in the first year. The presence of adjustment costs on investment, of habit persistence in

consumption and of nominal wage and price rigidities makes the response of private spending gradual. For instance, the difference in first and second year multipliers is large in the case of Portugal, which features relatively large investment adjustment costs.

Note that in the case of euro area countries the country-specific real interest rate does not greatly decrease and, hence, does not contribute significantly to the crowding-in of private demand. There are two reasons for this. First, the monetary policy rate, set at the union-wide level, is not greatly reduced after a shock, because each individual country has a small effect on euro area inflation and economic activity. Second, the response of the country-specific inflation rate is rather contained. In the case of Portugal, the multipliers increase around 10% in the first year when the model includes financial frictions. Along with lower aggregate demand, the price of capital decreases, as well as net worth. The entrepreneurial sector becomes more leveraged and is forced to face a higher external finance premium, which dampens investment. The presence of financial frictions also creates some persistence effects, as it takes time to rebuild lost net worth.

The zero lower bound

For euro area countries, multipliers are lower than one also under the ZLB (the only exception is France, which exhibits a multiplier slightly larger than one). For euro area countries other than Germany, multipliers are either unchanged or only slightly larger than in the case of the nominal interest rate reacting according to the Taylor rule. The ZLB does not greatly affect economic activity in the euro area, because it lasts for a relatively small (but plausible) number of periods (8 quarters) and the country-specific fiscal shock produces only small cross-country spillovers. Responses of economic activity and inflation in the rest of the euro area under the ZLB are muted, as in the case of the active Taylor rule. As such, the responses of the region-specific real interest rates (in the considered country and in the rest of the euro area) are muted and similar in both scenarios.

However, the ZLB leads to a significantly larger multiplier in the case of a reduction of public consumption at the euro area level, as reflected in the simulation results from the ECB's NAWM. When the ZLB does not bind, the euro area policy rate is reduced, favouring the crowding-in of private spending. When it is binding, the constant nominal interest rate and the decrease in euro area inflation lead to a rather strong increase in the euro area real interest rate that depresses private spending. For similar reasons, multipliers become significantly larger when the ZLB binds in the case of Czech Republic and Sweden, reaching values that are clearly larger than one.

Different taxes

Households' labour income tax rate

Table 2 presents the short-run GDP multipliers in case of a transitory (two-year) increase in the households' labour income tax rate.

Multipliers are lower than one in absolute value and smaller than those associated with the reduction in government consumption. They are generally around 0.1 in the first year and between 0.2-0.4 in the second year. The increase in labour taxes has a small impact on GDP as it operates mainly through its effects on wealth (permanent income) and incentives to work. As in the case of public consumption, the wealth effect is rather small because the fiscal measure is transitory. Public consumption has a larger multiplier because it directly reduces aggregate demand.

The impact of the labour income tax increase is larger in some of those models that feature strong non-Ricardian features, including a relatively high percentage of liquidity-constrained consumers, such as in case of Greece, Portugal and Czech Republic. To some extent, the size of the labour tax multipliers is also related to the share of labour income tax revenues-to-GDP and to the degree of wage indexation. For countries with a large labour income tax base, the multiplier tends to be smaller in absolute terms. This is explained by the fact that e.g. labour supply reacts to a change in the labour

income *tax rate*, whereby a change in the tax rate needs to be smaller for those countries with a large labour income tax base to achieve an 1% increase in the ratio of labour income tax revenues to GDP. Stronger wage indexation, in turn, makes wages more backward looking and therefore limits the temporary increase in wages due to the tax hike. This limits the short-run impact of the temporary tax hike on employment and economic activity, resulting in a smaller multiplier.

– Table 2 around here –

Unlike in the scenario prescribing a reduction in government consumption, a labour tax hike leads to an increase in the multiplier for the majority of countries when moving from the first to the second year. This reflects the presence of nominal and real frictions, which leads to a gradual response of aggregate demand to the labour income tax hike through the substitution effect.

The labour income tax hike scenario also differs from the government consumption-based scenario in that for the majority of countries the multipliers are slightly smaller when the nominal interest rate is held constant for two years. The contained increase in inflation (associated with negative supply side effects of higher labour taxes) and the fixed policy rate assumption together result in a slight decrease in the real interest rate, partially limiting the decrease in aggregate demand. One exception to the general result is Germany, whose multipliers are slightly larger when the monetary policy rate is constant. In the Portuguese case, the presence of credit market frictions does not change the multipliers as the effect on prices, particularly the price of capital, is rather muted.

For the ZLB experiments in the Swedish model, the effects of the shocks to the fiscal policy instruments on the interest rate have been offset by anticipated monetary policy shocks and this may explain why the multipliers change signs under the ZLB. As discussed by Laséen and Svensson (2011)

and by Carlstrom, Fuerst and Paustian (2012), anticipated monetary policy shocks may under some circumstances have implausibly large effects on inflation and output. The results from the ZLB experiments with the Swedish model should therefore be interpreted with some caution.

Capital income tax rate

Table 3 shows the short-run output multipliers of a transitory (two-year) increase in capital income taxation. The multipliers are generally rather small, below 0.3 in absolute terms. The short-run response of investment to an increase in the capital income tax is rather gradual, because of the short-run adjustment costs of investment. Moreover, there is no strong incentive to reduce investment since the increase in the capital income tax is transitory.

There are some exceptions. Multipliers are rather large in the case of Sweden and Greece. In the Greek model, the large multiplier is driven by the sizable reduction in the utilisation rate of capital and the price of capital that induce a strong negative response of output to the tax shock. In the Portuguese case, credit market frictions work to propagate and amplify the negative impact on GDP. Increasing capital income taxes directly affects entrepreneurial returns, increases leverage and the cost of external finance, which reduces investment.

Multipliers increase slightly under the 2-year ZLB scenario. As in the previous simulations, the decrease in union-wide inflation and economic activity due to the temporary drop in the country-specific demand is rather muted for countries belonging to the euro area. Under standard monetary policy, the policy rate does not greatly change and the country-specific real interest rate hardly moves. Similarly, the slowdown in country-specific inflation, and hence the increase in the country-specific real interest rate, is small under the ZLB. As a result, the ZLB does not significantly amplify the negative macroeconomic effects of the capital income tax increase. Concerning the effects for Sweden, the results under the ZLB should again be interpreted with some caution (see the discussion of the labour income tax hike simulations under the ZLB). In the Portuguese case, the presence of credit market

frictions has a slight amplification effect on the multipliers, also creating some persistence effects.

– Table 3 around here –

Consumption tax rate

Table 4 shows the short-run output multipliers associated with a transitory increase in consumption taxation. In the absence of the ZLB, all multipliers are below one in absolute value. The largest multiplier is equal to 0.7 and the smallest is equal to 0.1. These differences reflect, at least partly, differences in the calibration of the inter-temporal elasticity of substitution and consumption habit persistence. A higher inter-temporal elasticity of substitution and lower habit persistence make current consumption more responsive to changes in consumer prices which are directly affected by the transitory increase in consumption taxes. Habit persistence also tends to increase the multiplier in the second year relative to the first year, because households favour a gradual response of private consumption.

– Table 4 around here –

The ZLB does not change the overall picture significantly. The only exceptions are the euro area and Sweden. In the case of the euro area, where private consumption accounts for about 60% of GDP, a decrease in euro area consumption reduces inflation and, hence, the increase in the euro area real interest rate is relatively strong under the ZLB. For Sweden this effect is even stronger, leading to a multiplier larger than one.

c. Fiscal multipliers for permanent fiscal shocks

In the previous section, we have considered transitory fiscal shocks. We now turn to permanent fiscal shocks, which allow us to assess not only short but also long-run effects of discretionary changes in fiscal instruments. A permanent fiscal shock can be interpreted as "fiscal reform", which permanently alters the fiscal structure of the economy. For instance, a permanent reduction in government consumption, associated with the reduction in labour income taxes, reduces the size of the public sector and tax burden of the economy permanently. Similarly, a permanent change in one type of tax financed by another type of tax

represents a permanent change in the tax structure of the economy. Following the previous simulations, the fiscal rule is deactivated for the first two years. Thereafter it becomes active again and it stabilises the public debt and/or the deficit at their target values, which remain unchanged.

Since the long-run response of output critically depends on the fiscal instrument that is determined by the fiscal rule, we compare two cases. In the first case, the fiscal rule is specified in terms of the lump-sum tax, representing the benchmark assumption typically employed in the DSGE literature.[4] In the second, arguably more plausible case, the fiscal rule is instead specified in terms of the (more distortionary) households' labour income tax. It turns out that the choice of the instrument that serves to ensure fiscal sustainability is not innocuous, especially as regards the long-run multipliers.

Government consumption, fiscal rule in terms of lump-sum taxes

The first three columns of Table 5 show the short and long-run output multipliers of a permanent reduction in government consumption when the fiscal rule is specified in terms of the lump-sum tax.

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[4] See, for instance, Christiano, Eichenbaum and Rebelo (2011).

The estimated short-run multipliers are smaller than one in absolute value, ranging from 0.25 to 0.97 in the first year. The multipliers are generally smaller than their counterparts in the case of a transitory reduction in public consumption (see Table 1), because of the large positive wealth effect on households and firms. The permanent reduction in public consumption makes resources available for private spending on a permanent basis; this induces a larger crowding-in effect on private consumption and investment. As in the case of transitory shocks, the multipliers are smaller in the second than in the first year, because nominal and real rigidities lead to a gradual adjustment of private demand for consumption and investment.

The long-run multipliers are negative across all models and, with the exception of the Greek model, remain smaller than one in absolute value. In the long run, a decrease in government consumption translates into lower lump sum taxes for households. Since lump sum taxes or transfers do not alter labour supply of Ricardian households or impact on relative prices in the long run, lower aggregate demand due to lower public expenditures lead to a negative GDP effect.[5]

Government consumption, fiscal rule in terms of labour taxes

The last three columns of Table 5 show the short and long-run multipliers of a permanent reduction in government consumption when the fiscal rule is specified in terms of the households' labour income tax rate. Short-run multipliers are generally smaller than in the case of the lump-sum tax rule. The anticipation of lower future labour income taxes induces households to gradually increase their labour effort. The anticipation of higher labour income in the medium and long run strengthens the crowding-in effect on private demand already in the short run, leading to a lower short-run GDP multiplier.

In contrast to the previous results, long-run multipliers are now positive and, in some cases, larger than one. Typically, multipliers turn positive after three to

[5] This result is in line with earlier work by the WGEM, see ECB (2011).

six years. The permanent reduction in the labour tax rate leads to an outward shift of labour supply, providing incentives to increase employment. Higher employment in turn makes capital more productive. Since capital is rather elastic in the long run, there is a relatively large (supply-side) effect on production and economic activity. The largest multiplier is equal to 1.6 (Portuguese model), the smallest to 0.1 (German model). Interestingly, the long-run multipliers tend to be smaller and hence economic benefits of the reform are smaller for those countries that have a higher import penetration, i.e. higher import-to-GDP ratio. Larger trade linkages imply that a larger share of aggregate demand is satisfied by imports.

– Table 5 around here –

Distortionary taxes, fiscal rule in terms of lump-sum taxes

Table 6 shows the multipliers associated with a permanent increase in different tax revenues when the fiscal rule is specified in terms of lump-sum taxes.

We first consider the permanent increase in labour income taxes. Short-run multipliers are negative and generally lower than one in absolute value, ranging between 0.0 and 0.8 in the first year and between 0.1 and 1.0 in the second year. Long-run multipliers are negative as well and in the majority of cases larger than one in absolute value, reflecting the distortionary nature of labour income taxation. Due to the negative long-run GDP response and the associated wealth effect, short-run multipliers are in general larger than in the case of a transitory fiscal shock (see Table 2).[6] The estimates of short-run multipliers associated with capital income taxation vary quite a lot across

[6] This difference partly reflects the fact that fiscal rules for some models are different under transitory and permanent shocks, but the general conclusion about the negative wealth effect still holds.

models. In absolute values, the range goes from 0.0 for the German model in the first year to 2.5 in case of the Greek model in the second year. Long-run multipliers are unequivocally negative and much larger in absolute value than the multipliers associated with labour taxation. Physical capital fully adjusts to the new tax level, inducing a strong decline in labour and hence economic activity. Long-run multipliers are larger than 3 in France, Greece, Slovenia and Spain, and equal to or larger than 2 in the euro area, Belgium, Finland, Italy and Portugal.[7] Both short-run and long-run multipliers tend to be larger (in absolute terms) for those countries in which the private investment-to-GDP ratio is larger and where the initial capital tax revenues are lower. In the Portuguese model, financial frictions amplify the negative short-run impact on GDP, as a deterioration of entrepreneurs' net worth, due to higher capital income taxes, increases leverage and the cost of external funds (a result already highlighted in section IV b).

– Table 6 around here –

Finally, the short-run multipliers associated with the consumption tax hike are between 0.0 and 0.5 in absolute values, while long-run multipliers are between 0.3 and 0.7 (the only exceptions are Greece, whose long-run multiplier is about one, and Spain, whose long-run multiplier is 0.0). They are larger than the corresponding short-run multipliers because consumption habits lead to a gradual response of consumption to the increase in taxation. For the same reason the multiplier is usually larger in the second than in the first year.

Distortionary taxes, fiscal rule in terms of labour taxes

[7] Only Germany has a multiplier lower than one.

Finally, we assess the value of multipliers when the fiscal room created by the permanent increase in capital income or consumption taxation is used to permanently reduce households' labour income taxes (instead of lump-sum taxes). Table 7 reports the results.

Short-run multipliers associated with a permanent increase in capital income taxes are somewhat smaller in absolute values than in the case where the fiscal rules are specified in terms of the lump-sum tax. In the case of Finland, the multiplier even becomes positive in the first year. The anticipation of the permanent reduction in labour taxation provides an incentive to gradually increase labour supply. This partially counterbalances the incentive to reduce investment associated with a higher taxation of capital. Long-run multipliers are again much larger than one in absolute value in most cases, given that investment is very elastic in the long run. As such, the expansionary effects of lower labour taxation compensate only partially the strong recessionary effect of permanently higher capital income taxes.

Short-run multipliers associated with a permanent increase in consumption taxes are lower when the fiscal rule ensuring government debt sustainability is specified in terms of the labour income tax instead of the lump-sum tax, and in some cases even become positive (Estonia, Italy, Slovenia) due to the quick positive response of labour and the gradual response of consumption. The permanent reduction in labour taxes partially compensates for the permanent increase in consumption taxation. In the case of Estonia, the rather large multiplier is explained by strong competitiveness gains due to reduced labour costs, combined with the fact that trade effects in the Estonian model have a relatively large weight in the overall dynamics.

– Table 7 around here –

In contrast to the capital income tax-based scenario, the long-run consumption tax-based multipliers are positive. Lower labour taxes favour the

increase in employment, counterbalancing the negative effects due to an increase in consumption taxes. As such, economic activity increases in the long run. Higher short-run consumption tax multipliers tend to be associated with models that exhibit a larger share of liquidity-constrained consumers and a higher coefficient of risk aversion. Liquidity-constrained consumers have at most a limited ability to smooth consumption over time, hence their reaction to the consumption tax hike is large.

IV. Sensitivity analysis

Results presented so far are based on the benchmark calibrations of the models as described in Tables A2-A4 in the Appendix. In this section, we analyse the sensitivity of the results with respect to the following changes in the models' calibration:

- 30 percentage point increase in the share of liquidity-constrained households
- 10% reduction in the degree of price stickiness
- 10% reduction in the degree of wage stickiness
- 50% reduction in households' risk aversion
- 50% increase in investment adjustment costs

The sensitivity analysis is conducted with and without the ZLB. It focuses on two scenarios, a permanent reduction in government consumption and a permanent increase in labour income taxes. All other fiscal instruments are held constant for the first two years. After two years, lump-sum taxes are allowed to adjust according to the fiscal rules. Only a subset of models was used (euro area, Finland, Italy, Malta, Portugal, and Slovenia). Table A5 in the Appendix reports the average short-run and long-run multipliers across models.

The sensitivity analysis shows that short-run multipliers become larger in absolute terms when there are more liquidity-constrained households,

reflecting the fact that these households are less able to smooth consumption than unconstrained households. This effect becomes exacerbated when the ZLB is binding. Absent the ZLB, the short-run government consumption multipliers are typically smaller when prices are less sticky. Firms adjust goods prices faster, leading to a quicker accommodating monetary policy response. Results are similar with regard to wage stickiness. Absent the ZLB, the short-run government consumption multipliers are typically smaller when wages are more flexible. A lower degree of risk aversion translates into a higher interest rate elasticity of aggregate demand so that the accommodating monetary policy response has a stronger effect, thereby lowering short-run spending multipliers. It should also be noted that the fiscal multipliers are sensitive to the degree of financial frictions as shown in Tables 1-9 for the Portuguese model. The presence of financial frictions increases in particular the government consumption and the capital income tax multipliers. For other taxes, however, these frictions seem less relevant.

At the same time, the sensitivity of the multipliers with respect to investment adjustment costs differs across models, thus precluding the derivation of any straightforward conclusion.

As for the permanent increase in households' labour taxes, we again find that, typically, having more liquidity-constrained households leads to a stronger GDP effect in the short run. Again, the sensitivity of the short-run multipliers to the share of liquidity-constrained households gets amplified when the ZLB is binding (in those models that exhibit an endogenous monetary policy rule). Another relatively robust finding is that, contrary to the permanent spending shocks, lower risk aversion leads to stronger output effects, and hence higher multipliers in the case of permanent increases in labour income taxes. It should be noted, however, that this result does not hold true for all models.

V. Comparison of model-based fiscal multipliers and empirical results

In order to compare our results to those of the VAR studies, which try to deduce the multiplier of government spending either for single euro area countries or (in one case) for the euro area aggregate, some studies' results are comprised in Table 8, based on Boussard et al. (2012) (with the sign convention used in this paper, i.e. the impact of a reduction of government spending by 1% of GDP). The short-term multiplier comprises the impact multiplier and the first four periods, whereas the medium-run multiplier stretches three years into the future. What is striking from those results is the fact that the multipliers vary quite a lot even when focusing on a single country. Short-term multipliers range from -0.23 to -0.7 and long-run multipliers range from -1.27 to 0.23 depending on the sample periods and the identification strategy.

– Table 8 around here –

Concerning tax multipliers, Table 9 provides empirical evidence from studies carried out for euro area countries. This table is again largely based on the survey of Boussard et al. (2012). It shows a large heterogeneity among the euro area, with differences even in the sign of the multipliers in the short and in the medium run. Still, except for Germany in Bénassy-Quéré and Cimadomo (2012), empirical estimates reveal that tax shocks usually entail smaller effects on GDP than public expenditure.[8]

– Table 9 around here –

[8] In another strand of the empirical literature, which is not based on VAR but on simple regression analysis, some authors find on the contrary that fiscal stimulus based on tax cuts are more likely to increase growth than those based on spending increases (see for example Alesina and Ardagna, 2010).

Comparing fiscal multipliers from structural models with those from VAR-based approaches is not straightforward given that the specification of the fiscal shock matters significantly for the results. Furthermore, movements in expenditures and especially in tax revenues in empirical applications may consist of different expenditure and revenue items, making a direct comparison to our model-based results difficult.

Yet another problem is that the main objection raised against the use of SVAR models for the analysis of fiscal policy concerns the identification scheme and the treatment of expectations. Ramey (2011a) shows that government spending shocks identified following a Blanchard and Perotti procedure on U.S. data can be biased due to the fact that spending shocks are not entirely exogenous. In this case, estimated parameters and implied impulse-response functions (IRF) are inconsistent.

In order to address this issue, Ramey (2011a) embeds one of her news variables into a standard SVAR used for the analysis of fiscal policy. It turns out that private consumption decreases and private investment increases on impact for a Blanchard-Perotti contractionary shock, but that the opposite result holds for unanticipated government spending shocks. A recent controversy (Ramey, 2011b, Perotti, 2011) highlighted that these results were sensitive to the inclusion of particular observations and that IRFs for private consumption and GDP in the two cases were probably not significantly different. Using European data, Beetsma and Giuliodori (2011) do not find significant evidence of an anticipation effect either.

Nevertheless, with these caveats in mind, Table 10 presents a rough comparison of our results from structural models to empirical ones. Specifically, we contrast the estimates from the empirical literature with our short-run multipliers for transitory government expenditure and tax shocks.

– Table 10 around here –

Table 10 shows that the empirical VAR-based literature typically finds a large range of short-run fiscal multipliers for both expenditures and tax items. The most important finding is perhaps the fact that in the empirical applications, multipliers can be substantially larger than one in absolute terms for both expenditures and tax items. Another important difference is that some empirical applications find a positive tax multiplier, pointing towards the so called non-Keynesian effects of tax shocks. In the structural models used here, positive tax multipliers are found only in a few cases, e.g. when the consumption tax shock is deemed permanent and labour income tax adjusts in the long run (e.g. Italy and Estonia, see Table 7). In this case, the non-Keynesian effect arises at least partly due to the anticipation of long-run gains of lower labour income taxes in the future.

VI. Conclusions

We have provided estimates of the size and sign of fiscal multipliers - both in the short and in the long run - for European countries based on simulations of structural models used at the NCBs and the ECB. The heterogeneity of the models with regard to the specific model features and the calibration of parameters provided a useful environment to study the driving factors of fiscal multipliers. Differences in the size of the various fiscal multipliers can be traced back to the different nature of the fiscal shocks, as well as some country specific features, such as the share of liquidity-constrained consumers, financial frictions, and different degrees of price and wage rigidities. At the same time, while acknowledging the importance of these country differences, some of the findings are fairly robust across the variety of models.

Our first robust result is that under standard monetary policy short-run multipliers are smaller than one in absolute terms in the vast majority of models, irrespective of the fiscal instrument, the considered country or the

nature of the fiscal shock. Temporary reductions in government consumption are typically associated with larger short-run GDP effects than temporary increases in the households' labour income tax rate, the capital income tax rate, or the consumption tax rate.

The second robust finding is that a two-year long ZLB episode has relatively small effects on the multipliers if a temporary fiscal shock hits an individual country within the euro area. The reason is that cross-country spillovers turn out to be rather weak and the response of inflation to the country-specific fiscal shocks is in general rather muted. In contrast, when the fiscal shocks are simultaneously implemented in the euro area as a whole, the ZLB has a relatively strong impact on short-run government consumption multipliers, which can become larger than one. The same holds true for non-euro area countries that exhibit a country-specific monetary policy rule.

Third, if fiscal shocks are implemented permanently, short-run government consumption and consumption tax multipliers are smaller in absolute value than in case of a temporary implementation. Long-run multipliers are in general negative when the budgetary room materialising after the fiscal tightening is used to adjust lump-sum taxes. Instead, long-run multipliers are typically positive if the households' labour income tax rate is reduced in the medium to long term. Since households anticipate these long-run GDP effects at the outset of the simulations, short-run multipliers are more favourable when the budgetary room that materialises after the fiscal tightening is used to lower distortionary taxes.

Overall, our results and the review of empirical literature suggest that many factors affect the size of multipliers. As such, short and long-run multipliers can give rather different policy conclusions as regards the desirability of using a particular fiscal instrument. Expenditure-based fiscal adjustments typically have larger negative short-run effects than tax-based adjustments. However, in the long run, tax-based fiscal adjustments lower the long-run output potential of the economy, while expenditure-based fiscal adjustments can result in positive long-run output effects.

References

Adolfson, M., S. Laséen, L. Christiano, M. Trabandt and K. Walentin (2013). "Ramses II – Model Description," Sveriges Riksbank Occasional Paper Series 12.

Afonso, A. and R. M. Sousa (2009). "The macroeconomic effects of fiscal policy in Portugal: a Bayesian SVAR analysis," School of Economics and Management, Working Papers No. 09/2009/DE/UECE.

Alesina A. and S. Ardagna (2010). "Large Changes in Fiscal Policy: Taxes versus Spending," in Brown R., NBER book *Tax Policy and the Economy*, Vol. 24, pp. 35-68.

Almeida V., G. Castro, R.M. Félix, P. Júlio and J.R. Maria (2013). "Inside PESSOA - A detailed description of the model," Banco de Portugal Working Papers No. 16/2013.

Almeida, V., Castro, G., Félix, R.M. and Maria, J. (2013). "Fiscal Consolidation in a Small Euro-Area Economy," *International Journal of Central Banking, International Journal of Central Banking*, Vol. 9(4), pp. 1-38.

Ambrisko, R., J. Babecky, J. Rysanek and V. Valenta (2012). "Assessing the Impact of Fiscal Measures on the Czech Economy," Working Papers 2012/15, Czech National Bank.

Andrle, M., T. Hledik, O. Kamenik, and J. Vlcek (2009). "Implementing the New Structural Model of the Czech National Bank." Working Papers 2009/2, Czech National Bank.

Auerbach, A. and Y. Gorodnichenko (2012). "Measuring the Output Responses to Fiscal Policy," *American Economic Journal: Economic Policy*, Vol. 4(2), pp. 1-27.

Auerbach A.J. and Y. Gorodnichenko (2013). "Output Spillovers from Fiscal Policy," *American Economic Review*, Vol. 103(3), pp. 141-46.

Barro, R. J. and C. J. Redlick (2009). “Macroeconomic Effects from Government Purchases and Taxes,” NBER Working Paper 15369.

Baum, A, Köster, G. (2011). “The impact of fiscal policy on economic activity over the business cycle-evidence from a threshold VAR analysis,” Bundesbank Discussion Paper No. 03/2011

Baum, A., Poplawski-Ribeiro, M., Weber, A. (2012). “Fiscal Multipliers and the State of the Economy,” IMF Working Paper.

Beetsma, R. and M. Giuliodori (2011). “The Effects of Government Purchases Shocks: Review and Estimates for the EU,” *The Economic Journal*, Vol. 121, pp. 4-32.

Beetsma, R., Giuliodori, M. and F. Klaassen (2006). “Trade spillovers of fiscal policy in the european union: a panel analysis,” *Economic Policy*, Vol. 21(48), pp. 639-687.

Bénassy-Quéré, A. and J. Cimadomo (2012). “Changing patterns of fiscal policy multipliers in Germany, the UK and the US,” *Journal of Macroeconomics*, Vol. 34(3), pp. 845-873.

Benes, J., T. Hlédik, M. Kumhof and D. Vávra (2005). “An Economy in Transition and DSGE: What are the Czech National Bank’s New Projection Model Needs,” CNB Working Paper No. 12/2005.

Bernanke, B., Gertler, M. and Gilchrist, S. (1999), “The Financial Accelerator in a Quantitative Business Cycle Framework”, in: J. B. Taylor & M. Woodford (ed.), Handbook of Macroeconomics, edition 1, volume 1, chapter 21, pages 1341-1393 Elsevier.

Biau, O. and E. Girard (2005), “Politique budgétaire et dynamique économique en France: l'approche VAR structurel,” *Revue économique*, Vol. 56, pp. 755-764

Blanchard, O. and R. Perotti (2002). “An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output,” *The Quarterly Journal of Economics* 117 (4), 1329–1368.

Bouakez H., D. Larocque and M. Normandin (2013). “Separating the Wheat from the Chaff: A Disaggregate Analysis of the Effects of Public Spending in the U.S.” Mimeo.

Boussard, J., de Castro, F. and Salto, M. (2012). “Fiscal Multipliers and Public Debt Dynamics in Consolidations,” European Economy, Economic Papers 460, July 2012.

Burriel, P., de Castro, F., Garrote, D., Gordo, E., Paredes, J. and Pérez, J.J. (2010). "Fiscal policy shocks in theeuro area and the US: an empirical assessment," *Fiscal Studies* 31(2), 251–285.

Canova, F., M. Ciccarelli and P. Dallari (2013). “Spillover of fiscal shocks in the euro area.” Mimeo.

Carlstrom, C., T. Fuerst, and M. Paustian (2012). “Policy multipliers under an interest rate peg of deterministic versus stochastic duration,” Bank of England Working Paper No. 475.

Christiano C., M. Eichenbaum and S. Rebelo (2011). “When is the Government Spending Multiplier Large?” *The Journal of Political Economy*, Vol 119(1), pp. 78-121.

Cléaud G., M. Lemoine and P.-A. Pionnier (2013). “Which size and evolution of the government expenditure multiplier in France (1980-2010)?” Mimeo.

Coenen, G., C. Erceg, C. Freedman, D. Furceri, M. Kumhof, R. Lalonde, D Laxton,J.Lindé, A. Mourougane, D. Muir, S. Mursula, C. de Resende, J. Roberts, W. Roeger, S. Snudden, M. Trabandt, and J. in’t Veld (2012). “Effects of Fiscal Stimulus in Structural Models,” *American Economic Journal: Macroeconomics*, 4(1): 22–68.

Coenen, G., P. McAdam and R. Straub (2008). “Tax reform and labour-market performance in the euro area: A simulation-based analysis using the New Area-Wide Model,” *Journal of Economic Dynamics and Control*, Vol. 32, pp. 2543-2583.

Cogan, J., T. Cwik, J. Taylor and V. Wieland (2010). “New Keynesian versus old Keynesian government spending multipliers,” *Journal of Economic Dynamics and Control,* 34(3), pp. 281-295.

Cwik, T. and V. Wieland (2011). “Keynesian government spending multipliers and spillovers in the euro area,” *Economic Policy,* July 2011, pp. 493-549.

de Castro, F. (2006). “The macroeconomic effects of fiscal policy in Spain,” *Applied Economics*, 38, 913-924.

de Castro, F and L. Fernández (2011). “The Effects of Fiscal Shocks on the Exchange Rate in Spain,” Banco de España Working Paper No. 1121.

de Castro, F and P. Hernández de Cos (2008). “The economic effects of fiscal policy: the case of Spain,” *Journal of Macroeconomics*, 30, 1005-1028.

De Nederlandsche Bank (2011). “DELFI DNB’s Macroeconomic Policy Model of the Netherlands,” Occasional Studies Vol. 9, No. 1.

Eggertsson, G. (2011). “What fiscal policy is effective at zero interest rates?” NBER Macroeconomics Annual 2010, 25, pp. 59-112.

Forni, L., A. Gerali and M. Pisani (2010). “The macroeconomics of fiscal consolidations in a monetary union: the case of Italy,” Banca d’Italia Working Paper 747.

Gadatsch, Hauzenberger, Stähler (2014). Unpublished manuscript.

Gelain, P. and D. Kulikov (2009). “An Estimated Dynamic Stochastic General Equilibrium Model for Estonia,” Eesti Pank Working Paper No. 5/2009.

Giordano, R., S. Momigliano, S. Neri and R. Perotti (2007). “The effects of fiscal policy in Italy: Evidence from a VAR model,” *European Journal of Political Economy*, 23, pp. 707–733.

Gomes, S., P. Jacquinot and M. Pisani (2012). "The EAGLE. A model for policy analysis of macroeconomic interdependence in the euro area," Economic Modelling, Elsevier, vol. 29(5), pages 1686-1714.

Hall, R. E. (2009). “By How Much Does GDP Rise If the Government Buys More Output?” *Brookings Papers on Economic Activity*, Fall 2009, pp. 183–231.

Heppke-Falk, K.H., J. Tenhofen and G.B. Wolff (2006). “The macroeconomic effects of exogenous fiscal policy shocks in Germany: a disaggregated SVAR analysis,” *Journal of Economics and Statistics (Jahrbücher für Nationalökonomie und Statistik)*, Vol. 230(3), pp. 328-255.

in ‘t Veld (2013). “Fiscal consolidations and spillovers in the Euro area periphery and core,” European Economy, Economic Papers 506, October 2013.

Jacquinot P. and M. Lemoine (2013). "Quantifying the economic impact of fiscal harmonization between France and Germany," mimeo.

Jemec, N., A. Kastelec and A. Delakorda (2013). “How do fiscal shocks affect the macroeconomic dynamics in the Slovenian economy?” Bank of Slovenia Working Paper 1/2013.

Kilponen, J., H. Kinnunen and A. Ripatti (2006). “Population ageing in a small open economy – some policy experiments with a tractable general equilibrium model,” Bank of Finland Research Discussion Papers 28/2006.

Kirchner, M., J. Cimadomo, and S. Hauptmeier (2010). “Transmission of Government Spending Shocks in the Euro Area - Time Variation and Driving Forces,” ECB Working Paper No. 1219.

Laséen, S., and L.E.O. Svensson (2011). “Anticipated Alternative Policy Rate Paths in Policy Simulations,” *International Journal of Central Banking*, Vol. 7(3), pp. 1-35.

Locarno, A., A. Notarpietro and M. Pisani (2013). “Sovereign risk, monetary policy and fiscal multipliers: a structural model-based assessment,” Bank of Italy Working Paper No. 943.

Micallef, B. (2013). “Measuring the Effects of Structural Reforms in Malta: An Analysis using the EAGLE model,” Central Bank of Malta Working Paper No. 1/2013.

Papageorgiou, D. (2014). “BoGGEM: A Dynamic Stochastic General Equilibrium Model for Policy Simulations,” Bank of Greece Working Paper No. 182.

Perotti, R. (2004). “Estimating the effects of fiscal policy in OECD countries,” Proceedings, Federal Reserve Bank of San Francisco.

Perotti, R. (2011). “Expectations and Fiscal Policy: An Empirical Investigation,” mimeo.

Ramey, V. A. (2011a). A Reply to Roberto Perotti’s "Expectations and Fiscal Policy: An Empirical Investigation". Mimeo.

Ramey, V. A. (2011b). “Identifying Government Spending Shocks: It’s All in the Timing,” *The Quarterly Journal of Economics*, Vol. 126(1), pp. 1–50.

Staehler, N., and C. Thomas (2012). “FiMod – A DSGE model for fiscal policy simulations,” *Economic Modelling*, Vol. 29(2), pp. 239-261.

Woodford, M. (2011). “Simple Analytics of the Government Expenditure Multiplier,” *American Economic Journal: Macroeconomics,* 3(1), pp. 1-35.

Table 1. Short-run fiscal multipliers: Temporary reduction in government consumption

	No ZLB		2-year ZLB	
	Year 1	Year 2	Year 1	Year 2
Belgium	-0.93	-0.90	-0.97	-0.95
Czech Republic	-0.54	-0.54	-1.79	-1.57
Estonia	-0.83	-0.66	-0.98	-0.77
Euro area	-0.98	-0.91	-1.39	-1.30
Finland*	-0.78	-0.76	-0.78	-0.76
France	-0.92	-0.71	-1.05	-0.87
Germany	-0.52	-0.48	-0.72	-0.68
Greece*	-0.90	-0.73	-0.90	-0.73
Italy	-0.79	-0.67	-0.86	-0.73
Malta	-0.73	-0.49	-0.73	-0.49
Netherlands*	-0.74	-0.72	-0.74	-0.72
Portugal*	-0.76	-0.23	-0.76	-0.23
Portugal* (ff)	-0.85	-0.37	-0.85	-0.37
Slovenia	-0.66	-0.48	-0.68	-0.50
Spain	-0.50	-0.29	-0.50	-0.29
Sweden	-0.60	-0.63	-1.63	-2.07

* In these countries, monetary policy is exogenous. Portugal (ff) indicates the presence of financial frictions following Bernanke, Gertler and Gilchrist (1999).

Table 2. Short-run fiscal multipliers: Temporary increase in households' labour income tax rate

	No ZLB		2 year ZLB	
	Year 1	Year 2	Year 1	Year 2
Belgium	-0.04	-0.10	-0.03	-0.10
Czech Republic	-0.36	-0.40	-0.38	-0.28
Estonia	-0.21	-0.43	0.04	-0.22
Euro area	-0.11	-0.19	-0.04	-0.12
Finland*	-0.10	-0.13	-0.10	-0.13
France	-0.13	-0.30	-0.09	-0.25
Germany	-0.10	-0.09	-0.15	-0.14
Greece*	-0.50	-0.77	-0.50	-0.77
Italy	-0.06	-0.13	-0.05	-0.12
Malta	-0.09	-0.20	-0.09	-0.20
Netherlands*	-0.11	-0.15	-0.11	-0.15
Portugal*	-0.51	-0.91	-0.51	-0.91
Portugal* (ff)	-0.49	-0.86	-0.49	-0.86
Slovenia	-0.10	-0.19	-0.10	-0.19
Spain	-0.13	-0.11	-0.13	-0.11
Sweden	-0.27	-0.31	0.56	0.88

* In these countries, monetary policy is exogenous. Portugal (ff) indicates the presence of financial frictions following Bernanke, Gertler and Gilchrist (1999).

Table 3. Short-run fiscal multipliers: Temporary increase in capital tax rate

	No ZLB		2 year ZLB	
	Year 1	Year 2	Year 1	Year 2
Belgium	-0.06	-0.08	-0.06	-0.08
Estonia	-0.10	-0.11	-0.10	-0.12
Euro area	-0.12	-0.10	-0.19	-0.17
Finland*	-0.10	-0.12	-0.10	-0.12
France	-0.07	-0.08	-0.09	-0.10
Germany	-0.05	-0.08	-0.11	-0.14
Greece*	-0.65	-1.06	-0.65	-1.06
Italy	-0.08	-0.11	-0.09	-0.12
Malta	-0.02	-0.04	-0.02	-0.04
Portugal*	-0.10	-0.01	-0.10	-0.01
Portugal* (ff)	-0.19	-0.15	-0.19	-0.15
Slovenia	-0.11	-0.11	-0.12	-0.12
Spain	-0.09	-0.07	-0.09	-0.07
Sweden	-0.33	-0.50	-2.18	-3.14

* In these countries, monetary policy is exogenous. Portugal (ff) indicates the presence of financial frictions following Bernanke, Gertler and Gilchrist (1999).

Table 4. Short-run fiscal multipliers: Temporary increase in consumption tax rate

	No ZLB		2 year ZLB	
	Year 1	Year 2	Year 1	Year 2
Belgium	-0.19	-0.43	-0.20	-0.43
Czech Republic	-0.19	-0.09	-0.15	-0.03
Estonia	-0.25	-0.08	-0.25	-0.08
Euro area	-0.48	-0.62	-0.78	-0.92
Finland*	-0.72	-0.70	-0.72	-0.70
France	-0.14	-0.23	-0.18	-0.29
Germany	-0.17	-0.22	-0.17	-0.17
Greece*	-0.48	-0.56	-0.48	-0.56
Italy	-0.29	-0.36	-0.35	-0.41
Malta	-0.15	-0.18	-0.15	-0.18
Portugal*	-0.49	-0.38	-0.49	-0.38
Portugal* (ff)	-0.52	-0.43	-0.52	-0.43
Slovenia	-0.24	-0.25	-0.24	-0.25
Spain	-0.14	-0.19	-0.14	-0.19
Sweden	-0.17	-0.21	-1.05	-1.45

* In these countries, monetary policy is exogenous. * Portugal (ff) indicates the presence of financial frictions following Bernanke, Gertler and Gilchrist (1999).

Table 5. Short and long-run fiscal multipliers: Permanent reduction in government consumption

Fiscal rule:	lump-sum tax			households' labour income tax		
	Year 1	Year 2	long run	Year 1	Year 2	long run
Belgium	-0.95	-0.90	-0.63	-0.93	-0.83	0.70
Czech Republic	-0.25	-0.21	-0.43	--	--	--
Euro area	-0.83	-0.62	-0.61	-0.46	-0.29	0.34
Estonia	-0.65	-0.61	-0.68	-0.32	-0.22	0.84
Finland*	-0.40	-0.31	-0.63	-0.33	-0.25	0.91
France	-0.97	-0.76	-0.82	-0.82	-0.48	1.28
Germany	-0.62	-0.40	-0.24	-0.61	-0.51	0.06
Greece*	-0.87	-0.74	-1.05	-0.83	-0.81	0.53
Italy	-0.68	-0.52	-0.58	-0.51	-0.19	0.54
Malta	-0.68	-0.37	-0.51	-0.62	-0.21	0.30
Portugal*	-0.58	-0.35	-0.67	-0.62	-0.05	1.64
Portugal* (ff)	-0.67	-0.44	-0.66	-0.72	-0.20	1.55
Slovenia	-0.66	-0.41	-0.38	-0.56	-0.15	0.82
Spain	-0.57	-0.35	-0.39	-0.48	-0.38	0.31
Sweden	-0.48	-0.44	-0.60	--	--	--

* In these countries, monetary policy is exogenous. Portugal (ff) indicates the presence of financial frictions following Bernanke, Gertler and Gilchrist (1999).

Table 6. Short and long-run fiscal multipliers: Permanent increase in tax rate - lump-sum taxes adjust

Tax rate:	labour income tax			capital income tax			consumption tax		
	Year 1	Year 2	long run	Year 1	Year 2	long run	Year 1	Year 2	long run
Belgium	-0.02	-0.18	-1.03	-0.29	-0.58	-2.11	-0.24	-0.49	-0.57
Czech Republic	-0.20	-0.32	-0.11	--	--	--	-0.03	-0.07	-0.03
Euro area	-0.52	-0.66	-0.87	-1.69	-2.21	-2.56	-0.40	-0.45	-0.51
Estonia	-0.56	-0.65	-0.60	-0.92	-0.76	-1.25	0.00	0.01	-0.16
Finland*	-0.79	-0.64	-1.48	-0.12	-0.99	-1.97	-0.47	-0.10	-0.74
France	-0.28	-0.63	-1.24	-0.36	-0.61	-3.27	-0.18	-0.36	-0.61
Germany	-0.19	-0.15	-0.29	-0.02	-0.11	-0.79	-0.04	-0.06	-0.13
Greece*	-0.57	-0.82	-1.41	-1.18	-2.46	-3.77	-0.39	-0.58	-0.96
Italy	-0.19	-0.38	-0.91	-0.21	-0.57	-2.50	-0.08	-0.15	-0.36
Malta	-0.14	-0.33	-0.72	-0.06	-0.16	-1.67	-0.09	-0.17	-0.31
Portugal*	-0.47	-1.04	-1.27	-0.34	-0.45	-2.01	-0.29	-0.52	-0.66
Portugal* (ff)	-0.45	-0.98	-1.27	-0.54	-0.53	-2.00	-0.28	-0.50	-0.66
Slovenia	-0.26	-0.55	-1.42	-0.48	-0.77	-3.26	-0.13	-0.23	-0.54
Spain	-0.12	-0.11	-0.53	-0.26	-0.45	-3.25	-0.16	-0.18	0.00
Sweden	-0.35	-0.50	-0.68	-0.43	-0.80	-1.81	-0.15	-0.21	-0.28

* In these countries, monetary policy is exogenous. Lump-sum transfers adjust in the long run. Portugal (ff) indicates the presence of financial frictions following Bernanke, Gertler and Gilchrist (1999).

Table 7. Short and long-run fiscal multipliers: Permanent increase in tax rate – households' labour income tax rate adjusts

Tax rate:	capital income tax			consumption tax		
	Year 1	Year 2	long run	Year 1	Year 2	long run
Belgium	-0.29	-0.44	-1.04	-0.18	-0.35	0.53
Czech Republic	--	--	--	--	--	--
Euro area	-1.23	-1.82	-1.17	-0.09	-0.17	0.33
Estonia	-0.48	-0.64	-0.16	0.27	0.38	1.73
Finland*	0.13	-0.91	-1.52	-0.37	-0.28	1.07
France	-0.22	-0.41	-2.43	-0.05	-0.11	1.31
Germany	-0.14	-0.15	-0.98	-0.17	-0.20	1.41
Greece*	-1.17	-2.51	-2.69	-0.35	-0.56	0.55
Italy	-0.08	-0.30	-1.92	0.10	0.20	0.66
Malta	-0.02	-0.08	-1.26	-0.02	0.01	0.47
Portugal*	-0.34	-0.17	-0.79	-0.30	-0.36	0.58
Portugal* (ff)	-0.57	-0.30	-0.82	-0.31	-0.37	0.53
Slovenia	-0.39	-0.52	-2.36	-0.02	0.07	0.59
Spain	-0.29	-0.48	-2.79	-0.18	-0.21	0.74

* In these countries, monetary policy is exogenous. Labour income tax rate adjusts in the long run. Portugal (ff) indicates the presence of financial frictions following Bernanke, Gertler and Gilchrist (1999).

Table 8. VAR-based fiscal multipliers: reduction in government spending

Studies	Sample (Country and Periods)	Short-term Multiplier	Medium-term Multiplier
Perotti (2004)	Germany (1960:1-1974:4)	-0.53	0.27
	Germany (1975:1-1989:4)	-0.50	-0.07
Heppke-Falk et al. (2006)	Germany (1974:1–2004:4)	-0.62	-1.27
Baum and Koester (2011)	Germany (1976:1-2009:4)	-0.7	-0.69
Bénassy-Quéré and Cimadomo (2012)	Germany (1971:1-2004:4)	-0.23	0.23
Biau and Girard (2005)	France (1978:1-2003:4)	-1.4	not significant
Cléaud et al. (2013)	France (1980:1-2010:4)	-1.1	-0.5
Giordano et al. (2007)	Italy (1982:1-2004:4)	-1.2	-1.7
de Castro (2006)	Spain (1980:1-2001:2)	-1.14 to -1.54	-0.58 to -1.04
de Castro and Hernàndez de Cos (2008)	Spain (1980:1-2004:4)	-1.3	-1
de Castro and Fernández (2011)	Spain (1981:1-2008:4)	-0.94	-0.55
Jemec et al. (2013)	Slovenia (1995:1-2010:4)	-1.6	not significant
Burriel et al. (2010)	Euro Area (1981:1-2007:4)	-0.87	-0.85
Kirchner et al. (2010)	Euro Area (1980:1-2008:4)	-0.7 to -1.0	0.7 to 1.7

Table 9. VAR-based fiscal multipliers: Increase in net taxes

Studies	Sample (country and period)	Short-term Multiplier	Medium-term Multiplier
Perotti (2004)	Germany (1960:1-1974:4)	0.29	-0.05
	Germany (1975:1-1989:4)	-0.04	0.59
Baum and Koester (2011)	Germany (1976:1-2009:4)	-0.66	-0.53
Bénassy-Quéré and Cimadomo (2006)	Germany (1971:1-2004:4)	-1.17	-1.08
Biau and Girard (2005)	France (1978:1-2003:4)	-0.1	not significant
Giordano et al. (2007)	Italy (1982:1-2004:4)	0.16	
De Castro (2006)	Spain (1980:1-2001:2)	0.05	0.39
Afonso and Sousa (2009)	Portugal (1979:1-2007:4)	+	+
Jemec et al. (2013)	Slovenia (1995:1-2010:4)	-0.4	not significant
Burriel et al. (2010)	Euro Area (1981-2007)	-0.63	-0.49

Table 10. Comparing fiscal multipliers in structural and empirical models

	Empirical*		**Structural Models****	
	Min	Max	Min	Max
Expenditure Multipliers	-1.54	-0.23	-0.98	-0.50
Tax Multipliers	-1.17	0.29	-0.72	-0.02
- *Labour*			-0.51	-0.02
- *Consumption*			-0.72	-0.15
- *Capital*			-0.65	-0.02

* Minimum and maximum values are based on Tables 1-2, first column (Short Run)

** Minimum and maximum values are based on Tables 3-6, first column (Year 1, NO-ZLB)

Appendix

Table A1. Models used in the simulation exercises

Country	Model	Reference
Belgium	na	
Czech Republic	g3	Ambrisko, Babecky, Rysanek and Valenta (2012)
Estonia	EP DSGE	Gelain and Kulikov (2009)
Euro area	NAWM	Coenen, McAdam and Straub (2008)
Finland	Aino	Kilponen, Kinnunen and Ripatti (2006)
France	EAGLE	Jacquinot and Lemoine (2013)
Germany	GEAR	Gadatsch, Hauzenberger and Stähler (forthcoming, 2014)
Greece	BoGGEM	Papageorgiou (forthcoming, 2014)
Italy	IDEA-BI-EAGLE	Forni, Gerali and Pisani (2010)
Malta	EAGLE	Micallef (2013)
Netherlands	DELFI	De Nederlandsche Bank (2011)
Portugal	PESSOA	Almeida, Castro, Félix, Júlio and Maria (2013)
Slovenia	EAGLE	Gomes, Jacquinot and Pisani (2010)
Spain	FiMod	Stähler and Thomas (2012)
Sweden	Ramses II	Adolfson, Laséen, Christiano, Trabandt, Walentin (2013)

Table A2. Elements of calibration

	Belg.	Cz. Rep.	Estonia	EA	Finland
Name of the model		g3	EP DSGE	NAWM	Aino
Model calibrated/estimated	est.	est.	est.	cal.	cal.
Open economy features					
Number of countries	3	2	2	2	1
Number of countries in monetary Union	2	0	1	1	1
RoW/RoEA exogenous	no	yes	yes	no	yes
Tradable/nontradable goods	both	tr. only	both	tr.	tr.only
Steady state values					
Private consumption-to-GDP ratio	0.60	0.59	0.60	0.60	0.62
Private investment-to-GDP ratio	0.15	0.12	0.25	0.22	0.19
Imports-to-GDP ratio	0.74	0.29	0.90	0.18	0.38
Public consumption-to-GDP ratio	0.14	0.22	0.25	0.16	0.17
Public investment-to-GDP ratio	0.00	0.06	0.00	0.03	0.02
Public sector interest payment-to-GDP ratio	0.03	0.01	0.00	0.05	0.03
Labour income tax revenues-to-GDP ratio	0.31	0.11	0.11	0.07	0.14
Capital income tax revenues-to-GDP ratio	0.04	0.01	0.03	0.03	0.03
Consumption tax revenues-to-GDP ratio	0.10	0.12	0.11	0.11	0.14
Value of the public debt-to-annualized GDP	0.60	0.45	--	0.90	0.60
Value of the net foreign asset-to-yearly GDP	0.00	0.00	--	0.00	0.00
Annualized nominal interest rate	0.05	0.03	0.05	0.05	0.05
Annualized inflation	0.02	0.02	0.00	0.02	0.02
Calibration					
Share of liquidity-constrained households	0.00	0.40	0.00	0.25	0.00
Coefficient of risk aversion	2.12	N/A	1.61	1.00	3.00
Frisch elasticity of labour supply	2.08	2.84	1.78	2.00	> 2
Habit	0.66	0.75	0.65	0.60	0.00
Adjustment costs on investment	13.66	0.20	6.42	3.00	1.40
Price stickiness	0.71	0.50	0.69	0.90	0.85
Price indexation	0.59		0.27	0.70	1.00
Wage stickiness	0.78	0.80	0.55	0.75	0.85
Wage indexation	0.90		0.37	0.75	1.00
Own Taylor rule (cal. as ECBWP1195)	no	yes	no	yes	no
Fiscal rule react on deviation of pub. debt	yes	yes	yes	no	yes
Fiscal rule react on deviation of pub. deficit	no	no	no	yes	no
Fiscal rule react on deviation of gov. cons.	no	yes	no	no	no

Table A3. Elements of calibration

	France	Germany	Greece	Italy	Malta
Name of the model	EAGLE			EAGLE	EAGLE
Model calibrated/estimated	cal.	cal.	cal.	cal.	cal.
Open economy features					
Number of countries	5	3	1	3	4
Number of countries in monetary Union	3	2	1	2	2
RoW/RoEA exogenous	no	no	yes	no	no
Tradable/nontradable goods	both		tr. only	both	both
Steady state values					
Private consumption-to-GDP ratio	0.57	0.62	0.63	0.59	0.63
Private investment-to-GDP ratio	0.19	0.23	0.26	0.18	0.20
Imports-to-GDP ratio	0.27	0.22	0.17	0.25	0.50
Public consumption-to-GDP ratio	0.23	0.12	0.18	0.20	0.20
Public investment-to-GDP ratio	0.00	0.03	0.03	0.02	0.00
Public sector interest payment-to-GDP ratio	0.03	0.01	0.05	0.04	0.03
Labour income tax revenues-to-GDP ratio	0.24	0.35	0.23	0.21	0.15
Capital income tax revenues-to-GDP ratio	0.05	0.02	0.09	0.13	0.03
Consumption tax revenues-to-GDP ratio	0.10	0.09	0.11	0.10	0.11
Value of the public debt-to-annualized GDP	0.62	0.60	1.20	1.19	0.60
Value of the net foreign asset-to-yearly GDP	0.04	0.00	0.00	0.00	0.04
Annualized nominal interest rate	0.05	0.02	0.04	0.03	0.05
Annualized inflation	0.02	1.80	0.00	0.00	0.02
Calibration					
Share of liquidity-constrained households	0.25	0.40	0.40	0.00	0.25
Coefficient of risk aversion	1.00	1.40	1.00	1.00	1.00
Frisch elasticity of labour supply	2.00	11.00	1.00	0.50	2.00
Habit	0.90	0.60	0.65	0.60	0.70
Adjustment costs on investment	6.00	6.90	10.00	6.00	4.00
Price stickiness	0.75	0.90	0.71	0.75-0.8	0.75
Price indexation	0.75	0.45	0.27	0.50	0.50
Wage stickiness	0.92	200.00	BG07	0.75-0.8	0.75
Wage indexation	0.50	0.75		0.50	0.75
Own Taylor rule (cal. as ECBWP1195)	no	no	no	no	no
Fiscal rule react on deviation of pub. debt	yes	yes	yes	yes	yes
Fiscal rule react on deviation of pub. deficit	no	no	no	yes	no
Fiscal rule react on deviation of gov. cons.	no	no	no	no	no

Table A4. Elements of calibration

	Nether*.	Portugal	Slovenia	Spain	Sweden
Name of the model	DELFI	PESSOA	EAGLE	FiMod	Ramses II
Model calibrated/estimated	est.	cal.	cal.	cal.	est.
Open economy features					
Number of countries	1	1	4	2	2
Number of countries in monetary Union	1	1	2	2	0
RoW/RoEA exogenous	yes	yes	no	no	yes
Tradable/nontradable goods		tr. only	both	tr. only	tr. only
Steady state values					
Private consumption-to-GDP ratio		0.60	0.55	0.57	0.63
Private investment-to-GDP ratio		0.21	0.27	0.21	0.17
Imports-to-GDP ratio		0.33	0.61	0.27	0.44
Public consumption-to-GDP ratio		0.23	0.19	0.18	0.30
Public investment-to-GDP ratio				0.04	0.00
Public sector interest payment-to-GDP ratio		0.02	0.03	0.02	0.00
Labour income tax revenues-to-GDP ratio		0.11	0.23	0.07	0.29
Capital income tax revenues-to-GDP ratio		0.03	0.01	0.02	
Consumption tax revenues-to-GDP ratio		0.43	0.09	0.04	0.16
Value of the public debt-to-annualized GDP		0.53	0.60	0.48	0.00
Value of the net foreign asset-to-yearly GDP		-0.23	-0.09	0.00	0.00
Annualized nominal interest rate		0.05	0.05	0.04	0.04
Annualized inflation		0.02	0.02	0.00	0.02
Calibration					
Share of liquidity-constrained households		0.40	0.25	0.40	0.00
Coefficient of risk aversion		5.00	1.00	2.00	1.00
Frisch elasticity of labour supply		0.85	2.00	match. funct.	2.98
Habit		0.90	0.80	0.85	0.66
Adjustment costs on investment		10.00	5.00	2.50	2.35
Price stickiness		100.00	0.75	0.75	0.88
Price indexation		0.00	0.50	0.00	0.16
Wage stickiness		100.00	0.81	0,75/0,7	0.75
Wage indexation		0.00	0.75	0.50	0.34
Own Taylor rule (cal. as ECBWP1195)	no	no	no	no	yes
Fiscal rule react on deviation of pub. debt		yes	yes	yes	no
Fiscal rule react on deviation of pub. deficit		no	no	no	no
Fiscal rule react on deviation of gov. cons.		no	no	no	yes

*Netherland's model is not a DSGE model, hence some of the data is not available.

Table A5. Fiscal multipliers: Sensitivity with respect to key parameters

Panel A. Average multipliers across models in the first two years

	Baseline	More liquidity constrained households	Less price stickiness	Less wage stickiness	Lower risk aversion	Higher investment adjustment costs
Government consumption	-0.53	-0.70	-0.50	-0.51	-0.49	-0.54
Gov.consumption + 2 year ZLB	-0.59	-0.81	-0.59	-0.57	-0.56	-0.60
Labour income tax	-0.50	-0.56	-0.50	-0.53	-0.51	-0.51
Labour income tax + 2 year ZLB	-0.55	-0.66	-0.58	-0.59	-0.58	-0.56

Panel B. Average long-run multipliers across models

Government consumption	-0.56	-0.63	-0.56	-0.56	-0.47	-0.56
Labour income tax	-1.11	-1.07	-1.12	-1.12	-1.21	-1.12

Note: The sensitivity analysis is based on the results from the NAWM, 2 multi-country models and 2 small open economy models with fixed interest rate.

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