Comparing Fiscal Consolidation Multipliers across Models in Europe*

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This paper employs fifteen dynamic macroeconomic models maintained within the European System of Central Banks to assess the macroeconomic effects of a temporary fiscal tightening when the zero lower bound (ZLB) on monetary policy holds for two years. The main results are as follows. First, the ZLB does not greatly affect short-run multipliers in the case of a temporary fiscal tightening implemented in isolation by a generic euro-area (EA) country. Second, the ZLB unfolds quite sizable effects on the size of multipliers if the same fiscal tightening measure is simultaneously implemented in the whole EA. Third, public consumption multipliers are typically larger in absolute value than short-run tax (on labor income, capital income, and consumption) multipliers. Fourth, recessionary effects of the initial fiscal tightening are lower if distortionary taxes are reduced in the medium and long run.

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1. Introduction

The Great Recession has triggered a new wave of research on evaluating fiscal multipliers when monetary stabilization policy is constrained by the zero lower bound (ZLB) on the monetary policy rate. In Europe, the Great Recession merged into the European sovereign debt crisis and the subsequent period of fiscal consolidations. In the case of the euro area (EA), consolidation was country specific and took place against the background of a union-wide monetary policy. This adds two intertwined issues to the academic and policy debate on fiscal multipliers: (i) the implementation, country specific or cross-country simultaneous, of fiscal measures in a monetary union and (ii) the interaction between fiscal measures and the union-wide ZLB holdings.

Our paper addresses these issues from a quantitative (positive) perspective. We employ fifteen structural, calibrated or estimated, macroeconomic models maintained within the European System of Central Banks (ESCB) to evaluate country-specific fiscal multipliers in correspondence of the ZLB on the union-wide monetary policy rate and of alternative fiscal consolidation plans.

Since our suite of models contains (i) models representing individual EA countries of different size, (ii) models of countries not belonging to the EA, and (iii) a model of the EA as a whole, we can assess how the fiscal multipliers of measures unilaterally enacted by an EA country or simultaneously implemented by all EA countries are affected by the union-wide monetary policy stance, in particular when the ZLB holds. The simulation of country-specific quantitative models allows us to reduce model uncertainty and increase the robustness of the results along key features of EA countries, such as size, degree of openness, and nominal and financial frictions.

In each of the simulated scenarios, we consider the effects of a standardized discretionary change in a single fiscal policy instrument on domestic real GDP at the country level or, because we simulate the model featuring the EA as a single entity, at the union-wide level. We compare scenarios in which the union-wide policy rate is determined by a Taylor rule with scenarios in which the policy rate is constrained by the ZLB during the first two years of the fiscal

tightening.[1] The change in the policy instrument amounts to 1 percent of baseline GDP and represents a tightening of the fiscal stance. Specifically, we consider a reduction in (unproductive) government consumption and increases in tax rates on households' labor income, capital income, and consumption. To assess the impact of the design of the fiscal plan on the short-run fiscal multipliers, we make alternative assumptions on the taxes that are reduced in the long run in correspondence of the fiscal room created by the initial fiscal tightening (in all simulations it is assumed that the debt-to-GDP ratio, after decreasing, gradually returns to the initial pre-shock level). The reduction is fully anticipated by households and firms and, thus, factored into their (short- and long-run) optimal decisions.

Our first main result, *common to all models of individual EA countries*, is that imposing the ZLB to bind for two years does not greatly affect short-run multipliers in the case of a temporary fiscal tightening implemented in isolation by a generic EA country. 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 EA economy. In contrast, and this is our second main result, the ZLB unfolds quite sizable effects on the size of multipliers if the same fiscal (tightening) measure is simultaneously implemented in the whole EA. In particular, short-run government consumption multipliers become larger than one. The same holds true for non-EA countries in which monetary policy is determined domestically. The third result is that government consumption multipliers are typically larger in absolute value than short-run tax (on labor income, capital income, and consumption) multipliers. In the short run, tax multipliers are in general negative and smaller than one in absolute value. This result is quite robust with respect to the considered country, the considered fiscal instrument, and the duration of the fiscal shock. The fourth result is that the short-run multipliers tend to be more favorable if in the long run the distortionary taxes are reduced to exploit the fiscal room created by the initial tightening, since households anticipate long-run effects at the outset of the simulations.

[1] The common nominal interest rate is set in response to union-wide inflation and economic activity, to which each EA country contributes according to its share of the union-wide GDP.

Finally, long-run multipliers are in general negative when the budgetary room materializing after the fiscal tightening is used to reduce lump-sum taxes. Instead, long-run multipliers are typically positive if the households' labor income tax rate is reduced in the medium to long term.

Our paper is most closely related to a small set of studies that examine the robustness of fiscal multiplier estimates among 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 EA. 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 ZLB 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 expansionary fiscal shocks. 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 the role of a monetary union, and they analyze fiscal stimulus programs instead of fiscal consolidation plans. Erceg and Lindé (2013) and Forni, Gerali, and Pisani (2010) evaluate fiscal consolidation in a monetary union, and Farhi and Werning (2016) study fiscal multipliers in a currency union with a liquidity trap. Different from them, we make a comprehensive cross-country assessment of fiscal multipliers in the EA, and find a set of rather robust results. The novelty of our study is that while previous studies investigate multipliers associated with expansionary fiscal shocks, we consider fiscal retrenchments. The sign of the fiscal shocks matters in particular in those situations where the economy is at the ZLB. Otherwise, the fiscal multipliers studied in this paper are not sign dependent.

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 Christiano, Eichenbaum, and Rebelo (2011), Cogan et al. (2010), Eggertsson (2011), and Woodford (2011). In particular, our results are qualitatively similar to those in Drautzburg and Uhlig (2015). Different from them, our aim is to find robust cross-country results

on the size of short-run fiscal multipliers in a monetary union, and in particular how they are affected by the common monetary policy stance and by the design of the fiscal consolidation.

The remainder of the paper is structured as follows. Section 2 summarizes the models used in the simulation exercises. Section 3 describes the simulations and presents the results. Section 4 summarizes the results of the sensitivity analysis. Finally, section 5 concludes.

2. Model Setup

We use fifteen quarterly models from national central banks (NCBs) and the European Central Bank (ECB) in the simulation exercises. Fourteen out of fifteen are New Keynesian dynamic general equilibrium models. Ten are calibrated and five are estimated. A complete list of the models is presented in table 9 in the appendix.

The majority of models from NCBs of EA countries are based on multi-country setups, namely those of Belgium, Estonia, France, Germany, Italy, Malta, Slovenia, and Spain. These models exhibit a "home" country, the rest of the EA (possibly subdivided), and in some cases the rest of the world. In these models the EA 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 setups, with an exogenous rest of the EA and/or rest of the world: the Czech Republic, Finland, Greece, Netherlands, Portugal, and Sweden. If the corresponding country is in the EA, monetary policy is assumed to be exogenous. If not, the monetary policy is set according to a standard Taylor rule.

Finally, the ECB's New Area-Wide Model (NAWM) has also been used. It is a two-country model of the EA 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 stabilize 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 it reacts also to deviations of the public

deficit or public consumption from the target. Typically, either the labor income tax or lump-sum transfers are used as the fiscal instrument. In some of the simulations, the choice of the fiscal rule has been left to the discretion of each country's modelers. However, whenever the fiscal rule becomes critical for the results, we harmonized the instrument that is specified by the rule across models.

In general, the models share the pros and cons of structural models that have recently been discussed in the literature; see, e.g., Blanchard (2016). The models are theoretically motivated and well suited to this type of policy analysis, in which the stock-flow consistency and aggregate resource constraint are key features of the analysis. At the same time, there are elements of interaction that models may not fully capture, such as the impact of sovereign risk on sovereign funding conditions and spillovers of sovereign risk to banking and to financial-sector lending.

2.1 Steady-State Values and Calibration

Key parameters and their calibration are listed in tables 10–12 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. The lowest import penetration is found for Greece and the largest is found for Estonia. The models also differ substantially in terms of how public expenditures are financed. As an example, in the German model the labor income tax revenues amount to 35 percent of GDP, while in Spain they account for only 7 percent of GDP. The steady-state values of the debt-to-GDP ratio vary from 0 percent to 120 percent. The models also vary in the degree of home bias in government consumption. Most of the models assume full home bias, as is typical in this type of setup, and only a few feature somewhat lower home bias of around 90 percent. Finally, the share of liquidity-constrained consumers, i.e., households that have at most limited ability to smooth consumption over time, varies between 0 to 40 percent.

Regarding the calibration of some key parameters, household preferences, investment (or capital) adjustment costs, price and wage stickiness, and the proportion of firms (workers) that index their

price (wage) to inflation are quite different among models:[2] the Frisch elasticity of labor 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.

3. Simulation Experiments and Results

In each of the simulation scenarios reported below, we consider the short-run 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 percent of baseline (pre-shock) GDP and represents a tightening of the fiscal stance. The tightening can be temporary (lasting for two years) or permanent. Specifically, we consider a reduction in government consumption and increases in the tax rate on households' labor income, capital income, and consumption. Fiscal items (including social security contributions) other than the ones subject to discretionary change are held constant.[3] In the medium to long run (after the initial two years), either lump-sum or labor income taxes are allowed to adjust according to the country-specific fiscal rules to stabilize 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 stabilizes 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' labor income tax rule.[4]

Monetary policy is harmonized across models, assuming that the short-term nominal interest rate is determined by the Taylor rule used in Gomes, Jacquinot, and Pisani (2012), where the policy rate

[2]Nominal rigidities are characterized by a Calvo parameter or, if the value is larger than one, by a Rotemberg adjustment cost parameter.

[3]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.

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

responds to EA-wide inflation and output growth.[5] We also assess fiscal multipliers when the ZLB holds, assuming that the Taylor rule is deactivated and the short-term nominal interest rate is held constant at its baseline level during the initial two years.

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

Broadly speaking, the term "fiscal multiplier" describes the effects of changes in fiscal instruments on real GDP. Typically, it is defined as the ratio of the change in real GDP to the change in the fiscal balance. In this paper, we compare the effects on real GDP of different fiscal instruments. We therefore normalize the fiscal impulses in the experiments so that the size of the discretionary shock in each case represents a decrease in public consumption or an increase in revenues equal to 1 percent of baseline, pre-consolidation GDP for two years or on a permanent basis. The first-year multiplier is calculated by averaging the change of output from quarter 1 to quarter 4,

$$\textit{First-year multiplier} = \frac{\sum_{i=1}^{4} \frac{\Delta y_{t+i}}{4}}{\sum_{i=1}^{4} \frac{\Delta f_{t+i}}{4}},$$

where Δy_{t+i} and Δf_{t+i}, respectively, refer to changes in output and the fiscal instrument, i.e., government expenditures or tax revenues in quarter i relative to their corresponding before-shock values. The second-year multiplier is calculated similarly, by averaging the effects from quarter 5 to quarter 8. The long-run multiplier is

$$\textit{Long-run multiplier} = \frac{\Delta y_T}{\Delta f_T},$$

where Δy_T and Δf_T measure the permanent, long-run steady-state changes in output and fiscal instrument, respectively.

In what follows we first report GDP multipliers for transitory changes in each fiscal instrument implemented unilaterally by a single country. Subsequently we present multipliers associated with

[5]The rule is specified as $R_t^4 = \phi_R(R_{t-1}^4) + (1-\phi_R)[\bar{R}^4 + \phi_\Pi(\prod_t^4 - \bar{\prod}^4)] + \phi_Y\left(\frac{y_t}{y_{t-1}} - 1\right)$, where R_t is the quarterly gross interest rate ($\bar{R}$ is the steady-state value), $\prod$ is the quarterly inflation rate ($\bar{\prod}$ is the steady-state value), and y is the output level. $0 < \phi_R < 1, \phi_\Pi, \phi_Y > 0$ are parameters.

Table 1. Short-Run Fiscal Multipliers: Temporary (Two-Year) Reduction in Government Consumption

	No ZLB		Two-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).

permanent changes in each fiscal instrument. In both cases, two years after the initial shock the country-specific fiscal rule starts to operate, gradually bringing the debt-to-GDP ratio or deficit-to-GDP ratio back to its target level (the initial pre-shock level).

3.1 Temporary Fiscal Shocks

3.1.1 Government Consumption

Table 1 shows the government consumption multipliers, i.e., the response of GDP to a temporary (two-year) decrease in government consumption.

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 5). In the second case, denoted "Two-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 items are held constant at their corresponding baseline levels, including the fiscal instrument during the first two years as the fiscal rule kicks in thereafter.

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, the Czech Republic, and Sweden.

The intuition for multipliers being lower than one in absolute value is based on the crowding-in effect on private-sector spending, which partially compensates for the reduction in public consumption. In the majority of models, private-sector consumption and investment (not reported) increase. The crowding-in effect is not very large in the case of EA countries. The country-specific real interest rate does not greatly decrease and, thus, does not contribute significantly to the crowding in of private demand. This is for two reasons. First, the monetary policy rate, set at the union-wide level, is not greatly reduced after a country-specific shock, because the latter has a small effect on EA inflation and economic activity. Second, the response of the country-specific inflation rate is rather contained, because prices are sticky in the short run and the lower aggregate demand is also matched by lower imports (trade channel). Finally, the positive wealth effect is relatively small, because the fiscal retrenchment is temporary and, thus, the reduction in the present value of future tax payments required to balance the government's budget is contained.

The multipliers being lower than one is a result robust also to the introduction of financial frictions. In the case of Portugal, the multipliers increase around 10 percent 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.

Overall, second-year multipliers are only to some extent lower in absolute terms than the first-year multipliers. Adjustment costs on investment, habit persistence in consumption, and nominal wage

and price rigidities make the positive response of private spending gradual.

Interestingly, this is a crucial result of the paper, for EA countries multipliers are lower than one also under the ZLB (the only exception is France, which exhibits a multiplier slightly larger than one). They are either unchanged or only slightly larger than in the case of the nominal interest rate set according to the Taylor rule. The intuition is that EA countries are de facto at the ZLB also when the area-wide Taylor rule holds. Specifically, in the case of EA country-specific fiscal retrenchment, responses of economic activity and inflation in the rest of the EA are muted and, thus, in the case of the active Taylor rule the EA-wide policy rate does not greatly change. Moreover, the ZLB lasts for a relatively small (but plausible) number of periods (eight quarters) and, thus, is not able to largely amplify the cross-country spillovers of the fiscal shock. Overall, the responses of the region-specific real interest rates (in the considered country and in the rest of the EA) are muted and similar in both scenarios.

To the opposite, the ZLB makes the difference in the case of the *area-wide* (simultaneous across EA countries) decrease in public consumption. In this case, obtained by simulating the NAWM, the EA policy rate is reduced in response to the decrease in EA inflation, which is larger than in the case of country-specific fiscal shocks. The interest rate response favors the crowding in of private spending. When the ZLB holds, the constant nominal interest rate and the decrease in EA inflation lead to a rather strong increase in the EA real interest rate that depresses private spending. Consistent with this intuition, multipliers become significantly larger when the ZLB binds in the case of the Czech Republic and Sweden, which have their own monetary policy, reaching values that are clearly larger than one.

3.1.2 Taxes

Households' Labor Income Tax Rate. Table 2 reports the short-run GDP multipliers in the case of a transitory (two-year) increase in the households' labor income tax rate.[6]

[6]For some simulations Czech and Dutch results are not available.

Table 2. Short-Run Fiscal Multipliers: Temporary (Two-Year) Increase in Households' Labor Income Tax Rate

	No ZLB		Two-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).

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 and 0.4 in the second year.

The labor tax multiplier is relatively small because it operates mainly through its effects on wealth (the permanent income is reduced, inducing an increase in labor effort) and incentives to substitute leisure for labor effort. As in the case of public consumption, the wealth effect is rather small because the fiscal measure is transitory. The role of income is emphasized also by the larger multipliers in some of those models that feature strong non-Ricardian features and thus relatively large consumption responses to current income.

This is the case for the models that include a relatively high percentage of liquidity-constrained consumers (Greece, Portugal, and the Czech Republic).[7]

Unlike in the scenario of public consumption reduction, a labor tax hike leads to an increase in the multiplier for the majority of countries when moving from the first to the second year. Similar to that scenario, this reflects the presence of nominal and real frictions, which leads to a gradual response of private demand to the labor income tax hike.

As in the case of government consumption, multipliers associated with country-specific tax increases are not greatly affected by the ZLB. For the majority of countries, the multipliers are slightly smaller when the nominal interest rate is held constant for two years. The reason is the rather contained increase in inflation (associated with negative supply side effects of higher labor taxes) and the fixed policy rate assumption holding for a relatively small number of periods. They result in a slight decrease in the real interest rate, partially limiting the decrease in aggregate demand. To the opposite, and similarly to the case of public consumption, the ZLB does affect multipliers relatively more when the fiscal retrenchment is implemented in the whole monetary union (see the NAWM-based results) and in countries that do not belong to a monetary union and have their own monetary policy, nominal exchange rate, and, thus, inflation, widely responding to the fiscal shock.[8]

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. There is no strong incentive to reduce investment

[7]To some extent, the size of the labor tax multiplier is also related to the share of labor income tax revenues to GDP and to the degree of wage indexation. For countries with a large labor income tax base, the multiplier tends to be smaller in absolute terms. This is explained by the fact that, e.g., labor supply reacts to a change in the labor income *tax rate*, whereby a change in the tax rate needs to be smaller for those countries with a large labor income tax base to achieve a 1 percent increase in the ratio of labor income tax revenues to GDP.

[8]Multipliers can greatly change because of the relatively large change in nominal exchange rate and inflation when the ZLB holds. See, for example, the results of the Swedish model, the discussion in Laséen and Svensson (2011), and Carlstrom, Fuerst, and Paustian (2012). The results from the ZLB experiments with the Swedish model should therefore be interpreted with some caution.

Table 3. Short-Run Fiscal Multipliers: Temporary (Two-Year) Increase in Capital Tax Rate

	No ZLB		Two-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).

since the increase in the capital income tax is transitory. Multipliers are also relatively low in the Portuguese case, in which credit market frictions work to propagate and amplify the negative impact on GDP (the higher capital income tax negatively affects entrepreneurial returns and, thus, increases leverage and the cost of external finance, which reduces investment).

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 utilization rate of capital and the price of capital that induce a strong negative response of output to the tax shock.

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.

Multipliers increase slightly under the two-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 EA. 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. In the Portuguese case, the presence of credit market frictions has a slight amplification effect on the multipliers, also creating some persistence effects. The increase in multipliers is much larger in the case of the EA-wide shock (see the NAWM results) and in the Swedish case, where the role of exchange rate (that appreciates) in shaping inflation (which widely decreases) and, thus, the real interest rate, is more relevant.[9]

Consumption Tax Rate. Table 4 reports the short-run output multipliers associated with a transitory (two-year) 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.

The differences reflect the calibration of the intertemporal elasticity of substitution and consumption habit persistence. Higher intertemporal 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 favor a gradual response of private consumption.

The ZLB does not change the overall picture significantly. The only exceptions are, again, the EA as a whole and Sweden, where the monetary policy rate strongly reacts to the changing inflation conditions.

3.2 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

[9] Concerning the effects for Sweden, the results under the ZLB should again be interpreted with some caution.

Table 4. Short-Run Fiscal Multipliers: Temporary (Two-Year) Increase in Consumption Tax Rate

	No ZLB		Two-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).

both the short- and long-run effects of discretionary changes in fiscal instruments. A permanent fiscal shock can be interpreted as "fiscal reform," or an "announced and fully credible fiscal plan," which permanently alters the fiscal structure of the economy. For instance, the combination of permanent reduction in government consumption and permanent reduction in labor 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 an opposite change in another type of tax represents a permanent change in the tax structure of the economy. As in previous simulations, the fiscal rule is deactivated in the first two years, and thereafter it becomes active again to stabilize the public debt and/or the deficit at their target values, which remain unchanged (thus, we do not consider the case of a permanent reduction in public debt and/or public deficit).

Table 5. Short- and Long-Run Fiscal Multipliers: Permanent Reduction in Government Consumption

Fiscal Rule:	Lump-Sum Tax			Households' Labor 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	—	—	—
Estonia	−0.65	−0.61	−0.68	−0.32	−0.22	0.84
Euro Area	−0.83	−0.62	−0.61	−0.46	−0.29	0.34
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).

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 taxes (benchmark assumption). In the second, arguably more plausible, case the fiscal rule is instead specified in terms of the (distortionary) households' labor income tax.

3.2.1 Government Consumption, Lump-Sum Tax Rule

The first three columns of table 5 contain the short- and long-run output multipliers for a permanent reduction in government consumption when lump-sum taxes endogenously adjust according to the fiscal rule.

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 more 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 year 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 labor supply of Ricardian households or affect relative prices in the long run, lower aggregate demand due to lower public expenditure leads to a negative GDP effect.

3.2.2 Government Consumption, Labor Tax Rule

The last three columns of table 5 contain the short- and long-run multipliers of a permanent reduction in government consumption when the households' labor income tax rate endogenously adjusts according to the fiscal rule. Short-run multipliers are generally smaller than in the case of the lump-sum tax rule. Lower future labor income taxes induce households to gradually substitute labor for leisure. The increase in labor makes capital more productive, inducing firms to increase demand for investment. There is also a positive wealth effect, which induces households to increase their demand of consumption goods.[10]

[10]In the German and Spanish models, the second-year multipliers are larger when labor taxes adjust. In the case of Germany, the labor supply elasticity is calibrated to a very large number (see tables 10 and 11 in the appendix), and thus households widely shift labor effort to the long run, when labor taxes are lower. In the case of Spain, the labor market is modeled following the search-matching literature. Also in this case households postpone their labor effort.

In contrast to the previous results, long-run multipliers are now positive and, in some cases, larger than one. The largest multiplier is equal to 1.6 (Portuguese model), the smallest to 0.1 (German model). Typically, multipliers turn positive after three to six years. The permanent reduction in the labor tax rate leads to an outward shift of labor 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 long-run multipliers tend to be smaller and, thus, economic benefits of the reform are smaller for those countries that have a higher import penetration, i.e., higher import-to-GDP ratio.

3.2.3 Distortionary Taxes, Lump-Sum Tax Rule

Table 6 contains the multipliers for a permanent increase in distortionary tax revenues when the fiscal rule is specified in terms of lump-sum taxes.

We first consider the permanent increase in labor 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. Short-run multipliers are in general larger than in the case of a transitory fiscal shock (see table 2). Long-run multipliers are negative as well and, in seven out of fifteen cases, larger than one in absolute value. As labor income taxation is distortionary, its increase induces households to reduce labor in favor of leisure. Moreover, the rather large negative wealth effect, due to the fact that the measure is permanent, induces households to reduce aggregate demand.

The estimates of short-run multipliers associated with capital income taxation vary quite a lot across 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 labor taxation. Long-run multipliers are larger than three in France, Greece, Slovenia, and Spain, and are equal to or larger than two in the EA, Belgium, Finland, Italy, and Portugal. In the long run, the physical capital fully adjusts to the new tax level, inducing a strong decline in labor and, thus, economic

Table 6. Short- and Long-Run Fiscal Multipliers: Permanent Increase in Tax Rate—Lump-Sum Taxes Adjust

Tax Rate:	Labor 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
Estonia	−0.56	−0.65	−0.60	−0.92	−0.76	−1.25	0.00	0.01	−0.16
Euro Area	−0.52	−0.66	−0.87	−1.69	−2.21	−2.56	−0.40	−0.45	−0.51
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).

activity. Both short-run and long-run multipliers tend to be larger (in absolute terms) for those countries in which the ratio of private investment to GDP 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.

Finally, the short-run multipliers associated with the consumption tax hike are between 0.0 and 0.5 in absolute value, while long-run multipliers are between 0 and 1. Long-run multipliers are larger than the short-run counterparts because habit formation in consumption leads to a gradual response of consumption to the increase in taxation. For the same reason, the multiplier is usually larger in the second year than in the first year.

3.2.4 Distortionary Taxes, Labor Tax Rule

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' labor 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 value than in the case of fiscal rules specified in terms of lump-sum taxes. In the case of Finland, the multiplier even becomes positive in the first year. The reason is that anticipation of the permanent reduction in labor taxation provides an incentive to gradually increase labor supply. This partially counterbalances the incentive to reduce investment associated with a higher taxation of capital.

Long-run multipliers are negative and, again, much larger than one in absolute value in most cases, given that investment is very elastic in the long run. Thus, the expansionary effects of lower labor taxation compensate only partially for 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 is specified in terms of the labor income tax instead of the lump-sum tax. In some cases they become positive (Estonia, Italy, Slovenia) due to the quick

Table 7. Short- and Long-Run Fiscal Multipliers: Permanent Increase in Tax Rate—Households' Labor 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	—	—	—	—	—	—
Estonia	−0.48	−0.64	−0.16	0.27	0.38	1.73
Euro Area	−1.23	−1.82	−1.17	−0.09	−0.17	0.33
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. Labor income tax rate adjusts in the long run. Portugal (ff) indicates the presence of financial frictions following Bernanke, Gertler, and Gilchrist (1999).

positive response of labor and the gradual decrease in consumption associated with habit. In the case of Estonia, the rather large multiplier is explained by strong competitiveness gains due to reduced labor costs, combined with the fact that trade effects in the Estonian model have a relatively large weight in the overall dynamics.

In contrast to the capital-income-tax-based scenario, the long-run consumption-tax-based multipliers are positive. Lower labor taxes favor 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. The latter have at most a limited ability to smooth consumption over time,

and thus are more affected by the negative income effect associated with the increase in consumption taxes. Thus, their reaction to the consumption tax hike is large.

4. Sensitivity Analysis

Results presented so far are based on the benchmark calibrations of the models (tables 10–12 in the appendix). In this section, we analyze 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 percent reduction in the degree of price stickiness
- 10 percent reduction in the degree of wage stickiness
- 50 percent reduction in households' risk aversion
- 50 percent increase in investment adjustment costs

The sensitivity analysis is conducted with and without the ZLB. It focuses on two scenarios: (i) a permanent reduction in government consumption and (ii) a permanent increase in labor income taxes. All other fiscal items are held constant. After two years, lump-sum taxes are allowed to adjust according to the fiscal rules. Only a subset of models was used (EA, Finland, Italy, Malta, Portugal, and Slovenia).

Table 8 reports the average short-run and long-run multipliers across models. Short-run multipliers become larger in absolute terms when there are more liquidity-constrained households, because they are less able to smooth consumption than unconstrained (Ricardian) 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

Table 8. Fiscal Multipliers: Sensitivity with Respect to Key Parameters

	Baseline	More Liquidity-Constrained Households	Less Price Stickiness	Less Wage Stickiness	Lower Risk Aversion	Higher Investment Adjustment Costs
A. Average Multipliers across Models in the First Two Years						
Government Consumption	−0.53	−0.70	−0.50	−0.51	−0.49	−0.54
Gov. Consumption + Two-Year ZLB	−0.59	−0.81	−0.59	−0.57	−0.56	−0.60
Labor Income Tax	−0.50	−0.56	−0.50	−0.53	−0.51	−0.51
Labor Income Tax + Two-Year ZLB	−0.55	−0.66	−0.58	−0.59	−0.58	−0.56
B. Average Long-Run Multipliers across Models						
Government Consumption	−0.56	−0.63	−0.56	−0.56	−0.47	−0.56
Labor 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, three multi-country models, and two small open economy models with fixed interest rate.

monetary policy response has a stronger effect, thereby lowering the absolute value of 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 1–7 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.

5. Conclusions

We have provided estimates of the size and sign of fiscal multipliers—both in the short run 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 provided a useful environment to study the driving factors of fiscal multipliers. Cross-country differences in fiscal multipliers can be traced back to 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 the 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 tax rate on households' labor income, capital income, and consumption.

The second robust finding is that a two-year-long ZLB episode has relatively small effects on the multipliers in the case of a temporary measure enacted by a single EA country. Cross-country spillovers are rather weak, and the response of EA inflation to the country-specific fiscal shocks is rather muted. In contrast, when the

same fiscal measure is simultaneously implemented by many EA members, 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-EA countries that exhibit a country-specific monetary policy rule.

Third, if fiscal measures are implemented permanently, short-run government consumption and consumption tax multipliers are smaller in absolute value than in the case of a temporary implementation. Long-run multipliers are in general negative when the budgetary room materializing after the fiscal tightening is used to adjust lump-sum taxes. Instead, long-run multipliers are typically positive if the households' labor 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 favorable when the budgetary room that materializes after the fiscal tightening is used to reduce distortionary taxes.

Finally, 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.

The suite-of-models approach followed in this paper makes results robust to model uncertainty. However, there are some important dimensions that are missing from the models. For instance, limitations of the exercise can be associated with (i) the role of fiscal consolidation (in a ZLB situation) in reducing spillovers of sovereign risk to private-sector credit (à la Corsetti, Kuester, and Maier 2011); (ii) the role of accompanying government support for banks, à la Kollman et al. (2013), and more generally the way in which the banking sector is modeled (or not) in the simulated models; and (iii) the likely mismeasurement of fiscal policy changes, as addressed by Guajardo, Leigh, and Pescatori (2011), whereby changes in fiscal policy aiming at deficit reduction should be separated from those responding to prospective economic conditions. As model development within the central banks progresses and models become richer in the above-mentioned dimensions, the general approach provided in this paper could be repeated in order to gain more understanding of the relevance of these missing elements for evaluating fiscal multipliers.

Appendix

Table 9. Simulated Models

Country	Model	Reference
Belgium	BE-3C	Jeanfils, Wouters, and de Walque (2012)
Czech Republic	g3	Ambrisko et al. (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 (2015)
Greece	BoGGEM	Papageorgiou (2014)
Italy	IDEA-BI-EAGLE	Forni, Gerali, and Pisani (2010)
Malta	EAGLE	Micallef (2013)
Netherlands	DELFI	De Nederlandsche Bank (2011)
Portugal	PESSOA	Almeida et al. (2013)
Slovenia	EAGLE	Gomes, Jacquinot, and Pisani (2010)
Spain	FiMod	Stähler and Thomas (2012)
Sweden	Ramses II	Adolfson et al. (2013)

Table 10. Elements of Calibration

	Belg.	Cz. Rep.	Estonia	EA	Finland
Name of the Model	BE-3C	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/Non-tradable 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
Labor 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

(*continued*)

Table 10. (Continued)

	Belg.	**Cz. Rep.**	**Estonia**	**EA**	**Finland**
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 Labor Supply	2.08	2.84	1.78	2.00	> 2
Habit	0.65	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 11. Elements of Calibration

	France	Germany	Greece	Italy	Malta
Name of the Model	EAGLE	GEAR	BoGGEM	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/Non-tradable 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
Labor 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

(*continued*)

Table 11. (Continued)

	France	Germany	Greece	Italy	Malta
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 Labor 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	*	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

*The model features real wage rigidity following Blanchard and Galí (2007).

Table 12. 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/Non-tradable 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
Labor 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

(*continued*)

Table 12. (Continued)

	Nether.*	Portugal	Slovenia	Spain	Sweden
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 Labor 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.

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