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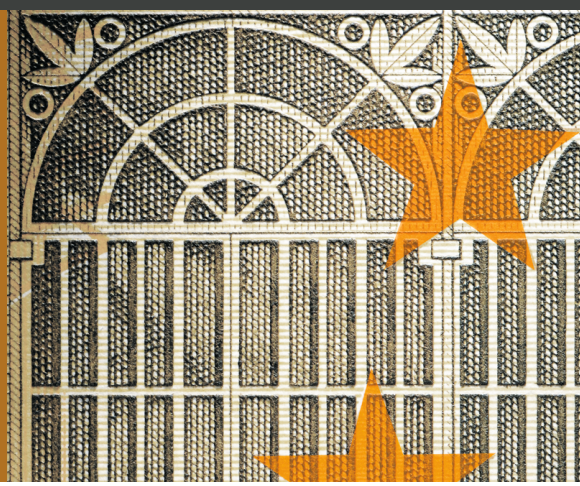

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Fiscal multipliers in a small euro area economy: How big can they get in crisis times?*

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July 2, 2013

Abstract

Using PESSOA, a small open economy DSGE model, we analyze the size of short-run fiscal multipliers associated with fiscal consolidation under two distinct alternative scenarios, *viz* "normal times" and "crisis times." The crisis times scenario embodies a higher share of hand-to-mouth households, stronger nominal rigidities, and more severe financial frictions, which purportedly better reflect the underlying economic environment during the "Great Recession." Results show that fiscal multipliers can be twice as large in crisis times, being approximately 2 for a government consumption-based fiscal consolidation in the first year. One-year ahead effects are also substantially larger if this type of consolidation is performed in crisis times. Revenue-based fiscal consolidations are also more recessive in crisis times, though the differences against normal times are less pronounced.

JEL Classification: E62, F41, H62
Keywords: Fiscal multipliers, crisis, DSGE model, euro area, monetary union, small open economy

*The views expressed in this article are those of the authors and do not necessarily reflect the views of Banco de Portugal. Any errors and mistakes are ours.

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1 Introduction

The large contractionary effects of fiscal consolidation across the globe during the "Great Recession" triggered the debate about the true size of fiscal multipliers in times of crisis. In a recent article, Blanchard and Leigh (2013) argue that fiscal multipliers associated with planned fiscal consolidations during the Great Recession are larger than those embodied in regular forecasting exercises by policy institutions. On the opposite direction, the authors find no evidence of systematic forecast errors related to planned fiscal policy changes in the pre-crisis period. This evidence suggests that fiscal multipliers may be substantially larger during severe downturns.

Recent empirical work, based on nonlinear frameworks, has already stressed the possibility of an asymmetric response of output to fiscal shocks, with several authors recognizing that fiscal multipliers are highly dependent on the underlying macroeconomic conditions and on the business cycle position (*e.g.* Corsetti, Meier, and Müller 2012; Auerbach and Gorodnichenko 2010, 2012; Baum, Poplawski-Ribeiro, and Weber 2012). Earlier empirical models based on linear approaches may have therefore underestimated the effects of government policies on output in recessions and overestimated it in expansions (Auerbach and Gorodnichenko 2012).

Using *PESSOA*, a small open economy DSGE model featuring non-Ricardian agents and financial frictions, we evaluate the sensitivity of short-run fiscal multipliers associated with fiscal consolidation to *(i)* the share of "hand-to-mouth" households; *(ii)* the degree of nominal rigidities; and *(iii)* the prevalence of financial frictions. These three key features are believed to display asymmetric developments in downturns and expansions.

Lower income, together with a poorly functional financial system, may lead to an increase in the number of hand-to-mouth households and therefore to larger fiscal multipliers, as the output response to changes in disposable income is magnified. Nominal wages may be rapid to adjust upwards, but slow to adjust downwards, if they react at all. During expansions, fiscal shocks are most probably absorbed by adjustments on the nominal side, as inflationary pressures tend to be swiftly channeled to nominal wages. During downturns, however, when nominal wages are under pressure to fall, stickiness emerges, and fiscal shocks originate adjustments on the real side, through decreases in employment. Nominal wage rigidities may therefore become binding during recessions (Auerbach and Gorodnichenko 2012; Shoag 2010). A similar argument can be applied to prices, as larger profit margins and higher inflation during expansions make firms more prone to adjust relative prices *vis-à-vis* employment, whereas smaller profit margins and lower inflation during downturns tend to be reflected into employment rather than in relative prices.

In addition, the asymmetric output response to fiscal shocks may be further magnified if recessive periods are also characterized by more severe financial frictions, as expected bankruptcy costs can increase dramatically (Levin, Natalucci, and Zakrajsek 2004) during such periods. A strong decline in aggregate demand increases financial distress and forces firms to cut back on investment in order to rebalance their balance sheets. The interaction

between financial and real variables has received an increased attention in the context of the Great Recession, as this was the first in recent history to have been triggered by problems in the financial system, namely in mature economies (Ozkan and Unsal 2012).

Our analysis differs from the existing literature in at least two key directions. First, the model is designed and calibrated for a small open economy integrated in a monetary union, in contrast with most DSGE models that address the size of fiscal multipliers. Hence, fiscal shocks do not generate any response from the monetary authority.[1] Second, we study the sensibility of output to shifts in several key parameters, which purportedly better reflect the underlying economic conditions during crisis times and may strengthen the size of fiscal multipliers. The exercise is carried out in a context where the government implements a credible fiscal consolidation that leads to a permanent decline in the debt-to-GDP ratio in the long run, in line with the policy decisions that are nowadays binding most advanced economies. To our best knowledge, such topic has not yet been covered within the same DSGE framework.[2] In addition, we consider also the interaction between financial frictions and fiscal shocks, a relatively novel topic that has been addressed in few studies (*e.g.* Anderson et al. 2013).

A key point implicit in our analysis is that the model's steady state, by being non-state contingent, does not capture by construction any drift in the underlying economic conditions associated with the business cycle position.[3] Business cycle fluctuations may however be accompanied by shifts in some key parameters that magnify or dampen the output response to shocks, such as fiscal shocks, originating asymmetric macroeconomic developments, as suggested by the empirical literature. To be as rigorous as possible, we compute fiscal multipliers—associated with both expenditure-based and revenue-based fiscal consolidations—conditional on two distinct steady states, *viz* "normal times" and "crisis times." The latter entails a higher share of hand-to-mouth households, stronger nominal rigidities, and more severe financial frictions. This approach ensures that calculations reflect only the fiscal multiplier, and hence the effects of parameter variations should be crystal clear.[4] The crisis times steady state can therefore be interpreted as a base-

[1] This is somewhat similar to the more standard case of a closed economy wherein the nominal interest rate binds at the zero-lower bound and fiscal shocks are transmitted in full to output (Eggertsson 2009; Christiano, Eichenbaum, and Rebelo 2011), or of an economy wherein the monetary authority accommodates fiscal shocks (Freedman et al. 2009).

[2] Coenen et al. (2012) analyze the effectiveness of a temporary fiscal stimulus using seven DSGE models from different by policymaking institutions. The authors conclude that different multipliers may be partly explained by differences in the population share of hand-to-mouth households and in the degree of nominal rigidities across models. However, the article does not address the effects of permanent changes in fiscal instruments, or how multipliers respond to changes in the underlying economic environment within the same model.

[3] As observed by Cogan et al. (2010), simulating a fiscal shock from the model's steady state or far below this level is irrelevant if there are no nonlinearities, but can make a difference under asymmetrical macroeconomic developments. Developing large scale state-contingent DSGE models is an extremely unrewarding task, as it greatly complicates the model's solution, calibration, and interpretation.

[4] A similar approach can be found in Christiano, Eichenbaum, and Rebelo (2011), and Woodford (2011), who mimic different monetary policy responses for distinct steady states. The macroeconomic effects of policy changes are only identified if the economy is assumed to be in some stationary situation; otherwise one cannot separate the cyclical effect, given by innovations in one or more parameters that capture conjunctural fluctuations, from the impact of fiscal shocks, given by innovations in policy variables.

line deviation from the normal times steady state that better reflects the macroeconomic environment during severe recessions.

Results suggest that fiscal multipliers can nearly double in crisis times for expenditure-based fiscal consolidations, and increase between 30 to 60 percent for revenue-based fiscal consolidations. For instance, the annual average government consumption multiplier is approximately 2 in crisis times in the first year, as opposed to a value slightly above 1 in normal times. One-year ahead multipliers are also substantially larger in periods of crisis, particularly for expenditure-based fiscal consolidations. Revenue-based consolidations are also more recessive in crisis times, though the differences against normal times are less pronounced. This is to a great extent explained by distinct price dynamics—depending on the fiscal instrument—that trigger different macroeconomic reactions to parameter shifts. In general, fiscal instruments that generate stronger downward inflationary pressures, such as those mostly depressing aggregate demand *vis-à-vis* aggregate supply, have their short-run multipliers further magnified in crisis times.

This article is structured as follows. Section 2 briefly reviews selected literature. Section 3 shortly describes the model. Section 4 presents and analyzes fiscal multipliers under a fiscal consolidation process. Section 5 concludes.

2 Selected literature overview

The literature on the size of fiscal multipliers is extensive and controversial, in both theoretical and empirical grounds. The controversy stems from the fact that there is no such thing as "a fiscal multiplier." In empirical studies, the size of the multiplier depends on the identification strategy, the country or group of countries analyzed, the time period, and the empirical model. The economic cycle, the type of fiscal instrument, the duration of the fiscal package, or even the credibility of fiscal measures play also a key role. The size of the multiplier is highly dependent on whether taxes, government expenditures, transfers, or some combination of these, are used, whether the fiscal package is deemed as temporary or permanent, or whether it implies some sort of fiscal consolidation with a permanent effect on government debt. It is therefore not surprising that empirical studies present a vast range of fiscal multipliers, which can hardly be compared with one another. Whereas authors that find low fiscal multipliers emphasize the role of Ricardian agents or market completeness, those that advocate larger fiscal multipliers stress the role of rule-of-thumb or hand-to-mouth households, non-Ricardian behavior, finite lifetimes, or nominal rigidities.

A great number of empirical studies (*e.g.* Barro 1981; Hall 1986; Perotti 2005; Barro and Redlick 2011) typically places the government spending multiplier within the 0.5–1 range, though other studies (*e.g.* Ramey and Shapiro 1998; Blanchard and Perotti 2002; Beetsma, Giuliodori, and Klaassen 2008; Beetsma and Giuliodori 2011; Ramey 2011b) suggest a higher interval, between 0.8–1.5.[5] Tax multipliers are addressed, *inter alia*, by

[5]See Hall (2009), Ramey (2011a), and Spilimbergo, Schindler, and Symansky (2009) for an overview of

Favero and Giavazzi (2012) and Perotti (2012), the former concluding in favor of a tax multiplier below one, and the latter in favor of a tax multiplier in the 1–1.5 range. These results contrast with those in Romer and Romer (2010), who estimate a tax multiplier comprised between 2.5 and 3. Chahrour, Schmitt-Grohe, and Uribe (2012) suggest that such contrasting results are explained by distinct estimation strategies, as different models identify different tax shocks. Ilzetzki, Mendoza, and Végh (2010) find that fiscal multipliers tend to be very small in the short run, but they are substantially larger, and potentially well above one, in the medium and long run.

In the theoretical front, most New-Keynesian models have been unable to generate multipliers substantially larger than one. This fact is explained to a great extent by several neoclassic features that are embodied in those models, namely the Ricardian behavior of households and the crowding-out effect of private consumption and investment, which contribute to partially offset the traditional Keynesian multiplier (*e.g.* Aiyagari, Christiano, and Eichenbaum 1992; Baxter and King 1993; Ramey and Shapiro 1998; Burnside, Eichenbaum, and Fisher 2004; Cogan et al. 2010).

In a recent article, Blanchard and Leigh (2013) argue that fiscal multipliers associated with planned fiscal consolidations during the Great Recession are about 0.7 to 1 percentage points larger than those embodied in forecasting exercises, but find no evidence of systematic forecast errors for the pre-crisis period. This study, alongside with the large contractionary effects of fiscal consolidation across the globe that are currently being observed, triggered the debate about the true size of fiscal multipliers in times of crisis, suggesting that they can therefore depend on the business cycle position of the economy.

The prevalence of state-contingent fiscal multipliers has already been addressed in a few studies, in both theoretical and empirical grounds. Using an empirical approach, Corsetti, Meier, and Müller (2012) find that the government consumption multiplier depends on the underlying economic conditions (such as the exchange rate regime, public indebtedness and the health of the financial system), being unusually high during a financial crisis. Auerbach and Gorodnichenko (2012) and Shoag (2010) attest that fiscal multipliers are larger when labor markets have slack, a fact that can be associated with a recessionary regime.[6] Earlier empirical models based on linear features may have therefore underestimated the effects of government consumption on output in recessions and overestimated it in expansions (Auerbach and Gorodnichenko 2012).[7]

Though DSGE models are mostly state independent, and thus unable to generate endogenously fiscal multipliers that are state contingent, recent theoretical work (Christiano, Eichenbaum, and Rebelo 2011; Woodford 2011) has put forward a potential explanation for the dependence of fiscal multipliers on the cyclical position of the economy. If the nom-

the literature.

[6] See also Baum, Poplawski-Ribeiro, and Weber (2012), Muir and Weber (2013), and Eyraud and Weber (2013).

[7] Several other studies address the sensibility of fiscal multipliers to the underlying economic conditions or to the degree of development in financial markets, though the business cycle position is often neglected (*e.g.* Corsetti, Kuester, and Müller 2011; Ilzetzki, Mendoza, and Végh 2010; Nakamura and Steinsson 2011; Favero, Giavazzi, and Perego 2011).

inal interest rate binds at the zero bound, the crowding-out effects of government spending over private consumption and private investment are reduced or even eliminated, and the fiscal multiplier can therefore take larger values, possibly larger than 2. This compares with a multiplier below 1 when monetary policy is governed by a Taylor rule at positive interest rates.[8] Galí, López-Salido, and Vallés (2007) were also able to generate government spending multipliers as high as 2 only if there are rule-of-thumb consumers in sufficient numbers and employment is demand determined.[9]

This article further explores the negative association between the size of fiscal multipliers and the state of the economy. We introduce an alternative, crisis times steady state—embodying a higher share of hand-to-mouth households, stronger nominal rigidities, and more severe financial frictions—which purportedly better reflects the underlying economic conditions during severe recessions, in line with recent evidence (*e.g.* Galí, López-Salido, and Vallés 2007; Shoag 2010; Krugman and Eggertsson 2011; Auerbach and Gorodnichenko 2012; Baum, Poplawski-Ribeiro, and Weber 2012). The present article is the follow up of our previous work on fiscal stimulus and consolidation (*e.g.* Almeida et al. 2010, 2013b).

3 A model for a small euro area economy

PESSOA is a New-Keynesian DSGE model for a monetarily-integrated small open economy. It features a multi-sectoral production structure, non-Ricardian characteristics, imperfect market competition, and a number of nominal and real rigidities that allow for realistic short-run dynamics and create room for welfare improving stabilization policies. In addition, the model contemplates financial frictions *à la* Bernanke, Gertler, and Gilchrist (1999), whereby financial shocks are transmitted and propagated to the real economy. This latter mechanism is particularly important for the study of the magnitude of fiscal multipliers in the context of a financial crisis, such as the Great Recession, since it may amplify the effects of fiscal shocks.

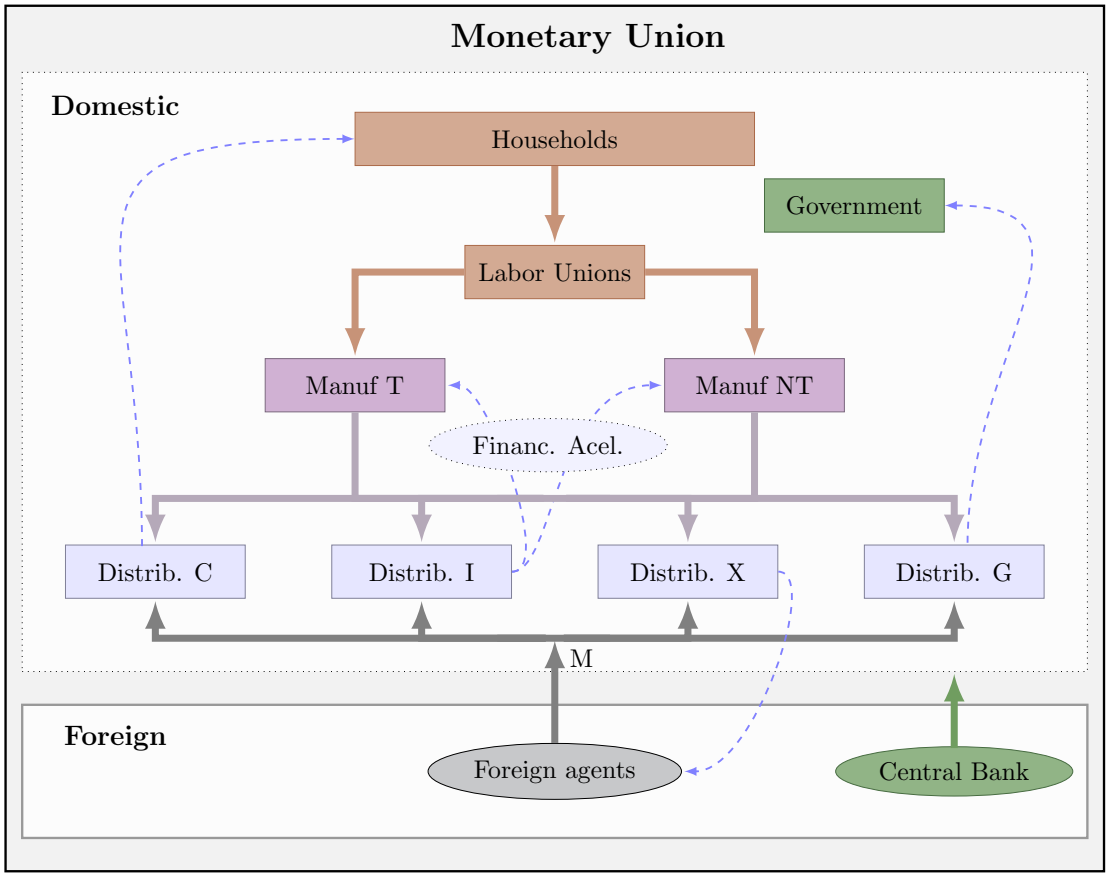
In *PESSOA*, monetary policy is set by the monetary union authority, *viz* the European Central Bank. The rest of the monetary union is immune to domestic shocks, a consequence of the small economy assumption. Hence, developments in euro area interest rates are orthogonal to domestic developments, as in Adolfson et al. (2007), and domestic interest rates can only deviate from the monetary union's reference rate by a risk premium. In addition, the nominal exchange rate *vis-à-vis* the rest of the monetary union is irrevocably set to unity. The euro area is assumed to last for the foreseeable future. For tractability, trade and financial flows are restricted to monetary union countries.

The economy is composed by nine types of agents: households, labor unions, capital goods producers, entrepreneurs, banks, intermediate goods producers (manufacturers),

[8] Some regime switching DSGE models have recently been developed (*e.g.* Kim and Nelson 1999; Liu and Mumtaz 2011; Liu, Waggoner, and Zha 2011), but they focus solely on different regimes in shock variances or policy variables (such as the inflation target).

[9] See also Monacelli and Perotti (2008).

Figure 1: *Interactions between agents in* PESSOA.



final goods producers (distributors), the government, and foreign agents (the rest of the monetary union). Figure 1 depicts the interactions between agents in *PESSOA*.

The rest of the section briefly reviews the main features of the model and the environment wherein each type of agent makes decisions. Additional details can be found in Almeida, Castro, and Félix (2010) and Almeida et al. (2013b), and the model's complete analytical solution in Almeida et al. (2013a).

3.1 Households

Households evolve according to the overlapping generations scheme first proposed in Blanchard (1985). They are subject to stochastic finite lifetimes and face an identical and constant probability of death, independent of age.[10] Population is constant, implying that in each period the number of newborn households equals the number of households that die. The overlapping generations framework is linked to a life insurance scheme along the lines in Yaari (1965), which ensures net wealth transfers from succumbing households to those that survive. Households rent labor services to a labor union, receiving in return a productivity adjusted wage rate, over which they pay a labor income tax. Labor produc-

[10]The probability of death can be also interpreted as the degree of "myopia" (Blanchard 1985; Frenkel and Razin 1996; Harrison et al. 2005; Bayoumi and Sgherri 2006). In other words, the future is seen as a period of lower economic relevance.

tivity is assumed to decay over lifetime at a constant rate, roughly mimicking the life-cycle income profile.

Two types of households coexist in the model: asset holders, who are able to smooth out consumption over their lifetime by trading assets; and hand-to-mouth households (*à la* Galí, López-Salido, and Vallés 2007), who have no access to asset markets and therefore consume all their income in each and every period. Both household types derive utility from consumption and leisure, according to a constant relative risk aversion utility function. It should be stressed that households discount future events at a higher rate *vis-à-vis* the market, as they face a positive probability of death.

Asset holders have four sources of income. First, they are remunerated for labor services rented to labor unions. Second, they receive dividends from firms and transfers from both the government and abroad. Third, they earn interest on their bond holdings. Besides foreign bonds, there are two types of domestic bonds: those issued by the national government and those issued by banks, which act as financial intermediaries by lending to entrepreneurs. Finally, asset holders receive a remuneration for financial services in the bankruptcy monitoring of firms, an activity which they perform at the request of financial intermediaries at no cost and with no effort whenever an entrepreneurial firm goes bankrupt. On the expenditure side, asset holders buy consumption goods and pay consumption and labor income taxes. The difference between expenditures and income is reflected in changes in their net asset position. Hand-to-mouth households consume in each and every period their current income, given by the after-tax wage income plus all transfers from both the government and abroad. They receive no dividends from firms.

Contrary to most general equilibrium models on small open economies, *PESSOA* has intrinsic non-Ricardian features. Asset holders are not indifferent as to financing government expenditure with tax levies or debt issuance (*i.e.* future taxes); in fact, they strongly prefer debt financing, since future taxes will be charged largely on yet-to-be born generations (Buiter 1988). Part of the debt held by current generations can therefore be used to finance private consumption during their lifetime, instead of being used to face future tax liabilities. Non-Ricardian effects are magnified by the life-cycle income profile, which shifts the proneness of agents towards paying taxes later, when labor income is lower, rather than sooner. Additionally, the prevalence of distortionary taxation on household consumption, labor, and capital income implies a preference for tax smoothing so as to minimize the intertemporal value of the deadweight loss, something that is achieved by managing the time path of debt, thus implying a deviation from the Ricardian Equivalence. The lack of access to asset markets by hand-to-mouth households is an additional non-Ricardian feature of the model.

It is well known that breaking the Ricardian equivalence is important to generate realistic private consumption responses to government expenditure shocks (Blanchard 1985; Galí, López-Salido, and Vallés 2007). The stochastic finite lifetime framework may generate sizeable wealth effects from public debt issuance, which are absent in the infinitely-lived agent framework (Frenkel and Razin 1996; Kumhof and Laxton 2009). In addition, the

stochastic finite lifetime framework allows the endogenous determination of the net foreign asset position of the economy, since finite lifetimes limit the amount of assets/debt that households can accumulate (Harrison et al. 2005). This generates a positive correlation between public debt and the net foreign debt position, representing thus an appealing feature for the simulation of permanent fiscal shocks.[11]

The utility maximization problem delivers a condition for each type of household that yields their optimal consumption-labor allocation and a consumption function that depends on current income, in the case of hand-to-mouth households, or on human and financial wealth, in the case of asset holders. Human wealth corresponds to the present discounted value of labor, transfers, and dividend income accruing in the future, while financial wealth corresponds to current domestic and foreign asset holdings. An interest rate parity condition resulting from portfolio optimization of asset holders defines the equilibrium in the bonds market. This no-arbitrage condition implies that the wedge between domestic and foreign interest rates corresponds to the risk premium for holding domestic assets.

3.2 Labor unions

Labor unions hire labor services from households and sell them to manufacturers operating in the intermediate goods market. Labor unions are perfectly competitive in the input market and monopolistically competitive in the output market—they charge a markup to manufacturers, therefore creating a wedge between the wage paid by these firms and the wage received by households. Market power arises from the fact that labor unions supply differentiated, imperfectly substitutable labor services. This modeling strategy—widely used in DSGE models—implies that households are rewarded for labor services in excess of their marginal rate of substitution between consumption and leisure. That is, they receive a wage premium from labor unions, corresponding to the markup, which does not affect their consumption-leisure choice. Labor unions face adjustment costs on wage changes in order to mimic the dynamics of sticky wage growth. The optimality condition resulting from their optimization problem yields a pricing rule, mapping wages paid to households to wages charged to manufacturers.

3.3 Firms

3.3.1 The non-financial sector: Manufacturers, distributors, and capital goods producers

The model's non-financial block includes manufacturers, distributors, and capital goods producers.

[11] On the contrary, in the infinitely-lived agents model, the steady-state net foreign asset position is pinned down exogenously (Schmitt-Grohe and Uribe 2003), implying that changes in the steady-state public debt are fully offset by changes in private savings, being therefore uncorrelated with net foreign debt. The link between fiscal consolidation and the current account balance has been assessed in IMF (2011).

Manufacturers combine capital, rented from entrepreneurs (capital goods producers in the model version with no financial frictions), with labor services, hired from labor unions, to produce an intermediate good, which is thereafter sold to distributors. There are two types of manufacturers: those producing tradable goods, and those producing nontradable goods. Manufacturers are perfectly competitive in the input market and monopolistically competitive in the output market, charging a markup over the marginal cost to distributors. The production process is based on a constant elasticity of substitution production function with labor augmenting technology. Inflation persistence and sluggish adjustment of hours worked are obtained through quadratic adjustment costs. Manufacturers pay social security taxes on their payroll and capital income taxes on profits. After-tax profits are distributed to asset holders in the form of dividends. The manufacturers' optimality conditions yield a pricing rule mapping the price charged to distributors to the marginal cost, a labor demand function, and a capital demand function.

Distributors produce four types of differentiated final goods, each acquired by a unique type of costumer: consumption goods are acquired by households, investment goods by capital goods producers, government consumption goods by the government, and export goods by foreign distributors. Final goods are produced in a two stage process, according to a constant elasticity of substitution production technology. In the first stage, distributors obtain assembled goods by combining domestic tradable goods with imported goods. This stage determines the demand for imports of the domestic economy. In the second stage, distributors combine assembled goods with domestic nontradable goods, obtaining the final good. Analogously to manufacturers, distributors are perfectly competitive in the input market and monopolistically competitive in the output market, charging a markup over the marginal cost to final costumers, and face price adjustment costs that generate inflation persistence. They pay capital income taxes on profits and distribute dividends to asset holders. Distributors' optimality conditions yield a demand for domestic tradable intermediate goods, domestic nontradable intermediate goods, and imported goods, and a pricing rule mapping the price charged to final costumers to the marginal cost.

Capital goods producers are the exclusive producers of capital in this economy. Before each production cycle, they buy the undepreciated capital stock from entrepreneurs (manufacturers in the model version with no financial frictions), combining it with investment goods bought from distributors, to produce new installed capital, which is thereafter sold to entrepreneurs (manufacturers). Capital goods producers face quadratic adjustment costs when changing investment levels and are assumed to operate in a perfectly competitive environment in both input and output markets. Their optimality condition yields a pricing rule, linking the price of capital (the price charged to entrepreneurs/manufacturers) to the cost of investment goods (the price paid to investment goods distributors).

3.3.2 The financial sector: Entrepreneurs and banks

The baseline model includes a financial transmission mechanism along the lines of Bernanke, Gertler, and Gilchrist (1999) and Christiano, Motto, and Rostagno (2010), whereby finan-

cial frictions affect the after-tax return on capital and therefore capital demand. The structure is based on Kumhof et al. (2010). Both normal times and crisis times are assumed to be characterized by financial frictions.

The financial sector is composed of two agents, entrepreneurs and banks. At the end of each period, entrepreneurs buy the new capital stock from capital goods producers, and rent it, partially or entirely, to manufacturers, for usage in the production process. They do not have access to sufficient internal funds to finance desired capital purchases, but can borrow the difference from banks at a cost. Each entrepreneur faces an idiosyncratic shock that changes the value of the firm after the balance sheet composition has been decided. If hit by a severe shock, the value of assets collapses, and the entrepreneur may be forced to declare bankruptcy, handing over the value of the firm to the bank. Contrarily, if hit by a propitious shock, the value of entrepreneur's assets rise, and her net worth increases as a result. The idiosyncratic risk is assumed to follow a lognormal distribution, and therefore some percentage of entrepreneurs goes bankrupt in each period. To ensure that the mass of entrepreneurs is kept constant through time, the same fraction of entrepreneurs is assumed to start a new business in the next period.

Entrepreneurs face two key decisions. First, they select the degree of leverage that maximizes the value of the firm, together with capital purchases. As net worth is taken as given, capital purchases directly determine the balance sheet composition and therefore leverage. In turn, the degree of leverage determines the relative risk of the firm and thus the probability of default. If leverage is low, the entrepreneur is able to face more adverse shocks, since losses are absorbed by net worth; if leverage is high, even small shocks to the firm value can have large implications in bankruptcy prospects. Consequently, as capital and leverage increase, so does the risks faced by financial intermediaries and therefore the cost of external finance.

Second, they must select the capital utilization rate that maximizes the present discounted value of after-tax profits related with the capital renting activity. Entrepreneurs may alter the fraction of capital that is rented to manufacturers by managing capital utilization, rather than by changing the capital stock that they demand from capital goods producers. The extent to which changing capital utilization is preferred to changing the capital stock depends on their relative costs. The optimality condition associated with capital utilization pins down the real rental rate of capital. Entrepreneurs pay a capital income tax on their profits. A fraction of net profits is kept in the firm as retained earnings, while the rest is distributed to asset holders as dividends.

Banks operate in a perfectly competitive environment, thus making zero *ex-ante* and *ex-post* profits at all times. They are pure financial intermediaries, with the sole mission of borrowing funds from asset holders and lending to entrepreneurs. If the entrepreneur goes bankrupt, the bank must pay monitoring costs (to asset holders) to be able to recover the value of the firm. Monitoring costs include all bankruptcy costs, such as auditing costs, asset liquidation or business interruption effects. Since capital acquisitions are risky, so are the loans of banks, who therefore charge a spread over the risk free rate

to cover for bankruptcy losses. The existence of identical *a priori* expectations on the idiosyncratic shock implies that the credit spread is identical for all entrepreneurs. Even though individual loans are risky, the aggregate portfolio of banks is risk free, since each bank is assumed to lend to many entrepreneurs, thus recovering through the credit spread what is lost to bankrupt entrepreneurs. In addition, the contract celebrated between the entrepreneur and the bank features a menu of state contingent interest rates, to be applied in all potential states of the world. Hence, if the economy is hit by a severe shock that increases the number of firms in financial distress or leads to larger bankruptcy losses, banks are able to charge higher interest rates on existing contracts, such that they still break-even *ex-post*. Households loans are therefore risk free at all times, and thus they lend to banks at the risk free rate.

The financial accelerator mechanism magnifies economic fluctuations, by creating an extra channel through which shocks are transmitted and propagated to the real economy. For instance, any shock originating a decrease in the price of capital increases also the number of entrepreneurs in financial distress and reduces the value of net worth for those that survive. As risk increases, so does the credit spread. With lower internal funds and higher borrowing costs, entrepreneurs acquire less physical capital. Investment is reduced, magnifying the fall in output and employment. The model therefore implies, realistically, a countercyclical credit spread, and procyclical consumption, investment, inflation, and employment, for aggregate demand shocks.

3.4 The government

The government buys consumption goods from distributors and performs lump-sum transfers across households. These activities are financed through tax levies on wage income, capital income, and households' consumption, and also through transfers from the euro area. The government may also issue one-period bonds to finance expenditures, paying an interest rate on public debt which is not necessarily equal to the monetary union's interest rate due to the existence of an exogenous country risk premium on domestic bonds. Taxes on wage income—henceforth referred to as labor taxes—include the labor income tax paid by employees and the payroll tax paid by manufacturers. The government's budget constraint is

$$B_t = i_{t-1}B_{t-1} + P_t^{\mathcal{G}}G_t + TRG_t - RV_t$$

where B_t denotes government bonds at time t, i_t is the domestic interest rate, $P_t^{\mathcal{G}}G_t$ is the nominal value of government purchases, TRG_t are lump-sum transfers, and finally, RV_t represents total government revenues. These are

$$RV_t = \sum_x \tau_t^x \cdot \left(\text{tax base}_t^x\right) + TRE_t$$

where τ_t^x is the tax rate levied on tax base$_t^x$—households' consumption, employees' labor income, manufacturers' payroll, and firms' capital income—at time t and TRE_t are transfers from abroad. We assume that all government debt is held by domestic asset holders, *i.e.* there is full home bias (markets are incomplete). Households can, however, borrow in international debt markets to buy domestic government bonds. Public debt allows the government to postpone tax levies required to finance public expenditure. This has a nontrivial impact on households' decisions, since part of the public debt is taken as net wealth by asset holders.

A fiscal rule, ensuring that debt follows a nonexplosive path, links the government debt-to-GDP ratio to a pre-determined debt target. Hence, deviations from that target are followed by tax adjustments or changes in public expenditures in order to restore long-run government debt to a sustainable path. The fiscal rule implies that at least one fiscal instrument adjusts endogenously. A common option relies on using the labor income tax rate as the endogenous fiscal policy instrument (Harrison et al. 2005; Kilponen, Kinnunen, and Ripatti 2006; Kumhof and Laxton 2007; Kumhof et al. 2010), though other possibilities—such as other tax rates, lump-sum transfers to households, government consumption or some combination of these—are also possible.

Although the above-mentioned fiscal block is suited to implement several fiscal simulations, the model remains a simplification of reality. Government consumption and investment are assumed to generate no externality, therefore not affecting the marginal utility of consumption and leisure, or the firms' productivity level. The only tangible impact of government consumption is on the demand conditions for a specific type of final good, which is particulary intensive in nontradable intermediate goods and has a low import content. The model is thus silent on other roles played by the government, in particular as a large-scale employer and investor, or on externalities associated with alternative fiscal policies. Notice also that the model does not feature unemployment benefits, since the labor market is not explicitly modeled.

3.5 The rest of the world

In *PESSOA*, the rest of the world corresponds to the rest of the monetary union, and thus the nominal effective exchange rate is irrevocably set to unity. The domestic economy interacts with the foreign economy *via* the goods market and the financial market. In the goods market, domestic distributors buy imported goods from abroad to be used in production. Likewise for foreign distributors, who buy export goods from domestic distributors. More specifically, the representative foreign distributor produces final goods by assembling domestic exports (*i.e.* foreign imports) and intermediate goods produced by foreign manufacturers. Foreign distributors are assumed to be identical to domestic ones and they face therefore a similar optimization problem. Domestic exports are essentially determined by the foreign distributors' imports demand, which, in turn, depends on price competitiveness and on foreign demand conditions exogenously determined.

The demand condition for domestic exports is fundamental to render the model dy-

namically stable. In particular, a large real exchange rate elasticity of exports is required. The model operates like a fixed nominal exchange rate model under perfect credibility, in which domestic price levels are pinned down by the external constraint that uniquely sets the real exchange rate in the steady state.[12] Moreover, the trade balance reflects final demand conditions and competitiveness of the domestic economy *vis-à-vis* the rest of the monetary union. All foreign variables, as well as monetary policy, are assumed to be unaffected by domestic developments.

In the international financial market, asset holders can trade assets to smooth out consumption. The small open economy approach implies that changes in the domestic net foreign asset position have negligible impacts on euro area aggregates and therefore on monetary policy decisions.

3.6 Market clearing conditions and GDP definition

The model is closed by a set of conditions imposing market clearing for each and every period. In the labor market, the wage received by households, the price charged by unions for labor services, and equilibrium labor, are jointly determined by the households' labor supply, the unions' pricing rule, and manufacturers' labor demand.

In the financial sector, total physical capital and its price follow from the equilibrium between the supply and the demand for capital, the former being decided by capital goods producers and the latter by entrepreneurs (manufacturers in the model version with no financial frictions). The stock of capital that is actually used by manufacturers in the production process may however differ from the total physical capital, since entrepreneurs set the fraction of the capital stock that is actually rented to manufacturers. The real rental rate of capital and the fraction of utilized capital result from the equilibrium between the manufacturers' demand and the entrepreneurs' supply of capital.

In the intermediate goods market, the price of tradable and nontradable goods follows from the equilibrium between manufacturers' supply and distributors' demand. The final goods price is determined by the equilibrium between the output produced by distributors and costumers' demand.

Nominal GDP is defined as the sum of expenditure components, *viz* consumption, investment, government spending, and net exports. In a frictionless international financial environment, financial flows are fully determined by national saving decisions at the prevailing interest rate, implying that changes in net foreign asset holdings must be identical to the current account balance.

[12] In the standard small open economy model, monetary policy is actively managed and the adjustment of real interest rate supplements the real exchange rate in rendering the model dynamically stable. In a small open economy within a monetary union, real interest rate dynamics tend to amplify demand driven business cycle fluctuations, due to the absence of monetary policy.

3.7 Calibration

PESSOA is calibrated to match Portuguese data. Besides historical data, calibration is based on information from studies on the Portuguese and euro area economies. Nonfinancial parameters and steady-state key ratios are based on Almeida, Castro, and Félix (2010) and Almeida et al. (2013b), with minor modifications. A detailed exposition of the calibration can be found therein. The financial sector is calibrated in line with Kumhof et al. (2010) and Christiano, Motto, and Rostagno (2010, 2013), and is presented in detail in Castro et al. (2013).

Baseline parameters underpinning the normal times scenario consider the standard calibration of the model. The crisis times scenario embodies a change in three key sets of parameters. First, the share of hand-to-mouth households is increased from 40 to 60 percent of total population. Second, nominal wage and price rigidities are raised, increasing the average contract duration by around 80 percent. Finally, the steady-state credit spread is doubled, from 4 to 8 percent, and steady-state leverage is increased by 25 percent, from 100 to 125 percent. These changes imply an increase in banks' monitoring costs from around 11 percent of the firm value in normal times to 22 percent in crisis times, in line with the results in Levin, Natalucci, and Zakrajsek (2004). The model's key ratios remain roughly unchanged between the normal times and the crisis times steady states.

4 Fiscal multipliers under a fiscal consolidation process

This section assesses the size of fiscal multipliers in normal and crisis times under a fiscal consolidation process. Each multiplier reflects the percentage change in real GDP against initial steady-state values, conditional on fiscal shocks that correspond in all cases to a permanent decrease of one percent of initial GDP.

The crisis times scenario embodies a higher share of hand-to-mouth households, stronger nominal rigidities, and more severe financial frictions, *vis-à-vis* normal times. These parameter shifts purportedly better reflect the underlying economic environment during crisis times. We consider the change in each set of parameters individually, so that the role played by each of them in the size of fiscal multipliers becomes completely clear, and analyze four types of fiscal instruments: government consumption and transfers to households on the expenditure side, and consumption and labor taxes on the revenue side.

Until the inception of the recent international crisis, the assumption that financial markets are complete and efficient seemed a reasonable approximation, at least in well-developed financial systems (Roger and Vlcek 2012). Negro and Schorfheide (2012), for instance, estimate modified versions of the Smets and Wouters model and report empirical evidence suggesting that a significant faction of the pre-crisis period can be more accurately forecasted by excluding financial frictions. On the opposite direction, other studies (*e.g.* Fornari and Stracca 2013; Villa 2013) show that financial shocks may play also an important role in explaining economic outcomes under normal economic conditions. We compute fiscal multipliers with and without financial frictions, so that their role in the

model's outcome is completely clear, but assume that financial friction also present in normal times.

The fiscal consolidation process considered herein consists in a permanent change in each one of the aforementioned fiscal instruments, with the objective of achieving a reduction of 25 percentage points in the government debt-to-GDP ratio in the long run. The permanent fiscal shock corresponds to 1 percent of the initial steady-state GDP. As fiscal consolidation leads to a lower level of government debt, interests outlays will decrease, providing the government with a fiscal buffer that is used to reduce government debt in the first 20 years. Thereafter, the government uses that additional fiscal buffer to reduce labor taxes, so that the government debt-to-GDP ratio smoothly converges to the new target level. This is implemented by switching on the fiscal rule 20 years after the shock.[13] Simulations assume perfect foresight, full credibility of fiscal authorities, and no implementation lags.

The analysis presented herein focuses only on short-run fiscal multipliers, namely on the impact of different fiscal consolidation strategies over the first 3 years. For the long-run effects of fiscal consolidation in a small euro area economy, see Almeida et al. (2013b).

4.1 Fiscal multipliers in "normal times"

Table 1 presents fiscal multipliers in normal times, for the first three years, of a fiscal consolidation. Results suggest that fiscal multipliers differ across instruments and time horizons, and that financial frictions have non-negligible macroeconomic impacts.

All fiscal tightening measures have a negative effect on GDP in the first year. Ignoring financial frictions, fiscal multipliers in the first year range from an annual average of 0.5, in the case of a decrease in transfers or an increase in taxes, to 1.0, in the case of a decrease in government consumption.[14] Government consumption feeds directly into aggregate demand, thus having a direct effect on output, whereas transfers or taxes operate mainly through current income and wealth, originating non-negligible leakages that are reflected into higher savings and imports and thus into lower multiplicative effects. From the second year onwards, the size of government expenditure multipliers is substantially reduced, as opposed to those associated with tax increases. In fact, taxes, and in particular labor taxes, affect incentives and decision-making, originating distortions that impact output negatively and more persistently.

Financial frictions amplify the size of expenditure-based fiscal multipliers between 20 and 25 percent in the first year. More specifically, the multiplier increases from 1.0 to 1.2 for a government consumption-based fiscal consolidation, and from 0.5 to 0.7 for a transfers-based one. In the second and third years, financial frictions magnify the output response to fiscal shocks only if government consumption is used as instrument, and dampen the expansionary effects of a reduction in transfers. Financial frictions play a

[13] Results are unaffected by the parameters of the fiscal rule, since agents perceive the changes in the fiscal instrument as very distant in time.

[14] Details for the first year fiscal multiplier are reported in Tables A.1 and A.2 in the appendix.

Table 1: *Fiscal multipliers in normal times*
(percentage deviation from initial steady state)

	Year 1	Year 2	Year 3
Decrease in government consumption	-1.2	-0.4	-0.4
of which:			
Baseline effect	-1.0	-0.1	-0.1
Financial frictions contribution	-0.2	-0.2	-0.3
Decrease in lump-sum transfers	-0.7	0.1	0.1
of which:			
Baseline effect	-0.5	0.2	0.3
Financial frictions contribution	-0.1	-0.2	-0.2
Increase in labor taxes	-0.5	-0.8	-0.8
of which:			
Baseline effect	-0.5	-0.9	-0.8
Financial frictions contribution	0.0	0.0	0.0
Increase in consumption tax rate	-0.5	-0.5	-0.5
of which:			
Baseline effect	-0.5	-0.4	-0.4
Financial frictions contribution	0.0	0.0	-0.1

Notes: Fiscal multipliers consider a permanent shock in each fiscal instrument corresponding to 1 percent of the initial steady-state GDP. The baseline effect corresponds to the multiplier of the model with no financial frictions. All figures represent annual averages.

lesser role in tax-based fiscal consolidations, as they have virtually no effect on the size of multipliers.

As monetary policy is exogenous, the effects on aggregate demand following a fiscal consolidation process are amplified by real interest rate developments. That is, a fiscal consolidation originating a downwards pressure on inflation leads to a larger increase in real interest rates *vis-à-vis* an economy where the monetary authority responds to demand conditions through a reduction in official interest rates. Asset holders face a larger wealth effect in the former case, as well as larger incentives to substitute current for future consumption, and the impacts of fiscal policy on private consumption and output are magnified through this channel. However, as inflation decreases against the initial steady-state level, so does the growth rate of the price of exported goods. The real exchange rate therefore depreciates. Besides shifting resources from the nontradable to the tradable sector, this expansionary effect counterbalances the rise in real interest rates.

Besides the direct effect in aggregate demand, a government consumption-based fiscal consolidation decreases the demand for intermediate goods, particularly nontradable goods, which are labor intensive. Labor demand and hours worked therefore decrease, as do real wages. This translates into a significant decline in households' current income and wealth and, consequently, in private consumption of both hand-to-mouth consumers and asset holders. The lower marginal costs of intermediate goods originate a domestic

price decrease, and therefore a significant real exchange rate depreciation. The economy experiences competitiveness gains, reflected into higher exports. This partly offsets the decline in both government consumption and private consumption, mainly after the first year. This type of consolidation has thus the largest impact on output in the first year, but the effects display little persistence. The cut in government consumption releases resources that can be allocated to other sectors, particularly to the tradable sector, where employment, capital, and production increase.

A decline in transfers to households operates directly *via* disposable income and wealth. Hand-to-mouth households are affected and become more willing to accept lower wages as they need to cope with lower income. Likewise for asset holders, who face a reduction in human wealth. Private consumption is thus negatively affected. Moreover, labor supply shifts outwards, leading to a decline in real wages, as well as in the manufacturer's marginal cost. Manufacturers therefore substitute capital for labor, given the change in inputs' relative prices, but they face also a reduction in intermediate goods' demand, which negatively affects the demand for both inputs. As a result, the number of hours worked in the economy is roughly unchanged in the first year, but the real wage falls sharply. Inflation decreases and the real exchange rate depreciates, thereby fostering exports. Competitiveness gains offset the negative output effects of the decline in transfers, particularly after the first year. In the second and third years, the economy is already fully recovered and fiscal multipliers become positive, in sharp contrast with other policy options, though the composition of GDP has changed: exports are now higher *vis-à-vis* the initial steady state, whereas private consumption is lower.[15]

By affecting the households' marginal rate of substitution, higher labor income taxes trigger a substitution effect from consumption to leisure, therefore originating a decrease in labor supply. Higher payroll taxes, in turn, induce manufacturers to substitute away from labor towards capital. In addition, as aggregate demand falls, so does the demand for both factors of production. Hence, wages, net of payroll taxes, remain roughly unchanged (as opposed to gross wages, which increase due to payroll taxes), but employment falls sharply. Capital also declines, despite the substitution effect. Households' disposable income and wealth therefore decline, leading to a reduction in private consumption. Likewise for investment, which is hampered due to lower capital accumulation. Contrarily to an expenditure-based fiscal consolidation, labor taxes distort decision-making by changing the consumption-labor allocation, and have thus protracted effects on the supply side. As a result, inflation remains roughly unchanged, and the economy experiences no competitiveness gains that could offset the effects of fiscal consolidation, in addition to a persistent decline in output. Notice also that the decline in output is magnified in the second year, a fact explained by several real rigidities that originate smooth adjustments of both employment and capital and few competitiveness gains. That is, adjustment costs on the real side prevent a swifter adjustment of output to the new demand conditions.

[15] In *PESSOA*, a cut in transfers shifts labor supply. In practice, however, transfers are to some extent targeted to pensioners, who do not actively supply labor. This feature is not captured by the model and may impose important limitations to labor supply impacts.

The fiscal multiplier of consumption taxes in the first year is similar to that of labor taxes, though it propagates through the economy differently. A hike in the consumption tax rate reduces the real value of households' wealth, and therefore private consumption. The wealth effect induces households to supply more labor, *ceteris paribus*. However, as demand falls, so does the manufacturers' demand for both labor and capital. The new labor market equilibrium yields a decline in hours worked—though in a lower extent *vis-à-vis* a labor tax-based fiscal consolidation—as well as a sharp decline in real wages. That is, a consumption tax-based fiscal consolidation originates larger nominal adjustments and smaller real adjustments in the labor market as compared to a labor tax-based one. In addition, even though a hike in the consumption tax rate generates inflation, the growth rate exported goods' prices, which are not subject to consumption taxes, declines. The economy therefore experiences some competitiveness gains, which attenuate the negative output effects of the fiscal consolidation and eliminate the magnification effect that is present from the second year onwards in the case of a labor tax-based fiscal consolidation. Competitiveness gains are however insufficient to revert the negative output effects in the medium term, as opposed to the outcome of an expenditure-based fiscal consolidation.

Financial frictions create an additional mechanism through which shocks are transmitted and propagated to the real economy. Lower government consumption reduces the demand for capital and thereby the price of capital, particularly in the nontradable goods sector. In addition, the real costs of external finance increase, since the lower inflationary pressures push the real interest rate upwards. Net worth declines and leverage increases as a result. Entrepreneurial projects become riskier, as entrepreneurs face a higher probability of financial distress, and banks demand larger credit spreads in order to break-even, to cover for higher expected losses. Entrepreneurial firms start therefore a deleveraging process, whereby capital demand and investment are reduced while they rebuilt lost net worth. This decline in investment originates an additional channel through which the fiscal consolidation process affects output, and explains the amplification effect associated with financial frictions. As it takes several years to rebuild lost net worth, financial frictions generate also more persistent effects. The mechanism is similar for a transfers-based fiscal consolidation, even though the amplification effect is weaker in this case, since transfers operate through households' disposable income and wealth, implying a smaller fall in demand and thus in the price of capital.

Financial frictions have virtually no effect on the size of fiscal multipliers for a revenue-based fiscal consolidation, though the explanation is different depending on the fiscal instrument. For a labor tax-based fiscal consolidation, there exists a persistent substitution effect from labor towards capital, explained by the payroll tax increase. The price of capital decreases only slightly, and the decline in net worth is thus not sufficient to generate a strong amplification effect. It is, however, sufficient to change marginally the composition of output and to induce no competitiveness loss. Entrepreneurs' dividends decrease alongside with net worth, and asset holders face therefore a negative wealth effect that partly mitigates the upwards shift in labor supply following the labor income tax increase. The

real wage, net of payroll taxes, decreases slightly—as opposed to the case with no financial frictions, where it remained roughly unchanged—leading to lower private consumption of both asset holders and hand-to-mouth households. This results in lower inflation.

A higher consumption tax rate increases inflation, thus originating a strong decline in real interest rates. This mitigates the increase in the credit spread and therefore in the external finance premium paid by entrepreneurs. Net worth is less affected as compared to expenditure based fiscal consolidations, despite the decline in the price of capital, and investment is therefore less hindered by the need to rebuild lost net worth.

All in all, the output effects of an expenditure-based fiscal tightening are short lived, as opposed to those arising from the a revenue-based one, which display great persistency. The former generates a stronger downward pressure on inflation, promoting stronger improvements in international competitiveness *vis-à-vis* the latter. These competitiveness gains offset the recessive impact of fiscal consolidation from the second year onwards. On the opposite direction, by distorting decisions, a tax based fiscal consolidation implies a protracted decline in output, private consumption, and investment.

4.2 Fiscal multipliers in "crisis times"

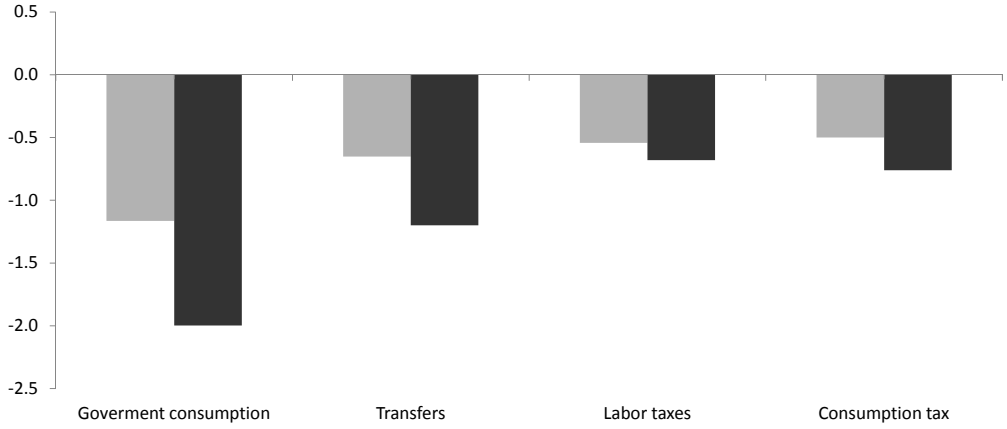
Fiscal multipliers in crisis times for the first three years are depicted in Figure 2. To ease comparisons, normal times fiscal multipliers are also presented. Table 2 shows the impacts of a higher share of hand-to-mouth households, stronger nominal rigidities, and more severe financial frictions, on the size of the crisis times multiplier.[16]

The average output effects in the first year of an expenditure-based fiscal consolidation are clearly larger during crisis times *vis-à-vis* normal times. A government consumption-based fiscal consolidation has an impact on output around 70 percent higher if carried out in a period of crisis, with the multiplier increasing from 1.2 to 2.0. If transfers are selected as the fiscal instrument, the fiscal multiplier increases around 85 percent, from 0.7 to 1.2. Multipliers increase also for a revenue-based fiscal consolidation, though to a lesser extent. An increase in the labor income tax raises the multiplier from 0.5 in normal times to 0.7 in crisis times, whereas an increase in consumption taxes raises the multiplier from 0.5 to 0.8. The increase in the magnitude of fiscal multipliers in crisis times is mostly explained by stronger nominal rigidities, and, to some extent, by more severe financial frictions. On the opposite direction, fiscal multipliers remain largely unresponsive to the share on hand-to-mouth households. One-year ahead fiscal multipliers are also negatively affected in periods of crisis, but results are reverted in the third year.

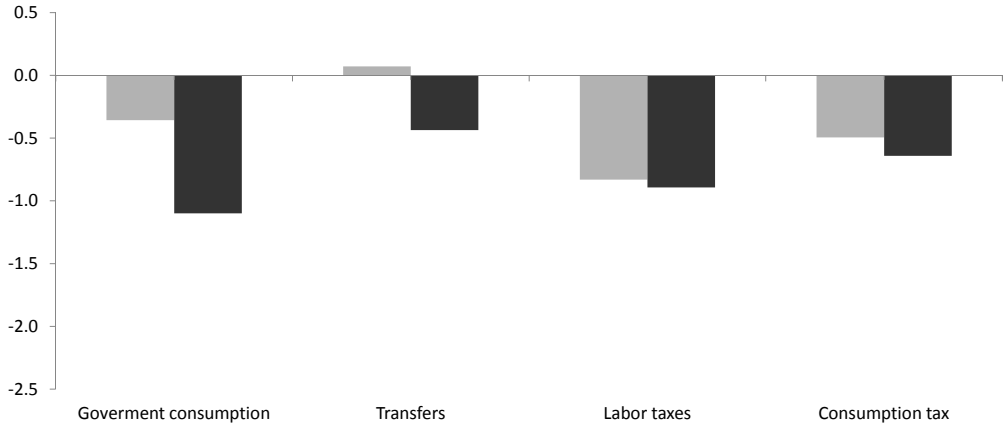
In the model, the fiscal rule is only activated twenty years after the beginning of the fiscal consolidation process. As asset holders are finitely lived (*i.e.* myopic), they discount future events at a higher rate *vis-à-vis* the market. They therefore perceive the future decrease in taxes, resulting from the lower level of debt, as very distant in time. For them, the debt reduction following the fiscal consolidation process represents a decline

[16] A detailed decomposition of the average output effects in the first year is provided in Tables B.1 to B.3, in the appendix.

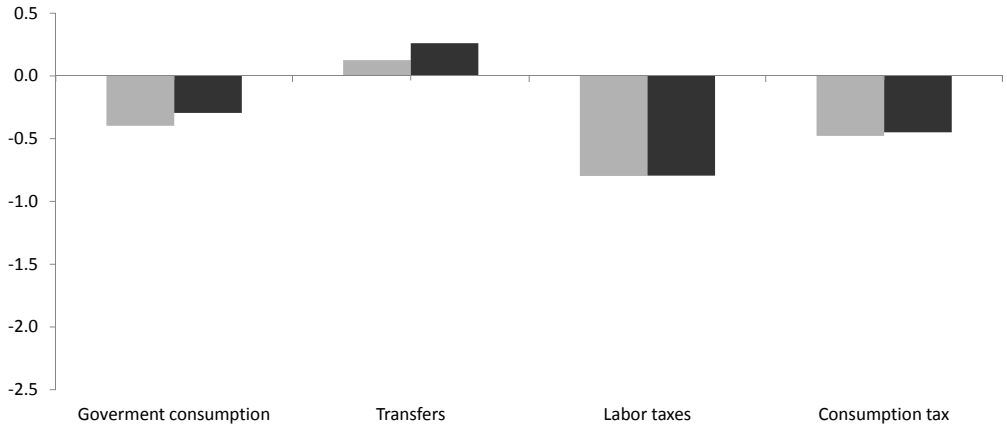
Figure 2: *Fiscal multipliers in normal and crisis times*
(percentage deviation from initial steady state)



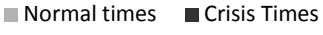
(a) 1st year fiscal multipliers



(b) 2nd year fiscal multipliers



(c) 3rd year fiscal multipliers



Note: Fiscal multipliers consider a permanent shock in each fiscal instrument corresponding to 1 percent of the initial steady-state GDP.

Table 2: *Fiscal multipliers in crisis times*
(percentage deviation from initial steady state)

	Year 1	Year 2	Year 3
Decrease in government consumption	-2.0	-1.1	-0.3
of which:			
Multiplier in normal times	-1.2	-0.4	-0.4
Higher share of "hand-to-mouth" consumers	0.0	0.0	0.0
Stronger nominal rigidities	-0.5	-0.5	0.3
More severe financial frictions	-0.4	-0.3	-0.2
Decrease in lump-sum transfers	-1.2	-0.4	0.3
of which:			
Multiplier in normal times	-0.7	0.1	0.1
Higher share of "hand-to-mouth" consumers	0.0	0.0	0.0
Stronger nominal rigidities	-0.4	-0.4	0.2
More severe financial frictions	-0.1	-0.1	-0.1
Increase in labor taxes	-0.7	-0.9	-0.8
of which:			
Multiplier in normal times	-0.5	-0.8	-0.8
Higher share of "hand-to-mouth" consumers	0.0	0.0	0.0
Stronger nominal rigidities	0.0	-0.1	0.0
More severe financial frictions	-0.1	0.0	0.0
Increase in consumption tax rate	-0.8	-0.6	-0.4
of which:			
Multiplier in normal times	-0.5	-0.5	-0.5
Higher share of "hand-to-mouth" consumers	0.0	0.0	0.0
Stronger nominal rigidities	-0.1	-0.1	0.0
More severe financial frictions	-0.1	0.0	0.0

Notes: Fiscal multipliers consider a permanent shock in each fiscal instrument corresponding to 1 percent of the initial steady-state GDP.

in wealth, as the benefits will be collected by yet-to-be born generations. Given that private consumption of both asset holders and hand-to-mouth households display similar responses to the fiscal consolidation process, changing their shares in total population affects output only marginally.[17]

Stronger wage and price rigidities lead to important increases in the size of fiscal multipliers in the first year, particularly for expenditure-based fiscal consolidations: from nearly 1.2 in normal times to 1.6 in crisis times for a decrease in government consumption, and from 0.7 to 1.1 for a decrease in transfers. As previously mentioned, an expenditure-based fiscal consolidation originates a strong downward pressure on both domestic inflation and output. However, stronger nominal rigidities increase the costs of adjusting from the nominal side *versus* the real side, and firms therefore decide to perform a larger share of the adjustment *via* quantities, rather then *via* prices. In addition, competitiveness gains take longer to be transmitted in full to the economy. The decline in output is therefore

[17]Results would be sensitive to the population share of hand-to-mouth households if the fiscal policy shock is temporary.

amplified in the first and second years after the shock, as opposed to prices, which present a more staggered adjustment. For the same reason, the decline in prices is also more persistent when nominal rigidities are more important, and thus households experience larger increases in real current income and wealth around the third year. By the same token, competitiveness gains are also larger in this time frame. The effects on output following the fiscal consolidation process are therefore reversed in the third year.

A labor tax-based fiscal consolidation has both strong demand and supply side effects, leaving inflation nearly unchanged. Stronger nominal rigidities have therefore no effect on firms' decisions, and consequently on the size of the fiscal multiplier. Nominal adjustments for a consumption tax-based fiscal consolidation are more important. Though higher consumption taxes generate inflation, the growth rate of prices, when measured at constant tax rates, declines. Stronger nominal rigidities affect therefore the rate at which prices and wages are adjusted, thus impacting the fiscal multiplier. The mechanism is similar to the one described above for an expenditure-based fiscal consolidation, though the effects at work are substantially weaker.

More severe financial frictions contribute also to amplify the size of fiscal multipliers during crisis times. The effects in the first year range from an increase of 12 percent, for the case of a labor tax-based fiscal consolidation, to 30 percent, for the case of a government consumption-based one. Intuitively, more severe financial frictions, by increasing agency costs, imply higher bankruptcy losses to financial intermediaries following a fiscal shock. Credit spread has therefore to increase even more for financial intermediaries to break-even. With more expensive credit, entrepreneurs cut back on capital acquisitions even further, implying a stronger fall in the price of capital, alongside with net worth. The additional slump in investment magnifies the output response to the fiscal shock. In addition, the larger fall in net worth contributes to foster the persistence of the shock, as investment will be lower while net worth reverts to the steady-state level *vis-à-vis* a scenario with baseline financial frictions.

Naturally, the effects are stronger the larger is the initial decline in the price of capital, which occurs for expenditure-based fiscal consolidation. In fact, an increase in labor taxes originates a substitution effect towards capital, preventing a strong decline in its price. Net worth is thus less affected, and the labor tax fiscal multiplier increases only slightly. Likewise for an increase in consumption taxes, though in this case the substitution effect is lower and therefore the amplification mechanism of credit markets is slightly stronger.

5 Concluding remarks

Using *PESSOA*—a small open economy DSGE model—we evaluate how big short-run fiscal multipliers, associated with a fiscal consolidation process, can get during crisis. The crisis times scenario is deemed as a situation embodying a higher share of hand-to-mouth households, stronger nominal rigidities, and more severe financial frictions *vis-à-vis* normal times. These changes purportedly better reflect the underlying economic environment

during severe slumps, such as the Great Recession.

Results show that contemporaneous fiscal multipliers increase in periods of crisis, though the effects are more significant for expenditure-based fiscal consolidations. The government consumption fiscal multiplier, in particular, increases from 1.2 in normal times, to around 2 in crisis times. The effects are also more persistent during crisis. These results are to a great extent explained by stronger nominal rigidities, which shift the adjustment from the nominal side to the real side, and by more severe financial frictions, which originate lower net capital accumulation. An higher share of hand-to-mouth households, on the other hand, has nearly no effect on the size of the fiscal multiplier, since asset holders respond to the decline in wealth following the debt reduction much in the same way as hand-to-mouth households respond to the reduction in current income.

In addition, fiscal instruments that generate greater downward inflationary pressures, such as those related to expenditure-based fiscal consolidations, have their short-run multipliers further magnified during crisis. In fact, the lower the inflationary pressure, the greater the role played by stronger nominal rigidities and by more severe financial frictions. The former prevents swift adjustments in the price level, originating stronger adjustments from the real side. The latter tends to be associated with larger declines in the price of capital, and therefore in net worth. Consequently, firms are forced to cut back on investment further in order to rebalance their financial position.

The results presented herein confirm that fiscal multipliers are largely conditional on the state of the economy, potentially changing in crisis times like the Great Recession. Hence, the output impacts of fiscal consolidation measures are expected to be bigger during severe recessions, as these tend to be associated with deeper changes in the underlying economic conditions.

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Appendices

A Normal times: macroeconomic impacts in the first year

Table A.1: *Selected impacts without financial frictions*

	Decrease in government consumption	Decrease in lump-sum transfers	Increase in labor taxes	Increase in consumption tax rate
GDP	-1.0	-0.5	-0.5	-0.4
Private consumption	-1.2	-2.2	-0.8	-1.1
Government consumption	-4.3	0.0	0.0	0.0
Private investment	-0.2	-0.1	-0.6	-0.4
Exports	1.6	1.8	-0.2	0.4
Imports	-1.0	-1.0	-0.4	-0.5
Hours	-1.0	-0.1	-0.6	-0.4
Real wage	-1.2	-1.4	0.0	-1.6
Real exchange rate	0.6	0.7	-0.1	0.2

Table A.2: *Selected impacts with financial frictions*

	Decrease in government consumption	Decrease in lump-sum transfers	Increase in labor taxes	Increase in consumption tax rate
GDP	-1.2	-0.7	-0.5	-0.5
Private consumption	-1.3	-2.3	-1.0	-1.2
Government consumption	-4.3	0.0	0.0	0.0
Private investment	-1.8	-1.3	-0.6	-0.7
Exports	1.8	2.0	0.0	0.6
Imports	-1.4	-1.3	-0.5	-0.7
Hours	-1.2	-0.2	-0.6	-0.5
Real wage	-1.3	-1.4	-0.1	-1.7
Real exchange rate	0.7	0.8	0.0	0.2

Notes: Reported outcomes in Tables A.1 and A.2 refer to percentage deviations from the initial steady state. Fiscal multipliers consider a permanent shock in each fiscal instrument corresponding to 1 percent of the initial steady-state GDP. An increase in the real exchange rate implies an depreciation. Table A.2 corresponds to the normal times scenario.

B Crisis times: macroeconomic impacts in the first year

Table B.1: *Selected impacts—Adding a higher share of hand-to-mouth consumers*

	Decrease in government consumption	Decrease in lump-sum transfers	Increase in labor taxes	Increase in consumption tax rate
GDP	-1.2	-0.7	-0.6	-0.5
Private consumption	-1.4	-2.3	-1.2	-1.4
Government consumption	-4.3	0.0	0.0	0.0
Private investment	-1.8	-1.2	-0.7	-0.7
Exports	1.9	2.0	0.1	0.7
Imports	-1.4	-1.3	-0.6	-0.7
Hours	-1.2	-0.2	-0.7	-0.5
Real wage	-1.4	-1.5	-0.2	-1.7
Real exchange rate	0.7	0.8	0.1	0.3

Table B.2: *Selected impacts—Adding stronger nominal rigidities*

	Decrease in government consumption	Decrease in lump-sum transfers	Increase in labor taxes	Increase in consumption tax rate
GDP	-1.7	-1.1	-0.6	-0.7
Private consumption	-1.7	-2.6	-1.2	-1.5
Government consumption	-4.3	0.0	0.0	0.0
Private investment	-2.4	-1.7	-0.7	-0.9
Exports	1.2	1.2	0.1	0.4
Imports	-1.6	-1.5	-0.6	-0.8
Hours	-1.9	-0.8	-0.7	-0.7
Real wage	-1.3	-1.3	-0.2	-1.9
Real exchange rate	0.5	0.5	0.0	0.2

Table B.3: *Selected impacts—Adding more severe financial frictions*

	Decrease in government consumption	Decrease in lump-sum transfers	Increase in labor taxes	Increase in consumption tax rate
GDP	-2.0	-1.2	-0.7	-0.8
Private consumption	-1.9	-2.6	-1.3	-1.6
Government consumption	-4.3	0.0	0.0	0.0
Private investment	-4.7	-2.7	-1.0	-1.4
Exports	1.3	1.2	0.2	0.5
Imports	-2.2	-1.7	-0.8	-1.0
Hours	-2.2	-0.9	-0.8	-0.8
Real wage	-1.6	-1.5	-0.3	-2.0
Real exchange rate	0.5	0.5	0.1	0.2

Notes: Reported outcomes in Tables B.1 to B.3 refer to percentage deviations from the initial steady state. Fiscal multipliers consider a permanent shock in each fiscal instrument corresponding to 1 percent of the initial steady-state GDP. An increase in the real exchange rate implies an depreciation. Results are commutative, *i.e.* Table B.1 adds a higher share of hand-to-mouth households to the normal times scenario, Table B.2 considers a higher share of hand-to-mouth households and stronger nominal rigidities, and finally, Table B.3 considers a higher share of hand-to-mouth households, stronger nominal rigidities, and more severe financial frictions. This latter case corresponds to the crisis times scenario.

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