Fiscal Multipliers, Monetary Policy and Sovereign Risk: A Structural Model-Based Assessment

Alberto Locarno*, Alessandro Notarpietro*, Massimiliano Pisani*

June 2013

Abstract

This paper provides a brief summary of the literature on fiscal multipliers and presents results for the Italian economy. The question of interest is whether an increase in government purchases leads to a greater than one-for-one increase in output, taking into account whether the zero lower bound is binding and whether initial conditions on public finances matter. Using a dynamic general equilibrium model for the Italian economy, we find that in general the government spending multiplier is lower than one, except when the monetary policy is stuck at the zero lower bound for an extended period of time. However, when the cost of borrowing for the sovereign is tightly linked to public finance conditions, the size of the government spending multiplier becomes much smaller. Tax multipliers are in all cases smaller than government consumption. Finally, we provide a tentative assessment of the fiscal consolidation measures adopted in Italy in 2011-2012 and find that the available evidence points to a much weaker impact on GDP that envisaged by the International Monetary Fund.

JEL Classification: E32, E52, E62.

Keywords: Fiscal multiplier, monetary policy, zero lower bound, sovereign risk.

Paper presented at the Workshop "The Sovereign Debt Crisis and the Euro Area" organized by the Bank of Italy and held in Rome on February 15, 2013. The proceedings are available at: http://www.bancaditalia.it/studiricerche/convegni/atti.

* Bank of Italy, Economic Outlook and Monetary Policy Department. Modeling and forecasting Division. E-mail: alberto.locarno@bancaditalia.it, alessandro.notarpietro@bancaditalia.it, massimiliano.pisani@bancaditalia.it.
We thank Fabio Canova and Francesco Nucci for useful comments and suggestions. The views expressed in the paper do not necessarily reflect those of the Banca d'Italia. All errors are the responsibility of the author.

1 Introduction

Until the outbreak of the 2007 financial crisis there was wide consensus that discretionary fiscal policy was an ineffective tool for stabilizing aggregate demand and fighting recessions. This view was justified by the realization that the lags in implementing fiscal policy were typically too long to be useful for combating cyclical downturns and was reinforced by the econometric evidence on the size of the fiscal multiplier, generally estimated to be small, especially if the fiscal stimulus was eventually tax-financed. The crisis shattered these beliefs and when monetary policy interest rates hit the dreaded "zero lower bound (ZLB)" in several countries, it became abundantly clear that the report about the death of discretionary fiscal policy had been greatly exaggerated.

This paper reconsiders the question of the effectiveness of fiscal policy as a demand-management tool, by evaluating the size of the fiscal multiplier under different macroeconomic conditions. The question of interest is whether an increase in government purchases leads to a greater than one-for-one increase in output.[1] Particular attention is devoted to explaining whether there are reasons to believe that the size of the fiscal multiplier is larger under Depression-like circumstances and whether the initial stock of public-sector debt matters.[2] Our contribution is twofold. First, we survey the main theories about the size of the fiscal multiplier and discuss the existing empirical evidence supporting or disconfirming the competing views on the effectiveness of government spending. Second, using the Banca d'Italia dynamic stochastic general equilibrium (DSGE) model we estimate the size of the fiscal multiplier in Italy under alternative assumptions about the stance of monetary policy, the financing of the fiscal expansion and the role of sovereign risk.[3] In so doing, we also provide a tentative assessment of the macroeconomic effects of the fiscal consolidation measures adopted in 2011-2012 in Italy.

We are mainly concerned with the short-term impact of fiscal expansions, but we provide also an assessment of their long-term effects. Our main conclusions are the following. First, short-run fiscal multipliers are typically below one and, in particular, multipliers associated with taxation are lower than those associated with public expenditure. Second, public spending multipliers are substantially larger than one when the monetary policy rate is kept constant at the ZLB, but only if the policy rate remains at the ZLB for a sufficiently long period of time (at least five years in our simulations). Third, under conditions similar to those currently prevailing in the euro area (EA), in countries with a high public debt, the stimulus induces a deterioration of public finances and hence a rapid increase in the sovereign risk premium, which in turn substantially reduces the size of the multiplier and the effectiveness of fiscal policy. Fourth, the short-run contractionary effects of fiscal consolidation efforts can be partially mitigated by a reduction in

[1] Government spending is treated as pure waste in the analysis, in order to focus on the pure macroeconomic effects of fiscal policy as a determinant of aggregate demand in the short run.

[2] The exchange rate regime may also affect the strength of a fiscal stimulus. Corsetti et al. (2012b) mention other factors, in particular trade openness and the health of the financial system. None of them is extensively considered in this paper.

[3] We consider Italy as an illustrative case. Our results should hold to a large extent also for other euro area countries characterized by high public debt and precarious financial conditions.

the risk premium.

The rest of the paper is organized as follows. Section 2 provides a summary of the literature on fiscal multipliers and presents related empirical evidence. Section 3 presents the model used in the simulations and elaborates on model calibration. Section 4 illustrates the simulation exercises and shows fiscal multipliers under different macroeconomic scenarios. Section 5 concludes.

2 Theory and evidence on the effects of government spending

Government spending can boost economic activity only if it increases hours worked: as the capital stock cannot instantaneously adjust and technical progress is unresponsive to fiscal stimuli, in the short run output can increase only if more labour is used in production. Thus, the value of the fiscal multiplier is tightly linked to the effect of government spending on hours worked, though the channels through which the former affects the latter vary according to whether a Keynesian or Neoclassical (viz. real-business cycle) perspective is adopted. The value of the fiscal multiplier depends on (i) the length of the policy stimulus; (ii) how the budget slippage is financed; (iii) whether the monetary policy responds or not (e.g. because the binding ZLB keeps the policy rate well above the desired level); (iv) which are the country's initial conditions (namely the extent of resources left idle by the lack of aggregate demand and the size of outstanding public debt). Each of them must be properly accounted for in order to provide a reliable assessment of the macroeconomic impact of a change in the discretional component of government spending.

2.1 Neoclassical approaches

According to the neoclassical paradigm, a debt-financed increase in government purchases - unexpected when it occurs but known to be permanent as soon as it is implemented - has a negative wealth effect on households, related to the expected payment of higher taxes in the future. Individuals respond by reducing consumption and leisure, as long as both are normal goods.[4] Because the increase in the labour input shifts up the marginal product schedule for capital, investment rises and remains higher than in the no-stimulus scenario; it stops increasing only when the pre-shock level of the capital-labour ratio is restored. In response to the upward jump in labour supply, the real wage declines and the rental rate of capital increases symmetrically; these factor-price movements are however temporary, as the accumulation of capital ultimately restores the original situation. According to Baxter and King (1993), the long-run fiscal multiplier is 1.16, corresponding to a 0.2 percentage point fall in consumption and a 0.3 rise

[4] The most-cited reference on this regard is Baxter and King (1993). The numbers for the fiscal multipliers quoted in this section refer to their paper. Under fairly general conditions, there is no difference between a debt-financed and a tax-financed fiscal stimulus, provided the latter is based on lump-sum taxes. Baxter and King (1993) consider a fiscal expansion financed by lump-sum taxes.

in investment;[5] welfare is unambiguously lower, as the representative agent consumes less and works more. Starkly different results are obtained when the increase in government spending is temporary.[6] As before, agents, who are hit by a negative wealth shock, save and work more; unlike before, investment falls, due to the increased government absorption of resources. On impact, output increases, though less that in the previous case. After T years, when public spending is back to the pre-stimulus level, investment jumps above its long-run level and gradually declines thereafter; consumption and leisure remain below the steady-state equilibrium level and so does output. Eventually, all variables revert to their steady-state level and the original equilibrium is restored. It is worth stressing that when the fiscal stimulus is withdrawn, output falls below the pre-shock level, reducing the growth rate of the economy, and stays there indefinitely.

Government purchases that are financed by means of distortionary taxes have radically different effects, as they lessen rather than boost output. The "stimulus" works as follows. First, the increase in tax rates creates a gap between marginal productivity and (net) factor compensation and hence reduces individuals' incentives to work and invest. Second, the fall in labour supply and capital accumulation compresses the tax base and calls for higher tax rates to balance the public-sector budget. Third, heavier fiscal duties depress output even more and force the government to find additional revenues. The downward spiral that ensues brings output well below the pre-shock level. According to Baxter and King (1993), the fiscal multiplier may become as low as -2.5, implying that private-sector spending is completely crowded out and tax distortions discourage work effort and capital accumulation.

In case of a tax-financed fiscal stimulus that lasts for T years, temporarily low after-tax factor rewards induce households and firms to increase leisure and postpone investment; output declines and remains below baseline for as long as the stimulus lasts. When the stimulus ends (and tax rates return to their normal level), hours worked and capital accumulation immediately increase, pushing output slightly above baseline. Eventually, the initial equilibrium is restored. To summarize, the Neoclassical theory provides three main insights: (1) permanent changes in government purchases exhibit a multiplier that is greater than 1;[7] (2) temporary fiscal stimuli are less effective, even in terms of the impact multiplier, which tends to be smaller than 1;[8] (3) financing decisions are of the utmost importance, as they can not only reduce the size of the multiplier, but also change its sign.

[5]As for the change in government spending, variations in consumption and investment are measured in terms of units of output.

[6]Once again it is assumed that the increase in government spending is unanticipated but, as soon as it occurs, it is know to last for T years.

[7]A short-run multiplier greater than 1 is also possible if the labour supply is highly elastic.

[8]The finding that temporary stimuli are less effective than permanent ones is not trivial. Barro (1981) and Hall (1980) reach opposite conclusions.

2.2 Keynesian approaches

Keynesian analysis focuses on situations in which aggregate demand is the binding constraint on production and employment. The essential policy implication of Keynesian analysis is that any increase in aggregate spending, from whatever source, will induce firms to expand production and draw workers into employment without necessitating any change in wages or prices. Under the assumptions that (i) the economy is closed; (ii) there is no capital; (iii) monetary policy does not respond to the fiscal stimulus; (iv) government spending is debt financed, then the multiplier corresponding to a permanent increase in government purchases is equal to the reciprocal of the marginal propensity to save. Allowing for foreign trade or for a response of the monetary policy maker, reduces the size of the output expansion; the opposite happens if capital accumulation is taken into account. Even if the fiscal stimulus is tax-financed, the multiplier remains positive and big, as the Haavelmo theorem shows.[9] If instead it is temporary, the size remains the same as in the permanent case, but it becomes zero as soon as the government stops spending. Accordingly, a temporary fiscal stimulus simply shifts aggregate demand from one period to another: first it provides a boost to growth, then it subtracts from it.

New Keynesian models generate predictions that are in-between those consistent with the Neoclassical and the Keynesian theories. Since New Keynesian models add sticky prices and other frictions to the real business cycle theory, neoclassical features tend to mute the Keynesian multiplier. Galí et al. (2007) show however that the traditional Keynesian predictions can be restored if two ingredients are added, namely: (1) a sufficiently high proportion of rule-of-thumb consumers, that helps increasing the marginal propensity to consume;[10] (2) an elastic labour supply, that makes workers willing to offer as many hours as firms demand.[11] Both assumptions however boil down to make the models heavily dependent on non-optimising behavior and are therefore not entirely appealing.

2.3 ZLB, hysteresis and (other) initial conditions

Monetary policy reacts to demand shocks that drive output and inflation up; accordingly, in normal times the value of the fiscal multiplier is low, as the fiscal stimulus is to a large extent offset by the response of the central bank. In severely depressed economies, in which the policy interest rate is well above the desired level because of the ZLB, this is no longer the case. A

[9] See Haavelmo (1945).

[10] Rule-of-thumb consumers are non-Ricardian. They consume just what they earn, regardless of the impact of government spending on the inter-temporal budget constraint. The higher the share of these non-optimizing agents, the lower the (negative) impact of wealth effects on consumption and the higher the multiplier.

[11] Households' labour-supply decision is driven by the intra-temporal equilibrium condition, which states that the marginal utility of leisure (u_l) must be equal to the (real) wage rate (w) times the marginal utility of consumption (u_c), i.e. $u_l = wu_c$. Because of the negative wealth effect of additional government spending, consumption falls and its marginal utility increases; to restore the equilibrium, either leisure has to diminish (i.e. hours worked have to increase) and/or the real wage has to fall. In the standard Neo-classical (i.e. real business cycle model) both things happen. By preventing the real wage to change, all the adjustment is born by the labour supply, that accordingly has to increase more, boosting the output response to a fiscal stimulus.

stream of the literature has recently resumed the Keynesian argument that government spending is likely to boost aggregate demand much more in times of recession than during booms, in particular when the monetary policy interest rate is stuck at the ZLB. Examples are Christiano et al. (2011), Eggertsson (2001) and Woodford (2011). The story runs as follows. An increase in government spending when the ZLB is strictly binding leads to a rise in output, marginal cost and expected inflation; with the nominal interest rate stuck at zero, the rise in expected inflation drives down the real interest rate, which drives up private spending; this rise in spending leads to a further rise in output, marginal cost, and expected inflation and a further decline in the real interest rate. The net result is a large rise in output and a large fall in the rate of deflation: the increase in government consumption counteracts the deflationary spiral associated with the ZLB state. The value of the government-spending multiplier depends on how long the ZLB is expected to be binding. Christiano et al. (2011) also respond to the practical objection that using fiscal policy to counteract a contraction associated with the ZLB state is unfeasible, as there are long lags in implementing increases in government spending: they state that the case for fiscal stimulus while the constraint binds applies only to the case in which the increased government purchases will be terminated as soon as the constraint ceases to bind.[12] Christiano et al. (2011) provide also some estimates, obtained with a DSGE model, of the size of the fiscal multiplier: under the assumption that government spending lasts for 12 quarters and the nominal interest rate remains constant, the impact multiplier is roughly 1.6 and reaches a peak value of about 2.3. However, large estimates of the spending multiplier implicitly rely upon the assumption that non-standard monetary policy measures are incapable of stimulating aggregate demand and preventing a deflationary spiral.

Another factor that may affect the size of the fiscal multiplier is the presence of hysteresis, especially in the labour market. The concept of hysteresis was borrowed by economists from its original application to physical systems. The key idea is that transitory causes may have permanent effects. The concept of hysteresis, first used by Blanchard and Summers (1986), has been recently revived by DeLong and Summers (2012). Their main claim is that in a depressed economy hysteresis is important and once it is taken into account, the impact on output of additional government purchases can become so large as to be self-financing. They define a depressed economy as one in which many workers are without employment for an extended period of time and as a consequence, many see their skills and their morale decay. A depressed economy is also one in which investment is low, the capital stock is growing slowly, if at all, and entrepreneurial exploration is low. These factors may affect future potential output, implying that a temporary shortage of aggregate demand may generate a permanent reduction in aggregate supply. Any policy that may avert such an outcome is therefore worth of being pursued; in particular, a temporary increase in government spending can not only have a large impact on output and help to end the recession, but can also ensure permanent output gains at no financial

[12]Woodford (2011) adds an additional condition, namely that the tax increase required to finance the budget deficit also occurs while the constraint binds.

cost.[13] As stressed by Blanchard and Leigh (2013), hysteresis effects bear upon the transmission of fiscal impulses in general, but are particularly strong during severe downturns.

Besides business cycle conditions, other initial conditions matter, in particular the state of public finances and the level of government debt. Blanchard (1990) proposes a model based on the idea that the size of the fiscal multiplier may be inversely related to the debt-to-gross domestic product (GDP) ratio. When a government consolidates its budget position, it affects expectations and thus consumption in two ways. First, the inter-temporal redistribution of taxes from the future to the present is likely to increase the tax burden of current taxpayers and reduce their consumption. This effect is the conventional one, and its strength depends on how much the economy departs from the benchmark of Ricardian equivalence. Second, by taking measures today, the government eliminates the need for larger, much more disruptive adjustments in the future; in so doing, it removes the danger of low output, increasing consumption as a consequence. Third, consolidation may be associated with a substantial drop in uncertainty, leading to a decrease (i) in precautionary savings and (ii) in the option value of waiting by consumers (to buy durables) and firms (to take investment decisions). The last two mechanisms are unconventional and may justify non-Keynesian effects of tighter fiscal policies. Symmetrically, if an increase in government purchases is perceived as putting under threat sustainability of public finances, it may have very small or even negative effects on output. Sutherland (1997) presents a model that shows how the power of fiscal policy to affect consumption can vary depending on the level of public debt. At moderate levels of debt, fiscal policy has the traditional Keynesian effects: current generations of consumers discount future taxes because they may not be alive at the time of the next debt stabilization policy. But when debt reaches extreme values current generations of consumers know that there is a high probability that they will be alive when the next stabilization programme is implemented. In these situations a fiscal deficit can have a contractionary effect on consumer spending. Nickel and Tudyka (2013) provide empirical evidence on the negative correlation between the size of the fiscal multiplier and the level of public debt. According to the authors, the private sector increasingly displays Ricardian features as the degree of indebtedness rises: for low levels of the debt-to-GDP ratio, consumers and firms neglect the inter-temporal budget constraint of the Government, while for higher levels of borrowing they appear to internalize the tax burden that is invariably associated with an expansion of government spending.

[13] DeLong and Summers (2012) provide an example showing that an incremental 1 dollar of government spending raises permanently future output by 0.015 if (1) the fiscal multiplier is 1.5; (ii) the average income tax rate is 33 percent; (iii) the real interest rate on long-term government debt is fixed at 1 percent.

2.4 Empirical evidence on the size of the fiscal multiplier

2.4.1 Pre-crisis estimates of the multiplier

Until recently, it seemed to be a well established fact that the government-spending multiplier was not substantially larger than one. Authors such as Hall (2009) argue that in the US the multiplier is in the range of 0.7 to 1.0, while authors such as Ramey (2011a) estimate the multiplier to be closer to 1.2.[14] In both studies the estimates are obtained by using structural VAR (SVAR) models, which suffer from difficult-to-solve identification problems.[15] Moreover, studies using aggregate data measure what happens on average when government spending changes: to assess the effect of a deficit-financed stimulus, one needs either to focus on periods in which taxes did not change significantly or to control for tax effects, which is far from easy, as the estimates of tax multipliers range from -0.5 to -5.0.[16]

Similar evidence is obtained with DSGE models: in standard new-Keynesian models the government-spending multiplier can be somewhat above or below one depending on the exact specification of agent's preferences, while in frictionless real-business-cycle models this multiplier is typically less than one.[17] Accordingly, due to limited fire-power, implementation lags and financing costs, fiscal policy was viewed until just a few years ago as a poor tool for aggregate-demand management. Things have changed since the 2007-2008 financial crisis, due also to the perceived powerlessness of monetary policy, stuck at the ZLB.

2.4.2 Recessions, depressions and the ZLB

The evidence on the size of the multiplier when monetary policy is at the ZLB is based on both calibrated DSGE models and more standard (and data-based) econometric techniques. Christiano et al. (2011) use a DSGE model whose parameters match the response of ten US

[14] Leigh et al. (2010) present estimates for 15 developed countries, including the US. They however consider not the standard government-purchases multiplier, but average multipliers, referring to fiscal packages consisting of a mixture of changes in transfers, taxes and purchases of goods and services. They find that a 1 percentage point of GDP fiscal consolidation on average reduces output after 2 years by half a percentage point (and increases the unemployment rate by 0.3).

[15] The critical issue is to distinguish changes in government spending that genuinely represent changes in the fiscal policy stance from those that are caused by economic events. One solution is to focus on military buildups, under the assumption that this type of spending is the least likely to respond to economic events. Nevertheless, as Ramey (2011b) points out, there is always the possibility that the events that lead to these buildups – e.g. the start of World War II and the start of the Cold War – could have other influences on the economy, apart from the effects on government spending, that could bias the estimates of the multiplier. For example, during World War II increased patriotism could have raised labour supply more than would be predicted by economic incentives and hence could have raised the multiplier. In contrast, rationing and capacity constraints during the world wars could have dampened the multiplier.

An additional factor complicating identification is that government spending shocks are most often anticipated, implying that the econometrician does not have all the information that individual agents may have. Thus, expectations of individual agents may not be based just on past information from the variables in the empirical model. Hence, the expectation or forecast errors cannot be the residuals of the model set up by the econometrician and, thus, the shocks of interest may not be forecast errors and may be nonfundamental. See Ramey (2011b) and Perotti (2011).

[16] Ramey (2011b) lists a number of studies tackling this issue.

[17] See e.g. the evidence presented in Cogan et al. (2010) and Coenen et al. (2012).

macro variables to (i) a neutral technology shock; (ii) a monetary impulse; and (iii) a capital-embodied technology shock. Their key findings are the following: first, when the central bank follows a Taylor rule, the value of the government spending multiplier is less than one, in line with most of the literature; second, when the nominal interest rate does not respond to the rise in government spending, the multiplier is much larger;[18] third, the value of the multiplier depends critically on how much government spending occurs in the period during which the nominal interest rate is constant. The evidence provided by Christiano et al. (2011) has been criticized on the grounds that it unduly relies on linearization around the steady-state for a case-study - i.e. the effects of fiscal policy when interest rates are at the ZLB - that is necessarily some distance from the steady-state. According to Braun et al. (2012), this mistake accounts for roughly one half of the estimated size of the fiscal multiplier. Auerbach and Gorodnichencko (2011) use regime-switching models and find large differences in the size of spending multipliers in recessions and expansions: the response in expansions never rises above 1 and soon falls below zero, while the response in recessions rises steadily, reaching a value of over 2.5 after 20 quarters.[19] Some aspects of their analysis are however unconvincing and cast a shadow on the reliability of their results: first, the peak of the GDP response is reached 20 periods after the shock, at the end of the forecast window, when output is apparently gaining further momentum; second, the government shock is still 1 percentage point of GDP higher than in the baseline after 20 periods, suggesting that the shock is permanent rather than transitory; third, the output and tax responses in expansions seem utterly unbelievable: at period 4, with taxes 1.5 percentage point of GDP below and government spending 2 percentage points of GDP above baseline, output is by and large unchanged.

The evidence presented in Ramey (2012) does not support the claim that the multiplier is higher when there is slack in the economy or when interest rates are at the ZLB. She studies the period 1933 to 1951, which is characterized by very low interest rates as well as very high unemployment rates. She estimates on monthly data the following regression:

$$\frac{\Delta Y_t}{Y_{t-1}} = \beta_0 + \beta_1 \frac{\Delta G_t}{Y_{t-1}} + \beta_2 \frac{\Delta Y_{t-1}}{Y_{t-2}} + I_t \left[\beta_3 + \beta_4 \frac{\Delta G_t}{Y_{t-1}} + \beta_5 \frac{\Delta Y_{t-1}}{Y_{t-2}} \right] + \varepsilon_t$$

where Y_t is output, G_t government spending and I_t a dummy variable equal to 1 in periods with high unemployment rates (i.e. larger than 7 percent) and zero otherwise. Unlike Auerbach and Gorodnichencko (2011), she finds that $\beta_4 \simeq 0$. Evidence reported in Ramey (2012) is supported by Owyang et al. (2013), who estimate essentially the same model but use (i) a longer sample period and (ii) a "news" variable (*viz.* the change in the expected present value of government spending in response to military events) rather than G_t: the multiplier is always below unity and, if anything, is slightly lower during the high unemployment state. Owyang et al. (2013)

[18]For example, for a 12-quarter hike in government spending the impact multiplier is roughly 1.6, with a peak value of about 2.3.

[19]It is worth stressing that none of the recessions in the sample (but maybe the last one) qualifies as a depression, in which the policy interest rate is at (or close to) the zero lower-bound.

estimate the same model also on Canadian data, finding this time results that are closer to those of obtained by Auerbach and Gorodnichencko (2011).

More recently, an article in the October 2012 World Economic Outlook of the International Monetary Fund (IMF), written by Blanchard and Leigh, presents evidence that the fiscal multiplier in the advanced economies may be considerably larger than had been assumed when fiscal austerity plans were set in train in most economies in 2010.[20] Using a sample including 28 advanced economies, Blanchard and Leigh regress the forecast error for real GDP growth during 2010-11 on forecasts of fiscal consolidation for 2010-11 that were made in early 2010. Under rational expectations, and assuming that the correct forecast model has been used, the coefficient on planned fiscal consolidation should be zero. Blanchard and Leigh find the coefficient on planned fiscal consolidation to be large, negative, and significant: the baseline estimate suggests that a planned fiscal consolidation of 1 percent of GDP is associated with a growth forecast error of about 1 percentage point (the estimates are in the range of 0.4 to 1.2 percentage points). As the multipliers underlying the growth forecasts made in early 2010 were about 0.5, their results indicate that multipliers have actually been in the 0.9 to 1.7 range. The Blanchard and Leigh study drew a lot of attention and a lot of criticisms. First, the estimates seem to be highly dependent on the inclusion in the sample of Greece and Germany. Second, the results were presented as general, but are limited to the specific time period chosen: the 2010 forecasts of deficits are not good predictors of errors in growth forecasts for 2010 or 2011 when the years are analyzed individually; its 2011 forecasts are not good predictors of anything.[21] Third, the size of the fiscal consolidation efforts assumed by the IMF in early 2010 underestimates the extent of the measures actually implemented. Fourth, the correlation between growth forecast errors and changes in the fiscal stance breaks down when increases in sovereign bond yields are included in the regression.[22] Fifth, the IMF analysis does not distinguish between budget expansions (in place in 2010) and fiscal tightenings (mostly enacted in 2011): usually the former are temporary, while the latter are permanent. The European Commission (2012a) estimates the same regression as the IMF for consolidating countries only and finds no correlation between growth forecast errors and changes in the fiscal stance. Sixth, multipliers differ greatly across countries and take different values depending on the credibility of the consolidation effort and on the response of sovereign risk premia.[23]

Blanchard and Leigh (2013) answer some, but not all, of the critiques raised against their analysis. They claim that their results are extremely robust and in particular do not depend on the inclusion of Germany and Greece in the sample; moreover, they assert that it is no surprise that estimating their model in different periods yields inconsistent results, as economic theory itself predicts that the fiscal multiplier depends on business cycle conditions and on the monetary

[20]The fiscal multiplier in this case does not refer to government purchases. It measures the output response to all the fiscal consolidation measures – on both the revenue and the expenditure side of the public-sector budget – adopted in the countries included in the IMF sample.

[21]On the two points, see Financial Times (2012).

[22]On the third and fourth point, see European Commission (2012a).

[23]See European Central Bank (2012).

policy stance; finally, they posit that sovereign risk premia respond to growth prospects, not to the fiscal stance, and accordingly consolidation measures, by weakening aggregate demand and economic activity, raise the cost of borrowing for governments and increase the multiplier.

2.4.3 Hysteresis

Regarding hysteresis, the evidence is scant at best. Concerning the DeLong and Summers (2012) example, one thing is worth stressing: the size of the hysteresis effects they assume - just 0.015 for each dollar of additional temporary government purchases - seems small, but it is not. In their example, the gains that can be reaped from a fiscal stimulus are permanent and their present value - based on a discount rate that is the same as the real interest rate they use for US long-term bonds - is 1.5, which is larger than the size of the shock itself. Is so large a gain achievable? According to an economist not insensitive to the virtues of expansionary fiscal policies, "massive, unsustainable deficit spending in the hopes that this will somehow generate a self-sustained recovery can be justified only by exotic stories about multiple equilibria, the sort of thing you would imagine only a professor could believe".[24]

2.4.4 Fiscal multipliers in high-debt countries and the sovereign risk channel

The evidence on the relevance of the debt/deficit position of a country on the size of the fiscal multiplier is mostly casual. The sovereign debt crisis has clearly shown that the leeway for governments in setting the stance of fiscal policy is limited: any action that is perceived as jeopardizing debt sustainability triggers immediately a punitive response of financial markets. In particular, for countries with dangerously weak fiscal finances it is to be expected that any attempt to increase public expenditures may spark an upward jump in the risk premium charged on their debt, reducing the output response to the fiscal stimulus, while the contrary is likely to happen for fiscal consolidation attempts.

Two studies by Perotti (1999) and Corsetti et al. (2012b) are however worth mentioning. Perotti (1999) lays out a simple model where government expenditure shocks have a positive, "Keynesian" correlation with private consumption in "normal" times, and a negative, "non-Keynesian" correlation in bad times. Symmetrically, tax shocks have a negative, Keynesian correlation in "normal" times and a positive, non-Keynesian correlation in bad times. What is needed to rationalize state-dependent fiscal multipliers of the type described above is a model in which the correlation between private consumption and shocks to government expenditure and revenues changes, depending on the initial conditions. The empirical model uses a 30-year long panel of 19 country members of the Organization for Economic Cooperation and Development (OECD) and distinguishes "good periods" and "bad periods", defined according to size of the cyclically-adjusted public debt and the probability of re-election of the incumbent government. The empirical evidence supports the claim that expenditure shocks have Keynesian effects at low

[24]Krugman (1999).

levels of debt, and non-Keynesian effects in the opposite circumstances. The evidence of a similar switch in the effects of tax shocks is less strong. Corsetti et al. (2012b) carry out an empirical exploration on a sample of 17 OECD countries (for the period 1975-2008) into the determinants of government spending multipliers, by studying how the fiscal transmission mechanism depends on the economic environment. In terms of conditioning factors, they focus on the exchange rate regime, the level of public debt and the deficit, and the occurrence of a financial crisis. They find that: (1) multipliers are virtually zero under "normal" conditions; (2) the exchange rate regime matters; (3) the fiscal multiplier increases markedly during times of financial crises, being 2.3 on impact and 2.9 at peak; (4) fiscal strains may take the multiplier into negative territory: the cumulative effects over the first 2 years are strongly negative, although the effects become weaker over longer horizons. The usual caveat on cross-country studies with small samples applies to the Corsetti et al. (2012b); moreover, the finding on the impact of financial crises on multipliers may be due to reverse causality, i.e. it may simply reflect the fact that in times of financial crisis, countries experience a large drop in output and government spending; finally, the response to a crisis should be quite different across countries, as larger ones have more fiscal rooms to implement counter-cyclical policies.

While it is clear that there are times and circumstances in which an increase in spending (or a reduction in taxation) may not only boost aggregate demand, but also raise borrowing costs, thus reducing the size of the fiscal multiplier, the evidence on this link is limited. Most empirical studies focus on countries with negligible default risk and postulate linear relationships, as if a country's initial conditions on the stock of outstanding debt were irrelevant. For the United States Laubach (2009) finds that a 1 percentage point increase in the projected deficit-to-GDP (debt-to-GDP) ratio raises long-term yields on Treasury bonds by 20 to 30 (3 to 4) basis point. Gruber and Kamin (2012) obtain similar results for OECD countries, but find no support for the hypothesis that changes in fiscal balances affect yields through their effect on perceived default risk. Attinasi et al. (2010) for the pre-2010 period estimate even lower responses of EA sovereign spreads to anticipated changes in government deficit and debt. A higher elasticity of sovereign risk premia to public finance conditions is found by Belhocine and Dell'Erba (2013), who estimate for 26 emerging countries the response of the yield to maturity of sovereign bonds to changes in the primary balance (to GDP ratio), allowing the response to depend on the level of the outstanding debt. They find that, for countries that have debt levels higher than 45 percent of GDP, a 1 percentage point worsening of the primary balance from its debt-stabilising level translates into a 53.69 basis-point increase in the cost of borrowing.

3 The model setup

The previous section reports the results for fiscal multipliers obtained in the literature. In particular, it is stressed that the size of the multipliers depends upon the stance of monetary policy and on the response of credit spread to changes in public debt and deficit. To further assess the role of these channels, in the results (see section 4) we will show the fiscal multipliers obtained by simulating a DSGE model of the Italian economy. Its main features are illustrated in this section.

The model represents a world economy composed by three regions: Italy, rest of the EA (REA) and rest of the world (RW). In each region there is a continuum of symmetric households and symmetric firms. Italian households are indexed by $j \in [0; s]$, households in the REA by $j^* \in (s; S]$, households in the RW by $j^{**} \in (S; 1]$.[25]

Italy and the REA share the currency and the monetary authority, that sets the nominal interest rate according to EA-wide variables. The presence of the RW outside the EA allows to assess the role of the nominal exchange rate and extra-EA trade in transmitting the shocks. In each region there are households and firms. Households consume a final good, which is a composite of intermediate nontradable and tradable goods. The latter are domestically produced or imported. Households trade a one-period nominal bond, denominated in euro. They also own domestic firms and use another final good (different from the final consumption good) to invest in physical capital. The latter is rented to domestic firms in a perfectly competitive market. All households supply differentiated labor services to domestic firms and act as wage setters in monopolistically competitive labor markets by charging a markup over their marginal rate of substitution between consumption and leisure.

On the production side, there are perfectly competitive firms that produce the two final goods (consumption and investment goods) and monopolistic firms that produce the intermediate goods. The two final goods are sold domestically and are produced combining all available intermediate goods using a constant-elasticity-of-substitution (CES) production function. The two resulting bundles can have different composition. Intermediate tradable and nontradable goods are produced combining domestic capital and labor, that are assumed to be mobile across sectors. Intermediate tradable goods can be sold domestically and abroad. Because intermediate goods are differentiated, firms have market power and restrict output to create excess profits. We also assume that markets for tradable goods are segmented, so that firms can set three different prices, one for each market. Similarly to other DSGE models of the EA (see, among the others, Christoffel et al. 2008 and Gomes et al. 2012), we include adjustment costs on real and nominal variables, ensuring that, in response to a shock, consumption, production and prices react in a gradual way. On the real side, habit preferences and quadratic costs prolong the adjustment of households consumption and investment, respectively. On the nominal side, quadratic costs make wages and prices sticky.[26]

In the following section we describe in detail the fiscal policy setup (the public sector budget constraint and the sovereign spread), the monetary policy setup, and the household's problem for the case of Italy. Similar equations, not reported to save on space, hold for other regions.

[25]The parameter s is the size of the Italian population, which is also equal to the number of firms in each Italian sector (final nontradable, intermediate tradable and intermediate nontradable). Similar assumptions holds for the REA and the RW.

[26]See Rotemberg (1982).

The only exception is the equation of the spread, that holds for Italy only.[27]

3.1 The fiscal authority

We report initially the budget constraint, the fiscal rule of the public sector and, subsequently, the sovereign spread.

3.1.1 Budget constraint and fiscal rule

Fiscal policy is set at the regional level. The government budget constraint is:

$$\left[\frac{B_{t+1}^{g}}{R_{t}^{H}}-B_{t}^{g}\right]=(1+\tau_{t}^{c})P_{N,t}C_{t}^{g}+Tr_{t}-T_{t} \tag{1}$$

where $B_t^g \geq 0$ is nominal public debt. It is a one-period nominal bond issued in the EA wide market that pays the gross nominal interest rate R_t^H. The variable C_t^g represents government purchases of goods and services, $Tr_t > 0$ (< 0) are lump-sum transfers (lump-sum taxes) to households. Consistent with the empirical evidence, C_t^g is fully biased towards the intermediate nontradable good. Hence it is multiplied by the corresponding price index $P_{N,t}$.[28]

We assume that the same tax rates apply to every household. Total government revenues T_t from distortionary taxation are given by the following identity:

$$T_{t}\equiv\int_{0}^{s}\left(\tau_{t}^{\ell}W_{t}\left(j\right)L_{t}\left(j\right)+\tau_{t}^{k}\left(R_{t}^{k}K_{t-1}\left(j\right)+\frac{\Pi_{t}^{P}}{s}\right)+\tau_{t}^{c}P_{t}C_{t}\left(j\right)\right)dj-\tau_{t}^{c}P_{N,t}C_{t}^{g} \tag{2}$$

where τ_t^ℓ is the tax rate on individual labor income $W_t(j)\,L_t(j)$, τ_t^k on capital income $R_t^k K_{t-1}(j)+\Pi_t^P/s$ and τ_t^c on consumption $C_t(j)$. The variable $W_t(j)$ represents the individual nominal wage, $L_t(j)$ is individual amount of hours worked, R_t^k is the rental rate of existing physical capital stock $K_{t-1}(j)$, Π_t^P stands for dividends from ownership of domestic monopolistic firms (they are equally shared across households) and P_t is the price of the consumption bundle.

The government follows a fiscal rule defined on a single fiscal instrument to bring the public debt as a percent of domestic GDP, $b^g > 0$, in line with its target $\bar{b}^g$ and to limit the increase in public deficit as ratio to GDP (b_t^g/b_{t-1}^g):[29]

$$\frac{i_{t}}{i_{t-1}}=\left(\frac{b_{t}^{g}}{\bar{b}^{g}}\right)^{\phi_{1}}\left(\frac{b_{t}^{g}}{b_{t-1}^{g}}\right)^{\phi_{2}} \tag{4}$$

[27] In the Appendix we lay down the rest of the model.

[28] See Corsetti and Mueller (2006, 2008).

[29] The definition of nominal GDP is:

$$GDP_{t}=P_{t}C_{t}+P_{t}^{I}I_{t}+P_{N,t}C_{t}^{g}+P_{t}^{EXP}EXP_{t}-P_{t}^{IMP}IMP_{t} \tag{3}$$

where P_t, P_t^I, P_t^{EXP}, P_t^{IMP} are prices of consumption, investment, exports and imports, respectively.

where i_t is one of the five fiscal instruments among three tax rates $(\tau_t^\ell, \tau_t^k, \tau_t^c)$ and the two expenditure items (C_t^g, Tr_t). Parameters ϕ_1, ϕ_2 are lower than zero when the rule is defined on an expenditure item calling for a reduction in expenditures whenever the debt level is above target and for a larger reduction whenever the dynamics of the debt is not converging. To the contrary, they are greater than zero when the rule is on tax rates.

3.1.2 Sovereign spread

The interest rate paid by the Italian government and Italian households when borrowing is determined as a spread over the EA risk-free nominal interest rate (which is set by the central bank of the EA). Following Corsetti et al. (2012a), the (gross) spread reflects the risk of sovereign default and is linked to (expected) variations in the fiscal stance as follows:

$$spread_t^H \equiv E_t\left[\left(\frac{b_{t+1}^g}{b_t^g}\right)^{\psi_b}\right] \tag{5}$$

The term on the right-hand side includes (expected) changes in the Italian public debt-to-GDP ratio, where $0 < \psi_b < 1$ is a parameter and $b_{t+1}^g > 0$ is the Italian public debt-to-GDP ratio at the beginning of period $t+1$. As such, the (gross) interest rate R^H paid by the Italian government is:

$$R_t^H \equiv R_t * spread_t^H \tag{6}$$

where R_t is the (gross) risk-free nominal interest rate. The spread also affects the intertemporal choices of the Italian households through the standard Euler equation, as reported later.

3.2 Monetary authority

The monetary authority controls the short-term policy rate R_t according to a Taylor rule of the form:

$$\left(\frac{R_t}{\bar{R}}\right) = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\rho_R} (\Pi_{EA,t})^{(1-\rho_R)\rho_\pi} \left(\frac{GDP_{EA,t}}{GDP_{EA,t-1}}\right)^{(1-\rho_R)\rho_{GDP}} \tag{7}$$

The parameter ρ_R $(0 < \rho_R < 1)$ captures inertia in interest rate setting, while the term $\bar{R}$ represents the steady state gross nominal policy rate. The parameters ρ_π and ρ_{GDP} are respectively the weights of EA CPI inflation rate $(\Pi_{EA,t})$ and GDP $(GDP_{EA,t})$. The CPI inflation rate is a geometric average of CPI inflation rates in Italy and the REA (respectively Π_t and Π_t^*) with weights equal to the correspondent country size (as a share of the EA):

$$\Pi_{EA,t} \equiv (\Pi_t)^{\frac{s}{s+S}} (\Pi_t^*)^{\frac{S}{s+S}} \tag{8}$$

The EA GDP, $GDP_{EA,t}$, is the sum of the Italian and REA GDPs (respectively GDP_t and GDP_t^*):

$$GDP_{EA,t} \equiv GDP_t + rer_t * GDP_t^* \tag{9}$$

where rer_t is the Italian-to-REA bilateral real exchange rate, defined as the ratio of REA to Italian consumer prices. In some simulations, the interest rate will be held constant at its steady state value for several periods, instead of following the Taylor rule (7), that eventually kicks in the future. In this way it is possible to assess the role of the monetary policy stance for the size of fiscal multipliers.

3.3 Households

Households' preferences are additively separable in consumption and labor effort. The generic Italian household j receives utility from consumption C and disutility from labor L. The expected value of the lifetime utility is:

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \left[\frac{\left(C_t(j) - hC_{t-1}\right)^{1-\sigma}}{(1-\sigma)} - \frac{L_t(j)^{1+\tau}}{1+\tau} \right] \right\} \tag{10}$$

where E_0 denotes the expectation conditional on information set at date 0, β is the discount factor ($0 < \beta < 1$), $1/\sigma$ is the elasticity of intertemporal substitution ($\sigma > 0$) and $1/\tau$ is the labor Frisch elasticity ($\tau > 0$). The parameter h ($0 < h < 1$) represents external habit formation in consumption.

The budget constraint of the household j is:

$$\begin{aligned} \frac{B_t(j)}{\left(1+R_t^H\right)} - B_{t-1}(j) \quad \leq \quad & (1-\tau_t^k)\left(\Pi_t^P(j) + R_t^K K_{t-1}(j)\right) + \\ & +(1-\tau_t^{\ell})W_t(j)L_t(j) - (1+\tau_t^c)P_t C_t(j) - P_t^I I_t(j) \\ & +Tr_t(j) - AC_t^W(j) \end{aligned}$$

Italian households hold a one-period bond, B_t, denominated in euro ($B_t > 0$ is a lending position). The short-term nominal rate R_t^H is paid at the beginning of period t and is known at time t.[30] We assume that government and private bonds are traded in the same international market. Households own all domestic firms and there is no international trade in claims on firms' profits. The variable Π_t^P includes profits accruing to the Italian households. The variable I_t is the investment bundle in physical capital and P_t^I the related price index, which is different from the price index of consumption because the two bundles have different composition.[31] Italian households accumulate physical capital K_t and rent it to domestic firms at the nominal rate R_t^k.

[30] A financial friction μ_t is introduced to guarantee that net asset positions follow a stationary process and the economy converge to a steady state. Revenues from financial intermediation are rebated in a lump-sum way to households in the REA. See Benigno (2009).

[31] See the Appendix for more details.

The law of motion of capital accumulation is:

$$K_t(j) = (1-\delta) K_{t-1}(j) + \left(1 - AC_t^I(j)\right) I_t(j) \tag{11}$$

where δ is the depreciation rate. Adjustment cost on investment AC_t^I is:

$$AC_t^I(j) \equiv \frac{\phi_I}{2}\left(\frac{I_t(j)}{I_{t-1}(j)} - 1\right)^2, \ \phi_I > 0 \tag{12}$$

Finally, Italian households act as wage setters in a monopolistic competitive labor market. Each household j sets her nominal wage taking into account labor demand and adjustment costs AC_t^W on the nominal wage $W_t(j)$:

$$AC_t^W(j) \equiv \frac{\kappa_W}{2}\left(\frac{W_t(j)}{W_{t-1}(j)} - 1\right)^2 W_t L_t, \ \kappa_W > 0 \tag{13}$$

The costs are proportional to the per-capita wage bill of the overall economy, $W_t L_t$.

The sovereign risk channel (see equation 6) does affect the choices of the Italian households through the interest rate R_H in the Euler equation (obtained by maximizing utility subject to the budget constraint with respect to the bond holdings B_t):

$$(C_t(j) - hC_{t-1})^{-\sigma} = \beta E_t\left(R_t^H (C_{t+1}(j) - hC_t)^{-\sigma}\right) \tag{14}$$

The higher the spread, the higher the interest rate R_t^H and the larger the incentive for Italian households to postpone consumption.

Similar relations hold in the REA and in the RW. The only exceptions are two, as we make two simplifying assumptions. First, the spread paid by Italian households and government are rebated in a lump-sum way to households in the REA. Second, neither the public sectors nor the private sectors in the REA and RW pay the spread when borrowing. So it is the riskless interest rate to appear in the corresponding Euler equations.

Finally, it is assumed that the bond traded by households and governments is in worldwide zero net supply. The implied market clearing condition is:

$$-B_t^g + \int_0^s B_t(j)\,dj - B_t^{g*} + \int_s^S B_t(j^*)\,dj^* - B_t^{g**} + \int_S^1 B_t(j^{**})\,dj^{**} = 0 \tag{15}$$

where B_t^{g*},$B_t^{g**} > 0$ are respectively the amounts of borrowing of the REA and RW public sectors, while $B_t(j^*)$ and $B_t^{**}(j^{**})$ are respectively the per-capita bond positions of households in the REA and in the RW.

3.4 Calibration

The model is calibrated at quarterly frequency. We set some parameter values so that steady-state ratios are consistent with 2010 national account data, which are the most recent and complete available data. For remaining parameters we resort to previous studies and estimates available in the literature.[32]

Table 1 contains parameters that regulate preferences and technology. Parameters with "$*$" and "$**$" are related to the REA and the RW, respectively. Throughout we assume perfect symmetry between the REA and the RW, unless differently specified. We assume that discount rates and elasticities of substitution have the same value across the three regions. The discount factor β is set to 0.9927, so that the steady state real interest rate is equal to 3.0 per cent on an annual basis. The value for the intertemporal elasticity of substitution, $1/\sigma$, is 1. The Frisch labor elasticity is set to 0.5. The depreciation rate of capital δ is set to 0.025. Habit is set to 0.6.

In the production functions of tradables and nontradables, the elasticity of substitution between labor and capital is set to 0.93. The bias towards capital in the production function of tradables is set to 0.56 in Italy and, in the REA and in the RW, to 0.46. The corresponding value in the production function of nontradables is set to 0.53 in Italy and 0.43 in the REA and RW. In the final consumption and investment goods the elasticity of substitution between domestic and imported tradable is set to 1.5, while the elasticity of substitution between tradables and nontradables to 0.5. In the consumption bundle the bias towards the domestic tradeable is 0.68 in Italy, 0.59 in the REA and 0.90 in the RW. The bias towards the composite tradeable is set to 0.68 in Italy, to 0.5 in the REA and the RW. For the investment basket, the bias towards the domestic tradable is 0.50 in Italy, 0.49 in the REA and 0.90 in the RW. The bias towards the composite tradable is 0.78 in Italy, 0.70 in the REA and in the RW. The biases towards the domestically produced good and composite tradable good are chosen to match the Italy and REA import-to-GDP ratios.

Table 2 reports gross markup values. In the Italian tradable and nontradable sectors and in the Italian labor market the markup is set to 1.08, 1.30 and 1.60, respectively (the corresponding elasticities of substitution across varieties are set to 13.32, 4.44 and 2.65). In the REA tradable and nontradable sectors and in the REA labor market the gross markups are respectively set to 1.11, 1.24 and 1.33 (the corresponding elasticities are set to 10.15, 5.19 and 4.00). Similar values are chosen for the corresponding parameters in the RW.

Table 3 contains parameters that regulate the dynamics. Adjustment costs on investment change are set to 6. Nominal wage quadratic adjustment costs are set to 200. In the tradable sector, we set the nominal adjustment cost parameter to 300 for Italian tradable goods sold domestically and in the REA; for Italian goods sold in the RW, the corresponding parameter is set to 50. The same parameterization is adopted for the REA, while for the rest of the world we set the adjustment cost on goods exported to Italy and the REA to 50. Nominal price adjustment

[32] Among others, see Forni et al. (2009, 2010a, 2010b).

costs are set to 500 in the nontradable sector. The parameters are calibrated to generate dynamic adjustments for the EA similar to those obtained with the New Area Wide Model (NAWM, see Christoffel et al. 2008) and Euro Area and Global Economy Model (EAGLE, see Gomes et al. 2010). The two parameters regulating the adjustment cost paid by the private agents on their net financial position are set to 0.00055 so that they do not greatly affect the model dynamics.

Table 4 reports parametrization of the systematic feedback rules followed by the fiscal and monetary authorities. In the fiscal policy rule (4) we set $\phi_1 = \pm 0.05$, $\phi_2 = \pm 1.01$ for Italy and $\phi_1 = \phi_2 = \pm 1.01$ for the REA and the RW. Their sign is positive when the fiscal instrument in the rule is a tax rate, it is negative when the instrument is a public expenditure. The central bank of the EA targets the contemporaneous EA wide consumer price inflation (the corresponding parameter is set to 1.7) and the output growth (the parameter is set to 0.1). Interest rate is set in an inertial way and hence its previous-period value enters the rule with a weight equal to 0.87. Same values hold for the corresponding parameters of the Taylor rule in the RW.

Table 5 reports the actual great ratios and tax rates, which are matched in the model steady state under our baseline calibration. We assume a zero steady state net foreign asset position of each region. This implies that for each region - in steady state - the net financial position of the private sector is equal to the public debt. The size of Italian and REA GDPs, as a share of world GDP, are set to 3 percent and to 17 percent, respectively.

As for fiscal policy variables, the public consumption-to-GDP ratio is set to 0.20. The tax rate on wage income τ^{ℓ} is set to 42.6 per cent in Italy and to 34.6 in the REA. The tax rate on physical capital income τ^{k} is set to 34.9 in Italy and 25.9 in the REA, while the tax rate on consumption τ^{c} is equal to 16.8 in Italy and to 20.3 in the REA. The public debt-to-yearly GDP ratio is calibrated to 119 percent for Italy and to 0.79 for the REA. Variables of the RW are set to values equal to those of corresponding REA variables.

Finally, we have to calibrate for Italy the relationship between the fiscal policy stance and the spread on sovereign debt, as defined in the definition (5). Absent operational estimates of the link between fiscal conditions and risk premia, we resort to our personal reading of the literature on the subject. We refer in particular to Belochine and Dell'Erba (2013) and posit that a 1 percentage point of GDP increase in government spending maps into a 75bp step-up in the sovereign risk premium. The higher sensitivity of borrowing costs with respect to their estimates is justified on the grounds that the Italian debt-to-GDP ratio is much higher than the threshold they find for emerging economies. Moreover, such value is in a way consistent with market developments since mid 2011. In June 2011 the spread between Italian and German 10-year bond yields was about 180 basis points, close to the level reached in the aftermath of the Lehman crisis. During the summer it suddenly started increasing. The intensification of the EA sovereign debt crisis fuelled fears concerning the sustainability of public finances in peripheral countries; the dithering political handling of the crisis failed to prevent market tensions from heightening and by mid November the spread on Italian bonds had reached 553bp, some

370bp more than five months before.[33] It took three fiscal consolidation packages, amounting on aggregate to 4.8 percentage points of GDP to stop the escalation of borrowing costs. By assuming that a budget adjustment of that size is what financial markets expected to keep at just 370bp the re-pricing of Italian sovereign risk, we can gauge in some 75bp the cost (gain) of increasing (reducing) the public-sector deficit by 1 percentage point of GDP.[34] The estimate is admittedly rough, highly tentative and does not distinguish sovereign risk from redenomination risk, but seems nonetheless reasonable and more plausible than the available alternatives.

A number of assumptions are required in order to map observed variations in long-term government bond yields into our model-based quarterly interest rate R_t^H. As a preliminary step, we follow common practice and focus on the return on 10-year government bonds as the most representative long-term market rate. Next, we lay out a procedure to map a given change in the yield on 10-year bonds into variations in R_t^H. We assume for simplicity that changes in the return on a given maturity are equally transmitted to all maturities, so that the shape of the term structure is unchanged. Hence, a higher (lower) return on 10-year government bonds would simply correspond to an upward (downward) shift in the whole yield curve, with no effect on its steepness. The assumption mirrors the implicit definition of the model-based long-term interest rate as a weighted average of expected future short-term rates, via the expectation hypothesis and the Euler equation. An expected change in the short-term rate would equally affect the returns paid at different maturities in our model, so that the shape of the term structure of interest rates would remain unchanged.

4 Results

In what follows we simulate the model to assess the fiscal multipliers for Italy under, alternatively, standard monetary policy, constant monetary policy rate, responses of the credit spread. All simulations are run under perfect foresight. All shocks are fully anticipated by households and firms, with the exception of the shock perturbing the economy in the first (initial) period.

4.1 Benchmark fiscal multipliers

Table 6 shows the short-term (first and second year) results of increasing Italian public consumption by one percent of (pre-stimulus) baseline GDP. For the case of the permanent fiscal shock, the table also reports the long-run multipliers.[35] Monetary policy is conducted according to the

[33] Spikes were observed immediately after (i) the downgrade of Portugal in July; (ii) the release of the plan for the Private Sector Involvement during the EU summit on 21-22 July; (iii) the announcement of the Greek referendum on 1 November. Domestic events, i.e. the tensions generated by the uncertainty on the fiscal consolidation measures and the political vacuum created by the falling apart of the ruling coalition, played a role as well, though a more limited one. For a detailed account of the impact of news on the Italian BTP-German Bund spread between June 2011 and March 2012, see Pericoli (2012).

[34] The decrease in the Italian BTP-Bund spread observed in the initial months of 2012 and since August is not considered in the computation, as it is most likely due to monetary policy.

[35] Long-run multipliers are zero in the case of temporary fiscal shocks.

Taylor rule (7), while public debt is stabilized by rising lump-sum taxes according to the fiscal rule (4).[36] After the end of the stimulus, public spending is immediately brought back to its initial steady state value.

The first two columns of Table 6 report multipliers of the Italian public consumption when the latter is increased for one year. In the first year the Italian GDP increases by 0.87 percent of its baseline value. Italian households' consumption and investment slightly decrease. The nominal policy rate does not increase, because it is set at the EA level and reacts to EA-wide inflation and output. The latter are not greatly affected by the increase in Italian GDP and - to a lesser extent - CPI. Following the small increase in the Italian prices, the real exchange rates of Italy against the REA and the RW slightly appreciate. Similarly, the terms of trade of Italy against the REA and the RW slightly improve. Consistently, tradable goods produced in the REA and in the RW become cheaper than those produced in Italy. The Italian net exports decrease (Italian gross exports and imports decrease and increase, respectively).[37] Spillovers towards the REA and RW are small, because of the relatively small size of Italy in the world economy and the relatively large home bias in the REA and RW consumption and investment baskets.[38]

The remaining columns of Table 6 report multipliers for the first two years in correspondence of two-, five-year and permanent fiscal stimuli (for the last one the long-run multiplier is also reported). In the first year the Italian GDP increases by 0.81, 0.79 and 0.69 percent, respectively; in the second year by 0.68, 0.56 and 0.52. In the case of a permanent fiscal stimulus, the long-run multiplier is 0.59. Responses of the output components quantitatively change across the different scenarios. The longer the duration of the stimulus, the larger the decrease in private consumption and the smaller the decrease in private investment; the latter increases when the stimulus lasts for five years or longer. Differences across the responses of households' demand are associated with the strength of the negative wealth effect of current and expected future public spending. The larger the amount of resources appropriated for public consumption, the larger the negative wealth effect, the more Italian households reduce consumption and increase labor supply. The increase in the latter makes capital more productive and induces higher investment and capital accumulation. Accordingly the aggregate supply can match the persistently higher public demand for consumption.

For comparison, Table 7 reports the values of the public consumption multipliers when both public spending and labor income taxes are simultaneously increased. The increase in the labor tax rate is such that the corresponding revenues are equal to one percent of pre-stimulus GDP, so that the fiscal stimulus is ex ante revenue-neutral. The multiplier is now lower than in the case of higher lump-sum taxes. There is a lower incentive to increase labor effort than in the

[36]The implications of distortionary taxation for the spending multiplier will be considered later in this section.

[37]This is true for (bilateral) exports and imports to and from REA and RW (to save on space we do not report them). Exports decrease more towards the RW as their prices increase more than those of the exports towards the REA (the former are more flexible than the latter).

[38]The REA and RW consumption and investment (not reported) slightly decrease to finance the increase in Italian borrowing associated with the fiscal stimulus and the consumption smoothing of Italian households.

previous case, as the increase in distortionary labor taxes reduces the after-tax real wage. The differences are large for the second year, in particular for long-lasting stimuli.

The previous simulations have shown the multipliers associated with public consumption spending. Table 8 reports the multipliers associated with stimuli based on reducing tax rates on labor income, capital income and consumption. The reduction in tax revenues is equal to one percent of (pre-stimulus) GDP and lasts for, alternatively, one, two, five years or is implemented on a permanent basis. After the stimulus, the public debt is stabilized by increasing lump-sum taxes according to the fiscal rule (4); public consumption is held constant at its pre-stimulus level. Results show that in the short run tax multipliers are lower than one and lower than public consumption multipliers. Moreover, they are larger in the second year than in the first year (the only exception is consumption tax), because households' consumption and investment react in a smooth way, given the assumptions of habit persistence and adjustment costs on investment. Finally, in the case of labor and capital income taxes, the longer the duration of the stimulus, the larger the multipliers, because households have a larger incentive to increase labor effort when the lower taxation on their (labor and capital) income is closer to being permanent. In particular, in the long run the GDP multiplier associated with a permanent reduction in the capital tax rate is larger than one.

Figure 1 shows the dynamic response of the main macroeconomic variables in the benchmark case of a public consumption increase financed with lump-sum taxes. Figure 2 reports responses to the labor tax reduction. In both cases the stimulus lasts for one year. It is interesting to note that the increase in public consumption immediately raises GDP, while the reduction in labor tax boosts GDP only gradually, as consumption and investment increase smoothly because of external habit formation in consumption and adjustment costs for investment.

Overall, results suggest that fiscal multipliers are below 1 and that multipliers associated with taxation are lower than those associated with public spending for short-lived shocks, but larger (in the long-run) when fiscal expansion is permanent.

4.2 Constant monetary policy rate

Previous simulations show fiscal multipliers under the assumption that monetary policy follows the Taylor rule (7). Table 9 reports results for increases in public consumption (by one percent of GDP) for one, two, five years and on a permanent basis when the (nominal) policy rate stays constant ("accommodative" monetary policy stance) during the fiscal stimulus; for the permanent stimulus, the accommodative stance lasts for five years. After the stimulus, monetary policy is conducted in a standard way (the Taylor rule 7 kicks in). As in previous simulations the public debt is stabilized by increasing lump-sum taxes according to rule (4).

In the case of one- and two-year stimuli the GDP multiplier is similar to the one obtained under the standard stance of monetary policy (Table 6). The multiplier increases well above one when the stimulus lasts for 5 years. It is equal to 1.42 in the first year (1.16 in the second year).

When the fiscal stimulus is permanent and the monetary policy is accommodative for five years, the lack of full overlap between the monetary and fiscal policy implies that the multiplier is only slightly larger than in the case of standard monetary policy (0.80 and 0.63 in the first two years vs. 0.69 and 0.52). The results are qualitatively in line with those reported in Woodford (2011), who finds that both fiscal stimulus and accommodative monetary policy have to be held in place for a sufficiently long amount of time to generate large multipliers, as inflation expectations need to be large enough to reduce the ex ante real interest rate. Note also that the 5-year mix of expansionary Italian fiscal policy and constant EA policy rate positively affects the REA activity and inflation, through trade leakages. When the interest rate is held constant for sufficiently long and there is full overlap with the fiscal stimulus, inflation expectations of REA households become high enough to widely reduce the ex ante real interest rate, stimulating households' demand for consumption and investment. The latter favors Italian exports, by partially counterbalancing the loss of competitiveness associated with the appreciation of the Italian real exchange rate.

Table 10 reports results under the assumption that the policy rate remains constant for a number of periods half as large as the number of periods of the fiscal stimulus (2.5 years in the case of the 5-year and permanent fiscal stimuli). Multipliers are lower than those reported in Table 9, as now the monetary policy accommodates to a lower extent the public consumption shock. If the latter lasts for 5 years or is permanent, the corresponding multipliers are equal to 0.89 (instead of 1.42) and 0.72 (instead of 0.80) in the first year, respectively; to 0.66 (instead of 1.16) and 0.55 (instead of 0.63) in the second year.

Table 11 reports results for tax-rate multipliers. For 1- and 2-year stimuli the tax multipliers under the assumption of constant interest rate are similar to those in the case of standard monetary policy (Table 8). For 5-year and permanent stimuli the tax multipliers are larger under no monetary-policy response than in the case of standard monetary policy. In particular, the multiplier associated with the capital income tax becomes larger than one. To the opposite, the multiplier associated with the labor income tax decreases in the case of 2- and 5-year stimuli: the reason is the large initial positive response of the supply side of the economy, which reduces inflation expectations and, given the absence of monetary policy response, increases the real interest rate. Consumption and investment fall accordingly, as monetary policy is not accommodative anymore.

Overall, the multiplier associated with public consumption is well above one only when the stance of the monetary policy is accommodative for sufficiently long; otherwise the value of the multipliers do not change much relatively to the case of standard monetary policy response and remains generally below 1.

4.3 Sovereign risk premium

The macroeconomic effects of a fiscal stimulus can be affected not only by the monetary policy stance, but also by the response of financial markets. As stressed in the survey (Section 2), if investors are concerned about the solvency of the government, they will ask for a higher premium in response to a fiscal expansion. Moreover, the sovereign risk premium will be transmitted rather quickly to the cost of borrowing of domestic households and firms, thereby crowding out their spending decisions (so called "sovereign risk channel of fiscal policy", see Corsetti et al. 2012a). As a consequence, the operation of the sovereign risk channel can reduce the size of the fiscal multiplier in times of financial turbulence. This conjecture is supported by the empirical evidence reported in recent studies. Laubach (2012) studies the dependence of the sovereign spread on the current level of fiscal indicators (such as the surplus-to-GDP or the debt-to-GDP ratios) for a panel of EA countries and finds that the estimated elasticity is small or nil in non-crisis periods, but increases rapidly and dramatically in times of financial stress.

This section reports results of simulating a 1 percent (of pre-stimulus GDP) increase in public consumption spending for, alternatively, 1, 2, 5 years and on a permanent basis. We assume that the fiscal expansion entails an immediate 75 basis points rise in the sovereign risk premium and hence in interest rate paid on Italian government bonds (see section 3.4). The effects of the stimulus crucially depend on the dynamics of the sovereign risk premium after the initial increase. We adopt an agnostic approach and assume that, after the initial rise, the Italian sovereign spread linearly declines and returns to its baseline level by the time the stimulus is withdrawn.[39] Consistent with the empirical evidence for Italy (see Albertazzi et al. (2012) and Zoli (2013)), the increase in sovereign risk is fully passed-through (in a quarter) to the borrowing rate paid by the Italian private sector. Monetary policy follows the standard Taylor rule and public debt is stabilized by lump-sum taxes after the end of the fiscal stimulus. The output multipliers are reported in Table 12. In the first year they are equal to 0.79, 0.62, 0.27 and 0.18 when, respectively, the stimulus lasts for 1, 2, 5 years or is permanent; in the second year, they fall to -0.11, 0.58, 0.07 and 0.02 . The values are lower compared to the scenarios that do not include the sovereign channel (Table 6), because of the larger crowding-out effect on private-sector spending, associated with the increase in the borrowing rates. Moreover, the longer the stimulus, the slower the spread decrease, the larger the reduction in the multiplier. In the case of the 5-year stimulus, private consumption decreases by 1.19 percent in the first year (1.28 in the second), private investment by 1.51 percent (2.36 percent). Absent the sovereign risk channel (see Table 6), private consumption would decrease by 0.15 percent in the first year (0.33 in the second), while private investment would increase.

Figure 3 sums up the results reported in this and the previous section. It shows that the size of government-consumption multiplier strongly depends on the monetary policy response and on the change of the sovereign risk premium; in particular, it can be larger than one only if the monetary policy rate is held constant for a rather long amount of time. Moreover, monetary policy should remain accommodative for as long as the duration of the fiscal stimulus (compare the bars "accommodative monetary policy"and "partial overlap"). Otherwise, multipliers are

[39] In the case of a permanent stimulus, we assume it takes 5 years for the sovereign risk premium to return to the baseline value.

lower - and possibly much lower - than one, if the sovereign risk premium increases.

4.4 Fiscal consolidation and sovereign risk

The results reported in the previous sections may be interpreted as suggesting that, in times of financial stress, fiscal consolidation may reduce borrowing costs for households and firms. If the consolidation is credible, financial markets might ask for a lower sovereign risk premium, as investors anticipate that public finances have become fully sustainable. With a quick and complete pass-through of the sovereign premium to the private sector borrowing rate, the lower borrowing cost of households and firms might partially counterbalance the contractionary effects of the consolidation.

This section analyzes the output effects of fiscal consolidation in the presence of a sovereign risk channel. As in the case of Italy in late 2011, the policy tightening may be induced by an abrupt increase in the sovereign spread, as a result of financial market turbulence. Our results about fiscal consolidation should be ideally compared to a benchmark scenario where the surge in sovereign risk premia is not accompanied by any fiscal plan.

Table 13 reports results for the case of permanently reducing the public debt-to-GDP ratio by 1 percentage point. In line with the composition of the fiscal package adopted in Italy in the second half of 2011, public spending is permanently reduced by 0.25 percentage points of pre-stimulus GDP, while taxation (on labor income, capital income and consumption) is increased by 0.75 percentage points.[40] The response of the sovereign spread is designed as follows: the spread decreases on impact by 75 basis points - in line with the reduction observed in Italy after the announcement of the fiscal consolidation plan in the fall of 2011 - then starts increasing and returns to its baseline value after, alternatively, 1, 2, 3 or 5 years. We simulate both the case of a standard monetary policy response and the case of the ZLB binding for five years.[41] Results suggest that the largest output decrease is equal to -0.70 (-0.80) in the first (second) year. It is obtained when the monetary policy is constrained by the ZLB and there is no sovereign risk channel. The smallest output decrease is equal to -0.03 (-0.15) in the first (second) year. It is obtained when the decrease in the risk premium lasts for a relatively large period of time (5 years). In this case, households benefit from a relatively low real interest rate, partially counterbalancing the increase in distortionary taxation.[42] Note that, as a limiting case, the effect on output can be positive in the first year if the spread returns to its baseline value in three and five years.

Simulation results suggest that under conditions of financial stress, when the sovereign risk channel is active, the negative impact of fiscal consolidation can be quite modest and is certainly

[40] See Ministero dell'Economia e delle Finanze (2012).

[41] Note that we do not posit an exogenous recessionary shock that takes the monetary policy rate down to the ZLB, as opposed to common practice in the literature, (see for example Corsetti et al. 2012a). The reason is that the ZLB holds at EA level and, hence, it can be taken as exogenous with respect to changes in the Italian economic conditions.

[42] Note that public spending decreases. As such, it contributes to crowding in households' spending for consumption and investment.

lower than under “normal” conditions.

4.5 Sensitivity analysis

This section reports the sensitivity analysis on the multipliers associated with higher public consumption when the sovereign risk premium augments by 0.75 percentage points on impact (first quarter) and then gradually returns to zero in an amount of time equal to the length of the fiscal stimulus. Differently from the benchmark results illustrated in section 4.3 we assume that the share of liquidity constrained households is 30 percent of the Italian population and, alternatively, that the increase in public consumption is implemented simultaneously in Italy and the REA, under standard or accommodative monetary policy.

4.5.1 Share of liquidity constrained households

Table 14 shows results when in Italy the share of liquidity constrained households is increased from zero to 30 percent of the overall Italian population.

Following Campbell and Mankiw (1989) and Galí et al. (2004, 2007), we assume that in each period liquidity constrained households consume their after-tax disposable income. That is, the budget constraint of the generic liquidity-constrained household j is:

$$(1+\tau_t^c)P_t C_t\left(j\right) = (1-\tau_t^{\ell})W_t\left(j\right)L_t\left(j\right)$$

We assume liquidity-constrained households wage and hours are the same as those of unconstrained households. We also assume that tax rates on labor income and consumption are the same for both constrained and unconstrained households.

Multipliers are larger than in the case of no liquidity constrained households. The higher values are due to the income effect associated with the liquidity constrained households, who immediately increase their consumption, as they do not save but spend all their available wage income. The latter increases because firms expand employment, to help production meet the higher aggregate demand. Differences with respect to the benchmark scenarios are not extremely large. More importantly, the multipliers continue to be below one.

4.5.2 Simultaneous fiscal stimulus in the EA

We also assess to which extent Italian fiscal multipliers do change when the stimulus is implemented simultaneously in Italy and the REA. We consider the case of an increase in public consumption by 1 percent of pre-shock GDP for two years. The monetary policy is conducted according to the Taylor rule or is accommodative (policy rate held at its baseline level during the fiscal stimulus).

Table 14 reports the results. Under standard monetary policy, they are slightly smaller in the case of EA-wide stimulus than in the case of Italian unilateral stimulus. As in the case of unilateral Italian stimulus, the multiplier is lower than one. Italian net exports (not reported) now decrease less, because the Italian bilateral exchange rate against the REA appreciates to a lower extent. The monetary policy rate now increases to a larger extent, given the increase in the EA-wide aggregate demand. As such, the real interest rate decreases to a lower extent when the fiscal stimulus is coordinated, contributing to crowding-out relative more Italian demand of households and firms.

Italian multipliers are larger than one when the monetary policy is accommodative for two years. The constant interest rate stimulates REA aggregate demand, because of the reduction in the REA real interest rate. Italian (gross) exports decrease less, driven by the higher aggregate demand in the REA. The Italian GDP multiplier is equal in the first year to 1.34 percent. It is 0.88 percent in the case of unilateral Italian stimulus and accommodative monetary policy (Table 9). This suggests that the accommodative monetary policy is more effective in driving the multiplier above one when the fiscal stimulus is simultaneously implemented at the EA level.

5 Conclusions

This paper provides estimates for Italy of the size of fiscal multipliers under alternative assumptions about the reaction of the central bank and the response of the sovereign risk premium. Our main conclusions are the following. First, short-run fiscal multipliers are typically below one and, in particular, multipliers associated with taxation are lower than those associated with public expenditure. Second, public spending multipliers are substantially larger than one when the monetary policy rate is kept constant at the ZLB, but only if the policy rate remains at the ZLB for a sufficiently long period of time (at least five years in our simulations). Third, under conditions similar to those currently prevailing in the euro area (EA), in countries with a high public debt, the stimulus induces a deterioration of public finances and hence a rapid increase in the sovereign risk premium, which in turn substantially reduces the size of the multiplier and the effectiveness of fiscal policy. Fourth, the short-run contractionary effects of fiscal consolidation efforts can be partially mitigated by a reduction in the risk premium. Overall, results suggest that the size of fiscal multipliers in times of financial distress can be different from that in "normal" times, as the initial public finance conditions and the monetary policy stance can greatly matter for the financing conditions of the private sector.

References

[1] Albertazzi, U., T. Ropele, G. Sene and F. M. Signoretti (2012), "The impact of the sovereign debt crisis on the activity of Italian banks", Questioni di Economia e Finanza (Occasional Papers), No. 133, Bank of Italy.

[2] Attinasi, M.G., C. Checherita-Westphal and C. Nickel (2010), "What Explains the Surge in Euro Area Sovereign Spreads During the Financial Crisis of 2007-09?", *Public Finance and Management*, Vol. 10.

[3] Auerbach, A. and Y. Gorodnichenko (2012), "Measuring the Output Responses to Fiscal Policy", *American Economic Journal: Economic Policy*, Vol. 4, No. 2, pages 1–27, May.

[4] Barro, R. (1981), "Output Effects of Government Purchases", *Journal of Political Economy*, Vol. 83, No. 6, pages 1113–44, December.

[5] Bayoumi, T. (2004), "GEM: A New International Macroeconomic Model", *IMF Occasional Paper* No. 239.

[6] Bayoumi, T., D. Laxton and P. Pesenti (2004), "Benefits and Spillovers of Greater Competition in Europe: a Macroeconomic Assessment", NBER Working Paper No. 10416.

[7] Baxter, M. and R. King (1993), "Fiscal Policy in General Equilibrium", *American Economic Review*, Vol. 83, No. 3, pages 315–34, June.

[8] Belhocine, N. and S. Dell'Erba (2013), "The Impact of Debt Sustainability and the Level of Debt on Emerging Markets Spreads", IMF Working Paper No.13/93, May.

[9] Benigno P. (2009), "Price Stability with Imperfect Financial Integration", *Journal of Money, Credit and Banking*, Vol. 41, No. 1, pages 121–149.

[10] Blanchard, O.J. (1990), "Comment on Giavazzi-Pagano", NBER Macroeconomics Annual.

[11] Blanchard, O.J. and D. Leigh (2013), "Growth Forecast Errors and Fiscal Multipliers", IMF Working Paper No. 13/1, January.

[12] Blanchard, O.J. and L.H. Summers (1986), "Hysteresis and the European Unemployment Problem", NBER Macroeconomic Annual.

[13] Braun, A. R., L.M. Körber and Y. Waki (2012), "Some Unpleasant Properties of Log-Linearized Solutions When the Nominal Rate Is Zero", Federal Reserve Bank of Atlanta Working Paper No. 2012-5a.

[14] Campbell, J. Y. and N. G. Mankiw (1989), "International evidence on the persistence of economic fluctuations", *Journal of Monetary Economics*, vol. 23, No. 2, pages 319–333, March.

[15] Christiano, L., M. Eichenbaum and S. Rebelo (2011), "When is the Government Spending Multiplier Large?", *Journal of Political Economy*, vol. 119, No 1, pages 78–121.

[16] Christoffel, K., G. Coenen and A. Warne (2008), "The New Area-Wide Model of the Euro Area: A Micro-Founded Open-Economy Model for Forecasting and Policy Analysis", ECB Working Paper Series No. 944.

[17] Coenen, G., M. Mohr and R. Straub (2008), "Fiscal Consolidation in the Euro Area: Long-Run Benefits and Short-Run Costs", Economic Modelling, Vol. 25, No. 5, pages 912–932, September.

[18] Coenen, G., C. Erceg, C. Freedman, D. Furceri, M. Kumhof, R. Lalonde, D. Laxton, J. Lind, A. Mourougane, D. Muir, S. Mursula, C. de Resende, J. Roberts, W. Roeger, S. Snudden, M. Trabandt, and J. in't Veld (2012), "Effects of fiscal stimulus in structural models", *American Economic Journal: Macroeconomics*, vol. 4, No. 1, pp. 22–68.

[19] Cogan, J.F., T. Cwik, J.B. Taylor and V. Wieland (2010), "New Keynesian and old Keynesian government spending multipliers", *Journal of Economic Dynamics & Control*, vol. 34, No. 3, pp. 281–295.

[20] Corsetti, G. and G. J. Mueller (2006), "Twin Deficits: Squaring Theory, Evidence and Common Sense", *Economic Policy*, Vol. 21, No. 48, pages 597–638, October.

[21] Corsetti, G. and G. J. Mueller (2008), "Twin Deficits, Openness and the Business Cycle", *Journal of European Economic Association*, Vol. 6, No. 2-3, pages 404–413.

[22] Corsetti, G., K. Kuester, A. Meier and G. J. Mueller (2012a), "Sovereign Risk, Fiscal Policy, and Macroeconomic Stability", IMF Working Paper.

[23] Corsetti, G., A. Meier and G.J. Müller (2012b), "What Determines Government Spending Multipliers?", *Economic Policy*, October, Vol. 27, No. 72, pages 521–565, October.

[24] DeLong, J.B. and L.H. Summers (2012), "Fiscal Policy in a Depressed Economy", presented to BPEA, March 2012.

[25] Eggertsson, G. (2001), "Real Government Spending in a Liquidity Trap", mimeo.

[26] Ergeg, C., C. Gust and L. Guerrieri (2006), "SIGMA: A New Open Economy Model for Policy Analysis", *International Journal of Central Banking*, Vol. 2, No. 1, pages 1–50, March.

[27] European Central Bank (2012), Monthly Bullettin, December, Box 6.

[28] European Commission (2012a), European Economic Forecast, Box 1.5, Autumn.

[29] European Commission (2012b), AMECO Database, Available at http://ec.europa.eu/economy_finance/db_indicators/ameco.

[30] Eurostat (2012): "Taxation trends in the European Union".

[31] Feldstein M. (2008): "Effects of Taxes on Economic Behavior", NBER Working Paper 13745.

[32] Financial Times (2012): "Robustness of IMF data scrutinised", October.

[33] Forni L., A. Gerali and M. Pisani (2010a), "The Macroeconomics of Fiscal Consolidations in Euro area countries", *Journal of Economic Dynamics and Control*, Vol. 34, No. 9., pages 1791–1812, September.

[34] Forni L., A. Gerali and M. Pisani (2010b), "Macroeconomic Effects of Greater Competition in the Service Sector: the Case of Italy", *Macroeconomic Dynamics*, Vol. 14, No. 5, pages 677-708, November.

[35] Forni L., L. Monteforte and L. Sessa (2009), "The General Equilibrium Effects of Fiscal Policy: Estimates for the Euro Area", *Journal of Public Economics*, Vol. 93, No.3–4, pages 559–585, April.

[36] Galí, J., J.D. López-Salído and J. Vallés, (2004), "Rule-of-thumb consumers and the design of interest rate rules", *Journal of Money, Credit and Banking*, Vol. 36, No. 4, pages 739–764.

[37] Galí, J., J.D. López-Salído and J. Vallés, (2007), "Understanding the Effects of Government Spending on Consumption", *Journal of the European Economic Association*, Vol. 5, No. 1, pages 227–270.

[38] Gomes, S. and Jacquinot, P. and M. Pisani, (2012), "The EAGLE. A Model for Policy Analysis of Macroeconomic Interdependence in the Euro Area", *Economic Modeling*, Vol. 29, No. 5, pages 1686–1714.

[39] Gruber, J.W. and S.B. Kamin (2012), "Fiscal Positions and Government Bond Yields in OECD Countries", *Journal of Money, Credit and Banking*, vol. 44, No. 8, pages 1563–1587, December.

[40] Haavelmo, T. (1945), "Multiplier Effects of a Balanced Budget", *Econometrica*, Vol. 13, No. 4, pp. 311–318, October.

[41] Hall, R. (1980), "Labor Supply and Aggregate Fluctuations", Carnegie-Rochester Conference Series on Public Policy, Vol. 12.

[42] Hall, R. (2009), "By How Much Does GDP Rise If the Government Buys More Output?", *Brookings Papers on Economic Activity*, Vol. 40, No. 2, pages 183–249, Fall.

[43] Juillard M. and F. Pelgrin (2007), "Computing Optimal Policy in a Timeless Perspective: an Application to a Small-Open Economy", Bank of Canada Working Paper, 32.

[44] Krugman, P. (1999), "Time on the cross: can fiscal stimulus save Japan?", downloadable at: http://web.mit.edu/krugman/www/SCURVE.htm.

[45] Laubach, T. (2009), "New Evidence on the Interest Rate Effects of Budget Deficits and Debt", *Journal of the European Economic Association*, Vol. 7, No.4, pages 858–885, June.

[46] Laubach, T. (2012), "Fiscal Policy and Interest Rates: The Role of Sovereign Default Risk", mimeo.

[47] Leigh, D., P. Devries, C. Freedman, J. Guajardo, D. Laxton and A. Pescatori (2010), "Will It Hurt? Macroeconomic Effects of Fiscal Consolidation", World Economic Outlook, October, International Monetary Fund.

[48] Mankiw, N.G. (2000), "The Savers–Spenders Theory of Fiscal Policy", *American Economic Review*, Vol. 90, No. 2, pages 120–125, May.

[49] Mankiw N.G. and M. Weinzierl (2006), "Dynamic Scoring: a Back-of-the-Envelope Guide", *Journal of Public Economics*, Vol. 90, No. 8-9, pages 1415-1433, September.

[50] McDermott, C. J. and R. F. Wescott (1996), "An Empirical Analysis of Fiscal Adjustment", *IMF Staff Paper*, Vol. 43, No. 4, pages 725-753.

[51] Ministero dell'Economia e delle Finanze (2012). Documento di economia e finanza 2012.

[52] Nickel, C. and A. Tudyka (2013), "Fiscal Stimulus in Times of High Debt: Reconsidering Multipliers and Twin Deficits", ECB Working Paper, No. 1513, February.

[53] Owyang, M.T., V.A. Ramey and S. Zubairy (2013), "Are Government Spending Multipliers Greater During Periods of Slack? Evidence from 20th Century Historical Data", *AEA Papers and Proceedings*, forthcoming.

[54] OECD (2012) Structural Analysis Database. Available at http://www.oecd.org/industry/ind/stanstructuralanalysisdatabase.htm

[55] Pericoli, M. (2012), "News, political uncertainty and the Italian sovereign risk premium from June 2011 to March 2012", mimeo.

[56] Perotti, R. (1999), "Fiscal Policy in Good Times and Bad", *The Quarterly Journal of Economics*, Vol. 114, No. 4, November.

[57] Perotti, R. (2011), "Expectations and Fiscal Policy: An Empirical Investigation", GRASP Working Paper No. 19.

[58] Pesenti, P. (2008), "The Global Economy Model (GEM): Theoretical framework", *IMF Staff Papers*, Vol. 55, No. 2, pages 243–284.

[59] Ramey, V.A. (2009), "Identifying Government Spending Shocks: It's All in the Timing", NBER Working Paper no. 15464.

[60] Ramey, V.A. (2011a), "Identifying Government Spending Shocks: It's All in the Timing", *Quarterly Journal of Economics,* vol. 22.

[61] Ramey, V.A. (2011b), "Can Government Purchases Stimulate the Economy?", *Journal of Economic Literature*, 2011, vol. 49, No. 3, pages 673–85.

[62] Ramey, V.A. (2012), "Discussant Comments on Fiscal Policy in a Depressed Economy", by J.B. DeLong and L.H. Summers.

[63] Rotemberg, J. J. (1982), "Monopolistic Price Adjustment and Aggregate Output", *Review of Economic Studies*, Vol. 49, No. 4, pages 517–31, October.

[64] Sutherland, A. (1997), "Fiscal Crises and Aggregate Demand: Can High Public Debt Reverse the Effects of Fiscal Policy?", *Journal of Public Economics*, vol. 65, No. 2, pages 147–162, August.

[65] Woodford, M. (2011), "Simple Analytics of the Government Expenditure Multiplier", *American Economic Journal: Macroeconomics*, Vol. 3, No. 1, pages 1–35, January.

[66] Zoli, E. (2013), "Italian Sovereign Spreads: Their Determinants and Pass-through to Bank Funding Costs and Lending Conditions", IMF Working Paper No. 13/84, April.

Table 1. Parametrization of Italy, the rest of the Euro Area and the rest of the world

Parameter	IT	REA	RW
Discount rate β	0.993	0.993	0.993
Intertemporal elasticity of substitution $1/\sigma$	1.0	1.0	1.0
Inverse of Frisch elasticity of labor supply τ	2.0	2.0	2.0
Habit h	0.6	0.6	0.6
Depreciation rate of (private and public) capital δ	0.025	0.025	0.025
Tradable Intermediate Goods			
Substitution between factors of production $\xi_T, \xi_T^*, \xi_T^{**}$	0.93	0.93	0.93
Bias towards capital $\alpha_T, \alpha_T^*, \alpha_T^{**}$	0.56	0.46	0.46
Nontradable Intermediate Goods			
Substitution between factors of production $\xi_N, \xi_N^*, \xi_N^{**}$	0.93	0.93	0.93
Bias towards capital $\alpha_N, \alpha_N^*, \alpha_N^{**}$	0.53	0.43	0.43
Final consumption goods			
Substitution between domestic and imported goods $\phi_A, \phi_A^*, \phi_A^{**}$	1.50	1.50	1.50
Bias towards domestic tradable goods a_H, a_F^*, a_G^*	0.68	0.59	0.90
Substitution between domestic tradables and nontradables $\rho_A, \rho_A^*, \rho_A^{**}$	0.50	0.50	0.50
Bias towards tradable goods a_T, a_T^*, a_T^{**}	0.68	0.50	0.50
Final investment goods			
Substitution between domestic and imported goods $\phi_E, \phi_E^*, \phi_E^{**}$	1.50	1.50	1.50
Bias towards domestic tradable goods υ_H, υ_F^*	0.50	0.49	0.90
Substitution between domestic tradables and nontradables ρ_E, ρ_E^*	0.50	0.50	0.50
Bias towards tradable goods υ_T, υ_T^*	0.78	0.70	0.70

Note: IT=Italy; REA=rest of the euro area; RW=rest of the world.

Table 2. Gross Markups

	Markups and Elasticities of Substitution		
	Tradables	Nontradables	Wages
IT	1.08 ($\theta_T = 13.32$)	1.30 ($\theta_N = 4.44$)	1.60 ($\psi = 2.65$)
REA	1.11 ($\theta_T^* = 10.15$)	1.24 ($\theta_N^* = 5.19$)	1.33 ($\psi^* = 4$)
RW	1.11 ($\theta_T^{**} = 10.15$)	1.24 ($\theta_N^{**} = 5.19$)	1.33 ($\psi^{**} = 4$)

Note: IT=Italy; REA=rest of the euro area; RW=rest of the world; source: OECD (2012).

.

Table 3. Real and Nominal Adjustment Costs

Parameter	IT	REA	RW
Real Adjustment Costs			
Investment ϕ_I, ϕ_I^*, ϕ_I^{**}	6.00	6.00	6.00
Households' financial net position ϕ_{b1}, ϕ_{b2}	0.00055, 0.00055	-	0.00055, 0.00055
Nominal Adjustment Costs			
Wages κ_W, κ_W^*, κ_W^{**}	200	200	200
Italian produced tradables κ_H, k_H^* k_H^{**}	300	300	50
REA produced tradables κ_H, k_H^* k_H^{**}	300	300	50
RW produced tradables κ_H, k_H^* k_H^{**}	50	50	300
Nontradables κ_N, κ_N^*, κ_N^{**}	500	500	500

Note: IT=Italy; REA=rest of the euro area; RW=rest of the world.

Table 4. Fiscal and Monetary Policy Rules

Parameter	IT	REA	EA	RW
Fiscal policy rule				
$\phi_1, \phi_1^*, \phi_1^{**}$	±0.05	±1.01	-	±1.01
$\phi_2, \phi_2^*, \phi_2^{**}$	±1.01	±1.01	-	±1.01
Common monetary policy rule	-	-		
Lagged interest rate at t-1 ρ_R, ρ_R^{**}	-	-	0.87	0.87
Inflation ρ_Π, ρ_Π^{**}	-	-	1.70	1.70
GDP growth $\rho_{GDP}, \rho_{GDP}^{**}$	-	-	0.10	0.10

Note: IT=Italy; REA=rest of the euro area; EA=euro area; RW=rest of the world.

Table 5. Main macroeconomic variables (ratio to GDP) and tax rates

	IT	REA	RW
Macroeconomic variables			
Private consumption	61.0	57.1	64.0
Private Investment	18.0	16.0	20.0
Imports	29.0	24.3	4.3
Net Foreign Asset Position	0.0	0.0	0.0
GDP (share of world GDP)	0.03	0.17	0.80
Public expenditures			
Public purchases	20.0	20.0	20.0
Interests	4.0	2.0	2.0
Public investment	2.0	3.0	3.0
Debt (ratio to annual GDP)	119	79	79
Tax Rates			
on wage	42.6	34.6	34.6
on rental rate of capital	34.9	25.9	25.9
on price of consumption	16.8	20.3	20.3

Note: IT=Italy; REA=rest of the euro area; RW=rest of the world. Sources: European Commission (2012b); tax rates (in percent) are from Eurostat (2012).

Table 6. Public consumption multipliers

	1 year-stimulus		2 year-stimulus		5 year-stimulus		permanent stimulus		
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	LR
Italian variables									
GDP	0.87	-0.09	0.81	0.68	0.79	0.56	0.69	0.52	0.59
Consumption	-0.04	-0.07	-0.08	-0.18	-0.15	-0.33	-0.53	-0.83	-0.82
Investment	-0.05	-0.13	-0.03	-0.25	0.34	0.31	0.56	1.01	0.55
Export (volumes)	-0.42	-0.18	-0.56	-0.74	-0.63	-0.99	-0.48	-0.68	-0.28
Import (volumes)	0.09	-0.01	0.13	0.09	0.26	0.33	0.03	0.11	-0.15
Terms of Tr. REA (+=deterior.)	-0.13	-0.11	-0.22	-0.36	-0.27	-0.54	-0.20	-0.37	-0.19
Terms of Tr. RW (+=deterior.)	-0.35	-0.12	-0.45	-0.56	-0.48	-0.70	-0.36	-0.49	-0.19
Real Exc. Rate REA (+=depr.)	-0.06	-0.05	-0.09	-0.16	-0.13	-0.28	-0.09	-0.19	-0.14
Real Exc. Rate RW (+=depr.)	-0.06	-0.05	-0.10	-0.17	-0.15	-0.30	-0.12	-0.21	-0.14
Inflation(annualized)	0.08	-0.04	0.15	0.02	0.20	0.11	0.14	0.06	0.00
Real.Int.Rate (annualized)	-0.03	0.04	-0.12	0.04	-0.18	-0.07	-0.12	-0.04	0.00
Nominal Int. Rate (annualized)	0.01	0.00	0.01	0.02	0.01	0.02	0.01	0.00	0.00
Labor	1.36	-0.16	1.24	1.01	1.19	0.75	1.03	0.66	0.47
Pub.Def.(%gdp)	0.74	-0.10	0.76	0.86	0.78	0.92	0.93	0.93	-0.39
Prim.Pub.Def.(%gdp)	0.75	-0.13	0.78	0.84	0.80	0.91	0.95	0.91	-0.41
REA GDP	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.01	0.00
RW GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: LR=long run, REA=rest of the euro area; RW=rest of the world. All variables as % dev. from steady state, inflation and interest rate as % point dev. from steady state.

Table 7. Public consumption multipliers. Labor tax-based financing

	1 year-stimulus		2 year-stimulus		5 year-stimulus		permanent stimulus		
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	LR
Italian variables									
GDP	0.84	-0.14	0.75	0.55	0.67	0.28	0.50	0.15	-0.33
Consumption	-0.05	-0.09	-0.11	-0.24	-0.22	-0.50	-0.85	-1.33	-1.77
Investment	-0.08	-0.18	-0.09	-0.42	0.23	-0.07	0.45	0.67	-0.14
Export (volumes)	-0.48	-0.26	-0.69	-0.98	-0.83	-1.47	-0.58	-0.98	-1.32
Import (volumes)	0.09	-0.01	0.13	0.09	0.26	0.30	-0.16	-0.18	-0.43
Terms of Tr. REA (+=deterior.)	-0.16	-0.15	-0.27	-0.48	-0.38	-0.82	-0.26	-0.57	-0.89
Terms of Tr. RW (+=deterior.)	-0.40	-0.18	-0.54	-0.73	-0.62	-1.04	-0.43	-0.69	-0.88
Real Exc. Rate REA (+=depr.)	-0.07	-0.07	-0.12	-0.23	-0.18	-0.43	-0.13	-0.32	-0.65
Real Exc. Rate RW (+=depr.)	-0.07	-0.07	-0.13	-0.23	-0.22	-0.46	-0.16	-0.33	-0.65
Inflation(annualized)	0.10	-0.03	0.20	0.04	0.30	0.20	0.20	0.13	0.00
Real.Int.Rate (annualized)	-0.05	0.04	-0.17	0.03	-0.29	-0.15	-0.20	-0.12	0.00
Nominal Int. Rate (annualized)	0.01	0.00	0.01	0.02	0.01	0.01	0.00	0.00	0.00
Labor	1.31	-0.24	1.13	0.78	0.98	0.24	0.69	0.02	-0.68
Pub.Def.(%gdp)	-0.29	-0.12	-0.27	-0.20	-0.25	-0.12	0.03	0.16	-0.10
Prim.Pub.Def.(%gdp)	-0.27	-0.11	-0.24	-0.18	-0.22	-0.09	0.06	0.18	-0.11
REA GDP	0.00	0.00	0.00	0.00	-0.02	-0.03	-0.02	-0.02	-0.01
RW GDP	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00

Note: LR=long run, REA=rest of the euro area; RW=rest of the world. All variables as % dev. from steady state, inflation and interest rate as % point dev. from steady state.

Table 8. Tax multipliers. Italian GDP and inflation

	labor tax			capital tax			consumption tax		
	1st year	2nd year	LR	1st year	2nd year	LR	1st year	2nd year	LR
GDP									
1 year-stimulus	0.03	0.04	0.00	0.02	0.02	0.00	0.34	0.07	0.00
2 year-stimulus	0.06	0.13	0.00	0.08	0.11	0.00	0.30	0.36	0.00
5 year-stimulus	0.11	0.29	0.00	0.23	0.47	0.00	0.28	0.30	0.00
permanent stimulus	0.19	0.37	0.90	0.15	0.52	2.49	0.08	0.15	0.36
Inflation									
1 year-stimulus	-0.02	0.00	0.00	0.00	0.00	0.00	0.06	-0.01	0.00
2 year-stimulus	-0.04	-0.02	0.00	0.00	-0.01	0.00	0.09	0.03	0.00
5 year-stimulus	-0.09	-0.08	0.00	0.04	-0.03	0.00	0.11	0.07	0.00
permanent stimulus	-0.06	-0.07	0.00	-0.01	-0.06	0.00	-0.03	-0.03	0.00

Note: LR=long run. GDP as % dev. from steady state, inflation as annualized % point dev. from steady state.

Table 9. Public consumption multipliers. Constant monetary policy rate

	1 year-stimulus		2 year-stimulus		5 year-stimulus		permanent stimulus		
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	LR
Italian variables									
GDP	0.89	-0.08	0.88	0.74	1.42	1.16	0.80	0.63	0.59
Consumption	-0.02	-0.05	-0.01	-0.11	0.52	0.24	-0.42	-0.73	-0.82
Investment	-0.02	-0.09	0.09	-0.09	1.47	1.84	0.77	1.28	0.54
Export (volumes)	-0.41	-0.17	-0.51	-0.71	-0.15	-0.71	-0.39	-0.63	-0.28
Import (volumes)	0.11	0.01	0.20	0.16	0.87	1.00	0.13	0.23	-0.15
Terms of Tr. REA (+=deterior.)	-0.14	-0.11	-0.22	-0.36	-0.29	-0.56	-0.20	-0.38	-0.19
Terms of Tr. RW (+=deterior.)	-0.36	-0.12	-0.48	-0.56	-0.78	-0.70	-0.41	-0.49	-0.19
Real Exc. Rate REA (+=depr.)	-0.06	-0.05	-0.09	-0.16	-0.13	-0.28	-0.09	-0.19	-0.14
Real Exc. Rate RW (+=depr.)	-0.03	-0.04	0.01	-0.11	0.79	0.18	0.05	-0.12	-0.14
Inflation(annualized)	0.10	-0.03	0.22	0.05	0.84	0.45	0.25	0.12	0.00
Real.Int.Rate (annualized)	-0.06	0.03	-0.19	0.00	-0.80	-0.36	-0.23	-0.09	0.00
Nominal Int. Rate (annualized)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labor	1.39	-0.14	1.36	1.11	2.29	1.68	1.22	0.83	0.48
Pub.Def.(%gdp)	0.71	-0.12	0.72	0.80	0.44	0.55	0.91	0.92	-0.40
Prim.Pub.Def.(%gdp)	0.74	-0.14	0.75	0.80	0.50	0.62	0.93	0.92	-0.43
REA GDP	0.02	0.01	0.07	0.06	0.61	0.55	0.10	0.09	0.00
RW GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: LR=long run, REA=rest of the euro area; RW=rest of the world. All variables as % dev. from steady state, inflation and interest rate as % point dev. from steady state.

Table 10. Public consumption multipliers. Partial monetary policy accommodation

	1 year-stimulus		2 year-stimulus		5 year-stimulus		permanent stimulus		
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	LR
Italian variables									
GDP	0.88	-0.09	0.82	0.69	0.89	0.66	0.72	0.55	0.59
Consumption	-0.03	-0.06	-0.06	-0.16	-0.04	-0.23	-0.50	-0.81	-0.82
Investment	-0.04	-0.11	0.00	-0.22	0.53	0.56	0.62	1.08	0.55
Export (volumes)	-0.41	-0.17	-0.55	-0.73	-0.55	-0.94	-0.46	-0.67	-0.28
Import (volumes)	0.10	0.00	0.15	0.11	0.36	0.44	0.05	0.14	-0.15
Terms of Tr. REA (+=deterior.)	-0.14	-0.11	-0.22	-0.36	-0.27	-0.55	-0.20	-0.37	-0.19
Terms of Tr. RW (+=deterior.)	-0.36	-0.12	-0.46	-0.56	-0.53	-0.70	-0.37	-0.49	-0.19
Real Exc. Rate REA (+=depr.)	-0.06	-0.05	-0.09	-0.16	-0.13	-0.28	-0.09	-0.19	-0.14
Real Exc. Rate RW (+=depr.)	-0.04	-0.05	-0.07	-0.16	0.01	-0.22	-0.07	-0.19	-0.14
Inflation(annualized)	0.09	-0.03	0.17	0.03	0.30	0.16	0.16	0.08	0.00
Real.Int.Rate (annualized)	-0.05	0.03	-0.15	0.03	-0.29	-0.13	-0.15	-0.06	0.00
Nominal Int. Rate (annualized)	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Labor	1.38	-0.15	1.27	1.03	1.37	0.91	1.08	0.70	0.47
Pub.Def.(%gdp)	0.72	-0.11	0.74	0.84	0.71	0.85	0.92	0.92	-0.39
Prim.Pub.Def.(%gdp)	0.74	-0.13	0.77	0.83	0.75	0.86	0.94	0.92	-0.42
REA GDP	0.01	0.01	0.02	0.01	0.09	0.08	0.01	0.01	0.00
RW GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: LR=long run, REA=rest of the euro area; RW=rest of the world. All variables as % dev. from steady state, inflation and interest rate as % point dev. from steady state.

Table 11. Tax multipliers. Constant monetary policy rate. Italian GDP and inflation

	labor tax			capital tax			consumption tax		
	1st year	2nd year	LR	1st year	2nd year	LR	1st year	2nd year	LR
GDP									
1 year-stimulus	0.03	0.04	0.00	0.02	0.02	0.00	0.35	0.08	0.00
2 year-stimulus	0.05	0.12	0.00	0.09	0.12	0.00	0.36	0.42	-0.03
5 year-stimulus	0.00	0.17	0.00	0.47	0.70	0.00	0.82	0.82	0.00
permanent stimulus	0.39	0.56	0.90	1.47	1.77	2.50	0.16	0.23	0.36
Inflation									
1 year-stimulus	-0.02	0.00	0.00	0.00	0.00	0.00	0.07	-0.01	0.00
2 year-stimulus	-0.05	-0.03	0.00	0.02	-0.01	0.00	0.15	0.06	0.00
5 year-stimulus	-0.22	-0.15	0.00	0.27	0.09	0.00	0.66	0.37	0.00
permanent stimulus	0.14	0.04	0.00	1.34	0.66	0.00	0.06	0.02	0.00

Note: LR=long run. GDP as % dev. from steady state, inflation as annualized % point dev. from steady state.

Table 12. Public consumption multipliers. Spread increase

	1 year-stimulus		2 year-stimulus		5 year-stimulus		permanent stimulus		
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	LR
Italian variables									
GDP	0.79	-0.11	0.62	0.58	0.27	0.07	0.18	0.02	0.59
Consumption	-0.22	-0.10	-0.48	-0.37	-1.19	-1.28	-1.57	-1.78	-0.75
Investment	-0.20	-0.21	-0.51	-0.67	-1.51	-2.36	-1.29	-1.65	0.59
Export (volumes)	-0.37	-0.15	-0.43	-0.63	-0.15	-0.33	0.00	-0.02	-0.35
Import (volumes)	-0.08	-0.06	-0.32	-0.20	-1.15	-1.37	-1.38	-1.58	-0.05
Terms of Tr. REA (+=deterior.)	-0.12	-0.10	-0.17	-0.31	-0.09	-0.25	-0.02	-0.08	-0.24
Terms of Tr. RW (+=deterior.)	-0.31	-0.10	-0.34	-0.47	-0.10	-0.21	0.01	0.00	-0.24
Real Exc. Rate REA (+=depr.)	-0.05	-0.05	-0.08	-0.14	-0.05	-0.15	-0.02	-0.07	-0.17
Real Exc. Rate RW (+=depr.)	-0.05	-0.05	-0.08	-0.14	-0.06	-0.16	-0.03	-0.07	-0.18
Inflation(annualized)	0.07	-0.03	0.12	0.03	0.07	0.09	0.00	0.05	0.00
Real.Int.Rate (annualized)	-0.03	0.03	-0.10	0.02	-0.07	-0.12	-0.01	-0.08	0.00
Nominal Int. Rate (annualized)	0.01	0.00	0.01	0.01	0.00	-0.01	-0.01	-0.02	0.00
Labor	1.23	-0.18	0.93	0.89	0.36	0.13	0.20	0.04	0.45
Pub.Def.(%gdp)	1.29	-0.04	1.47	1.32	1.74	1.91	1.70	1.54	-0.34
Prim.Pub.Def.(%gdp)	0.80	-0.14	0.89	0.88	1.09	1.15	1.05	0.80	-0.33
REA GDP	0.00	0.00	-0.01	-0.01	-0.03	-0.03	-0.03	-0.03	0.00
RW GDP	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	0.00	0.00

Note: LR=long run, REA=rest of the euro area; RW=rest of the world. All variables as % dev. from steady state, inflation and interest rate as % point dev. from steady state.

Table 13. Fiscal consolidation and spread reduction. Italian GDP

	standard monetary policy		5 year-ZLB	
	1st year	2nd year	1st year	2nd year
No spread	-0.28	-0.39	-0.70	-0.80
Spread: -75 bp on impact, 0 bp after 1 year	-0.20	-0.38	-0.62	-0.78
Spread: -75 bp on impact, 0 bp after 2 years	-0.09	-0.30	-0.51	-0.70
Spread: -75 bp on impact, 0 bp after 3 years	0.02	-0.17	-0.38	-0.56
Spread: -75 bp on impact, 0 bp after 5 years	0.23	0.10	-0.03	-0.15

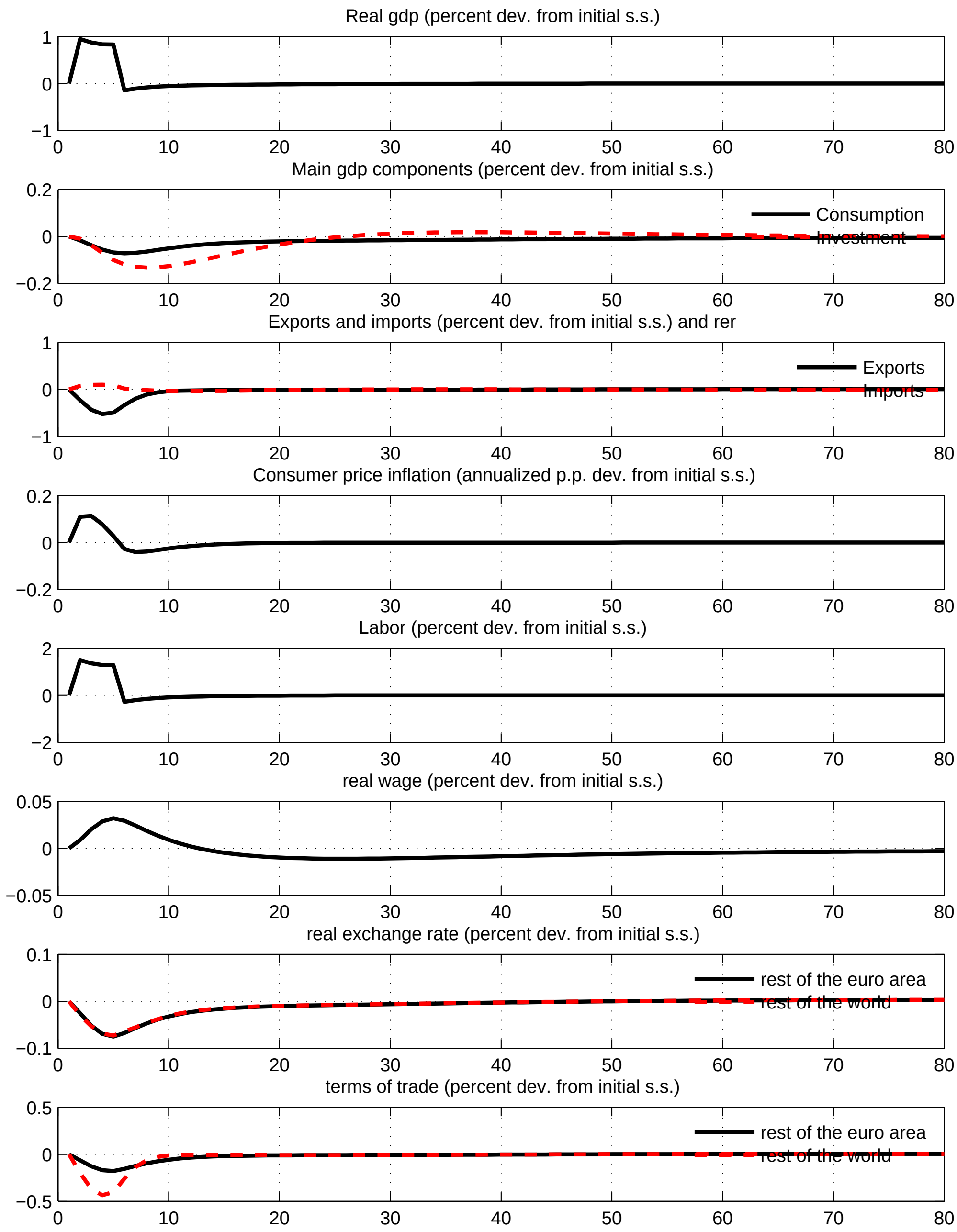
Note: GDP as % dev. from steady state.

Table 14. Sensitivity on public consumption multipliers. Italian GDP and inflation

	benchmark			ROT households			fiscal coord.			fiscal coord.+ZLB		
	1st year	2nd year	LR	1st year	2nd year	LR	1st year	2nd year	LR	1st year	2nd year	LR
GDP												
1 year-stimulus	0.87	-0.09	0.00	0.92	-0.14	0.00	0.87	-0.09	0.00	1.01	0.01	0.00
2 year-stimulus	0.81	0.68	0.00	0.73	0.66	0.00	0.76	0.64	0.00	1.34	1.16	0.00
5 year-stimulus	0.79	0.56	0.00	0.39	0.13	0.00	0.61	0.36	0.00	7.35	6.50	0.00
permanent stimulus	0.69	0.52	0.59	0.26	0.07	0.68	0.53	0.37	0.56	1.61	1.38	0.58
Inflation												
1 year-stimulus	0.08	-0.04	0.00	0.08	-0.04	0.00	0.12	-0.02	0.00	0.12	-0.02	0.00
2 year-stimulus	0.15	0.02	0.00	0.14	0.03	0.00	0.20	0.07	0.00	0.20	0.07	0.00
5 year-stimulus	0.20	0.11	0.00	0.09	0.11	0.00	0.17	0.17	0.00	0.17	0.17	0.00
permanent stimulus	0.14	0.06	0.00	0.00	0.04	0.00	0.04	0.03	0.00	0.04	0.03	0.00

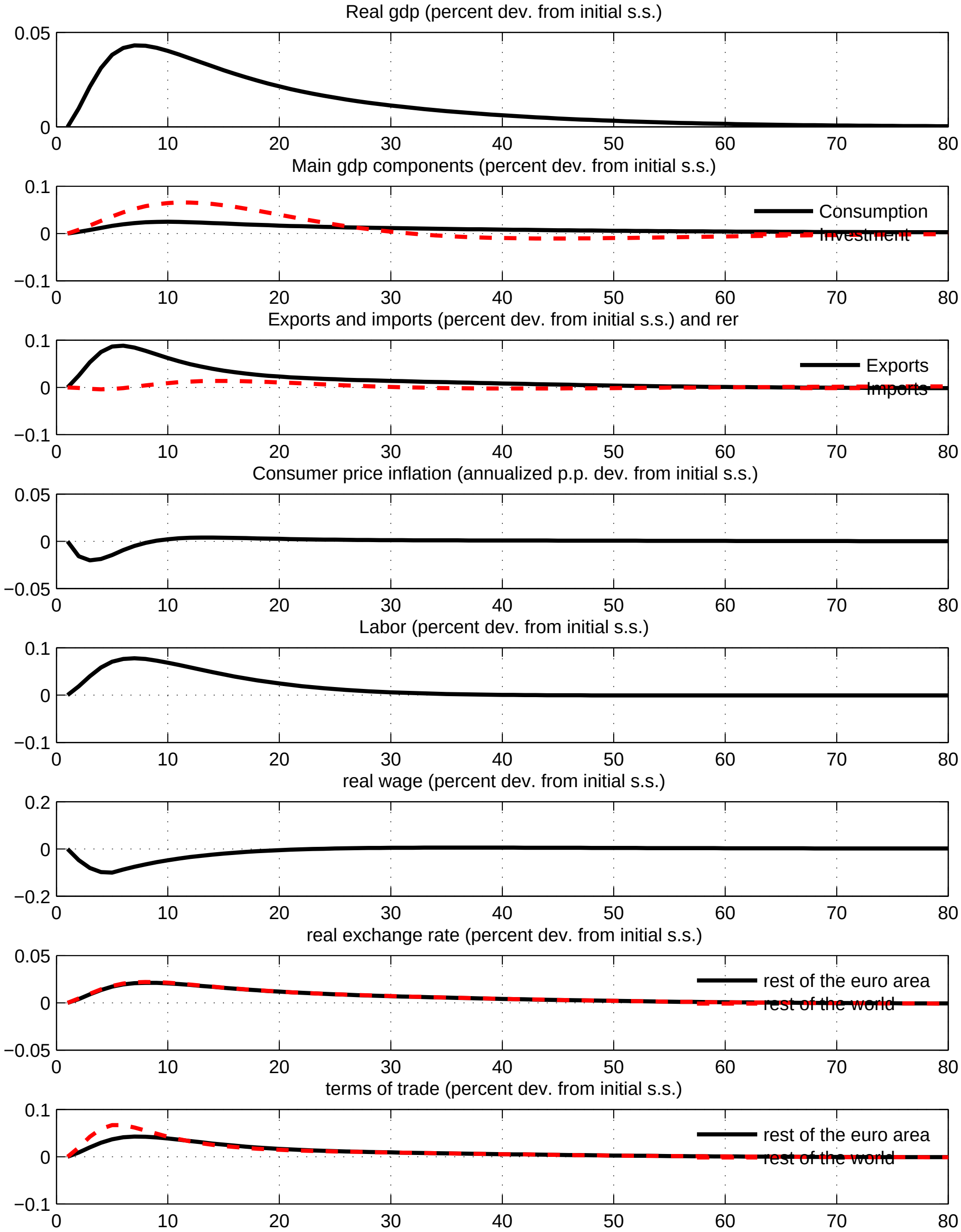
Note: LR=long run; GDP as % dev. from steady state, inflation as annualized % point dev. from steady state.

Figure 1. Italian public consumption shock



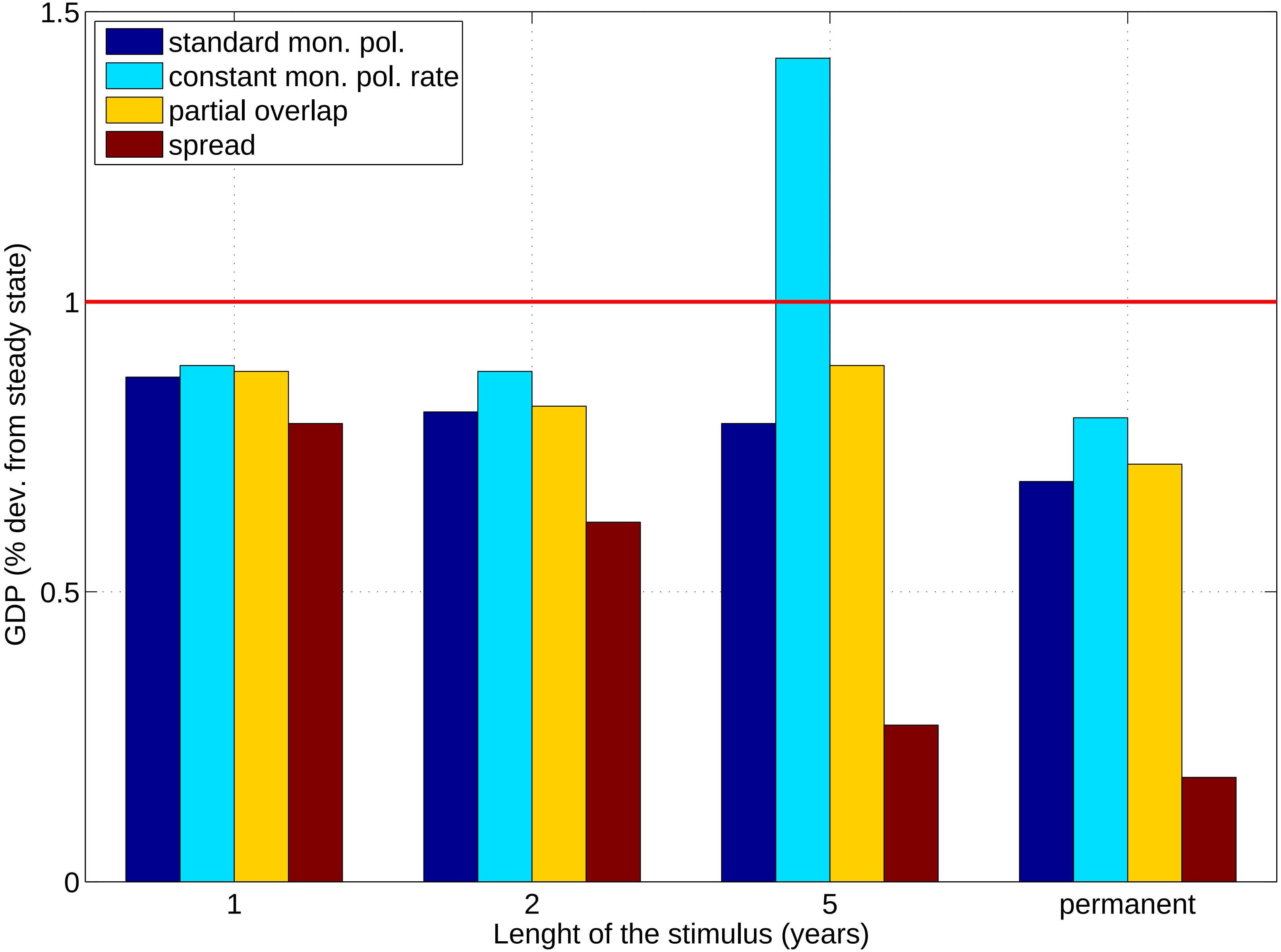
Note: 1-year increase in public consumption of 1% of (pre-shock) Italian GDP. Horizontal axis: quarters.

Figure 2. Italian labor tax shock



Note: 1-year reduction in labor taxation of 1% of (pre-shock) Italian GDP. Horizontal axis: quarters.

Figure 3. First year−GDP multiplier associated with public consumption



Appendix

In this Appendix we report a detailed description of the model, excluding the fiscal and monetary policy part and the description of the households optimization problem that are reported in the main text.[43]

There are three countries, Italy, the rest of the euro area (REA) and the rest of the world (RW). They have different sizes. Italy and the REA share the currency and the monetary authority. In each region there are households and firms. Each household consumes a final composite good made of nontradable, domestic tradable and imported intermediate goods. Households have access to financial markets and smooth consumption by trading a risk-free one-period nominal bond, denominated in euro. They also own domestic firms and capital stock, which is rent to domestic firms in a perfectly competitive market. Households supply differentiated labor services to domestic firms and act as wage setters in monopolistically competitive markets by charging a markup over their marginal rate of substitution.

On the production side, there are perfectly competitive firms that produce the final goods and monopolistic firms that produce the intermediate goods. Two final goods (private consumption and private investment) are produced combining all available intermediate goods according to constant-elasticity-of-substitution bundle. The public consumption good is a bundle of intermediate nontradable goods.

Tradable and nontradable intermediate goods are produced combining capital and labor in the same way. Tradable intermediate goods can be sold domestically or abroad. Because intermediate goods are differentiated, firms have market power and restrict output to create excess profits. We assume that goods markets are internationally segmented and the law of one price for tradables does not hold. Hence, each firm producing a tradable good sets three prices, one for the domestic market and the other two for the export market (one for each region). Since the firm faces the same marginal costs regardless of the scale of production in each market, the different price-setting problems are independent of each other.

To capture the empirical persistence of the aggregate data and generate realistic dynamics, we include adjustment costs on real and nominal variables, ensuring that, in response to a shock, consumption and production react in a gradual way. On the real side, quadratic costs and habit prolong the adjustment of the investment and consumption. On the nominal side, quadratic costs make wage and prices sticky.

In what follows we illustrate the Italian economy. The structure of each of the other two regions (REA and the RW) is similar and to save on space we do not report it.

[43] For a detailed description of the main features of the model see also Bayoumi (2004) and Pesenti (2008).

5.1 Final consumption and investment goods

There is a continuum of symmetric Italian firms producing final nontradable consumption under perfect competition. Each firm producing the consumption good is indexed by $x \in (0, s]$, where the parameter $0 < s < 1$ measures the size of Italy. Firms in the REA and in the RW are indexed by $x^* \in (s, S]$ and $x^{**} \in (S, 1]$, respectively (the size of the world economy is normalized to 1). The CES production technology used by the generic firm x is:

$$A_t(x) \equiv \left(\begin{array}{c} a_T^{\frac{1}{\phi_A}} \left(a_H^{\frac{1}{\rho_A}} Q_{HA,t}(x)^{\frac{\rho_A - 1}{\rho_A}} + a_G^{\frac{1}{\rho_A}} Q_{GA,t}(x)^{\frac{\rho_A - 1}{\rho_A}} (1 - a_H - a_G)^{\frac{1}{\rho_A}} Q_{FA,t}(x)^{\frac{\rho_A - 1}{\rho_A}} \right)^{\frac{\rho_A}{\rho_A - 1} \frac{\phi_A - 1}{\phi_A}} \\ + (1 - a_T)^{\frac{1}{\phi_A}} Q_{NA,t}(x)^{\frac{\phi_A - 1}{\phi_A}} \end{array} \right)^{\frac{\phi_A}{\phi_A - 1}}$$

where Q_{HA}, Q_{GA}, Q_{FA} and Q_{NA} are bundles of respectively intermediate tradables produced in Italy, intermediate tradables produced in the REA, intermediate tradables produced in the RW and intermediate nontradables produced in Italy. The parameter $\rho_A > 0$ is the elasticity of substitution between tradables and $\phi_A > 0$ is the elasticity of substitution between tradable and nontradable goods. The parameter a_H $(0 < a_H < 1)$ is the weight of the Italian tradable, the parameter a_G $(0 < a_G < 1)$ the weight of tradables imported from the REA, a_T $(0 < a_T < 1)$ the weight of tradable goods.

The production of investment good is similar. There are symmetric Italian firms under perfect competition indexed by $y \in (0, s]$. Firms in the REA and in the RW are indexed by $y^* \in (s, S]$ and $y^{**} \in (S, 1]$. Output of the generic Italian firm y is:

$$E_t(y) \equiv \left(\begin{array}{c} v_T^{\frac{1}{\phi_E}} \left(v_H^{\frac{1}{\rho_E}} Q_{HE,t}(y)^{\frac{\rho_E - 1}{\rho_E}} + v_G^{\frac{1}{\rho_E}} Q_{GE,t}(y)^{\frac{\rho_E - 1}{\rho_E}} + (1 - v_H - v_G)^{\frac{1}{\rho_E}} Q_{FE,t}(y)^{\frac{\rho_E - 1}{\rho_E}} \right)^{\frac{\rho_E}{\rho_E - 1} \frac{\phi_E - 1}{\phi_E}} \\ + (1 - v_T)^{\frac{1}{\phi_E}} Q_{NE,t}(y)^{\frac{\phi_E - 1}{\phi_E}} \end{array} \right)^{\frac{\phi_E}{\phi_E - 1}}$$

Finally, we assume that public expenditure C^g is composed by intermediate nontradable goods only.

5.2 Intermediate goods

5.2.1 Demand

Bundles used to produce the final consumption goods are CES indexes of differentiated intermediate goods, each produced by a single firm under conditions of monopolistic competition:

$$Q_{HA}(x) \equiv \left[\left(\frac{1}{s}\right)^{\theta_T} \int_0^s Q(h,x)^{\frac{\theta_T-1}{\theta_T}}\, dh\right]^{\frac{\theta_T}{\theta_T-1}} \tag{16}$$

$$Q_{GA}(x) \equiv \left[\left(\frac{1}{S-s}\right)^{\theta_T} \int_s^S Q(g,x)^{\frac{\theta_T-1}{\theta_T}}\, dg\right]^{\frac{\theta_T}{\theta_T-1}} \tag{17}$$

$$Q_{FA}(x) \equiv \left[\left(\frac{1}{1-S}\right)^{\theta_T} \int_S^1 Q(f,x)^{\frac{\theta_T-1}{\theta_T}}\, df\right]^{\frac{\theta_T}{\theta_T-1}} \tag{18}$$

$$Q_{NA}(x) \equiv \left[\left(\frac{1}{s}\right)^{\theta_N} \int_0^s Q(n,x)^{\frac{\theta_N-1}{\theta_N}}\, dn\right]^{\frac{\theta_N}{\theta_T-1}} \tag{19}$$

where firms in the Italian intermediate tradable and nontradable sectors are respectively indexed by $h \in (0,s)$ and $n \in (0,s)$, firms in the REA by $g \in (s,S]$ and firms in the RW by $f \in (S,1]$. Parameters θ_T, $\theta_N > 1$ are respectively the elasticity of substitution across brands in the tradable and nontradable sector. The prices of the intermediate nontradable goods are denoted $p(n)$. Each firm x takes these prices as given when minimizing production costs of the final good. The resulting demand for intermediate nontradable input n is:

$$Q_{A,t}(n,x) = \left(\frac{1}{s}\right)\left(\frac{P_t(n)}{P_{N,t}}\right)^{-\theta_N} Q_{NA,t}(x) \tag{20}$$

where $P_{N,t}$ is the cost-minimizing price of one basket of local intermediates:

$$P_{N,t} = \left[\int_0^s P_t(n)^{1-\theta_N}\, dn\right]^{\frac{1}{1-\theta_N}} \tag{21}$$

We can derive $Q_A(h,x)$, $Q_A(f,x)$, $C_A^g(h,x)$, $C_A^g(f,x)$, P_H and P_F in a similar way. Firms y producing the final investment goods have similar demand curves. Aggregating over x and y, it can be shown that total demand for intermediate nontradable good n is:

$$\begin{aligned} &\int_0^s Q_{A,t}(n,x)\,dx + \int_0^s Q_{E,t}(n,y)\,dy + \int_0^s C_t^g(n,x)\,dx \\ = &\left(\frac{P_t(n)}{P_{N,t}}\right)^{-\theta_N} \left(Q_{NA,t} + Q_{NE,t} + C_{N,t}^g\right) \end{aligned}$$

where C_N^g is public sector consumption. Italy demands for (intermediate) domestic and imported tradable goods can be derived in a similar way.

5.2.2 Supply

The supply of each Italian intermediate nontradable good n is denoted by $N^S(n)$:

$$N_t^S(n) = \left((1-\alpha_N)^{\frac{1}{\xi_N}} L_{N,t}(n)^{\frac{\xi_N-1}{\xi_N}} + \alpha^{\frac{1}{\xi_N}} K_{N,t}(n)^{\frac{\xi_N-1}{\xi_N}} \right)^{\frac{\xi_N}{\xi_N-1}} \quad (22)$$

Firm n uses labor $L_{N,t}^p(n)$ and capital $K_{N,t}(n)$ with constant elasticity of input substitution $\xi_N > 0$ and capital weight $0 < \alpha_N < 1$. Firms producing intermediate goods take the prices of labor inputs and capital as given. Denoting W_t the nominal wage index and R_t^K the nominal rental price of capital, cost minimization implies:

$$L_{N,t}(n) = (1-\alpha_N) \left(\frac{W_t}{MC_{N,t}(n)} \right)^{-\xi_N} N_t^S(n) \quad (23)$$

$$K_{N,t}(n) = \alpha \left(\frac{R_t^K}{MC_{N,t}(n)} \right)^{-\xi_N} N_t^S(n)$$

where $MC_{N,t}(n)$ is the nominal marginal cost:

$$MC_{N,t}(n) = \left((1-\alpha) W_t^{1-\xi_N} + \alpha \left(R_t^K \right)^{1-\xi_N} \right)^{\frac{1}{1-\xi_N}} \quad (24)$$

The productions of each Italian tradable good, $T^S(h)$, is similarly characterized.

5.2.3 Price setting in the intermediate sector

Consider now profit maximization in the Italian intermediate nontradable sector. Each firm n sets the price $p_t(n)$ by maximizing the present discounted value of profits subject to the demand constraint and the quadratic adjustment costs:

$$AC_{N,t}^p(n) \equiv \frac{\kappa_N^p}{2} \left(\frac{P_t(n)}{P_{t-1}(n)} - 1 \right)^2 Q_{N,t} \quad \kappa_N^p \geq 0$$

paid in unit of sectorial product $Q_{N,t}$ and where κ_N^p measures the degree of price stickiness. The resulting first-order condition, expressed in terms of domestic consumption, is:

$$p_t(n) = \frac{\theta_N}{\theta_N - 1} mc_t(n) - \frac{A_t(n)}{\theta_N - 1} \quad (25)$$

where $mc_t(n)$ is the real marginal cost and $A(n)$ contains terms related to the presence of price adjustment costs:

$$\begin{aligned} A_t(n) \quad &\approx \quad \kappa_N^p \frac{P_t(n)}{P_{t-1}(n)} \left(\frac{P_t(n)}{P_{t-1}(n)} - 1 \right) \\ &\quad -\beta \kappa_N^p \frac{P_{t+1}(n)}{P_t(n)} \left(\frac{P_{t+1}(n)}{P_t(n)} - 1 \right) \frac{Q_{N,t+1}}{Q_{N,t}} \end{aligned}$$

The above equations clarify the link between imperfect competition and nominal rigidities. As emphasized by Bayoumi et al. (2004), when the elasticity of substitution θ_N is very large and hence the competition in the sector is high, prices closely follow marginal costs, even though adjustment costs are large. To the contrary, it may be optimal to maintain stable prices and accommodate changes in demand through supply adjustments when the average markup over marginal costs is relatively high. If prices were flexible, optimal pricing would collapse to the standard pricing rule of constant markup over marginal costs (expressed in units of domestic consumption):

$$p_t(n) = \frac{\theta_N}{\theta_N - 1} mc_{N,t}(n) \tag{26}$$

Firms operating in the intermediate tradable sector solve a similar problem. We assume that there is market segmentation. Hence the firm producing the brand h chooses $p_t(h)$ in the Italian market,a price $p_t^*(h)$ in the REA and a price $p_t^{**}(h)$ in the RW to maximize the expected flow of profits (in terms of domestic consumption units):

$$E_t \sum_{\tau=t}^{\infty} \Lambda_{t,\tau} \left[\begin{array}{c} p_\tau(h) y_\tau(h) + p_\tau^*(h) y_\tau^*(h) + p_\tau^{**}(h) y_\tau^{**}(h) \\ -mc_{H,\tau}(h) \left(y_\tau(h) + y_\tau^*(h) + y_\tau^{**}(h) \right) \end{array} \right]$$

subject to quadratic price adjustment costs similar to those considered for nontradables and standard demand constraints. The term E_t denotes the expectation operator conditional on the information set at time t, $\Lambda_{t,\tau}$ is the appropriate discount rate and $mc_{H,t}(h)$ is the real marginal cost. The first order conditions with respect to $p_t(h)$, $p_t^*(h)$ and $p_t^{**}(h)$ are:

$$p_t(h) = \frac{\theta_T}{\theta_T - 1} mc_t(h) - \frac{A_t(h)}{\theta_T - 1} \tag{27}$$

$$p_t^*(h) = \frac{\theta_T}{\theta_T - 1} mc_t(h) - \frac{A_t^*(h)}{\theta_T - 1} \tag{28}$$

$$p_t^{**}(h) = \frac{\theta_T}{\theta_T - 1} mc_t(h) - \frac{A_t^{**}(h)}{\theta_T - 1} \tag{29}$$

where θ_T is the elasticity of substitution of intermediate tradable goods, while $A(h)$ and $A^*(h)$ involve terms related to the presence of price adjustment costs:

$$
\begin{aligned}
A_t(h) &\approx \kappa_H^p \frac{P_t(h)}{P_{t-1}(h)} \left(\frac{P_t(h)}{P_{t-1}(h)} - 1 \right) \\
&\quad -\beta \kappa_H^p \frac{P_{t+1}(h)}{P_t(h)} \left(\frac{P_{t+1}(h)}{P_t(h)} - 1 \right) \frac{Q_{H,t+1}}{Q_{H,t}} \\
A_t^*(h) &\approx \theta_T - 1 + \kappa_H^p \frac{P_t^*(h)}{P_{t-1}^*(h)} \left(\frac{P_t^*(h)}{P_{t-1}^*(h)} - 1 \right) \\
&\quad -\beta \kappa_H^p \frac{P_{t+1}^*(h)}{P_t^*(h)} \left(\frac{P_{t+1}^*(h)}{P_t^*(h)} - 1 \right) \frac{Q_{H,t+1}^*}{Q_{H,t}^*} \\
A_t^{**}(h) &\approx \theta_T - 1 + \kappa_H^p \frac{P_t^{**}(h)}{P_{t-1}^{**}(h)} \left(\frac{P_t^{**}(h)}{P_{t-1}^{**}(h)} - 1 \right) \\
&\quad -\beta \kappa_H^p \frac{P_{t+1}^{**}(h)}{P_t^{**}(h)} \left(\frac{P_{t+1}^{**}(h)}{P_t^{**}(h)} - 1 \right) \frac{Q_{H,t+1}^{**}}{Q_{H,t}^{**}}
\end{aligned}
$$

where κ_H^p,${\kappa_H^p}^*$,${\kappa_H^p}^{**} > 0$ respectively measure the degree of nominal rigidity in Italy, in the REA and in the RW. If nominal rigidities in the (domestic) export market are highly relevant (that is, if is relatively large), the degree of inertia of Italian goods prices in the foreign markets will be high. If prices were flexible ($\kappa_H^p = \kappa_H^{p*} = \kappa_H^{p**} = 0$) then optimal price setting would be consistent with the cross-border law of one price (prices of the same tradable goods would be equal when denominated in the same currency).

5.3 Labor Market

In the case of firms in the intermediate nontradable sector, the labor input $L_N(n)$ is a CES combination of differentiated labor inputs supplied by domestic agents and defined over a continuum of mass equal to the country size ($j \in [0, s]$):

$$
L_{N,t}(n) \equiv \left(\frac{1}{s} \right)^{\frac{1}{\psi}} \left[\int_0^s L_t(n,j)^{\frac{\psi-1}{\psi}} dj \right]^{\frac{\psi}{\psi-1}} \tag{30}
$$

where $L(n,j)$ is the demand of the labor input of type j by the producer of good n and $\psi > 1$ is the elasticity of substitution among labor inputs. Cost minimization implies:

$$
L_t(n,j) = \left(\frac{1}{s} \right) \left(\frac{W_t(j)}{W_t} \right)^{-\psi} L_{N,t}(j), \tag{31}
$$

where $W(j)$ is the nominal wage of labor input j and the wage index W is:

$$
W_t = \left[\left(\frac{1}{s} \right) \int_0^s W_t(h)^{1-\psi} dj \right]^{\frac{1}{1-\psi}}. \tag{32}
$$

Similar equations hold for firms producing intermediate tradable goods. Each household is the monopolistic supplier of a labor input j and sets the nominal wage facing a downward-sloping demand, obtained by aggregating demand across Italian firms. The wage adjustment is sluggish because of quadratic costs paid in terms of the total wage bill:

$$AC_t^W = \frac{\kappa_W}{2}\left(\frac{W_t}{W_{t-1}} - 1\right)^2 W_t L_t \tag{33}$$

where the parameter $\kappa_W > 0$ measures the degree of nominal wage rigidity and L is the total amount of labor in the Italian economy.

5.4 The equilibrium

We find a symmetric equilibrium of the model. In each country there is a representative agent and four representative sectorial firms (in the intermediate tradable sector, intermediate nontradable sector, consumption production sector and investment production sector). The equilibrium is a sequence of allocations and prices such that, given initial conditions and the sequence of exogenous shocks, each private agent and firm satisfy the correspondent first order conditions, the private and public sector budget constraints and market clearing conditions for goods, labor, capital and bond holdings.