Fiscal Multipliers: Lessons from the Great Recession for Small Open Economies

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Abstract

We assess empirical evidence and theoretical work on the determinants of the fiscal multiplier. Recent empirical literature suggests that short-run spending multipliers are larger under fixed exchange rate regimes, in economic downturns and during financial crises. However, the evidence on their magnitude under fiscal stress is mixed. Using a stylised model of a small open economy, we carry out a close-up analysis of the transmission of fiscal policy conditional on monetary/exchange rate regimes, policy rates at the zero lower bound, credit constraints and sovereign risk. We show that the size of short-run multipliers crucially depends on the interaction of monetary and budget consolidation policies, especially when weak public finances expose the economy to sovereign risk crises.

Keywords: Fiscal multiplier, Fiscal policy, Monetary policy, Exchange rate regime, Sovereign risk channel, Zero lower bound

JEL-Codes: F41, F42, E32

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1 Introduction

The great recession has motivated an overarching reassessment of fiscal policy after a long period of rising skepticism about its effectiveness. In the first phase of the crisis, fiscal policy has been widely relied upon as a first line of defense against the large recessionary shock of 2008 and 2009. Policymakers in advanced countries agreed on pursuing a strongly expansionary stance—either via explicit discretionary stimulus measures, or by letting automatic stabilizers work to their full extent, disregarding the implied strong deterioration of fiscal deficits (see Corsetti and Müller, 2013, for an overview).

However, as the crisis and recession turned out to be more persistent than initially anticipated, the ongoing deterioration of the fiscal outlook led governments to take a more cautious approach—not least because, per effect of contingent and implicit public liabilities, government borrowing rapidly rose to unprecedented levels. Debt sustainability became the main policy issue, especially in the euro area (Lane, 2012).

Thus, different phases of the crisis have been characterised by significant variation in the context and sign of fiscal policy measures: fiscal stimulus during a disruptive financial crisis and deep recession was followed by retrenchment in a period of persistently large output gaps and looming sovereign risk crisis. In either phase, fiscal measures were expected, or feared, to have a first-order impact on economic activity. In other words, multiplier effects were perceived to be large.

In this context, the Swedish Fiscal Policy Council has asked us to provide an assessment of the multiplier effects of fiscal policy. The following questions are of particular interest.

1. What do we know about the size of fiscal multipliers in different circumstances and for different instruments?

2. Is the old consensus that discretionary policy should be avoided and only used in exceptional circumstances still a good advice? If not, can it be replaced with something else, e.g., the Temporary, Targeted and Timely advice?

3. Is there a substantial difference in terms of the value stabilizing different types of shocks, e.g., to export demand, domestic demand and supply, and if so what is then the impact of this on the optimal policy?

4. Would it be possible to set up an early warning system for fiscal vulnerability?

5. The financial crisis illustrated the connection between financial and fiscal fragility. Do we know anything about the implications of this for fiscal policy?

The starting point of our analysis is the observation that there is no such thing as "the" multiplier—an insight which motivated much of our work on the determinants of the topic (Corsetti et al., 2012b). After all, the multiplier is not a parameter of the model, but an equilibrium outcome, contingent on the state of the economy which includes the policy framework which is put in or expected to remain in place. In the context of the crisis, this insight has become a major theme in the literature on fiscal policy.

Consistent with this insight, in what follows we first review recent empirical studies of the multipliers, providing evidence on how these differ across exchange rate regimes, countries with stronger or weaker public finances, during financial and banking crisis, or during an economic downturn. If only briefly, we will also discuss open methodological issues challenging these studies. Then, we will specify a macro model of a small open economy and use model-based simulations to provide a close-up analysis of fiscal transmission conditional on different monetary policy regimes, a varying incidence of liquidity constraints in the economy, vulnerability to sovereign risk, and alternative budget and debt consolidation regimes.

In our analysis we will specifically elaborate on how the multiplier depends on the extent to which budget and monetary regimes anchor expectations concerning macroeconomic and financial stability over the medium and the long run. With the crisis, monetary policy rates being constrained by the zero (or slightly negative) lower bound, monetary authorities have increasingly relied on forward guidance to pursue their stabilisation goals. Managing expectations is equally, if not more important for the transmission of short-run fiscal policy. Multipliers crucially depend on market expectations over the path of future debt and deficits, and the likelihood of credit events.

In carrying out our study, we will not aim for a broad survey of the literature—a demanding task, given the riches of the contributions on the subject—but draw mostly on our own work. With a view towards providing a focused discussion, we will restrict our attention to the multiplier of government spending. In particular, for space considerations, we will abstract from the current debate on fiscal transfers, and their effects on the consumption of liquidity constrained households (Kaplan and Violante, 2014). That said, credit and liquidity constraints play an important role in our analysis of government spending multipliers.

Throughout our analysis, we will complement our study of the multiplier with a comparative analysis on the macroeconomic impact of negative shocks to external demand. This exercise is meant to account for a key channel through which the global crisis in 2008 has propagated across the globe and impacted on small open economies like Sweden, creating a need for fiscal stabilisation.

The text is organised as follows. Section 2 discusses the empirical evidence. Section 3 specifies our model, detailing the alternative features and policy regimes that we will use in our analysis. Section 4 is devoted to model-based analysis. Two subsections will discuss the implications for the multiplier of, respectively, constraints on monetary policy and sovereign risk. Section 5 concludes addressing the five questions raised by the Swedish Fiscal Policy Council as listed above, based on our main results.

2 Time-series evidence

This section discusses recent evidence on how fiscal multipliers vary across countries and periods depending on monetary and fiscal regimes, and especially cyclical and financial conditions. The crisis has strongly motivated empirical work on such policy-driven questions as: Is fiscal policy more effective when monetary policy is constrained by the zero lower bound? Are multipliers particularly large during an economic downturn associated with a financial crisis? To what extent is the effect of fiscal policy undermined by weak public finances and sovereign risk?

Our goal is not to provide an exhaustive survey, but to present a selection of results restricting our focus on the output effect of changes in government consumption in order to set the stage for our model-based analysis below.[1]

2.1 Methodology

Prior to the crisis, empirical work on fiscal policy transmission mostly relied on linear time-series models estimated on data from the US or a few other countries, depending on the availability of information over a long enough period. With a few exceptions, the primary goal of the literature was to obtain reliable evidence on "the" multiplier. The debate mostly focused on how to identify exogenous variations in spending or taxation, see Blanchard and Perotti (2002), Mountford and Uhlig (2008), and Ramey (2011), among others.

Interestingly, over time, many passages of this debate have been substantially reconsidered. The work by Caldara and Kamps (2012), for instance, has clarified the root of the differences between Blanchard and Perotti and Mountford and Uhlig, in terms of elasticities assumed in the empirical model. By the same token, the divide between Blanchard and Perotti and Ramey results appear fairly small, at least for more recent sample periods.

Figure 1, which reproduces some results of our joint work with André Meier (Corsetti et al., 2012a), illustrates this point. We contrast impulse responses of selected variables to a

[1] The empirical literature has also investigated the effects of transfers policies. We briefly discuss recent studies in an appendix.

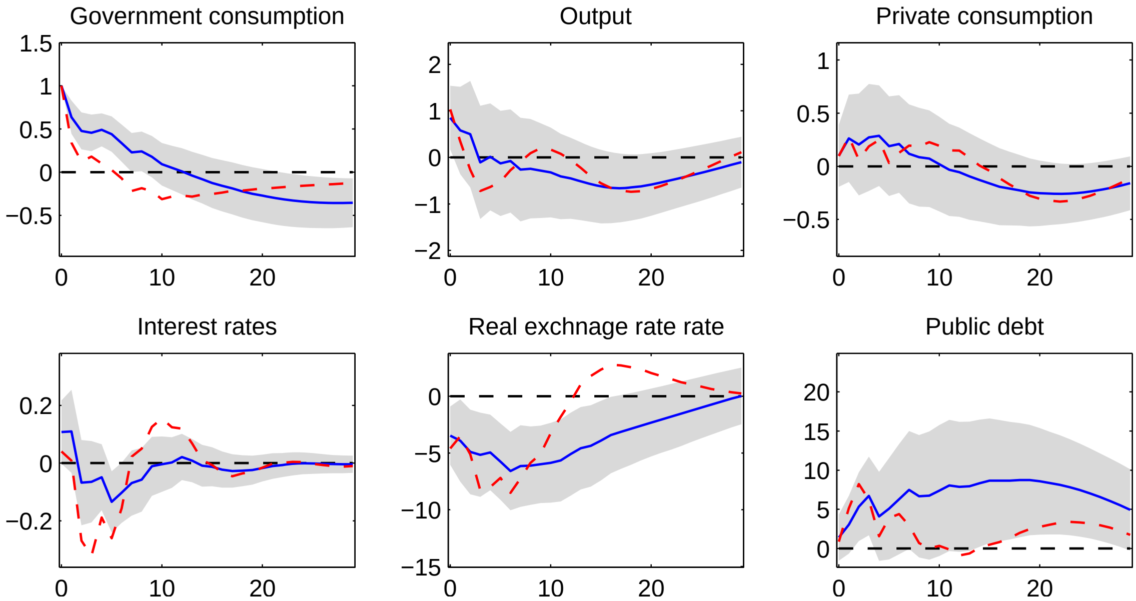

Figure 1: Estimated effect of government consumption shock in US data (1983–2007). Shock is one percent of trend output. Horizontal axes measure time in quarters, vertical axes measure percentage deviation from pre-shock level. Solid line: point estimate under Blanchard-Perotti identification with shaded areas indicating 90 percent confidence bounds; dashed line: identification based on forecast errors as in Ramey (2011). Source: Corsetti et al. (2012a).

government consumption shock obtained using the Blanchard-Perotti identification scheme and Ramey's alternative identification scheme. While the former approach assumes that government consumption is predetermined relative to the other variables in the VAR model, the latter identifies fiscal innovations relative to earlier projections by professional forecasters. Note that our VAR model differs from Ramey's in several respects, notably sample length and the choice of variables included in the baseline VAR model. Nevertheless, we find that impulse responses are fairly similar across the two identification schemes: the solid line shows the results for Blanchard-Perotti, with shaded areas indicating 90 percent confidence bounds; the dashed line shows results for the Ramey approach. Note that we normalize the shock to one percent of GDP. The second panel in the top row shows the response of output in percentage deviation from the pre-shock level. It is thus a direct measure of the fiscal multiplier. On impact it is about unity under both identification schemes.

Similarly, the notion that the Blancard-Perotti identification scheme hinges critically on the use of quarterly data has been qualified. Born and Müller (2012), for instance, find that the estimated effects of government consumption shocks in four OECD countries are quite similar, independent of whether estimates are based on quarterly or annual data (see also Beetsma et al., 2009).

After the crisis, the debate has shifted substantially, focusing on the possible state dependence of fiscal multiplies. Even if fiscal shocks could be perfectly identified, linear time series models would still average multipliers across possibly distinct regimes and circumstances. So, a low estimate for the multiplier may conceal important differences, that may be especially relevant to countercyclical policy. Hence, identifying exogenous and unanticipated variations in fiscal policy defines only one dimension of the empirical challenge. An equally important and difficult issue is how to distinguish the effect of stimulus across economic circumstances and regimes of fiscal and monetary policy interactions.

Early on, a few empirical studies examined the dependence of fiscal policy on the health of public finances, most notably Perotti (1999), explored asymmetries across expansions and contractions, see e.g. Tagkalakis (2008), or re-examined the role of exchange rate regimes (Born et al., 2013; Ilzetzki et al., 2013).

More recent studies explicitly condition the effects of fiscal policy on issues emerging from the crisis, such as downturns (Auerbach and Gorodnichenko, 2012, 2013) and inequality and sovereign risk (Born et al., 2015). More recently, still, Brinca et al. (2014) explore the role of inequality, as an indicator of the incidence of liquidity and credit constraints, for the size of fiscal multipliers. We also stress, however, that the new methods and results are not unchallenged (see e.g. Alloza, 2014; Ramey and Zubairy, 2014).

2.2 Estimates of state-contingent multipliers

In order to illustrate the importance of this broad empirical agenda we find it useful to reproduce synthetic results on regime- and state-dependent multipliers, drawing from previous work of ours. We do so in Table 2.2. The upper panel reports estimates of Corsetti et al. (2012b). These estimates are based on an unbalanced panel of 17 OECD countries covering the period 1975–2008. The frequency of observations is annual. The second panel summarizes estimates of Born et al. (2015), based on an unbalanced panel of 31 emerging and advanced economies. In this case the sample includes more than 2300 quarterly observations. So, while pursuing a similar empirical strategy, the two studies differ in the sample size, data frequency and reference period.

In both studies, the main idea is to exploit variations in policy regimes and cyclical and financial conditions of the economy both across countries and over time, to investigate the sensitivity of estimated multipliers. Both panels show the effects on output of exogenous variations in government spending identified following the Blanchard-Perotti approach.

In the first panel, multipliers are estimated conditional on (i) exchange rate regimes (floats versus peg), (ii) the state of public finances and (iii) the occurrence of financial and bank-

	Multiplier on output		
	Impact	Maximum	Cumulative
Baseline	−0.0	−0.0	−0.2
Currency Peg	0.6	0.6	0.6
Weak Public Finances	−0.7	0.2	−1.2
Financial crisis	2.3	2.9	2.2
Benign times	−0.14	−0.33	−0.45
Fiscal stress	0.65	1.18	1.72
Boom	0.02	0.68	0.69
Recession	0.50	0.80	1.45

Upper panel: estimates by Corsetti et al. (2012b); lower panels: estimates by Born et al. (2015); cumulative multiplier computed over a horizon of two years: ($\sum Y_t / \sum G_t$)

ing crises. Variations in these dimensions are accounted for by dummy variables based on, respectively, official/de facto classifications of exchange rate regimes; chronologies of crises available in the literature; threshold values for the size of debt and deficits—all subject to extensive robustness checks. In the table, we report the value of the output multiplier on impact (only for the first period, column 1 of the table), cumulated over 2 years (column 3), at its peak over a longer horizon (column 2).

The baseline case (first row) corresponds to years in which the countries in the sample let the exchange rate float freely, are not affected by a crisis, and have relatively sound public finances. Relative to the baseline case, we then consider deviation in one dimension at a time. In the second row, we look at country-year observations in which countries have strong public finances and are not in a crisis, but pursue an exchange rate peg. In the third row, the deviation from the baseline concerns the state of public finances; in the last row—financial stability. The original text and the literature provides more detailed definitions of the variables, and extensive discussion of the model and open methodological issues. Here we call attention on four main results.

First, under normal economic circumstances (baseline), multipliers are estimated to be zero on impact. The point estimate for the cumulative multiplier is actually negative, although not significantly different from zero. We should note here that in the same sample, the output multiplier estimated without conditioning is as high as .7. Our finding thus supports the notion that, in an economy with flexible exchange rates in normal times, the macroeconomic effects of a government spending expansion are generally weaker than suggested by time series models.

Second, multipliers appear to be larger under a currency peg than under a float. This is consistent with the received wisdom from conventional models. The difference relative to the baseline is however relatively modest. There is also little or no evidence that the difference is driven by stronger crowding out of net exports under a float. If anything, real exchange rates tend to depreciate in response to a rise in spending, at odds with theoretical results from a wide array of models (see Corsetti et al., 2012a, for further discussion).

Third, multipliers are lower when public debt and deficits are high. Ilzetzki et al. (2013) and Auerbach and Gorodnichenko (2013) report similar findings. This is, however, the result that is most sensitive to the criterion adopted in the definition of the dummy—unsurprisingly perhaps, because the size of official debt and deficits are not, per se, good indicators of fiscal stress (Bi, 2012).

Fourth, the highest impact of fiscal policy is detected for periods in which a country faces a financial and banking crisis, typically associated with macroeconomic stress. On the one hand, this finding appears to support the argument that higher fiscal outlays are particularly effective as a stabilization tool in a financial crisis, arguably because liquidity constraints become more pervasive. In fact, the recent policy debate has featured repeated claims that fiscal multipliers could be as large as two under current conditions. Our estimates are consistent with a multiplier of this magnitude, even though our results for "normal times" do not suggest large fiscal multipliers at all.

On the other hand, it is worth stressing that, according to the evidence, many of the financial crises in the reference sample have induced policymakers to cut, rather than increase government spending—out of concerns about financial or fiscal sustainability. In this sense, a large multiplier can be a warning about the possibility of large negative effects, if and when the government is forced to retrench spending in the midst of a financial turmoil. This consideration clearly underscores the case for preserving and strengthening fiscal buffers in good times.[2]

A key question is whether, as many see as plausible, fiscal sustainability is a precondition for obtaining high positive multipliers during a financial crisis. The estimates by Born et al. (2015), in the lower panel of the table, sheds light on this important issue. The last two rows of the Table contrast multipliers conditional on benign (fiscal) times, with multipliers conditional on fiscal stress. Different from other studies (and the first panel of the table),

[2] We should observe that, while the results in the table are robust to extending the sample through 2010, the results in the first panel of the table above are obtained from a sample of economies which at no point in time are at the zero lower bound.

Born et al identifies fiscal stress by relying on sovereign yield spreads, rather than threshold indicators based on public debt or deficits. The approach relies on a finer and arguably better targeted measure of fiscal instability: yield spreads are not a latent state variable, but provide a direct assessment of fiscal sustainability by market participants. Moreover the threshold for stress is not imposed ex ante, but follows endogenously from in-sample variation of yield spreads.

The evidence in the table suggests that estimated multipliers are larger under fiscal stress associated with explicit financial turmoil. In this dimension, Born et al. (2015) are in accord with the result by Corsetti et al. (2012b): estimated multipliers are higher during financial crises. The evidence would thus suggest similar considerations concerning fiscal prudence as detailed above. However, the result is also seemingly at odds with estimates of negative multipliers when the size of public debt and deficits is used to define weak public finances—irrespective of whether sovereign spreads are high.

A last notable result highlighted by the table concerns the differential effects of government consumption on output during booms and recessions—results are reported in the last two lines of the table. In line with conventional wisdom, multipliers are larger during recessions. Born et al. (2015) thus confirm for a larger sample earlier results by Auerbach and Gorodnichenko (2012, 2013).

Overall, the empirical literature has documented considerable heterogeneity in multiplier effects, confirming our theoretical prior. Some results are in full accord with the conventional wisdom. Multipliers are probably very small in "normal times," larger during recessions and/or financial crisis, and larger under a peg relative to a float. Other results are more controversial. Most importantly, fiscal conditions do matter, but the evidence on how these impact multiplies is mixed. The sign and magnitude of the multiplier under fiscal stress will therefore be a leading feature of our discussion to follow.

3 A small open economy model

In the following we outline the New Keynesian small open economy model which guides our discussion. Galí and Monacelli (2005) develop a version of the model which features complete financial markets. Our analysis, instead, features various financial frictions. We consider the possibility that, first, a fraction of domestic households may be excluded from financial markets altogether and, second, international financial markets are incomplete across borders. Third, government debt is not riskless and sovereign risk may spill over and affect private sector borrowing conditions adversely as in Corsetti et al. (2013b). Our exposition largely follows Corsetti et al. (2013a).

3.1 Final Good Firms

The final consumption good, C_t, is a composite of intermediate goods produced by a continuum of monopolistically competitive firms both at home and abroad. We use $j \in [0,1]$ to index intermediate good firms as well as their products and prices. Final good firms operate under perfect competition and purchase domestically produced intermediate goods, $Y_{H,t}(j)$, as well as imported intermediate goods, $Y_{F,t}(j)$. Final good firms minimize expenditures subject to the following aggregation technology

$$C_t = \left[(1-\omega)^{\frac{1}{\sigma}} \left(\left[\int_0^1 Y_{H,t}(j)^{\frac{\epsilon-1}{\epsilon}} dj \right]^{\frac{\epsilon}{\epsilon-1}} \right)^{\frac{\sigma-1}{\sigma}} + \omega^{\frac{1}{\sigma}} \left(\left[\int_0^1 Y_{F,t}(j)^{\frac{\epsilon-1}{\epsilon}} dj \right]^{\frac{\epsilon}{\epsilon-1}} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad (1)$$

where σ measures the trade price elasticity, i.e., the extent of substitution between domestically produced goods and imports for a given change in the terms of trade. The parameter $\epsilon > 1$ measures the price elasticity across intermediate goods produced within the same country, while ω measures the weight of imports in the production of final consumption goods—a value lower than 1/2 corresponds to home bias in consumption.

Expenditure minimization implies the following price indices for domestically produced intermediate goods and imported intermediate goods, respectively,

$$P_{H,t} = \left(\int_0^1 P_{H,t}(j)^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}}, \qquad P_{F,t} = \left(\int_0^1 P_{F,t}(j)^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}}. \quad (2)$$

By the same token, the consumption price index is

$$P_t = \left((1-\omega) P_{H,t}^{1-\sigma} + \omega P_{F,t}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}. \quad (3)$$

Regarding the Rest of the World (henceforth ROW), we assume an isomorphic aggregation technology. Further, the law of one price is assumed to hold at the level of intermediate goods such that

$$P_{F,t} = \mathcal{E}_t P_t^*, \quad (4)$$

where $\mathcal{E}_t$ is the nominal exchange rate (the price of foreign currency in terms of domestic currency) and P_t^* denotes the price index of imports measured in foreign currency. It corresponds to the foreign price level, as imports account for a negligible fraction of ROW consumption. For future reference we define the terms of trade and the real exchange rate as

$$S_t = \frac{P_{H,t}}{P_{F,t}}, \; Q_t = \frac{P_t}{\mathcal{E}_t P_t^*} \quad (5)$$

respectively. Note that while the law of one price holds throughout, deviations from purchasing power parity (PPP) are possible in the short run, due to home bias in consumption. Below we will consider the dynamics of the model around a symmetric steady state such that PPP holds in the long run.

3.2 Intermediate Good Firms

Intermediate goods are produced on the basis of the following production function: $Y_t(j) = H_t(j)$, where $H_t(j)$ measures the amount of labor employed by firm j.

Intermediate good firms operate under imperfect competition. We assume that price setting is constrained exogenously à la Calvo. Each firm has the opportunity to change its price with a given probability $1 - \xi$. Given this possibility, a generic firm j will set $P_{H,t}(j)$ in order to solve

$$\max E_t \sum_{k=0}^{\infty} \xi^k \rho_{t,t+k} \left[Y_{t,t+k}(j) P_{H,t}(j) - W_{t+k} H_{t+k}(j) \right], \tag{6}$$

where $\rho_{t,t+k}$ denotes the stochastic discount factor and $Y_{t,t+k}(j)$ denotes demand in period $t + k$, given that prices have been set optimally in period t. E_t denotes the expectations operator.

3.3 Households

We assume that a fraction of households is without access to financial markets and thus consumes its disposable income in each period. That setup is similar to the closed-economy variants of Galí et al. (2007) and Bilbiie et al. (2008). Specifically, out of a continuum of households in $[0, 1]$ residing in our small open economy, a fraction $1 - \lambda$ are asset holders, indexed by a subscript 'A'.

Asset holders households own the firms and have access to a complete set of Arrow-Debreu securities traded within the countries—financial markets are complete within each country. Across borders, these households may either trade a complete set of state-contingent claims or borrow and lend issuing nominally non-contingent one-period bonds (the structure of financial markets will vary across exercises). The remaining households (a fraction λ of the total) do not participate at all in asset markets, i.e., they are 'non-asset holders.' They are indexed by subscript 'N'.

A representative asset-holding household chooses consumption, $C_{A,t}$, and supplies labor, $H_{A,t}$, to intermediate good firms in order to maximize the following criterion

$$E_t \sum_{k=0}^{\infty} \beta^k \left(\frac{C_{A,t+k}^{1-\gamma}}{1-\gamma} - \frac{H_{A,t+k}^{1+\varphi}}{1+\varphi} \right). \tag{7}$$

We will assume either complete or incomplete asset markets at the international level. In the latter case, the household trades two discount bonds on international financial markets, one paying one unit of domestic currency tomorrow, the other pays one unit of foreign currency. Specifically, letting B_t denote the domestic-currency bond and B_t^* the foreign-currency bond, traded at price $Q_{B,t}$ and $Q_{B^*,t}$, respectively, the budget constraint reads as follows

$$Q_{B,t}B_t + Q_{B^*,t}B_t^*\mathcal{E}_t + P_tC_{A,t} = (1-\tau)(W_tH_{A,t} + \Upsilon_t) - T_t + B_{t-1} + B_{t-1}^*\mathcal{E}_t, \tag{8}$$

where τ is a constant tax rate, T_t and Υ_t denotes lump-sum taxes and profits of intermediate good firms (owned by asset-holding households). Ponzi schemes are ruled out by assumption. Alternatively, we assume that the household trades a complete set of state-contingent securities with the rest of the world. Letting Ξ_{t+1} denote the payoff in units of domestic currency in period $t+1$ of the portfolio held at the end of period t, the budget constraint of the household is given by

$$E_t\{\rho_{t,t+1}\Xi_{t+1}\} - \Xi_t = (1-\tau)(W_tH_{A,t} + \Upsilon_t) - T_t - P_tC_{A,t}.$$

A representative non-asset holding household chooses consumption, $C_{N,t}$, and supplies labor, $H_{N,t}$, to intermediate good firms in order to maximize its utility flow on a period-by-period basis. So the objective is given by

$$\max \frac{C_{N,t}^{1-\gamma}}{1-\gamma} - \frac{H_{N,t}^{1+\varphi}}{1+\varphi}, \tag{9}$$

subject to the constraint that consumption expenditure equals net income

$$P_tC_{N,t} = (1-\tau)W_tH_{N,t} - T_t. \tag{10}$$

For non-asset holders, consumption equals disposable income in each period; hence they are also referred to as 'hand-to-mouth consumers'.

Aggregate consumption and labor supply are given by

$$C_t = \lambda C_{N,t} + (1-\lambda)C_{A,t} \tag{11}$$

$$H_t = \lambda H_{N,t} + (1-\lambda)H_{A,t}, \tag{12}$$

where $H_t = \int_0^1 H_t(j)dj$ is aggregate labor employed by domestic intermediate good firms.

3.4 Monetary and fiscal policy

Monetary policy plays a key role in determining the impact of fiscal policy measures (see, e.g. Woodford, 2011). In our analysis of fiscal policy, we take the monetary regime as given, that is, we abstract from issues which arise from the joint determination of the two policies. However, we cannot abstract from their interactions. We will study fiscal multipliers and budget regimes conditional on alternative specifications of the monetary regime as well as of the constraints that may hamper efficient monetary stabilization.

3.4.1 An instrument rule for monetary policy

To capture the relevant cases in an efficient way, we specify an instrument rule spanning monetary policies from flexible inflation targeting to a peg. Specifically, we assume an augmented interest rate rule according to which the policy rate, $R_t \equiv 1/E_t\rho_{t,t+1}$, is adjusted in response to producer price inflation and the exchange rate:

$$\log(R_t) = \log(R) + \phi(\Pi_{H,t} - \Pi_H) + (1.5 - \phi)\log(\mathcal{E}_t/\mathcal{E}), \tag{13}$$

with $\phi \in [0, 1.5]$. This rule is particularly convenient as it nests, as limiting cases, a policy of a freely floating exchange rate with a classic Taylor-rule coefficient $\phi = 1.5$ and an exchange rate peg ($\phi = 0$).[3] For intermediate values of ϕ, different combinations of the weight on inflation and exchange rate account for differences in the actual conduct of monetary policy under inflation targeting.

This point is not obvious and requires some explanation. In modern monetary theory, optimal policy is typically characterized by "targeting rules", defining the path for endogenous policy targets such as output gaps and inflation that the central bank should pursue. Under commitment, this optimal path is defined in terms of growth rates of these variables—implying that the central bank is effectively pursuing a price level target to anchor market expectations (see Woodford, 2003).

In our analysis, however, we proceed by positing an instrument rule, relating policy rates to inflation and the exchange rate via fixed coefficients. A well-known drawback of positing instrument rules of this type is that they may not properly account for the central bank's conduct of optimal policy in the face of shocks which imply a trade-off between the stabilization of output gaps and inflation. A conventional Taylor rule fails to account for much of the gains from commitment.

Our specification of the instrument rule in (13) addresses, in part, this drawback. Namely, it can be shown that augmenting an instrument rule with a term in deviations from a price level target can improve social welfare, and bring the economy to operate closer to the equilibrium conditional on targeting rules. The reason is straightforward. A moderate feedback to a price level target provides guidance to agents, anchoring their expectations above and beyond the inflation target. An equivalent way to achieve the same outcome consists of augmenting the instrument rule with a feedback to deviations from an exchange rate level. By purchasing power parity—holding over long horizons both in the model and in the data—an exchange target is akin to targeting the foreign price level (see, e.g. Galí and Monacelli, 2013).[4]

[3] If the policy rate is not adjusted to inflation at all, a peg can be maintained for arbitrarily small, but positive values of the exchange rate coefficient (Benigno et al., 2007).

[4] To be clear: this consideration does not mechanically translate into a case for an exchange rate target,

For our purpose, varying ϕ in our interest rule (13) allows us to model a flexible inflation targeting regime while accounting for different degrees of central bank commitment/credibility. In the analysis below, we will report the response to exogenous shocks and fiscal policy for different values of the parameter ϕ in the instrument rule.

In addition, we account for the possibility of a binding zero lower bound on nominal interest rates, albeit in a rough way. Specifically, we will impose that the policy rate may not be adjusted according to the rule (13) for 8 periods after a shock impacts the economy. This is meant to account for a situation in which the central bank considers the current policy rate as too high, given the level of inflation, but cannot lower it any further. Hence, it would not raise it in the response to a shock which would otherwise trigger a rise of the policy rate. This way of capturing the zero lower bound constraint is subject to a number of caveats, chief among them the possibility that a shock may stop the zero lower bound from being binding (Erceg and Lindé, 2014). For the purpose at hand, however, there is not much loss of generality in adopting our approach.

3.4.2 Government consumption and sovereign risk

As regards fiscal and budget policy, we assume that government spending falls on an aggregate of domestic intermediate goods only:

$$G_t = \left(\int_0^1 Y_{H,t}(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}} . \tag{14}$$

We also posit that intermediate goods are assembled so as to minimize costs. Thus the price index for government spending is given by $P_{H,t}$.

Government spending is financed either through lump sum taxes, T_t, or through issuance of nominal one-period debt, D_t.

The period budget constraint of the government reads as follows:

$$Q_{D,t}D_t = D_{t-1}(1-\delta_t) + P_{H,t}G_t - (\tau(W_tH_{A,t} + \Upsilon_t) + \tau W_t H_{N,t} + T_t), \tag{15}$$

where δ_t is a haircut applied to government debt in some state of the world.

As in Corsetti et al. (2013b) we assume that the probability of default p_t increases in the level of debt relative to steady-state output:

$$p_t = F_{\text{beta}} \left(\frac{D_t}{4Y} \frac{1}{\overline{d}}; \alpha_{b^g}, \beta_{b^g} \right). \tag{16}$$

Here $\overline{d}$ denotes the upper end of the support for the debt-to-GDP ratio.

since the same result can be achieved in different ways. Nonetheless, our rule has a clear theoretical link to (and motivation from) early work by Svensson (2003), stressing the advantage of an exchange rate target in a zero lower bound situation.

Assuming a constant haircut $\delta > 0$ whenever there is default, this implies

$$\delta_t = \begin{cases} \delta & \text{with probability } p_t, \\ 0 & \text{with probability } 1 - p_t. \end{cases} \tag{17}$$

Defining $D_{Rt} = D_t/P_{H,t-1}$ as a measure for real, beginning-of-period, debt, and $T_t^r = T_t/P_t$ as taxes in real terms, we posit that fiscal policy is described by the following feedback rules from debt accumulation to the level of spending and taxes:

$$G_t = (1-\rho)G + \rho G_{t-1} - \psi_G D_{Rt} + \varepsilon_t, \;\; T_{Rt} = \psi_T D_{Rt}, \tag{18}$$

where ε_t measures an exogenous iid shock to government spending. The ψ-parameters capture the responsiveness of spending and taxes to government spending and debt. Note that standard analyses of the fiscal transmission typically assume that $\psi_G = 0$. Compared to this benchmark, allowing for $\psi_G > 0$ fundamentally alters the fiscal transmission mechanism (see Corsetti et al., 2012a).

3.5 Bond prices

Government debt is held by risk-neutral investors in the rest of the world. It is subject to the risk of an outright sovereign default (haircut) as well as to the risk of changes in the price of currencies, which gives rise to the following bond price schedule

$$Q_{D,t} = \beta E_t(1 - \delta_{t+1})\mathcal{E}_t/\mathcal{E}_{t+1}. \tag{19}$$

Assuming that international financial markets are incomplete, we allow the asset-holding household to trade two assets with the rest of the world. In this case, we allow for the possibility that sovereign default risk impacts their price

$$Q_{B,t} = R_t^{-1} E_t(1 - \tilde{\chi}\delta_{t+1}), \quad Q_{B^*,t} = \beta E_t(1 - \tilde{\chi}\delta_{t+1}). \tag{20}$$

Note that β $(= R^{*-1})$ is the (constant) nominal interest rate in the rest of the world. The parameter $\tilde{\chi} \geq 0$ captures the degree of spillover of sovereign risk into private borrowing. Following Corsetti et al. (2013b) we rationalize a value of χ larger than zero by the observation that private-sector contracts may not be fully enforced in the event of a sovereign default.[5] Importantly, however, we assume that even though lenders may not be fully serviced in the event of sovereign default, borrowers may not retain resources either. Rather, resources are lost in the process.[6]

[5] Specification (20) follows Kriwoluzky et al. (2014).

[6] Hence, whether the sovereign defaults or not has no direct bearing on the household's budget constraint. Otherwise, borrowers' interest rate would rise with sovereign risk only *notionally*, not affecting behaviour up to first order, as explained in Cúrdia and Woodford (2009). Bocola (2014) models the pass-through of sovereign risk while explicitly accounting for financial intermediation.

3.6 Equilibrium

Equilibrium requires that firms and households behave optimally for given initial conditions, exogenously given developments in the ROW, and government policies. Moreover, market clearing conditions need to be satisfied. At the level of each intermediate good, supply must equal total demand stemming from final good firms, the ROW, and the government:

$$Y_t(j) = \left(\frac{P_{H,t}(j)}{P_{H,t}}\right)^{-\epsilon} \left((1-\omega)\left(\frac{P_{H,t}}{P_t}\right)^{-\sigma} C_t + \omega \left(\frac{P^*_{H,t}}{P^*_t}\right)^{-\sigma} C^*_t + G_t\right), \tag{21}$$

where $P^*_{H,t}$ and C^*_t denote the price index of domestic goods expressed in foreign currency and ROW consumption, respectively. It is convenient to define an index for aggregate domestic output: $Y_t = \left(\int_0^1 Y_t^{\frac{\epsilon-1}{\epsilon}}(j)dj\right)^{\frac{\epsilon}{\epsilon-1}}$. Substituting for $Y_t(j)$ using (21) gives the aggregate relationship

$$Y_t = (1-\omega)\left(\frac{P_{H,t}}{P_t}\right)^{-\sigma} C_t + \omega \left(\frac{P^*_{H,t}}{P^*_t}\right)^{-\sigma} C^*_t + G_t. \tag{22}$$

We also define the trade balance in terms of steady-state output

$$TB_t = \frac{1}{Y}\left(Y_t - \frac{P_t}{P_{H,t}} C_t - G_t\right). \tag{23}$$

In what follows, we will consider a first-order approximation of the equilibrium conditions of the model around a deterministic steady state with balanced trade, zero debt, zero inflation, and purchasing power parity. Further, we consider only shocks that originate in the domestic economy and thus do not affect the ROW.

Asset markets: we assume that (private) domestic bonds are in zero net supply and that public debt, denominated in domestic currency, is held by international investors.

3.7 Approximate equilibrium dynamics

Below we analyze the fiscal transmission mechanism using model simulations. These are based on a log-linear approximation of the equilibrium conditions around a deterministic steady state. For this steady state we assume symmetry between the small open economy and the rest of the world such that the terms of trade are unity and PPP holds. Moreover, we assume that public debt and inflation is zero in steady state. As a result, expectations of a sovereign default impact equilibrium dynamics only via risk premia. We abstract from a possible wealth effect due to sovereign default (see Hürtgen and Rühmkorf, 2014). In the appendix we report the approximated equilibrium conditions used in the model simulations. For our numerical experiments we adopt the following parameter values: a period in the model corresponds to one quarter. The discount factor β is set to 0.99. We assume that the inverse of the Frisch elasticity of labor supply, φ, takes the value of one. The trade price elasticity σ is set equal to unity as well. Regarding openness, we assume $\omega = 0.3$. As price rigidities are bound to play an important role in the transmission of government spending shocks, we assume a fairly flat Phillips curve. We do so by setting $\xi = 0.9$, a value that implies an average price duration of 10 quarters. Note that such a parameterization *prima facie* is in conflict with evidence from microeconomic studies such as Nakamura and Steinsson (2008). Nonetheless, the choice of a relatively high degree of price rigidities seems appropriate in the context of our framework, as we abstract from several model features that would imply a flatter Philips curve for any given value of ξ, e.g., non-constant returns to scale in the variable factor of production or non-constant elasticities of demand.[7] We also abstract from wage rigidities. We set $\epsilon = 11$, such that the steady-state markup is equal to 10 percent. Finally, the average share of government spending in GDP is set to 20 percent, and we assume that the persistence of government spending is $\rho = 0.9$.

In our baseline scenario we assume that the country adopts a freely floating exchange rate, that is, we set $\phi = 1.5$; that all households participate in asset markets ($\lambda = 0$); and that international financial markets are complete. We also assume that there is no pass-through of sovereign risk ($\chi = 0$) and that taxes adjust to stabilize debt $\psi_T = 0.02$, while $\psi_G = 0$.

Below we also consider the possibility of a pass-through of sovereign risk into private sector borrowing conditions. As we are working with a linear approximation of the model, a single parameter $\chi \equiv \tilde{\chi}\gamma$ captures the pass-through of public debt into private borrowing rates. Here γ determines the expected losses $E_t\delta_t$ in the event of a sovereign default as a function of outstanding sovereign debt. It thus compounds the haircut parameter δ and the marginal effect of a change in the debt level on the probability of default (at the point of approximation). We consider several values for $\chi \in [0, 0.005]$, where $\chi = 0.005$ captures a scenario of a strong sovereign risk channel (see Corsetti et al., 2013b, for evidence).

Note that $\sigma = 1$ implies that—in response to shocks to government consumption—the trade is always balanced under our baseline scenario. This follows from our assumption of log-utility in consumption (Galí and Monacelli, 2005). Intuitively, valuation effects and risk-sharing just offsets the changing in the consumption baskets at home and abroad due to substitution effects (Müller, 2008). In this case terms of trade movements can insure country-specific risks even if international financial markets are incomplete (Cole and Obstfeld, 1991; Corsetti and Pesenti, 2001).

In order to set the stage for our numerical results, we find it useful to explicitly show the

[7] See Galí et al. (2001) or Eichenbaum and Fisher (2007) for further discussion of how real rigidities interact with nominal price rigidities in the context of the New Keynesian model. Note that the latter study also considers a non-constant price elasticity of demand, which further increases the degree of real rigidities.

Euler equation which determines the intertemporal allocation of private sector expenditure. In terms of deviation from steady state (indicate by lower-case letters) we have

$$\begin{aligned} c_t &= E_t c_{t+1} - (r_t - E_t \pi_{t+1}) \\ &= E_t c_{t+1} - (r_t - E_t[\pi_{H,t+1} - \omega \Delta s_{t+1})] \end{aligned} \quad (24)$$

Alternatively, we can write

$$\tilde{c}_t = E_t \tilde{c}_{t+1} - (1 - g_y)(r_t - E_t(\pi_{H,t+1}), \quad (25)$$

where $\tilde{c}_t \equiv c_t - (1 - g_y)\omega s_t$ measures consumption in units of steady-state output of domestically produced goods.

Using this definition, we can write the New Keynesian Phillips curve as follows

$$\pi_{H,t} = \beta E_t \pi_{H,t+1} + \kappa \left[(1 - g_y)\tilde{c}_t + \varphi y_t\right]. \quad (26)$$

Measuring all variables in units of steady-state output (indicated by hats), we can state the national accounts identity

$$\hat{y}_t = \tilde{c}_t + \hat{g}_t + \hat{nx}_t. \quad (27)$$

with $\sigma = 1$, the multiplier on output is simply given by $g_t + c_t$. To better understand the adjustment of private expenditure, we can solve equation (25) forward (assuming only transitory shocks) to obtain:

$$\tilde{c}_t = -E_t \sum_{s=0}^{\infty} (r_{t+s} - \pi_{H,t+s+1}). \quad (28)$$

4 Model-based analysis

In what follows, we make use of our stylized framework to reconsider and systematize recent research on the transmission of fiscal policy, and how this varies with the state of the economy and policy regimes.

In a first section, we will contrast the effects of fiscal stimulus under different specifications of monetary policy. This step will clarify the difference between a zero lower bound situation under a float, and the lack of exchange rate response to country-specific shocks under a peg. To provide a cyclical context for fiscal policy, we will contrast the transmission of fiscal policy to the effect of an exogenous contraction in world demand for the country's tradables at business cycle frequency.

In the second section, we will introduce sovereign risk in the analysis and explore its implications for the fiscal multiplier. While monetary policy accommodation will remain a key determinant of the multiplier, budget correction and debt stabilization will also acquire a central role.

In each section, we will first present the main results using impulse responses for a wide set of economic variables relying on a reasonable specification of parameters. Then we will synthesize our key results in graphs showing only the impact (first period) response of output varying relevant parameters. The exposition will be structured in steps, each providing an analytical survey of classical and recent debates in the literature, and building up towards the synthetic summary that we provide last.

4.1 Multipliers under a constrained monetary policy

In this section, we discuss the role of monetary policy regimes in determining the size of fiscal multipliers, specifically focusing on the implications of constraints on the ability by the central bank to stabilize the economy using conventional interest rate policy. The key issue—forcefully raised by the experience in advanced countries during the great recession—is the extent to which fiscal policy is effective when monetary policy has exhausted its stabilization capacity.

In this section, the core transmission channel of fiscal and monetary policy will work through variations in long-term rates driving private demand decisions (see equation (28)). We assume that international financial markets are complete in order to "close" the model (Schmitt-Grohe and Uribe, 2003). Despite this assumption, we will be able to account for financial frictions, by assuming "limited participation" in financial markets by part of the country's population. In some experiments, we will posit that one out of three consumers does not trade financial contracts at all. Modelling a significant fraction of consumers as hand-to-mouth allows us to account for the presence of credit constraints in the economy (McKay and Reis, 2013).

4.1.1 Float versus peg

Figure 2 shows the transmission of fiscal stimulus, in the form of higher spending on domestically produced goods, in an economy with full asset market participation ($\lambda = 0$). The figure contrasts (i) the baseline case of a floating exchange rate regime and unconstrained monetary policy (dashed line), to (ii) the case of a peg (dash-dotted line) and (iii) the case of a float with monetary policy being constrained by the zero lower bound (solid lines). Formally, these cases correspond to (i) $\phi = 1.5$, (ii) $\phi = 0$ and, again (iii) $\phi = 1.5$ but now with the additional constraint that policy rates are unchanged during the first 8 quarters after the initial increase of government consumption.

The initial increase of government consumption is equal to one percent of GDP. Horizontal

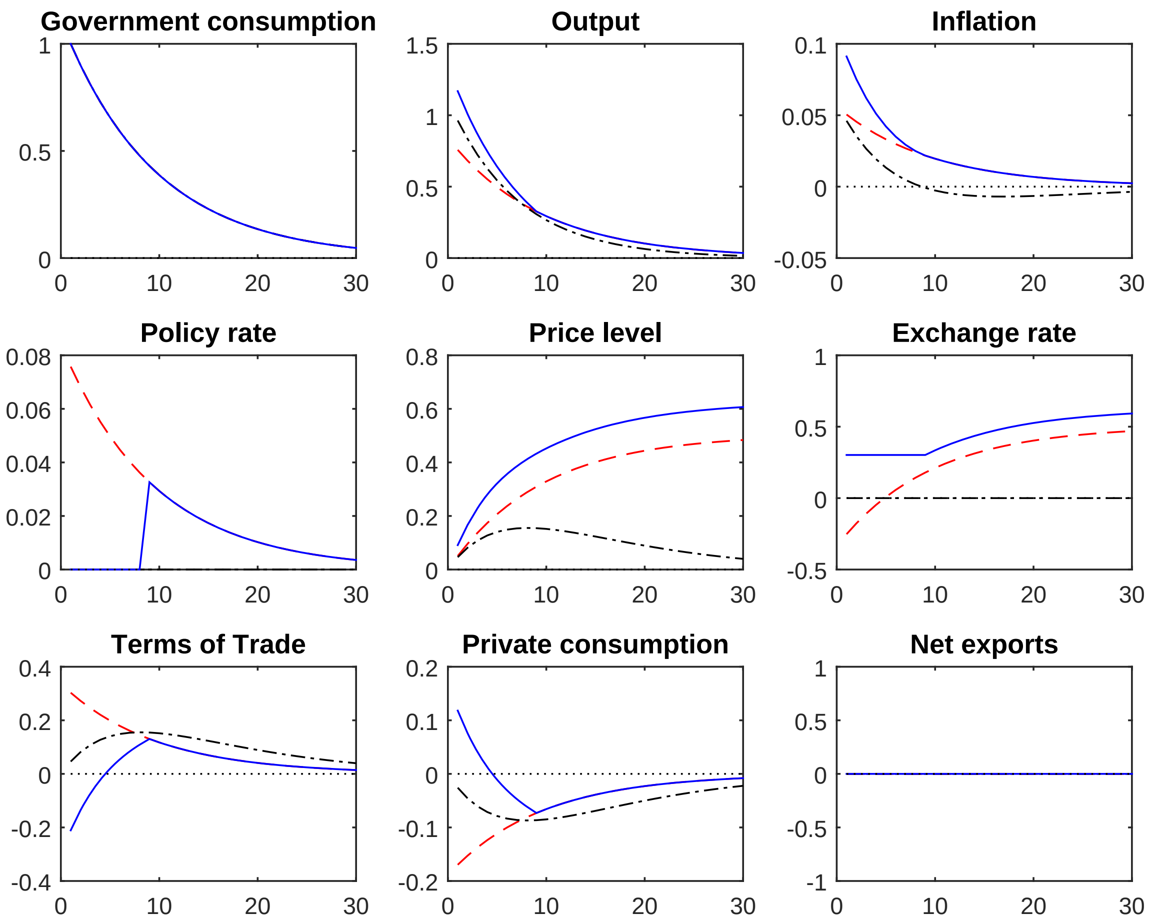

Figure 2: Effect of government consumption shock: unconstrained monetary policy (dashed line) vs constant-interest-rate period of 8 quarters (solid line) and exchange rate peg (dash-dotted line). Horizontal axes measure time in quarters. Vertical axes measure deviations from the pre-shock path, in percent of steady state output (in case of quantities) or percent (in case of prices).

axes measure time in quarters. Vertical axes measure deviations from the pre-shock path, in percent of steady state output (in case of quantities) or percent (in terms of prices).

In this subsection, we focus on the first two cases, pegs versus floats (the dash-dotted and the dashed line in the Figure). Observe that, relative to a float, under a peg policy rates are "constrained" in the sense that they are pinned down by foreign monetary policy, hence cannot respond to country-idiosyncratic shocks. Yet, to the extent that the peg is credible, relative Purchasing Power Parity constrains the path of the price level over the medium and long-run and thus guides expectations of inflation. No such forward guidance is provided if monetary policy sticks to a standard Taylor rule. This point is discussed in depth by Corsetti et al. (2013a) on which we draw in what follows.

The effects displayed in Figure 2 are in line with the received wisdom in a key dimension. The output multiplier is larger, at least initially, under a peg. The impact multiplier is around .7 under the unconstrained float, slightly below 1 under a peg. The difference reflects a higher degree of monetary accommodation in the latter regime. Note however that the multiplier under a float is not zero, as stated by a popular tenet in macro textbooks. On the contrary, it is possible that the multiplier under a float be larger than under a peg, if the monetary policy pursued by the central bank is accommodative enough (Corsetti et al., 2013a).

Another notable difference from textbook analyses is that the transmission mechanism mainly operates through internal (consumption) demand. On impact, consumption sharply falls under a float; it remains almost unaffected under a peg. This is where modern dynamic macro deviates most sharply from early Mundell-Fleming analysis. In either approach, what drives spending decisions is not the short-term, but the long-term rate in real terms, reflecting market expectations over the entire path of current and future policy rates and inflation. Mundell-Fleming analyses, however, typically posit that the short and the long-term rate move always in tandem, an assumption that may not be granted under a peg.

As clarified by the model, under a float and a Taylor rule with zero weight on the exchange rate (the case depicted in the figure), policy rates rise more than inflation over the entire horizon of the dynamic adjustment to the shock. As a result, long-term rates rise substantially in real terms: the monetary response to a government spending shock is unambiguously contractionary, reducing the equilibrium value of the multiplier. Yet, note that sustained monetary contraction does not prevent the price level from drifting away from its initial value. In the long run, purchasing power parity is re-established via a proportional depreciation in the nominal exchange rate (right panels in the middle row of Figure 2).

Under a credible peg, instead, while short-term policy rates cannot react to the shock, by relative PPP any initial inflation caused by the government expansion (or any other shock) must be eventually offset by a fall of inflation below the foreign average. For given nominal interest rates, this means that short-term real interest rates fall at first, then rise, with the dynamic adjustment of inflation. In Corsetti et al. (2013a) we show that the implied impact response of long-term real rates to a change in demand is proportional to the impact rate of inflation.

This rate is positive but overall moderate, explaining the muted response of consumption under a peg reported in the Figure.[8] Needless to say, this general property of the transmission of shocks under a credible peg is valid *a fortiori* also in a credible monetary union. Moreover,

[8] In Mundell-Fleming models, the analysis of a peg is developed by maintaining the assumption that short and long real rate move in the same direction. As explained above, this assumption is appropriate for a floating rate. It is logically inconsistent with the analysis of a peg, as long as some (mild) form of PPP holds.

by purchasing power parity, an exchange rate anchor (if only as a long-run target) can guide expectations over the dynamic of inflation and the price level also under a float.

A last point concerns the role of net exports in the transmission mechanism. As discussed above, under our assumption of a unitary trade price elasticity, net exports are completely isolated from terms of trade movements and, hence, do not respond to the increase of government consumption which falls completely on domestically produced goods. This is a convenient baseline scenario as it allows us to clarify how the fiscal transmission mechanism operates through private internal demand and to long-term interest rates. Still, a muted response of net exports is also in line with many theoretical and empirical studies, although the issue remains controversial to date (Corsetti and Müller, 2006; Kim and Roubini, 2008; Ravn et al., 2012).

4.1.2 Zero lower bound

We now bring our analysis to bear on fiscal policy transmission at the zero lower bound. In Figure 2, solid lines refer to an economy in which policy rates are constrained not to respond to inflation for 8 quarters, after which monetary policy is again set using the standard Taylor rule with $\phi = 1.5$. This scenario is meant to mimic a binding zero lower bound constraint, as discussed above.

The macroeconomic outlook is radically different from a peg. Absent a short run policy rate response to increased government consumption, the inflationary effect of the fiscal stimulus lowers real rates, crowding in private expenditure. The multiplier thus exceeds unity (see, e.g., Christiano et al., 2011, for an influential analysis within a closed-economy framework). Note that, for the multiplier to be high, the government needs to raise spending at least over the time horizon over which policy rates remain constant. A one-period rise in spending would not do, since the extra multiplier effects essentially obtain through anticipation of higher inflation. In our specification, spending follows an AR(1)-process. So, while still positive over the relevant 8 quarters horizon, its intensity falls, muting its effects on the economy. As a result, the output response is strong—well above 1—but clearly not at its potential peak.[9]

Figure 2 warns against interpretations equating the zero lower bound to a peg, on the ground that in neither the policy rate can respond to deflation. There is an important difference, stressed in Corsetti et al. (2013a) and more recently discussed by Farhi and Werning (2012). In the constant-rate case shown in the figure, monetary policy does not contain the price

[9] The size of the multiplier depends, inter alia, on the degree of nominal rigidities interacted with the time horizon of the spell of constant rates (see Christiano et al., 2011). It should also be stressed that the economy becomes vulnerable to indeterminacy problems, if the expected duration of the zero lower bound episode increases (see Corsetti et al., 2014; Woodford, 2011).

level drift in the long run—similarly to the case of the unconstrained float. Multipliers are high exactly because spending is effective in raising anticipated inflation for given short-term policy rates. In contrast, under a peg, PPP naturally constrains the dynamics of the price level and contains expectations of inflation. As a result, changes in government consumption cannot have substantial effects on real rates through anticipated inflation: multipliers are much lower.

That said, it is possible that the multiplier in the zero lower bound case is smaller than in case of an exchange rate peg—a point stressed by Erceg and Lindé (2012). While the multiplier under the peg is not very sensitive to changes in the model's parameter values, it is in the zero lower bound case. Assuming a higher than unitary trade price elasticity and a very flat Phillips curve, Erceg and Lindé (2012) show that the multiplier at the zero lower bound is below unity and, in fact, below the value obtained for the peg case.

As a final observation, note that, with a constant rate, the exchange rate weakens on impact with the fall in the long-term real rates. For reasons already discussed, however, this endogenous response in the exchange rate does not have any effect on net exports under our parameterization (but similarly does not have any significant effects in more general models).

4.1.3 Foreign demand shock and multipliers compared

At this point of the analysis, we find it instructive to turn our attention to an exercise meant to capture a key channel through which the global crisis in 2008 has propagated across the globe and impacted on small open economies like Sweden. Namely, we consider the effects of an unexpected fall in the world demand for the country's tradables. In Figure 2, we analyze the transmission of such a shock contrasting the case of an unconstrained float, to that of a peg and a temporarily unresponsive interest rate. Essentially, in this exercise, we replace an unexpected rise in government spending in Figure 1, with a negative shock to external demand—meant to capture the cyclical conditions motivating fiscal stabilization in the first place. Also in this exercise we abstract from financial frictions.

Results are shown in Figure 3, contrasting again the three monetary policy regimes of interest. Under the unconstrained inflation targeting regime (dashed lines), monetary authorities cut policy rates to counteract the recessionary/deflationary impact of the shock. Lower rates prevent private consumption from falling sharply on impact, and cause a sharp depreciation of the exchange rate.

Unsurprisingly, the short-run macroeconomic outlook is substantially worse at the zero lower bound, i.e. if policy rates cannot be appropriately cut in the short run (solid lines). Stronger deflationary expectations translate into a hike in long-term real rates and drag down con-

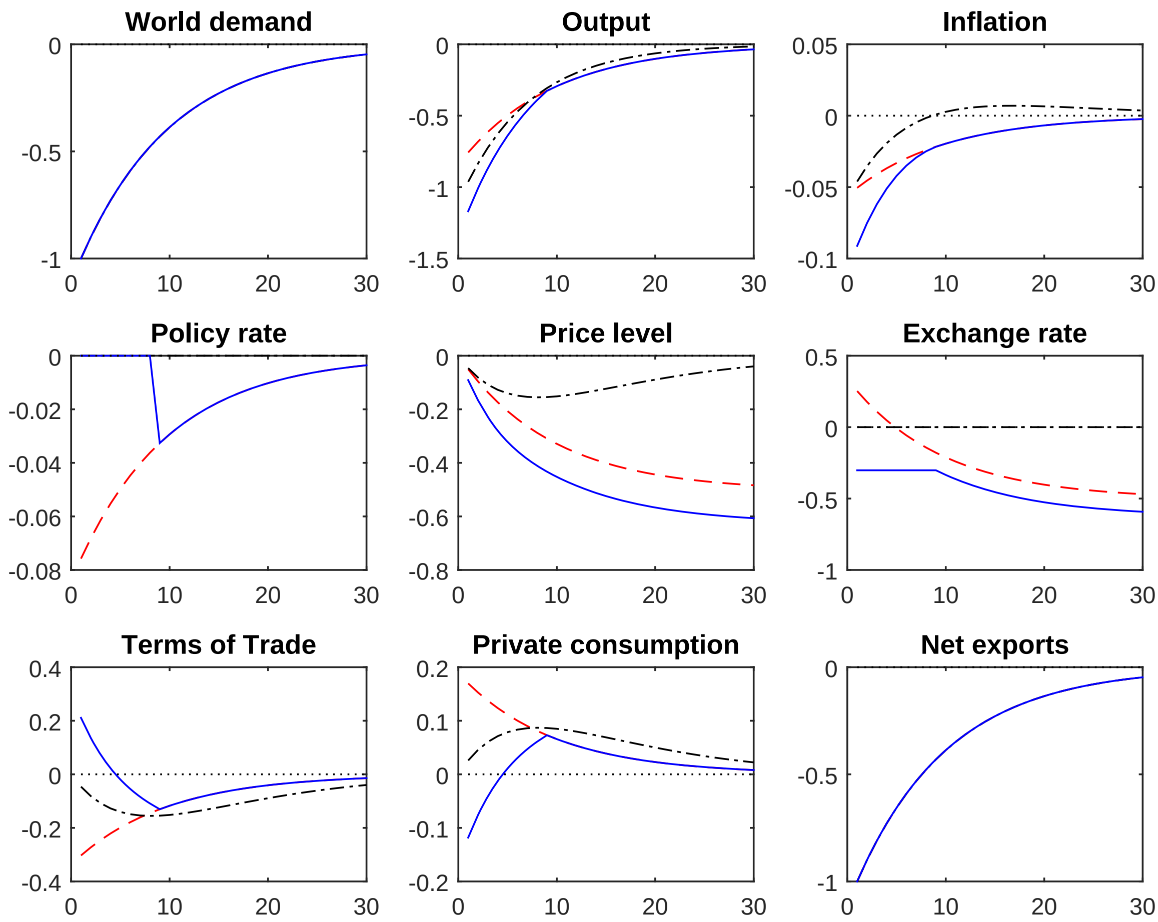

Figure 3: Effect of world demand shock: unconstrained monetary policy (dashed line) vs constant-interest-rate period of 8 quarters (solid line) and exchange rate peg (dash-dotted line). Horizontal axes measure time in quarters. Vertical axes measure deviations from the pre-shock path, in percent of steady state output (in case of quantities) or percent (in case of prices).

sumption and economic activity. With high long-term rates, the exchange rate remains too strong.

The inability by the central bank to respond to the shock by cutting policy rates, however, is much less consequential under a credible peg. The reason is again linked to the effects of relative PPP on expectations of inflation and the path of the price level. The model indeed suggests that members of a (credible) monetary union should be substantially less exposed to large external shocks than countries with an independent monetary policy. We will consider below an important caveat, related to vulnerability to sovereign risk. Here, we also point out that the resilience of a member country crucially depends on the effect of the recessionary shock on the price level in the monetary union as a whole. The macroeconomic outlook is worse if the whole union is in a deflationary recession. Various cases are analyzed by Cook and Devereux (2014).

4.1.4 A synthesis and generalization

We conclude this section by providing a synthesis and a generalization of our results, extending the analysis to economies with credit contraints—impulse responses analysis for this case is not shown to save space.

Figure 4 reports the impact (first-period) effect on output due to an increase of government consumption by one percent of GDP (left column) and due to a drop of world demand by one percent of GDP (right column). Output is measured in percentage deviation from the pre-shock level, such that the left panels provide a direct measure of the fiscal multiplier (for the impact period). Along the horizonal axis we measure the value of the interest rate rule coefficient ϕ which we use in the model simulation. We consider the whole range of cases going from a peg (to the extreme left of each graph) to a standard Taylor rule with no exchange rate target (to the extreme right of each graph).

In the top panels we contrast our baseline economy with an unconstrained monetary policy, to an economy where policy rates are constrained (to remain constant for eight quarters). The two panels in the bottom row of the figure report the same exercise, but in an economy where 1/3 of the population is 'hand-to-mouth.'

Consider the right-hand side of each of the four graphs in the figure. As is apparent, both the multiplier of government spending and the impact of negative shocks are amplified by lack of monetary policy reaction—if short rates are not adjusted in the short run—relative to the case in which the central bank can and does react.

As the relative weight on the exchange rate in the interest rate rule rises, however, the gap between the cases of constrained and unconstrained monetary policy progressively narrows.

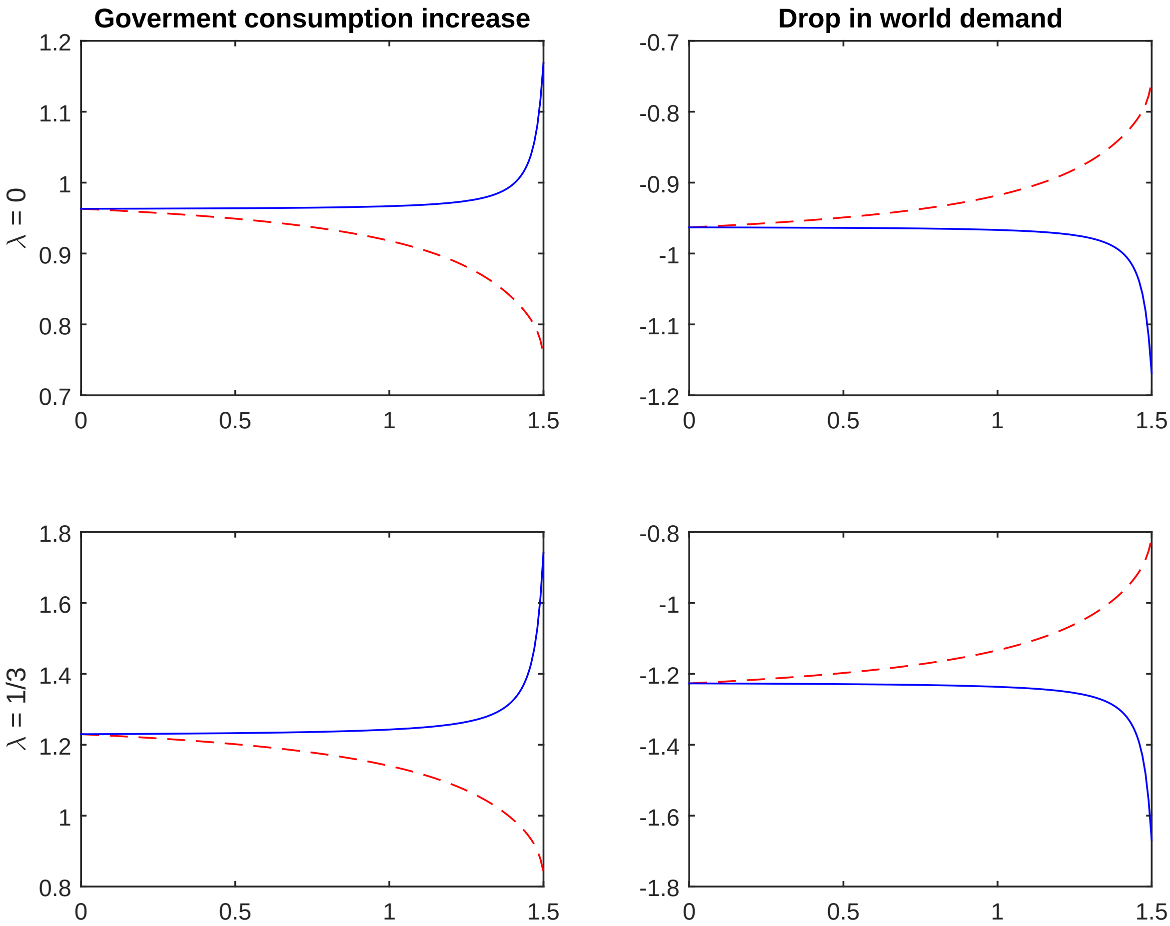

Figure 4: Impact effect on output. Left: increase in government consumption by one percent of GDP. Right: drop in world demand by 1 percent of GDP. Vertical axis measures output response on impact (percent). Horizontal axes measure ϕ in policy rule $r_t = \phi\pi_t + (1.5 - \phi)e_t$: the very left of each panel corresponds to an exchange rate peg which—by moving along the horizontal axis—is gradually relaxed in favor of a more flexible exchange rate; the very right of each panel corresponds to a free float. Dashed line: interest rate always adjusted according to rule. Solid: interest rate constant for first 8 quarters. Top panels: $\lambda = 0$, bottom panels: $\lambda = 1/3$.

A stronger reaction by monetary policy to the deviation of the exchange rate from target enforces a faster convergence of inflation to PPP. As inflation expectations become better anchored, the zero lower bound problem becomes less consequential. As explained above, including an exchange rate target in our Taylor rule is equivalent to tying monetary policy to a price level target in the long run.

In our view, the concrete experience of flexible inflation targeting is best approximated by instrument rules that incorporate (if only imperfect) credibility in policy making. This is an argument for mapping inflation targeting regimes not at the extreme right of the graph, but in some intermediate region. Note that, as ϕ decreases, multipliers converge (to the peg standard) quite rapidly in the economy with rates at the zero lower bound, but more gradually in the unconstrained economy.

These conclusions remain unaffected in economies with credit frictions, except that the scale of the multiplier becomes substantially larger. The graphs in the second row of the figure are very similar to the one in the first row. However, government multipliers are higher by half a percentage point of output—the negative impact of a shock to external demand is about 30 percent stronger.

Overall, the figure imparts a simple but important lesson: in the economies considered so far, large multipliers tend to obtain under economic circumstances in which the propagation of negative shocks is also more pervasive. As we will see below, however, this may not longer hold once shocks create vulnerability to sovereign risk crisis.

4.2 Multipliers in a sovereign risk crisis

In the previous section we have analyzed in detail the conditions under which constraints on monetary policy and credit frictions can be expected to boost the value of multipliers. The comforting message is that, in circumstances in which the economy is particularly vulnerable to negative cyclical shocks, fiscal policy seems to have reasonably strong stabilization properties.

We now turn to a different, and arguably more pervasive issue, emerging with special force from the experience of the Eurozone members in the crisis years. The issue concerns possibilities of fiscal stabilization in an environment in which markets may lose confidence in "sovereign signatures". To lay out the relevant trade-off, we build on previous work of ours and the literature on "fiscal limits". In the context of our model, we allow for a specific transmission channel that accounts, if only in reduced form, for the link between high and variable sovereign risk premia, and the level of borrowing costs faced by a country's residents—a link that we dubbed the "sovereign risk channel."[10]

The economics of the "sovereign risk channel" has theoretical roots in recent developments of standard macro models that encompass financial intermediation—most notably Cúrdia and Woodford (2009). In our approach, deficit-financed fiscal stimulus may affect the risk premium required by investors to buy government debt; a hike in risk premia in turn is passed through into the effective rates in the private sector.[11] Fiscal instability thus affects the intertemporal price relevant to private demand decisions.

Different from the previous section, whether international financial markets are complete or incomplete matters in the presence of a sovereign risk channel. In what follows we assume that residents can only trade non-contingent bonds across borders.

4.2.1 Sovereign risk and the negative transmission of world demand shocks

We start by analyzing the dynamic response of the economy to a negative shock to world demand—prior to our discussion of the multiplier. We do so motivated by an argument set forth by Krugman (2014), according to which a hike in sovereign risk can actually produce overall expansionary effects, via a pro-competitive depreciation of the exchange rate. Using the model, we can assess this argument, by looking at the dynamic response to a recessionary shock which may deteriorate the fiscal outlook of the country, and generate doubts about public debt sustainability.

Figure 5 shows the effects of a contraction of world demand for the country's output. The ensuing recession triggers an endogenous rise of the budget deficit. Public debt builds up, as shown in the lower left panel. In the figure, we assume that the country pursues a floating exchange rate regime and a standard Taylor rule ($\phi = 1.5$). For comparison, the dashed line reproduces the results for the baseline case in Figure 3, with complete international financial markets and no a sovereign risk channel.

The figure shows that the output effects of an external shocks are not too different in the economy vulnerable to sovereign risk (dash-dotted line), relative to our baseline from our previous section (dashed line). The net effect on output is actually muted in the former, in line with the argument developed by Krugman: the destabilizing effects of the shock in the sovereign debt market ends up moderating its recessionary impact on economic activity. The reason is apparent from the other graphs in the figure: sovereign risk amplifies the deflationary

[10]This link has been the subject of recent literature, mostly but not exclusively focused on the so-called "diabolic loop" between sovereign risk and banking fragility (Bocola, 2014; Brunnermeier et al., 2011). While the link is two ways, there are arguments to support the view that, once in a sovereign risk crisis, the direction of causality tilts in favor of a large independent role for policy (Bahaj, 2014).

[11]In their normative analysis, **CurdiaWoodford2010** show that monetary policy should lean against the increase in private borrowing costs due to financial frictions.

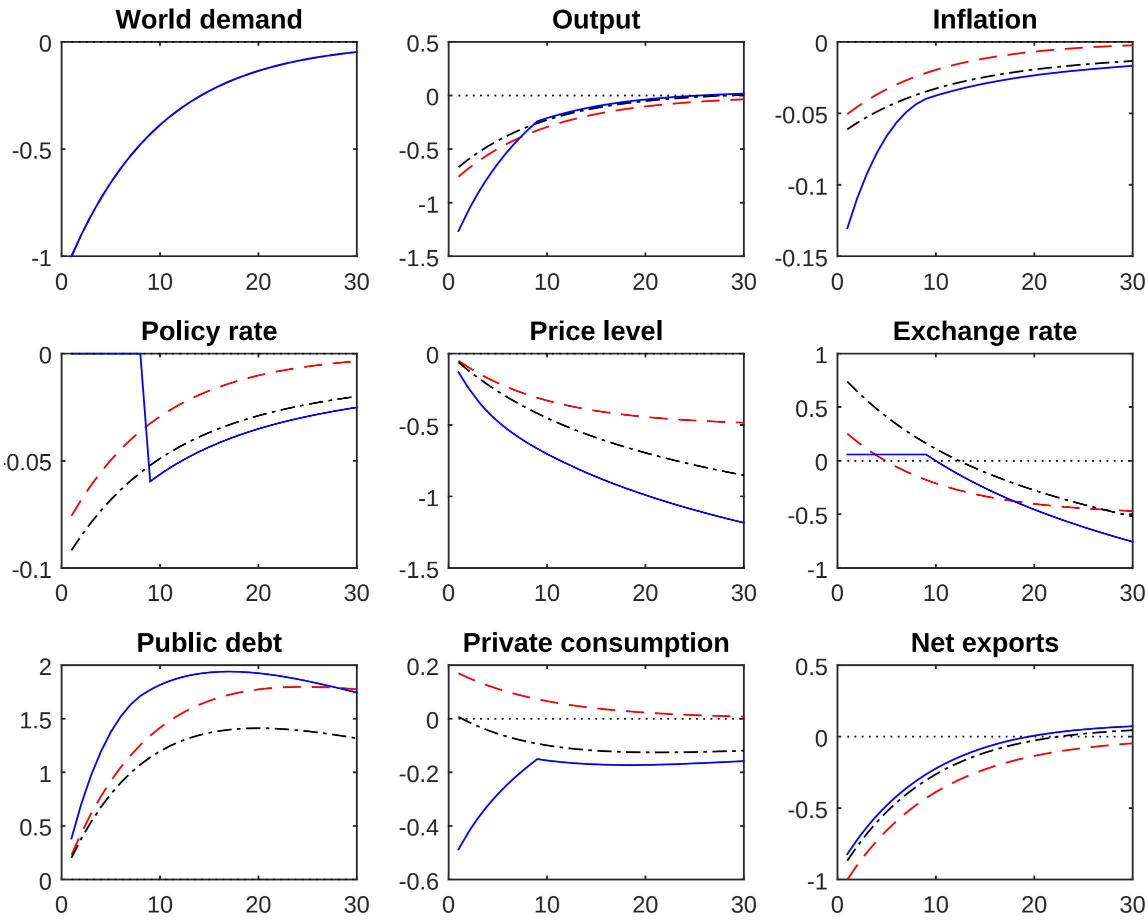

Figure 5: Effect of world demand shock under float: baseline (dashed line) vs $\chi = .005$ with unconstrained monetary policy (dash-dotted line) and constant interest rate for 8 quarters (solid line). Horizontal axes measure time in quarters. Vertical axes measure deviations from the pre-shock path, in percent of steady state output (in case of quantities) or percent (in case of prices).

effects of the shock, and so induces monetary authorities to cut rates more strongly. The exchange rate depreciates more sharply, promoting net exports.

The analysis of the transmission mechanism, however, makes it clear that, for Krugman's argument to go through, monetary policy must have sufficient room for maneuver—it would not work as well under a zero lower bound constraint. Indeed, if the central bank faces constraints on rate policy (solid line), the recessionary impact of the shock substantially worsens, dragging down consumption and inflation.

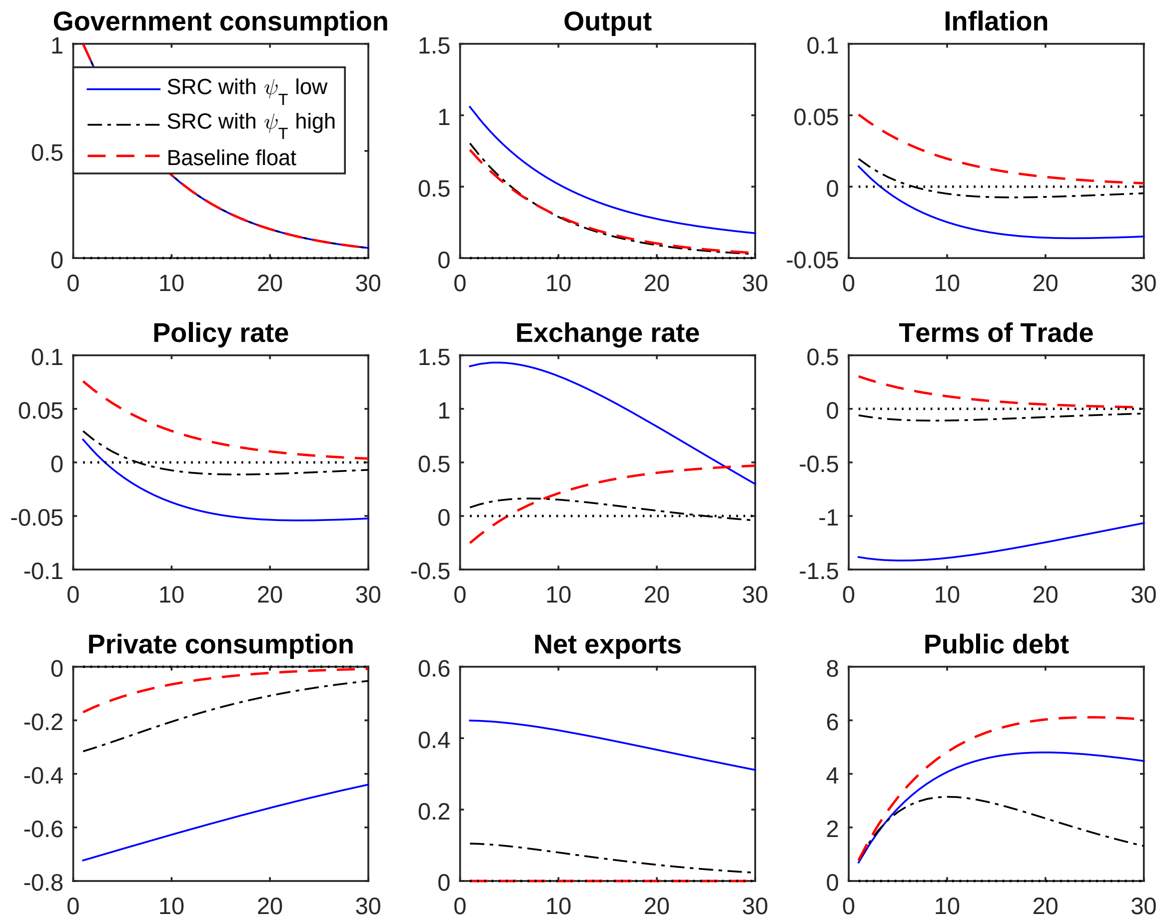

Figure 6: Effect of government consumption shock under float: baseline (dashed line) vs $\chi = 0.005$ with high and low debt-stabilization parameter ($\psi_T = \{0.02, 0.1\}$. Horizontal axes measure time in quarters. Vertical axes measure deviations from the pre-shock path, in percent of steady state output (in case of quantities) or percent (in case of prices).

4.2.2 Sovereign risk and fiscal multipliers

In Figure 4.2.5 we turn to an analysis of the effects of government spending, addressing the question of whether and under what circumstances the argument by Krugman also applies to the case of fiscal stimulus. The very mechanism discussed above indeed suggests that, away from the zero lower bound, the output multiplier of government spending may paradoxically be higher when deficits foster sovereign risk.

This is confirmed by the dynamics depicted in Figure 4.2.5. The figure contrasts the baseline scenario without a sovereign risk channel (dashed lines) with an economy with sovereign risk. In the latter case we distinguish a scenario of moderate debt consolidation (solid line, $\psi_T = 0.02$) and a scenario of rapid debt consolidation (dashed-dotted line, $\psi_T = 0.1$).

Given a standard Taylor rule, sovereign risk results in extra monetary accommodation to fiscal stimulus. The rise in private borrowing costs associated with sovereign risk depresses internal demand to such an extent that the response of inflation to spending is very small initially, and becomes negative over time—as public debt keeps accumulating. A deflationary outlook generates expectations of expansionary monetary policies, that translate into a large impact depreciation of the exchange rate. While private consumption falls, a significant jump in net exports sustains economic activity. As a result, contrary to conventional wisdom, government spending ends up crowding in, rather than crowding out, net exports, and depreciates the exchange rate. In sum, a hike in sovereign risk caused by deficit spending produces an overall "expansionary effect" on economic activity, essentially by moderating or even reversing the inflationary effects of spending. Hence, dynamically, a strongly expansionary monetary policy accompanies a rapid, financially destabilizing, accumulation of public debt.

4.2.3 Stimulus with dynamic debt consolidation under a float

Fiscal rules which govern the response of the government budget to the accumulation of public debt substantially affects the above results. To see this compare the impulse responses for moderate debt consolidation (solid line, $\psi_T = 0.02$) and for rapid debt consolidation (dashed-dotted line, $\psi_T = 0.1$) in Figure 4.2.5. In the second case, public debt peaks about 10 quarters after the shock, and declines rapidly over a 30 quarters horizon. Rapid debt stabilization contains risk premia and thus the hike in borrowing costs faced by the private sector. Internal consumption demand falls by less, so does inflation. Monetary policy correspondingly becomes less expansionary.

Comparing the impulse responses in Figure 4.2.5 suggests two observations. On the one hand, the claim by Krugman—that sovereign risk may end up biasing the effect of shocks towards output expansions—may be substantiated by dynamic analysis. On the other hand, the mechanism by which output expands in Figure 4.2.5 heavily relies on a rise in financial and macroeconomic distress producing deflationary effects. In light of this second observation, and especially given the limits of our understanding of financial and fiscal crises, the arguments for dynamic budget correction and policies maintaining a stable fiscal outlook remain quite strong.[12]

[12] We should stress two caveats. First, in our analysis, we abstract from frictions which may be relevant in choosing the speed of budget adjustment. Second, we abstract from a possible multiplicity of equilibria, which we analyze in related work (Corsetti et al., 2013b, 2014). Also, our model abstracts from self-fulfilling sovereign risk crises, which may call for a monetary backstop of the kind analyzed in Corsetti and Dedola (2012).

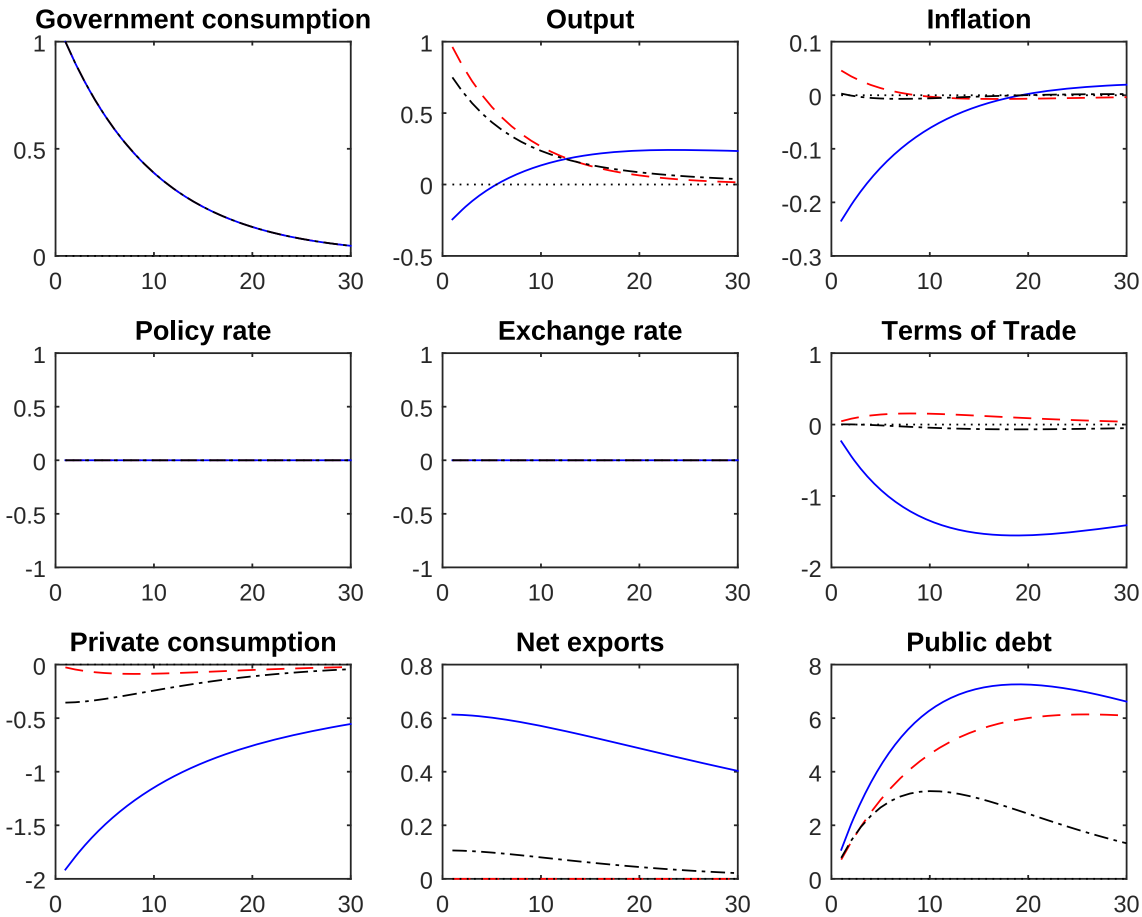

Figure 7: Effect of government consumption shock under an exchange rate peg: baseline (dashed line) vs $\chi = 0.005$ (solid line) vs $\chi = 0.005$ and $\psi = .1$ (dash-dotted line). Horizontal axes measure time in quarters. Vertical axes measure deviations from the pre-shock path, in percent of steady state output (in case of quantities) or percent (in case of prices).

4.2.4 Stimulus with dynamic debt consolidation under a peg

Medium term debt and deficit adjustment becomes central to the determination of spending multipliers in countries that pursue a credible peg or participate in a monetary union. The dynamics are shown in Figures 7. Dashed lines represent the baseline scenario of a peg, absent the sovereign risk channel. Against this benchmark, we assess the implications of the sovereign risk channel for the fiscal transmission mechanism: we set $\chi = 0.005$, and again distinguish a scenario of moderate debt consolidation (solid line, $\psi_T = 0.02$) and a scenario of rapid debt consolidation (dashed-dotted line, $\psi_T = 0.1$).

With a looming sovereign risk crisis, pursuing short-run fiscal stimulus without simultaneously offsetting budget deficits in the medium run turns out to be ineffective. The potential benefit of a price level anchor on inflation expectations can be completely offset, or even overturned, by rising borrowing costs in a context of financial instability.

As shown by the impulse responses depicted as solid lines in the figure, private consumption contracts sharply in response to a rise in government spending. Vis-á-vis a contraction in internal demand caused by the sovereign risk channel, output remains almost unaffected per effect of higher public demand and higher net exports—the latter jump on impact. In the resulting macroeconomic outlook, spending exacerbates financial instability and the economic downturn, leading to a large drop in internal demand. Weak internal demand in turn drives a strong "current account correction" via a large contraction in imports.

The impulse responses differ in case there is rapid debt consolidation (dash-dotted line): short-run stimulus is matched by raising taxes, explicitly leading to budget and debt correction. In this case, the multiplier is closer to the baseline, as sovereign risk remains small.

4.2.5 Adjustment via spending reversals

In related work of ours (Corsetti et al., 2012a), we have shown that spending multipliers are higher when the dynamic adjustment in debt partly falls on spending, lowering it sufficiently below baseline at a business cycle horizon. This is because prospective spending contractions generate expectations of monetary easing over time. This case is shown in Figure 8, which contrasts our baseline with government spending following an AR(1)-process (dashed lines), with the case of a stimulus associated to a "spending reversal" (solid lines).

In the first panel of the figure, government consumption falls below trend after 10 quarters, reaching a negative trough around quarter 20. Policy rates follow a similar pattern. As a result of anticipated monetary expansion over this time horizon, the impact multiplier is higher under the reversal scenario. By the logic of this argument, it is intuitive that a similar mechanism is at work also when rates are temporarily at the zero lower bound—but the effect of the multiplier is positive only provided that the reversal is implemented when there is again room for downward adjustment in policy rates (Corsetti et al., 2010).

Reversals are effective also in the presence of sovereign risk (not shown), but the transmission mechanism in this case is closer to the case of the dynamic budget adjustment via taxes discussed in the previous subsections. Under both a float and a peg, reversals are a substitute for tax adjustment in preventing sovereign risk from weighing on the macroeconomic outlook. Essentially, the dynamics are similar to what is shown in Figure above, except that multipliers are a bit higher for the extra monetary stimulus induced by an anticipation of spending cuts. Together, this and the previous exercise confirm the received wisdom according to which both the timing and the composition of the budget correction (between taxes and spending) are

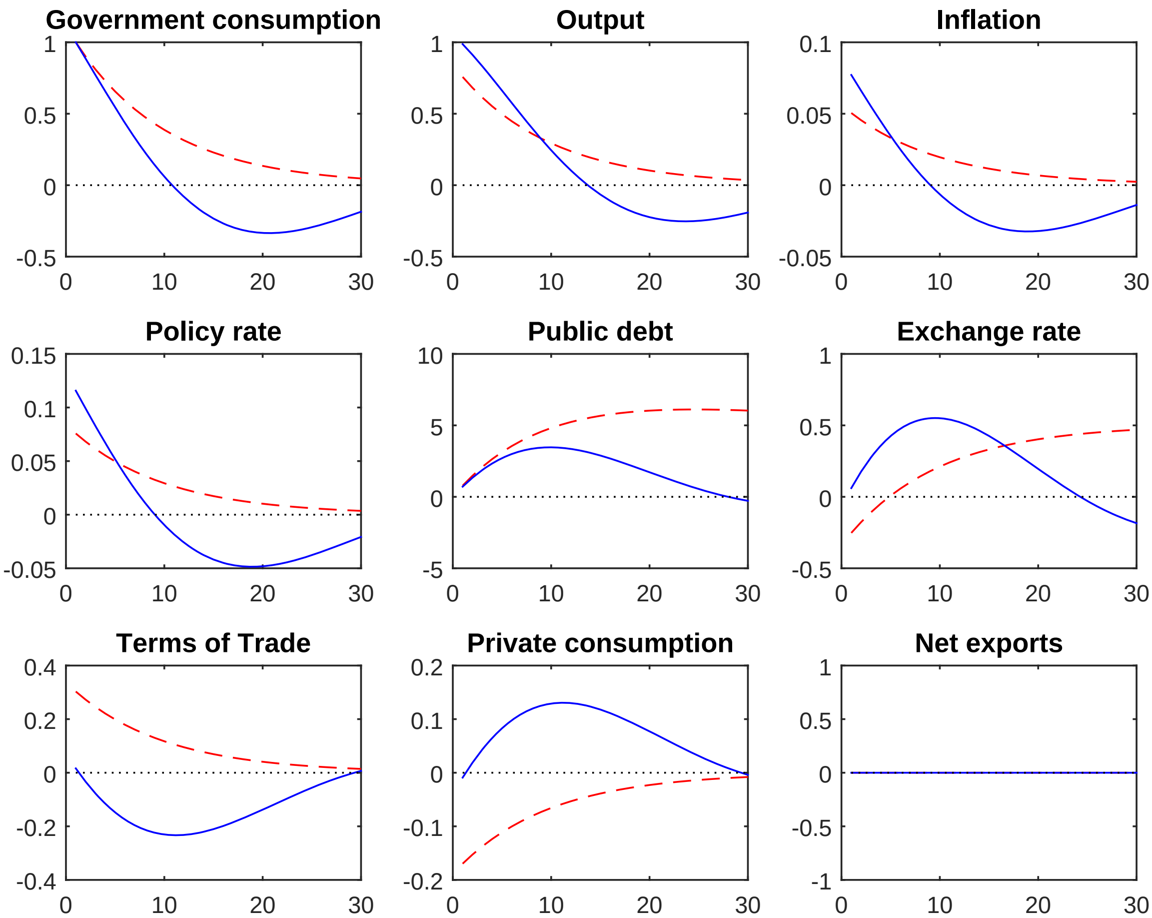

Figure 8: Effect of government consumption shock under float: baseline (dashed line) vs debt stabilization through spending cuts (solid line). Horizontal axes measure time in quarters. Vertical axes measure deviations from the pre-shock path, in percent of steady state output (in case of quantities) or percent (in case of prices).

primary determinants of the transmission of fiscal policy in the short run. The assessment of stimulus or retrenchment cannot be decoupled and carried out independently from the medium-term outlook of debt and deficit stabilization.

4.2.6 A synthesis and generalization

To discuss synthetically the main message from this section, we compare impact output multipliers of fiscal spending and the transmission of external shocks across economies with different exposures to the relevant financial friction. Our focus is on the share of households with no access to financial markets, λ, and the strength of the sovereign risk channel, captured by χ.

Results are shown in Figure 9 for three different scenarios regarding monetary policy: dashed

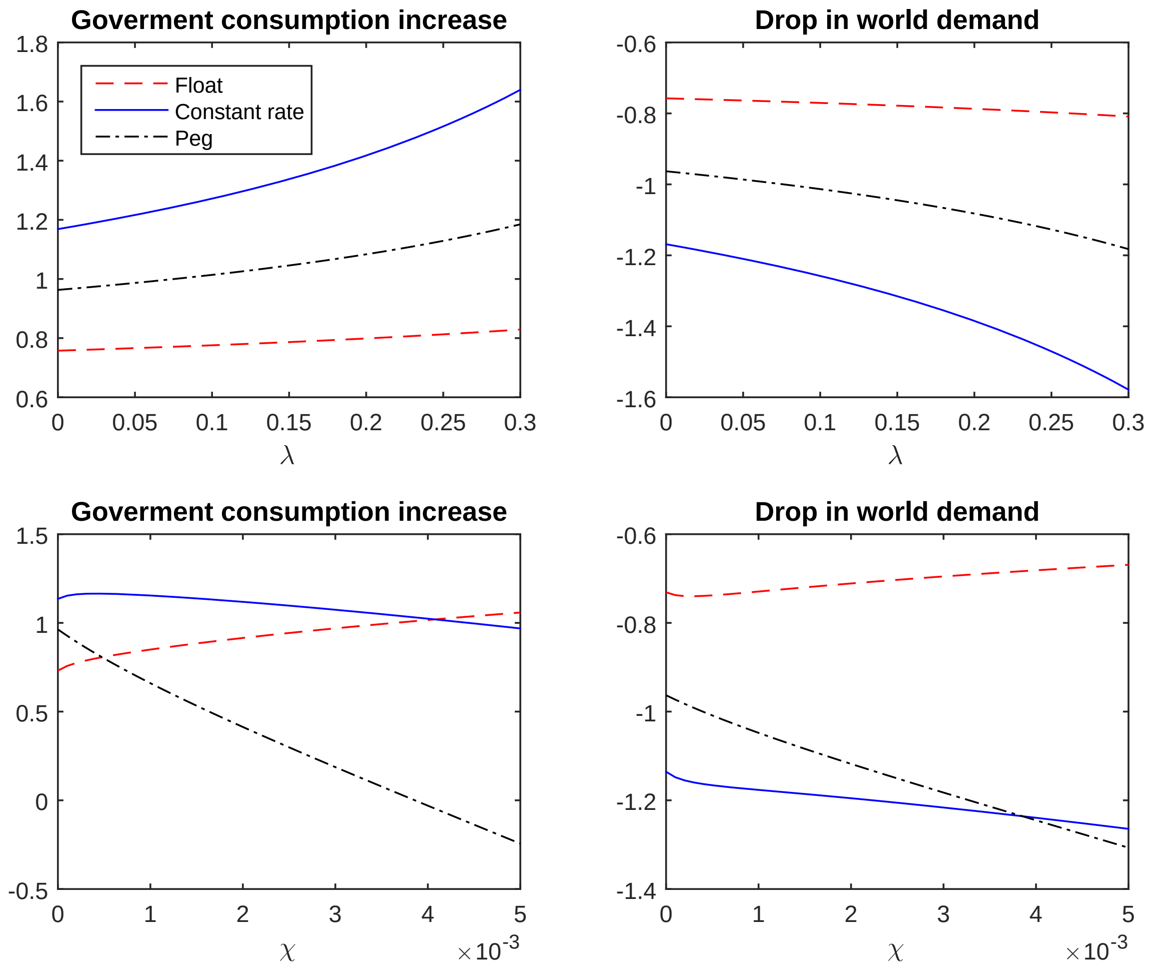

Figure 9: Impact effect on output. Left: increase in government consumption by one percent of GDP. Right: drop in world demand by 1 percent of GDP. Vertical axis measures output response on impact (percent). In the upper panels, horizontal axes measure λ, the fraction of credit constrained households. In the lower panels, horizontal axes measure χ the pass-through of sovereign risk into private-sector borrowing rates.

lines show the case of a free float ($\phi = 1.5$), dashed-dotted lines show the case of peg ($\phi = 0$) and solid lines show the case of a free float when policy rates are not adjusted for 8 quarters, that is, the zero-lower-bound scenario. The panels in the upper row trace the effects of a rising share λ of credit constrained agents in the economy. Both the multiplier effect and the (negative) transmission of external shocks are monotonically rising in this share, independently of the monetary regimes. Still, monetary regimes matter: there is a clear ranking in the magnitude of the response across them.

Interestingly, the slope of the three lines differ markedly between the baseline free float (dashed line) and the other two: it is flatter for the baseline. This result suggests that monetary stabilization has first-order effects on the economy that mute the implications of credit constraints for output stability in response to shocks. Under a peg, conversely, the rise in the multiplier with a larger λ is steeper—its value growing above 1. Under constant rates, for λ close to 1/3, the multiplier is above 1.5—similarly strong is the recessionary effect of a contraction in external demand.

The difference across regimes is more complex when we vary the degree of sovereign risk—as shown in the bottom panels of the figure. As discussed above, an unconstrained monetary policy tends to make sovereign risk less consequential for the output effect of the two shocks: the dashed line is quite flat in χ. Intuitively, because of monetary accommodation, the consequences of a negative shock on output are milder, and the spending multiplier higher, the stronger the sovereign risk channel. However, we should stress the observation made earlier, namely that a stable output response is the result of a severe contraction in domestic demand and deflation.

The consequences of sovereign risk are stronger under the other two regimes. In fact, sovereign risk monotonically worsens the impact of an external shock on economic activity across pegs and constrained floats. The deterioration of economic conditions is much more apparent under a peg. The indirect benefit of a price level anchor under a peg is swamped by worsening financial conditions in the economy.

An important asymmetry relative to the previous section emerges. With elevated sovereign risk, the multiplier at the zero lower bound and under a peg is actually smaller. At the same time, high sovereign risk exacerbates the transmission of external shocks. This is particularly true under a peg—and *a fortiori* for countries in a monetary union.[13]

[13]Regarding the float, output multipliers are still increasing in sovereign risk, mainly thanks to strong monetary expansions. But this is cold comfort. First, monetary policy must have enough room for cutting rates appropriately—a room which may not exist in practice in the kind of crisis for which fiscal policy may be needed the most. Second, apart from the level of output, the economic outlook in an economy with high sovereign risk is all but benign. Rates are cut in response to deflation driven by a collapse in internal demand. Stimulus counteracts the collapse in output by boosting external demand.

5 Conclusion

We conclude our text by bringing our analysis to bear on the questions raised by the Swedish Fiscal Policy Council and listed in the introduction.

Q1. What do we know about the size of fiscal multipliers in different circumstances and for different instruments?

Recent empirical evidence lends support to the view that multipliers vary significantly across circumstances. The studies discussed in Section 2 of this paper find that spending multipliers are larger under fixed exchange rate regimes, in recession and during financial crisis—unfortunately, empirical studies of fiscal policy at the zero lower bound are (still) constrained by the the availability of samples of the appropriate size. The evidence on the effect of fiscal stress on the multiplier, on the other hand, is mixed.

Our model-based analysis supports these findings and permits further refinements. In particular, it is well understood that monetary policy plays a key role of how fiscal policy impacts the economy (Woodford (2011, see, e.g.,)): our model provides a comprehensive assessment of two policy relevant cases, that is, a binding constraint on monetary policy due to the zero lower bound, and fixed exchange rates. In a baseline scenario without credit frictions and fiscal stress, the multiplier is smaller under a float than under an exchange rate peg. In both cases it is below unity. At the zero lower bound, however, it exceeds unity. Our model-based analysis can also account for the finding that multipliers are larger during financial crisis—-for instance, per effect of a crisis, a large fraction of households may come to face credit constraints (see Galí et al., 2007).

Most importantly, especially in light of the Great Recession, our analysis provides an exploration of multipliers under fiscal stress conditions. Our model encompasses a specific (sovereign risk) channel by which shocks and policy that deteriorate the fiscal outlook up to feeding doubts about debt sustainability and drive up risk premia on government debt, also raise private borrowing costs and thus impact aggregate demand. The presence of a sovereign risk channel reduces the output multiplier of deficit-financed stimulus (or even changes its sign), at least to the extent that monetary policy is unable to accommodate and offset increased sovereign risk. In this paper we have shown that this mechanism can have seriously destabilizing effects in economies stuck at the zero lower bound (as previously analyzed in (Corsetti et al., 2013b), as well as in economies pursuing an exchange rate peg.

An interesting and controversial result from our analysis is that, if monetary policy operates a freely floating exchange rate regime and is unconstrained by the zero lower bound, the sovereign risk channel may actually increase the output multiplier. This is reminiscent of a point recently emphasized by Krugman (2014), that sovereign risk can have expansionary effects via a depreciation of the exchange rate. Still, our analysis illustrates that these effects rely on strong monetary accommodation—and that, under the circumstances, fiscal stimulus does not prevent a collapse in internal demand and deflation.

Q2. Is the old consensus that discretionary policy should be avoided and only used in exceptional circumstances still a good advice? If not, can it be replaced with something else, e.g., the Temporary, Targeted and Timely advice?

In line with the results of much of the recent literature, our analysis suggests that fiscal policy can be particularly effective to stabilise large shocks as long as the country maintains solid fiscal credentials. In this sense the old consensus is confirmed and refined. First, it is appropriate to reserve strong fiscal interventions for exceptional circumstances, when it may be more effective. Second, under normal circumstances, it is wise to conduct fiscal policy so as to maintain sufficient space of manoeuvring under exceptional ones, preserving full market confidence on public debt.

Of course, an important qualifier—already part of the old consensus—concerns the exchange rate regime. In countries which either participate in a currency union or maintain an exchange rate peg, fiscal policy can be a useful stabilization tool in normal times as well (Beetsma and Jensen, 2005; Galí and Monacelli, 2008). Nonetheless, with an inflexible exchange rate and no monetary independence, the extent to which the sovereign risk can impair the fiscal transmission mechanism is particularly strong. So is the case for maintaining a sound fiscal outlook.

Under flexible exchange rates, a binding zero lower bound constraint on monetary policy is a key indicator of exceptional circumstances. In principle, "temporary, targeted and timely" action would be good advice, not in conflict with the old consensus. Fiscal stimulus is most effective if it comes into effect precisely as the economy is stuck at the zero lower bound, and is expected to continue throughout the recession (Christiano et al., 2011). Under the same circumstances, there is also an argument for spending reversals (lowering government demand below baseline in the medium term), as long as these are expected to take place *after* policy rates are no longer constrained.[14] That said, it is important to keep in mind that, in the presence of very large recessionary shocks associated with financial crisis, the forecast horizon of the recovery is highly uncertain (Meier, 2009). This is a practical but pervasive issue—made apparent by the recent crisis—that complicates the design of "temporary, targeted and

[14] In previous work of ours, we have shown how and why spending reversals can further enhance the expansionary effect of short run stimulus, also at the zero lower bound (Corsetti et al., 2010)

timely" interventions.

Q3. Would it be possible to set up an early warning system for fiscal vulnerability?

The level of public debt is perhaps the single most important indicator to assess the risks of a sovereign default and thus features prominently in quantitative analyses of sovereign default (Arellano, 2008). Also in our analysis, whereas fiscal vulnerability impairs the fiscal transmission mechanism through the sovereign risk channel, for tractability we assume that this channel becomes stronger as public debt increases. At the same time, however, we do recognise that the level of public debt is no sufficient criterion to assess the sustainability of public finances—a point stressed by recent literature on fiscal limits (Bi, 2012).
A straightforward but important lesson from the great recession is that a country's fiscal outlook is stable and credible up to the quality of the country's overall governance, in particular as regards financial systems, labor and product markets. An effective regime of supervision, regulation and resolution of financial intermediaries, for instance, can prevent the accumulation of hidden and contingent public liabilities. Lacking good governance, constitutional rules and budget institutions constraining fiscal policy are not hard-wired in the economy, and are likely to be breached in stress situations.
These considerations suggest that, in addition to defining numerical guidelines for debt and deficits, it would be desirable to develop analytical frameworks for a comprehensive assessment of implicit and contingent liabilities in situations of fiscal and macroeconomic stress. It would be, in fact, beneficial to construct the analog of a "value at risk" analysis—to provide quantitative guidance concerning the level of fiscal capacity required to stabilize the economy in response to severe shocks. This contingent assessment would include financial stability, demographic as well as health risks, and global disruptions.

Q4. Is there a substantial difference in terms of the value stabilizing different types of shocks, e.g., to export demand, domestic demand and supply, and if so what is then the impact of this on the optimal policy?

In our analysis we focus on external demand shocks in addition to exogenous changes in government spending. This allow us to illustrate how specific economic circumstances alter jointly the effects of shocks, and those of policy instruments. Absent a sovereign risk channel, we obtain a straightforward result: large multipliers tend to obtain under economic circumstances in which the propagation of negative shocks is also more pervasive. This, again, provides a rationale for using fiscal stabilization tools only under exceptional circumstances. However, we also show that sovereign risk tends to reduce the multiplier at the zero lower bound and under a peg, while—at the same time—strengthening the adverse impact of external shocks. As a result, the scope for fiscal stabilization is quite reduced under these circumstances.

This is, however, not the only reason to prevent the build-up of fiscal imbalances. There is also a second, complementary, reason: fiscal stress may act as a catalyst of endogenous risk shocks, causing macroeconomic disruptions. Especially after the Great Recession, the literature has become increasingly aware of the potentially large real effects of swings in endogenous financial risk—as early on envisioned by Raghuram G. Rajan and Hyun Shin at the 2005 Jackson Hole Meetings (Rajan, 2005). A well-designed fiscal policy framework is a key pillar, complementing supervision and regulation as well as monetary policy, of an effective strategy of macroeconomic and financial resilience.

Specifically, in Corsetti et al. (2013b, 2014) we show that if a) monetary policy is constrained by the zero lower bound and b) the sovereign risk channel is strong, the economy is vulnerable to indeterminacy, and expectations become easily unanchored. To wit: pessimistic arbitrary expectations of growth feed anticipations of larger deficits and debt; these in turn drive up sovereign risk and borrowing costs for domestic residents, curbing demand and thus validating ex post the initial pessimistic expectations. Similarly, less than sound public finances may create an environment where self-fulfilling runs on public debt become possible. The possibility of belief-driven runs give rise to a number of difficult challenges for both fiscal and monetary policy—see, e.g., Corsetti and Dedola, 2012 for an analysis of the conditions under which the central bank can credibly provide a backstop to government debt.[15]

Q5. The financial crisis illustrated the connection between financial and fiscal fragility. Do we know anything about the implications of this for fiscal policy?

In our analysis we explore how a particular aspect of the fiscal-financial nexus impacts the fiscal transmission mechanism. Specifically, we allow for the possibility that sovereign risk, i.e., fiscal fragility, is passed-through into private borrowing conditions, i.e., financial fragility. Such spillovers can originate in the banking system: falling bond prices deteriorate the balance sheet of financial intermediaries and these in turn curb lending (Bocola, 2014). Wherever they originate, we find that these spillovers have stark implications for fiscal policy—up to the point

[15] In short: the ability of central banks to provide a monetary backstop is predicated on its ability to issue liabilities, in the form of (possibly interest bearing) reserves that are subject to inflation risk, but are default-free (they are themselves claim on monetary central bank liabilities). Hence, by intervening in the sovereign debt market, central banks effectively swap default risky nominal debt with default free nominal liabilities, thus reduce the overall interest cost of public debt. A credible monetary backstop eliminates self-fulfilling runs on debt, by virtue of the central bank ability to cap the cost of debt service. The credibility of the backstop is however not granted. Because of the possibility of fundamental default, the central bank balance sheet is exposed to risk of large losses, that may force monetary authorities to carry out inefficient inflation policies. To the extent that these are welfare costly, central bank interventions may not be granted.

of changing the not only the size, but also the sign of fiscal multipliers. As a result, the scope for fiscal stabilization becomes severely limited, notably under a fixed exchange rate regime or at the zero lower bound.

At the same time, the crisis has also illustrated that financial fragility may impair fiscal stability. Prime examples include the collapse of the housing market in Ireland and Spain and its dramatic implications for public finances as a result of a large financial sector bailout. In fact, much of the recent work, at theoretical as well as at policy level, has highlighted the diabolic loop through which financial and fiscal instability reinforce each other (see, e.g., Brunnermeier et al., 2011).

In the eighth year after the eruption of the financial crisis in August 2007, the global economy is still struggling to find its way to a firm recovery path, burdened by a large average stock of accumulated public and private liabilities. With debt overhang effects constraining growth and creating financial vulnerabilities, the recovery may be disrupted by large destabilizing shocks. Prospective macroeconomic risk strengthens the arguments in favour of a rigorous application of sound principles in the conduct of fiscal policy.

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A Equilibrium conditions used in model simulation

Optimality of household behavior implies

$$\hat{c}_{A,t} = E_t\hat{c}_{A,t+1} - (1-g_y)(r_t + \chi\hat{d}_t - \alpha\hat{b}^*_t - E_t\pi_{t+1}). \quad \text{(L.1)}$$

$$\hat{c}_{N,t} = (1-\tau)\frac{(\epsilon-1)}{\epsilon}(w^r_t + h_{N,t}) - \hat{t}^r_t \quad \text{(L.2)}$$

$$\hat{c}_t = \hat{c}_{N,t} + (1-\lambda)\hat{c}_{A,t} \quad \text{(L.3)}$$

$$(1-\chi)w^r_t = \hat{c}_{A,t} + (1-\chi)\varphi h_{A,t} \quad \text{(L.4)}$$

$$(1-\chi)w^r_t = \hat{c}_{N,t} + (1-\chi)\varphi h_{N,t} \quad \text{(L.5)}$$

$$h_t = h_{N,t} + (1-\lambda)h_{A,t} \quad \text{(L.6)}$$

The budget constraint of asset-holders and the UIP condition

$$\beta\hat{b}^*_t + \hat{c}_t = \hat{b}^*_{t-1} + (1-\tau)\frac{\epsilon-1}{\epsilon}(w^r_t + h_{A,t} - \omega s_t) + (1-\tau)\frac{\hat{\Psi}^{r,pc}_t}{1-\lambda} + (1-g_y)\omega s_t - \hat{t}^r_t \quad \text{(L.7)}$$

$$r_t = \Delta E_t e_{t+1}. \quad \text{(L.8)}$$

Instead, under complete markets we use the risk-sharing condition and zero foreign bond holdings

$$\hat{c}_{A,t} = -(1-g_y)q_t \quad \text{(L.7')}$$

$$\hat{b}_t = 0. \quad \text{(L.8')}$$

Intermediate good firms' behavior is governed by marginal costs, the Philips curve and the production function:

$$mc^r_t = w^r_t - \omega s_t \quad \text{(L.9)}$$

$$\pi_{H,t} = \beta E_t\pi_{H,t+1} + \kappa mc^r_t \quad \text{(L.10)}$$

$$y_t = h_t \quad \text{(L.11)}$$

Government policies, government budget constraint and market clearing are given by:

$$r_t = \phi\pi_{H,t} + (1.5-\phi)e_t \quad \text{(L.12)}$$

$$\hat{t}^r_t = \psi_T\hat{d}^r_t \quad \text{(L.13)}$$

$$\hat{g}_t = \rho\hat{g}_{t-1} - \psi_G\hat{d}^r_t + \varepsilon_t \quad \text{(L.14)}$$

$$\beta\hat{d}^r_{t+1} = \hat{d}^r_t + \hat{g}_t - \hat{t}^r_t - \tau y_t \quad \text{(L.15)}$$

$$y_t = -(1-g_y)(2-\omega)\sigma\omega s_t + (1-\omega)\hat{c}_t + \hat{g}_t. \quad \text{(L.16)}$$

Definitions for the trade balance, relative prices, inflation and profits are given by:

$$tb_t = y_t - \hat{c}_t + (1 - g_y)\omega s_t - \hat{g}_t \tag{L.17}$$

$$\pi_t = \pi_{H,t} - \omega \Delta s_t \tag{L.18}$$

$$\Delta e_t = (1 - \omega)\Delta s_t - \pi_t \tag{L.19}$$

$$q_t = (1 - \omega)s_t \tag{L.20}$$

$$\hat{\Psi}_t^{pc,r} = y_t - \frac{\epsilon - 1}{\epsilon}(w_t^r + h_t - \omega s_t). \tag{L.21}$$