THE CURSE OF SOVEREIGN DEBT

AND IMPLICATIONS FOR FISCAL POLICY
The curse of sovereign debt
and implications for fiscal policy

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Voor mijn geliefde ouders,
Arnold en Siti Bonam.
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\[ \text{1The last one might be a bit hard to remember, but he was the Lieutenant in *Starship Troopers.*} \]
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Chapter 1

Introduction

“A national debt, if it is not excessive, will be to us a national blessing.”

-Alexander Hamilton, 1781

A few years ago, when the world faced its most devastating recession in decades, governments worldwide engaged in massive fiscal expansions to keep their economies afloat. The spirit of John Maynard Keynes was clearly tangible in nearly all crisis-hit countries as many governments fiercely raised public expenditures and reduced taxes in an attempt to stimulate aggregate demand and curtail the rise in unemployment. Whether or not these massive Keynesian fiscal endeavours have been successful in mitigating the crisis is still an open-ended question. What is far less ambiguous, however, is the Great Recession’s ‘Great Legacy’: a tremendous increase in government indebtedness.

Panel (a) of Figure 1.1 displays the level of government debt as a share of gross domestic product (GDP). This figure illustrates the steady rise in government indebtedness during the crisis, with some countries experiencing debt ratio’s of even more than 100%. Of course, borrowing money does not come free, yet involves periodic interest payments. Panel (b) of Figure 1.1 shows the return on long-term government bonds, which is a measure of the government’s cost of borrowing, in comparison to the return on a similar ‘risk-free’ bond. The remaining spread can be interpreted as a sovereign risk premium that
Figure 1.1: Government indebtedness and sovereign risk premia in Europe (2000Q1-2013Q4)

(a) Government debt (percentage of GDP)

(b) Sovereign risk premia (basis points)

Notes: Panel (a) plots gross government debt as a share of nominal GDP (quarterly data for Greek debt ratio’s were unavailable). Panel (b) shows the trend in quarterly long-term (10-year) government bond returns, minus the return on a similar German bond which is typically assumed to be risk-free. Source: OECD National Accounts Statistics.
compensates investors for the risk of non-repayment by the government.\(^1\) In the years leading up to the crisis, between 2000 and 2008, sovereign risk premia were close to zero, which suggests that investors were confident about the government’s ability and willingness to honour its debt obligations. Consequently, when studying the impact of discretionary fiscal policy on the economy, the academic literature mostly ignored the sovereign risk premium and, instead, assumed governments could borrow at very low costs.

This assumption, although realistic during 2000-08, no longer seems to apply for at least some countries following the crisis. As Figure 1.1 shows, those countries that became heavily indebted after 2008 were required to pay a much higher interest rate than the risk-free rate and thus faced a higher sovereign risk premium. The sovereign risk premium directly influences the government’s cost of borrowing and therefore the sustainability of fiscal policy. Higher sovereign risk premia might also adversely affect private credit conditions. For instance, most banks hold government bonds as collateral in order to borrow money from the central bank or from other banks. When the government is expected to renege on its debt obligations, the collateral value of these bonds falls which makes it more difficult for banks to attract funding at low interest rates. When faced with higher interest rates, banks tend to ‘pass’ the costs onto their clients and raise interest rates on the loans they supply to households and firms. Figure 1.2, for instance, shows how private borrowing costs in Greece and Portugal, the two countries in Europe that faced the most dire sovereign debt problems, moved in the same direction as the sovereign risk premium during the height of the crisis. Higher interest rates, in turn, discourage investment and thereby slow down economic activity. Therefore, sovereign risk premia also affect the economic impact of fiscal policy through their effects on private credit conditions.\(^2\)

\(^1\)Throughout, the terms ‘government’ and ‘sovereign’ are used interchangeably.

\(^2\)There are other channels through which higher sovereign risk premia could affect private credit conditions. For instance, when the government faces extremely high borrowing costs which it wants to reduce, people might expect the government to raise taxes and reduce public spending in order to bring down the debt level. In some critical cases, the government might even appropriate and sell private properties, and use the proceeds to redeem its debt obligations. Such fiscal actions reduce private net income and private wealth, and makes it more difficult for households and firms to redeem their own debt obligations. Being more risky borrowers, households and firms would then be more likely to face higher borrowing costs. For an empirical account of the relationship between sovereign risk and private credit conditions, see Bruyckere et al. (2013), and references therein.
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Figure 1.2: Public and private cost of borrowing (2008M1-2012M12)

Notes: The figures show the composite cost of borrowing (which is a weighted average of interest rates on short- and long-term loans) for households and non-financial corporations (vertical axis), and the yield on 10-year government bonds minus the yield of a similar German bond (horizontal axis). Source: ECB Statistical Data Warehouse.

Given the significant rise in government debt in recent years and the associated surge in sovereign risk premia in a number of advanced economies, economists are forced to think differently about the role of sovereign risk when studying fiscal policy. This thesis is a step towards this new way of thinking. Particularly, my aim is to investigate the implications of sovereign risk for various aspects of fiscal policy, such as the sustainability of fiscal policy, the effects of fiscal policy on aggregate demand and the design of optimal fiscal policy. One simple, yet important message emerges recurrently: the weaker are a country’s public finances, the less effective are conventional fiscal stimulus measures in raising aggregate demand. One could say that, when excessive, a nation’s debt will no longer be a blessing, yet rather a curse on fiscal policy.

I start my venture in Chapter 2 with a simple theoretical model to study the sustainability of countercyclical fiscal policies. When fiscal policy is countercyclical, it means that the government reduces taxes (or raises expenditures) whenever the economy is in a recession and raises taxes in times of economic
prosperity.\(^3\) Because tax reductions stimulate household consumption, countercyclical fiscal policies generally help stabilise the economy. Of course, such policies also imply that the government runs budget deficits from time to time, which adds to the accumulation of a country’s public debt. These short-run budget deficits do not necessarily pose a threat to debt sustainability, as long as the debt converges to some constant long-run level over time. In the model, I therefore assume that, whenever the debt exceeds this long-run level, the government will raise taxes in order to bring the debt down.\(^4\) Given this assumption, I show that countercyclical fiscal policies can be used to stabilise the economy, without generating explosive debt dynamics. This is good news for countries that occasionally face an economic crisis and rely on expansionary fiscal policy to prevent the crisis from escalating.

Countercyclical fiscal policies are less likely to be sustainable, however, in the presence of sovereign risk. As suggested by Figure 1.1, when government debt reaches historically high levels, there might be a strong rise in the sovereign risk premium as investors express their concerns about the government’s debt repayment capacity.\(^5\) Figure 1.2, in turn, suggests that a higher sovereign risk premium raises private borrowing costs.\(^6\) Finally, higher private borrowing costs reduce consumption and investment. Hence, whenever there is a recession, a countercyclical response of fiscal policy that leads to a reduction in taxes and increase in debt may cause consumption to fall rather than rise, thereby worsening the recession. When consumption falls and fiscal

\(^3\)These measures are typically ‘automatic’ in nature. For instance, when an economy faces a recession, many people lose their jobs. Hence, national income falls and the government’s tax revenue automatically falls as well. At the same time, those people who have lost their job might receive unemployment insurance from the government, which implies that government expenditures automatically rise.

\(^4\)For instance, governments in the euro area may want to raise taxes when their debt-to-GDP ratio exceeds 60%, which is the maximum permissible debt ratio imposed by the European Stability and Growth Pact.

\(^5\)Such concerns may arise, for instance, if the only way to repay the debt is to raise taxes to very high levels; levels that are politically infeasible and therefore unlikely to attain.

\(^6\)The model that I use does not explicitly feature a financial sector through which changes in sovereign risk are channelled to interest rates on household and firm loans. Instead, consumption behaviour of households—who are also the owners of the firms in the model—is captured by an equation in which current consumption is positively related to future income (to reflect wealth effects) and negatively related to the real interest rate (to reflect savings opportunities). The real interest rate, in turn, is positively related to the sovereign risk premium. Therefore, a stylised link between sovereign risk and private expenditures is established indirectly without explicit notion of private borrowers and lenders.
policy remains countercyclical, the government is forced to cut taxes yet again, causing the sovereign risk premium to go up further and lowering consumption even more. Countercyclical fiscal policy thus becomes a source of instability and might throw the economy into a vicious cycle of rising debt and economic decline.

Under these conditions, the government needs to adopt a more-than-usual aggressive debt-reduction policy in order to bring the sovereign risk premium down and thereby ensure sustainability of fiscal policy. If the government is unable (or unwilling) to pursue such aggressive fiscal adjustment, then the central bank must step in to sustain government debt. It can do so by lowering the interest rate, which offsets the rise in the sovereign risk premium and thereby mitigates the adverse effects on private spending. However, the ability of the central bank to lower the interest rate is not without bounds, as the interest cannot fall below zero percent. In recent years, central banks in both the US and the euro area have faced difficulties because their interest rates have reached this ‘zero lower bound’. An important lesson that can be drawn from this Chapter is therefore that countries should keep their debt levels sufficiently low, such that they can pursue countercyclical fiscal policy to stabilise their economies without upsetting bond markets and raising risk premia.

Whereas Chapter 2 considers the long-run implications of sovereign risk for fiscal policy sustainability, Chapters 3 and 4 focus on how sovereign risk affects the short-run effects of fiscal policy on aggregate output. In Chapter 3, I examine the effects of an increase in government spending on output, which is captured by the government spending multiplier. The multiplier-effect of government spending on output can be explained as follows: when the government raises demand for goods and services, firms are pushed to hire more workers to meet the extra demand, which leads to a fall in unemployment and an increase in wages, which in turn allows households to consume more goods and services, thereby pushing firms to hire even more workers, etc. I illustrate this channel using a theoretical model for a small open economy and show that an increase in government spending generally leads to higher output levels. Furthermore, and in line with traditional Keynesian theory, the multiplier tends to be higher in countries that have a fixed, rather than flexible, exchange rate.

The expansionary effects of government spending are substantially dimin-
ished, however, in the presence of sovereign risk, depending on the prevailing exchange rate regime. Particularly, when the government raises debt to finance its expenditures, it also drives up the interest rate through the sovereign risk premium which reduces private consumption (as in Chapter 2). The presence of the sovereign risk premium thus reduces the multiplier, yet less so if countries have a flexible exchange rate. The latter result arises because an increase in sovereign risk makes holding government bonds less attractive and causes foreign lenders to invest their money outside the country. The consequent depreciation of the country’s currency is beneficial to the exporting industry and thereby supports the multiplier. This offsetting effect is absent under fixed exchange rates, which implies that the multiplier can be larger under flexible exchange rates—a result that goes against traditional Keynesian theory.

In Chapter 4, I assess the government spending multiplier under a monetary union, i.e. a group of countries that share a common currency. I show that, for small member states, fiscal expansions at the national level can boost output levels (as in Chapter 3) and can even be welfare improving, at least when sovereign risk is absent. However, if a country is large, output fluctuations would be smoothed also through countercyclical monetary policy, which means that tax reductions during recessions would stimulate the economy ‘too much’ and thereby raise income variability which reduces welfare. Therefore, for larger countries, a pro-cyclical fiscal stance maximises welfare.

This result is reversed in times of sovereign risk: small countries benefit most from pro-cyclical fiscal policies, whereas large countries benefit most from countercyclical fiscal policies. In small countries, the pro-cyclical stance is required to suppress the sovereign risk premium during a recession and thereby mitigate the adverse effects on private consumption. In large countries, a countercyclical stance provides a better balance between fiscal and monetary policy.

The following chapters thus show that, once countries cave under the weight of their accumulated debt, the sustainability, effects and optimal design of fiscal policy change markedly, forcing policymakers to stop exercising Keynes’ doctrine and instead take a different approach to achieve stable economic outcomes. I hope my analyses can guide policymakers of today in dealing with the Great Legacy and help policymakers of tomorrow establish a strong line of defense for when the next Great Recession creeps around the corner.
Chapter 2

Fiscal and monetary policy coordination, macroeconomic stability and sovereign risk premia

The Great Recession has forced governments worldwide to engage in massive fiscal expansions in order to keep their economies afloat, especially since monetary instruments have been effectively depleted due to the zero lower bound. In some cases, these Keynesian-style fiscal policies have resulted in a surge of government indebtedness and widening sovereign bond yields, mostly reflecting concerns regarding the sustainability of public finances. In more critical cases, the fiscal response to the crisis did more bad than good, as the risk of sovereign default became too high and eventually led to a collapse of sovereign bond markets. This begs the question: how does the use of fiscal policy in stabilising macroeconomic conditions affect the ability to ensure a sustainable path for sovereign debt?

We address this question through the lens of the canonical New Keynesian closed economy model. A fiscal authority (or ‘government’) follows a feedback rule that relates the primary balance to changes in government debt and aggregate output. Leeper (1991) has already shown that, to obtain a stable equilibrium, the response of the primary balance to a given change in debt should

*This chapter is based on Bonam and Lukkezen (2014a).
be strong enough to maintain debt growth below the long-run real interest rate. In order to achieve determinacy, this ‘passive fiscal policy’ must then be paired with an ‘active monetary policy’, which ensures that the nominal interest rate moves by more than one-for-one with inflation.\footnote{According to the Fiscal Theory of the Price Level, stability and uniqueness can also be ensured when fiscal policy is insufficient to deliver long-run debt sustainability, yet only if the central bank allows the price level to keep the real value of government debt outstanding consistent with the intertemporal government budget constraint (see Leeper, 1991, Sims, 1994, Woodford, 1996, and Woodford, 2001, among others).} Inflation-targeting is performed by a monetary authority (or ‘central bank’) who follows a standard Taylor rule (Taylor, 1993). Furthermore, in order to capture the recently observed changes in the demand elasticity for government bonds, we introduce a sovereign risk premium which forms a wedge between the bond rate and risk-free rate. The risk premium rises with government indebtedness when agents are concerned with fiscal solvency and remains constant otherwise.

Our main contribution is to show, both analytically and numerically, that the well-established stability and uniqueness requirements from Leeper (1991) change markedly under a debt-elastic sovereign risk premium, and depend strongly on the government’s endogenous fiscal response to the business cycle. In particular, when the government maintains a countercyclical fiscal stance, such that output contractions are met by reductions in the primary surplus, a stable and unique equilibrium might be unable to obtain, even if fiscal policy is passive and monetary policy active. Intuitively, when a random shock adversely hits the economy and the primary surplus falls, the stock of government debt rises which drives up the sovereign risk premium. Consequently, the interest rate rises which prompts agents to save more and consume less, causing output and inflation to fall. This crowding-out effect of the sovereign risk premium therefore exacerbates the initial decline in output. Given the countercyclical nature of fiscal policy, the government then automatically raises the deficit further, which again drives up debt and the risk premium, causing consumption and output to fall even more, etc. etc. In order to avoid this self-reinforcing cycle of rising debt and falling output, and keep long-term financing costs low, the government must signal its commitment to debt sustainability by pursuing more aggressive debt consolidation. The more responsive is the sovereign risk premium to changes in government indebtedness, the greater becomes the required effort to consolidate debt.
The required ‘passiveness’ of fiscal policy that delivers equilibrium stability depends, not only on the severity of the sovereign debt crisis, but also on monetary policy. If monetary policy is active, the rise in the sovereign risk premium and consequent fall in inflation is met by a reduction in the policy rate, which partially offsets the crowding-out effect. However, the less responsive is the central bank to changes in inflation, the weaker is this monetary offset. Keeping the risk premium low then requires greater debt reduction by the government. Our results therefore imply that the interdependence between fiscal and monetary policy is much stronger in the presence of debt-elastic sovereign risk premia and warrants closer coordination between the government and central bank than suggested by Leeper (1991).

When the government maintains a pro-cyclical fiscal stance, such that output contractions are met by fiscal contractions, the stability and uniqueness requirements under a debt-elastic sovereign risk premium are relaxed. Particularly, when the primary surplus rises following an adverse shock to output, government debt falls, which reduces the risk premium and interest rate, and raises consumption, thereby offsetting the initial output contraction. The pro-cyclical nature of fiscal policy thus not only eases the task of sustaining government debt by keeping the risk premium low, which makes it possible to obtain stability even if fiscal policy is not passive, it also helps control inflation by essentially substituting for monetary policy, which opens up the possibility for determinacy even if monetary policy is not active.

If the sovereign risk premium remains constant over time, regardless of the degree of government indebtedness, the conventional passive fiscal plus active monetary policy combination becomes a necessary and sufficient condition for equilibrium stability and uniqueness. Also, the stability and uniqueness requirements become independent from the government’s cyclical stance. This means that, as long as fiscal policy is passive, the government may pursue countercyclical fiscal policies and run budget deficits from time to time without endangering long-run debt sustainability or price level determinacy. Under a debt-elastic risk premium, however, short-run debt developments are no longer trivial and the government must take immediate action and signal its commitment to sustain debt. If it does not, then the onus of ensuring stable macroeconomic conditions falls entirely upon the central bank. Our results therefore formalise the need for greater measures of fiscal austerity during times of sov-
Sovereign debt crises and also questions the desirability of fiscal expansions when public finances are critically weak.

The present chapter is closely related to the literature on the relationship between macroeconomic stability and government debt non-neutrality. For instance, Canzoneri and Diba (2005) and Linnemann and Schabert (2010) show that the conditions for equilibrium stability change when government bonds can be used for transactions. In contrast to our study, an increase in the amount of government bonds outstanding would then have a positive effect on output and inflation through a reduction in the liquidity premium. Fiscal policy is therefore able to accommodate monetary policy in controlling inflation, and determinacy can be achieved even when monetary policy is not active. Piergallini (2005) and Leith and von Thadden (2008) show that similar results can be derived in overlapping generations models in which government bonds generate wealth effects. Furthermore, Schabert and van Wijnbergen (2014) investigate the implications of debt non-neutrality arising from sovereign default risk using an otherwise standard New Keynesian model for a small open economy. The authors show that, in the presence of sovereign risk, the government must respond more aggressively to changes in debt to deliver a stable and unique steady state if the central bank actively targets inflation. Although these results are similar to ours, they are driven by a completely different mechanism. Particularly, whereas in our model the sovereign risk premium crowds out consumption and output, sovereign risk is expansionary in Schabert and van Wijnbergen due to its negative effect on the effective real return on government bonds. While we acknowledge the possibility of sovereign risk to have positive effects on inflation (at least in the short run), we believe the adverse effects on financial market conditions associated with rising sovereign risk premia dominate the overall implications for output and inflation dynamics (see also Corsetti et al., 2013a).

The remainder of this chapter is organised as follows. In the following section, we briefly describe the model, its main building blocks and the calibration of the structural parameters. In Section 2.2, we derive the conditions for equilibrium stability and uniqueness, and show the implications of the cyclicality of fiscal policy and the sovereign risk premium. Finally, Section 2.3 concludes and offers directions for future work.
2.1 A closed economy model

For our main analysis, we use the canonical New Keynesian closed economy model, which is presented in this section. We start by focusing on the public sector, which consists of a fiscal authority, or ‘government’, and a monetary authority, or ‘central bank’. Although the government and central bank act independently from each other, the equilibrium properties of the model are determined jointly by fiscal and monetary policy. Furthermore, we assume that the carrying cost of government debt is subject to a sovereign risk premium which itself is a function of government indebtedness. Our aim is to reveal how the presence of such a risk premium affects the feasible set of fiscal and monetary policies that deliver stable and unique equilibria. We close this section with a brief description of the household and firm sector, the market clearing conditions and equilibrium, and the calibration of the model’s structural parameters.

2.1.1 The public sector and sovereign risk premium

The government issues nominal, one-period government bonds, \( B_t \), and levies lump-sum taxes, \( T_t \), in order to cover a constant level of public consumption, \( g \), and repay outstanding debt plus interest. Let \( R_{g,t} \) denote the gross nominal interest rate on government bonds, \( P_t \) the aggregate price index and \( s_t \equiv T_t - g \) the real primary budget surplus. Government debt then accumulates due to the difference between gross public debt and the primary surplus:

\[
B_t = R_{g,t-1}B_{t-1} - P_ts_t. \tag{2.1}
\]

Dividing (2.1) by \( P_t \) and then solving forward recursively yields the intertemporal government budget constraint:

\[
R_{g,t-1} \frac{B_{t-1}}{P_t} = \sum_{n=0}^{\infty} \left( \prod_{m=0}^{n} r_{g,t+m}^{-1} \right) s_{t+n}, \tag{2.2}
\]

where \( r_{g,t} \equiv R_{g,t}(P_t/P_{t+1}) \) denotes the real bond rate and where we have imposed the following transversality condition which prevents the government
from rolling-over its debt indefinitely:

$$\lim_{k \to \infty} \left( \prod_{m=0}^{k-1} \frac{1}{r_{g,t+m}} \right) \frac{B_{t+k}}{P_{t+k}} = 0. \quad (2.3)$$

According to the intertemporal government budget constraint given by (2.2), a feasible set of fiscal and monetary policy is one which ensures that real outstanding public liabilities (left-hand side) equals the discounted sum of current and future primary surpluses (right-hand side).

The trajectory of the primary surplus \( \{s_{t+k}\}_{k=0}^{\infty} \) would ordinarily be shaped by many economic and political considerations. Rather than developing a full-blown political economy model that features such considerations, we assume that \( s_t \) moves endogenously with changes in the real level of government debt outstanding at \( t \), which is denoted by \( b_{t-1} \equiv B_{t-1}/P_{t-1} \), and aggregate output, \( y_t \):

$$s_t = \gamma_b \left( b_{t-1} - \bar{b} \right) + \gamma_y \left( y_t - \bar{y} \right), \quad (2.4)$$

where \( \bar{b} \) and \( \bar{y} \) denote target values for government debt and output, respectively, and are assumed to equal the corresponding steady-state values.\(^2\) The parameter \( \gamma_b \geq 0 \) reflects the government’s effort to consolidate outstanding debt within a given period. In order to facilitate our discussion, we adopt the terminology from Leeper (1991) and introduce the following definition characterising fiscal policy:

**Definition 1.** Fiscal policy is called ‘passive’ if \( \gamma_b > r_g - 1 \). Otherwise, fiscal policy is said to be ‘active’.

The parameter \( r_g \) denotes the steady-state value of the real bond rate. Hence, when fiscal policy is passive, the government prevents debt from growing at a rate that exceeds the cost of borrowing, and thereby ensures that debt gradu-

\(^2\)Fiscal rules similar to (2.4) have been used extensively in the empirical literature to test for the sustainability of public debt and estimate the cyclical stance of fiscal policy in both advanced and emerging market economies (see e.g. Gavin and Perotti, 1997; Galí and Perotti, 2003; Greiner et al., 2007; Mendoza and Ostry, 2008; Debrun and Kapoor, 2010; Ghosh et al., 2013). In the theoretical literature, such fiscal rules are often used to describe government behaviour (e.g. Linnemann, 2006). Although most models restrict the government to respond only to lagged variables (to reflect political constraints that might delay the implementation of fiscal policy), we allow the contemporary level of output to enter the fiscal rule for analytical convenience. However, replacing \( y_t \) with \( y_{t-1} \) does not alter the main results of this chapter.
2.1 A closed economy model

ally converges to some sustainable level in the long run. When, on the other hand, fiscal policy is active, an increase in the level of debt will not be met by a sufficient rise in the primary surplus, which opens up the possibility of explosive debt dynamics.

The parameter $\gamma_y$ reflects the government’s stance with regards to the business cycle and therefore indicates the cyclicality of fiscal policy, which we characterise as follows:

**Definition 2.** When $\gamma_y > 0$, fiscal policy is called ‘countercyclical’. When $\gamma_y < 0$, fiscal policy is called ‘pro-cyclical’.

A countercyclical fiscal stance essentially indicates that the government uses automatic stabilisers to suppress fluctuations in output: during recessions, when output falls below target, the primary surplus falls *automatically*, whereas during economic prosperity, the primary surplus rises. Pro-cyclical fiscal policies, on the other hand, tend to intensify the business cycle as output contractions (expansions) are met by an increase (decrease) in the primary surplus. Whereas existing literature has mostly focused on the effects of fiscal stabilisation policy on short-run dynamics (see e.g. Galí, 1994, Fatás and Mihov, 2001, and Debrun and Kapoor, 2010), we will show later on that the built-in fiscal response to the business cycle can play a pivotal role in the determination of long-run equilibrium outcomes as well.

One of the key ingredients of the model is a *sovereign risk premium* that raises the cost of public borrowing. Before we discuss how the sovereign risk premium is introduced to the model, we need to make clear what we mean by ‘sovereign risk’. In this regard, our modelling approach is line with Davig et al. (2011) and Bi (2012). In particular, we assume that sovereign risk may arise due to the presence of a so-called ‘fiscal limit’ which determines the maximum primary surplus, say $S$, that is politically (or economically) feasible, and therefore determines the maximum amount of government debt, denoted by $B$, that can be repaid. The latter is determined by

$$B = \sum_{n=0}^{\infty} \left( \prod_{m=0}^{n} r_{g,t+m-1} \right) S_{t+n}.$$  

When the stock of government debt reaches a level that, by the fiscal rule (2.4), forces the primary surplus to breach the fiscal limit, i.e. when $s_t >$
\(S\), the government (partially) defaults on its outstanding debt, since raising the surplus beyond \(S\) is not feasible. On the other hand, when \(s_t < S\), the government fully honours its debt. Although agents do not know \(S\) prior to entering a sovereign bond contract (\(S\) is observed only when the bond matures), they know its distribution and, since they are forward-looking, form expectations about future sovereign default probabilities. Consequently, even if the economy has not yet reached the fiscal limit, the mere possibility of getting there can affect today’s bond price: the higher is the probability of reaching the fiscal limit, the lower is the price.

Since the fiscal limit is stochastic and dependent on the state of the economy, explicitly modelling its conditional distribution can be quite cumbersome. Also, the fiscal limit implies non-linearities within the model, which renders a linear approximation unsuitable to study the model’s equilibrium properties. We do not take up the task to solve these problems here, yet instead circumvent them by assuming that \(S\) and \(B\) are determined exogenously (see Corsetti et al., 2013c, Daniel and Shiamptanis, 2013, Locarno et al., 2013, Roeger and in ’t Veld, 2013, and Schabert and van Wijnbergen, 2014, for similar treatments of the fiscal limit). Furthermore, we assume that, when \(b_t\) is perceived to be close to the threshold level \(B\), a sovereign risk premium emerges, denoted by \(\Xi_{g,t}\), which forms a wedge between the bond rate, \(R_{g,t}\), and the risk-free policy rate set by the central bank, \(R_t\), i.e.

\[
R_{g,t} = \Xi_{g,t} R_t. \tag{2.5}
\]

When, however, agents believe \(b_t\) to lie far below \(B\), the risk premium disappears and the government simply pays the risk-free rate. This non-linear relationship between the risk premium and government indebtedness has been confirmed by many empirical studies (e.g. Bernoth et al., 2004; Laubach, 2009; Afonso et al., 2012; Jaramillo and Weber, 2013) and is captured here by the following function:

\[
\Xi_{g,t} = \exp \left( \chi_g \frac{b_t}{y} \right). \tag{2.6}
\]

The coefficient \(\chi_g \geq 0\) determines the sensitivity of the sovereign risk premium to changes in government debt. When \(\chi_g = 0\), concerns regarding fiscal insolvency are absent and so further increases in government indebtedness do not
2.1 A closed economy model

affect the bond price. Hence, we say that the risk premium is debt-inelastic. Positive values of \( \chi_g \), on the other hand, indicate that agents expect the fiscal limit to be breached soon and thus require a higher risk premium when holding government bonds. In that case, the demand curve for government bonds is downward-sloping and we say that the risk premium is debt-elastic.\(^3\)

The central bank sets the policy rate in order to target inflation, which is denoted by \( \pi_t \equiv P_t/P_{t-1} \), according to the following rule:

\[
R_t = \left( \frac{\pi_t}{\pi} \right)^{ \alpha_\pi },
\]

(2.7)

where \( \alpha_\pi > 0 \) measures the aggressiveness with which the central bank responds to deviations of inflation from target, \( \pi \), which is assumed to equal steady-state inflation. Following Leeper, the monetary stance is characterised by the following definition:

**Definition 3.** Monetary policy is called ‘active’ if \( \alpha_\pi > 1 \). Otherwise, monetary policy is said to be ‘passive’.

Under active monetary policy, the central bank is able to ensure price level determinacy by moving the nominal interest rate by more than one-for-one with inflation, such that any positive shock to inflation is offset by an increase in the real interest rate. Generally speaking, an active monetary policy stance satisfies the Taylor-principle.

2.1.2 Households and firms

An infinitely-lived, representative household chooses the optimal level of consumption, \( c_t \), number of hours worked, \( n_t \), and nominal holdings of government bonds in order to maximise expected life-time utility, given by

\[
E_t \sum_{k=0}^{\infty} \beta^k \left( \frac{c_{t+k}^{1-\sigma}}{1 - \sigma} - \frac{n_{t+k}^{1+\varphi}}{1 + \varphi} \right),
\]

(2.8)

\(^3\)The sovereign risk premium function is deliberately kept simple in order to derive analytical results. Of course, other factors might influence variations in the risk premium. For instance, most empirical studies that estimate equations like (2.6) control for the forward-looking behaviour of investors by including expected fiscal variables (see Gale and Orszag, 2003, for an extensive review). We have experimented with similar ‘forward-looking’ specifications, yet our results did not change qualitatively. Other factors, such as expected output growth and inflation, and persistence in the risk premium have been tested as well, yet they did not alter our results.
with $\beta \in (0, 1)$ the household’s discount factor, $1/\sigma > 0$ the elasticity of intertemporal substitution, and $1/\varphi > 0$ the Frisch elasticity of labour supply. The household pays lump-sum taxes to the government and receives labour income, $W_t n_t$ with $W_t$ the nominal wage, and real dividends, $\psi_t$, from firms. The household’s flow budget constraint is given by

$$B_t + P_t c_t + P_t T_t = R_{g,t-1} B_{t-1} + W_t n_t + P_t \psi_t.$$  \hspace{1cm} (2.9)

Subject to (2.9) and the transversality condition (2.3), the household maximises (2.8) which delivers the following first-order conditions:

$$\frac{n_t^\varphi}{c_t^{-\sigma}} = w_t,$$  \hspace{1cm} (2.10)

$$c_t^{-\sigma} = \beta E_t \left[ r_{g,t} c_{t+1}^{-\sigma} \right].$$  \hspace{1cm} (2.11)

Equation (2.10) determines the household’s optimal labour supply decision by relating the marginal rate of substitution between consumption and leisure to the real wage rate $w_t \equiv W_t/P_t$. The Euler equation (2.11) determines the household’s optimal savings decision by relating expected consumption growth to the real bond rate.

The firm sector is straightforward (see Appendix 2.A for more details). A representative final good firm, who is a price-taker, assembles differentiated intermediate goods to produce the final good using a standard constant elasticity of substitution production function. Intermediate goods are produced by a large number of monopolistic firms using labour (supplied by households) and a constant returns to scale production technology. Intermediate goods firms can set prices in excess of marginal costs, yet face a price-setting constraint as in Calvo (1983): in every period, only a share, $1 - \theta \in (0, 1]$, of firms can re-set prices, while remaining firms are forced to keep prices unchanged. The optimal price-setting condition is based on a profit-maximisation problem, which is derived in Appendix 2.A.

### 2.1.3 Market clearing and equilibrium

In equilibrium, the economy’s aggregate resource constraint, $y_t = c_t + g$, must be satisfied and the government bond market clears. Furthermore, labour
2.1 A closed economy model

Table 2.1: Benchmark calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>Discount factor</td>
<td>0.9926</td>
</tr>
<tr>
<td>( 1/\sigma )</td>
<td>Intertemporal elasticity of substitution</td>
<td>1</td>
</tr>
<tr>
<td>( 1/\varphi )</td>
<td>Frisch elasticity of labour supply</td>
<td>1/3</td>
</tr>
<tr>
<td>( \theta )</td>
<td>Probability of non-price adjustment</td>
<td>0.75</td>
</tr>
<tr>
<td>( \epsilon )</td>
<td>Elasticity of substitution between intermediate goods</td>
<td>11</td>
</tr>
<tr>
<td>( b/y )</td>
<td>Steady-state debt to output ratio (annualised)</td>
<td>0.6</td>
</tr>
<tr>
<td>( c/y )</td>
<td>Steady-state private consumption to output ratio</td>
<td>0.8</td>
</tr>
<tr>
<td>( g/y )</td>
<td>Steady-state government consumption to output ratio</td>
<td>0.2</td>
</tr>
<tr>
<td>( T/y )</td>
<td>Steady-state tax revenue to output ratio</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Market clearing implies \( n_t = \int_0^1 y_t(i) \, di = y_t D_t \), where \( D_t \equiv \int_0^1 (P_t(i)/P_t)^{-\epsilon} \, di \) is a measure of price dispersion.

Equilibrium is then given by a sequence of \( c_{t+k}, n_{t+k}, y_{t+k}, w_{t+k}, b_{t+k}, \pi_{t+k}, \Xi_{g,t+k}, R_{t+k}, R_{g,t+k} \) and \( s_{t+k} \) that satisfies the public’s budget constraint (2.1), the fiscal policy rule (2.4), the bond-pricing equation (2.5), the sovereign risk premium function (2.6), the monetary policy rule (2.7), the household’s first-order conditions (2.10) and (2.11), the firm’s optimal re-set price condition (see Appendix 2.A) and the market clearing conditions, given exogenous sequences for the fiscal limits \( S \) and \( B \), for all \( k \).

2.1.4 Calibration

The model is calibrated based on a quarterly frequency. For many parameters in the model, we take those values that are most commonly found in the literature. For an overview, see Table 2.1.

We set the discount rate equal to \( \beta = 0.9926 \), such that the (annual) equilibrium net bond rate equals about \( r_g - 1 = 3\% \). As in Galí and Monacelli (2008), the intertemporal elasticity of substitution is assumed to be \( \sigma = 1 \), such that household utility depends on the log of consumption. Also, we assume \( \varphi = 3 \), which implies a Frisch elasticity of 1/3, and set \( \theta = 0.75 \), which is consistent with an average price contract of one year. Following Corsetti et al. (2012a), we set the elasticity of substitution between intermediate goods.
at \( \epsilon = 11 \), implying a price mark-up of 10\%. Furthermore, the steady-state debt to output ratio is given the value of \( b/y = 0.6 \) (on an annual basis), while private and public consumption as a share of output in steady state are set to \( c/y = 0.8 \) and \( g/y = 0.2 \), which corresponds to long-run data of OECD countries. The government’s flow budget constraint (2.1) then implies a steady-state tax revenue to output ratio of around \( T/y = 0.22 \). Values for the policy parameters, \( \gamma_b \), \( \gamma_y \) and \( \alpha_\pi \), are chosen within realistic ranges when we explore the set of feasible fiscal and monetary policies.

The key parameter of our model is \( \chi_g \), which governs the sensitivity of the sovereign risk premium to changes in government indebtedness. There exists a breadth of empirical studies on the effects of government debt (and other variables) on sovereign bond spreads; for an extensive overview, see Haugh et al. (2009). Estimated coefficients similar to \( \chi_g \) vary considerably across (and within) studies, although its sign is usually found to be positive, as is consistent with theory. For our numerical analysis, we choose \( \chi_g \) to be 0.08 for the case when demand for bonds is elastic, which is in line with estimates based on European data from De Grauwe and Ji (2012), and implies that a 1\% increase in the government debt ratio raises the risk premium by 8 basis points. However, we also experiment with alternative values to test for robustness and show that our results hold, even if \( \chi_g \) is set closer to zero.

### 2.2 Requirements for equilibrium stability and uniqueness

In this section, we discuss the fiscal and monetary policy requirements for long-run debt sustainability and price level determinacy. We start by reducing a linearised version of the model presented in the previous section to a manageable system of four equations. This allows us to derive analytical expressions for the stability and uniqueness requirements imposed on the parameters \( \gamma_b \) and \( \alpha_\pi \). We then discuss these requirements for the case in which the sovereign risk premium is debt-inelastic. This case serves as a benchmark and, as shall be shown, reproduces the results of Leeper. We also explain how the government’s output stabilisation objective, which plays no role in Leeper’s analysis, affects the government’s ability to ensure long-run debt sustainability. Finally,
we discuss how the requirements change when the sovereign risk premium is debt-elastic.

### 2.2.1 Dynamics of the model

The model is linearised around a deterministic steady state, in which prices are fully flexible \((\theta \rightarrow 0)\) and inflation zero \((\pi = 1)\), using a first-order Taylor approximation. Let variables without a \(t\) subscript denote the corresponding steady-state value and define \(\hat{x}_t \equiv (x_t - x) / x\) as the percentage deviation of any generic variable \(x_t\) from its steady state. Using the auxiliary variable \(\hat{\pi}_t = \hat{\pi}_t\), the model can then be reduced to the following 4 \(\times\) 4 system of linear difference equations (see Appendix 2.B for a brief derivation):

\[
\begin{bmatrix}
E_t \hat{\pi}_{t+1} \\
E_t \hat{c}_{t+1} \\
\hat{b}_t \\
\hat{\pi}_t'
\end{bmatrix} =
A_1
\begin{bmatrix}
\hat{\pi}_t \\
\hat{c}_t \\
\hat{b}_{t-1} \\
\hat{\pi}_{t-1}'
\end{bmatrix},
\]

\[(2.12)\]

where

\[
A_0 \equiv \begin{bmatrix}
1 & \sigma & -\chi_g \frac{b}{y} & 0 \\
\beta & 0 & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1
\end{bmatrix}, \quad
A_1 \equiv \begin{bmatrix}
\alpha_\pi & \sigma & 0 & 0 \\
1 & -\Psi & 0 & 0 \\
-\frac{1}{\beta} & -\gamma_c \frac{c}{y} b/y & \frac{1+\chi_g b}{\beta} - \gamma_b & \frac{1}{\beta} \alpha_\pi \\
1 & 0 & 0 & 0
\end{bmatrix},
\]

and where \(\Psi \equiv (1 - \theta) (1 - \theta \beta) / \theta (\varphi c / y + \sigma) > 0\).

The system of endogenous variables described by (2.12) consists of two forward-looking (jump) variables, \(\hat{c}_t\) and \(\hat{\pi}_t\), one pre-determined (state) variable, \(\hat{b}_t\), and an auxiliary variable \(\hat{\pi}_t\). As shown by Blanchard and Kahn (1980), the matrix \(A \equiv A_0^{-1} A_1\) should then contain exactly one stable eigenvalue (i.e. smaller than modulus one) and two unstable eigenvalues (i.e. larger than modulus one) to guarantee a stable and unique equilibrium (the eigenvalue corresponding to \(\hat{\pi}_t\) equals unity by construction). Too many unstable
eigenvalues suggests that the trajectory of government debt is explosive and an equilibrium in which agents are willing to hold government bonds does not exist. If there are too few unstable eigenvalues, it means that the system has infinitely many solutions and admits the possibility of sunspot shocks affecting equilibrium allocations such that the price level sequence is indeterminate.

2.2.2 Reproducing Leeper (1991)

The conditions under which a stable and unique equilibrium can be supported when the sovereign risk premium is debt-inelastic (i.e. when \( \chi_g = 0 \)) are given by the following proposition:

**Proposition 1.** Given \( \chi_g = 0 \), a fiscal rule of the form \( (2.4) \) and a monetary rule of the form \( (2.7) \), sufficient conditions for a stable and unique rational expectations equilibrium are either

\[
\frac{\gamma_b}{\beta} > 1 - \frac{1}{\beta} \quad \text{and} \quad \alpha_\pi > 1, \tag{2.13}
\]

or

\[
\frac{\gamma_b}{\beta} < 1 - \frac{1}{\beta} \quad \text{and} \quad \alpha_\pi < 1. \tag{2.14}
\]

provided that \( \gamma_b < 1/\beta \min(\Psi/\sigma,1) \) and \( \alpha_\pi > 0 \).

**Proof.** See Appendix 2.C. \( \Box \)

The intuition underlying Proposition 1 is discussed next and illustrated by Figure 2.1, which shows the number of unstable eigenvalues of \( A \) as a function of the fiscal and monetary policy stance (which are governed by \( \gamma_b \) and \( \alpha_\pi \)). The vertical dashed line crosses the horizontal axis at \( 1/\beta - 1 \), which is equal to \( r_g - 1 \) under steady state (see Equation [2.11]), and so partitions the parameter space into active and passive fiscal policy. The horizontal dashed line crosses the vertical axis at 1, such that monetary policy is active above the line and passive below. In the dark-grey area, matrix \( A \) has zero unstable eigenvalues, which suggests that expectations are not well-anchored and that the price level is not uniquely determined (‘Indeterminate’). In the two light-grey areas, there are two unstable eigenvalues and so equilibrium is both stable and unique (‘Stable and Unique’). In the white area, there are three unstable eigenvalues,
2.2 Requirements for equilibrium stability and uniqueness

Figure 2.1: The ‘fiscal-monetary dichotomy’

Notes: The figure displays the model’s equilibrium properties as a function of $\gamma_b$ and $\alpha_\pi$ for $\chi_g = 0$.

which means that a combination of fiscal and monetary policy within this region is not feasible (‘Non-Existence’).

As shown by Figure 2.1, there are two regions in which fiscal and monetary policy deliver a stable and unique equilibrium. In the top-right region, fiscal policy is passive, i.e. $\gamma_b > r_g - 1$, while monetary policy is active, i.e. $\alpha_\pi > 1$. To see how this combination of fiscal and monetary policy delivers stable and unique equilibria, consider a positive shock to output. The rise in output leads to an increase in demand for labour, which raises marginal costs and hence inflation. Given the active stance of monetary policy, the central bank responds by raising the nominal interest rate by more than one-for-one with the change in inflation, causing the real interest rate to go up. By the household’s Euler equation (2.11), consumption then falls, which gradually returns output, labour demand and marginal costs back to their respective steady states. Under an active monetary policy stance, the central bank thus successfully pins down expectations and controls inflation. Meanwhile, the higher interest rate drives up public interest expenses, which raises the budget deficit and government debt. Since fiscal policy is passive, the government responds by raising
the primary surplus by enough to offset the rise in interest costs and prevent the stock of debt from ever-accumulating. Passive fiscal policy thus achieves long-run debt sustainability. This regime of passive fiscal and active monetary policy, typically referred to as the ‘Ricardian regime’ (following Woodford, 2001), usually prevails in conventional dynamic macroeconomic models. We therefore refer to the region associated with this policy regime as Ricardian.

When fiscal policy is active and insufficient to prevent explosive debt dynamics, i.e. when \( \gamma_{b} \leq r_{g} - 1 \), condition (2.14) of Proposition 1 suggests that a stable and unique equilibrium can still be achieved if the central bank does not actively target inflation, yet adopts a passive monetary policy, i.e. if \( \alpha_{\pi} \leq 1 \). This result is shown in the lower-left region of Figure 2.1. Under active fiscal policy, changes in the public’s interest expenses are insufficiently offset by the primary surplus and so debt can grow without bounds. To prevent such explosive dynamics, the central bank must allow the price level \( P_{t} \) to jump to whatever level is necessary to keep the real value of outstanding government liabilities consistent with the intertemporal government budget constraint (2.2). This regime of active fiscal and passive monetary policy, which we refer to as non-Ricardian, relates to the ‘Fiscal Theory of the Price Level’ in which the price level is effectively determined by public finances (see Leeper, 1991, Sims, 1994, Woodford, 1996, and Woodford, 2001, among others).

Furthermore, Figure 2.1 shows that, when monetary and fiscal policy are both passive (lower-right region), equilibrium is indeterminate, which indicates that fiscal solvency is obtained for an infinite number of price level sequences. When both policies are active (upper-left region), no equilibrium that supports demand for government bonds exists since the government’s debt consolidation policy is too weak to avoid explosive dynamics and monetary policy does not accommodate nominal debt growth.

The policy requirements for equilibrium stability and uniqueness under the benchmark case are well-known and identical to those obtained by Leeper. However, the results hold two lesser known insights. First of all, equilibrium outcomes depend on the mixture of fiscal and monetary policies, yet not on the relative policy strengths. For instance, as shown by Figure 2.1, a stable and unique equilibrium is obtained under the Ricardian regime as long as fiscal policy is passive and monetary policy active. This result holds, regardless of the ‘passiveness’ of fiscal policy or ‘activeness’ of monetary policy. Policy co-
2.2 Requirements for equilibrium stability and uniqueness

Figure 2.2: Feasible and unfeasible fiscal policies

\[ Fiscal \ response \ to \ output \ (\gamma_y) \]
\[ Fiscal \ response \ to \ outstanding \ public \ debt \ (\gamma_b) \times 10^{-3} \]

Notes: The figure displays the model’s equilibrium properties as a function of \( \gamma_b \) and \( \gamma_y \) for \( \chi_g = 0 \) and \( \alpha_\pi > 1 \).

ordination between the government and central bank can therefore be kept at a minimum and we refer to this near policy independence as the fiscal-monetary dichotomy. Second, note that the parameter \( \gamma_y \), which determines the cyclicality of fiscal policy, does not enter the stability and uniqueness requirements of Proposition 1. Therefore, the government’s systematic response to changes in output, whether it be counter- or pro-cyclical, is irrelevant for the determination of the equilibrium outcome.

The irrelevance of the cyclical stance of fiscal policy for the model’s equilibrium properties is evidenced by Figure 2.2, which shows the number of unstable eigenvalues as a function of \( \gamma_b \) and \( \gamma_y \), while assuming that monetary policy is active. The horizontal dashed line now partitions the parameter space into counter- and pro-cyclical fiscal policy. When \( \alpha_\pi > 1 \), we know that \( \gamma_b > r_g - 1 \) ensures a stable and unique equilibrium. Figure 2.2 shows that this condition holds regardless of the size and sign of \( \gamma_y \). Therefore, as long as fiscal policy is passive, and debt sustainability is ensured in the long run, can policymakers generate deficits over the short run and let automatic stabilisers work fully
to absorb adverse aggregate shocks. In other words, both counter- and pro-
cyclical policies are feasible under the Ricardian regime of passive fiscal and
active monetary policy.

In the following section, we compare the results from the benchmark case to
the case in which the sovereign risk premium rises with the stock of government
debt.

### 2.2.3 Implications of the debt-elastic sovereign risk premium

The policy requirements for equilibrium stability and uniqueness in the pres-
ence of a debt-elastic sovereign risk premium are given by the following pro-
position:

**Proposition 2.** Given a fiscal rule of the form (2.4) and a monetary rule of the
form (2.7), sufficient conditions for a stable and unique rational expectations
equilibrium are either

\[
\gamma_b > \frac{1}{\beta} - 1 + \frac{\chi_g \gamma_y \xi (1 - \beta)}{\Psi (\alpha - 1)} \quad \text{and} \quad \alpha > 1 + \frac{\chi_g \gamma_y \xi (1 - \beta)}{\Psi [\gamma_b - (\frac{1}{\beta} - 1)]}, \tag{2.15}
\]

\[
\gamma_b < \frac{1}{\beta} - 1 + \frac{\chi_g \gamma_y \xi (1 - \beta)}{\Psi (\alpha - 1)} \quad \text{and} \quad \alpha < 1 + \frac{\chi_g \gamma_y \xi (1 - \beta)}{\Psi [\gamma_b - (\frac{1}{\beta} - 1)]}. \tag{2.16}
\]

provided that \(\gamma_b < 1/\beta \min(\Psi/\sigma, 1), \alpha > 0\) and (for \(\chi_g > 0\)) \(\gamma_y < (\sigma/\beta) (b/c)\).

**Proof.** See Appendix 2.C. \(\square\)

First, note that for \(\chi_g = 0\), the requirements stated in Proposition 2 reduce
to those of the benchmark case under Proposition 1. Second, for \(\chi_g > 0\) and
\(\gamma_y \neq 0\), the requirements for fiscal policy depend more strongly on monetary
policy, and vice versa, as the parameters \(\gamma_b\) and \(\alpha\) are now a function of each
other. Third, the parameter \(\gamma_y\) now enters the requirements for both fiscal and
monetary policy, indicating that the cyclical stance of fiscal policy is no longer
irrelevant for equilibrium outcomes.

Underlying the change in the stability and uniqueness requirements is a
crowding-out effect of fiscal policy on consumption that works through the
sovereign risk premium \(\Xi_{g,t}\). Specifically, when the level of government debt
rises, the risk premium goes up by Equation (2.6) which leads to a higher
interest rate $R_{g,t}$. In turn, the higher interest rate induces households to save more and consume less by the Euler equation (2.11). The higher is $\chi_g$, the stronger is the rise in the risk premium for a given increase in government debt, and so the greater is the crowding-out effect on consumption. One could think of the crowding-out effect as reflecting the exposure of the banking sector to sovereign default risk. Widespread empirical evidence shows that, due to this exposure, sovereign risk can have significant adverse effects on private interest rates and credit supply to households and firms when the home sovereign runs high budget deficits (see e.g. Borensztein and Panizza, 2009; Balteanu et al., 2011; Panetta et al., 2013; Bofondi et al., 2013; Demirgüç-Kunt and Huizinga, 2013; Zoli, 2013; Popov and Van Horen, 2013; Albertazzi et al., 2014). The parameter $\chi_g$ then captures the degree of pass-through of sovereign risk to private borrowing conditions. Furthermore, since a reduction in consumption causes output to decline, inflation falls as well. Hence, Ricardian equivalence breaks down and the ability of the central bank to safeguard price stability is more strongly affected by the choice of fiscal policy and the dynamics of government debt, which in turn depend on the cyclical stance of fiscal policy.

When fiscal policy is countercyclical, that is when $\gamma_y > 0$, the budget deficit rises during economic downturns and falls during economic prosperity. Therefore, when a random shock causes output to contract, the stock of government debt and the risk premium rises which, as explained earlier, crowds out consumption and thereby exacerbates the initial contraction in output. Given the countercyclical nature of fiscal policy, the government automatically responds to the decline in output by reducing taxes further, causing government debt and the risk premium to go up even more, resulting in a further decline in consumption, output and inflation, etc. etc. Without an appropriate adjustment in the fiscal policy stance, this vicious cycle of rising levels of government debt and economic decline continues. As agents are forward-looking, an equilibrium that supports the demand for government bonds under these conditions might not exist, even if fiscal policy is passive.

Given the sensitivity of the sovereign risk premium to changes in government indebtedness, the government could avoid the self-reinforcing debt crisis by adopting a more aggressive debt consolidation policy under the Ricardian regime. In fact, according to condition (2.15) of Proposition 2, the higher is $\chi_g$, the greater must be the government’s effort to curtail the level of debt...
back to target, and so the higher must be $\gamma_b$. The higher debt coefficient $\gamma_b$ serves as a signal to holders of government bonds of a commitment by the government to keep a firm grip on public finances. Any surge in government indebtedness would then be met by forceful fiscal contractions to constrain the accumulation of debt and keep the sovereign risk premium at bay.\footnote{Under the non-Ricardian regime, the government’s debt consolidation policy must be relaxed as the sovereign risk premium becomes more responsive to debt changes. Considering that sovereign debt crises typically display more (rather than less) fiscal austerity, we perceive the non-Ricardian regime as less plausible and focus, instead, on the Ricardian regime.}

Note that the required amount of debt consolidation in the presence of a debt-elastic sovereign risk premium depends, not only on $\chi_g$, but also on $\alpha_\pi$. Intuitively, under the Ricardian regime, in which monetary policy is active, the central bank responds to the rise in the sovereign risk premium and consequent fall in inflation by reducing the policy rate $R_t$, which reduces $R_{g,t}$ and raises consumption, and thus partially offsets the crowding-out effect.\footnote{As shown by Attinasi et al. (2011), the European Central Bank’s main refinancing operations have contributed to narrowing sovereign risk premia during the recent financial crisis.} However, the lower is $\alpha_\pi$, the less the rise in the sovereign risk premium will be neutralised. Therefore, equilibrium might be indeterminate if monetary policy is not active enough due to the self-reinforcing effects of the sovereign risk premium on consumption and inflation. Preventing the risk premium from damaging the economy would then require more aggressive debt consolidation by the government. In fact, the weaker is the central bank’s ability to respond to changes in inflation, i.e. the lower is $\alpha_\pi$, the higher must be $\gamma_b$. The stronger interdependence between fiscal and monetary policy as compared to the benchmark case indicates that the fiscal-monetary dichotomy breaks down. Consequently, policy coordination between the government and central bank becomes much more relevant in the context of macroeconomic stabilisation.\footnote{The crowding-out effect of sovereign risk also depends on the degree of price stickiness and the sensitivity of the private sector to interest rate shocks. Intuitively, the greater is the share of firms unable to adjust their price (i.e. the higher is $\theta$), the stronger will be the contraction in output for a given fall in aggregate demand. Hence, sticky prices amplify the adverse effects of sovereign risk. Further, the lower is the coefficient of relative risk aversion (denoted by $\sigma$), the greater is the consumption response to changes in the real interest rate (see [2.11]) and hence the stronger will be the crowding-out effect. Incidentally, these robustness checks (available upon request) confirm that our results do not hinge on log preferences.}

The implications of the debt-elastic sovereign risk premium for the stability
2.2 Requirements for equilibrium stability and uniqueness

Figure 2.3: Equilibrium outcome under debt-elastic risk premia (\(\chi_g > 0\)) and countercyclical fiscal policy (\(\gamma_y > 0\))

\[
\begin{array}{cc}
\text{Active fiscal pol.} & \text{Passive fiscal pol.} \\
\text{Non-Existence} & \text{Stable and Unique (Ricardian)} \\
\text{\(\alpha_\pi = 1\)} & \text{Indeterminate} \\
\gamma_b = r_g - 1 & \gamma_b = r_g - 1 \\
\end{array}
\]

Notes: The figure displays the model’s equilibrium properties as a function of \(\gamma_b\) and \(\alpha_\pi\) for \(\chi_g > 0\).

and uniqueness requirements under countercyclical fiscal policy are visualised by Figure 2.3, which, as Figure 2.1, shows the properties of the model’s steady state as a function of the fiscal and monetary stance. According to the figure, the parameter space that supports a stable and unique equilibrium contracts relative to the benchmark case (as reflected by the reduction of the regions related to the Ricardian and non-Ricardian regimes). On the other hand, the likelihood of obtaining either multiple equilibria or non-existence of equilibrium rises. The dashed lines that separate active from passive fiscal and monetary policies are again included to facilitate comparison with the benchmark case. In contrast to the results from the previous section, a stable and unique equilibrium might not be feasible, even if fiscal policy is passive and monetary policy active. Furthermore, the figure suggests that higher values for \(\chi_g\) result in smaller stability and uniqueness regions.\(^7\)

When fiscal policy is pro-cyclical, that is when \(\gamma_y < 0\), the stability and uniqueness requirements under a debt-elastic sovereign risk premium are re-

\(^7\)Figure 2.6 in Appendix 2.D shows that more positive values for \(\gamma_y\) also contract the stability and uniqueness regions.
Figure 2.4: Equilibrium outcome under debt-elastic risk premia ($\chi_g > 0$) and pro-cyclical fiscal policy ($\gamma_y < 0$)

Notes: See notes under Figure 2.3.

laxed, as compared to the benchmark case, for both fiscal and monetary policy. Particularly, when the primary surplus rises following an adverse shock to output, the stock of government debt falls, which reduces the risk premium and interest rate, and raises consumption, thereby offsetting the initial output contraction. The pro-cyclical nature of fiscal policy thus not only eases the task of sustaining government debt by keeping interest costs low, which makes it possible to obtain a stable equilibrium even if fiscal policy is not passive, it also helps pin down household expectations by essentially substituting for monetary policy, which opens up the possibility for equilibrium uniqueness even if the central bank violates the Taylor-principle.

Figure 2.4 again shows the model’s equilibrium properties as a function of fiscal and monetary policy in the presence of a debt-elastic sovereign risk premium, yet this time assuming that fiscal policy is pro-cyclical. According to the figure, the stability and uniqueness regions now expand, as compared to the benchmark case, whereas the non-existence and indeterminacy regions contract. For a given active monetary policy, it is now possible to obtain a stable and unique equilibrium, even if fiscal policy is also active; stability
2.2 Requirements for equilibrium stability and uniqueness

Figure 2.5: Feasible and unfeasible fiscal policies when $\chi_g > 0$

Notes: The figure displays the model’s equilibrium properties as a function of $\gamma_b$ and $\gamma_y$ for $\chi_g > 0$ and $\alpha_\pi > 1$.

and uniqueness can also be obtained if the government and central bank both pursue passive policies. Furthermore, the figure shows that the size of the stability regions is larger, the greater is $\chi_g$.

Figures 2.3 and 2.4 imply that the cyclical stance of fiscal policy plays a key role in determining the equilibrium outcome when the sovereign risk premium is debt-elastic. Recall that, when the sovereign risk premium is debt-inelastic, agents are always willing to hold government bonds, regardless of the degree of government indebtedness, provided that government debt is sustainable in the long run. The latter merely requires fiscal policy to be passive and therefore allows the government to let automatic stabilisers work fully, pursue countercyclical fiscal policies and run budget deficits from time to time. However, when agents believe the economy is near its fiscal limit, an increase in the budget deficit today raises the probability of breaching the fiscal limit tomorrow. Hence, short-run debt developments are no longer trivial and the government may find it more difficult to run budget deficits without upsetting bond markets. Instead, the government must take immediate action

---

8Figure 2.6 in Appendix 2.D shows that more negative values for $\gamma_y$ also expand the stability and uniqueness regions.
2 Fiscal and monetary policy under sovereign risk premia

and signal its commitment to sustain debt, which it can achieve through either a pro-cyclical stance or more aggressive debt consolidation.

The importance of the government’s attitude towards the business cycle is visualised by Figure 2.5. According to the figure, when monetary policy is active, a passive fiscal stance combined with a countercyclical stance might not be feasible. In fact, the stronger is the countercyclical bent of fiscal policy (i.e. the higher is $\gamma_y$), the greater must be the fiscal contraction following any given rise in government debt in order to ensure the existence of equilibrium (i.e. the higher must be $\gamma_b$). Thus, compared to Figure 2.2 from the benchmark case, the feasible set encompassing countercyclical policies contracts, especially when the bond market is particularly anxious and $\chi_g$ relatively high. On the other hand, the feasible set encompassing pro-cyclical policies expands and a stable equilibrium can be supported, even if fiscal policy is active.

2.3 Concluding remarks

In this chapter, we reviewed the well-established conditions for equilibrium stability and uniqueness from the seminal contribution of Leeper (1991) and showed that these conditions change markedly under debt-elastic sovereign risk premia and depend strongly on the government’s endogenous fiscal response to the business cycle. Whereas in Leeper, short-run debt developments do not change the feasible set of fiscal and monetary policies, we show that they can affect the ability to ensure long-run sustainability when demand for government bonds is highly elastic.

Our results suggest that countercyclical policies could come at great cost in terms of widening interest rate spreads and macroeconomic instability. The results therefore provide an interpretation for why some countries, that run large deficits or face severe financial market constraints, tend to pursue pro-cyclical fiscal policies in order to keep interest rate spreads low, as shown empirically by Gavin and Perotti (1997) and Combes et al. (2014). We show that countercyclical fiscal policies can be feasible, provided they are accompanied by sufficiently aggressive debt consolidation policies and/or active inflation-targeting. Alternatively, maintaining the primary balance well below the maximum (politically or economically) feasible level would allow automatic stabilisers to absorb adverse shocks without immediately provoking sharp interest
While our results point towards the importance of fiscal austerity and monetary accommodation during sovereign debt crises, such policies might not always be feasible (or even desirable). For instance, the scope for fiscal austerity might be limited due to political constraints or because the economy has reached the top of its Laffer curve, whereas monetary expansions are constrained by the zero lower bound. Also, the choice between a fiscal or monetary solution to the crisis may have strong implications for welfare (in terms of both the variability and distribution of income). Therefore, a suitable welfare analysis is needed to reveal the optimal mix of fiscal and monetary policy when risk premia are debt-elastic. We would also like to stress that our model does not allow for policymakers to alter their objectives over time. Augmenting the model with regime-switching possibilities might, however, help reveal how ‘often’ countercyclical policies are permissible and to what extent they contribute to macroeconomic stability. Finally, although our reduced-form specification of the sovereign risk premium is helpful in deriving analytical results, omitting potential non-linear interactions between bond spreads and fiscal fundamentals involves the risk of overlooking important second-order effects (e.g. heightened uncertainty when governments are close to default). Building the sovereign risk premium from micro-foundations would help to account for such effects, yet would most likely merely exaggerate our results. We leave these extensions for future work.

**2.A Optimal demand and price-setting**

A representative final good firm combines differentiated intermediate goods, \( y_t(i) \), purchased from intermediate goods firm \( i \in [0, 1] \), to produce the final good, \( y_t \), using the following production technology:

\[
y_t = \left( \int_0^1 y_t(i)^{\frac{\epsilon}{\epsilon - 1}} di \right)^{\frac{\epsilon - 1}{\epsilon}}, \tag{2.17}
\]

where \( \epsilon > 1 \) measures the elasticity of substitution between intermediate goods. Minimising the costs of assembling \( y_t \), subject to (2.17), results in the optimal
demand schedule for $y_t(i)$ and an expression for the aggregate price index, $P_t$:

$$y_t(i) = \left( \frac{P_t(i)}{P_t} \right)^{-\epsilon} y_t, \quad P_t = \left( \int_0^1 P_t(i)^{1-\epsilon} \, di \right)^{\frac{1}{1-\epsilon}}. \quad (2.18)$$

Intermediate goods firms, which are owned by the households, face the following linear production technology:

$$y_t(i) = n_t(i). \quad (2.19)$$

Subject to (2.19), the firm aims to minimise labour costs, which results in a condition that equates real marginal costs, $mc_t(i)$, to the marginal product of hiring one additional unit of labour:

$$mc_t(i) = w_t. \quad (2.20)$$

Intermediate goods firms set prices with the aim of maximising the discounted sum of current and future profits, conditional on the probability of non-price adjustment (which is governed by $\theta$):

$$E_t \sum_{k=0}^{\infty} \theta^k Q_{t,t+k} \left( \overline{P}_t y_{t,t+k}(i) - W_{t+k} n_{t,t+k}(i) \right),$$

where $\overline{P}_t$ is the optimal re-set price\(^9\) and $Q_{t,t+k} \equiv \beta^k (c_{t+k}/c_t)^{-\sigma} / \pi_{t+k}$ is the $k$-step ahead equilibrium pricing-kernel. Profits are distributed as dividends to the households. Subject to the demand schedule (2.18), the production technology (2.19) and the optimality condition for labour demand (2.20), profit maximisation leads to the following optimal re-set price:

$$\overline{P}_t = M E_t \sum_{k=0}^{\infty} \left( \frac{\theta \beta}{\epsilon} \right)^k P_{t+k}^e c_{t+k}^{-\sigma} y_{t+k} m c_{t+k}. \quad (2.21)$$

According to (2.21), the optimal re-set price is a mark-up $\mathcal{M} \equiv \epsilon / (\epsilon - 1)$ over current and expected real marginal costs. Note that, under flexible prices, $\theta \to 0$ and $\overline{P}_t = P_t$ for all $t$, such that (2.21) collapses to $mc_t = 1/\mathcal{M}$.

\(^9\)Due to symmetry among firms, we can ignore the $i$-index.
2.B Reducing the linearised model

The full model from Section 2.1 in linear form is given by:

\[
\begin{align*}
\sigma \hat{c}_t &= \sigma E_t \hat{c}_{t+1} - \left( \hat{R}_{g,t} - E_t \hat{p}_{t+1} \right), \\
\phi \hat{n}_t &= \hat{w}_t - \sigma \hat{c}_t, \\
\hat{y}_t &= \frac{c}{y} \hat{c}_t, \\
\hat{y}_t &= \hat{n}_t, \\
\hat{\pi}_t &= \beta E_t \hat{\pi}_{t+1} + \kappa \hat{w}_t, \\
\frac{T_y}{y} \hat{T}_t &= \gamma_b - b_{t-1} + \gamma_y \hat{y}_t, \\
\hat{R}_t &= \alpha \hat{\pi}_t, \\
b_t &= \frac{1}{\beta} \left( b_{t-1} + \hat{R}_{g,t-1} - \hat{\pi}_t \right) - \frac{T/y}{b/y} \hat{T}_t, \\
\hat{\xi}_{g,t} &= \beta g b \hat{y}_t, \\
\hat{R}_{g,t} &= \hat{R}_t + \hat{\xi}_{g,t},
\end{align*}
\]

where $\kappa \equiv (1 - \theta) (1 - \theta \beta) / \theta$.

To reduce the model, insert (2.25) and (2.24) into (2.23):

\[
\hat{w}_t = \left( \frac{\phi c}{y} + \sigma \right) \hat{c}_t.
\]

Insert this new expression for $\hat{w}_t$ into the New Keynesian Phillips curve (2.26):

\[
\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} + \kappa \left( \frac{\phi c}{y} + \sigma \right) \hat{c}_t.
\]

Insert (2.31), (2.28) and (2.30) into (2.22):

\[
\sigma \hat{c}_t = \sigma E_t \hat{c}_{t+1} - \left( \alpha \hat{\pi}_t + \frac{b_g}{y} b_t - E_t \hat{p}_{t+1} \right).
\]

Finally, insert (2.31), (2.28), (2.30), (2.24) and (2.27) into (2.29):

\[
b_t = \frac{1}{\beta} \alpha \hat{\pi}_{t-1} - \frac{1}{\beta} \hat{\pi}_t - \gamma_y \frac{c/y}{b/y} \hat{c}_t + \left( \frac{1 + \chi_g b}{\beta} - \gamma_b \right) b_{t-1}.
\]
The reduced system is then given by equations (2.32)-(2.34). Using the auxiliary variable \( \hat{\pi}_t' = \hat{\pi}_t \), we obtain the state-space representation (2.12) from the main text.

### 2.C Proof of Propositions 1 and 2

The 4 \times 4 system of dynamic equations is given by

\[
\begin{bmatrix}
E_t \hat{\pi}_{t+1} \\
E_t \hat{c}_{t+1} \\
\hat{b}_t \\
\hat{\pi}_t'
\end{bmatrix} =
\begin{bmatrix}
\frac{-\Psi}{\sigma} & 0 & \frac{1}{\beta} & 0 \\
\frac{1 + \Psi}{\sigma \beta} - \gamma y c \frac{1}{\beta} y \chi g & \frac{1}{\sigma} \chi g b \frac{1 + \chi g b}{\beta} - \gamma b & \frac{\alpha \pi}{\sigma} - \frac{1}{\sigma \beta} - \frac{1}{\sigma \beta} \chi g b \frac{\alpha \pi}{\beta \sigma} \chi g b \frac{1}{y} \\
-\gamma c & \frac{1 + \chi g b}{\beta} - \gamma b & -\frac{1}{\beta} & \frac{\alpha \pi}{\beta} \\
0 & 0 & 1 & 0
\end{bmatrix}
\begin{bmatrix}
\hat{\pi}_t \\
\hat{c}_t \\
\hat{b}_{t-1} \\
\hat{\pi}_{t-1}'
\end{bmatrix},
\]

where \( \Psi = \kappa (\varphi c / y + \sigma) \). As there is one auxiliary variable, its characteristic polynomial can be written as \( H(\lambda) = \lambda G(\lambda) \) with

\[
G(\lambda) = \lambda^3 - \lambda^2 \left[ 1 + \frac{\Psi}{\sigma \beta} + \left( 1 - \gamma y c \frac{1}{\beta} y \chi g \right) + \left( \frac{1}{\beta} - \gamma b \right) + \frac{1}{\beta} \chi g b \frac{1}{y} + \left( \frac{1}{\beta} - 1 \right) \right] \\
+ \lambda \left( \frac{1}{\beta} - \gamma b \right) \left( 1 + \frac{1}{\beta} + \frac{\Psi}{\sigma \beta} \right) + \frac{1}{\beta} \chi g b \frac{1}{y} \left( 1 + \frac{1}{\beta} \right) + \frac{1}{\beta} \left( 1 - \gamma y c \frac{1}{\beta} y \sigma \chi g \right) + \frac{\Psi}{\beta \sigma} \alpha \pi \right] \\
- \left[ \frac{1}{\beta} - \gamma b \right] \left( \frac{1}{\beta} + \frac{\alpha \pi}{\sigma \beta} \right) + \frac{1}{\beta^2} \chi g b \frac{1}{y}.
\]

Our aim is to derive sufficient conditions such that \( G(\lambda) = 0 \) twice for \( |\lambda| > 1 \) and once for \( |\lambda| < 1 \).

First, note that as \( G(-\infty) = -\infty \) and for \( \gamma b < 1 / \beta \) and \( \alpha \pi > 0 \), \( G(0) < 0 \) and \( dG(\lambda) / d\lambda > 0 \) for \( \lambda < 0 \), \( G(\lambda) < 0 \) for \( \lambda < 0 \). So, the characteristic polynomial has no eigenvalues smaller than zero. As it needs to have one eigenvalue smaller than one, \( G(1) > 0 \), \( G(1) < 0 \) allows only two or zero
2.C Proof of Propositions 1 and 2

eigenvalues smaller than one. $G(1) > 0$ implies

$$\gamma_b > \frac{1}{\beta} - 1 + \frac{\chi_y \gamma y \frac{c}{y} (1 - \beta)}{\Psi(\alpha - 1)} \quad \text{and} \quad \alpha > 1 + \frac{\chi_y \gamma y \frac{c}{y} (1 - \beta)}{\Psi \left(\gamma_b - \left(\frac{1}{\beta} - 1\right)\right)}, \quad (2.35)$$

or

$$\gamma_b < \frac{1}{\beta} - 1 + \frac{\chi_y \gamma y \frac{c}{y} (1 - \beta)}{\Psi(\alpha - 1)} \quad \text{and} \quad \alpha < 1 + \frac{\chi_y \gamma y \frac{c}{y} (1 - \beta)}{\Psi \left(\gamma_b - \left(\frac{1}{\beta} - 1\right)\right)}. \quad (2.36)$$

To rule out three eigenvalues smaller than one, note that $d^2 G(0)/d\lambda^2$ equals the sum of eigenvalues. If it is larger than 3, there can be only one eigenvalue small than one. This implies

$$0 < 2 \left(\frac{1}{\beta} - 1\right) + \chi_y \left[1 \frac{b}{\beta y} - \gamma y 1 \frac{c}{y \sigma}\right] + \left(\frac{\Psi}{\sigma - \gamma b}\right),$$

which holds if $\gamma_b < \Psi / (\sigma \beta)$ and $(\sigma \beta) (b/c) > \gamma y$. This proves the proposition.
2. D Additional graphs

Figure 2.6: Equilibrium outcome under debt-elastic risk premia \((\chi_g > 0)\) and alternative cyclical fiscal stances

**Countercyclical fiscal policy \((\gamma_y > 0)\)**

\[ \alpha_\pi = 1 \]

\[ \gamma_b = r_g - 1 \]

**Pro-cyclical fiscal policy \((\gamma_y < 0)\)**

\[ \gamma_y = -0.5 \quad \text{and} \quad \gamma_y = -1.5 \]
Chapter 3

Government spending shocks, sovereign risk and the exchange rate regime*

"...the currency regime makes a huge difference to the stories we tell about debt."

-Paul Krugman, Mundell-Fleming Lecture 2013

In most of the developed world, fiscal policy has made a comeback as a viable tool for macroeconomic stabilisation. Not surprisingly, the recent literature has spend much effort assessing the efficacy of fiscal policy, particularly emphasising the role of the economic environment. Estimations by Auerbach and Gorodnichenko (2012), Ilzetzki et al. (2012), and Corsetti et al. (2012b) indicate that the effects of discretionary fiscal policy on output, as measured by the fiscal multiplier, depend, among other things, on the exchange rate regime in place and the state of public finances: the multiplier tends to be larger when exchange rates are held fixed and lower in times when public finances are perceived as unsustainable. These environments have thus far been studied separately, yet anecdotal evidence by De Grauwe (2012) suggests that the effects of weak public finances on the transmission of fiscal shocks depend crucially on the exchange rate regime in place. The objective of this chapter

*This chapter is based on Bonam and Lukkezen (2014b).
is to study this interaction. In contrast to conventional wisdom, we find that in the presence of weak public finances the fiscal multiplier is larger under floating exchange rates than under fixed exchange rates.

Standard Keynesian theory predicts that government spending multipliers are larger under fixed exchange rate regimes than under flexible exchange rate regimes, a result which can be traced back to the well-known Mundell-Fleming model. According to this model, an exogenous increase in government spending raises aggregate demand, which drives up the price level. In response, the central bank raises the interest rate in an attempt to stabilise inflation, which in turn leads to an appreciation of the nominal exchange rate and a reduction in net exports, thereby reducing the size of the multiplier. However, under fixed exchange rates, the central bank has to keep the interest rate at par with the interest rate of the anchor-country in order to maintain the peg. A government spending increase would therefore not be followed by an interest rate hike and exchange rate appreciation, allowing for a larger multiplier. Recent theoretical New Keynesian models have been able to confirm these results from the static Mundell-Fleming model (see e.g. Galí and Monacelli, 2008, and Corsetti et al., 2013d).

In most theoretical work on fiscal multipliers, public finances play an auxiliary role. The government is most often assumed to be solvent at all times and concerns regarding government debt sustainability are thus absent. In this chapter, we deviate from such conventions to assess the implications of weak public finances for the size of the fiscal multiplier, under alternative exchange rate regimes. We do so by augmenting an otherwise basic New Keynesian model for a small open economy in two ways. First, we allow for the possibility that the government reneges on its outstanding debt obligations. Following Schabert and van Wijnbergen (2014), we introduce the possibility of sovereign default through the presence of a fiscal limit. This fiscal limit determines the maximum level of debt that the government is willing to service. When public debt is near the fiscal limit, an increase in government spending, or any other form of fiscal expansion, raises sovereign default expectations. In the model, this increase in sovereign risk triggers an outflow of capital by foreign investors in search of safer assets. When the exchange rate is allowed to float, a depreciation of the nominal exchange rate then follows which supports net exports. The presence of sovereign risk therefore alters the traditional fiscal
transmission mechanism and generates an exchange rate effect which increases the multiplier. Under fixed exchange rates, the exchange rate effect is not present as the central bank prevents the exchange rate from moving.

Second, we assume that private borrowing conditions are affected by a worsening of public finances. This assumption captures heightened funding strains in the private sector induced by fiscal stress (for an empirical account of the relationship between sovereign default risk and private credit conditions, see Bruyckere et al., 2013, and references therein). Sovereign risk therefore leads to a higher risk premium on private external debt. We refer to this feature as sovereign risk pass-through, as in Corsetti et al. (2013c). Higher private borrowing costs reduce aggregate domestic expenditures, suggesting that sovereign risk opens up a new crowding-out effect of fiscal policy which reduces the multiplier. Under flexible exchange rates, the crowding-out effect is mitigated through accommodating countercyclical monetary policy. Hence, any reduction in the fiscal multiplier caused by the crowding-out effect is less pronounced under flexible than under fixed exchange rates.

Our model indicates that the exchange rate effect of sovereign risk has a positive impact on the government spending multiplier, yet only under flexible exchange rates, whereas the crowding-out effect has a smaller negative effect on the multiplier under flexible exchange rates than under fixed exchange rates. Therefore, the government spending multiplier can be larger under flexible than fixed exchange rates in the presence of sovereign risk. This result stands in contrast to the conclusions of the traditional Mundell-Fleming model and is the main result of the chapter. We present some stylized statistics that support our claim and test this hypothesis formally for several OECD countries using the two-step regression method suggested by Corsetti et al. (2012b). In the first step of this method, we estimate a simple fiscal rule which accounts for the endogenous components of fiscal policy, such as the fiscal response to the business cycle. The residuals from this estimation are identified as exogenous fiscal policy changes. In the second step, we estimate the effects of these exogenous fiscal policy changes on output and other variables of interest. In the absence of sovereign risk, we find that the output response to a government spending shock is positive and larger in countries that maintain a fixed, rather than flexible, exchange rate. If we condition on weak public finances, we find that the reverse holds: the effect of government spending on output is larger under
flexible than under fixed exchange rates. In line with our theoretical exercise, these empirical results seem to be driven by the response of the exchange rate, which depreciates substantially in the presence of sovereign risk.

Our results indicate that so-called Non-Keynesian effects of fiscal policy can dominate standard Keynesian effects, thereby giving rise to the possibility of expansionary fiscal contractions (Giavazzi and Pagano, 1990). We demonstrate that a reduction in government spending can bring about a positive output response, yet only under fixed exchange rates. Particularly, an improvement of the fiscal balance reduces sovereign risk, thereby lowering the risk premium on private debt which raises aggregate private consumption. The stronger is the effect of fiscal policy on private credit conditions, the more likely it is that a fiscal contraction is expansionary. Fiscal contractions are, however, unlikely to be expansionary under flexible exchange rates due to an appreciation of the exchange rate, following the improvement of public finances, and the associated decline in net exports.

The remainder of this chapter is structured as follows. In Section 3.1, we extend a basic New Keynesian small open economy model with sovereign risk and sovereign risk pass-through. In Section 3.2, a reduced version of the model explains how the exchange rate and crowding-out effects of sovereign risk alter the traditional Keynesian fiscal transmission mechanism. We explore these effects further using impulse responses generated by the full model in Section 3.3, and confront our theoretical findings with the data in Section 3.4. The possibility of expansionary effects of fiscal contractions in times of sovereign risk is examined in Section 3.5. Finally, Section 3.6 concludes.

### 3.1 A small open economy model

Our model extends the New Keynesian small open economy model of Galí and Monacelli (2008) by introducing risky government bonds along the lines of Schabert and van Wijnbergen (2014), and by allowing for spillovers from sovereign risk to private credit conditions.

The model contains a continuum of small countries that interact on international goods and asset markets. We focus on one country, named ‘Home’, whose small size implies the domestic economy does not exert a significant influence on the economies of the other countries, which we lump together...
under the heading ‘Foreign’. All Foreign variables are denoted with a ‘*’ superscript and the subscripts $H$ and $F$ indicate Home and Foreign demand for a particular good or asset.

The private sector in the Home country consists of optimising households and firms. Households consume domestic and foreign goods, supply labour to firms and invest in internationally traded government and foreign bonds. Monopolistic distortions are introduced to allow for producer price rigidities as in Calvo (1983). Furthermore, there is a public sector consisting of a fiscal authority (or ‘government’) and a monetary authority (‘central bank’) who act independently from each other. Government spending is financed by lump-sum taxes and government bonds. Monetary policy either targets inflation (under a flexible exchange rate regime) or pegs the exchange rate (under a fixed exchange rate regime).

### 3.1.1 The public sector and sovereign risk

The first key feature of the model is the possibility that the government reneges on its outstanding debt obligations. Following Corsetti et al. (2013c) and Schabert and van Wijnbergen (2014), among others, we assume that the economy faces a fiscal limit which represents the maximum level of debt the government is able or willing to repay, and beyond which sovereign default ensues. Consequently, sovereign default expectations become a function of fiscal policy, a property which we refer to as sovereign risk. We make the simplifying assumption that the fiscal limit is determined exogenously. When examining the transition of the economy towards its fiscal limit, an endogenous fiscal limit might be necessary (e.g. Davig et al., 2010), yet this is not the purpose of this chapter.

In modelling sovereign default, we follow Schabert and van Wijnbergen (2014) and assume that the fiscal limit, say $B$, is driven by unobservable political sentiments and unknown ex-ante to all agents. However, agents do know the distribution from which the fiscal limit is drawn, which occurs upon maturity of the sovereign bond contract. If it so happens that total real government debt outstanding exceeds the fiscal limit, the government fully defaults; otherwise, debt is fully repaid. Let $B_t$ denote the total amount of nominal one-period government bonds issued at the beginning of period $t$, $R_t$ the gross nominal
interest rate on government bonds, and define \( r_t \equiv R_t (P_t / P_{t+1}) \) as the gross real interest rate, with \( P_t \) the consumer price index (CPI), and \( b_t \equiv B_t / P_t \) as the real value of government debt. The ex-post default indicator, \( \Delta_t \), is then defined as
\[
\Delta_t = \begin{cases} 
0 & \text{if } r_{t-1} b_{t-1} \leq \mathcal{B} \\
1 & \text{otherwise}
\end{cases}.
\] (3.1)

Since all agents know that the decision to default is governed by (3.1), and since they are familiar with the distribution of \( \mathcal{B} \), they base their decisions on the ex-ante probability \( \delta_t \in [0, 1) \) that the real debt burden exceeds the fiscal limit, which is given by
\[
\delta_t = E_{t-1} \Delta_t = \int_{0}^{r_{t-1} b_{t-1}} h(\mathcal{B}) \, d\mathcal{B} = \mathcal{H}(r_{t-1} b_{t-1}),
\]
where \( E_t \) is the expectations operator conditional on the information available at \( t \), \( h(\mathcal{B}) \) is the probability density function of the fiscal limit and \( \mathcal{H}(r_{t-1} b_{t-1}) \) the associated distribution function. Figure 3.1 plots a representation of \( h(\mathcal{B}) \) and highlights \( \delta_t \) as the probability that \( \mathcal{B} \) is drawn from the shaded area.

For the local analysis of the model, we make use of the default elasticity which indicates by how much the default probability changes for a given change in \( r_{t-1} b_{t-1} \). Following Schabert and van Wijnbergen, we define the default elasticity as \( \Phi \equiv \delta' rb / (1 - \delta) \), where \( rb \) and \( \delta \) denote the steady-state values of the real public debt burden and the default probability, respectively.

The rest of the government sector is straightforward. Real government spending \( g_t \) is financed by government bonds and real lump-sum taxes \( T_t \). Changes in real public debt then arise due to differences in public debt outstanding (ex-post default) and the primary budget surplus, i.e.
\[
b_t = (1 - \Delta_t) r_{t-1} b_{t-1} - \frac{P_{H,t}}{P_t} (T_t - g_t),
\] (3.2)
where \( P_{H,t} \) denotes the domestic aggregate price level. Government consumption is determined exogenously by the following AR(1) process:
\[
\frac{g_t}{g} = \left( \frac{g_{t-1}}{g} \right)^{\rho_g} \varepsilon_{g,t},
\] (3.3)
3.1 A small open economy model

Figure 3.1: Distribution of the fiscal limit and the determination of the default probability

Notes: \( h(B) \) is the probability distribution function of the fiscal limit \( B \) and \( r_{t-1}b_{t-1} \) denotes real gross government debt outstanding. In the grey area, the real debt burden exceeds the fiscal limit and thus sovereign default follows. The sovereign default probability \( \delta_t \) is given by the surface of the grey area. Finally, \( \delta_t' \) is the derivative of \( \delta_t \) with respect to \( r_{t-1}b_{t-1} \).

where \( g \) is the level of real steady-state government consumption, \( \rho_g \in [0, 1) \) the autocorrelation coefficient and \( \varepsilon_{g,t} \sim N(0, \sigma_g) \) a random i.i.d. government spending shock. We assume public consumption falls entirely on domestically produced goods, reflecting the high degree of home bias in public spending in advanced economies.

Furthermore, we assume that the government follows a tax rule of the form

\[
\frac{T_t}{T} = \left( \frac{b_{t-1}}{b} \right)^{\gamma_b},
\]

where \( T \) denotes steady-state taxes, chosen to ensure that steady-state real public debt \( b \) is positive, and where \( \gamma_b > 0 \) is set sufficiently large so as to prevent explosive debt developments.

Monetary policy is fully credible and dictated by the prevailing exchange rate regime. We consider two regimes: a flexible and a fixed exchange rate regime. Under flexible exchange rates, the central bank aims to stabilise CPI inflation \( \pi_t \equiv \pi_t / P_{t-1} \) by setting \( R_t \) through open market operations according
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3.1 Households and sovereign risk pass-through

The second key feature of the model is that private borrowing conditions are affected by a worsening of public finances. There are several channels through which this feature, which we refer to as sovereign risk pass-through, might work. First, an increase in sovereign risk deteriorates the balance sheets of financial institutions who hold significant amounts of domestic government bonds. This raises the borrowing costs of these institutions and of their clients (i.e. households and firms). Recent empirical studies have identified this channel during the euro area debt crisis. Second, sovereign risk may also adversely affect private borrowing conditions when the government is forced to increase taxes significantly, appropriate private property or even trigger a currency crisis; any

1Here, we adopt a forward-looking interest rate rule for the central bank for analytical convenience. However, using the more familiar contemporary rule, in which the central bank targets \( \pi_t \) rather than \( E_t \pi_{t+1} \), would not alter our main results in any significant way.

2Demirgüç-Kunt and Huizinga (2013) report a reduction in bank’s market-to-book value (and an increase in bank credit default swap (CDS) spreads) in countries running large public deficits. Furthermore, Harjes (2011) and Acharya et al. (2014) show that sovereign credit costs were closely related to private funding costs.
3.1 A small open economy model

such circumstances would make it more difficult for private borrowers to meet their debt payments, prompting lenders to demand a higher risk premium on private debt.3

We implement sovereign risk pass-through as follows. Households borrow an amount $F^*_t$ denominated in foreign currency from international investors. Following Turnovsky (1985), the household pays a private risk premium, denoted by $\Xi^*_{h,t}$, on top of the foreign gross nominal interest rate, $R^*_t$. We assume that the private risk premium is monotonically increasing in the degree of household indebtedness and the expected loss due to sovereign default, i.e. $\delta_t b_{F,t}$, where $b_{F,t} \equiv B_{F,t}/P_t$, incurred by Foreign investors. We work with the following reduced form expression of $\Xi^*_{h,t}$:

$$
\Xi^*_{h,t} = \exp \left( \chi_{h,1} \frac{q_t f^*_t}{y} \right) \exp \left( \chi_{h,2} \delta_t b_{F,t} \right),
$$

(3.7)

where $f^*_t \equiv F^*_t/P^*_t$ denotes the total real amount of household debt, $q_t \equiv e_t P^*_t/P_t$ the real exchange rate and $y$ is the steady-state level of aggregate domestic output. This reduced form expression of the private risk premium is similar to the ‘sovereign risk channel’ of Corsetti et al. (2013c), who follow Cúrdia and Woodford (2010). Corsetti et al. derive a sovereign risk channel in a closed economy with borrowers and savers. In their paper, the authors assume that a deterioration of public finances, reflected by a rise in the government bond spread, leads to an increase in loan origination costs incurred by financial intermediaries which increases the wedge between deposit and lending rates.

The coefficient $\chi_{h,1} > 0$ measures the elasticity of the risk premium with respect to external liabilities, whereas $\chi_{h,2}$ determines the degree of pass-through from public to private credit risk. As explained by Schmitt-Grohé and Uribe (2003), the non-negativity restriction on $\chi_{h,1}$ is required in small open economy models featuring incomplete asset markets to obtain a stable net foreign asset position. However, no restriction is required for $\chi_{h,2}$, which allows us to isolate the effects of sovereign risk pass-through. In particular, if $\chi_{h,2} = 0$,

\[\text{Durbin and Ng (2005) find that bond spreads of firms in emerging market economies are usually higher than those of their home government. They also find that the reverse holds for firms with substantial earnings abroad, which supports the argument mentioned above, as such earnings cannot be taxed or appropriated by the home government.}\]
the expected loss from sovereign default does not translate into higher private borrowing spreads and the private risk premium depends solely on outstanding private liabilities. However, if $\chi_{h,2} > 0$, an increase in the expected loss from sovereign default raises concerns of foreign lenders about the ability of households to meet debt obligations which requires a compensating rise in the private risk premium.

The rest of the household sector is straightforward. The infinitely lived household chooses consumption, $c_t$, and labour supply, $n_t$, to maximise lifetime utility, given by

$$E_t \sum_{k=0}^{\infty} \beta^k \left( \frac{c_{t+k}^{1-\sigma}}{1-\sigma} - \frac{n_{t+k}^{1+\varphi}}{1+\varphi} \right),$$

with $\beta \in (0,1)$ the household’s discount factor, $1/\sigma > 0$ the intertemporal elasticity of substitution, and $1/\varphi > 0$ the Frisch elasticity of labour supply, subject to an appropriate transversality condition and the following budget constraint:

$$b_{H,t} + c_t + \frac{P_{H,t}}{P_t} T_t + q_t \Xi_{h,t-1} r_{t-1}^* f_{t-1}^* = (1 - \Delta_t) r_{t-1} b_{H,t-1} + q_t f_t^* + w_t n_t + \frac{P_{H,t}}{P_t} \psi_t,$$

where $b_{H,t} \equiv B_{H,t}/P_t$ denotes the real value of domestically held government bonds, $r_t^* \equiv R_t^* \left( P_t^* / P_{t+1}^* \right)$, $w_t$ the real wage rate and $\psi_t$ real dividends from firms. The solution to the household’s problem leads to the following first-order conditions:

$$n_t^\varphi = c_t^{-\sigma} w_t,$$

$$q_t c_t^{-\sigma} = \beta E_t \left[ c_{t+1}^{-\sigma} q_{t+1} \Xi_{h,t}^* r_t^* \right],$$

$$c_t^{-\sigma} = \beta E_t \left[ c_{t+1}^{-\sigma} (1 - \delta_{t+1}) r_t \right].$$

Equation (3.10) describes the household’s optimal intratemporal decision and determines the desired supply of labour by relating the marginal rate of substitution between consumption and leisure to the real wage rate. Equations (3.11) and (3.12) determine the household’s optimal level of external debt and holdings of domestic government bonds, respectively, by relating expected consumption growth to the effective real rate of return corresponding to the two assets. Note that, since $1 = \beta R^* / \pi^*$, the private risk premium is nil in steady
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Given the optimal path for $c_t$, the household then decides upon the allocation between Home and Foreign goods, $c_{H,t}$ and $c_{F,t}$, using a standard constant elasticity of substitution (CES) aggregator. The corresponding optimal demand schedules and the expression for the CPI are derived in Appendix 3.A.1.

Foreign households face similar preferences as Home households (i.e. $\beta^* = \beta$ and $\sigma^* = \sigma$). Furthermore, they may hold government bonds issued by the Home government, $B_{F,t}$, and loans issued by Home households, $F_t^*$. Since the Foreign household can invest in two types of assets, the following no-arbitrage condition must hold:

$$E_t \left( c_{t+1}^* \right)^{-\sigma} \frac{R_t^*}{\pi_{t+1}^*} = E_t \left( c_{t+1}^* \right)^{-\sigma} \left( q_t \frac{q_{t+1}}{q_t} (1 - \delta_{t+1}) \frac{R_t}{\pi_{t+1}} \right).$$

(3.13)

Note that Equation (3.13) is a variant of the uncovered interest parity (UIP) condition.

3.1.3 Completing the model

We complete the model by adding a firm sector and providing the market clearing conditions.

There are two types of firms: monopolistically competitive intermediate goods firms, indexed by $i \in [0, 1]$, and perfectly competitive final goods firms. Nominal rigidities are introduced via staggered price setting of intermediate goods firms, as in Calvo (1983). Intermediate goods firms use a linear, constant returns to scale production technology, in which only labour is allowed to enter as an input factor:

$$y_t(i) = n_t(i).$$

(3.14)

Subject to (3.14), the firm aims to minimise its labour costs, which results in a condition that equates the marginal cost and product of hiring one additional unit of labour:

$$mc_t(i) = \frac{P_t}{F_{H,t}} w_t,$$

(3.15)

where $mc_t(i)$ denotes real marginal costs.

Intermediate goods firms can set prices in excess of marginal cost, yet face
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In every period, only a share, \(1 - \theta \in [0, 1)\), of intermediate goods firms can adjust prices in response to shocks, while others keep prices unchanged. Firms that are able to adjust their price do so with the aim of maximising current and expected future profits. The resulting optimal reset price, \(\bar{P}_{H,t}\), is a mark-up over current and expected real marginal costs (see Appendix 3.A.1 for details).

Final goods firms combine intermediate goods to produce the final good, \(y_t\), using a standard CES production technology. Minimizing costs of assembling \(y_t\) results in the optimal demand schedule for goods produced by intermediate goods firm \(i\), \(y_t(i)\), as well as the aggregate domestic price level, \(P_{H,t}\) (see Appendix 3.A.1). We assume that the Law of One Price holds, such that \(P_{H,t} = e_tP^*_H\) and \(P_{F,t} = e_tP^*_F\). Since Home is a small country, its weight in Foreign’s CPI is negligible and so \(P^*_F = P^*_t\).

In equilibrium, the government bond market clears, which implies

\[ B_t = B_{H,t} + B_{F,t}. \]  

Also, we assume that the relative shares of foreign and domestic bond holdings are constant, i.e.

\[ B_{F,t} = \frac{B_F}{B} B_t. \]  

Goods market clearing implies \(y_t = c_{H,t} + g_{H,t} + c^*_t\). After substituting in the private and public demand schedules derived in Appendix 3.A.1, we obtain

\[ y_t = (1 - \alpha) \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} c_t + g_t + \alpha^* q^* \left( \frac{P_{H,t}}{P_t} \right)^{-\eta^*} c^*_t, \]  

where \(\eta > 0\) denotes the intratemporal elasticity of substitution between Home and Foreign goods, and where \(\alpha \in [0, 1)\) denotes the import share in the basket of household consumption.

Furthermore, labour market clearing implies \(N_t = \int_0^1 N_t(i) di\). Using the production function of the intermediate goods firm, given by (3.14), and the optimal demand schedule of the final good firm, we can write this conditions as

\[ n_t = y_tD_t, \]  

where \(D_t \equiv \int_0^1 \left( P_{H,t}(i)/P_{H,t} \right)^{-\epsilon} \) is a measure of price dispersion.
Finally, the balance of payments condition follows from consolidating the government’s and household’s budget constraints, while substituting for aggregate firm profits, $P_{H,t} \psi_t = P_{H,t} y_t - W_t n_t$:

$$\frac{P_{H,t}}{P_t} (y_t - g_t) - c_t = q_t r^{*}_{t-1} \Xi_{h,t-1}^* f^{*}_{t-1} + (1 - \Delta_t) r_{t-1} b_{F,t-1} - (q_t f^{*}_t + b_{F,t}). \quad (3.20)$$

Equation (3.20) shows that national savings must equal net capital outflows. Also, for future use, we derive the following expression for Home net exports, denoted by $nx_t$ (see Appendix 3.A.2):

$$nx_t = \alpha^* \left( \frac{q_t^{\eta-1}}{1 - \alpha} \right) c_t - \alpha q_t^{-\eta} c_t. \quad (3.21)$$

### 3.1.4 Steady state and equilibrium

Given constant private consumption in steady state, i.e. $c_t = c$, Equation (3.12) implies that the steady-state gross real interest rate is determined by $r = 1/\left[ \beta (1 - \delta) \right]$. Also, in steady state, $\theta \to 0$ and $P_{H,t} = P_{H,t}$. Finally, we assume that Foreign and Home prices are the same in steady state, such that $e = q = 1$.

Equilibrium is then given by a sequence of $c_{t+k}, n_{t+k}, y_{t+k}, nx_{t+k}, w_{t+k}, b_{t+k}, b_{H,t+k}, b_{F,t+k}, f^{*}_{t+k}, \pi_{t+k}, \pi_{H,t+k}, q_{t+k}, e_{t+k}, R_{t+k}, \Xi^{*}_{h,t+k}, \delta_{t+k}$ and $T_{t+k}$ that satisfies the public’s budget constraint (3.2), the default scheme (3.1), an exogenous sequence for government spending (3.3), the fiscal policy rule (3.4), the monetary policy rule (3.5) or (3.6), the household’s budget constraint (3.9), and first-order conditions (3.10), (3.11) and (3.12), the private risk premium function (3.7), the UIP condition (3.13), the price indices and producer price-setting decision in Appendix 3.A, and the market clearing conditions (3.16), (3.17), (3.18), (3.19) and (3.20), given sequences for $B, c^{*}_{t+k}, R^{*}_{t+k}$ and $\pi^{*}_{t+k}$, for all $k \geq 0$.

### 3.2 Exploring the mechanism

The presence of the fiscal limit in the New Keynesian model alters the fiscal transmission mechanism in two important ways. First of all, the response of the exchange rate to a government spending shock changes under sovereign
risk, which affects the response of net exports. This implication of sovereign risk is referred to as the exchange rate effect. Second, the presence of sovereign risk pass-through generates a new crowding-out effect on aggregate private consumption. We shall explain these two effects separately in the following two sub-sections using a reduced version of the model presented in the previous section. Subsequently, in Section 3.3, we show the implications of sovereign risk as implied by the full-fledged model.

All results originate from a linear approximation around the deterministic steady state, which is derived in Appendix 3.B. In what follows, variables with a hat express the percentage deviation of that variable from its steady-state level, while variables without a time-index denote the steady-state level of the corresponding variable, such that $\hat{x}_t = (x_t - x) / x$, for any generic variable $x_t$. For simplicity, we assume that Foreign consumption, inflation and the nominal interest rate remain constant, i.e. $c^*_t = c^*$, $\pi^*_t = \pi^*$ and $R^*_t = R^*$ for all $t$.

### 3.2.1 The exchange rate effect of sovereign risk

We start by explaining the exchange rate effect, for which we make two simplifying assumptions. First, we assume full international risk sharing, which implies $\hat{q}_t = \sigma \hat{c}_t$. Full international risk sharing eliminates the effects of sovereign risk on private borrowing conditions, which allows us to ignore the crowding-out effect for now. Second, bond holdings in equilibrium are assumed as follows: all government bonds are held by foreigners (such that $b_H = 0$) and net private bond holdings are zero ($f^* = 0$). The assumptions on bond holdings facilitate notation and have no qualitative effects.

Using these assumptions, only three linearised equations subject to sovereign risk remain: the UIP condition, the balance of payments equation and the government budget constraint, i.e.
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\[ \hat{q}_t = E_t \hat{q}_{t+1} - (1 - \Phi) \left( \hat{R}_t - E_t \hat{\pi}_{t+1} \right) + \Phi \hat{b}_t, \]  
(3.22)

\[ \hat{b}_t = \left( \frac{1 - \Phi}{\beta} \right) \left( \hat{R}_{t-1} - \hat{\pi}_t + \hat{b}_{t-1} \right) + \left( \frac{b}{Y} \right)^{-1} \left[ \left( \frac{\alpha}{1 - \alpha} + \frac{1}{\sigma y} \right) \hat{q}_t - \hat{y}_t + \frac{g}{y} \hat{g}_t \right], \]  
(3.23)

\[ \hat{b}_t = \left( \frac{1 - \Phi}{\beta} \right) \left( \hat{R}_{t-1} - \hat{\pi}_t + \hat{b}_{t-1} \right) - \gamma b \frac{T}{b} \hat{b}_{t-1} + \frac{g}{b} \hat{g}_t. \]  
(3.24)

Under a fixed exchange rate regime, a government spending shock is met by a counteracting monetary response of the central bank in order to prevent movements in the nominal exchange rate. In particular, when government spending rises, the public’s budget deficit rises as well, which pushes the stock of government debt towards the fiscal limit. The subsequent increase in sovereign risk reduces the real effective return on government bonds, which creates tensions on international capital markets. In order to prevent an outflow of capital and a change in the exchange rate, the central bank then intervenes by fully offsetting the effects of sovereign risk through an appropriate adjustment in the policy rate. By maintaining a constant return on government bonds, the central bank prevents changes in cross-border capital flows, which implies a constant nominal exchange rate. Hence, sovereign risk does not affect the traditional fiscal transmission mechanism under a fixed exchange rate regime (and without sovereign risk pass-through). To see this more clearly, note that a fixed nominal exchange rate implies \( \hat{e}_t = 0 \) and therefore \( E_t \hat{q}_{t+1} - \hat{q}_t = -E_t \hat{\pi}_{t+1} \).

The following new interest rate rule then follows from the UIP condition (3.22):

\[ \hat{R}_t = \frac{\Phi}{1 - \Phi} \left( \hat{b}_t - E_t \hat{\pi}_{t+1} \right). \]

Using this rule to substitute out \( \hat{R}_t \) from (3.23) and (3.24) eliminates the sovereign default elasticity \( \Phi \) from the model.\(^4\)

\(^4\)Under fixed exchange rates, the effects of sovereign risk can be eliminated in the full-fledged model as well, provided that sovereign risk pass-through is ruled out. This can be shown as follows: for \( \hat{e}_t = e \) for all \( t \), the UIP condition (3.13) becomes \( (1 - E_t \delta_{t+1}) r_t = r_t^* \). Using this expression to substitute for \( R_t \) in the public’s budget constraint (3.2), the household’s Euler equation (3.12), and the balance of payments condition (3.20), the sovereign default probability, \( \delta_t \), can be eliminated from the model.
Sovereign risk does enter the model under a flexible exchange rate regime, because the central bank targets inflation, rather than the exchange rate, and therefore does not fully neutralise the impact of sovereign risk on the exchange rate. To assess the implications of sovereign risk for the transmission of fiscal shocks under a regime of flexible exchange rates, we use a simple IS-BOP model as in Bouakez and Eyquem (2015). For convenience, we assume that the policy rate moves one-for-one with expected inflation, i.e. $\hat{R}_t = E_t\hat{\pi}_{t+1}$, which corresponds to setting $\alpha_\pi = 1$ and $\rho_R = 0$ in Equation (3.5). The IS and BOP curves are then given by

$$\hat{y}_t = \Psi_1\hat{q}_t + \frac{g}{y}\hat{q}_t, \quad (3.25)$$

$$\hat{y}_t = b\left(1 - \frac{\Phi}{\beta}\right)\hat{b}_{t-1} + \Psi_2\hat{q}_t + \left(\Phi\Psi_3 + \frac{g}{y}\right)\hat{q}_t, \quad (3.26)$$

where $\Psi_1 > 0$, $\Psi_2 < \Psi_1$ and $\Psi_3 > 0$ are derived in Appendix 3.C. Figure 3.2 gives a graphical representation of the IS and BOP curves. The IS curve is upward sloping and shifts to the right upon a government spending shock. The BOP curve is downward sloping for most parameter choices (and if it is upward sloping, it will be less steep than the IS curve) and also shifts to the right upon a government spending shock.

In equilibrium, the two curves cross at point A, where $\hat{q}_t = \hat{y}_t = 0$. An increase in government spending then yields a new equilibrium with a higher level of output, as indicated by point B. On the vertical axis, point B is located at $\Phi\Psi_3 / (\Psi_1 - \Psi_2)$ and hence the real exchange rate rises, i.e. depreciates, upon a government spending shock. In the absence of sovereign risk, $\Phi = 0$ and so the real exchange rate remains constant.

According to Figure 3.2, a rise in government spending is followed by a depreciation of the exchange rate, which stands in contrast to the traditional Mundell-Fleming model. To understand why, note that an increase in government spending raises the budget deficit and thereby the stock of public debt. In times of sovereign default risk, the rise in public debt generates concerns regarding fiscal insolvency, making sovereign bonds a more risky asset. Foreign investors respond by reducing their demand for bonds, while increasing their demand for Foreign (and relatively safer) assets. The ensuing capital outflow then necessitates an exchange rate depreciation in order to restore equilibrium.
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Figure 3.2: The effects of a positive government spending shock under sovereign risk and flexible exchange rates

in the balance of payments. We refer to this effect as the ‘exchange rate effect’ of sovereign risk.

The exchange rate effect tends to increase the size of the government spending multiplier through a depreciation of the real exchange rate and an increase in net exports (see Equation [3.21]). This result stands in contrast to the Mundell-Fleming model which predicts an appreciation of the real exchange rate and a fall in net exports upon an increase in government spending. Under fixed exchange rates, the effects of sovereign risk are completely offset by the central bank and the exchange rate effect is not present, suggesting that the effects of government spending on output can be larger under flexible than fixed exchange rates. In the next section, we explore this possibility further by examining the effect of sovereign risk pass-through.

3.2.2 The crowding-out effect of sovereign risk

Here, we assess the impact of a government spending shock when private borrowing conditions are affected by a worsening of public finances. To facilitate interpretation, we shut down the exchange rate effect described earlier and focus on a shock in the private risk premium without portfolio adjustment effects (i.e. \( \hat{b}_t = 0 \)). For simplicity, we assume the private risk premium evolves

\[ \text{Equation [3.21]} \]

These results are closely related to Bouakez and Eyquem (2015), who show that an increase in government spending raises the real exchange rate due to an increase in the risk premium on household external liabilities.
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according to \( \hat{\xi}_{h,t} = \rho \hat{\xi}_{h,t-1} + \varepsilon_{\xi,t} \), with \( \rho \in (0,1) \) and \( \varepsilon_{\xi,t} \sim N(0, \sigma_{\xi}) \) a random i.i.d. risk premium shock (we can therefore ignore \( \Phi \)). Finally, since the exchange rate effect is absent also in an economy without foreign trade, we set \( \alpha = \alpha^* = 0 \). Given these assumptions, the dynamic equations of the model become

\[
\begin{align*}
\sigma \hat{c}_t &= \sigma E_t \hat{c}_{t+1} - (1 - \Phi) \left( \hat{R}_t - E_t \hat{\pi}_{t+1} \right), \quad (3.27) \\
\hat{\pi}_t &= \beta E_t \hat{\pi}_{t+1} + \Omega \hat{c}_t, \quad (3.28)
\end{align*}
\]

where \( \Omega = (1 - \theta) (1 - \theta \beta) / \theta (\varphi c/y + \sigma) \). \( \hat{R}_t \), which is now the interest rate against which households can borrow, equals the policy rate plus the risk premium, i.e. \( \alpha \pi E_t \hat{\pi}_{t+1} + \hat{\xi}^*_{h,t} \), with \( \alpha \pi = 0 \) under fixed exchange rates and \( \alpha \pi > 0 \) under flexible exchange rates.

Solving the system of (3.27)-(3.28) using the method of undetermined coefficients yields the following solution for consumption:

\[
\hat{c}_t = - \frac{1}{\sigma \left( \frac{1 - \rho_{\xi}}{1 - \Phi} \right) + \rho \xi (\alpha \pi - 1) \left( \frac{\Omega}{1 - \rho \xi \beta} \right)} \hat{\xi}^*_{h,t}. \quad (3.29)
\]

Since \( \sigma (1 - \rho_{\xi}) - \rho \xi \Omega / (1 - \rho \xi \beta) > 0 \), an increase in the risk premium reduces household consumption. We call this effect the ‘crowding-out effect’ of sovereign risk.

Note that the crowding-out effect is smaller under a flexible exchange rate regime, as the central bank sets \( \alpha \pi > 0 \) which raises the denominator in (3.29). Specifically, under flexible exchange rates, the central bank responds to any reduction in inflation that might arise following a drop in consumption by lowering \( \hat{R}_t \), which partially offsets the adverse effects of the rise in \( \hat{\xi}^*_{h,t} \). In contrast, under fixed exchange rates, the central bank is unable to counteract any change in \( \hat{\xi}^*_{h,t} \), since it needs to maintain \( \alpha \pi = 0 \). Hence, when a rise in government spending leads to sovereign default expectations, the associated crowding-out effects reduce the size of the fiscal multiplier, yet the reduction is generally less pronounced under flexible exchange rates.

The analytical results from the reduced version of the model presented in this section indicate that sovereign risk gives rise to two counteracting effects that alter the traditional Keynesian transmission mechanism of fiscal policy: an exchange rate effect, which raises the government spending multiplier due
3.3 The effects of government spending shocks

to a positive effect on net exports through the exchange rate, and a crowding-out effect, which reduces the multiplier due to adverse effects on household consumption through the private risk premium. The former arises only under a flexible exchange rate regime and the latter arises under both regimes, yet is less pronounced under flexible exchange rates. The latter suggests that the multiplier can be higher under floating than under fixed exchange rates. In the next section, we provide numerical simulations using the full-fledged linearised model.

3.3 The effects of government spending shocks

The full version of the model shows how the exchange rate effect and the crowding-out effect of sovereign risk behave and interact without the limiting assumptions made in the previous section. After calibrating the model, we discuss the effects of a government spending shock on the economy in the absence of sovereign risk. This exercise allows us to reconcile our results with conventional Keynesian predictions about the effects of fiscal policy and is used as a benchmark. We then proceed by showing how the results change in the presence of sovereign risk (Section 3.3.3) and when sovereign risk passes through to the private sector (Section 3.3.4).

3.3.1 Calibration

We calibrate the model on a quarterly frequency. For an overview of the parameterisation, see Table 3.1. The parameters $\sigma$, $\varphi$, $\beta$, $\eta$ and $\theta$ are assigned values most commonly found in the literature, since their iterations have no qualitative effects on our results. In what follows, we elaborate on the calibration of those parameters that can be expected to influence our main results and the equilibrium properties of the linearised model.

The essential parameters for the strength of the exchange rate effect are $\eta^*$, which measures Foreign’s elasticity of substitution between consumption on Home and Foreign goods, and $\alpha$, which measures Home’s import share and thus reflects the degree of country openness. As a benchmark, we set $\eta^* = 1.25$ and $\alpha = 0.6$ (the latter corresponds to the average import-to-consumption ratio of OECD countries). We shall experiment with alternative values for $\eta^*$ and
### Table 3.1: Benchmark calibration

<table>
<thead>
<tr>
<th>Preference and production parameters</th>
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<th></th>
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<tbody>
<tr>
<td>$1/\sigma$</td>
<td>Intertemporal elasticity of substitution</td>
<td>1</td>
</tr>
<tr>
<td>$1/\varphi$</td>
<td>Frisch elasticity of labour supply</td>
<td>1</td>
</tr>
<tr>
<td>$\beta$</td>
<td>Subjective discount factor</td>
<td>0.99</td>
</tr>
<tr>
<td>$\eta, \eta^*$</td>
<td>Elasticity of substitution between Foreign and Home goods</td>
<td>1.25</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Country openness</td>
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</tr>
<tr>
<td>$\alpha^*$</td>
<td>Foreign’s openness with respect to Home</td>
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</tr>
<tr>
<td>$\theta$</td>
<td>Probability of non-price adjustment</td>
<td>0.85</td>
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<th>Steady states</th>
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<tr>
<td>$g/y$</td>
<td>Government consumption as a share of output</td>
<td>0.2</td>
</tr>
<tr>
<td>$c/y$</td>
<td>Household consumption as a share of output</td>
<td>0.79</td>
</tr>
<tr>
<td>$nx/y$</td>
<td>Home net exports as a share of output</td>
<td>0.01</td>
</tr>
<tr>
<td>$b/y$</td>
<td>Real government debt as a share of output (annualised)</td>
<td>0.6</td>
</tr>
<tr>
<td>$b_F/y$</td>
<td>Real government debt held by Foreign as a share of output (annualised)</td>
<td>0.3</td>
</tr>
<tr>
<td>$f^*/y$</td>
<td>Real household external debt as a share of output (annualised)</td>
<td>0.6</td>
</tr>
<tr>
<td>$T/y$</td>
<td>Taxes as a share of output</td>
<td>0.2</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Policy parameters</th>
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<tbody>
<tr>
<td>$\alpha_\pi$</td>
<td>Monetary policy rule coefficient</td>
<td>1.5</td>
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<tr>
<td>$\rho_R$</td>
<td>Policy interest rate smoothing parameter</td>
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<tr>
<td>$\gamma_b$</td>
<td>Fiscal policy rule coefficient</td>
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<tr>
<td>$\rho_g$</td>
<td>Persistence in government spending shocks</td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sovereign risk and capital market imperfection</th>
<th></th>
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<tbody>
<tr>
<td>$\delta$</td>
<td>Sovereign default probability</td>
<td>0.0025</td>
</tr>
<tr>
<td>$\Phi$</td>
<td>Sovereign default elasticity</td>
<td>0.03</td>
</tr>
<tr>
<td>$\chi_{h,1}$</td>
<td>Risk premium elasticity w.r.t. household net foreign debt</td>
<td>0.0017</td>
</tr>
<tr>
<td>$\chi_{h,2}$</td>
<td>Degree of sovereign risk pass-through</td>
<td>0.17</td>
</tr>
</tbody>
</table>
3.3 The effects of government spending shocks

α in order to highlight the transmission mechanism of fiscal policy.

The steady-state parameters are set to match long-run averages from OECD countries. Specifically, we set the annual steady-state public and private debt-to-output ratio’s equal to 0.6, the share of government debt held by Foreign investors to 50% (in line with Andritzky, 2012) and \( g/y = 0.2 \). We set \( \alpha^* = 0.01 \) to reflect the small size of the Home country and obtain the share of household consumption in steady state output by the balance of payments condition (3.20) as \( c/y = 0.79 \). The public’s budget constraint (3.2) implies a steady-state tax-to-output ratio of \( T/y = 0.2 \). Further, using the goods market clearing condition (3.18) to calculate \( c^*/y = 48 \), we obtain a net exports ratio of around 0.01 (which is around the long-run average in the euro area).

Regarding the policy parameters, we set \( \alpha_\pi = 1.5 \) (such that the central bank obeys the Taylor-principle) and \( \rho_R = 0.8 \). The feedback coefficient between taxes and real government debt is set to \( \gamma_b = 0.15 \), roughly in line with estimates of Ballabriga and Martinez-Mongay (2010) for euro area countries and ensuring that the debt level remains bounded (see Bohn, 1998). As in Galí and Gertler (2007), we set the autocorrelation coefficient of government consumption to \( \rho_g = 0.9 \).

The central parameters in our model are those governing sovereign risk, \( \delta \) and \( \Phi \), and capital market imperfections, \( \chi_{h,1} \) and \( \chi_{h,2} \). We assume that, when the level of government debt is near the fiscal limit, the Home economy faces an annual government bond spread of 1%, which implies a steady-state sovereign default probability of \( \delta = 0.0025 \). The default elasticity, \( \Phi \), measures the response of the sovereign default probability to changes in the outstanding stock of real gross public debt. We rely on estimates reported by Cottarelli and Jaramillo (2012), who examine the effects of gross public debt on sovereign CDS spreads for a number of advanced economies. Based on their estimation of \( \delta' \equiv d\delta/d(rb) = 0.01 \), we obtain \( \Phi = 0.03 \). Since estimates of \( \delta' \) differ somewhat across studies (see e.g. Ardagna et al., 2007, and Laubach, 2009), we experiment with alternative values for \( \Phi \) to check for robustness. Furthermore, following Bouakez and Eyquem (2015), who rely on estimates of Lane and Milesi-Ferretti (2002), we set the elasticity of the private risk premium with respect to changes in household net external debt to \( \chi_{h,1} = 0.0017 \). Finally, we assume that sovereign risk pass-through is 20%, which means that a 1% increase in the sovereign default probability raises the private risk premium by
20 basis points. Using Equation (3.7), we obtain $\chi_{h,2} = 0.17$. As in the case of the default elasticity parameter, we check for robustness of our results by varying the degree of sovereign risk pass-through.

### 3.3.2 Benchmark case: no sovereign risk

The responses to an exogenous government spending shock of output, the real exchange rate, net exports and consumption are shown in Figure 3.3, and the responses of the nominal exchange rate, the nominal interest rate, the (effective) real rate of return on government bonds, and the private risk premium are shown in Figure 3.4.\(^6\) The responses without sovereign risk, where $\delta = \Phi = \chi_{h,2} = 0$, are presented in the left column of both figures and constitute as our benchmark. We find that an increase in government spending has a positive effect on output under both flexible and fixed exchange rates, yet, in line with the conclusions of the Mundell-Fleming model, the output response is larger under fixed exchange rates.

Driving these results are the responses of the exchange rate, net exports and consumption. Particularly, the rise in government spending raises CPI inflation, which, under flexible exchange rates, induces the central bank to raise the nominal interest rate. The higher interest rate leads to an appreciation (i.e. fall) of both the nominal and real exchange rate, which has an adverse effect on net exports. When the nominal exchange rate is held constant, however, the rise in CPI inflation is followed by a more gradual appreciation of the real exchange rate and a smaller reduction in net exports.

The consumption response is determined by substitution and income effects, which go in opposite directions. The appreciation of the real exchange rate following the fiscal expansion causes foreign goods to be relatively cheaper, thereby prompting households to raise consumption on foreign goods. Further, the rise in inflation reduces the real interest rate, yet only under fixed exchange rates, causing households to intertemporally substitute current for future consumption. These two substitution effects both tend to raise consumption. On the other hand, the increase in government spending induces a negative wealth effect through an increase in expected future taxes, which reduces consumption. As the response of consumption is positive, the substitution effects

---

\(^6\)The responses of the remaining variables are available upon request.
3.3 The effects of government spending shocks

Figure 3.3: Effects of a positive government spending shock

No sovereign risk

Output

Real exchange rate

Net exports

Consumption

Sovereign risk

Output

Real exchange rate

Net exports

Consumption

Sovereign risk pass-through

Output

Real exchange rate

Net exports

Consumption

Notes: Figures show the impulse responses upon an exogenous increase in government spending from steady state of 1% of output.
Figure 3.4: Effects of a positive government spending shock

**No sovereign risk**

- **Nominal exchange rate**
- **Policy rate**
- **Effective real return**
- **Risk premium**

**Sovereign risk**

- **Nominal exchange rate**
- **Policy rate**
- **Effective real return**
- **Risk premium**

**Sovereign risk pass-through**

- **Nominal exchange rate**
- **Policy rate**
- **Effective real return**
- **Risk premium**

Notes: See notes under Figure 3.3.
3.3 The effects of government spending shocks

dominate the income effect. And, as the substitution effects are larger under fixed exchange rates, the consumption response is higher under fixed than under flexible exchange rates.

The different responses of net exports and household consumption to the government spending shock across monetary regimes explains why the output response is higher under fixed than under flexible exchange rates. These findings are in line with conventional Keynesian wisdom. Note, however, that the differences in output responses across monetary regimes are smaller than predicted by the traditional Mundell-Fleming model, yet correspond to the theoretical results of Corsetti et al. (2013d) and empirical findings reported by Corsetti et al. (2012b), Ilzetzki et al. (2012) and Born et al. (2013).

3.3.3 Introducing sovereign risk

The middle columns of Figures 3.3 and 3.4 show the effects of a government spending shock when the economy is near its fiscal limit and an increase in government debt raises the sovereign default probability. These figures are generated for \( \delta = 0.0025, \Phi = 0.03 \) and \( \chi_{h,2} = 0 \). As explained in Section 3.2.1, introducing sovereign risk without pass-through does not alter the fiscal policy transmission mechanism under fixed exchange rates, because the central bank raises the policy interest rate to fully offset the effects of changes in sovereign risk. Hence, the effective real rate of return is unchanged and the responses of the other endogenous variables are the same as in the benchmark case.

Under flexible exchange rates, however, the dynamics following a government spending shock differ from the benchmark case due to the exchange rate effect. The output response is higher than in the benchmark case and exceeds the output response under the fixed exchange rate regime. This result is driven by a depreciation of the real exchange rate and the consequent rise in net exports. Particularly, as the fiscal expansion worsens the fiscal position, sovereign default expectations, \( E_t \delta_{t+1} \), rise which reduce the effective real rate of return on government bonds, \( (1 - E_t \delta_{t+1}) r_t \). Consequently, Foreign investors reduce their holdings of bonds, which leads to a depreciation of the exchange rate and, subsequently, a rise in net exports. This result stands in sharp contrast to the traditional Mundell-Fleming model.

The strength of the exchange rate effect is increasing in the parameters
\( \eta^* \), \( \alpha \) and \( \Phi \). In particular, \( \eta^* \) governs the responsiveness of Foreign demand for Home goods to changes in relative international prices. Thus, for a given depreciation of the real exchange rate, net exports will rise by more for higher values of \( \eta^* \). Furthermore, the greater is \( \alpha \), the more open is the economy to foreign trade, and thus the more the production sector benefits from a depreciation of the real exchange rate. In Figure 3.7 of Appendix 3.D, we show that indeed the differences in the output responses between flexible and fixed exchange rates is increasing in both \( \eta^* \) and \( \alpha \) under sovereign risk. Also, if the economy faces a higher sovereign default elasticity, \( \Phi \), a government spending shock exerts a stronger effect on Foreign demand for Home government bonds, and therefore also on the real exchange rate, net exports and output. Figure 3.8 in Appendix 3.D shows that raising \( \Phi \), while keeping the other parameters fixed at their benchmark values, indeed raises the difference in output responses upon a government spending shock between flexible and fixed exchange rates.

Finally, note that the response of consumption under flexible exchange rates is higher in the presence of sovereign risk than in the benchmark case without sovereign risk. This is due to the fall in the effective real rate of return on bonds, which, according to the household’s Euler equation (3.12), induces households to reduce their holdings of government bonds and raise consumption. An increase in sovereign risk therefore has an expansionary effect on consumption, which is rather counter-intuitive. As shown in the next section, this result changes in the presence of sovereign risk pass-through.

### 3.3.4 Introducing sovereign risk pass-through

The right columns of Figures 3.3 and 3.4 present the responses to a government spending shock when sovereign risk leads to an increase in the private risk premium. Here, the private risk premium increases by 20 basis points for every 100 basis points increase in the sovereign default probability. We set \( \chi_{h,2} = 0.17 \) and keep \( \delta = 0.0025 \) and \( \Phi = 0.03 \). Under this assumption, the increase in government spending raises the risk premium, which in turn worsens private borrowing conditions and reduces household consumption. This is the crowding-out effect discussed in Section 3.2.2.

The output response to the government spending shock remains positive under both monetary regimes, despite the crowding-out effect. However, the
difference between the government spending multiplier under flexible and fixed exchange rates is now larger than it was in the absence of sovereign risk pass-through, especially if the sovereign default elasticity $\Phi$ is high (see Figure 3.9 in Appendix 3.D). This is because the negative crowding-out effect is larger under fixed exchange rates than under flexible exchange rates, as explained in Section 3.2.2.

Figure 3.10 in Appendix 3.D shows that a higher degree of sovereign risk pass-through raises the government spending multiplier under flexible exchange rates, indicating that the exchange rate effect dominates. However, the multiplier falls under fixed exchange rates as sovereign risk pass-through becomes more pronounced, which suggests that the crowding-out effect dominates.

### 3.3.5 Robustness

We conclude this section by two robustness checks on our assumptions. First, we deny capital market access to some of the households. Without the ability to save or borrow, these households maximise utility simply by consuming their entire disposable income for that period. We refer to these households as Non-Ricardian as they are not subject to wealth effects generated by fiscal policy. Appendix 3.E derives the model in the presence of Non-Ricardian households and finds that the crowding-out effects of sovereign risk are slightly muted, due to a smaller decline in aggregate consumption. Nevertheless, the presence of Non-Ricardian households does not alter our main results: a positive shock to government spending still raises output by more under flexible than fixed exchange rates, because the exchange rate effect of sovereign risk remains present.

Second, we consider the case in which the government bond rate is no longer equal to the policy rate of the central bank. Recall that in our current set-up, the central bank controls the interest rate on government bonds, such that investors are unable to respond to changes in sovereign risk by adjusting the bonds price; instead, they must respond by changing their demand for bonds. Changes in foreign demand for government bonds give rise to the exchange rate effect, which underlies our main results. If bond holders were insured against the risk of sovereign default, the direct effect on the exchange rate would be mitigated. However, the indirect effects of sovereign risk through
private credit risk are still present. Hence, in the presence of sovereign risk pass-through, we still see a depreciation of the exchange rate (and therefore a rise in net exports) following a fiscal expansion. Appendix 3.F derives the model under the assumption that holders of government bonds are completely insured against the direct effects of sovereign risk, yet not against the indirect effects, and shows that the effects of a government spending shock are still higher under floating than fixed exchange rates when sovereign risk passes through to private credit conditions.

3.4 Empirical assessment

In this section, we confront the predictions from our New Keynesian model to the data. First we show some stylized statistics. Next, we estimate the effects of a government spending shock on output as a function of both the exchange rate regime and the state of public finances.

3.4.1 Stylized statistics

The results from the previous section indicate that the interaction between the exchange rate regime and the state of public finances should not be ignored. A similar argument is made by De Grauwe (2012), who compares substantial increases in government debt in the UK and Spain, and who finds that the subsequent economic experiences in these two countries have been very different. In the UK, the rise in public debt was met by a depreciation of the nominal exchange rate, which supported net exports and thus facilitated economic growth, whereas in Spain, no such depreciation could take place and the rise in government debt was associated by a decline in output growth.

Here, we compare key stylized statistics of those countries that have experienced an increase in sovereign risk during the crisis to those who have not and condition on the exchange rate regime in place. We identify sovereign risk using CDS rates. For those OECD countries that have experienced sovereign risk during 2007-11, we calculate the average change in output, and other key macroeconomic aggregates, over this time period and compare them to (unweighted) averages of all OECD members.

The statistics confirm De Grauwe’s story: in countries with flexible ex-
3.4 Empirical assessment

Table 3.3: Stylized statistics for the OECD: average change in the group vis-à-vis the OECD average between 2007 and 2011

<table>
<thead>
<tr>
<th></th>
<th>Output</th>
<th>Consumption</th>
<th>Exports</th>
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<tr>
<td></td>
<td>flex</td>
<td>fixed</td>
<td>flex</td>
</tr>
<tr>
<td>No SR</td>
<td>-0.7</td>
<td>1.5</td>
<td>No SR</td>
</tr>
<tr>
<td>SR</td>
<td>1.5</td>
<td>-2.0</td>
<td>SR</td>
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<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td>SR</td>
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<table>
<thead>
<tr>
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<th>Nominal exchange rate</th>
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<td>flex</td>
<td>fixed</td>
<td>flex</td>
</tr>
<tr>
<td>No SR</td>
<td>-7.9</td>
<td>-</td>
<td>No SR</td>
</tr>
<tr>
<td>SR</td>
<td>15.7</td>
<td>-</td>
<td>SR</td>
</tr>
</tbody>
</table>

Notes: All figures are in percent changes and annualized; a positive change in the nominal and real exchange rate indicates a depreciation; a positive change in CPI indicates inflation. Flex denotes countries with a flexible exchange rate, fixed with a fixed exchange rate, no SR countries that have not faced sovereign risk, SR countries that have experienced sovereign risk. Exchange rate regime classifications from Ilzetzki et al. (2010). Experiencing sovereign risk is defined as having a CDS rate on 10 year bonds larger than 100 bp on average during 2007-2011. Source: OECD National Accounts Statistics.

Change rates that faced sovereign risk, the nominal and real exchange rate depreciated compared to the OECD mean by 16% and 7%, respectively, and net exports and output rose by 5% and 2%, respectively. On the other hand, in countries with fixed exchange rates, the real exchange rate barely changed during episodes of sovereign risk, while net exports and output both fell by 2% compared to the OECD average. While these observations do not establish a link with government spending, they do corroborate with the exchange rate effect of sovereign risk explained in Section 3.2.1, i.e. an increase in sovereign risk coincides with an exchange rate depreciation and an increase in exports under flexible exchange rates.

3.4.2 Estimating government spending multipliers

Our empirical investigation on the effects of government spending shocks extends the work of Corsetti et al. (2012b). Corsetti et al. report larger fiscal multipliers under fixed exchange rates than under flexible exchange rates, which is in line with the predictions of the Mundell-Fleming model. Also, they find
that the effects of government spending on output are lower when there is fiscal strain.\footnote{Other recent empirical contributions that study the influence of the economic environment on the effects of fiscal shocks on output are Auerbach and Gorodnichenko (2012) and Ilzetzki et al. (2012).} We extend their work by examining whether the effects of the exchange rate regime on the efficacy of fiscal policy are different in countries with weak public finances. To this end, we condition on the state of public finances and the exchange rate regime \textit{jointly}, whereas Corsetti et al. do so separately.

We follow the two-step methodology suggested by Corsetti et al. (2012b). In the first step, we estimate a government spending rule for each country $i$:

$$
\text{GOVT}_{it} = \text{CONST}_i + \gamma_{i1}\text{GOVT}_{it-1} + \gamma_{i2}\text{OUTPUT}_{it-1} + \gamma_{i3}\text{CLI}_{it-1} + \gamma_{i4}\text{DEBT}_{it} + \gamma_{i5}\text{RISK}_{it-1} + \gamma_{i6}\text{REGIME}_{it-1} + \text{INNOVATIONS}_{it},
$$

where GOVT$_{it}$ denotes the log of government consumption per capita at $t$, OUTPUT$_{it}$ the log of gross domestic product (GDP) per capita, CLI$_{it-1}$ the composite leading indicator, DEBT$_{it}$ the debt-to-GDP ratio at the beginning of the period, RISK$_{it}$ is a dummy variable which indicates whether the corresponding country is facing sovereign risk, and REGIME$_{it}$ is a dummy indicating the monetary regime. Following Corsetti et al. (2012b), sovereign risk is assumed to be present whenever the debt-to-GDP ratio is larger than 100\% and/or the budget deficit exceeds 6\% of GDP in the previous year. The exchange rate regime classification follows Ilzetzki et al. (2010).\footnote{See Appendix 3.G for a list of sovereign risk episodes and the exchange rate regime classifications used in this chapter.} The variable INNOVATIONS$_{it}$ is the estimation residual and serves as a proxy for the exogenous discretionary change in government spending.

In the second step, we perform a fixed-effects panel regression on a number of macroeconomic variables using the residuals from the previous step as explanatory variables. To gauge the role of sovereign risk, we split the sample into a sub-sample of countries that faced sovereign risk and a sub-sample of countries that did not. Then, for VAR$_{it}$ being the variable of interest, we
3.4 Empirical assessment

Figure 3.5: Effects of a government spending shock: empirical estimates

\[
\begin{align*}
\text{Without sovereign risk} & \quad \text{With sovereign risk} \\
\text{Output} & \\
\text{Real exchange rate} & \\
\end{align*}
\]

Notes: ‘Output’ denotes the log of GDP per capita; ‘Real exchange rate’ denotes the change in the real exchange rate; a positive (negative) change in the real exchange rate refers to a depreciation (appreciation).

estimate for each sub-sample the following regression:

\[
\begin{align*}
\text{VAR}_{it} & = \text{CONST}_i + \beta_{i1}\text{VAR}_{it-1} + \sum_{s=0}^{k} \beta_{2s}\text{INNOVATIONS}_{it-s} \\
& \quad + \sum_{s=0}^{k} \beta_{3s}\text{INNOVATIONS}_{it-s} \times \text{REGIME}_{it-1} + \text{ERROR}_{it} 
\end{align*}
\]

As in Corsetti et al. (2012b), we set \( k = 3 \). In Equation (3.31), the coefficient \( \beta_{2s} \) measures the unconditional fiscal multiplier of a government spending shock \( s \) periods ago, whereas \( \beta_{2s} + \beta_{3s} \) is the fiscal multiplier conditional on the type of monetary regime. Our panel contains 17 countries, covers 1970-2012 and is unbalanced. Data is from the OECD National Accounts Statistics and the IMF WEO Database and summary statistics are provided in Appendix 3.G.

Using the estimated coefficients, we simulate the impulse responses of output and the real exchange rate upon a shock to government spending of 1% of output. The results are shown in Figure 3.5. The figures in the left column show the responses for the sub-sample in which sovereign risk is absent and serve as a benchmark. In line with the findings of Corsetti et al. (2012b), the impact response of output is higher under fixed exchange rates than under...
flexible exchange rates. The figures in the right column show the responses for the sub-sample in which sovereign risk is present. In this case, the output response is higher under flexible exchange rates than under fixed exchange rates, contrasting traditional Keynesian wisdom. The results also show that the rise in government consumption in the presence of sovereign risk is accompanied by a significant depreciation (i.e. increase) of the real exchange rate under the flexible exchange rate regime, whereas the real exchange rate depreciates only marginally under the fixed exchange rate regime. These contrasting output and exchange rate dynamics match our theoretical results shown in the right column of Figure 3.3.

3.5 Expansionary fiscal contractions?

Can fiscal contractions be expansionary? This question, originally raised by Giavazzi and Pagano (1990), has prompted a large debate in the academic literature as well as in policy circles. In their paper, Giavazzi and Pagano make an excellent account of an increase in private consumption that occurred during substantive fiscal contractions in Denmark and Ireland during the 1980s. These ‘Non-Keynesian’ effects of fiscal policy may arise when a credible fiscal retrenchment reduces expected future tax liabilities, thereby generating a positive wealth effect and inducing households to raise current consumption (see Sutherland, 1997). In our model, a fiscal contraction may also lead to higher household consumption by mitigating the crowding-out effect of sovereign risk. In particular, when the government raises taxes, or reduces spending, the level of public debt moves away from the fiscal limit and sovereign default expectations fall. Consequently, the private risk premium falls as well, which allows households to raise consumption.

In this section, we assess the ‘expansionary fiscal contraction hypothesis’ by simulating the response of output upon a temporary reduction in government spending. Because we expect the effects of a fiscal contraction to depend on

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9 Our benchmark results differ slightly from those of Corsetti et al. (2012b), as we use a larger sample and our classification of the exchange rate regime follows Ilzetzki et al. (2010) more strictly.

10 Sutherland (1997), Alesina and Ardagna (1998) and Perotti (1999) are significant contributions. Recently, the debate has resurfaced with contributions from Alesina and Ardagna (2010), Leigh et al. (2011) and Jordà and Taylor (2013), among others.
3.5 Expansionary fiscal contractions?

Figure 3.6: Effects of a fiscal contraction on output

Flexible exchange rate

Fixed exchange rate

Notes: Figures show the responses upon impact and the average responses over time of output following a fall in government spending of 1% of output as a function of the sovereign default elasticity, $\Phi \in [0, 0.06]$, and the degree of sovereign risk pass-through, $\chi_{h,2} \in [0, 0.85]$, under flexible exchange rates (left column) and fixed exchange rates (right column).

the strength of the crowding-out effect of sovereign risk, we will consider a wide range of values for the sovereign default elasticity $\Phi$ and sovereign risk pass-through parameter $\chi_{h,2}$ (the remaining parameters are as given in Table 3.1). In particular, we ask: how much sovereign risk and pass-through of sovereign risk to private credit conditions is required for a fiscal consolidation to be expansionary? Also, what is the role of the exchange rate regime?

The top-left quadrant of Figure 3.6 suggests that, under flexible exchange rates, a reduction in government consumption leads to output losses for any degree of sovereign risk and sovereign risk pass-through. In fact, the larger are $\Phi$ and $\chi_{h,2}$, the stronger is the output loss upon a fiscal contraction. This result follows directly from our discussion in Section 3.3.3, in which we showed that the real exchange rate response to a government spending shock is positively related to the amount of sovereign risk. Specifically, as the fiscal contraction
reduces the stock of debt, sovereign risk falls such that foreign investors are induced to increase their holdings of Home assets. Re-shifting of Foreign’s asset portfolio towards assets denominated in Home currency puts downward pressure on the real exchange rate, i.e. the real exchange rate appreciates, which in turn has a negative effect on output. The larger is the default elasticity with respect to public debt ($\Phi$), the stronger is the response of Foreign investors to an improvement of the fiscal balance and the greater is the pressure on the exchange rate and aggregate production.

Under fixed exchange rates, however, a fiscal consolidation can generate positive output responses when both the default elasticity and the degree of sovereign risk pass-through are substantial (see top-right quadrant of Figure 3.6). Again, the reduction in public debt restores confidence in financial markets and raises demand for government bonds by foreign investors. However, unlike under flexible exchange rates, the rise in foreign demand for government debt does not lead to an appreciation of the exchange rate. Hence, the response of output following the fiscal consolidation is driven by the response of household consumption. The latter rises upon a fall in public spending due to a reduction in the risk premium on household loans. Therefore, if the pass-through from sovereign risk to the private risk premium is large enough, i.e. if $\chi_{h,2}$ is sufficiently high, the net effect on output following a fiscal consolidation can become positive.

The impact responses of output upon a fall in government consumption conceal potentially important long-run effects. The bottom row of Figure 3.6 therefore shows the average output response, defined as the cumulative response divided by the number of periods under consideration (i.e. 5 years). Under flexible exchange rates, the average effects on output are again dictated by the sovereign default elasticity and its interaction with the real exchange rate. Higher measures of $\Phi$ result in greater output losses for a given reduction in government spending (see bottom-left quadrant of Figure 3.6). Under fixed exchange rates, we observe that the average output response to a government spending cut is also negative for all combinations of $\Phi$ and $\chi_{h,2}$ due to a fall in output in the long run, which completely offsets the potential positive effects of the fiscal contraction in the short run.

Summarizing, it is possible for a fiscal consolidation to generate a positive output response, yet only in the presence of considerable fiscal strain and
sovereign risk pass-through. In addition, a fiscal contraction is only favourable in terms of output gains under fixed exchange rates and only in the short run.

3.6 Conclusion

Recent sovereign debt crises in a number of advanced economies have highlighted the importance of public debt sustainability for fiscal policy outcomes. In this chapter, we examined the implications of sovereign risk for the economic effects of fiscal policy under different monetary regimes. Specifically, we have shown, both theoretically and empirically, that in the presence of sovereign risk, a government spending shock can generate higher output responses under flexible than under fixed exchange rates. This stands in contrast to both the traditional Mundell-Fleming model and conventional New Keynesian models.

Intuitively, an increase in the probability of sovereign default, following a rise in government spending, leads to a fall in foreign demand for domestic assets. The consequent nominal exchange rate depreciation under a float supports aggregate output through an increase in net exports, especially when the elasticity of substitution between foreign and domestic goods and the degree of country openness are large. Under fixed exchange rates, however, the favourable relative price change is eliminated through central bank intervention. Instead, the crowding-out effects of sovereign risk that are associated with the fiscal expansion dominate and so the output response is lower than under flexible exchange rates.

Our model and empirical exercise formalise the discussion in De Grauwe (2012), in which it is argued that a rise in sovereign default beliefs can have positive externalities provided sovereign debt is largely denominated in domestic currency and the exchange rate is allowed to act as a natural adjustment mechanism. Countries experiencing a relatively high degree of sovereign risk and whose external debt is denominated in foreign currency, however, face a higher probability of falling into unstable equilibria, characterised by explosive debt developments. Our results are therefore particularly relevant for countries that are struggling with weak public finances, while contemplating to anchor their exchange rate or adopt a common currency.

Finally, we have shown that it is possible for a fiscal contraction to generate
a positive output response, yet only in the presence of a considerable degree of sovereign risk pass-through. In addition, a fiscal contraction is favourable in terms of output gains only under fixed exchange rates and only in the short run. The average effects of fiscal contractions over the long run are contractionary, irrespective of the exchange rate regime. Whether these results can be confirmed empirically, and what they might imply for the design of optimal fiscal policy, is a venue we leave for future work.

3. A Equilibrium conditions

In this section, we present the equilibrium conditions that were omitted from the main text for the sake of exposition.

3. A. 1 Optimal demand and price indices

Household consumption

Total household consumption, $c_t$, is a composite index determined by consumption on domestically produced goods, $c_{H,t}$, and imported goods, $c_{F,t}$, defined by the following CES aggregator:

$$c_t \equiv \left[ (1 - \alpha) \frac{1}{\eta} \left( c_{H,t} \right)^{\frac{\eta-1}{\eta}} + \alpha \frac{1}{\eta} \left( c_{F,t} \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}. \quad (3.32)$$

The household optimally allocates consumption between $c_{H,t}$ and $c_{F,t}$ by maximising (3.32) subject to the expenditure constraint $P_t c_t \geq P_{H,t} c_{H,t} + P_{F,t} c_{F,t}$.

The optimal demand schedules and CPI equation that follow are given by

$$c_{H,t} = (1 - \alpha) \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} c_t, \quad (3.33)$$

$$c_{F,t} = \alpha \left( \frac{P_{F,t}}{P_t} \right)^{-\eta} c_t, \quad (3.34)$$

$$P_t = \left[ (1 - \alpha) P_{H,t}^{1-\eta} + \alpha P_{F,t}^{1-\eta} \right]^\frac{1}{1-\eta}. \quad (3.35)$$

Similarly, optimal demand by Foreign households for Foreign goods, $c_{F,t}^*$,
and Home goods, $c_{H,t}^*$, is given by

$$c_{H,t}^* = \alpha^*(\frac{P_{H,t}^*}{P_t^*})^{-\eta^*} c_t^*, \quad c_{F,t}^* = (1 - \alpha^*) \left(\frac{P_{F,t}^*}{P_t^*}\right)^{-\eta^*} c_t^*. \quad (3.36)$$

**Firm demand and price setting**

The final good firm combines intermediate goods to produce the final good, $y_t$, using a standard CES production technology, i.e.

$$y_t = \left(\int_0^1 y_t(i) \frac{-1}{\epsilon} \, di\right)^{-\frac{1}{1-\epsilon}}, \quad (3.37)$$

where $\epsilon > 1$ is the constant elasticity of substitution between intermediate goods. Minimisation of the costs of assembling $y_t$, subject to (3.37), results in the following optimal demand schedule for goods produced by intermediate goods firm $i$ and the Home aggregate domestic price level:

$$y_t(i) = \left(\frac{P_{H,t}(i)}{P_{H,t}}\right)^{-\epsilon} y_t, \quad (3.38)$$

$$P_{H,t} = \left(\int_0^1 P_{H,t}(i)^{1-\epsilon} \, di\right)^{\frac{1}{1-\epsilon}}. \quad (3.39)$$

The intermediate goods firm, on the other hand, uses the linear production function (3.14) and aims to maximise current and expected future profits, subject to (3.38) and (3.14), while taking the nominal wage rate, $W_t$, and the probability of non-price adjustment in the future as given:

$$\max_{P_{H,t}} E_t \sum_{k=0}^{\infty} \theta^k Q_{t,t+k} \left(\frac{P_{H,t} y_{t,t+k}(i)}{y_{t,t+k}(i)} - W_{t+k} n_{t,t+k}(i)\right),$$

where $P_{H,t}$ is the optimal reset price\(^{11}\), $Q_{t,t+k} \equiv \beta^k (1 - \delta_{t+k}) (c_{t+k}/c_t)^{-\sigma} / \pi_{t+k}$ is the stochastic discount factor for nominal pay-offs in period $t+k$ (see [3.12]), and $y_{t,t+k}(i)$ is the amount of output produced by firm $i$ who last reset its price in period $t$. The optimal reset price that follows is a mark-up $\mathcal{M} \equiv \epsilon / (\epsilon - 1)$

\(^{11}\)Note that the optimal reset price is not firm-specific, due to symmetry among firms.
over current and expected real marginal costs, given by

$$P_{H,t} = M E_t \sum_{k=0}^{\infty} (\theta \beta)^k (1 - \delta_{t+k}) P_{t+k}^{-1} P_{t+k}^{1+\epsilon} c_{t+k}^\sigma y_{t+k} m c_{t+k}.$$

(3.40)

Note that, under flexible prices, $\theta \to 0$ and $P_{H,t} = P_{H,t}$ for all $t$, such that (3.40) reduces to $mc_t = 1/M$.

### 3.A.2 Net exports

The expression for Home net exports given by (3.21) is derived as follows. First, rewrite the CPI equation, (3.35), using the law of one price, $P_{F,t} = e_t P_{F,t}^*$, and the definition of the real exchange rate, $q_t = e_t P_{F,t}^* / P_t$:

$$P_t = (1 - \alpha) P_{H,t}^{1-\eta} + \alpha (q_t P_t)^{1-\eta}.$$

Then, divide by $P_t$ and solve for $P_{H,t}/P_t$:

$$1 = \left( (1 - \alpha) \left( \frac{P_{H,t}}{P_t} \right)^{1-\eta} + \alpha q_t^{1-\eta} \right)^{\frac{1}{1-\eta}},$$

$$P_{H,t} / P_t = \left( \frac{1 - \alpha q_t^{1-\eta}}{1 - \alpha} \right)^{\frac{1}{1-\eta}}.$$

Rewrite the Foreign demand schedule for Home goods, (3.36), by substituting $P_{H,t}/P_t$:

$$c_{H,t}^* = \alpha^* \left( \frac{P_{H,t}^*}{P_t^*} \right)^{-\eta^*} c_t^* = \alpha^* q_t^{\eta^*} \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} c_t^* = \alpha^* \left( \frac{q_t^{\eta-1} - \alpha}{1 - \alpha} \right)^{\frac{\eta^*}{\eta}} c_t^*.$$

Rewrite the Home demand schedule for Foreign goods, (3.34):

$$c_{F,t} = \alpha \left( \frac{P_{F,t}}{P_t} \right)^{-\eta} c_t = \alpha \left( \frac{e_t P_{F,t}^*}{P_t^*} \right)^{-\eta} c_t = \alpha \left( \frac{e_t P_{F,t}^*}{P_t} \right)^{-\eta} c_t = \alpha q_t^{-\eta} c_t.$$
3.B Linearisation

Net exports is then defined as the difference between \( c_{H,t}^* \) and \( c_{F,t} \):

\[
nx_t \equiv c_{H,t}^* - c_{F,t} = \alpha^* \left( \frac{q_t^{-1} - \alpha}{1 - \alpha} \right) c_t^* - \alpha q_t^{-\eta} c_t.
\]

3.B Linearisation

The linearised versions of the equilibrium conditions (3.2), (3.7), (3.12), (3.13) and (3.20) follow once we have linearised \( 1 - \delta_t \):

\[
1 - \delta_t \approx (1 - \delta) - \delta' \left( \frac{R_{t-1}}{\pi_t} b_{t-1} - \frac{R}{\pi} b \right), \quad (3.41)
\]

\[
\frac{(1 - \delta_t) - (1 - \delta)}{1 - \delta} \approx -\delta' \left( \frac{R}{\pi} b \right) \left( \frac{R_{t-1}}{\pi_t} b_{t-1} - \frac{R}{\pi} b \right)
= -\Phi \left( \hat{R}_{t-1} - \hat{\pi}_t + \hat{b}_{t-1} \right).
\]

Using (3.41), we obtain the following linear equations:

\[
\sigma \hat{c}_t = \sigma E_t \hat{c}_{t+1} - (1 - \Phi) \left( \hat{R}_t - E_t \hat{\pi}_{t+1} \right) + \Phi \hat{b}_t, \quad (3.42)
\]

\[
\hat{b}_t = \left( \frac{1 - \Phi}{\beta} \right) \left( \hat{R}_t - \hat{\pi}_t + \hat{b}_{t-1} \right) + \frac{\alpha}{1 - \alpha} \left( \frac{T - q}{b} \right) \hat{q}_t - \frac{T}{b} \hat{y}_t + \frac{g}{b} \hat{y}_t, \quad (3.43)
\]

\[
\hat{y}_t - \frac{c}{y} \hat{c}_t - \frac{g}{y} \hat{y}_t = \frac{f^*}{y} \left[ \frac{1}{\beta} \left( \hat{f}^*_{t-1} + \hat{\xi}_{h,t-1}^* \right) - \hat{f}_t \right]
+ \left[ \left( \frac{1}{\beta} - 1 \right) \frac{f^*}{y} + \frac{\alpha}{1 - \alpha} \left( 1 - \frac{g}{y} \right) \right] \hat{q}_t - \frac{b_F^*}{y} \hat{b}_{F,t}
+ \frac{1}{\beta} \frac{b_F}{y} \left[ (1 - \Phi) \left( \hat{R}_{t-1} - \hat{\pi}_t \right) - \left( \Phi \hat{b}_{t-1} - \hat{b}_{F,t-1} \right) \right],
\]

\[
\hat{\xi}_{h,t}^* = \chi_{h,1} \frac{f^*}{y} \left( \hat{f}_t + \hat{q}_t \right)
+ \chi_{h,2} \frac{b_F}{y} \left[ (1 - \delta) \Phi \left( \hat{R}_{t-1} - \hat{\pi}_t + \hat{b}_{t-1} \right) + \delta \hat{b}_{F,t} \right],
\]

\[
\hat{q}_t = E_t \hat{q}_{t+1} - \left[ (1 - \Phi) \left( \hat{R}_t - E_t \hat{\pi}_{t+1} \right) - \Phi \hat{b}_t \right]. \quad (3.46)
\]
The linearised versions of the remaining equilibrium conditions are given by

\begin{align}
\dot{\varphi} &= \dot{w} - \sigma \dot{c}, \tag{3.47} \\
\sigma \dot{c} &= \sigma E_t \dot{c}_{t+1} - (E_t \dot{q}_{t+1} - \dot{q}_t) - \dot{\Xi}_{h,t}, \tag{3.48} \\
\dot{T} &= \gamma b \dot{b}_{t-1}, \tag{3.49} \\
\dot{g} &= \left( \eta \alpha c y + \eta^* \left( \frac{\alpha^*}{1 - \alpha} \right) \right) \dot{q}_t + (1 - \alpha) \frac{c}{y} \dot{c}_t + \frac{g}{y} \dot{g}_t, \tag{3.50} \\
\dot{b} &= \frac{b_H}{b} \dot{b}_{H,t} + \frac{b_{F,t}}{b} \dot{b}_{F,t}, \tag{3.51} \\
\dot{b}_{F,t} &= \dot{b}_{t}, \tag{3.52} \\
\dot{\gamma} &= \rho g \dot{\gamma}_{t-1} + \varepsilon_{g,t}, \tag{3.53} \\
\dot{n} &= \left( \frac{\eta^*}{1 - \alpha} + \eta \right) \dot{q}_t - \dot{c}_t. \tag{3.54}
\end{align}

Finally, linearisation of the monetary policy rule under flexible exchange rates, given by (3.5), yields

\[ \hat{R}_t = \rho R \hat{R}_{t-1} + (1 - \rho R) \alpha E_t \hat{\pi}_{t+1}. \tag{3.55} \]

Under fixed exchange rates, the linear monetary policy rule is given by

\[ \dot{c}_t = 0. \tag{3.56} \]

### 3.C Derivation of the IS and BOP curve

The IS curve is given by the goods market clearing condition using \( \dot{q}_t = \sigma \dot{c}_t \):

\[ \dot{q}_t = \Psi_1 \dot{q}_t + \frac{g}{y} \dot{g}_t, \tag{3.57} \]

Since \( \Psi_1 \equiv [\eta \alpha + (1 - \alpha) / \sigma] c/y + \eta^* \alpha^* / (1 - \alpha) c^*/y > 0 \), the IS curve is upward sloping.

To derive the BOP curve, we first establish a relationship between the debt level and the real exchange rate. We substitute the monetary policy rule in equations (3.22) to (3.24), the government budget constraint in the UIP condition and the IS curve in the BOP equation. This yields the following
system of two equations:

\[
\hat{q}_t = E_t \hat{q}_{t+1} + \Phi \Pi_1 \hat{b}_{t-1} + \Phi g \hat{g}_t, \tag{3.58}
\]

\[
\hat{b}_t = \left( \frac{1 - \Phi}{\beta} \right) \hat{b}_{t-1} + \Pi_2 \hat{g}_t, \tag{3.59}
\]

where

\[
\Pi_1 \equiv \frac{1 - \Phi}{\beta} - \gamma \frac{T}{b}, \quad \Pi_2 \equiv \left( \frac{b}{y} \right)^{-1} \left( \frac{\alpha}{1 - \alpha} + \frac{1}{\sigma y} - \Psi \right).
\]

These two equations describe the dynamics for the real exchange rate, \( \hat{q}_t \), and government debt, \( \hat{b}_t \), and can be decoupled from the rest of the model. We use the method of undetermined coefficients to find a stable solution to the system above and conjecture

\[
\hat{q}_t = \psi_1 \hat{b}_{t-1} + \Phi \psi_2 \hat{g}_t, \tag{3.60}
\]

where the \( \psi \) coefficients are functions of the model’s structural parameters. Rewrite (3.58) using (3.60):

\[
\hat{b}_t = \left( \frac{\psi_1 - \Phi \Pi_1}{\psi_1} \right) \hat{b}_{t-1} + \left[ \frac{\psi_2 (1 - \rho_g) - \Phi g}{\psi_1} \right] \hat{g}_t.
\]

Also, rewrite (3.59) using (3.60) and combine the result with the equation above to yield

\[
\left[ \frac{1 - \Phi}{\beta} + \psi_1 \Pi_2 - \left( \frac{\psi_1 - \Phi \Pi_1}{\psi_1} \right) \right] \hat{b}_{t-1} + \left\{ \psi_2 \Pi_2 - \left[ \frac{\psi_2 (1 - \rho_g) - \Phi g}{\psi_1} \right] \right\} \hat{g}_t = 0.
\]

This implies that for (3.60) to actually be a solution to (3.58)-(3.59), the following conditions must hold:

\[
\psi_1 = \frac{(1 - \Phi - \beta) + \sqrt{(1 - \Phi - \beta)^2 - 4 \Phi \Pi_2 \beta^2}}{2 \Pi_2 \beta}, \quad \psi_2 = \frac{\beta}{1 - \rho_g - \psi_1 \Pi_2}.
\]

The second solution for \( \psi_1 \) is excluded as it is not a stable solution.

Second, we use (3.60) to substitute out \( E_t \hat{q}_{t+1} \) from the UIP condition (3.22), solve for \( \hat{b}_t \) and insert in the balance of payments condition (3.23), and finally solve for \( \hat{g}_t \):
\[ \hat{y}_t = b \left( \frac{1 - \Phi}{\beta} \right) \hat{b}_{t-1} + \Psi_2 \hat{y}_t + \left( \Phi_3 + g \right) \hat{y}_t, \]  
\text{(3.61)}

where
\[ \Psi_2 \equiv \frac{\alpha}{1 - \alpha} + \frac{1}{\sigma y} - \frac{b}{y} \frac{1}{\psi_1 + \Phi}, \quad \Psi_3 \equiv \frac{b}{y} \frac{\psi_2}{\psi_1 + \Phi}. \]

\( \Pi_1 > 0 \) and \( \Pi_2 < 0 \) imply \( \psi_1 > 0 \). \( \psi_1 > 0 \) and \( \psi_2 > 0 \) imply \( \Psi_3 > 0 \). The condition \( \Psi_1 > \Psi_2 \) can be rewritten into \( (1 - \Phi) \Phi_2 \beta \Pi_2 \left[ (1 - \Phi) + \beta (1 - \Pi_1) \right] > 0 \), which holds as \( 0 \leq \Phi < 1, \beta > 0, \Pi_2 < 0 \) and \( 0 < \Pi_1 < 1 \) (for \( \Pi_1 \geq 1 \), the debt level would be non-stationary and such that a unique solution to the model would not exist).

From (3.60), we find that a higher debt level leads to a depreciation of the real exchange rate. Also, an increase in government spending leads to a depreciation of the real exchange rate under sovereign risk since \( \psi_2 > 0 \). This result is stronger for a higher default elasticity, \( \Phi \). The greater is the persistence of the government spending shock, i.e. the higher is \( \rho_g \), and the greater is the share of government spending to output, \( g/y \), the stronger is the response of the real exchange rate to changes in government spending.
3.D Additional graphs

Figure 3.7: Differences in output responses upon impact across monetary regimes

Notes: Figures show differences in output responses upon impact (in percentage deviation from steady state) across monetary regimes, denoted by $\Delta \% \text{dev} = \% \text{dev}_{\text{flex}} - \% \text{dev}_{\text{fixed}}$, for different values of $\eta^*$ and $\alpha$, in the presence of sovereign risk, i.e. for $\delta = 0.0025$ and $\Phi = 0.03$ (here, we assume that $\chi_{h,2} = 0$, which means that there is no sovereign risk pass-through).

Figure 3.8: The effect of $\Phi$: output responses to a government spending shock under sovereign risk and without sovereign risk pass-through

Notes: Figures are generated based on the calibration reported in Table 3.1, yet assuming $\chi_{h,2} = 0$. 

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3 Government spending, sovereign risk and exchange rates

Figure 3.9: The effect of $\Phi$: output responses to a government spending shock under sovereign risk and 20% sovereign risk pass-through

$\Phi = 0, \delta = 0$

$\Phi = 0.03, \delta = 0.0025$

$\Phi = 0.06, \delta = 0.0025$

Notes: Figures are generated based on the calibration reported in Table 3.1.

Figure 3.10: The effect of $\chi_{h,2}$: output responses to a government spending shock under different degrees of sovereign risk pass-through

6% pass-through ($\chi_2 = 0.05$) 20% pass-through ($\chi_2 = 0.17$) 100% pass-through ($\chi_2 = 0.85$)

Notes: See notes under Figure 3.9.
### 3.E Non-Ricardian households

In this section, we modify the model outlined in Section 3.1 by assuming that not all households have access to financial markets and are thus prohibited from investing and borrowing. Since savings and borrowing decisions no longer enter the optimisation problem, these types of households maximise utility by simply consuming all of their disposable income in every period. In that sense, Ricardian equivalence fails, as changes in government spending, that affect the government’s intertemporal budget constraint, no longer induce private wealth effects through expected changes in future taxes. Such households are therefore often referred to as Non-Ricardian. Non-Ricardian households have become a standard feature in many contemporary New Keynesian models.

We introduce Non-Ricardian households to the model and index them by NR. The remaining (Ricardian) households are indexed by R. Accordingly, the first-order conditions of a representative Ricardian household, derived in Section 3.1.2, are changed to

\[
\begin{align*}
\hat{n}_t^\phi &= c_{R,t}^\phi w_t, \\
q_t c_{R,t}^\sigma &= \beta E_t \left[ c_{R,t+1}^\sigma q_{t+1}^\sigma \tilde{r}_{t+1}^* \right], \\
c_{R,t}^\sigma &= \beta E_t \left[ c_{R,t+1}^\sigma (1 - \delta_{t+1}) r_t \right].
\end{align*}
\]

The consumption function of a representative Non-Ricardian household is given by

\[
P_t c_{NR,t} = W_t n_{NR,t} - P_{H,t} T_{NR,t}.
\]

We assume that Non-Ricardian households do not own any shares of intermediate goods firms. Subject to (3.65), the Non-Ricardian household chooses consumption and labour supply to maximise its current utility, i.e.

\[
\frac{c_{NR,t}^{1-\sigma}}{1-\sigma} - \frac{n_{NR,t}^{1+\phi}}{1+\phi}.
\]

Let \(s_{NR}\) denote the share of Non-Ricardian households. Then, aggregate consumption is defined as

\[
c_t \equiv s_{NR} c_{NR,t} + (1 - s_{NR}) c_{R,t}.
\]
Since both types of households supply the same quality of labour, labour demand is distributed equally across households. Hence \( n_t = n_{NR,t} = n_{R,t} \), for all \( t \). The same holds for lump-sum taxes, i.e. \( T_t = T_{NR,t} = T_{R,t} \). Moreover, bonds market clearing now requires

\[
B_t = (1 - s_{NR}) B_{H,t} + B_{F,t}. \tag{3.67}
\]

All other market clearing conditions, the first-order conditions of the firms, the public budget constraint and the policy rules remain the same.

We linearise equations (3.62)-(3.64) and replace them for (3.47), (3.42) and (3.46), respectively. Additionally, we linearise (3.65)-(3.67) and add them to the model. We set the share of Non-Ricardian households equal to \( s_{NR} = 0.2 \). Also, assuming consumption by Ricardian households is 80% of aggregate output in steady state, i.e. \( c_R/y = 0.8 \), and using (3.66) yields \( c_{NR}/y = 0.75 \). We proceed by simulating the responses of the endogenous variables to a government spending shock for alternative assumptions regarding sovereign risk. The results are shown in Figures 3.11 and 3.12.

The inclusion of Non-Ricardian households does not affect the results presented in Section 3.3: following a positive shock to government consumption, and in the absence of sovereign risk, output rises and the response is larger under fixed than flexible exchange rates. This result is reversed when sovereign risk is introduced, with the difference between output responses under the two monetary regimes being larger in the presence of sovereign risk spillovers to private credit conditions.

While qualitatively very much similar, the adverse crowding-out effects of sovereign risk on aggregate consumption are somewhat muted as compared to the case without Non-Ricardian households. This is because sovereign risk only affects the optimal path of consumption for Ricardian households, but not for Non-Ricardian households. Specifically, upon an increase in sovereign risk, Ricardian households face higher borrowing costs, due to sovereign risk pass-through, and therefore reduce consumption (as before), yet Non-Ricardian households only adjust their level of consumption insofar there are changes in their disposable income. Since the fiscal expansion raises output and disposable income immediately, through an increase in government spending, and indirectly, through an increase in net exports owing to the exchange
Figure 3.11: Responses to a government spending shock in the presence of Non-Ricardian households

<table>
<thead>
<tr>
<th>No sovereign risk</th>
<th>Sovereign risk</th>
<th>Sovereign risk pass-through</th>
</tr>
</thead>
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<tr>
<td><strong>Output</strong></td>
<td><strong>Output</strong></td>
<td><strong>Output</strong></td>
</tr>
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<td><em>fixed</em></td>
<td></td>
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<td>% from SS</td>
<td>% from SS</td>
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<tr>
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<td>5 10 15 20</td>
<td>5 10 15 20</td>
</tr>
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<td>1 0.4 0.2</td>
<td>1 0.4 0.2</td>
</tr>
<tr>
<td>Real exchange rate</td>
<td>Real exchange rate</td>
<td>Real exchange rate</td>
</tr>
<tr>
<td>% from SS</td>
<td>% from SS</td>
<td>% from SS</td>
</tr>
<tr>
<td>5 10 15 20</td>
<td>5 10 15 20</td>
<td>5 10 15 20</td>
</tr>
<tr>
<td>-0.05 -0.1 -0.15</td>
<td>-0.05 -0.1 -0.15</td>
<td>-0.05 -0.1 -0.15</td>
</tr>
<tr>
<td>Net exports</td>
<td>Net exports</td>
<td>Net exports</td>
</tr>
<tr>
<td>% from SS</td>
<td>% from SS</td>
<td>% from SS</td>
</tr>
<tr>
<td>5 10 15 20</td>
<td>5 10 15 20</td>
<td>5 10 15 20</td>
</tr>
<tr>
<td>-0.2 -0.3 -0.4</td>
<td>-0.2 -0.3 -0.4</td>
<td>-0.2 -0.3 -0.4</td>
</tr>
</tbody>
</table>

Notes: Figures are generated based on the calibration reported in Table 3.1 and a 20% share of Non-Ricardian households.
Figure 3.12: Responses to a government spending shock in the presence of Non-Ricardian households

Notes: See notes under Figure 3.11.
rate effect (explained in Section 3.2.1), Non-Ricardian households raise consumption. Therefore, the reduction in aggregate consumption is lower than in the case where Non-Ricardian households were absent. In fact, for higher values of $s_{NR}$, aggregate consumption may even respond positively under both monetary regimes.

Since the presence of Non-Ricardian households mutes the adverse effects of sovereign risk, the government spending multiplier becomes larger, yet more so under flexible than fixed exchange rates. This is because the exchange rate effect is still driving most of the results: without sovereign risk, the government spending shock leads to an appreciation of the real exchange rate and a fall in net exports under both monetary regimes. When sovereign risk is present, however, the exchange rate depreciates, which supports net exports and output, and more so when exchange rates are allowed to float. Therefore, and in accordance with our previous results, the response of output to a government spending shock is larger under flexible than fixed exchange rates in the presence of sovereign risk.

3.F Insurance against sovereign default

Thus far, we have assumed that the central bank controls the interest rate on government bonds, $R_t$, which implies that bondholders cannot respond to changes in the risk of sovereign default by adjusting the bond price. Instead, they must respond by changing their demand for bonds. Thus, when a fiscal expansion raises sovereign risk, bondholders sell domestic government bonds in exchange for (relatively safer) foreign assets, which gives rise to the exchange rate effect that underlies our main results. If, on the other hand, bondholders were able to partially insure against the risk of sovereign default, the exchange rate effect would be mitigated.

However, our results would still hold even if government bond holders were completely insured against sovereign risk. This is because of the presence of sovereign risk pass-through, which establishes a link between public and private credit risk. Since foreign lenders cannot perfectly control for changes in the riskiness of private borrowers induced by sovereign risk, an increase in the sovereign default probability would still put upward pressure on the exchange rate, at least in the floating exchange rate regime. An increase in government
spending would therefore generate qualitatively the same results as shown in Section 3.3.4.

In this section, we illustrate this result, and thereby also demonstrate the robustness of our previous results, by considering the case in which holders of government bonds are completely insured against the direct effects of sovereign risk, while still allowing for the presence of sovereign risk pass-through. In particular, we assume that the central bank sets the risk-free rate, $R_{f,t}$, rather than the bond rate, whereas the bond rate is determined in equilibrium by the following condition:

$$R_t = \frac{1}{1 - E_t \delta_{t+1}} R_{f,t}. \quad (3.68)$$

According to (3.68), a change in the sovereign default probability must be offset by a change in the bond rate. Thus, bond holders are completely insured against the direct effects of sovereign risk. We also make the appropriate changes to the monetary policy rule, given by (3.5):

$$\frac{R_{f,t}}{R_f} = \left( \frac{R_{f,t-1}}{R_f} \right)^{\rho_r} \left( \frac{E_t \pi_{t+1}}{\pi} \right)^{(1-\rho_R)\phi_r},$$

and add the linearised version of (3.68) to the model.

The output responses following a government spending shock generated by the new model are shown by Figure 3.13. The figures are all generated under the assumption that $\delta = 0.0025$ and $\Phi = 0.03$. Therefore, sovereign
risk is present in all cases. If there is no pass-through from public to private credit risk, i.e. $\chi_{h,2} = 0$, the output responses are higher under fixed exchange rates than under flexible exchange rates, despite the presence of sovereign risk (left column of Figure 3.13). This result arises because investors can perfectly insure themselves against changes in sovereign risk: without a response of foreign bond holders to a change in sovereign risk, the exchange rate effect is no longer present and the effects of an increase in government spending are in line with traditional Keynesian theory. However, when we allow for sovereign risk pass-through and set $\chi_{h,2} = 0.17$, we re-obtain the results from Section 3.3.4 and find that the output response is higher under flexible than fixed exchange rates.
3.G Additional tables

Table 3.4: Exchange rate regime classification

<table>
<thead>
<tr>
<th>Country</th>
<th>Fixed</th>
<th>Flexible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>1975-1983</td>
<td>1984-2012</td>
</tr>
<tr>
<td>Austria</td>
<td>1975-2012</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>1975-2012</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>1975-2012</td>
<td>1975-2012</td>
</tr>
<tr>
<td>Denmark</td>
<td>1975-2012</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>1996-2012</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>1979-1991</td>
<td>1975-1978</td>
</tr>
<tr>
<td>Japan</td>
<td>1980-1989</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>1975-1979</td>
<td>1975-2012</td>
</tr>
<tr>
<td></td>
<td>1978-1993</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>1975-2012</td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>1975-2012</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.5: Episodes of weak public finances

<table>
<thead>
<tr>
<th>Country</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>1976-2004 2012</td>
</tr>
<tr>
<td>Denmark</td>
<td>1982-1984</td>
</tr>
<tr>
<td>Finland</td>
<td>1994-1996</td>
</tr>
<tr>
<td>France</td>
<td>1994 2010-2011</td>
</tr>
<tr>
<td>Ireland</td>
<td>2009-2012</td>
</tr>
<tr>
<td>Italy</td>
<td>1975-2012</td>
</tr>
<tr>
<td>Japan</td>
<td>1988-2012</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1983 1996</td>
</tr>
<tr>
<td>Sweden</td>
<td>1983 1993-1996</td>
</tr>
<tr>
<td>UK</td>
<td>1993-1995 2010-2012</td>
</tr>
<tr>
<td>US</td>
<td>2009-2012</td>
</tr>
</tbody>
</table>
Table 3.6: Data description, summary statistics and correlation coefficients

<table>
<thead>
<tr>
<th>Name</th>
<th>Source</th>
<th>#Obs</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log government consumption/capita (GOVT)</td>
<td>OECD EO92</td>
<td>711</td>
<td>4.01</td>
<td>2.83</td>
<td>5.90</td>
<td>0.65</td>
</tr>
<tr>
<td>Log GDP/capita (OUTPUT)</td>
<td>OECD EO92</td>
<td>711</td>
<td>4.68</td>
<td>3.78</td>
<td>6.61</td>
<td>0.64</td>
</tr>
<tr>
<td>Composite Leading Indicator (CLI)</td>
<td>OECD EO92</td>
<td>692</td>
<td>0.00</td>
<td>-0.05</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Debt/GDP (DEBT)</td>
<td>**</td>
<td>731</td>
<td>0.59</td>
<td>0.00</td>
<td>2.14</td>
<td>0.33</td>
</tr>
<tr>
<td>Change in the REER (REER)</td>
<td>OECD EO92</td>
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<td>0.00</td>
<td>-0.18</td>
<td>0.30</td>
<td>0.05</td>
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<tr>
<td>Weak public finances (RISK)</td>
<td>Corsetti et al (2012)</td>
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<td>0.22</td>
<td>0</td>
<td>1</td>
<td>0.41</td>
</tr>
<tr>
<td>Peg (REGIME)</td>
<td>Ilzetzki et al (2010)</td>
<td>731</td>
<td>0.59</td>
<td>0</td>
<td>1</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Notes: 'Std' denotes overall standard deviation, within the within standard deviation and between the between standard deviation. For 'Debt/GDP', we used IMF CRS data whenever the data was not supplied by the OECD Eo92.

Correlations:

<table>
<thead>
<tr>
<th></th>
<th>GOVT</th>
<th>OUTPUT</th>
<th>CLI</th>
<th>DEBT</th>
<th>REER</th>
<th>RISK</th>
<th>REGIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOVT</td>
<td>0.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTPUT</td>
<td></td>
<td>0.01</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLI</td>
<td>0.53</td>
<td>0.01</td>
<td>0.04</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEBT</td>
<td>0.50</td>
<td>0.00</td>
<td>0.09</td>
<td>0.12</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REER</td>
<td>-0.04</td>
<td>0.00</td>
<td>-0.09</td>
<td>0.00</td>
<td>-0.12</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>RISK</td>
<td>0.16</td>
<td>0.09</td>
<td>0.04</td>
<td>-0.13</td>
<td>0.09</td>
<td>0.10</td>
<td>0.12</td>
</tr>
<tr>
<td>REGIME</td>
<td>-0.12</td>
<td>-0.10</td>
<td>0.05</td>
<td>-0.01</td>
<td>0.10</td>
<td>-0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Notes: Correlations are averages of the correlations per country.
Chapter 4

Fiscal policy and sovereign risk premia under monetary union*

The role of fiscal policy in stabilising economic conditions has been of particular relevance to countries that belong to a monetary union given their inability to (independently) use monetary policy to absorb country-specific shocks. A number of recent theoretical papers has shown that fiscal policy can play an important role in enhancing welfare by offsetting country-specific shocks, especially when price rigidities are strong (e.g. Beetsma and Jensen, 2005; Galí and Monacelli, 2008). Furthermore, according to traditional Keynesian theory, fiscal expansions can be very effective in stimulating aggregate demand if they are not offset by a monetary contraction, suggesting that fiscal multipliers can be quite large in small member states of a monetary union.

The recent sovereign debt crisis in Europe has, however, exposed the limits of fiscal policy. Figure 4.1, for instance, suggests that countries may face a certain threshold for sovereign debt, beyond which sovereign bond holders no longer perceive fiscal policy to be on a sustainable path and sharply raise sovereign risk premia. This has been particularly the case for euro area periphery countries during the sovereign debt crisis (indicated by the dark (blue) circles), whereas before the crisis sovereign risk premia seemed to respond little to changes in sovereign indebtedness. The extent to which higher sovereign

*This chapter has benefited greatly from comments and suggestions from Eric Bartelsman, Jeffrey Campbell, Bart Hobijn, Kostas Mavromatis, Andrea Tambalotti and seminar participants at De Nederlandsche Bank, the Bank of England, the Federal Reserve Bank of Chicago, the Federal Reserve Bank of New York and VU University.
Figure 4.1: The debt-to-output ratio vs. the sovereign risk premium

(a) Euro area periphery countries

(b) Euro area core countries

Notes: The figure shows quarterly data for long-term (10 year) government bond yields, minus the yield on a similar German bond, and gross government debt as a share of nominal GDP. Source: OECD National Accounts Statistics.
risk premia affect the ability of fiscal policy to stabilise the economy depends *inter alia* on how they affect private borrowing conditions (and, subsequently, consumption and investment decisions). Figure 4.2 shows that, during the sovereign debt crisis, there has been a remarkable strong and positive relationship between sovereign credit default swap (CDS) rates and the CDS rates of the two largest domestic commercial banks within the corresponding country, suggesting that the perceived riskiness of banks has been moving in tandem with the perceived riskiness of the home sovereign. Fiscal policy may therefore have significant crowding-out effects on private spending through its effect on sovereign and private risk premia. If that is the case, (1) can fiscal policy still prove successful in stabilising macroeconomic conditions and (2) what should be the optimal fiscal policy stance? The objective of this chapter is to answer these questions.

Our point of departure is a New Keynesian model for a two-country monetary union (much like Benigno, 2004). The two countries in this union are identical in terms of preferences and technology, but may differ in size and face different shocks. There is a single monetary authority which sets the policy interest rate in order to stabilise union-aggregate inflation and output. Furthermore, in each country there is a fiscal authority which sets a distortionary income tax as a function of domestic output and sovereign debt. Following Davig *et al.* (2011) and Bi (2012), we allow for the presence of a ‘fiscal limit’, which determines the maximum sustainable level of sovereign debt. Although the fiscal limit is unknown, agents are aware of its distribution and form expectations about future sovereign default probabilities. Rather than modelling the fiscal limit explicitly, we follow Daniel and Shiamptanis (2013), Locarno *et al.* (2013), Roeger and ‘t Veld (2013) and Schabert and van Wijnbergen (2014), among others, and assume a sovereign risk premium arises once agents believe the economy is near its fiscal limit. The sovereign risk premium is assumed to be a function of sovereign indebtedness and we calibrate this function using the data presented in Figure 4.1. Also, as in Erceg and Lindé (2010) and Corsetti *et al.* (2013b), we let the sovereign risk premium affect private borrowing conditions so as to capture the link between sovereign and

---

Figure 4.2: Sovereign CDS rates vs. domestic bank CDS rates, 2008-2012

(a) Euro area periphery countries

(b) Euro area core countries

Notes: The figure shows daily data between 2008 and 2012 for sovereign and bank CDS rates. The latter is determined by taking the (unweighted) average of the CDS rates of the two largest banks within the corresponding country (Italy: Intesa Sanpaolo and Unicredito; Portugal: Banco Comercial Portugês and Banco Espírito Santo; Spain: Banco Santander and Banco Bilbao Vizcaya Argentaria; Ireland: Allied Irish Banks and Bank of Ireland; Austria: Erste Bank and Raiffeisen International Bank; Belgium: Dexia and KBC Group; France: Société Générale and BNP Paribas; Netherlands: ABN Amro Bank and ING Group). Source: Datastream.
private risk premia as displayed in Figure 4.2.

We show that, in general, national fiscal authorities of small member states are able to stabilise macroeconomic conditions through use of countercyclical policies. Pro-cyclical fiscal policies, however, tend to intensify the business cycle and raise output variability. Furthermore, smaller member states tend to enjoy larger government spending multipliers than do larger member states, since smaller countries elicit a weaker offsetting monetary response by the central bank. We therefore confirm the results of traditional Keynesian theory on the effects of fiscal policy, at least under the assumption that sovereign risk premia are absent.

However, when sovereign risk premia become sensitive to changes in government indebtedness, fiscal policy can be a source of instability and raise output variability. In particular, when the fiscal authority reduces taxes in response to economic crises, the level of sovereign debt rises which triggers an increase in the sovereign risk premium when bond holders expect the fiscal limit to be breached. The higher risk premium raises public borrowing costs and further raises sovereign debt, which again raises the risk premium, etc. etc. In order to avoid a sovereign debt crisis and prevent debt dynamics from spiralling out of control, future tax liabilities need to rise, which reduces the expected life-time disposable income of households. In addition, the rise in the sovereign risk premium leads to an increase in private borrowing costs, prompting households to borrow less and save more. Hence, when responding to economic crises, countercyclical fiscal policy can lead to negative wealth and crowding-out effects and a reduction in private consumption, thereby exacerbating the crisis. On the other hand, pro-cyclical policies aimed at reducing the stock of sovereign debt have the opposite effect and can stabilise economic conditions, even under very persistent negative shocks to output.

Furthermore, we show that government spending multipliers under sovereign risk premia are typically lower than when sovereign risk premia are absent, especially when the central bank is unable to offset the rise in the risk premium by reducing the policy interest rate. In fact, we find that when monetary policy keeps the interest rate fixed, the government spending multiplier can even be negative. This result contrasts earlier theoretical studies on the effects of fiscal policy when monetary policy is constrained by the zero lower bound, as these studies typically find multipliers to be very large (e.g.
Eggertsson, 2001; Christiano et al., 2009; Woodford, 2011).

The implications of sovereign risk premia for the effects of fiscal policy are reflected by the optimal fiscal policy stance. Using a utility-based welfare criterion (as in Woodford, 2003), we show that, in normal times, fiscal policy can be welfare-improving if the government responds to changes in domestic output and absorbs country-specific aggregate shocks. The optimal fiscal response to a negative productivity shock should be countercyclical when the country is relatively small, especially when the degree of price stickiness is large, yet procyclical when the country is large (in which case monetary policy is more accommodative). However, in the presence of sovereign risk premia, optimal fiscal policy in a small member state dictates a pro-cyclical response to output contractions in order to prevent prolonged episodes of high distortionary taxes in the future that are otherwise needed to force sovereign debt back to its sustainable level. On the other hand, when the member state is relatively large, the rise in the sovereign risk premium is partially offset by the central bank and so optimal fiscal policy requires a countercyclical stance. Our results therefore indicate that the optimal fiscal stance depends crucially on the perceived riskiness of sovereign debt and the relative size of the member state within the monetary union.

The present chapter is on the verge of at least two branches of the recent macroeconomics literature. Firstly, the chapter is related to the literature on ‘expansionary fiscal contractions’, pioneered by Giavazzi and Pagano (1990), Sutherland (1997), Alesina and Ardagna (1998) and Perotti (1999), in which it is hypothesised that increases in the budget surplus can stimulate private spending if the fiscal authority manages to reduce long-term real interest rates and thereby also expected future tax liabilities.\(^2\) Similarly, we show that in times of elevated sovereign risk premia, tax hikes can stabilise aggregate output and increase welfare in small member states of a monetary union. However, whereas this literature is centred around the effects of exogenous fiscal

\(^2\)The expansionary fiscal contraction hypothesis has recently been tested empirically with mixed results. Jordà and Taylor (2013) and Leigh et al. (2014), for instance, find that fiscal contractions lead to a reduction in output growth, whereas Perotti (2012) shows that contractions are associated with economic expansions due to an accompanying exchange rate depreciation (see also Bonam and Lukkezen, 2014b). Furthermore, Coenen et al. (2008) argue that fiscal contractions lead to non-negligible adjustment costs in the short run, but can be expansionary in the long run if they reduce (and thereby mitigate the adverse effects of) distortionary taxes.
4.1 A two-country monetary union

We use a dynamic stochastic general equilibrium model for a two-country monetary union along the lines of Benigno (2004). The monetary union consists of two countries (or regions), ‘Home’ and ‘Foreign’, that interact with each other on international goods and asset markets. The union as a whole is assumed to be a closed economy. Each country is inhabited by a continuum of households. Households that live in Home are indexed by $h \in [0, s]$, while those that live in Foreign are indexed by $f \in (s, 1]$. The parameter $s$ measures the relative size of the Home country.

Each household consumes domestically produced and imported goods, saves by investing in domestic nominal sovereign bonds, and supplies labour to monopolistically competitive firms in which it is a shareholder. Households may also issue or hold an internationally traded non-state contingent bond. Unlike Benigno (2004), we assume that households face a cost when taking foreign...
asset positions, which reflects intermediation costs and is proportional to both private and public indebtedness.

Each firm produces a differentiated intermediate good and faces a price-setting constraint as in Calvo (1983). We assume only domestic labour is used in the production process of intermediate goods (hence, there is no mobility of labour across countries). Domestic producers charge the same price for their goods at home and abroad; together with the assumption of symmetric household preferences and absence of home bias in consumption, this implies that purchasing power parity holds at all times.

Monetary policy is conducted at the supranational level by a single monetary authority (or ‘central bank’) that sets the interest rate to target (a weighted average of) union-aggregate inflation and output. Fiscal policy, on the other hand, is conducted at the national level. In particular, each country has its own fiscal authority (or ‘government’) which is responsible for stabilising domestic output and the sustainability of sovereign debt. We assume that the fiscal authority may face fiscal solvency concerns by holders of sovereign bonds, reflected by a sovereign risk premium which is increasing in the public debt-to-output ratio.

The two countries are symmetric, yet are allowed to differ in country size and face idiosyncratic shocks. In the following, we focus on the Home environment; the behavioural and identity equations of the Foreign country are similar, unless specified otherwise. Variables expressed in Foreign currency are denoted with a '*' superscript. Wherever needed, demand for and prices of Home and Foreign goods are indexed by $H$ and $F$, respectively.

### 4.1.2 Households

In each period $t$, a representative household in the Home country chooses consumption, $c_t$, and labour supply, $n_t$, in order to maximise expected lifetime utility, expressed by

$$
E_t \sum_{k=0}^{\infty} \beta^k \left( \frac{c_{t+k}^{1-\sigma}}{1-\sigma} - \frac{n_{t+k}^{1+\varphi}}{1+\varphi} \right),
$$

where $E_t$ is the expectations operator conditional on the information available at $t$, $\beta \in (0, 1)$ denotes the household’s discount factor, $1/\sigma > 0$ is the inter-
4.1 A two-country monetary union

temporal elasticity of substitution and $1/\varphi > 0$ the Frisch elasticity of labour supply. The household receives labour income, $W_t n_t$ where $W_t$ denotes the nominal wage rate. Firm profits made by domestic intermediate goods firms, $\psi_t = \int_0^s \psi_t (h) \, dh$, are paid out as dividends to the household sector. The household must pay a tax proportional to its labour and dividend income to the home fiscal authority; the tax rate is denoted by $\tau_t$.

Asset markets are assumed to be incomplete and the household may hold only two types of one-period (non-state contingent) nominal bonds: a domestically traded sovereign bond, $B_t$, and an internationally traded foreign bond, $F^*_t$. The sovereign bond offers a gross nominal return of $R_{g,t}$, which is equal to the product of the (risk-free) policy rate set by the central bank and a sovereign risk premium which arises when holders of sovereign bonds grow concerns about fiscal insolvency (see below). Regarding the foreign bond, we assume that the household is a net debtor and, following Turnovsky (1985), must pay a ‘private risk premium’, denoted by $\Xi_{h,t}$, over the risk-free foreign interest rate $R^*_t$ when borrowing abroad.\(^3\)

In line with recent literature, the private risk premium represents financial intermediation costs and is increasing in the country’s private external liabilities. Technically speaking, having $\Xi_{h,t}$ be determined by private external debt allows one to uniquely pin down $F^*$, i.e. the steady-state net foreign asset position of the household (see Schmitt-Grohé and Uribe, 2003). However, a reduced form financial friction of this kind also has a straightforward economic justification: as the household issues more and more debt and $F^*$ rises (relative to income), lenders become more concerned about the household’s ability to honour outstanding debt obligations and will therefore demand a higher risk premium to bear the additional credit risk.

In modelling the private risk premium, we also take into account the strong positive correlation between private credit risk and sovereign risk observed during the recent sovereign debt crisis in Europe (see Figure 4.2). Although causality may run in both directions (see Alter and Schüler, 2012), empirical evidence on the adverse effects of sovereign risk on private borrowing conditions is extensive (e.g. Borensztein and Panizza, 2009; Balteanu et al., 2011; Panetta et al., 2011; Bofondi et al., 2013; Demirgüç-Kunt and Huizinga,\(^3\)A similar international financial friction has been applied more recently by Benigno (2009) and De Paoli (2009).
2013; Zoli, 2013; Popov and Van Horen, 2013; Albertazzi et al., 2014). Such ‘sovereign risk pass-through’ is often explained by a significant exposure to sovereign default risk of financial intermediaries that hold large amounts of domestic sovereign bonds on their balance sheets, thereby making the financial sector more susceptible to a banking crisis following sovereign default.\footnote{According to another channel of sovereign risk pass-through, heavily strained public finances may adversely affect private borrowing conditions when a country’s sovereign is forced to raise future taxes significantly, or even appropriate private property, thereby limiting the ability of firms and households to honour their own debt obligations.}

The theoretical literature on sovereign risk pass-through is more limited, yet growing. For example, Bolton and Jeanne (2011), Gennaioli et al. (2014) and Sosa-Padilla (2014) use stylized models to capture the empirically observed relationship between sovereign default and bank lending rates and credit supply. Furthermore, Erceg and Lindé (2010) and Corsetti et al. (2013c) allow for the possibility that the risk of sovereign default, rather than default itself, can affect private borrowing conditions. This type of sovereign risk pass-through can be motivated by the fact that sovereign bonds are often used by banks as collateral when tapping the wholesale market for funds. An increase in sovereign risk then reduces the price, and hence collateral value, of sovereign bonds, which in turn impairs the banks’ balance sheets and raises private interest rate spreads, even in the absence of sovereign default. Since we abstain from sovereign default events, and only focus on scenarios in which sovereign bonds can be perceived as more risky, we follow the latter approach and postulate the following function for $\Xi_{h,t}^*$:

$$\Xi_{h,t}^* = \exp(\chi_{h,1} F_t^* P_t) \exp(\chi_{h,2} B_t P_t y_t),$$

\begin{equation}
\tag{4.2}
\end{equation}

with $\chi_{h,1} > 0$ and where $P_t$ denotes the Home consumer price index (CPI) and $y_t$ real domestic aggregate output. Equation (4.2) implies that the degree of private and public indebtedness are used as proxy’s for private credit risk and sovereign risk, respectively, and both are used to determine the private risk premium. The extent to which investors expect sovereign risk to affect the household’s ability to repay is captured by the coefficient $\chi_{h,2} \geq 0$, which, as in Erceg and Lindé (2010) and Corsetti et al. (2013c), therefore serves as a reduced form representation of sovereign risk pass-through.\footnote{Since we refrain from the analysis of financial shocks, we ignore the possibility of conta-}
4.1 A two-country monetary union

Let $P_{H,t}$ denote the aggregate domestic price index. The household’s flow budget constraint can then be written as

$$P_{t}c_{t} + B_{t} + \xi_{h,t} R_{t-1}^{*} F_{t-1}^{*} = (1 - \tau_{t}) (W_{t}n_{t} + P_{H,t} \psi_{t}) + R_{g,t-1} B_{t-1} + F_{t}^{*}. \quad (4.3)$$

Maximising (4.1), subject to (4.3) and appropriate transversality conditions, while taking prices, the wage rate, the tax rate, the interest rates on sovereign and foreign bonds, the private risk premium and initial asset holdings, $B_{-1}$ and $F_{-1}^{*}$, as given, yields the following intratemporal first-order condition:

$$n_{t}^{\sigma} = (1 - \tau_{t}) \frac{W_{t}}{P_{t}} c_{t}^{-\sigma}, \quad (4.4)$$

which reflects that, in any point in time, the household equates the marginal disutility of working to the marginal utility of consumption times the effective real wage, and two Euler equations:

$$c_{t}^{-\sigma} = \beta E_{t} \left[ r_{g,t} c_{t+1}^{\sigma} \right], \quad (4.5)$$

$$c_{t}^{-\sigma} = \beta E_{t} \left[ \xi_{h,t} r_{t}^{*} c_{t+1}^{\sigma} \right], \quad (4.6)$$

with $r_{g,t} \equiv R_{g,t} (P_{t}/P_{t+1})$ and $r_{t}^{*} \equiv R_{t}^{*} \left( P_{t}^{*}/P_{t+1}^{*} \right)$, which determine the household’s optimal intertemporal allocation of consumption and savings by equating expected consumption growth to the real return of the assets available to the household.

A representative Foreign household has similar preferences and faces the following period budget constraint:

$$P_{t}^{*} c_{t}^{*} + B_{t}^{*} + F_{t}^{*} = (1 - \tau_{t}^{*}) \left( W_{t}^{*} n_{t}^{*} + P_{F,t}^{*} \psi_{t}^{*} \right) + R_{g,t-1}^{*} B_{t-1}^{*} + R_{t-1}^{*} F_{t-1}^{*} + \Upsilon_{t}^{*},$$

where $\Upsilon_{t}^{*}$ represents the intermediation profits. In equilibrium, the optimality conditions for labour supply, consumption and savings of the Foreign household give rise to private credit risk to sovereign risk; hence, the household sector might be exposed to deteriorating financial conditions in the public sector, but not the other way around.
are given by

\[(n_t^*)^{\sigma^*} = (1 - \tau_t^*) \frac{W_t^*}{P_t^*} (c_t^*)^{-\sigma^*}, \]  
\[(c_t^*)^{-\sigma^*} = \beta E_t \left[ r_{g,t}^* (E_{t+1} c_{t+1}^*)^{-\sigma^*} \right], \]  
\[(c_t^*)^{-\sigma^*} = \beta E_t \left[ r_t^* (E_t c_{t+1}^*)^{-\sigma^*} \right]. \]  

The household’s consumption bundle is a composite of domestically produced goods, \(c_{H,t}\), and imported goods, \(c_{F,t}\), as defined by the following Cobb-Douglas function:

\[c_t \equiv \frac{c_{H,t}^{1-s} c_{F,t}^s}{s^s (1 - s)^{1-s}}. \]  

Given the optimal choice of \(c_t\), and taking the aggregate Home and Foreign price indices as given, the household chooses the optimal allocation of Home and Foreign goods so as to minimise total consumption expenditures. The resulting demand schedules are given by

\[c_{H,t} = s \frac{P_{t}}{P_{H,t}} c_t, \quad c_{F,t} = (1 - s) \frac{P_{t}}{P_{F,t}} c_t, \]  

where the CPI is given by \(P_t = P_{H,t} P_{F,t}^{1-s}\). Similarly, Foreign demand for Home goods, \(c_{H,t}^*\), and Foreign goods, \(c_{F,t}^*\), is given by

\[c_{H,t}^* = s \frac{P_{t}^*}{P_{H,t}^*} c_t^* , \quad c_{F,t}^* = (1 - s) \frac{P_{t}^*}{P_{F,t}^*} c_t^* . \]  

Home and Foreign intermediate goods, \(c_{H,t}(h)\) and \(c_{F,t}(f)\), are aggregated according to the following CES composite indices:

\[c_{H,t} \equiv \left[ \left( \frac{1}{s} \right)^{\frac{1}{\epsilon - 1}} \int_0^s c_{H,t}(h)^{\frac{1}{\epsilon - 1}} \, dh \right]^{\frac{\epsilon - 1}{\epsilon}}, \quad c_{F,t} \equiv \left[ \left( \frac{1}{1 - s} \right)^{\frac{1}{\epsilon - 1}} \int_s^1 c_{F,t}(f)^{\frac{1}{\epsilon - 1}} \, df \right]^{\frac{\epsilon - 1}{\epsilon}}, \]  

where \(\epsilon > 1\) measures the elasticity of substitution between differentiated intermediate goods produced in the same country. Let \(P_{H,t}(h)\) and \(P_{F,t}(f)\) be the Home and Foreign price of the intermediate good produced by firm \(h\) and \(f\). The optimal allocation of expenditure within each variety of goods then
implies the following demand schedules:

\[ c_{H,t}(h) = \frac{1}{s} \left( \frac{P_{H,t}(h)}{P_{H,t}} \right)^{-\epsilon} c_{H,t}, \quad c_{F,t}(f) = \frac{1}{1-s} \left( \frac{P_{F,t}(f)}{P_{F,t}} \right)^{-\epsilon} c_{F,t}, \] (4.14)

Similarly, for Foreign households we find

\[ c^*_{H,t}(h) = \frac{1}{s} \left( \frac{P^*_H(h)}{P^*_H} \right)^{-\epsilon} c^*_{H,t}, \quad c^*_{F,t}(f) = \frac{1}{1-s} \left( \frac{P^*_F(f)}{P^*_F} \right)^{-\epsilon} c^*_{F,t}, \] (4.15)

where we have assumed that \( \epsilon = \epsilon^* \).

Since the Law of One Price holds, and because both countries share the same currency, prices are the same in each country, i.e. \( P_{H,t}(h) = P^*_{H,t}(h) \) and \( P_{F,t}(f) = P^*_{F,t}(f) \). The Home and Foreign aggregate price indices are given by

\[ P_{H,t} = P^*_{H,t} = \left[ \frac{1}{s} \int_0^s P_{H,t}(h)^{1-\epsilon} dh \right]^\frac{1}{1-\epsilon}, \quad P_{F,t} = P^*_{F,t} = \left[ \frac{1}{1-s} \int_s^1 P_{F,t}(f)^{1-\epsilon} df \right]^\frac{1}{1-\epsilon}. \] (4.16)

4.1.3 Firms

Each household owns an intermediate goods firm which produces a differentiated good \( y_t(h) \) using the following constant returns to scale production technology:

\[ y_t(h) = a_t n_t(h), \] (4.17)

where \( n_t(h) \) is the amount of labour demanded by firm \( h \). The variable \( a_t \) denotes a shock to labour productivity.

The firm aims to minimise its labour costs, \( W_t n_t(h) \), subject to the technology constraint (4.17). The resulting optimality condition for labour demand is given by

\[ \Lambda_t(h) = \frac{W_t}{a_t}, \] (4.18)

where \( \Lambda_t(h) \) denotes the Lagrange multiplier to (4.17) and is referred to as the firm’s nominal marginal costs, i.e. \( \Lambda_t(h) \equiv MC_t(h) \). Equation (4.18) holds for all firms and therefore \( MC_t(h) = MC_t \).

Although firms have monopolistic power over prices and are able to set
prices in excess of marginal costs, they face a price-setting constraint ala Calvo (1983). In particular, only a share of 1 − θ randomly selected firms is free to adjust prices in response to changing economic conditions, whilst remaining firms are forced to keep prices constant. Flexible price firms choose the optimal reset price, \( \overline{P}_{H,t} \), in order to maximise expected discounted profits, i.e.\(^6\)

\[
\max E_t \sum_{k=0}^{\infty} \theta^k Q_{t,t+k} \left( \overline{P}_{H,t} y_{t+k} (h) - W_{t+k} n_{t+k} (h) \right),
\]

subject to the production function and the function determining the demand for the firm’s goods, which is given by

\[
y_t (h) = \left( \overline{P}_{H,t} / P_{H,t} \right)^{-\epsilon} y_t.
\]

\( Q_{t,t+k} \) is a k-step ahead equilibrium pricing kernel satisfying

\[
Q_{t,t+k} = \beta E_t \left[ (c_{t+k} / c_t)^{\sigma} (P_t / P_{t+k}) \right].
\]

The resulting optimal reset price is then a mark-up over current and future discounted real marginal costs, i.e.

\[
\overline{P}_{H,t} = \mathcal{M} \frac{E_t \sum_{k=0}^{\infty} \theta^k Q_{t,t+k} P_{H,t+k}^{1+\epsilon} y_{t+k}^{1+\epsilon} y_t^{1+\epsilon} m c_{t+k}^{1+\epsilon}}{E_t \sum_{k=0}^{\infty} \theta^k Q_{t,t+k} P_{H,t+k}^{1+\epsilon} y_{t+k}^{1+\epsilon} m c_{t+k}^{1+\epsilon}},
\]  

(4.19)

where \( \mathcal{M} \equiv \epsilon / (\epsilon - 1) \) is the price mark-up and \( m c_t \equiv M C_t / P_{H,t} \) denotes real marginal costs. Note that, under flexible prices, \( \theta \to 0 \) and \( \overline{P}_{H,t} = P_{H,t} \), such that this equation collapses to \( m c_t = 1 / \mathcal{M} \).

A Foreign intermediate goods firm faces a similar technology and price-setting constraint and sets prices according to

\[
\overline{P}_{F,t} = \mathcal{M} \frac{E_t \sum_{k=0}^{\infty} (\theta^*)^k Q_{t,t+k}^* P_{F,t+k}^{1+\epsilon} y_{t+k}^{1+\epsilon} m c_{t+k}^{1+\epsilon}}{E_t \sum_{k=0}^{\infty} (\theta^*)^k Q_{t,t+k}^* P_{F,t+k}^{1+\epsilon} y_{t+k}^{1+\epsilon} m c_{t+k}^{1+\epsilon}},
\]  

(4.20)

where \( m c_t^{*} \equiv M C_t^{*} / P_{F,t}^{*} = (W_t^{*} / a_t^{*}) / P_{F,t}^{*} \) denotes Foreign real marginal costs.

### 4.1.4 Monetary and fiscal policy

Monetary policy is conducted at the supranational level by a single monetary authority which follows a variant of the familiar Taylor rule (Taylor, 1993). It aims to maintain macroeconomic stability at the union-wide level by relating the gross nominal policy rate, \( R_t \), to deviations of union-aggregate inflation

\(^{6}\)Due to symmetry across firms, the optimal reset price can be written without the \( h \) index.
and output from their respective targets/steady-state levels:

\[
\frac{R_t}{R} = \left( \frac{R_{t-1}}{R} \right)^{\rho_R} \left[ \frac{\pi_{W,t}}{\pi_W} \right]^{\alpha_\pi} \left( \frac{y_{W,t}}{y_W} \right)^{\alpha_y} \left( 1 - \rho_R \right),
\]

(4.21)

where \( \rho_R \in [0, 1] \) reflects the degree of interest rate smoothing (or policy inertia) and \( \alpha_\pi > 1 \) (\( \alpha_y \geq 0 \)) measures the aggressiveness of the central bank’s inflation (output) policy. Union-wide inflation and output are weighted averages of Home and Foreign variables, where country sizes \( s \) and \( 1 - s \) are used as weights, i.e. \( \pi_{W,t} \equiv s\pi_t + (1 - s)\pi_t^* \), where \( \pi_t \equiv p_t/p_{t-1} \) and \( \pi_t^* \equiv p_t^*/p_{t-1}^* \) denote Home and Foreign CPI inflation, and \( y_{W,t} \equiv sy_t + (1 - s)y_t^* \). The target values for union-wide inflation and output, denoted by \( \pi_W \) and \( y_W \), are equal to their respective steady state values.

In each country, there is a fiscal authority which levies a proportional income tax and issues one-period nominal bonds (to domestic households only) to cover public expenditures. The stock of government debt at the beginning of the period equals current outstanding public liabilities minus the government’s primary budget surplus. For the Home country, this boils down to the following period budget constraint:

\[
B_t = R_{g,t-1}B_{t-1} - P_{H,t} (\tau_t y_t - g_t),
\]

(4.22)

where \( g_t \) denotes real public consumption. Since \( g_t \) does not affect household utility, nor the production technology of the intermediate goods firms, we assume that \( g_t \) evolves exogenously according to an AR(1) process.

Dividing (4.22) by \( P_t \) and then solving forward recursively yields the inter-temporal government budget constraint:

\[
R_{g,t-1} \frac{B_{t-1}}{P_t} = \sum_{n=0}^{\infty} \left( \prod_{m=0}^{n} r_{g,t+m}^{-1} \right) \frac{P_{H,t+n}}{P_{t+n}} (\tau_{t+n} y_{t+n} - g_{t+n}),
\]

(4.23)

where we have imposed the following no-Ponzi scheme condition which prevents the government from rolling over its debt indefinitely:

\[
\lim_{k \to \infty} \left( \prod_{m=0}^{k-1} r_{g,t+m}^{-1} \right) \frac{B_{t+k}}{P_{t+k}} = 0.
\]

(4.24)

Equation (4.23) is an equilibrium condition and requires that the real value
of outstanding government debt (left-hand side) equals the discounted sum of future real primary budget surpluses (right-hand side). In order to ensure that the fiscal authority makes appropriate adjustments in its primary surplus over time to satisfy (4.23), we impose the following rule for taxes:\footnote{The Foreign government faces a similar tax rule.}

\[
\tau_t = \tau + \gamma_b \left( \frac{b_{t-1}}{y_{t-1}} - \frac{\bar{b}}{\bar{y}} \right) + \gamma_y (y_{t-1} - \bar{y}),
\]

(4.25)

where \(b_t \equiv B_t/P_t\) denotes the level of real public debt. The target values for the debt ratio and the level of aggregate output, denoted by \(\bar{b}/\bar{y}\) and \(\bar{y}\), are assumed to equal their respective steady state values. Rules similar to equation (4.25) have been used extensively in the empirical literature to test for the sustainability of public debt and estimate the cyclical fiscal stance in both advanced and emerging market economies (see e.g. Gavin and Perotti, 1997; Galí and Perotti, 2003; Greiner et al., 2007; Mendoza and Ostry, 2008; Debrun and Kapoor, 2010; Ghosh et al., 2013). In line with empirical evidence, we restrict the government to respond only to lagged variables, reflecting political constraints that impede on and delay fiscal decision making.\footnote{Allowing the government respond to contemporary variables does not alter our main results in any significant way.}

As shown by Bohn (1998), a positive feedback from debt to the primary budget surplus is sufficient to ensure the no-Ponzi scheme condition (4.24) holds (and therefore also the intertemporal government budget constraint [4.23]; see Bohn, 2007, and Bohn, 2008). Furthermore, the slope of the tax rule needs to be higher than the steady-state real interest rate in order for government debt to be stationary in equilibrium (see also Leeper, 1991). We therefore impose the following fiscal solvency and sustainability requirement:

\[\gamma_b > r_g - 1.\]

The tax rule also captures the output stabilisation objective of the government. The desire to use fiscal policy to stabilise domestic output may arise when a country enters a monetary union and faces country-specific aggregate shocks (see for instance Beetsma and Jensen, 2005, and Galí and Monacelli, 2008). Having lost autonomy over monetary policy, a union member must then rely on fiscal policy to absorb such shocks (especially when its weight in the monetary policy rule is small). If the government sets \(\gamma_y > 0\), a con-
traction in output is met by a fall in the primary surplus and fiscal policy is said to be ‘countercyclical’; if, on the other hand, \( \gamma_y < 0 \), fiscal policy tends to intensify the business cycle as the government responds in a ‘pro-cyclical’ way to changes in output. Therefore, \( \gamma_y \) reflects the cyclic fiscal stance of the government. The main objective in this chapter is to examine the effects of sovereign risk on the performance of countercyclical fiscal policy in terms of output stabilisation and to uncover the optimal cyclical fiscal stance.

4.1.5 Introducing sovereign risk

We introduce sovereign risk following the approach of Davig et al. (2011) and Bi (2012). In particular, we assume that sovereign risk may arise due to the presence of a so-called ‘fiscal limit’ which determines the maximum rate of taxes, say \( T \), that is politically (or economically) feasible.\(^9\) When the stock of government debt reaches a level that, by the tax rule (4.25), forces the tax rate to breach the fiscal limit, the government (partially) defaults on its outstanding debt, since it will not (or cannot) raise taxes beyond \( T \); on the other hand, when \( \tau_t < T \), the government fully honours its debt. Although agents do not know \( T \) prior to entering a sovereign bond contract (\( T \) is observed only when the bond matures), they know its distribution and, since they are forward-looking, form expectations about future sovereign default probabilities. Consequently, even if the economy is not at its fiscal limit, the mere possibility of getting there can affect today’s bond price: the higher is the probability of reaching the fiscal limit, the lower is the price.

Since the fiscal limit is stochastic and dependent on the state of the economy, explicitly modelling its conditional distribution can be quite cumbersome. Also, the fiscal limit implies non-linearities within the model, which renders a linear approximation unsuitable to study the model’s dynamics. Furthermore, since demand for sovereign bonds can or cannot be sustained in equilibrium, depending on whether or not \( T \) has been breached, one easily runs into problems of multiple (and possibly self-fulfilling) equilibria (see Calvo, 1988). We do not take up the task to solve these problems here, yet instead circumvent them by assuming that \( T \) is determined exogenously (see

\(^9\)As discussed by Ghosh et al. (2013), countries that belong to a monetary union are more prone to reaching the fiscal limit (which they refer to as ‘fiscal fatigue’), since they are more constrained in their use of monetary policy.
also Corsetti et al., 2013c, Daniel and Shiamptanis, 2013, Locarno et al., 2013, Roeger and in ’t Veld, 2013, and Schabert and van Wijnbergen (2014), for similar treatments of the fiscal limit). This allows us to distinguish two separate equilibria: a ‘good equilibrium’ in which $\tau_t$ is far below $T$ and the risk of breaching the fiscal limit is negligible, and a ‘bad equilibrium’ in which $\tau_t$ is close to $T$ such that breaching the fiscal limit, and therefore sovereign default, is more likely. In doing so, we dismiss realisations of sovereign defaults altogether and rather focus on the risk of default, which, as evidenced by the recent sovereign debt crisis in Europe, can have significant effects on sovereign bond spreads even if default never occurs.

Characterising investor expectations in either equilibria is a ‘sovereign risk premium’, denoted by $\Xi_{g,t}$, which is monotonically increasing in the level of government debt as a share of domestic output:

$$
\Xi_{g,t} = \exp\left(\frac{b_t}{\gamma_b} - \frac{\gamma_g - 1}{\gamma_b}\right),
$$

$$
R_{g,t} = \Xi_{g,t}R_t.
$$

The coefficient $\chi_g \geq 0$ essentially reflects the slope of the fitted lines in Figure 4.1 and identifies which equilibrium, good or bad, prevails. In the good equilibrium, $\chi_g$ is (close to) zero such that an increase in government debt does not translate into a higher sovereign risk premium. In this case, investors fully trust the government to be able to sufficiently (and acutely) raise taxes to cover outstanding debt obligations and avoid default, even if the level of debt is relatively high (as was the case for Belgium before the euro crisis erupted). In the bad equilibrium, investors believe that further debt issuance brings the economy closer to the fiscal limit, which raises the risk of sovereign default (even if the government satisfies the fiscal solvency requirement $\gamma_b > r_g - 1$). To compensate for the additional risk, investors will then demand a higher sovereign risk premium and so $\chi_g$ takes on positive values. The bad equilibrium is thus associated with a downward sloping demand curve for sovereign bonds, which limits the government’s scope to issue debt at low rates (as was the case for many euro periphery countries during the hight of the sovereign

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10 We assume that the Foreign fiscal authority does not face a sovereign risk premium such that $R_{g,t}^* = R_t$. 

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debt crisis). The calibration of \( \chi_g \) is discussed further below.\(^{11}\)

4.1.6 Market clearing

Public consumption is assumed to be entirely in terms of domestically produced goods (reflecting the high degree of home bias in public spending often observed in advanced economies) and is aggregated using the same CES technology as used by households. Under these assumptions, aggregate demand for the Home and Foreign intermediate good is given by

\[
y_t(h) = \left( \frac{P_{H,t}(h)}{P_{H,t}} \right)^{-\epsilon} \left[ S_t^{1-s} (sc_t + (1-s)c_t^*) + g_t \right], \tag{4.28}
\]

\[
y_t(f) = \left( \frac{P_{F,t}(f)}{P_{F,t}} \right)^{-\epsilon} \left[ S_t^{-s} (sc_t + (1-s)c_t^*) + g_t^* \right], \tag{4.29}
\]

where \( S_t \equiv P_{F,t}/P_{H,t} \) refers to the terms of trade. Using appropriate aggregators for the intermediate goods \( y_t(h) \) and \( y_t(f) \), we can derive the following goods market clearing conditions for the Home and Foreign country:

\[
y_t = S_t^{1-s} (sc_t + (1-s)c_t^*) + g_t, \tag{4.30}
\]

\[
y_t^* = S_t^{-s} (sc_t + (1-s)c_t^*) + g_t^*. \tag{4.31}
\]

Using the production function of and demand schedule for intermediate goods, we obtain the following labour market clearing condition for Home:

\[
n_t = \int_0^s n_t(h) \, dh = \frac{y_t}{a_t} \int_0^s \left( \frac{P_{H,t}(h)}{P_{H,t}} \right)^{-\epsilon} \, dh, \tag{4.32}
\]

and for Foreign:

\[
n_t^* = \int_s^1 n_t^*(f) \, df = \frac{y_t^*}{a_t} \int_s^1 \left( \frac{P_{F,t}^*(f)}{P_{F,t}^*} \right)^{-\epsilon} \, df, \tag{4.33}
\]

Finally, the balance of payments condition is derived by consolidating the household’s and public’s budget constraints and implies that national savings

\(^{11}\)Equation (4.26) can also be seen as a reduced form representation of the pricing rule for sovereign bonds developed by Bi (2012), who derives the fiscal limit endogenously using dynamic Laffer curves and shows that the sovereign risk premium is a non-linear and convex function of the government debt-to-output ratio.
must equal net capital outflow:

\[ P_{H,t}(y_t - g_t) - P_t c_t = \Xi^*_{h,t-1} R^*_t F^*_t - F^*_t. \]  (4.34)

By Walras’ law, we do not need a similar condition for the Foreign country.

### 4.1.7 Equilibrium

A rational expectations equilibrium is given by a sequence of the model’s endogenous variables that satisfies the labour supply and savings decisions of the households, determined by conditions (4.4)-(4.6), the household’s budget constraint (4.3), demand schedules and price indices (4.11), (4.14) and (4.16), the firm’s price-setting condition (4.19), the monetary and fiscal policy rules (4.21) and (4.25), the public’s intertemporal budget constraint (4.23), the bond pricing equations (4.26) and (4.27), the labour and goods market clearing conditions (4.30) and (4.32), the balance of payments conditions (4.34), and Foreign counterparts, given exogenous processes for productivity and government spending shocks and the fiscal limit.

### 4.1.8 Calibration

To analyse the dynamics of the model, we linearise the equilibrium conditions around a deterministic steady state. The model is then calibrated based on a quarterly frequency. Unless stated otherwise, Foreign parameters are assigned the same value as Home parameters. The benchmark parameterisation is listed in Table 4.1.

For most of the model’s structural parameters, we take those values that are commonly found in the literature. In particular, we set the discount factor equal to \( \beta = 0.99 \), which implies an annualised real interest rate of about 4%, assume \( \sigma = 1 \), such that utility depends on the log of consumption, and choose \( \varphi = 3 \), implying a Frisch elasticity of labour supply of 1/3. Consistent with estimates of Smets and Wouters (2003), we set \( \theta = 0.9 \), which implies an average price-contract of 2.5 years, and, following Corsetti et al. (2012a), we set the elasticity of substitution between intermediate goods at \( \epsilon = 11 \), implying a price mark-up of 10%. Further, following Bouakez and Eyquem

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12Details of the linearisation are provided in Appendix 4.A.
Table 4.1: Benchmark calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
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</tr>
<tr>
<td>$1/\sigma$</td>
<td>Intertemporal elasticity of substitution</td>
<td>1</td>
</tr>
<tr>
<td>$1/\varphi$</td>
<td>Frisch elasticity of labour supply</td>
<td>1/3</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Probability of non-price adjustment</td>
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</tr>
<tr>
<td>$\epsilon$</td>
<td>Elasticity of substitution between intermediate goods</td>
<td>11</td>
</tr>
<tr>
<td>$\chi_{h,1}$</td>
<td>Private risk premium elasticity w.r.t. private debt</td>
<td>0.0017</td>
</tr>
<tr>
<td>$\chi_{h,2}$</td>
<td>Private risk premium elasticity w.r.t. public debt</td>
<td>0 or $0.1 \times \chi_g$</td>
</tr>
<tr>
<td>$\chi_g$</td>
<td>Sovereign risk premium elasticity w.r.t. public debt</td>
<td>0 or 0.115</td>
</tr>
<tr>
<td>$\rho_a$</td>
<td>Persistence of productivity shocks</td>
<td>0.95</td>
</tr>
<tr>
<td>$\rho_g$</td>
<td>Persistence of government spending shocks</td>
<td>0.95</td>
</tr>
<tr>
<td>$b/y$</td>
<td>Steady-state public debt ratio (annualised)</td>
<td>0.6</td>
</tr>
<tr>
<td>$f^*/y$</td>
<td>Steady-state private debt ratio (annualised)</td>
<td>0.6</td>
</tr>
<tr>
<td>$g/y$</td>
<td>Steady-state government consumption ratio</td>
<td>0.2</td>
</tr>
<tr>
<td>$c/y$</td>
<td>Steady-state private consumption ratio</td>
<td>0.8</td>
</tr>
<tr>
<td>$\tau$</td>
<td>Steady-state tax rate</td>
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</tr>
<tr>
<td>$s$</td>
<td>Relative size of the Home country</td>
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</tr>
<tr>
<td>$\rho_R$</td>
<td>Interest rate smoothing</td>
<td>0.8</td>
</tr>
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<td>$\alpha_\pi$</td>
<td>Monetary response to inflation</td>
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</tr>
<tr>
<td>$\alpha_g$</td>
<td>Monetary response to output</td>
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</tr>
<tr>
<td>$\gamma_b$</td>
<td>Fiscal response to government debt ratio</td>
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</tr>
<tr>
<td>$\gamma_g^*$</td>
<td>Fiscal response to output (in Foreign)</td>
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</tr>
</tbody>
</table>
(2015), who rely on estimates of Lane and Milesi-Ferretti (2002), we set the elasticity of the private risk premium with respect to changes in household net external debt to $\chi_{h,1} = 0.0017$. Also, we assume that, in times when public finances are perceived as weak, 10% of an increase in sovereign risk is passed on to private borrowing conditions, such that $\chi_{h,2} = 0.1 \times \chi_g$.\(^{13}\)

Productivity and government spending shocks evolve according to the following AR(1) processes:

\begin{align}
    a_t &= \rho_a a_{t-1} + \varepsilon_{a,t}, \\
    g_t &= \rho_g g_{t-1} + \varepsilon_{g,t},
\end{align}

where $\rho_a \in [0, 1]$ and $\rho_g \in [0, 1]$ measure the persistence of the shocks and where $\varepsilon_{a,t} \sim \mathcal{N}(0, \sigma_a^2)$ and $\varepsilon_{g,t} \sim \mathcal{N}(0, \sigma_g^2)$ are random i.i.d. terms. Similar expressions apply for $a^*_t$ and $g^*_t$. Importantly, we assume that shocks are uncorrelated across countries in order to highlight the role of fiscal stabilisation policy at the national level. Following estimates from King and Rebelo (1999), we set $\rho_a = 0.95$, whereas we choose $\rho_g = 0.95$ as in Smets and Wouters (2003).

The steady-state private and public debt-to-output ratio’s are assumed to be 60% (on an annual basis), while public consumption as a share of output in steady state is set to 20%, consistent with euro area averages. Using the balance of payments condition (4.34) and the government’s flow budget constraint (4.22), we then obtain a steady-state consumption-to-output ratio of about 80%, and a steady-state tax rate of around 20%. As a benchmark, we consider a ‘small member state’ in which the relative economic size of the Home country is equal to $s = 0.02$ (which is about the size of Greece’s GDP as a share of total euro area GDP).

The monetary policy parameters are given values equal to $\rho_R = 0.8$, $\alpha_x = 1.5$ and $\alpha_y = 0.5$, which ensures that the Taylor-principle is satisfied and equilibrium determinacy guaranteed. We consider alternative values for the fiscal policy parameter $\gamma_y$ to assess the performance of fiscal stabilisation policy, while the debt parameter is set to $\gamma_b = 0.2$, which is large enough to ensure a stationary path for government debt in equilibrium. Throughout, we assume

\(^{13}\)Our choice for $\chi_{h,2}$ is somewhat on the lower end of recent estimates from the empirical literature. For example, Zoli (2013) finds that of a 1% increase in Italian sovereign risk, as measured by the sovereign CDS rate, roughly 35% is transmitted to the CDS rates of Italian banks.
4.1 A two-country monetary union

Table 4.2: Estimates for $\chi_g$: the relationship between the debt ratio and the sovereign risk premium in the euro area

<table>
<thead>
<tr>
<th>Sovereign risk premium</th>
<th>Full sample</th>
<th>Only euro crisis$^1$</th>
<th>Only euro periphery countries$^2$</th>
<th>Only euro crisis and periphery countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt ratio</td>
<td>5.57***</td>
<td>10.17***</td>
<td>7.00***</td>
<td>11.49***</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.66)</td>
<td>(0.37)</td>
<td>(1.02)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.71</td>
<td>0.80</td>
<td>0.59</td>
<td>0.71</td>
</tr>
<tr>
<td>No. of observations</td>
<td>783</td>
<td>221</td>
<td>258</td>
<td>68</td>
</tr>
</tbody>
</table>

Notes: ‘Sovereign risk premium’ is defined as the long-run (10 year) government bond yield, minus the yield on a similar German bond (in basis points), and ‘debt ratio’ denotes gross government debt as a share of nominal GDP (in percentage points); constants and country fixed effects dummies have been suppressed. Standard errors are given in parentheses. *** denotes a $p$-value lower than 0.001. Data are for Austria, Belgium, Estonia, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Slovak Republic and Spain. Source: own estimates based on data from the OECD National Accounts Statistics database.

(1) The euro crisis covers the period 2008Q1-2012Q1. (2) Euro periphery countries refer to Ireland, Italy, Portugal and Spain (quarterly data for Greece were unavailable).

fiscal policy in Foreign is a-cyclical, i.e. $\gamma_y^* = 0$.

The key parameter of this chapter is $\chi_g$, which measures the sensitivity of the sovereign risk premium with respect to changes in the government debt ratio and plays an important role in characterising equilibrium properties. Empirical estimates for $\chi_g$ are somewhat inconclusive. For instance, Laubach (2009) finds that an increase in the debt ratio of 1% in the US raises long-term real interest rates by 2-4 basis points. Jaramillo and Weber (2013), on the other hand, find higher estimates for emerging economies during times of elevated risk aversion, with 10-year bond yields increasing by 6 basis points for every 1% increase in the expected debt-output ratio. Here, we provide our own estimates for $\chi_g$ by simply estimating the sovereign risk premium function (4.26) using a fixed-effects panel model and the data presented in Figure 4.1. To increase the number of observations, we use a larger time-window (from 1995Q1 to 2013Q4) and include data for additional European countries (Estonia, Finland, Germany, Luxembourg, and Slovak Republic). All data are retrieved from the OECD database.

The results are displayed in Table 4.2. As expected, an increase in the debt...
ratio is associated with a higher sovereign risk premium, especially during the crisis period. Since we are particularly interested in the relationship between the sovereign risk premium and government indebtedness in the ‘bad equilibrium’, in which investors assign higher probabilities of sovereign default, we also estimate \( \chi_g \) based on data from euro periphery countries only. As evidenced by Figure 4.1, these countries have experienced sharper increases in the sovereign risk premium than other European countries, especially during the sovereign debt crisis. Columns 3 and 4 of Table 4.2 indeed report larger estimates for \( \chi_g \), predicting a rise in the sovereign risk premium of 11.49 basis points for every 1% increase in the debt ratio during 2008-2012. Based on these results, we set \( \chi_g = 0.115 \) when considering the bad equilibrium case and \( \chi_g = 0 \) otherwise. However, as these results should be treated with caution, we shall experiment with alternative values for \( \chi_g \) to test for the robustness of our numerical results.

4.2 Fiscal stabilisation policy and sovereign risk

4.2.1 Endogenous fiscal policy

We start by assessing the performance of the output stabilisation function of fiscal policy and the implications of sovereign risk premia. We do so by assuming the Home country experiences an economic crisis in the form of a negative country-specific productivity shock. The reason that we do not consider shocks that are symmetric across the monetary union (or shocks borne from the much larger Foreign country) is because such shocks would elicit a much stronger countercyclical monetary response by the central bank which reduces the role of fiscal policy in stabilising output at the national level. Instead, small member states facing country-specific shocks receive less ‘monetary support’ (as their weight in the monetary policy rule is small) and must therefore rely more heavily on fiscal policy.

Figure 4.3 shows the responses of output, consumption, government debt (as a share of output), CPI inflation and the sovereign risk premium following a negative productivity shock in Home. In each plot, the endogenous fiscal response to the shock can either be countercyclical (indicated by the marked (blue) lines), in which case taxes are cut following a reduction in output, a-
4.2 Fiscal stabilisation policy and sovereign risk

Figure 4.3: Responses to a negative productivity shock in Home as a function of the cyclical fiscal stance ($\gamma_y$)

Without sovereign risk ($\chi_g = 0$)

With sovereign risk ($\chi_g = 0.115$)

Notes: The figures show the responses of selected endogenous variables, in terms of percentage deviations from steady state, following a negative, country-specific productivity shock in Home. Alternative cyclical fiscal stances are considered: dotted lines = countercyclical; dashed lines = pro-cyclical; solid lines = a-cyclical.
cyclical (solid (black) lines), in which case taxes do not respond to changes in output, or pro-cyclical (dashed (red) lines), in which case taxes are raised following a reduction in output. In the first column, we have considered the ‘good equilibrium’ such that \( \chi_g = 0 \) and the sovereign risk premium remains constant over time. Upon impact, output and consumption contract, whereas inflation rises due to the rise in firm’s real marginal costs. Government indebtedness rises as well, since tax revenue is proportional to income. In the absence of a time-varying sovereign risk premium, the cyclicity of fiscal policy does not seem to affect macroeconomic conditions much, although output contractions can be mitigated somewhat if the government pursues a more countercyclical fiscal stance. Particularly, when \( \gamma_y \) is assigned positive values, the government automatically reduces taxes in response to output contractions. Since lowering taxes stimulates labour supply and production, the government partially offsets the initial adverse effects of the negative productivity shock.

Note, however, that a countercyclical fiscal stance also leads to a stronger accumulation of sovereign debt. In the second column of Figure 4.3, we have assumed that such a build-up of debt pushes the economy into the ‘bad equilibrium’ and induces sovereign bond holders to raise the sovereign risk premium (i.e. \( \chi_g > 0 \)). Under such conditions, the role of the cyclical stance of fiscal policy in stabilising the economy changes markedly. Now, a countercyclical fiscal response to the crisis worsens the contraction in output and leads to stronger output fluctuations, whereas a pro-cyclical fiscal stance mitigates the output contraction and reduces fluctuations in output. Also, the reduction in consumption is much larger under a time-varying sovereign risk premium when fiscal policy is countercyclical, whereas consumption rises under pro-cyclical fiscal policy.

To understand how raising, rather than cutting, taxes in response to a contraction in output can lead to more stable economic conditions in times of sovereign risk, note first that reducing taxes generates budget deficits and, subsequently, an increase in the accumulation of government debt due to a higher sovereign risk premium. In order to satisfy the government’s intertemporal budget constraint (4.23), future tax liabilities need to rise which lowers the expected life-time disposable income of households. At the same time, an increase in the sovereign risk premium also leads to an increase in the private risk premium, as implied by (4.2), and thus worsens private borrowing condi-
Figure 4.4: Output variability under negative productivity shocks in Home as a function of shock persistence ($\rho_a$) and fiscal policy ($\gamma_y$)

**Notes:** The figures show the standard deviation of output in Home following a negative productivity shock as a function of $\rho_a \in [0, 1]$, which is the auto-correlation coefficient of the productivity shock $a_t$ (see [4.35]). Alternative cyclical fiscal stances are considered: dotted lines = countercyclical; dashed lines = pro-cyclical; solid lines = a-cyclical.

Households respond by increasing (precautionary) savings and reducing the level of consumption, causing output to fall by more than under a constant sovereign risk premium. Therefore, when faced with a negative productivity shock, reducing taxes can actually be destabilising and exacerbate the ensuing crisis through a negative wealth and crowding-out effect on private spending. If, on the other hand, the government were to place more emphasis on stabilising debt and raises taxes, the effects of the crisis can be mitigated as the consequent reduction in the stock of debt reduces the need for higher future taxes and also reduces the private risk premium, both of which support household consumption.\footnote{To some degree, these results are akin to the ideas of the ‘expansionary fiscal contractions’ hypothesis, pioneered by Giavazzi and Pagano (1990), Sutherland (1997), Alesina and Ardagna (1998) and Perotti (1999).}

The effects of fiscal stabilisation policy on output variability as a function of the persistence of the productivity shock, $\rho_a$, are displayed in Figure 4.4. The figure shows that the standard deviation of output, following a negative productivity shock in Home, rises as the shock becomes more persistent (i.e. the larger is $\rho_a$). The figure in the left panel, in which the sovereign risk...
Figure 4.5: Responses to a positive government spending shock in Home

Notes: The figures show the responses of selected endogenous variables, in terms of percentage deviations from steady state, following a positive government spending shock in Home (of 1% of output). Here, we assume $\gamma_y = 0$.

4.2.2 Discretionary fiscal policy

The implications of the sovereign risk premium for the performance of endogenous fiscal responses to aggregate shocks are similar when considering discretionary fiscal policy. In Figure 4.5, we consider the effects of a transit-
ory government spending shock (of 1% of output) in Home. We assume fiscal policy is a-cyclical and set $\gamma_y = 0$ so as to ignore the effects of the endogenous fiscal response to output. According to standard Keynesian theory, government spending multipliers are typically larger when monetary policy is less responsive to fiscal policy and therefore predicts larger multipliers when interest rates are pegged (see Hebous, 2011, for an overview of the literature). This may apply to our small Home country as well, since it essentially faces a pegged interest rate. According to Figure 4.5, the output response following the government spending shock is indeed large and the impact government spending multiplier even exceeds unity in the absence of sovereign risk (indicated by the solid (black) line). Also, as aggregate demand rises, and without a strong offsetting monetary response, inflation rises. Furthermore, the government expansion leads to an increase in government debt, which creates a negative wealth effect and induces households to reduce consumption and raise labour supply.

The effects of government spending on output are weakened, however, when the sovereign risk premium becomes more responsive to changes in government indebtedness (see the marked and dashed (red) lines). As the sovereign risk premium elasticity $\chi_g$ rises, output contracts faster following the initial jump and the cumulative government spending multiplier falls (output can even fall below steady state when $\chi_g$ is sufficiently large). Underlying the weaker potency of fiscal policy are again the effects of the sovereign risk premium on consumption, as evidenced by the stronger contraction in consumption following the government spending shock the larger is $\chi_g$. In a sense, the rise in the sovereign risk premium acts as an offsetting contractionary monetary response, that would have otherwise occurred if Home was a closed economy, and amplifies the crowding-out effects on consumption.

In Figure 4.6, we examine what happens to the potency of discretionary fiscal policy when the Home country approaches the closed economy case, i.e. as $s \to 1$. In line with traditional Keynesian wisdom, we find that the impact government spending multiplier falls as country size rises, as shown in the left panel of Figure 4.6: the larger is the economy, the more responsive the central bank becomes to regional shocks and the more it will raise the interest rate following a fiscal expansion. Consistent with Figure 4.5, the government spending multiplier falls in the presence of sovereign risk premia as long as the
Figure 4.6: Government spending multiplier as a function of country size ($s$)

Notes: The figures show the impact output response in Home following a positive government spending shock (of 1% of output) as a function of $s$, which denotes the size of the Home country. Here, we assume $\gamma_y = 0$.

The central bank keeps the interest smoothing parameter at $\rho_R = 0.8$, as shown in the right panel of Figure 4.6. However, note that when the central bank pursues a more aggressive inflation policy and reduces $\rho_R$, the multiplier falls by less and can even increase with country size if $\rho_R$ is sufficiently low. Intuitively, the larger is the economy, the more the central bank will accommodate the fall in inflation (and consumption), caused by the rise in the sovereign risk premium, by reducing the interest rate. Hence, when approaching the closed economy case, government spending multipliers in the presence of sovereign risk can still be large, provided the central bank fully offsets the rise in the sovereign risk premium. If the central bank were unable to reduce the interest rate, for instance, because it is constrained by the zero lower bound on the nominal policy rate, the multiplier can be low and even negative (for the case where $\rho_R \to 1$, see Figure 4.9 in Appendix 4.D).\(^{15}\)

The results presented in this section indicate that the performance of fiscal

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\(^{15}\)These results are in line with Bonam and Lukkezen (2014b), who show that government spending multipliers in the presence of sovereign risk can be larger under flexible exchange rates than under fixed exchange rates. As in the present chapter, the authors show that sovereign risk can generate considerable crowding-out effects on household consumption, yet these may be less severe under flexible exchange rates when monetary policy is free to offset the effects of sovereign risk by lowering the interest rate.
stabilisation policy crucially depends on the perceived riskiness of sovereign
debt. Whereas reducing taxes in the event of an economic crisis may help sta-
bilise output in ‘normal times’, it might exacerbate economic conditions when
sovereign risk premia are very responsive to changes in government indebted-
ness. Furthermore, the results indicate that government spending multipliers
can be low or negative, even when monetary policy is effectively unresponsive
to shocks, for instance under considerable interest rate smoothing or when the
zero lower bound binds. It is therefore not clear whether previous results on
the effects of fiscal policy under liquidity traps (e.g. Eggertsson, 2001; Christi-
ano et al., 2009; Woodford, 2011) can be generalised to regimes characterised
by critically weak public finances. In fact, our results imply that monetary uni-
ons facing interest rates close to zero and a severe sovereign debt crisis would
benefit from (coordinated) fiscal consolidation policies and can overcome the
zero lower bound problem by reducing effective real interest rates through a
reduction in sovereign risk premia (see also Erceg and Lindé, 2010).

4.3 Optimal fiscal policy

Having examined the implications of sovereign risk premia for the stabilising
effects of fiscal policy, we now turn to the implications for the design of optimal
fiscal policy. For simplicity, yet without loss of generality, we assume that
government spending remains constant, i.e. \( g_t = g \) for all \( t \).

In order to define the optimal fiscal stance for the Home government, we
need to determine a suitable welfare criterion. As has become standard prac-
tice in the macroeconomics literature, we proxy welfare by the expected life-
time utility of the Home household, as given by Equation (4.1).\footnote{Earlier studies on optimal fiscal policy in a currency union often assume a benevol-
ent social planner that aims to maximise (a weighted average of) union-wide welfare (e.g. Kirsanova et al., 2007; Pappa and Vassilatos, 2007; Ferrero, 2009). However, we believe this
to be somewhat unrealistic and, in line with the current institutional set-up of the European
Economic and Monetary Union, consider fiscal authorities that are only concerned with
domestic welfare and conduct their policies non-cooperatively.} Using the
procedure proposed by Woodford (2003), we derive a second-order Taylor ap-

\[ 16 \]
proximation of (4.1), which is given by

\[
E_t \sum_{k=0}^{\infty} \beta^k W_{t+k} = -\left(\frac{c}{y}\right)^{-1} \sum_{k=0}^{\infty} \beta^k \left[\frac{(1+\varphi)}{2} (\hat{y}_{t+k} - \hat{y}_{t+k})^2 \right] \\
+ \frac{\epsilon}{2\kappa} \hat{\pi}_{t+k}^2 + (1 + \varphi) \hat{y}_{t+k} (\hat{y}_{t+k} - \hat{a}_{t+k}) \right] + \text{t.i.p.} + \mathcal{O}\left(\|\zeta\|^3\right),
\]

with \(\kappa \equiv (1 - \theta)(1 - \theta\beta) / \theta\) and where a variable with a hat denotes the percentage deviation of that variable from its steady-state level and a variable with a tilde denotes the corresponding natural level. Terms that are of order strictly higher than 2 are collected in \(\mathcal{O}\left(\|\zeta\|^3\right)\), while terms independent of policy (such as constants and shocks not affected by changes in policy) are collected in ‘t.i.p.’ As in Benigno (2004), we have derived Equation (4.37) around the ‘efficient steady state’, in which prices are fully flexible and monopolistic distortions are eliminated through use of an appropriate tax subsidy.\(^{17}\)

According to Equation (4.37), welfare \(W_t\) is decreasing in output variability, which provides a potential role for fiscal stabilisation policy. We assume that the Home government aims to maximise the well-being of its citizens by setting fiscal policy according to the tax rule given by Equation (4.25), while taking Foreign fiscal policy and the central bank’s monetary policy as given. Specifically, the government’s objective boils down to finding the value of \(\gamma_y\) that maximises Equation (4.37); we denote this value by \(\gamma_{y,opt}\).\(^{18}\)

Assuming the Home country faces a country-specific shock to productivity, we calculate \(\gamma_{y,opt}\) under different assumptions about the sovereign risk premium elasticity. In Figure 4.7, we plot \(\gamma_{y,opt}\) as a function of the relative size of the Home country. According to the figure in the left panel, where we have assumed a constant sovereign risk premium and \(\chi_g = 0\), optimal fiscal policy requires a high and positive value for \(\gamma_{y,opt}\) when Home is relatively

\(^{17}\)A brief derivation of the flexible-price equilibrium and the utility-based welfare criterion is provided in Appendix 4.B and 4.C.

\(^{18}\)Alternatively, the government could choose to follow the Ramsey policy, which prescribes the processes of the model’s endogenous variables that maximise the welfare criterion. However, using an optimised tax rule like Equation (4.25), rather than the Ramsey policy, offers a number of advantages. First of all, following a simple rule makes it much easier to communicate policy with the general public. Second, although policymakers can alter their policy stance, committing to a pre-specified rule makes it more difficult to deviate from agreed-upon objectives, thereby eliminating the scope for discretion. And last, the Ramsey policy might not even be feasible in practice, as it would require policymakers to respond to variables that are unobservable (such as shocks).
4.3 Optimal fiscal policy

Figure 4.7: Optimal cyclical fiscal stance as a function of country size ($s$)

Notes: The figures show the values for $\gamma_{y,\text{opt}}$, which is the value of $\gamma_y$ from the tax rule (4.25) that maximises the welfare criterion (4.37), for different assumptions about country size, $s$.

small, implying that countercyclical fiscal policies can be welfare enhancing. When the economy is large, however, optimal fiscal policy takes into account the offsetting accommodating effects of monetary policy following negative shocks and thus requires a pro-cyclical stance so as not to amplify output fluctuations.

The optimal fiscal stance critically depends, not only on country size, but also on the perceived riskiness of government debt, as evidenced by the right panel of Figure 4.7. Here, we assume that increases in government debt raise the sovereign risk premium, which makes it more difficult to pursue countercyclical policies in the face of output contractions. Consequently, the optimal fiscal stance for relatively small member states is pro-cyclical, rather than countercyclical.\footnote{These results are in line with empirical estimates reported by Gavin and Perotti (1997) and Combes et al. (2014), who show that countries with high levels of public debt, or which face severe financial market constraints, tend to pursue pro-cyclical fiscal policies.} This result follows from our earlier discussion in Section 4.2: lower taxes today raise government debt and the sovereign risk premium, which leads to lower household consumption. In order to avoid the negative crowding-out effects of sovereign risk, the government must raise taxes and thereby reduce the sovereign risk premium. However, since taxes are distor-
Figure 4.8: Optimal cyclical fiscal stance as a function of price stickiness ($\theta$)

Notes: See notes under Figure 4.7. Here, we have assumed that $s = 0.02$.

...tionary, strong tax hikes should be avoided, despite their negative effects on the risk premium. This is reflected by the much smaller values for $\gamma_{y,\text{opt}}$, indicating that taxes should be raised with caution. When member states are relatively large, however, the effects of sovereign risk are offset by a reduction in the policy rate by the central bank. To offset the expansionary monetary policy effects, optimal fiscal policy then requires a countercyclical stance.

The ability of fiscal policy to stabilise output arises from the presence of price sluggishness. Indeed, the greater is the share of firms that are unable to adjust their prices in response to aggregate shocks (i.e. the higher is $\theta$), the stronger are the effects of productivity shocks on output and thus the more aggressive should be the fiscal authority’s response to output fluctuations. In Figure 4.8, we plot $\gamma_{y,\text{opt}}$ as a function of the Calvo parameter $\theta$ for the small member case (i.e. $s = 0.02$). According to the figure in the left panel, in which sovereign risk is assumed absent, the stronger is the degree of price stickiness, the stronger should be the countercyclical tax response to changes in output (i.e. the higher should be $\gamma_y$). Conversely, when $\theta$ is close to zero and prices are more flexible, fiscal policy should be more a-cyclical so as not to generate inefficient changes in taxes. In the presence of sovereign risk, greater price stickiness also requires a more aggressive tax response to changes in output, yet fiscal policy should now be pro-cyclical, as shown in the right panel of...
4.4 Conclusion

Monetary union requires its member states to rely more on fiscal policy at the national level to absorb country-specific shocks, especially when member states are relatively small. In this chapter, we used a New Keynesian model for a two-country monetary union in order to provide new insights into the performance of fiscal policy under alternative assumptions about the perceived strength of public finances. To do so, we have introduced a time-varying sovereign risk premium, which is a convex function of government indebtedness, and allowed for changes in this sovereign risk premium to affect private borrowing conditions.

We have shown that, in the absence of sovereign risk premia, fiscal policy can stabilise macroeconomic conditions and enhance welfare in small member states if fiscal policy is countercyclical, i.e. if the government reduces taxes in the face of economic crises and raises taxes during expansions. Larger countries within monetary union, however, receive more monetary accommodation in the face of economic crises and should therefore adopt pro-cyclical fiscal policies so as to avoid output fluctuations from becoming too large. Furthermore, government spending multipliers tend to be larger when member states are small, since fiscal shocks borne from small countries do not induce the central bank to strongly raise interest rates.

The effects of (discretionary) fiscal policy are, however, markedly different when further increases in sovereign debt lead to concerns about fiscal insolvency and higher sovereign risk premia. Under such conditions, countercyclical fiscal policy can exacerbate economic crises, whereas pro-cyclical policies help stabilise the economy. Intuitively, when cutting taxes, the budget deficit rises, which leads to a stronger build-up of sovereign debt and an increase in the sovereign risk premium, which raises debt even further. In order to ensure a sustainable path for debt, the government is required to raise taxes over time which reduces the expected life-time income of households. In addition, the higher sovereign risk premium raises interest rates on private bonds and discourages households from borrowing. Therefore, fiscal expansions can lead to strong negative wealth and crowding-out effects on consumption through
higher sovereign risk premia. Consequently, the optimal fiscal stance should be pro-cyclical and geared towards reducing the stock of government debt, but only when a country is relatively small. When countries are large, the sovereign debt crisis and ensuing fall in consumption and inflation will prompt the central bank to reduce the interest rate and thereby offset the rise in the sovereign risk premium, which calls for a more countercyclical fiscal stance. Finally, we showed how government spending multipliers are generally lower in the face of time-varying sovereign risk premia, especially if the central bank is unable to offset the rise in the sovereign risk premium (for instance, when the nominal policy rate is stuck at the zero lower bound).

Our results shed new light on previous notions about the effects (and optimal design) of fiscal policy under monetary union. In future work, we would like to extend our framework in order to examine how the effects of fiscal policy depend on other country characteristics (e.g. country openness), other frictions (e.g. wage rigidities, liquidity constraints and capital adjustment costs) and policy regimes (e.g. fiscal union and unconventional monetary policy). Endogenising the fiscal limit that gives rise to the sovereign risk premium would be helpful in quantifying some of the numerical results and exploring the role of policy uncertainty in more detail. Finally, a natural extension to the model would be to add additional fiscal instruments (e.g. fiscal transfers, consumption taxes and capital taxes) in order to examine which fiscal tool is most successful in stabilising the economy in both the presence and absence of sovereign risk premia.

4. A Linearisation

In this section, we derive a first-order Taylor approximation of the non-linear model outlined in Section 4.1 around a non-stochastic steady state. We assume that prices are fully flexible in steady state and that $a = a^* = 1$. Define variables with a hat as the percentage deviation of that variable from its steady-state level, and let variables without a time-index denote the steady-state level of the corresponding variable, such that $\hat{x}_t = (x_t - x) / x$, for any generic
variable $x_t$. The full linearised equations are then given by

$$\varphi \dot{n}_t = \dot{w}_t - \sigma \dot{c}_t - \mu \dot{\tau}_t, \quad (4.38)$$

$$\sigma \dot{c}_t = \sigma E_t \dot{c}_{t+1} - \left( \dot{R}_{g,t} - E_t \hat{\pi}_{t+1} \right), \quad (4.39)$$

$$\sigma \dot{\tau}_t = \sigma E_t \dot{c}_{t+1} - \left( \dot{\Xi}_{h,t} + \dot{R}_t - E_t \hat{\pi}_t \right), \quad (4.40)$$

$$\dot{\Xi}_{h,t} = \chi_{h,1} f_s \left( \dot{f}_t - \dot{y}_t \right) + \chi_{h,2} \frac{b}{y} \left( \dot{b}_t - \dot{y}_t \right), \quad (4.41)$$

$$\dot{y}_t = \left[ 1 - \frac{g}{y} \right] \left[ (1 - s) \dot{S}_t + \dot{c}_W_t \right] + \frac{g}{y} \dot{y}_t, \quad (4.42)$$

$$\dot{n}_t = \dot{y}_t - \dot{a}_t, \quad (4.43)$$

$$\dot{\pi}_{H,t} = \beta E_t \hat{\pi}_{H,t+1} + \kappa \dot{m}_c_t, \quad (4.44)$$

$$\dot{m}_c_t = \dot{w}_t - \hat{\alpha}_t + (1 - s) \dot{S}_t, \quad (4.45)$$

$$\dot{b}_t = \frac{1}{\beta} \left( \dot{R}_{g,t-1} - \hat{\pi}_t + \dot{b}_{t-1} \right) \quad (4.46)$$

$$\dot{\tau}_t = \frac{1}{\tau} \left[ \frac{b}{y} \left( \dot{b}_{t-1} - \dot{y}_{t-1} \right) + \gamma_y \dot{y}_{t-1} \right], \quad (4.47)$$

$$\dot{\gamma}_t = \rho_g \dot{g}_t + \varepsilon_{g,t}, \quad (4.48)$$

$$\dot{\alpha}_t = \rho_a \dot{a}_t + \varepsilon_{a,t}, \quad (4.49)$$

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for the Home country, and

\[
\varphi \hat{n}_t^* = \hat{u}_t^* - \sigma^* \hat{c}_t^* - \mu^* \hat{\tau}_t^*,
\]

(4.51)

\[
\sigma^* \hat{c}_t^* = \sigma E_t \hat{c}_{t+1} - \left( \hat{R}_{g,t} - E_t \hat{n}_{t+1} \right),
\]

(4.52)

\[
\sigma^* \hat{c}_t^* = \sigma E_t \hat{c}_{t+1} - \left( \hat{R}_t - E_t \hat{n}_{t+1} \right),
\]

(4.53)

\[
\hat{g}_t^* = \left(1 - \frac{g^*}{y^*}\right) \left( -s \hat{\Sigma}_t + \hat{c}_{W,t} \right) + \frac{g^*}{y^*} \hat{g}_t^*;
\]

(4.54)

\[
\hat{a}_t^* = \hat{g}_t^* - \hat{a}_t^*;
\]

(4.55)

\[
\hat{\pi}_{F,t}^* = \beta^* E_t \hat{\pi}_{F,t+1} + \kappa^* \hat{m} \hat{c}_t^*;
\]

(4.56)

\[
\hat{m} \hat{c}_t^* = \hat{u}_t^* - \hat{a}_t^* - s \hat{\Sigma}_t;
\]

(4.57)

\[
\hat{b}_t^* = \frac{1}{\beta} \left( \hat{R}_{g,t-1} - \hat{\pi}_t^* + \hat{b}_{t-1}^* \right)
\]

\[
+ \left( \frac{b^*}{y^*} \right)^{-1} \left[ \frac{g^*}{y^*} \hat{g}_t^* - \tau^* \left( \hat{\pi}_t^* + \hat{g}_t^* \right) - \left( \frac{\tau^* g^*}{y^*} \right) s \hat{\Sigma}_t \right],
\]

(4.58)

\[
\hat{\pi}_t^* = \frac{1}{\tau^*} \left[ \gamma_b^* \left( \frac{b_{t-1}^*}{y^*} \hat{b}_{t-1}^* - \hat{g}_{t-1}^* \right) + \gamma_y \hat{g}_{t-1}^* \right],
\]

(4.59)

\[
\hat{g}_t^* = \rho_y \hat{g}_{t-1}^* + \varepsilon_{y,t}^*;
\]

(4.60)

\[
\hat{a}_t^* = \rho_a \hat{a}_{t-1}^* + \varepsilon_{a,t}^*;
\]

(4.61)

for the Foreign country, where \( \kappa \equiv (1 - \theta) (1 - \theta \beta) / \theta, \kappa^* \equiv (1 - \theta^* (1 - \theta^* \beta^*) / \theta^*, \)

\( \mu = \mu^* \equiv \tau / (1 - \tau) \) and \( \hat{c}_{W,t} = s \hat{c}_t + (1 - s) \hat{c}_t^* \). Linearisation of the monetary policy rule (4.21) yields

\[
\hat{R}_t = \rho R \hat{R}_{t-1} + (1 - \rho R) (\alpha_x \hat{\pi}_{W,t} + \alpha_y \hat{g}_{W,t}),
\]

(4.62)

where \( \hat{\pi}_{W,t} = s \hat{\pi}_t + (1 - s) \hat{\pi}_t^* \) and \( \hat{g}_{W,t} = s \hat{g}_t + (1 - s) \hat{g}_t^* \). Finally, the bond rate of the Foreign government bond is determined by \( \hat{R}^*_{g,t} = \hat{R}_t \), whereas the government bond rate in Home is determined by \( \hat{R}_{g,t} = \hat{\Xi}_{g,t} + \hat{R}_t \), where the sovereign risk premium function \( \hat{\Xi}_{g,t} \) has linear form \( \hat{\Xi}_{g,t} = \chi_g \left( b/y \right) \left( \hat{b}_t - \hat{g}_t \right) \).

### 4. B Flexible price equilibrium

Under flexible prices, all firms set the same prices, i.e. \( \overline{P}_{H,t} = P_{H,t} \). Therefore, the optimal price-setting condition collapses to \( 1 / \mathcal{M} = mc_t \). As in Benigno (2004), we assume that the fiscal authority sets the tax rate in the flexible price


**4.B Flexible price equilibrium**

equilibrium such that monopolistic distortions are neutralised, which can be accomplished by setting $\tau = \tilde{\tau} = 1 - M$. Using these conditions, together with the labour supply condition implied by the household’s optimal intratemporal condition (4.4), and the aggregate production function $y_t = a_t n_t$ (which holds for all firms under flexible prices), we can write:

$$
\frac{1}{1 - \tilde{\tau}_t} = \tilde{m}c_t = S_t^{1 - s} \frac{\tilde{y}^{(1+\varphi)}_t}{\tilde{c}^{-\sigma}_t} \frac{1}{1 - \tilde{\tau}_t},
$$

where a tilde over a variable indicates a variable’s flexible-price (or ‘natural’) level. Linearise this condition to obtain the Home natural output level (assume $g_t = g$ for all $t$):

$$
\tilde{y}_t = \left(1 + \frac{\varphi}{\varphi}\right) \tilde{a}_t - \sigma \tilde{c}_t - \left(\frac{1 - s}{\varphi}\right) \tilde{S}_t. \quad (4.63)
$$

Eliminate $\tilde{y}_t$ from the previous equation using the goods market clearing condition to obtain:

$$
\left(1 - \frac{g}{y}\right) \left[(1 - s) \tilde{S}_t + \tilde{c}_{W,t}\right] = \left(\frac{1 + \varphi}{\varphi}\right) \tilde{a}_t - \sigma \tilde{c}_t - \left(\frac{1 - s}{\varphi}\right) \tilde{S}_t.
$$

Rewrite to obtain the Home natural consumption level:

$$
- \sigma \tilde{C}_t = (1 - s) \tilde{S}_t + \varphi \left(1 - \frac{g}{y}\right) \left[(1 - s) \tilde{S}_t + \tilde{c}_{W,t}\right] - (1 + \varphi) \tilde{a}_t. \quad (4.64)
$$

Similarly, Foreign natural output and consumption are given by

$$
\tilde{y}_t^* = \left(1 + \frac{\varphi}{\varphi}\right) \tilde{a}_t^* - \sigma \tilde{c}_t^* + \frac{s}{\varphi} \tilde{S}_t, \quad (4.65)
$$

$$
- \sigma \tilde{c}_t^* = -s \tilde{S}_t + \varphi \left(1 - \frac{g^*}{y^*}\right) \left(-s \tilde{S}_t + \tilde{c}_{W,t}\right) - (1 + \varphi) \tilde{a}_t^*. \quad (4.66)
$$

Take a weighted average of the expressions for $\tilde{c}_t$ and $\tilde{c}_t^*$ (with weights $s$ and $1 - s$) to obtain an expression for natural aggregate consumption (assume that $g/y = g^*/y^*$):

$$
\tilde{c}_{W,t} = \left[\frac{1 + \varphi}{\varphi \left(1 - \frac{g}{y}\right) + \sigma}\right] \tilde{a}_{W,t}. \quad (4.67)
$$
where \( \hat{a}_{W,t} \equiv s \hat{a}_t + (1 - s) \hat{a}_t^* \).

Finally, from the balance of payments condition, we can derive an expression for the natural terms of trade:

\[
\tilde{S}_t = \left[ \frac{1}{(1 - \frac{s}{y}) (1 - s)} \right] \left( \frac{\bar{y}_t}{y} - \frac{c_t}{y} \right).
\] (4.68)

### 4.C The utility-based welfare criterion

In this section, we briefly derive the welfare criterion used in the model, which is based on the household’s period utility function denoted by

\[
\mathbb{W}_t = \frac{c_t^{1-\sigma}}{1 - \sigma} - \frac{n_t^{1+\varphi}}{1 + \varphi}.
\] (4.69)

Following Woodford (2003), we take a second-order Taylor-approximation of \( \mathbb{W}_t \):

\[
\mathbb{W}_t \simeq \mathbb{W}_{eq} \left\{ \hat{c}_t + \left( \frac{1 - \sigma}{2} \right) \hat{c}_t^2 - \frac{\mathbb{W}_n n}{\mathbb{W}_{eq}} \left[ \hat{n}_t + \left( \frac{1 + \varphi}{2} \right) \hat{n}_t^2 \right] \right\} + \mathcal{O} \left( \| \zeta \|^3 \right),
\] (4.70)

where terms that are of order higher than 2 are collected in \( \mathcal{O} \left( \| \zeta \|^3 \right) \). In order to substitute out \( \hat{n}_t \), we make use of the labour market clearing condition, \( n_t = \frac{y_t}{a_t D_t} \), where \( D_t \equiv \int_0^\infty (P_{H,t}(h) / P_{H,t})^{-\epsilon} \, dh \) is a measure of price-dispersion. Linearising this condition yields

\[
\hat{n}_t \simeq \hat{y}_t - \hat{a}_t + D_t + \mathcal{O} \left( \| \zeta \|^3 \right).
\] (4.71)

As in Woodford (2003), \( D_t \simeq \epsilon / 2 \text{var} \hat{P}_{h,t} + \text{t.i.p.} + \mathcal{O} \left( \| \zeta \|^3 \right) \), where terms independent of policy (such as constants and shocks) are collected in ‘t.i.p.’. Taking the discounted sum for all \( t \geq 0 \), we obtain

\[
\sum_{k=0}^{\infty} \beta^k D_{t+k} \simeq \frac{\epsilon}{2K} \sum_{k=0}^{\infty} \hat{\pi}_{H,t+k}^2 + \text{t.i.p.} + \mathcal{O} \left( \| \zeta \|^3 \right).
\] (4.72)

We can then use (4.71) to substitute out \( \hat{N}_t \) in (4.70).\(^{20}\)

\(^{20}\)The linear terms drop out, since we linearise around the efficient steady state.
Finally, expressing in gap terms and then taking the expected discounted sum using, (4.72), we obtain Equation (4.37) in the main text (for $\sigma = 1$).

4.D Additional graphs

Figure 4.9: Government spending multiplier as a function of country size ($s$) for $\rho_R \to 1$ and $\chi_g = 0.115$

Notes: The figure shows the impact output response in Home following a positive government spending shock (of 1% of output) as a function of $s$, which denotes the size of Home. Here, we assume very rigid interest rates, i.e. $\rho_R \to 1$ (see Equation [4.21]) and an a-cyclical fiscal stance $\gamma_y = 0$. 
4 Fiscal policy and sovereign risk premia under monetary union
Chapter 5

Summary

As evidenced by the recent crisis in Europe, very high levels of sovereign debt can lead to concerns about the government’s ability to meet its debt obligations. In this thesis, I have discussed and examined how such concerns affect the sustainability, effectiveness and optimal design of fiscal policy.

In Chapter 2, I used a theoretical model to study the sustainability of countercyclical fiscal policies.\(^1\) Under countercyclical policies, taxes are reduced (or government expenditures raised) during recessions, whereas taxes are raised during episodes of economic prosperity. Because tax cuts stimulate consumption, countercyclical fiscal policy usually tends to contribute to macroeconomic stability. The key assumption of this model is that the government’s cost of borrowing is affected by a sovereign risk premium. The sovereign risk premium forms a wedge between the ‘risk-free’ interest rate and the interest rate that the government must pay on its outstanding debt. When concerns of fiscal insolvency loom large, further increases in government indebtedness push up the sovereign risk premium.\(^2\) In the model, I also assumed that the sovereign risk premium affects the real interest rate which determines the optimal split between household consumption and savings. This link between sovereign risk

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\(^{1}\)Fiscal policy is said to be *sustainable* if the government can keep up with the periodic interest payment on outstanding debt, such that debt converges to a sustainable long-run level. The risk that the government is unable to meet its debt obligations is referred to as *sovereign risk*.

\(^{2}\)This positive relationship between sovereign debt and the sovereign risk premium was clearly present during the sovereign debt crisis in Europe, as countries with relatively large levels of sovereign debt had to pay a higher sovereign risk premium (like Greece and Portugal) than countries with relatively low levels of sovereign debt (like Germany and the Netherlands).
and the private sector is motivated by the observation that many financial intermediaries hold government bonds as collateral to tap wholesale funding. When there is an increase in sovereign risk, the collateral value of these bonds falls which pushes up the funding costs of financial intermediaries. In turn, the higher funding costs might be passed on to the rest of the private sector in the form of higher interest rates on household and firm loans, thereby depressing aggregate private expenditures.

I showed that, in the presence of a sovereign risk premium, countercyclical policies might not be sustainable. Intuitively, when a countercyclical tax cuts raises the stock of government debt and results in a higher sovereign risk premium, the interest rate faced by the private sector goes up which crowds out consumption by households. The fall in consumption induces a further countercyclical tax reduction, a further increase in government debt and the sovereign risk premium, and an even stronger crowding out of consumption. This vicious cycle is clearly not feasible, as it implies an explosive path for government debt.

In order to avoid or break the vicious cycle, the government needs to adopt a more-than-usual aggressive debt consolidation policy in order to keep the sovereign risk premium low and minimise the crowding-out effects on consumption. If the government is unable or unwilling to reduce the stock of debt, then it is up to the central bank to keep the interest rate low. The results from Chapter 2 therefore indicate that, in times of high and sensitive sovereign risk premia, the sustainability of fiscal policy and macroeconomic stability depend strongly on the cyclical stance of fiscal policy and the coordination between the government and central bank.

In Chapter 3, I studied the government spending multiplier, i.e. the percentage change in output due to a change in government spending. Using a modified version of the model from the previous chapter, which now describes a small open economy, I showed that the multiplier can be larger under flexible than fixed exchange rates when a country faces sovereign default risk. This result goes against traditional Keynesian theory. As in Chapter 2, sovereign risk generates a crowding-out effect on household consumption that works through the interest rate. This crowding-out effect lowers the multiplier under both flexible and fixed exchange rates. However, an increase in sovereign risk also leads to a depreciation of the exchange rate, which benefits the export-
ing industry and therefore raises the multiplier. Of course, the latter occurs only when the exchange rate is allowed to float, which implies that the multiplier could be larger under flexible, rather than fixed, exchange rates. In fact, the multiplier can even be negative when crowding-out effects are particularly severe and the exchange rate is unable to depreciate.

The results from Chapter 3 suggest that the ability of the government to stimulate aggregate demand is limited by the degree of government indebtedness. When sovereign debt has reached an unsustainable level and drives up the interest rate, the power to rejuvenate the economy through increases in government spending is considerably weakened. The model showed that countries with fixed exchange rates suffer from this sovereign debt curse the most, since the adverse effects of sovereign default risk cannot be absorbed by adjustments in the exchange rate. In that case, economic recovery must stem from adjustments in prices and wages, yet these are often very rigid in the short term.

In Chapter 4, I expanded the analysis from the preceding chapter and examined the multiplier under monetary union. The model I used describes a monetary union that consists of two countries. Fiscal policy is conducted nationally and independently between countries, and the two countries may differ in size and face different shocks, yet are otherwise symmetric. Just like under a fixed exchange rate regime, the nominal exchange rate between members of a monetary union is held fixed. Therefore, as in Chapter 3, the multiplier tends to be lower during episodes of sovereign risk due to the crowding-out effect on consumption and the absence of an offsetting exchange rate depreciation. Furthermore, I showed that the multiplier is lower, the weaker is the ability of the central bank to reduce interest rates. This result stands in contrast to the recent literature on fiscal multipliers, in which multipliers are often found to be larger when interest rates are rigid. Instead, when accounting for sovereign risk, I showed that the multiplier can turn negative when interest rates are completely fixed.

I also investigated which fiscal policy stance maximises welfare, i.e. optimal fiscal policy. In particular, I compared welfare outcomes under both counter- and pro-cyclical fiscal policies and showed that, in ‘normal times’ without sovereign risk, welfare is maximised when fiscal policy is countercyclical. By offsetting movements in output, countercyclical fiscal policies reduce income
variability which improves welfare. This result, however, only applies to countries that are relatively small. If a country is large, and thus have a strong influence on the rest of the monetary union, output fluctuations would be smoothed also through countercyclical monetary policy, which means that tax reductions during recessions stimulate the economy by ‘too much’. Therefore, for larger countries, a pro-cyclical fiscal stance maximises welfare.

This result is reversed in times of sovereign risk: small countries benefit most from pro-cyclical fiscal policies, whereas large countries benefit most from countercyclical fiscal policies. In small countries, a pro-cyclical fiscal stance is required to suppress the sovereign risk premium and thereby mitigate the crowding-out effects on consumption. In large countries, a countercyclical stance provides a better balance between fiscal and monetary policy. The results from Chapter 4 therefore suggest that the optimal design of fiscal policy under monetary union depends strongly on both the size of a country’s stock of public debt and the relative size of a country’s economy.
De Europese schuldencrisis heeft aangetoond dat een zeer hoog niveau van de staatsschuld kan leiden tot oplopende rentelasten die economisch herstel tegengaan. In dit proefschrift doe ik onderzoek naar de implicaties van een te hoge staatsschuld voor begrotingsbeleid. Ik zal mij onder meer richten op de vraag hoe zorgen over de schuldhoudbaarheid kunnen leiden tot macro-economische instabiliteit, en hoe dergelijke zorgen het effect van begrotingsbeleid op de economie beïnvloeden.

In Hoofdstuk 2 maak ik gebruik van een theoretisch model voor een gesloten economie om de houdbaarheid van anticyclisch begrotingsbeleid te bestuderen. Onder anticyclisch begrotingsbeleid worden belastingen automatisch verlaagd (of overheidsuitgaven verhoogd) gedurende een recessie, en worden belastingen verhoogd tijdens economische voorspoed. De begroting van de overheid beweegt dus in tegengestelde richting mee met de conjunctuur (vandaar de term ‘anticyclisch’). Onder normale omstandigheden draagt anticyclisch beleid bij aan een stabielere economie: immers, een daling in het inkomen wordt automatisch opgevangen door een verlaging in de belasting, waardoor het besteedbaar inkomen (en dus het consumptieniveau) min of meer gelijk blijft. In dit hoofdstuk wordt gekeken of het laatste ook opgaat wanneer de overheid een

1Met begrotingsbeleid wordt bedoeld het beleid omtrent veranderingen in de inkomens- en/of uitgavenkant van de overheidsbegroting, met als doel het beïnvloeden van economische activiteit. Bijvoorbeeld, een daling in de loonbelasting (inkomenskant) of een toename in de werkloosheidsuitkering (uitgavenkant) ter bevordering van de huishoudelijke consumptie.

2Begrotingsbeleid wordt gezien als houdbaar wanneer men gelooft dat de overheid de rente op uitstaande schuld kan blijven betalen; in dat geval zal de schuld namelijk op lange termijn convergeren naar een stabiel niveau. Het risico dat de staatsschuld niet langer houdbaar is wordt aangeduid als staatsschuldenrisico.
risicopremie moet betalen zodra zij geld leent van investeerders. Deze risicopremie vormt een wig tussen de ‘risico-vrije’ rente en de rente die de overheid betaalt op uitstaande leningen. Zodra investeerders twijfelen over de houdbaarheid van de staatsschuld, zal een verdere toename in de schuld leiden tot een hogere risicopremie.\(^3\) In het model wordt verder aangenomen dat de risicopremie ook het consumptiegedrag van huishoudens beïnvloedt. Deze aanname is gebaseerd op recente ervaringen uit de financiële sector. Toen bekend werd dat sommige overheden in betalingsproblemen kwamen, stegen de financieringskosten van financiële instellingen die veel staatsobligaties gebruikten als onderpand om goedkope leningen af te sluiten. Deze hogere financieringskosten werden vervolgens doorberekend aan huishoudens (in de vorm van een hogere rente), waardoor huishoudens minder geld konden lenen en aldus gedwongen waren hun consumptie te verlagen.

Met behulp van het model laat ik zien dat, in de aanwezigheid van een risicopremie op staatsschuld, een anticyclisch begrotingsbeleid niet altijd houdbaar is en juist kan leiden tot economische instabiliteit. Wanneer, bijvoorbeeld, de overheid de belastingen verlaagt in tijden van crisis, dan zal daarmee niet alleen de staatsschuld, maar ook de risicopremie stijgen. Hierdoor nemen de renteleasten van huishoudens toe en daalt de private consumptie. De daling in consumptie verergerd de crisis en zal, gegeven het anticyclische begrotingsbeleid van de overheid, een verdere belastingverlaging in gang zetten wat vervolgens weer leidt tot een verdere toename in de overheidsschuld en risicopremie, en een nog sterkere daling in consumptie. Deze vicieuze cirkel is uiteraard niet houdbaar, aangezien het een explosieve schuldontwikkeling impliceert.

Om de vicieuze cirkel te voorkomen of doorbreken zal de overheid een zeer agressief bezuinigingsbeleid moeten voeren om de schuld en de risicopremie te verlagen. Op deze manier dalen namelijk de renteleasten van huishoudens en zal de private consumptie niet verder afnemen. Luik het de overheid niet om voldoende te bezuinigen, dan zal de centrale bank moeten inspringen en de rente verlagen. Echter bestaat er een limiet aan hoever de centrale bank de rente kan verlagen: de rente kan namelijk niet lager zijn dan nul procent. De centrale banken van de VS en het euro gebied hebben sinds de economische

\(^3\)Deze positieve relatie tussen de staatsschuld en de risicopremie was sterk aanwezig tijdens de Europese schuldencrisis, waarin landen met een zeer hoge staatsschuld (zoals Griekenland en Portugal) een hogere risicopremie moesten betalen dan landen met een relatief lage staatsschuld (zoals Duitsland en Nederland).
crisis van 2008 de rente dusdanig ver laagd, dat zij bij deze ondergrens terecht zijn gekomen. Hierdoor is er haast geen ruimte meer voor verdere ondersteuning vanuit de centrale bank. De resultaten uit Hoofdstuk 2 impliceren dus dat, in tijden van een hoge en gevoelige risicopremie op de staatsschuld, de houdbaarheid van begrotingsbeleid en economische stabiliteit sterk afhankelijk zijn van de cycliciteit van begrotingsbeleid en de beleidscoördinatie tussen de overheid en centrale bank.

In tegenstelling tot Hoofdstuk 2, waarin voornamelijk wordt gekeken naar de lange-termijn houdbaarheid van begrotingsbeleid, richt ik mij in Hoofdstukken 3 en 4 op de korte-termijn effecten van begrotingsbeleid op het nationaal inkomen. In Hoofdstuk 3 kijk ik naar de begrotingsmultiplier, oftewel de procentuele verandering in het inkomen als gevolg van een toename in de overheidsuitgaven. Hoe groter de multiplier, hoe effectiever de overheid is in het beïnvloeden van economische activiteit. Het model uit het voorgaande hoofdstuk wordt enigszins uitgebreid en beschrijft nu een kleine open economie. In het model wordt onderscheid gemaakt tussen twee soorten wisselkoersregimes: vaste en flexibele wisselkoersen.\footnote{De \textit{wisselkoers} is de prijs van de binnenlandse munt uitgedrukt in buitenlandse valuta.}

Ik toon aan dat, wanneer de economie te maken heeft met een hoge mate van onzekerheid omtrent de schuldhoudbaarheid, de multiplier groter kan zijn in landen met een flexibele wisselkoers dan in landen met een vaste wisselkoers. Dit resultaat gaat tegen de voorspellingen in van bestaande economische theorieën. Net als in Hoofdstuk 2 zorgt staatsschuldenrisico voor een stijgende rente, waardoor huishoudens minder zullen consumeren. Dit zogeheten \textit{crowding-out effect} op consumptie verkleint de multiplier en komt voor in regimes met zowel flexibele als vaste wisselkoersen. Staatsschuldenrisico heeft echter nog een effect dat in het gesloten economie model van Hoofdstuk 2 niet tot uitdrukking kwam. Onder toenemende staatsschuldenrisico zullen investeerders namelijk staatsobligaties verkopen in ruil voor relatief veiligere buitenlandse obligaties. De met deze actie gepaard gaande waardevermindering van de munt impliceert een daling in de wisselkoers die juist gunstig is voor exporterende bedrijven (binnenlandse goederen worden dan namelijk relatief goedkoper dan buitenlandse producten). Dit indirecte \textit{wisselkoerseffect} van staatsschuldenrisico vergroot de multiplier. Uiteraard kan het wisselkoerseffect alleen plaatsvinden in een systeem met flexibele wisselkoersen en om
deze reden kan de multiplier groter zijn onder flexibele dan onder vaste wisselkoersen. Sterker nog, ik laat zien dat, onder aanzienlijke crowding-out effecten, de multiplier negatief kan zijn als de wisselkoers zich niet kan aanpassen.

De resultaten uit Hoofdstuk 3 geven aan dat het vermogen van de overheid om de economie te stimuleren beperkt wordt door de omvang van de staatsschuld. Zodra de staatsschuld een onhoudbaar niveau heeft bereikt en de rente omhoog drijft zal, zonder tegenwerkende beleidsmaatregelen, het stimulerende vermogen van begrotingsbeleid afnemen. Het model toont aan dat vooral landen met een vaste wisselkoers hier last van hebben, omdat de negatieve effecten van de te hoge staatsschuld niet (automatisch) opgevangen zullen worden door een depreciatie van de wisselkoers. In dat geval zal de economie zich moeizaam moeten herstellen middels aanpassingen in de productprijzen en arbeidslozen. Echter, omdat deze prijzen op korte termijn vaak zeer rigide zijn, kan dit aanpassingsproces erg lang duren.

In Hoofdstuk 4 breid ik de analyse uit het voorgaande hoofdstuk uit en bestudeer ik de begrotingsmultiplier in een monetaire unie, oftewel een groep landen (lidstaten) die een gezamenlijke munt invoeren (de VS en het eurogebied zijn voorbeelden van een monetaire unie). Ik gebruik hiervoor een model dat een monetaire unie beschrijft bestaande uit twee lidstaten. Beide lidstaten voeren onafhankelijk begrotingsbeleid, kunnen verschillen qua omvang hebben te maken met verschillende schokken; verder zijn zij symmetrisch. Net als in een systeem met vaste wisselkoersen, wordt in een monetaire unie de wisselkoers tussen lidstaten vastgezet (bijvoorbeeld, elke euro is altijd evenveel waard in Nederland als in België, en elke dollar is evenveel waard in Californië als in Florida). Overeenkomend met de resultaten uit Hoofdstuk 3 geeft het model aan dat de multiplier kleiner is wanneer er sprake is van staatsschuldenrisico vanwege het crowding-out effect op consumptie (en het ontbreken van het gunstige wisselkoerseffect). Verder laat ik zien dat de omvang van de multiplier tevens wordt bepaald door monetair beleid, oftewel het rentebeleid van de centrale bank. Des te moeilijker het is om de rente te verlagen in tijden van staatsschuldenrisico, des te sterker is het crowding-out effect en des te kleiner is de multiplier. Dit resultaat gaat tegen de conclusies in van recente literatuur over begrotingsmultipliers, die zegt dat multipliers groter zijn onder een constante rente. Ik laat juist zien dat, in tijden van staatsschuldenrisico, de multiplier zelfs negatief kan zijn wanneer de rente constant blijft.
In Hoofdstuk 4 kijk ik ook naar het *optimale begrotingsbeleid*, oftewel het beleid dat de welvaart maximaliseert. Ik vergelijk welvaartsuitkomsten onder zowel anticyclisch als procyclisch begrotingsbeleid en laat zien dat, in ‘normale tijden’ zonder staatsschuldenrisico, de welvaart haar maximale niveau bereikt wanneer begrotingsbeleid anticyclisch is. Dit komt vanwege het stabiliserende karakter van anticyclisch begrotingsbeleid (zie tweede alinea), maar geldt alleen voor relatief kleine lidstaten binnen de monetaire unie. Relatief grote lidstaten hebben daarentegen meer baat bij een procyclisch begrotingsbeleid. Wanneer een land relatief groot is, en dus een grote (economische) invloed heeft op de rest van de monetaire unie, zullen schokken afkomstig uit dit land (deels) worden opgevangen door centraal geleid monetair beleid. Anticyclisch begrotingsbeleid zal in tijden van een recessie dus leiden tot ‘te veel’ stimulans, waardoor inkomensfluctuaties te hoog worden en er sprake is van welvaartsverlies.

In tijden van staatsschuldenrisico wordt dit resultaat omgedraaid: welvaart is maximaal onder een procyclisch begrotingsbeleid in kleine lidstaten, en onder anticyclisch beleid in grote lidstaten. In kleine lidstaten is een procyclisch begrotingsbeleid nodig om de risicopremie op de staatsschuld laag te houden en de eerder besproken crowding-out effecten op consumptie te verkleinen. In grote lidstaten zorgt een anticyclisch begrotingsbeleid juist voor een betere balans tussen begrotings- en monetair beleid. Met Hoofdstuk 4 geef ik dus aan dat het optimale begrotingsbeleid binnen een monetaire unie sterk afhankelijk is van zowel de omvang van de staatsschuld als de relatieve omvang van de economie.

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Onder een *procyclisch begrotingsbeleid* worden belastingen verhoogd tijdens een economische crisis en verlaagd tijdens economische voorspoed. Procyclisch begrotingsbeleid is dus het tegenovergestelde van anticyclisch beleid.
References


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