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This paper studies the dynamics of macroeconomic risk, fiscal policy and the macroeconomy in a two-country monetary union framework, under the assumption that agents do not have rational expectations, but use heuristics to determine their consumption over time, as well as to assess macroeconomic risk. Further, the macroeconomic consequences of a divergence between the design of fiscal policy and the behavioral perception of macroeconomic risk by the financial markets are investigated using numerical simulations. Among other things, these simulations show that an extreme focus on debt stabilization can be counterproductive if the financial markets care more about other indicators, such as the country's output gap or external imbalances.

**Keywords:** Behavioral macroeconomics, macroeconomic risk, fiscal policy rules, monetary unions, macroeconomic stability

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# Macroeconomic Risk, Fiscal Policy Rules and Aggregate Volatility in Asymmetric Currency Unions: A Behavioral Perspective

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**Abstract**

Based on the assumption that agents do not have rational expectations, but use heuristics for the determination of their consumption over time, as well as for their assessment of macroeconomic risk, this paper studies the dynamics of macroeconomic risk, fiscal policy and the macroeconomy in a two-country monetary union framework. Further, the macroeconomic consequences of a divergence between the design of fiscal policy, and the behavioral perception of macroeconomic risk by the financial markets are investigated through numerical simulations. Among other things, these simulations show that an extreme focus on debt stabilization can be counterproductive if the financial markets care more about the country's output gap, or about its external imbalances.

**Keywords:** Behavioral macroeconomics, macroeconomic risk, fiscal policy rules, monetary unions, macroeconomic stability

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# 1 Introduction

To what extent are sovereign bond yields determined by macroeconomic fundamentals, and to what extent by partial perceptions and moods of the financial markets? Do different economic agents (especially, financial institutions and governments) have consistent expectations and/or beliefs with respect to macroeconomic risk and fiscal debt sustainability? And what are the consequences of an eventual discrepancy in such beliefs for the dynamics of sovereign yields, the governments' fiscal stances, and in general terms, for the macroeconomic stability of a monetary union?

In the context of the European Monetary Union, these questions have gained a particular relevance as the assessment of macroeconomic risk and sovereign debt sustainability by the financial markets seems to have experienced significant variation since the outbreak of the still unresolved euro area crisis at the end of 2009. Indeed, while prior to the 2007-08 financial crisis yield spreads of most euro area government bonds vis-à-vis German government bonds were mainly driven by a common international factor related to the global risk perception and not (or to an almost negligible extent) by country-specific factors (see e.g. Codogno et al. (2003) and Geyer et al. (2004)),[1] since the default of Lehman Brothers in September 2008, the role played by country-specific macroeconomic fundamentals in the pricing of government bonds has not only increased but their influence itself seems to increase with the level of general risk aversion (see e.g. Manganelli and Wolswijk (2009), Haugh et al. (2009), Attinasi et al. (2009), Barrios et al. (2009) Schuknecht et al. (2010), Arghyrou and Kontonikas (2011), Borgy et al. (2012) and De Grauwe and Ji (2013)). As pointed out by Arghyrou and Kontonikas (2011), "This regime-shift not only explains the sudden escalation of the Greek debt crisis but also the difference in spread values observed between Greece and other periphery EMU countries with not too dissimilar macroeconomic outlook: Compared to Ireland, Portugal and Spain, markets perceive a much higher probability of a Greek voluntary exit from the EMU, and/or a Greek default. In short, Greece's problems are as much about trust as they are about economics."

This indirect evidence for a time-varying and differentiated risk perception by the financial market participants stands however in stark contrast with the nowadays predominant assumption of forward-looking agents with rational expectations who, accordingly, use all information available for the calculation of forecasts which are consistent with the actual, though unobservable data generating process (DGP). Indeed, as the extensive literature on behavioral finance (see e.g. Shiller (1981), Frankel and Froot (1987), Lux (1995) and Manzan and Westerhoff (2007)) has shown over the last twenty years, trading in the financial markets is driven to a major extent by fads, moods and contagion phenomena which are seldomly consistent with the rational expectations paradigm based on the work of Muth (1961).[2]

[1] During the period 2000-08, euro area sovereign spreads were quite close to zero, reflecting the market's perception of the relative default risk of individual countries as almost nil despite quite differentiated underlying macroeconomic fundamentals.

[2] For instance, De Grauwe and Ji (2013) argue that the irrationality of market expectations and its self-fulfilling

As the advantages of deviating from the rational expectations modeling paradigm are being increasingly acknowledged by the profession, a new generation of macroeconomic models which deviates – in different directions and extent – from the canonical DSGE framework as discussed for example by Christiano et al. (2005) has emerged over the last ten years (see e.g. Branch and McGough (2009), Proaño (2011), De Grauwe (2012) and Woodford (2013)). Along these lines, in this paper I set up a two-country monetary union model characterized by various features which make it useful for the analysis of the interaction between the perceived macroeconomic risk by the financial markets and its interaction with the macroeconomy in a rigorous way. Macroeconomic risk, and the related expected risk of sovereign bonds is specified in a behavioral, not necessarily model-consistent manner, in stark contrast to the standard general equilibrium asset pricing specification.[3] Through the explicit modeling and variation of the set of variables used for the assessment of macroeconomic risk by different market participants, as well as their relative importance in such forecasts, it is possible to analyze the macroeconomic consequences of eventual differences between those sets of variables and the governments' policy targets in a straightforward and clear manner.[4] Indeed, as already pointed out, in the real world the link between the pricing of risk and the observable macroeconomic fundamentals seems to be rather loose and in a nonlinear time- or regime-dependent way linked to macroeconomic fundamentals. The second innovative feature of the theoretical framework set up in this paper is the behavioral motivation for aggregate private consumption, which is based on the fact that the optimal intertemporal determination of aggregate consumption requires a different degree of rationality than the intratemporal determination of the actual composition of the consumption bundle.[5] Accordingly, aggregate private consumption is explicitly separated into a long-run trend component (which may or may not be the result of the maximization of the households' expected discounted value of their intertemporal utility) and a cyclical component which is linked to the state of the business cycle and the macroeconomic risk in a behavioral manner.[6]

The analysis for the present paper thus aims to address the following questions: What if governments pursue other goals than what financial market participants consider as relevant for the pricing of sovereign bonds, and what would be the macroeconomic consequences of such a discrepancy in expectations and actions? What are the macroeconomic consequences of a strict focus on sovereign

nature have been the driving factors of sovereign risk premia of government debt of euro area countries not only after the 2007-08 financial crisis and the outbreak of the still ongoing euro area crisis, but in the period before these events.

[3] In recent times, various studies have investigated the interaction between macroeconomic risk and economic activity in otherwise rather standard macroeconomic frameworks, see e.g. Adrian et al. (2010).

[4] This approach can be related to the Farmer's "belief function", see e.g. Farmer (2010).

[5] Indeed, as discussed by Kahneman and Thaler (2006), people do not always know what they will like; they often make systematic errors in predicting their future experience of outcomes and, as a result, fail to maximize their expected utility.

[6] Woodford (2013,p.4) proceeds is a similar manner by focusing only on modifications of the log-linear approximation of the model's true nonlinear steady state in which, "(i) all exogenous state variables are forever constant, (ii) monetary and fiscal policy are specified to maintain a constant zero rate of inflation and some constant positive level of public debt, and (iii) all subjective expectations are correct (i.e., households and firms have perfect foresight)."

debt reduction by the fiscal authorities, if markets do not consider this as a major determinant in their assessment of macroeconomic and sovereign risk? And what are the implications of macroeconomic risk being primarily determined by the trade imbalances for the performance of fiscal policy?

The remainder of this paper is organized as follows: In section 2 a two-country behavioral macroeconomic model of a monetary union is introduced. In section 3 the various transmission mechanisms featured in the present framework are outlined through the analysis of the dynamic adjustments of the model to an exogenous shock in macroeconomic risk, and the consequences of alternative specifications based on different sets of macroeconomic fundamentals determining the macroeconomic and sovereign risk premia for the macroeconomic volatility of the individual economies, and the monetary union as a whole, are investigated. Finally, in section 4 some policy implications and concluding remarks from this study are drawn.

## 2 The Model

Let us consider a two-country monetary union which is populated by a continuum of agents on the interval $[0, 1]$, a segment $[0, n]$ residing in a country labeled $H$(ome) the other segment living in the other country labeled $F$(oreign). There is no migration between regions. Both countries are assumed to produce tradable consumption goods, which are however considered as imperfect substitutes due to a standard home bias argument, and to feature otherwise the same characteristics what the structure of their behavioral equations concerns. The governments in the Home and Foreign regions dictate their fiscal policy in an independent and sovereign manner, financing their expenditures through the raise of taxes and the issuance of bonds (with a maturity of $m$ periods). Further, there is a single monetary policy authority (the monetary union's central bank or MUCB) which sets the riskless short-term interest rate which acts as reference for the pricing of the Home and Foreign government bonds. Even though perfect capital mobility within the monetary union is assumed, so that Home households can hold bonds issued by the Home's and Foreign's governments, due to a home bias in financial assets similar to the one on consumption goods, agents will prefer to hold a larger share of domestic government bonds, even if they are associated with the same expected return. Further, the Foreign country's government will be assumed to be considered as more solvent by the market's participants, becoming in the limit a safe haven for financial capital.[7]

### 2.1 Households

As it is widely known, the optimal consumption problem of an agent living over multiple periods – as it is the case for the Home and Foreign households in the current framework – can be divided

[7] The following exercise could be related in the EU case to the analysis of the interaction between Germany and Italy or Spain, for example.

under the assumption of timely additive preferences (a standard assumption in the DSGE approach) into two independent economic decisions: the contemporaneous choice of the optimal composition of the consumption bundle or aggregate composite consumption good, and the determination of this aggregate composite good over time. However, these two economic decisions demand different degrees of rationality from the economic agents as they imply different degrees of complexity for their respective optimization: While the intra-temporal problem can be solved in a straightforward manner if all goods prices are publicly known, the optimization of the intertemporal problem requires a much larger knowledge or information set to be employed by the economic agents, as well as a higher degree of rationality.

From this perspective, it is intuitive to assume a standard optimizing behavior by the economic agents for the intra-temporal decision problem, while specifying the intertemporal decision problem in a less neoclassical, and more "behavioral" manner. Therefore, concerning the intra-temporal decision problem, Home and Foreign households are assumed to be able to choose in each period the composition of their aggregate consumption bundle in an optimal manner. Accordingly, taking $P_t^h$ and $P_t^f$ – the average price levels of the domestically and foreign produced consumption goods $C_{h,t}$ and $C_{f,t}$, respectively – as given, Home households minimize the costs associated with the consumption of a CES composite of home- and foreign-produced goods defined as

$$C_t^H = \left[\gamma_h^{1/a}(C_{h,t})^{(a-1)/a} + (1-\gamma_h^{1/a})(C_{f,t})^{(a-1)/a}\right]^{a/(a-1)} \tag{1}$$

with $a > 1$ denoting the price elasticity of goods demand and $\frac{1}{2} < \gamma < 1$ representing the degree of home bias towards domestic consumption by demanding in each period an amount of home- and foreign produced goods determined by[8]

$$C_{h,t}^H = \gamma_h \left(\frac{P_t^h}{P_{c,t}^H}\right)^{-a} C_t^H, \quad \text{and} \quad C_{f,t}^H = (1-\gamma_h)\left(\frac{P_t^f}{P_{c,t}^H}\right)^{-a} C_t^H \tag{2}$$

where $P_{c,t}^H$ is the corresponding the aggregate Consumer Price Index in the Home country, i.e.

$$P_{c,t}^H \equiv [\gamma_h (P_{h,t})^{1-a} + (1-\gamma_h)(P_{f,t})^{1-a}]^{1/(1-a)}. \tag{3}$$

Assuming an analogous behavior for the Foreign households, their optimal consumption of Home- and Foreign-produced goods is given by

$$C_{f,t}^F = \gamma_f \left(\frac{P_t^f}{P_{c,t}^F}\right)^{-a} C_t^F, \quad \text{and} \quad C_{h,t}^F = (1-\gamma_f)\left(\frac{P_t^h}{P_{c,t}^F}\right)^{-a} C_t^F, \tag{4}$$

respectively, with

$$P_{c,t}^F \equiv [\gamma_f (P_t^f)^{1-a} + (1-\gamma_f)(P_t^h)^{1-a}]^{1/(1-a)}. \tag{5}$$

[8] As discussed e.g. by Walsh (2010, p.431), these expressions are the solution for the minimization problem of achieving a given level of $C_t$ under the cost constraint $P_t^h C_{h,t} + P_t^f C_{f,t}$ taking $P_t^h$ and $P_t^f$ as given, where $\lambda_t$ – the corresponding Lagrange multiplier of this problem – is equal to the aggregate Consumer Price Index described by eq.(3).

being the aggregate Consumer Price Index in the Foreign country.

By contrast, as it was previously mentioned, households are assumed to proceed in a behavioral manner with respect to the intertemporal determination of their aggregate consumption bundle due to the higher complexity and information requirements implied by an optimization of their intertemporal utility.[9] For this, (the log of) aggregate consumption is separated into a trend and a cyclical component, i.e.

$$\ln(C_t^k) = \ln(\mathbb{C}_t^k) + c_t^k, \quad k = \{H, F\} \tag{8}$$

where $\mathbb{C}_t^k$ represents the long-run trend of aggregate consumption, assumed here to be exogenously given and determined in the real world by factors such as population growth and technological level of the respective society, and $c_t^k$ represents the cyclical component of $C_t^k$, given by

$$c_t^k = \tilde{E}_t[c_{t+1}^k] - \alpha_{yr}(i_{t-1} - \pi_{c,t}^k) + \varepsilon_t^c \tag{9}$$

where $i_t$ is the short-term nominal interest rate, $\pi_{c,t}^k$ is the price inflation (measured in CPI terms), $\varepsilon_t^c$ is a stochastic shock to be defined further below and $\tilde{E}_t[c_{t+1}^k]$ represents the households' subjective expectation of their future cyclical consumption $c_{t+1}$, assumed in the following that to be given by

$$\tilde{E}[c_{t+1}^k] = (1 - \alpha_{y\xi}\tilde{E}_t[\zeta_t^k])y_{t-1}^k. \tag{10}$$

where $y_{t-1}^k$ represents the output gap, defined as the log deviation of aggregate output $Y_t$ from its long-run trend $\mathbb{Y}_t^k$, and $\tilde{E}[\zeta_t^k]$ represents the perceived macroeconomic risk (see Adrian et al. (2010)), to be defined below. The rationale for this specification is straightforward: When determining the cyclical component of their consumption expenditures, the economic agents use as predictors the observed output gap in the previous period (as a measure of the state of the business cycle in the economy), as well as the perceived macroeconomic risk in the current period. Accordingly, an increase in the output gap will ceteris paribus lead to an increase in cyclical consumption, and an increase in the perceived macroeconomic risk to the opposite effect due to a precautionary saving behavior by the economic agents.

[9] In the canonical DSGE approach (see e.g. Woodford (2003) and Walsh (2010)), households choose the level of their aggregate consumption at date $t$ according to the maximization of the expected present discounted value of an intertemporal utility function such as

$$\tilde{E}_t \sum_{i=0}^{\infty} \beta^i \left( \frac{C_{t+i}^{1-\sigma}}{1-\sigma} \right) \tag{6}$$

where $0 < \beta < 1$ is the discount factor, $R_t$ represents the gross nominal interest rate and $E_t$ is the mathematical expectations operator conditional on the information available at date $t$, subject to their period budget constraint. As it is widely know, the solution to the households' constrained intertemporal utility maximization problem is the so-called the Euler equation

$$C_t^{-\sigma} = \beta E_t \left[ (1 + R_t) \left( \frac{P_{c,t}}{P_{c,t+1}} \right) C_{t+1}^{-\sigma} \right], \tag{7}$$

which thus describes the optimal intertemporal path of aggregate consumption under the complete exhaustion of all available information at date $t$ (what is implied by the use of $E_t$), i.e. under rational expectations.

It should be again pointed out that this behavioral formulation of aggregate consumption, while similar to the log-linear approximation of the neoclassical Euler equation employed in the majority of DSGE models, stems from a complete different perspective. Indeed, as the log-linear Euler equation is only an approximation of the true nonlinear model, both the nonlinear and linearized model describe the dynamics resulting from the intertemporal maximization of utility and profits by households and firms under the assumption of rational expectations. In contrast, eqs. (2), (8) and (9) highlight different aspects in the determination of aggregate consumption, at different horizons and frequencies. Accordingly, while in the present model the (log) long-trend consumption $\mathbb{C}_t^k$ is assumed to be exogenously given, one could also assume, as recently done by Woodford (2013), that $\mathbb{C}_t^k$ does indeed represent the optimal intertemporal path of consumption, therefore allowing for deviations from the rational expectations equilibrium in the short-run.[10]

Concerning the households' investment decisions, a home bias with respect to the demand of financial assets is assumed in the same spirit of the assumption of home bias in the preferences for consumption goods.[11] Accordingly, the Home households use their period savings for the purchase of a composite fund of government bonds of $m$-period maturity (Foreign households behave accordingly)

$$B_{c,t+m}^{H} = \left[(1-\gamma_b)^{1/a_b}(B_{h,t+m})^{(a_b-1)/a_b} + \gamma_b^{1/a_b}(B_{f,t+m})^{(a_b-1)/a_b}\right]^{a_b/(a_b-1)} \tag{11}$$

where $B_{h,t+m}$ and $B_{f,t+m}$ represent the value at maturity of the stock of nominal bonds issued by Home's and Foreign's governments, respectively, and $a_b$ is the price elasticity of the households' government bond demands.

The households' optimal demand for Home and Foreign government bond is determined analogously to the Home- and Foreign produced goods demand described by eqs. (1) – (5) (the optimal financial assets demands of the Foreign households are derived accordingly), namely

$$B_{h,t}^{H} = (1-\gamma_b)\left(\frac{P_{h,t}^{(m)}}{P_{c,t}^{(m)}}\right)^{-a_b} W_t^H, \quad \text{and} \quad B_{f,t}^{H} = \gamma_b\left(\frac{P_{f,t}^{(m)}}{P_{c,t}^{(m)}}\right)^{-a_b} W_t^H \tag{12}$$

where $P_{h,t}^{(m)}$ and $P_{f,t}^{(m)}$ denote the prices for Home- and Foreign government and $P_{c,t}^{(m)}$ represents the aggregate bond price index

$$P_{c,t}^{(m)} \equiv [(1-\gamma_b)(P_{h,t}^{(m)})^{1-a_b} + \gamma_b(P_{f,t}^{(m)})^{1-a_b}]^{1/(1-a_b)}. \tag{13}$$

[10] This approach has been extensively pursued in the literature on adaptive learning (see e.g. Marcet and Sargent (1989) and Evans and Honkapohja (2001)).

[11] According to French and Poterba (1991), the home bias in financial assets – and especially in equities – has been a perennial feature of international capital markets. Coeurdacier and Rey (2012) distinguish between three broad classes of explanations why economic agents may hold in their financial portfolios a much higher share of domestic financial assets than as predicted by a mean-variance optimization process: (i) hedging motives in frictionless financial markets (real exchange rate and non-tradable income risk), (ii) asset trade costs in international financial markets (such as transaction costs, differences in tax treatments between national and foreign assets or differences in legal frameworks) and (iii) informational frictions and behavioural biases.

The financial wealth of Home and Foreign households (in real terms) at the beginning of period $t$ is then

$$W_t^k \quad = \quad (1+\gamma_b R_{t-1}^H + (1-\gamma_b)R_{t-1}^F - \pi_t^k)W_{t-1}^k + Y_t^k - C_t^k - T_t^k$$

with $Y_t^k$ representing national income, $T_t^k$ the taxes paid by the firm owning households and $R_{t-1}^k$ the households' gross rate of return on their financial assets held from $t-1$ into $t$.

### 2.2 Firms

Firms in both countries are assumed to redistribute the totality of their profits back to the households, so that the division of labor and capital income, and thus of functional income distribution, does not play any role in the present framework. Further, in order to keep the model as simple as possible, firms in both countries are assumed to use a linear single input factor technology for the consumption goods production (no intermediate goods – neither home- or foreign-produced – are need for the final goods production), so that in the aggregate it holds

$$Y_t^k = A_t^k N_t^k, \tag{14}$$

where $N_t^k$ denotes the actual (realized) level of employment and $A_t^k$ represents the average labor productivity level in country $k$. Analogously, the full employment, potential output level $\mathbb{Y}_t^k$ is assumed to be determined by

$$\mathbb{Y}_t^k = \mathbb{A}_t^k L_t^k \tag{15}$$

where $L_t^k$ is total labor supply in country $k$ and $\mathbb{A}_t^k$ is the trend labor productivity level, assumed to be common to both economies for notational simplicity.

As in Proaño (2012*a*), let us assume that the level of output produced by firms – and therefore their labor demand – is determined solely by the level of aggregate demand, and that firms, confronted with it, set their labor demand (analogously to eq.(14)) according to

$$L_t^{\mathrm{D},k} = Y_t^k / \mathbb{A}_t^k. \tag{16}$$

where not $A_t^k$ (which is still to be determined and thus still not observable for firms at the beginning of period $t$) but $\mathbb{A}_t^k$, the trend labor productivity, is used.[12]

Due to the existence of labor market frictions, however, the actual level of employment $N_t^k$ is not necessarily consistent with the labor demand by firms $L_t^{\mathrm{D},k}$, so that $L_t^{\mathrm{D},k} = N_t$ does not hold in the normal case. Instead, the actual number of employed workers at $t$ is determined by the level of

[12] The assumption that the firms's labor demand is the binding constraint for the actual employment level in the economy is common in traditional Keynesian models, but it has been recently applied in a DSGE framework by Schmitt-Grohe and Uribe (2013).

remaining jobs from the previous period and by the "matches" occurred at the beginning of the actual period. At $t$, the number of employees is determined by

$$N_t^k = (1-\rho)N_{t-1}^k + m(U_t^k, V_t^k) \tag{17}$$

where $\rho$ represents an exogenous job separation rate[13] and $m(U_t, V_t)$ is a matching function of a standard Cobb-Douglas type

$$m(U_t^k, V_t^k) = \mu(U_t^k)^{\nu}\ (V_t^k)^{1-\nu}, \tag{18}$$

with $\mu \in (0,1)$ representing the matching technology level, $U_t^k = L_t^k - (1-\rho)N_{t-1}^k$ the number of unemployed, $V_t^k = L_t^{\mathrm{D},k} - (1-\rho)N_{t-1}^k$ the number of vacancies at the beginning of period $t$, and $\nu \in (0,1)$ the parameter in the Cobb-Douglas matching function.

From eqs. (14) and (15) it follows that the average labor productivity level $A_t^k$ is determined in a residual manner, as

$$A_t = \mathbb{A}_t^k \exp(y_t) \cdot L_t^k / N_t^k.$$

The rationale for this specification is straightforward: Given a specific aggregate demand level and a subsequent given employment level (determined also by the specific labor market frictions in the economy), firms adjust the average labor productivity of their employees to meet the required level of production.

Further, by defining $u_t^k = U_t^k/L_t^k$ and $v_t^k = V_t^k/L_t^k$ as the unemployment and vacancy rates, respectively, gathering eqs. (15) and (16) to

$$L_t^{\mathrm{D},k}/L_t^k = \frac{Y_t^k/\mathbb{A}_t^k}{\mathbb{Y}_t^k/\mathbb{A}_t^k} = Y_t^k/\mathbb{Y}_t^k, \tag{19}$$

and normalizing the total labor supply to $L_t^k = \bar{L}^k$, we can reformulate eq.(17) in terms of the employment rate $e_t^k = N_t^k/\bar{L}^k$ as

$$e_t^k = (1-\rho)e_{t-1}^k + \mu[1-(1-\rho)e_{t-1}^k]^{\nu}\left[Y_t^k/\mathbb{Y}_t^k - (1-\rho)e_{t-1}^k\right]^{1-\nu}. \tag{20}$$

As this labor market module is thus formulated, the state of the market influences in a direct way the capability of firms to serve aggregate demand: Indeed, due to the existence of labor market frictions, firms usually do not obtain their desired level of labor demand $L_t^{\mathrm{D},k}$, but obtain only $N_t^k$ instead. Furthermore, as discussed in Proaño (2012*a*), the magnitude of the discrepancy between $L_t^{\mathrm{D},k}$

[13]The assumption of an exogenous job separation rate is consistent with Hall (2005) and Shimer (2005), who find that the rise in unemployment during economic slowdowns is caused not by a higher rate of job destruction (at least in the U.S. employed workers do not get fired more frequently than in economic booms), but by a lower rate of job creation. While this assumption is also met by Gertler and Trigari (2009), Trigari (2009) and Christoffel et al. (2009), Campolmi and Faia (2006), in contrast, assume that the job separation rate depends partly on the position of the economy within the business cycle, making the separation rate of employment partly endogenous.

and $N_t^k$ depends in a non-linear manner on all three labor market parameters comprised in eq.(20), namely $\mu$, $\rho$ and $\nu$.[14]

Given this constraint, it is natural to assume that firms may use their price-setting power to improve their profit margins. Of course, different specifications may be consistent with this notion. However, for the sake of consistency with the behavioral approach pursued throughout this paper, let us assume for the determination of domestic price inflation a standard backward-looking Phillips curve relationship

$$\pi_t^k = \beta_{py} y_t^k + \alpha_\pi \pi_{t-1}^k + \varepsilon_t^p \tag{21}$$

where $\beta_{py}$ is the slope of the Phillips curve and $\alpha_\pi \in [0,1]$ represents the degree of persistence in the inflation dynamics, and $\varepsilon_t^p$ is a cost-push shock to be defined further below.[15]

### 2.3 Monetary Authorities

Concerning the behavior of the monetary union's central bank (MUCB), the following simple operational monetary instrument rule is assumed as in Proaño (2012*c*)[16]

$$i_{\mathrm{T}} \quad = \quad i_o + \phi_i i_{t-1} + (1-\phi_i)\phi_\pi(\pi_t^{\mathrm{T}} - \pi^*) + \varepsilon_t^i \tag{22}$$

where $i_o$ denotes the steady state nominal interest rate, $\pi_t^{\mathrm{T}}$ the target inflation rate (to be defined below) and $\pi^*$ the inflation target (which in the following will be assumed to be equal to steady state inflation rate $\pi_o$ ), $\phi_\pi$ the responsiveness of the monetary policy instrument interest rate to deviations of inflation from its target level (with $\phi_\pi > 1$) and $\varepsilon_t^i$ is a random shock.[17]

The MUCB's target inflation rate $\pi^T$ – which in the case of EMU is given by the aggregate Monetary Union Index of Consumer Prices (MUICP) –, is defined here as

$$\pi_t^T \quad = \quad \omega_H \pi_t^H + (1-\omega_H)\pi_t^F \tag{23}$$

[14] Note that, as discussed in Proaño (2012*a*), this formulation of the employment rate dynamics differs significantly from traditional search and matching labor market models, because here the vacancies are determined basically by the goods aggregate demand pendant on the labor market (since $L_t^{\mathrm{D},k}/\bar{L} = Y_t^k/\mathbb{Y}^k$) and not, as usual, through a forward-looking decision process including Bellman equations and therein the cost-benefit considerations of both workers and firms.

[15] Using a New Keynesian Phillips curve derived from an intertemporal profit maximizing behavior by monopolistic firms, as discussed e.g. Walsh (2010), would have been possible here, but assuming a behavior on the basis of rational expectations would have been inconsistent with the households' bounded rationality assumption.

[16] That is, in the words of Svensson (2003, p.1), a rule which "expresses the central bank's instrument (usually a short interest rate, the *instrument* rate [...]) as an explicit function of information available to the central bank".

[17] Given the implicit focus of this paper on the EMU, for this baseline scenario this specification seems to be appropriate since it describes a *systematic* conduction of monetary policy which comprises literally the mandate of the European Central Bank as determined by Article 105 of the Maastricht Treaty, whereafter "the primary objective of the ESCB [European System of Central Banks] is to maintain price stability." This quote, however, goes on as following: "Without prejudice of the objective of price stability the ESCB shall support the general economic policies in the Community with a view to contributing to the achievement of the objectives of the Community [...]."

where $\omega_H$ represents the weighting parameter for the member country $H$ to be discretionarily determined by the MUCB.

### 2.4 Fiscal Authorities

As in Beetsma and Jensen (2005), national governments are assumed to purchase only goods produced in their own country in order to highlight the stabilizing role of fiscal policy at the national level, and denote by $G_t^H$ and $G_t^F$ the government spending in the respective home and foreign countries.

In the same manner as aggregate private consumption was decomposed into a long-trend and a cyclical component (see eqs.(8) and (9)), the (log) level of government expenditures is decomposed into

$$\ln(G_t^k) = \ln(\mathbb{G}_t^k) + g_t^k \tag{24}$$

where the long-run component $\ln(\mathbb{G}_t^k)$ is assumed here to be exogenously given[18] and the cyclical component $g_t^k$ is assumed to be determined by

$$g_t^k \quad = \quad -\phi_{gy} \ln\left(\frac{Y_{t-1}^k}{\mathbb{Y}_{t-1}^k}\right) - \phi_b \left(\frac{B_{t-1}^k}{Y_{t-1}^k} - \Psi^k\right) \tag{25}$$

where $\Psi^k$ represents the debt-to-GDP ratio pursued by the fiscal authorities. Eq.(25) consists thus of an anticyclical term meant to summarize the automatic stabilizers in public finances, and a long-run term aimed at the stabilization of the debt-to-GDP ratio at a level given by $\Psi^k$, and could be related to the structurally-adjusted deficit, as in Mayer and Stähler (2013).[19] Government taxes are in contrast assumed to be determined by

$$T_t^k = \mathbb{T}_t^k \cdot \left(\frac{Y_t^k}{\mathbb{Y}_t^k}\right)^{\tau_y} \tag{26}$$

where $\mathbb{T}_t^k$ is the long-run component of tax revenues and $\left(\frac{Y_t^k}{\mathbb{Y}_t^k}\right)^{\tau_y}$ is the corresponding cyclical component.

The country $k$'s government is assumed to finance its expenditures $G_t^k$ and the interest on outstanding debt $R_{t-1}^k B_t^k$ through tax revenues $T_t^k$, as well as through the issuance of new bonds. Under these assumptions, the governments' flow budget constraint (GBC) in real terms is described by

$$B_{t+1}^k = (1 + R_{t-1}^k - \pi_t^k) B_t^k + G_t^k - T_t^k. \tag{27}$$

[18] In reality, the great share of total government expenditures in the great majority of economies is predetermined by entitlements such as the Social Security in the United States, and is not the result of an optimizing behavior by the government. Therefore, it seems adequate to split the government expeditures into a exogenously given component and a discretionary component.

[19] Mayer and Stähler (2013, p.13), using a DSGE framework, analyze also the performance of a balanced budget rule, finding that "due to erratic spending behavior, the balance budget rule tends to destabilize the economic and gives rise to sunspot equilibria. Cyclical fluctuations tend to be more pronounced under this regime and cyclical smoothing does not take place. In terms of welfare considerations, this regime also does comparatively poor."

### 2.5 Macroeconomic Risk and Sovereign Bond Pricing

Following Adrian et al. (2010), the perceived macroeconomic risk at time $t$ is specified as a linear combination of various macroeconomic fundamentals contained in a vector $\mathbb{F}^k_{t-1}$, i.e.

$$\tilde{E}_t[\zeta^k_t] = \boldsymbol{\xi}^k_{\mathbb{F}} \mathbb{F}^k_{t-1}. \tag{28}$$

where $\boldsymbol{\xi}^k_{\mathbb{F}}$ is a exogenously given coefficient vector which determines the relative importance of a particular variable in $\mathbb{F}^k_{t-1}$ in the assessment of $\tilde{E}_t[\zeta^k_t]$. More specifically, let

$$\mathbb{F}^k_{t-1}{}' = \left[1, \frac{Y^k_{t-1}}{\mathbb{Y}^k_{t-1}} - 1, \frac{B^k_{t-1}}{Y^k_{t-1}} - \Psi^k, \frac{TB^k_{t-1}}{Y^k_{t-1}}\right]',$$

so that

$$\tilde{E}_t[\xi^k_t] = \xi^k_0 - \xi^k_y \ln\left(\frac{Y^k_{t-1}}{\mathbb{Y}^k_{t-1}}\right) + \xi^k_b \left(\frac{B^k_{t-1}}{Y^k_{t-1}} - \Psi^k\right) - \xi^k_{tb} \left(\frac{TB^k_{t-1}}{Y^k_{t-1}}\right) + \varepsilon^\zeta_t. \tag{29}$$

where $TB^k$ represent the country's trade balance (to be defined below) and $\varepsilon^\zeta_t$ is a stochastic shock to be defined below. As it can be easily seen, the values of $\boldsymbol{\xi}^k_{\mathbb{F}} = \{\xi^k_0, \xi^k_b, \xi^k_y, \xi^k_{tb}\}$ are central for the assessment of the macroeconomic risk of Home and Foreign, and allow us to investigate the consequences of a differentiated perception of country risk by the financial markets at the macroeconomic level. According to eq.(29), the perceived macroeconomic risk of country $k$ is a negative function of the country $k$'s output gap in the previous period (which is observable to all agents in the economy), a positive function of the country's level of indebtedness (relative to a given target level) at date $t-1$, and a negative function of the trade balance as a ratio of GDP at $t-1$ – increasing when country $k$ runs a trade deficit, and decreasing when the country is running a trade surplus. Further, $\xi^H_o$ and $\xi^F_o$ represent the perceived intrinsic country-specific macroeconomic risk: By assuming that $\xi^H_o > \xi^F_o$, Home's macroeconomic environment will be assumed to be considered riskier than that of Foreign under otherwise similar macroeconomic conditions. Further, if $\xi^H_{\mathbb{F}} > \xi^F_{\mathbb{F}}$, the macroeconomic fundamentals will have a higher impact in the subjective assessment of Home's macroeconomic risk than of Foreign's.

At this point it should be noted that, as these expressions are formulated, there is no endogenous variation in the link between the macroeconomic risk and the different fundamentals contained in $\mathbb{F}^k_{t-1}$. Obviously, a possible approach to endogenize the relative importance of these variables would be to follow the increasing literature on macroeconomics and behavioral heterogeneous expectations (see e.g. Branch and McGough (2009), Proaño (2011, 2012*b*), De Grauwe (2012), Bask (2012) and Lengnick and Wohltmann (2013)) and let the expected macroeconomic risk be endogenously determined through different behavioral forecasting rules.[20] However, for the sake of simplicity and clarity

[20] Indeed, as previously mentioned, a stylized fact of the recent euro area debt crisis is the non-linear, apparently country-specific and state-dependent link between the sovereign risk premium, and the underlying macroeconomic fundamentals of various euro area countries.

of exposition these coefficients will not become endogenously determined, but directly varied in an exogenous manner in the simulation analysis below.

Concerning the pricing of sovereign bonds of Home's and Foreign's governments, since these are assumed to be one-period ($m = 1$) zero-coupon (pure discount) bonds, it holds that

$$P_{k,t}^{(1)} = \frac{1}{(1 + R_t^k)}. \quad k = \{H, F\} \tag{30}$$

where $R_t^k$ represents the bond's corresponding nominal yield to maturity, and $P_{h,t+1}^{(0)} = P_{f,t+1}^{(0)} = 1$ is the pay-off price at maturity.

As the demand for Home and Foreign government bonds by Home and Foreign households is based on a home bias argument, see eq.(11), there is no need to impose a no-arbitrage condition between the two financial assets, but it is sufficient to specify the corresponding nominal yield to maturity $R_{k,t}^{(m)}$ in order to fully describe the bond demands functions of Home's and Foreign's households. For the sake of simplicity in the following let us assume that market participants consider the sovereign risk to be equal to the overall macroeconomic risk in the economy, so that

$$R_{k,t}^k = i_t + \tilde{E}_t[\zeta_t^k]. \tag{31}$$

Accordingly, if the perceived macroeconomic risk in Home or Foreign increases either through changes in the macroeconomic fundamentals, or due to an autonomous shift in the market's confidence on the state of the economy (represented by an exogenous change in $\xi_0^k$), the yields on sovereign bonds will increase, affecting their fiscal stances and thus reducing their scope of action.[21]

### 2.6 External Imbalances

Having described the structure of the private and the government sectors in both economies, it is straightforward to derive the expressions for the trade balances of the Home and Foreign economies. This is important for the following analysis since one of the goals of this paper is to investigate how the dynamics of the economy change if there is a mismatch between the set of variables considered as relevant for the determination of the macroeconomic risk by the markets, and the set of variables considered as relevant by the fiscal authorities.

As previously mentioned, in the current framework aggregate investment is abstracted from, and the governments are assumed to consume only domestically-produced goods. Under these assumptions, and after inserting eqs.(1) – (5), the market equilibrium condition in the Home and Foreign countries

[21] While considering macroeconomic and sovereign risk as identical may appear as an extreme assumption on first sight, these two variables are quite interrelated to each other through a variety of transmission channels, as recently discussed by Brunnermeier and Oehmke (2012).

can be expressed as

$$\begin{aligned} Y_t^H &= \underbrace{C_t^H}_{\text{Priv. Consumption}} + \underbrace{G_t^H}_{\text{Gov. Consumption}} + \underbrace{C_{t,h}^F}_{\text{Exports}} - \underbrace{C_{t,f}^H}_{\text{Imports}} \\ &= C_t^H + G_t^H + \underbrace{(1-\gamma)\left(\frac{P_t^h}{P_{c,t}^F}\right)^{-a} C_t^F}_{\text{Exports}} - \underbrace{(1-\gamma)\left(\frac{P_t^f}{P_{c,t}^H}\right)^{-a} C_t^H}_{\text{Imports}}, \end{aligned} \tag{32}$$

and

$$\begin{aligned} Y_t^F &= \underbrace{C_t^F}_{\text{Priv. Consumption}} + \underbrace{G_t^F}_{\text{Gov. Consumption}} + \underbrace{C_{t,f}^H}_{\text{Exports}} - \underbrace{C_{t,h}^F}_{\text{Imports}} \\ &= C_t^F + G_t^F + \underbrace{(1-\gamma)\left(\frac{P_t^f}{P_{c,t}^H}\right)^{-a} C_t^H}_{\text{Exports}} - \underbrace{(1-\gamma)\left(\frac{P_t^h}{P_{c,t}^F}\right)^{-a} C_t^F}_{\text{Imports}}. \end{aligned} \tag{33}$$

From here, it is straightforward to confirm that *H*ome's and *F*oreign's trade balances are given by

$$TB_t^H = \underbrace{(1-\gamma)\left(\frac{P_t^h}{P_{c,t}^F}\right)^{-a} C_t^F}_{\text{Exports}} - \underbrace{(1-\gamma)\left(\frac{P_t^f}{P_{c,t}^H}\right)^{-a} C_t^H}_{\text{Imports}}, \tag{34}$$

and

$$TB_t^F = \underbrace{(1-\gamma)\left(\frac{P_t^f}{P_{c,t}^H}\right)^{-a} C_t^H}_{\text{Exports}} - \underbrace{(1-\gamma)\left(\frac{P_t^h}{P_{c,t}^F}\right)^{-a} C_t^F}_{\text{Imports}}, \tag{35}$$

## 3 Model Analysis

Since the present framework deviates in various dimensions to standard DSGE Models, and a proper estimation of the same is beyond the scope of this paper, the choice of the model's parameters is not quite straightforward. However, whenever possible, I take parameters widely accepted in the literature. For instance, I set the long-run trend components of consumption, government expenditures and lump-sum taxes equal to $\mathbb{C} = 75$, $\mathbb{G} = 25$ and $\mathbb{T} = 25$, respectively, what leads to an steady state output level of $\mathbb{Y} = 100$, and thus to a long-run private consumption to GDP ratio of 0.75, a government expenditures to GDP ration of 0.25 (and thus a ratio of private to government consumption of three), and a balanced government budget in the long-run, as it is standard in the literature, see e.g. Beetsma and Jensen (2005). The degree of home bias is set equal to 0.8, what implies a share of imports to GDP of 0.15, under a long-run zero trade balance. Further, the cyclical elasticity of government expenditures and tax revenues is set equal to $\phi_y = 0.20$ and $t_y = 0.12$, respectively, following Mayer and Stähler (2013), who set a total cyclical elasticity of the structural budget deficit equal to 0.32. Also

following Mayer and Stähler (2013), I set the elasticity of the cyclical government expenditures to the debt-to-GDP as $\phi_b = 0.02$. Concerning the labor markets, I introduce a slight asymmetry between

Table 1: Parameter Values

| Parameter | Symbol | Value |
|---|---|---|
| Long-run component of consumption | $\mathbb{C}$ | 75 |
| Elasticity of substitution in consumption | $a$ | 1.1 |
| Degree of home bias in consumption | $\gamma_h$ | 0.8 |
| Interest rate elasticity of cyclical consumption | $\alpha_{yr}$ | 0.15 |
| Sovereign risk elasticity of cyclical consumption | $\alpha_{y\xi}$ | 0.35 |
| Long-run component of government expenditures | $\mathbb{G}$ | 25 |
| Output gap elasticity of cyclical government expenditures | $\phi_{gy}$ | 0.20 |
| Debt elasticity of cyclical government expenditures | $\phi_b$ | 0.2 |
| Target Debt-to-GDP ratio | $\Psi$ | 0.6 |
| Lump-sum Taxes | $\mathbb{T}$ | 25 |
| Output gap elasticity of cyclical tax revenues | $t_y$ | 0.12 |
| Home's labor matching technological level | $\mu_H$ | 0.38 |
| Foreign's labor matching technological level in | $\mu_F$ | 0.46 |
| Cobb-Douglas labor matching parameter | $\nu$ | 0.42 |
| Job separation rate | $\rho$ | 0.05 |
| Output gap coefficient in Phillips Curve | $\beta_{py}$ | 0.15 |
| Lagged inflation coefficient in Phillips Curve | $\alpha_\pi$ | 0.75 |
| Inflation gap coefficient in interest rule | $\phi_\pi$ | 2.0 |
| Output gap coefficient in interest rule | $\phi_y$ | 0.0 |
| Home's weight in the interest rate rule | $\omega_H$ | 0.5 |
| Idiosincratic sovereign risk premium | $\xi_0^k$ | 0.0 |
| Home's sovereign debt coefficient in risk premium | $\xi_b^H$ | 0.001 |
| Foreign's sovereign debt coefficient in risk premium | $\xi_b^F$ | 0.0 |
| Home's fiscal deficit coefficient in risk premium | $\xi_b^H$ | 0.0 |
| Foreign's fiscal deficit coefficient in risk premium | $\xi_b^F$ | 0.0 |
| Output gap coefficient in risk premium | $\xi_y^k$ | 0.01 |
| Trade balance coefficient in risk premium | $\xi_{tb}^k$ | 0 |

Home and Foreign through the values of $\mu_H = 0.40$ and $\mu_F = 0.44$, both of which are however consistent in their average with the estimates of De Haan et al. (2000) (Christoffel et al. (2009) calibrate their model with $\mu = 0.42$), as well as the Cobb-Douglas parameter $\xi_H = \xi_F = 0.42$, which is concordant with the empirical findings of European countries and the U.S. surveyed by Petrongolo and Pissarides (2001) (Walsh (2005) sets this parameter equal to 0.4). Further, the job separation rate $\rho$ is set equal to 0.1 following the empirical findings by Hall (1995), Hall (2005), Shimer (2005). After assuming for simplicity a long-run technology level of $\mathbb{A} = 1$, these parameters deliver a steady state employment rate in Home of $e_o^H = 0.869$ and in Foreign of $e_o^F = 0.887$, and a corresponding

average labor productivity of $A^H = 1.15$ and $1.12$.[22] Based on the empirical estimates of Goodhart and Hofmann (2005) for the euro area, the slope of the Phillips is set equal to 0.125, and the past inflation rate coefficient to 0.75.

Concerning the MUCB monetary policy rule, as in Proaño (2012*c*) I assume that $\phi_\pi = 2.0$ and $\phi_y = 0.0$, as this specification seems to be appropriate since it describes a *systematic* conduction of monetary policy which comprises literally the mandate of the European Central Bank as determined by Article 105 of the Maastricht Treaty, whereafter "the primary objective of the ESCB [European System of Central Banks] is to maintain price stability."[23] Further, the weighting parameter for the member country $H$ in the interest rate rule is set $\omega_{_H} = 0.5$, assuming an equal weight of both countries in the MUCB's loss function. With respect to the reaction parameters in the market expectations of Home and Foreign's sovereign risk, given the lack of empirical estimates, I set them arbitrarily to $\xi_o^H = \xi_o^F = 0.0$, $\xi_b^H = 0.02$, $\xi_d^H = 0.0$; $\xi_y^H = 0.25$ and $\xi_{tb}^H = 0.0$. Table 1 summarizes all these parameter values.

Finally, concerning the stochastic shocks to the system, I assume in a standard manner that all of them follow an AR(1) process and that the corresponding autoregressive coefficients and standard deviations of the innovations are given by the values summarized in Table 2.

Table 2: Standard Deviations of Stochastic Shocks

| Variable | Autoregressive Term | Std. Dev. |
|---|---|---|
| Home and Foreign cyclical consumption | 0.7 | 0.03 |
| Home and Foreign sovereign risk premium | 0.7 | 0.05 |
| Home and Foreign price mark-up | 0 | 0.014 |
| Monetary policy | 0.7 | 0.024 |

### 3.1 Transmission Mechanisms and Dynamic Adjustments

Before discussing the performance of alternative fiscal policy rules under different perceived macroeconomic risk specifications in terms of macroeconomic volatility, it is worthwhile to analyze the model's dynamic adjustments to a one-time exogenous increase in the perceived macroeconomic risk of Home.[24]

As Figure 1 clearly illustrates, an increase in the market's expectations of Home's macroeco-

[22] This comes from the fact that in the present model (as in Proaño (2012*a*)), labor productivity is determined residually and as a function of the frictions in the labor market. Accordingly, a more flexible labor market is related to lower average labor productivity, while a more rigid labor market is related with a higher average labor productivity.

[23] This quote, however, goes on as following: "Without prejudice of the objective of price stability the ESCB shall support the general economic policies in the Community with a view to contributing to the achievement of the objectives of the Community [...]."

[24] All numerical simulations in this paper were done using Dynare 4.3.3, see Adjemian et al. (2011). The codes are available from the author upon request.

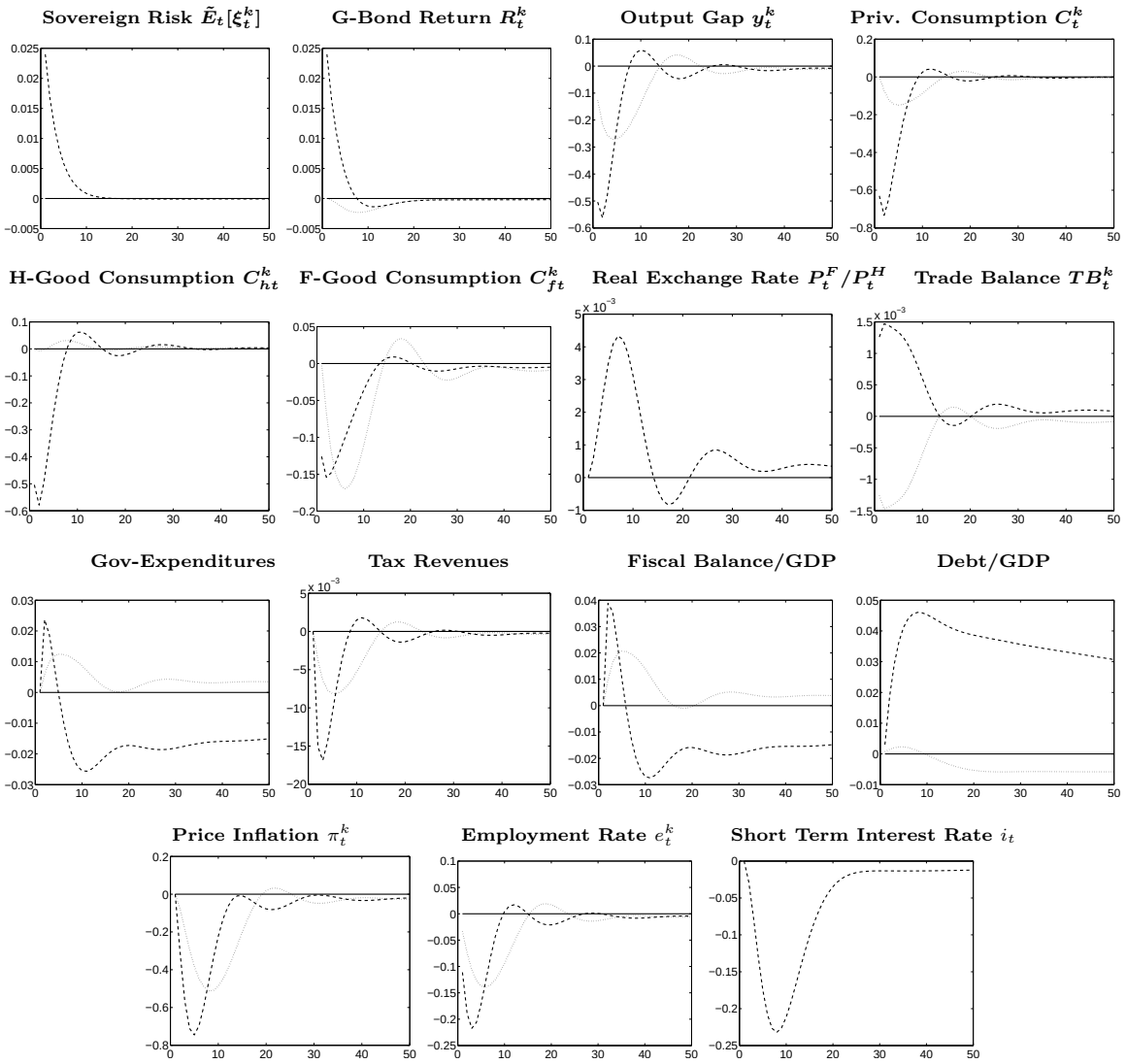


Figure 1: Dynamic responses in Home (dashed line) and Foreign (dotted line) to a one-time one std. dev. increase in the market's expectations of Home's macroeconomic/sovereign risk

nomic/sovereign risk reduces economic activity through two main channels, namely through the reduction in aggregate private consumption resulting from a more pessimistic outlook with respect to future economic development, see eq.(10), and through the increase in Home's sovereign debt and the subsequent fiscal consolidation efforts, see eq.(25). Given the international trade interactions between Home and Foreign, an increase in $\tilde{E}_t[\zeta_t^H]$ has a negative impact on economic activity not only of Home, but also of Foreign due to the reduction in the Home's demand for Foreign's consumption goods, what leads to a temporary trade account imbalance between the two countries. Further, again due to Foreign's assumed safe haven status, Foreign's expected sovereign risk remains unchanged and equal to zero despite of the reaction of the corresponding macroeconomic variables resulting from the

interaction between Foreign and Home.[25]

### 3.2 Aggregate Volatility under Alternative Macroeconomic Risk Expectations and Fiscal Policy Rules

As it is well-known, in the standard DSGE framework the performance of monetary and fiscal policy is analyzed using a welfare criterion derived from the utility function of the representative agent(s) and the flexible-price equilibrium under rational expectations, see e.g. Rotemberg and Woodford (1997). Since the present framework is not "microfounded" in the sense of the DSGE approach, and does not rely on the rational expectations assumption, but on the notion of behavioral forecasting rules and a perceived macroeconomic risk eventually determined by specific variables only, such an evaluation strategy is not applicable here.

To circumvent this shortcoming, aggregate macroeconomic volatility – defined in terms of the output gap –, i.e.

$$\mathcal{V}_{\mathrm{T}}^{k} = \sum_{t=1}^{T} \left[ \left( \ln \left( Y_{t-1}^{k} \right) - \ln \left( \mathbb{Y}_{t-1}^{k} \right) \right)^{2} \right] \tag{36}$$

is employed as the evaluation measure, where $T$ represents the evaluation horizon. The following numerical simulations thus illustrate the value of $\mathcal{V}_{\mathrm{T}}^{k}$ for $T = 10000$ (2500 years given the quarterly frequency assumed here) using the parameter values summarized in Tables 1 and 2 for varying pairs of model coefficients. As in each period the two-country framework is hit by five exogenous random shocks (see Table 2), the following simulations illustrate the performance of alternative fiscal policy rules under different assumptions concerning the determinants of macroeconomic and sovereign risk in a stochastic environment.

Figure 2 illustrates the aggregate volatility as defined by eq.(36) of Home, Foreign and the whole monetary union calculated over 10000 periods for varying values of $\xi_y^H$, the output gap coefficient in the perceived macroeconomic risk in Home, and of $\phi_b^H$, the debt-stabilization coefficient in the fiscal policy rule of Home's government. As it can be clearly observed in Figure 2, aggregate output volatility in Home and Foreign is a positive function of the fiscal debt stabilization coefficient $\phi_b^H$ as well as of the perceived macroeconomic risk reaction w.r.t. Home's output gap $\xi_y^H$. Even though these findings are not necessarily surprising, the fact that the slope of the output volatility surface becomes steeper as $\phi_b^H$ and $\xi_y^H$ increase suggests that a larger discrepancy between the extent of debt stabilization, and the output gap role in the perception of Home's macroeconomic risk leads to a higher aggregate volatility. The economic rationale for this outcome is relatively straightforward: As increased focus on the stabilization of the sovereign debt-to-GDP ratio by Home's government (reflected by a ceteris paribus larger value of $\phi_b^H$) reduces the relative role of output stabilization in

[25] As previously mentioned, while Home could be related to Spain or Italy in the current euro area crisis, Foreign would be represent Germany.

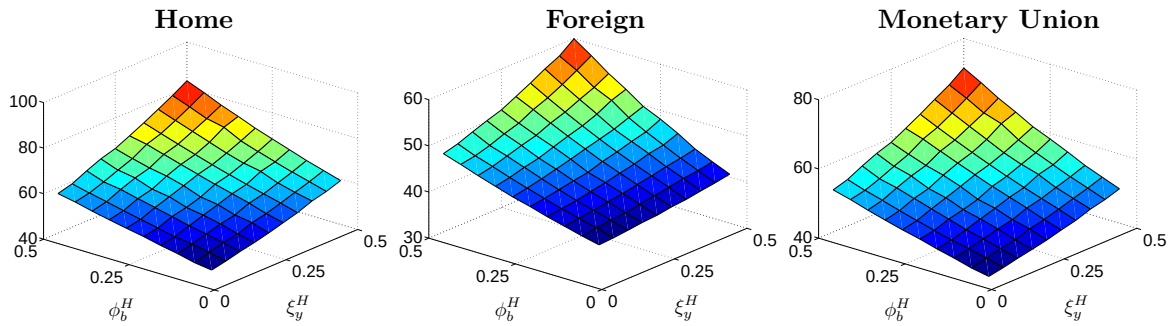


Figure 2: Aggregate volatility in Home, Foreign and in the Monetary Union for varying parameter values of $\phi_b^H \in (0.02, 0.52)$ and $\xi_y^H \in (0.05, 0.55)$, with all remaining parameters as in Tables 1 and 2.

the fiscal policy rule, a relatively higher output volatility can be expected, which in turn leads to an increase volatility in the perceived macroeconomic risk. This affects the pricing of Home's government bonds, and thus the interest payments on government debt, which in turn makes a stabilization of sovereign debt more difficult to achieve. These developments affect in turn Foreign's economy through two main channels: On the one hand, the increased output volatility leads to an increased volatility both of Foreign's exports (as Home's demand for Foreign's goods is more volatile), as well as Foreign's imports (primarily due to the changes in the relative prices of Home's and Foreign's consumption goods). The second channel concerns the short-term interest rate channel: As the MUCB reacts to the price inflation developments on both countries to the same extent, and inflation is a function of the output gap, increased volatility in Home leads to higher short-term interest rate volatility, which in turn affects Foreign's economy through its effect on private consumption, and on the pricing of Foreign's government debt.

A second scenario worth to be considered concerns the case where the perceived macroeconomic risk may be driven by Home's trade account position. Indeed, while the causes and possible macroeconomic consequences of the significant external imbalances around the world have been a matter of hot debate among academics and policy makers over the last years (see e.g. Geithner (2010), Wolf (2013) and U.S. Treasury (2013)), they have become a central issue particularly in the European policy debate since the outbreak of the euro area crisis in 2009. For instance, Geithner (2010) stresses the need to reduce external imbalances in the following way:

> [...] First, G-20 countries should commit to undertake policies consistent with reducing external imbalances below a specified share of GDP over the next few years [...]. This means that G-20 countries running persistent deficits should boost national savings by adopting credible medium-term fiscal targets consistent with sustainable debt levels and by strengthening export performance. Conversely, G-20 countries with persistent surpluses should undertake structural, fiscal, and exchange rate policies to boost domestic sources

of growth and support global demand. [...]

In this context, the following simulation aims to answer the following question: What if the perceived macroeconomic risk is indeed driven by external imbalances, but fiscal policy is focused on the stabilization of sovereign debt, as it has been the case since 2009 in the euro area?

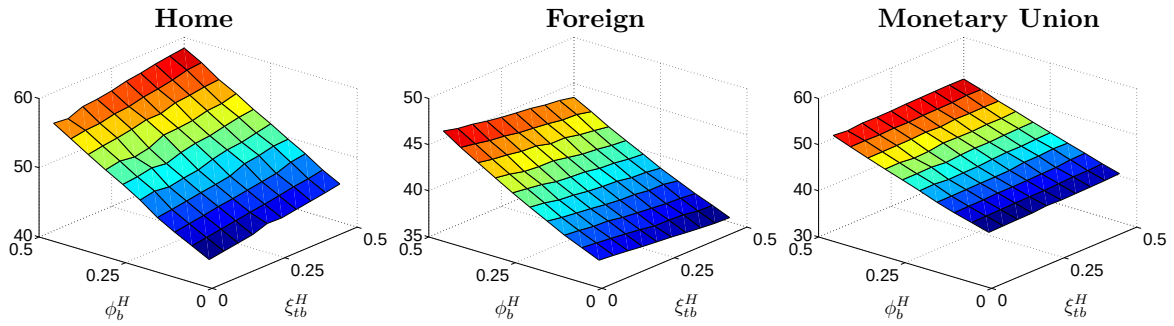


Figure 3: Aggregate volatility in Home, Foreign and in the Monetary Union for varying parameter values of $\phi_b^H \in (0.02, 0.52)$ and $\xi_{tb}^H \in (0.0, 0.5)$, with all remaining parameters as in Tables 1 and 2.

Figure 3 illustrates the aggregate volatility for this case, namely for varying parameters of $\phi_b^H$, the debt-stabilization coefficient in the fiscal policy rule of Home's government, and $\xi_{tb}^H$, the coefficient of Home's trade balance (as a fraction of Home's aggregate output) in Home's perceived macroeconomic risk. As in the previous case, it can easily be observed in Figure 3 that an increasing discrepancy between Home's fiscal policy actions (aimed at the stabilization of sovereign debt) and the relative role of Home's trade imbalances for the perception of macroeconomic risk leads to an overall higher aggregate volatility not only in Home, but also in Foreign and thus at the monetary union level.

A natural policy consequence which could be drawn from this numerical simulation results could be that fiscal policy should try in a systematic manner to reduce external imbalances. Within the current theoretical framework, this fiscal policy strategy could be implemented through the use of a fiscal policy rule featuring a trade balance stabilization term, namely

$$g_t^k = -\phi_{gy} \ln\left(\frac{Y_{t-1}^k}{\mathbb{Y}_{t-1}^k}\right) - \phi_b \left(\frac{B_{t-1}^k}{Y_{t-1}^k} - \Psi^k\right) + \phi_{tb} \left(\frac{TB_{t-1}^k}{Y_{t-1}^k}\right) \tag{37}$$

with $\phi_{tb} \in (0, 0.5)$. Accordingly, government expenditures would react positively to higher trade account surpluses, increasing domestic aggregate demand when the country has a trade account surplus and decreasing it when the country has a trade account deficit.[26]

Figure 4 illustrates the aggregate volatility resulting from this modified fiscal policy rule using the same parameter values as in the previous scenario, now however with $\phi_b^H = 0$ and $\phi_{gy}^H = 0$ and for varying values of $\phi_{tb}^H$.

[26] Obviously, one could also specify a given threshold value beyond which government expenditures would react to trade imbalances.

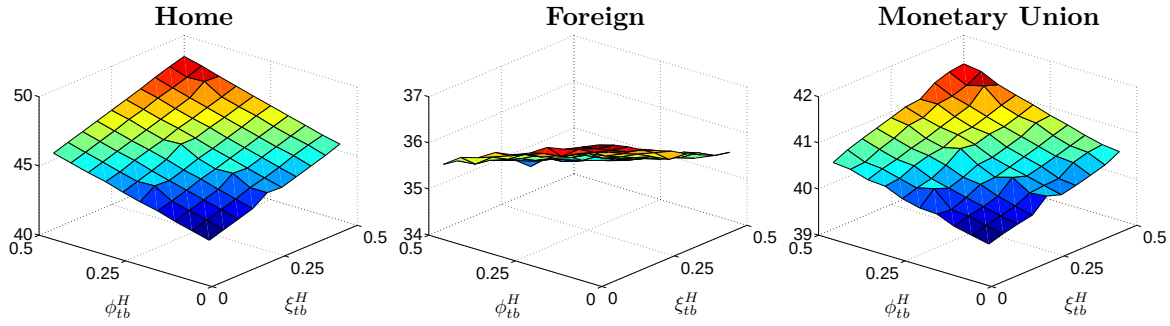


Figure 4: Aggregate volatility in Home, Foreign and in the Monetary Union for varying parameter values of $\phi^H_{tb} \in (0.0, 0.5)$ and $\xi^H_{tb} \in (0.0, 0.5)$, with all remaining parameters as in Tables 1 and 2.

The implementation of such a fiscal policy rule does not seem however to have the expected positive effects even under the assumption that Home's perceived macroeconomic risk is driven by Home's trade imbalances. As Figure 4 clearly illustrates, Home's aggregate output volatility is an increasing function of both $\phi^H_{tb}$ and $\xi^H_{tb}$, and even though the positive is true for Foreign, aggregate output volatility at a monetary union level seems also to depend positively on both $\phi^H_{tb}$ and $\xi^H_{tb}$. This rather unexpected result – given the fact that Home's macroeconomic risk was assumed to depend on Home's trade balance in this scenario – can be however explained as follows: Since in this scenario fiscal policy reacts solely to Home's trade imbalance, its role as a countercyclical stabilization tool is greatly diminished, which increases aggregate output volatility in Home even though Home's perceived macroeconomic risk is reacting to Home's trade imbalances.

Finally, Figure 5 illustrates the consequences for aggregate output volatility of an increasing importance of Home's trade imbalances in Home's macroeconomic risk – as in the previous scenario –, and an increasingly countercyclical fiscal policy by Home's government. According to these last figures, a

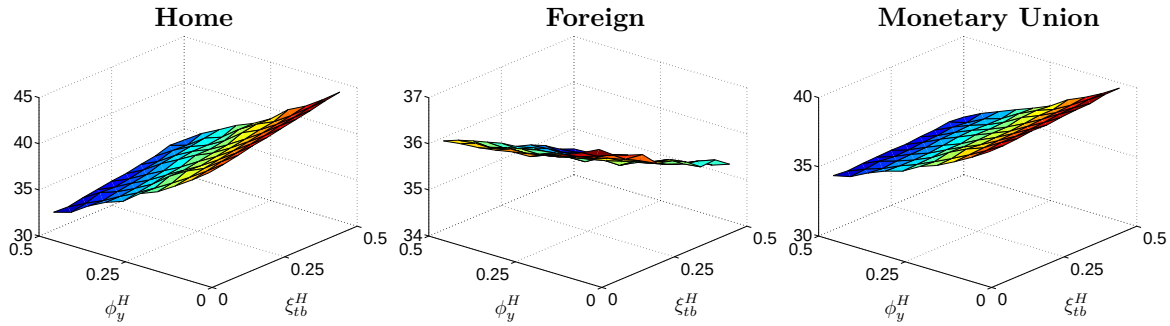


Figure 5: Aggregate volatility in Home, Foreign and in the Monetary Union for varying parameter values of $\phi^H_{y} \in (0.2, 0.7)$ and $\xi^H_{tb} \in (0.0, 0.5)$, with all remaining parameters as in Tables 1 and 2.

more pronounced countercyclical policy is more advantageous in terms of macroeconomic stabilization

even in situations where the macroeconomic risk premium is *not* directly determined by the output gaps, but by other macroeconomic variables such as, in this case, the trade imbalances. This is however no simple coincidence: Given the model's assumption that national governments only purchase goods produced in their own country, a more pronounced countercyclical fiscal policy does not only stabilize output in a direct manner, but it also contributes to the reduction of trade imbalances by increasing or decreasing internal demand indirectly. For instance, assume that a country is running both a trade deficit and experiencing a negative output gap: In such a situation, a counter-cyclical fiscal policy would try to reduce the output gap by increasing cyclical government expenditures and cyclical private consumption (see eq.(9)), which in turn would increase Home's imports (see eqs. (2) and (34)). This of course would worsen the trade deficit. However, since the increase in aggregate output would be larger than the increase in imports ceteris paribus, the trade balance *ratio* to GDP would decrease, leading to an improvement in the perception of macroeconomic risk. By the same token, if a country has both a positive output gap, as well as a trade surplus vis-a-vis its trading partners, and counter-cyclical fiscal policy reduces government spending, both imports and the output level would decrease, the latter to a major extent, though, leading to an overall decrease in the trade balance to GDP ratio in absolute terms. Under the assumption that the perceived macroeconomic and sovereign risk depends on trade imbalances, such an improvement in Home's external position in relation to its overall level of economic activity will lead to a reduction of the perceived macro risk, and by extension to a reduction of sovereign bond yields and an improvement of the public finances.

## 4 Concluding Remarks

As previously mentioned, the main motivation for this paper was to address the following questions: What if governments pursue other goals than what financial market participants consider as relevant for the assessment of macroeconomic risk – and the subsequent pricing of sovereign bonds – and what would be the macroeconomic consequences of such discrepancy in expectations?

In order to shed some light on these issues, a theoretical model of a two-country monetary union was developed which featured a variety of innovative modeling aspects to existent in the literature so far. On the basis that the intertemporal aspect of the consumption determination demands a higher degree of rationality than the intratemporal aspect, a behavioral specification for private consumption was formulated according to which households use the perceived macroeconomic risk in their heuristics for the determination of their cyclical consumption. Further, different specifications for perceived macroeconomic risk were used to analyze its interaction with the model's remaining variables both in terms of dynamic adjustments, as well as aggregate volatility.

In this context, various scenarios were investigated by means of numerical simulations. The first scenario concerned the case where fiscal policy is increasingly oriented towards meeting a specific debt-to-GDP target, while the perceived macroeconomic risk is primarily determined by the state of

the business cycle. As the role of trade imbalances as a source of macroeconomic instability has been put forward in the policy debate in recent times (see e.g. Geithner (2010) and Wolf (2013)), the second main scenario concerned the case where the perceived macroeconomic risk is primarily determined by the dimension of trade imbalances between the members of the monetary union. Under this assumption, the macroeconomic consequences of a fiscal policy increasingly oriented towards meeting a specific debt-to-GDP target were investigated, as well as what would be the effects of a direct trade balance stabilization through fiscal policy.

The numerical simulations of these scenarios highlighted in a clear manner the pitfalls of the conduction of economic policy in the real world, where it cannot be taken for granted that markets may share with governments the same goals, targets and expectations, and where a learning mechanism along the lines of Evans and Honkapohja (2001) may not be feasible due to various reasons. Further, in the context of the current euro area crisis, this paper highlighted the dangers of a too restrictive fiscal policy aimed at the stabilization of sovereign debt. Indeed, as acknowledged even by IMF staff (Anderson et al., 2013), a too restrictive fiscal consolidation is quite likely to affect a country's macroeconomic activity, especially if the markets do not share the same views or targets as the governments following such a fiscal austerity path.

On more general grounds, this paper highlights the importance of the analysis of situations which may not be accurately represented by rational expectations model, where agents share the same information sets and have consistent beliefs with the respect to the future evolution of the economy. Indeed, as the wide empirical evidence on behavioral finance as well as the recent studies on euro area sovereign spreads in recent times seem to suggest, the pricing of sovereign debt seems to be much more complex than what the rational expectations framework may allow for.

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