

A Transfer Mechanism for a Monetary Union (Preliminary draft; Please do not quote)

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Abstract

We show in a dynamic stochastic general equilibrium framework that the introduction of a common currency by a group of countries with only partially integrated goods markets, incomplete financial markets and no labor migration across member states, significantly increases volatility of consumption and employment in the face of asymmetric shocks. We propose a simple transfer mechanism between member countries of the union that reduces this volatility. Furthermore, we show that this mechanism is more effective than anticyclical policies at the national level while in the long run deeper integration of goods markets could reduce volatility significantly.

Keywords: Monetary Union, Asymmetric Shocks, Fiscal Policy, Fiscal Transfers

JEL classification: F41, F44, E2, E3, E52

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1 Introduction

Now in its teenager years, the euro area has reached a crucial phase. The sovereign debt crisis has brutally shown the limits to the economic governance of a monetary union of heterogenous member states that have not agreed upon a set of adequate policies that would deal with asymmetric shocks to individual member states. For the euro area to survive it crucially matters that new instruments are designed to address these structural flaws. In the public debate a lot has been said about the desirability of a deeper economic union as a complement to the monetary union. However, when the debate turns to what exactly would constitute necessary instruments and reforms, policy makers usually add little flesh to that claim. In this paper we want to contribute to this debate over suitable institutional reforms to make the euro area fit for the future. Based on simulations in a standard open economy dynamic stochastic general equilibrium model we propose a simple transfer mechanism that is suitable to address asymmetries across the monetary union.

Our starting point is the observation that national cyclical fluctuations can turn a lot more severe when countries form a currency area whose degree of economic integration, i.e. with respect to goods, labor and financial markets, is low. With a common monetary policy, the volatility caused by asymmetric shocks can no longer be mitigated by a country specific monetary policy. The remaining options to deal with this volatility are labor migration from depressed to booming member states and an anti-cyclical fiscal policy. With insufficient labor mobility across countries within the euro area the only available option is fiscal policy.

All successful currency unions of heterogenous regions have common fiscal instruments to deal with asymmetric shocks.¹ These are common social security and tax systems, common debt issuance and expenditure programs and a creditor of last resort, the central bank². Such a common set of instruments is missing in the euro area, so that the burden of national anti-cyclical stabilization policies rests entirely on national budget deficits and the willingness of private creditors to provide credit to national governments. Monacelli and Galí (2008) and Ferrero (2009) show that under complete financial markets such policies are indeed optimal and Nakamura and Steinsson (2011) show that fiscal multipliers can be expected to be quite large in such an environment. However, the current crisis has clearly exposed the limits to debt financing and thereby to stabilization policies at the national level. It

¹See, for example Bordo et al. (2011) for a recent account.

²See de Grauwe (2011a,b) for an account of central banks acting as creditors of last resort to governments when multiple equilibria are possible in sovereign debt markets.

therefore appears straightforward to provide instruments for stabilization at the union level.

Within the framework of a dynamic stochastic general equilibrium model we propose a fiscal transfer mechanism as one such instrument that helps to reduce volatility and to synchronize business cycles across countries. If countries of a monetary union differ in their state of the business cycle, for example one country growing below trend while the rest of the union growing above trend, the poorly performing country would receive a transfer from the booming part of the union. Thereby aggregate demand could be increased in the first and reduced in the second. The advantages of such a transfer mechanism are straightforward: First, the cyclical fluctuations are mitigated in both regions. This could not be accomplished with the common monetary policy when cycles are asymmetric. Second, if the transfers are not paid out of national government budgets but are implemented as direct payments and receipts out of a pool of resources controlled by a union wide authority, they do not affect national governments' fiscal positions. Thus, national fiscal solvency issues do not arise in times of a severe downturn because of this mechanism. Risk premia related to sovereign default risk will not arise and, consequently, real interest rates will not be anticyclical as observed in the current crisis in many countries of the euro zone. Furthermore, Ricardian equivalence effects do not play any role in our transfer mechanism which render it a much more effective stabilization tool than national deficit financed fiscal stabilization.

We constructed the transfer mechanism in our model in a way that it looks very much like unemployment insurance schemes that have been up and running in many countries for ages: Workers in a booming region transfer resources to workers in a depressed region. As such insurance schemes work in a quasi-automatic fashion with little delay, the well-known drawbacks of decision and implementation lags of discretionary stabilization measures do not apply. If set up like an insurance scheme, this would imply that the central fiscal authority does not gain access to resources it can spend, it is just a measure to re-distribute resources across the union in a well-defined, state-contingent manner for a specific purpose that benefits members in the entire region. This may thus be a step towards political and fiscal union that is politically much more feasible than setting up an agency with taxing and spending power (i.e. yielding more power to "Brussels").

We also show that in the long-run such a transfer system might not be needed as much as in the short-run as deeper integration reduces the asymmetry of business cycles in the presence of asymmetric shocks. To some extent a transfer system can thus be regarded as an instrument that is needed on the way to a deeper union that will be in place some time in the future.

However, it is unclear that even strong policy measures fostering the further integration of goods, services and factor markets will result in such an optimum currency area without a need for strong central fiscal institutions as the example of the United States suggests. Deeper union in the form of a transfer mechanism may thus be desirable in any case.

The general idea of such a transfer mechanism is not new, of course³. But as the current debate on the future of the eurozone lacks a focus on structural asymmetries, we believe it is necessary to turn attention to this aspect. Furthermore, by analysing such a transfer mechanism in a widely used model for policy analysis, we are able to provide an analytical framework to assess the merits of different configurations of such a transfer system.

The rest of the paper is structured as follows. Section 2 provides some evidence on the asymmetric business cycles in the euro area while section 3 provides the set-up of the model and the transfer mechanism used for the analysis in section 4. Section 5 concludes.

2 Economic Integration and Business Cycles in the Euro Area

In this section we briefly shed light on the empirics of the European economic integration process in order to illustrate that the euro area, although possibly, but not necessarily on the way to it, has not achieved the status of an optimum currency area yet.

Figure 1 presents the business cycles across euro area member states measured in terms of the respective output gaps. We computed them as percent deviations of output from a Hodrick- Prescott filtered trend with data from the International Monetary Fund's International Financial Statistics (IFS) database. At first sight, the business cycles have followed a common pattern, booms and busts are positively correlated and the figure lends support to the finding by Rose (2009) that business cycle correlation has increased after the introduction of the euro. It appears to be straightforward to interpret this as symmetric shocks driving the common market. However, large differences in the size of the gaps are still visible and, as can be seen in Figures 2 and 3, dispersion in real interest rates and unemployment even increased significantly in recent years (data also taken from the IFS). The reason for this could be that either countries react differently to common shocks or that they are hit, in addition, by a set of idiosyncratic shocks. For the last few years of the sample, at least, the global financial crisis clearly acted as a large symmetric

³Add references...

shock dominating the up and down movements in the output gap series in Figure 1 that began in 2007.⁴ It is unclear, however, if such large common shocks will prevail indefinitely or if, instead, asymmetric shocks will play a greater relative role. If the latter will be the case, it even seems possible that a greater heterogeneity in business cycles will follow in coming years.

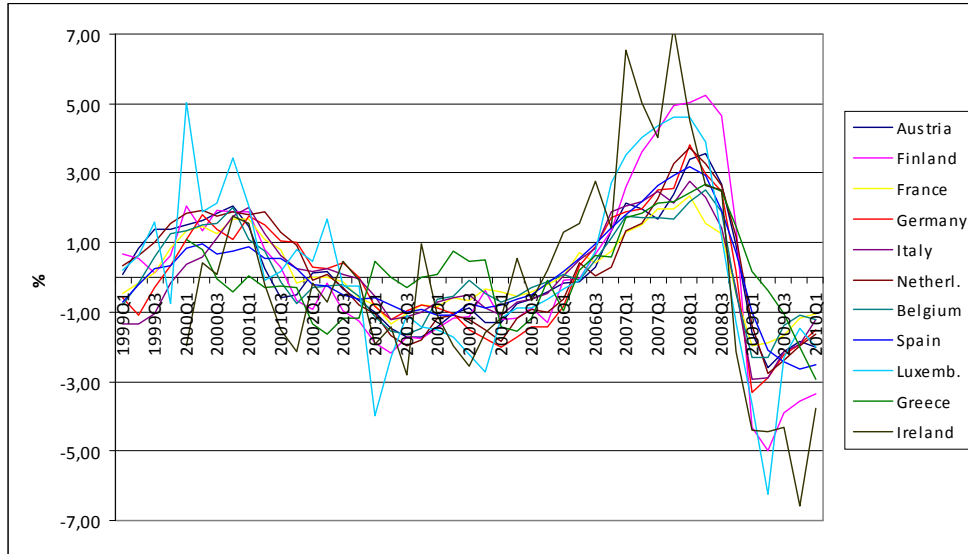


Figure 1: Output Gaps

Another useful indicator of economic integration, in particular financial market integration, is the correlation of consumption growth rates. Figure 4 presents the 3-year moving average correlation coefficient of the EU-12 euro area countries' real per-capita consumption growth rates with the group's weighted average consumption growth rate.⁵ It is clearly visible that for most of the time in this sample, there was very little consumption risk sharing. However, towards the end of the sample (fourth quarter 2010) there is an enormous increase in the correlation. But this, like the strong co-movement of the output gap series, should be interpreted with care as it was clearly influenced by the global financial crisis and it seems unlikely to persist in light of the European sovereign debt crisis that ensued.

⁴One might argue that the financial crisis did not have an effect on output in 2007 yet. However, the large contraction later on resulted in a much reduced trend component already in 2007.

⁵The stated dates in the figure are the end-dates of the three year periods. The growth rates used are the quarterly year-on-year changes. The data are again taken from the IFS database.

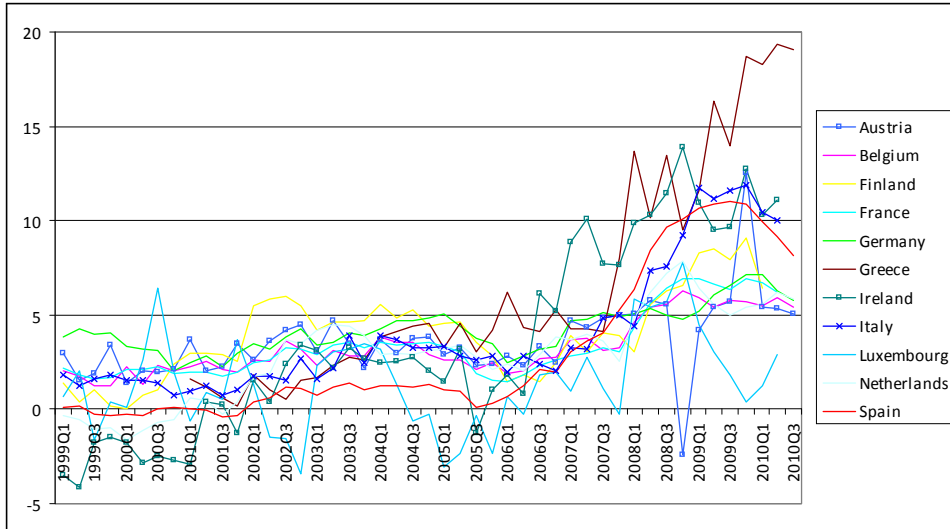


Figure 2: Real interest rates (in percent)

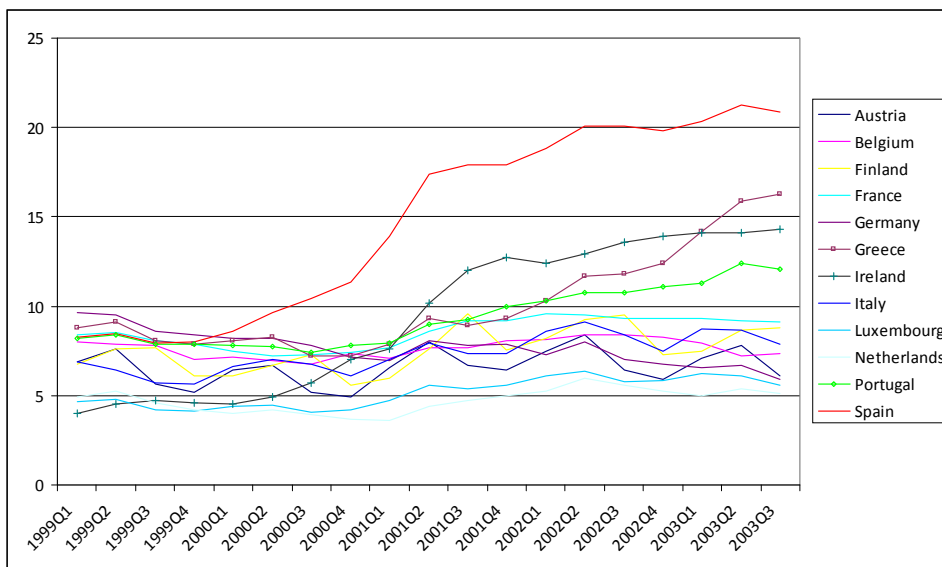


Figure 3: Unemployment rates (in %)

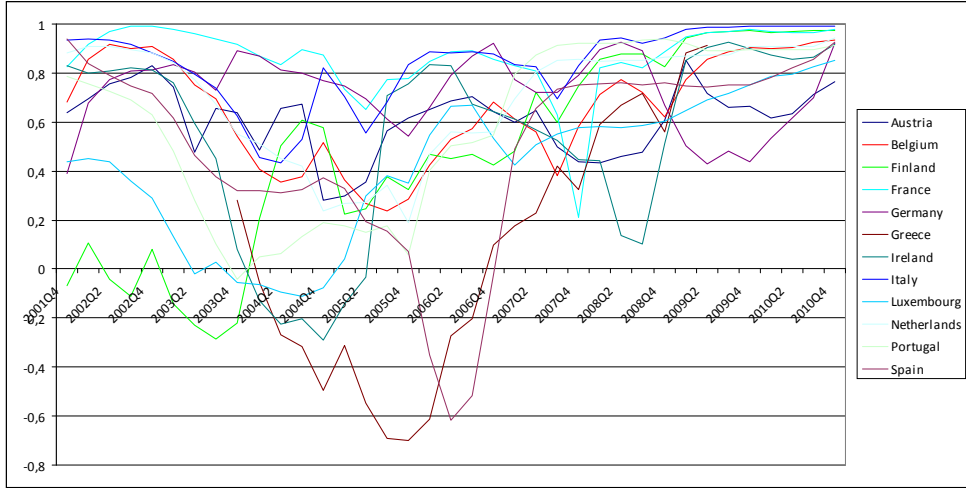


Figure 4: Correlation between per-capita consumption growth with EU12 average (3-year moving average)

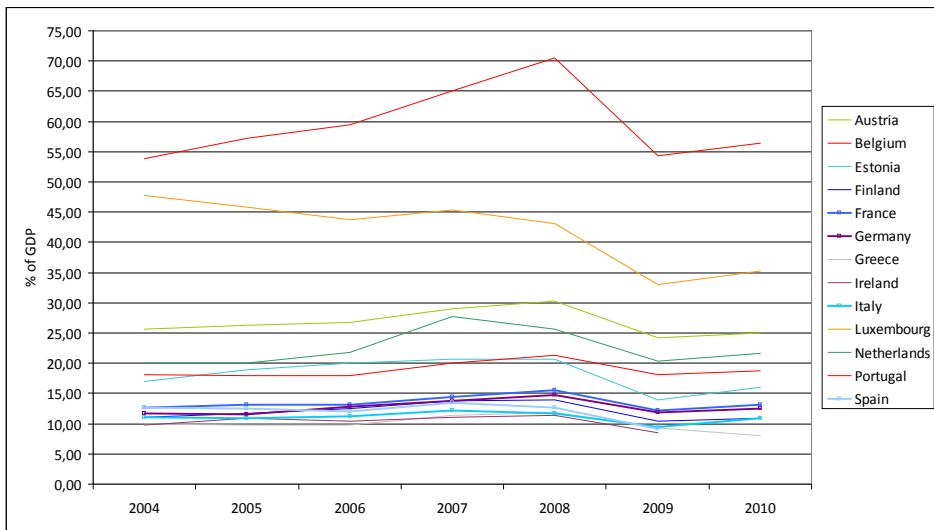


Figure 5: Imports of Goods and Services from other Eurozone countries as a fraction of GDP.

The low degree of risk-sharing can, on the one hand, be attributed to the imperfect degree of financial market integration within the euro area despite much progress in recent years.⁶ On the other hand, it could be a lack of trade integration that results in small spillover effects through trade flows. In his meta-analysis using results from a large number of studies on the euro's effect on trade integration, Rose (2009) found significantly increased trade flows within the euro area. But, as figure 5 indicates, the fraction of imports from other euro area countries relative to GDP remains quite low for most countries. Intra-union trade increased for most countries between 2004 and 2008 but fell in 2009. Whether the increase in 2010 is an indication of a return to a trend towards deeper integration remains to be seen.

After having presented these stylized facts on the incomplete degree of economic integration within the euro area, we now turn to a theoretical model that helps explain the lack of business cycle alignment in a monetary union with trade integration as low as observed in Figure 5 and present a proposal for increasing business cycle alignment and reducing volatility.

3 The Model

The model economy consists of two countries which first have independent monetary policies and a flexible exchange rate between them and then form a currency union with a common central bank. The two-country setting can be regarded as a short-cut to a multiple country setting as one country will be modelled as a small economy and the second country as a large one, which can be interpreted as an aggregate of all remaining countries. Each country is populated by two types of households, denoted as "Ricardian" and "rule-of-thumb" households as in Galí, López-Salido and Vallés (2007). The first type of households have access to a non-state contingent internationally traded bond allowing them to smooth consumption across time while the latter can consume only their current disposable income. This is motivated by the finding of Mankiw and Campbell (1989) that aggregate consumption is explained both by a random walk component and current income.⁷ Households are assumed to set wages in a monopolistic fashion as in Erceg, Henderson and Levine (2000) and Engler (2011) in that they are able to set a mark-up over their marginal rates of substitution. They consume domestically and foreign produced goods and supply labor to domestic firms. Firms,

⁶See Lane (2009) for an excellent survey of the literature on the integration of euro area financial markets and the lack of improvements in risk sharing across countries. For more recent results on cross-border banking activity see Kalemli-Ozcan et al. (2010).

⁷See also Mankiw (2000) and Galí et al. (2007) and the literature surveyed therein.

too, are acting in a monopolistically competitive environment and set prices as a mark up over marginal costs. The only input factor to production is labor so for simplicity we abstract from investment decisions and the role of capital in production. Both wages and prices are set in a staggered fashion à la Calvo (1983). The central banks of the two countries before forming the monetary union implement monetary policies by setting the short-term interest rate following a Taylor-type rule (Taylor, 1993). The common central bank in the monetary union follows a Taylor rule with target values that are weighted averages of member countries' target realizations. Fiscal policy is modelled as a constant level of aggregate government spending while lump-sum taxes may or may not react endogenously to output fluctuations. The transfer mechanism is introduced in section 4.

3.1 Households

The fraction $(1 - \lambda)$ of households, denoted 'Ricardian' henceforth, or asset holders, are allowed to smooth out consumption over time using the capital market. The remaining fraction λ , denoted 'rule of thumb' consumers or non-asset holders, only consumes its current income. We first describe their decisions with respect to consumption and then with respect to wage setting and labor supply.

3.1.1 Consumption decisions

Ricardian households choose a plan $\{C_t^A, N_t^A, A_t, B_t\}_{t=0}^{\infty}$ (superscript A refers to asset holders) to maximize the following lifetime utility subject to a standard CES utility function

$$\mathbb{E}_t \sum_{k=0}^{\infty} \exp(a_{t+k}) \beta^k \left\{ \frac{(C_{t+k}^A)^{1-\gamma}}{1-\gamma} - \frac{(N_{t+k}^A)^{1+\phi}}{1+\phi} \right\}$$

and to the nominal period budget constraint

$$A_{t+1} + B_{t+1} \mathcal{E}_t + P_t C_t^A = R_{t-1} A_t + R_{t-1}^* B_t \mathcal{E}_t + W_t N_t^A + \Pi_t^{pc} - T_t + Tr_t^H$$

where W_t denotes the economy-wide nominal wage, N_t^A the amount of hours worked, Π_t^{pc} nominal profits per capita (earned by Ricardian households only) and T_t nominal taxes. Tr_t^H is an income transfer between home households, to which superscript H refers, and foreign households which will be discussed in detail below. A_t and B_t denote the (beginning of period) holdings of bonds issued by the government of the household's home country and by the households of the other country, respectively. \mathcal{E}_t denotes the nominal exchange

rate. There are thus three distinct borrower-lender relationships: Between domestic Ricardian households and the domestic government, between foreign Ricardian households and the foreign government and between domestic and foreign households.

Lastly, a_t is an intertemporal preference shock following the autoregressive process $a_t = \rho^a a_{t-1} + \varepsilon_t^a$ with white noise disturbance ε_t . This shock acts like an asymmetric demand shock across countries in the analysis below.

The intertemporally optimal allocation of consumption is governed by the following standard Euler equations, referring to the use of the domestic and foreign bond respectively:

$$R_t^{-1} = \exp(a_{t+1}) \beta \mathbb{E}_t \left\{ \frac{(C_{t+1}^A)^{-\gamma} P_t}{(C_t^A)^{-\gamma} P_{t+1}} \right\}$$

$$(R_t^*)^{-1} = \beta \mathbb{E}_t \left\{ \frac{(C_{t+1}^A)^{-\gamma} P_t \mathcal{E}_{t+1}}{(C_t^A)^{-\gamma} P_{t+1} \mathcal{E}_t} \right\}$$

It follows that in the steady state, the returns on both bonds (i.e. R_t and R_t^*) are equal. Domestic and foreign interest rates are linked by an interest rate parity condition and a risk premium:

$$R_t = R_t^* \mathbb{E}_t \left\{ \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} \right\} - \psi (\exp(B_t) - 1)$$

The risk premium, $-\psi (\exp(B_t) - 1)$, is zero for a steady state with a zero net foreign asset position ($B = 0$)⁸ and positive for a negative net foreign asset position ($B_t < 0$). As Schmidt-Grohé and Uribe (2003) have shown, this risk premium guarantees a unique steady state. But rather than using this risk premium just as a technical device to ensure stationarity, which is usually done by setting ψ very low, in a robustness analysis we will allow it to be "large" and we allow, in addition, the level of government debt to determine the risk premium to show that this crucially affects the relative effectiveness of national fiscal stabilization measures and the transfer mechanism we propose.

Rule-of-thumb consumers (superscript N denotes non asset holders) do not have access to capital markets and are bound on the following one-period budget constraint:

$$P_t C_t^N = W_t N_t^N - T_t + Tr_t^H$$

⁸This could easily be generalized to a steady state where $B \neq 0$.

Rule-of-thumb households' period t consumption thus simply equals their current disposable income which is determined by wage income, transfers and taxes⁹.

Both types of households consume the same bundle of goods. This aggregate comprises two bundles C_t^H and C_t^F , which in turn contain the firm specific good-variations from the home- and foreign country respectively.

$$C_t = \left\{ (1 - \omega^{H,p})^{\frac{1}{\sigma}} (C_t^H)^{\frac{\sigma-1}{\sigma}} + (\omega^{H,p})^{\frac{1}{\sigma}} (C_t^F)^{\frac{\sigma-1}{\sigma}} \right\}^{\frac{\sigma}{1-\sigma}}$$

where $\omega^{H,p}$ is the import share of (private) households' consumption and C_t^H and C_t^F are defined as

$$C_t^H = \left[(1-n)^{-\frac{1}{\epsilon}} \int_n^1 (C_t^H(i))^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}}, \quad C_t^F = \left[n^{-\frac{1}{\epsilon}} \int_0^n (C_t^F(i))^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}}$$

where $C_t^H(i)$ and $C_t^F(i)$ are home and foreign produced goods of the respective firm i with $i \in [0, n]$ denoting foreign firms and $i \in [n, 1]$ denoting domestic firms. n is thus the relative size of the two countries and an import share $\omega^{H,p} < 1 - n$ implies a home-bias in consumption because home consumers consume a disproportionate share of home goods compared to relative country sizes. σ and ϵ are the price elasticities of substitution between home and foreign goods and between different goods produced in the same country, respectively. Cost minimization and aggregation across households results in the following standard demand functions:

$$C_t^H(i) = \frac{1 - \omega^{H,p}}{1 - n} \left(\frac{P_t^H(i)}{P_t^H} \right)^{-\epsilon} \left(\frac{P_t^H}{P_t} \right)^{-\sigma} C_t \quad (1)$$

$$C_t^F(i) = \frac{\omega^{H,p}}{n} \left(\frac{P_t^F(i)}{P_t^F} \right)^{-\epsilon} \left(\frac{P_t^F}{P_t} \right)^{-\sigma} C_t \quad (2)$$

where $C_t = \lambda C_t^N + (1 - \lambda) C_t^A$ is aggregate consumption, $P_t^j(i)$ is the price of country j firm i 's good in units of the domestic currency, with $j \in (H, F)$. P_t^H , P_t^F and P_t are the home and foreign producer price indexes and the domestic consumer price index defined as

$$P_t^H = \left((1-n)^{-1} \int_n^1 P_t^H(i)^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}}, \quad P_t^F = \left(n^{-1} \int_0^n P_t^F(i)^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}}$$

⁹We calibrate the model such that consumption does not turn negative.

$$P_t = \left((1 - \omega^{H,p}) (P_t^H)^{1-\sigma} + \omega^{H,p} (P_t^F)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

For the foreign country corresponding equations apply:

$$\begin{aligned} C_t^{*,H}(i) &= \frac{\omega^{F,p}}{1-n} \left(\frac{P_t^{*,H}(i)}{P_t^{*,H}} \right)^{-\epsilon} \left(\frac{P_t^H}{\mathcal{E}_t P_t^*} \right)^{-\sigma} C_t^* \\ C_t^{*,F}(i) &= \frac{1 - \omega^{F,p}}{n} \left(\frac{P_t^{*,F}(i)}{P_t^{*,F}} \right)^{-\epsilon} \left(\frac{P_t^{*,F}}{P_t^*} \right)^{-\sigma} C_t^* \end{aligned} \quad (3)$$

where $C_t^{*,H}$ and $C_t^{*,F}$ denote the foreign household's demand for domestic- and foreign goods respectively. We made use of the assumption that the law of one price holds for individual goods so that $P_t^H = \mathcal{E}_t P_t^{*,H}$ where $P_t^{*,H} \equiv \left((1-n)^{-1} \int_n P_t^{*,H}(i)^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}}$ is the price index for domestic goods expressed in terms of foreign currency units. The foreign consumer price index reads as follows:

$$P_t^* = \left((1 - \omega^{F,p}) (P_t^{*,F})^{1-\sigma} + \omega^{F,p} (P_t^{*,H})^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

The terms of trade are defined as the price of one unit of the foreign goods aggregate measured in units of the domestic goods aggregate:

$$\mathcal{S}_t = \frac{P_t^F}{P_t^H} = \frac{\mathcal{E}_t P_t^{*,F}}{P_t^H}$$

3.1.2 Current account

A country's current account is defined as the change in its net asset position, which is determined by its net interest earnings on the outstanding net asset position plus the trade balance TB_t . Expressed as a fraction of nominal GDP, this is

$$\begin{aligned} \frac{B_{t+1} - B_t}{P_t^H Y_t^H} &= \frac{R_t^* B_t + TB_t}{P_t^H Y_t^H} \\ &= \frac{R_t^* B_t + P_t^H Y_t^H - P_t C_t^H}{P_t^H Y_t^H} \\ &= \frac{R_t^* B_t}{P_t^H Y_t^H} + 1 - \frac{P_t C_t^H}{P_t^H Y_t^H} \end{aligned}$$

3.1.3 Wage setting and labor supply

Households supply differentiated labor inputs to firms, denoted as types z , and these types are assumed to be imperfect substitutes. This allows trade unions representing these types to exert some market power when setting wages. Firm i uses the labor index $N_t(i)$ comprising its inputs of all labor types denoted as $N_t(z, i)$ in its production function (defined below)

$$N_t(i) = \left(\int_0^1 N_t(z, i)^{1-\frac{1}{\epsilon_w}} dz \right)^{\frac{\epsilon_w}{\epsilon_w-1}}$$

where $\epsilon_w > 1$ is the elasticity of substitution between labor types. Profit maximization by firms and aggregation over all firms leads to the standard demand function

$$N_t(z) = \left(\frac{W_t(z)}{W_t} \right)^{-\epsilon_w} N_t \quad (4)$$

where $N_t(z) \equiv \int_n^1 N_t(z, i) di$ and $N_t \equiv \int_n^1 N_t(i) di$ are aggregate demand for type z labor and for overall labor respectively and where $W_t = \left(\int_0^1 W_t(z)^{1-\epsilon_w} dz \right)^{\frac{1}{1-\epsilon_w}}$ is an aggregate wage index. Trade unions that represent workers of type z are able to set real wages as mark-ups over households' marginal rates of substitution. Wages are re-set only infrequently as in Calvo (1983) so that only an exogenously given fraction $1 - \theta_w$ of trade unions re-set wages in any given period as in Erceg et al. (2000). As in Galí et al. (2007), labor types are equally distributed across Ricardian and rule-of-thumb households so that firms' demand for labor across households will not differ implying that on average employment will be the same for Ricardian and rule-of-thumb households. However, consumption levels in general will not coincide, implying that the marginal rates of substitution differ. The unions therefore set wages as a mark-up over a weighted average of the marginal rates of substitution of Ricardian and rule-of-thumb consumers. A union representing type z has the objective

$$\max_{W_t(z)} \sum_{k=0}^{\infty} \beta^k \theta_w^k E_t \left\{ \tilde{C}_{t+k}^{-\gamma} \frac{W_t(z)}{P_{t+k}} N_{t+k|t}(z) - \frac{N(z)_{t+k|t}^{1+\phi}}{1+\phi} \right\}$$

with $\tilde{C}_t^{-\gamma} \equiv \left(\frac{1-\lambda}{C_{R,t}^\gamma} + \frac{\lambda}{C_{N,t}^\gamma} \right)$ that it maximizes subject to labor demand (4) resulting in the first order condition.

$$\sum_{k=0}^{\infty} \beta^k \theta_w^k E_t \left\{ N(z)_{t+k|t} \tilde{C}_{t+k}^{-\gamma} \left(\frac{W_t^*}{P_{t+k}} - \frac{\epsilon_w}{\epsilon_w - 1} MRS_{t+k|t} \right) \right\} = 0$$

where $MRS_{t+k|t} \equiv N(z)_{t+k|t}^\phi / \tilde{C}_{t+k}^{-\gamma}$. Note that we made use of the assumption that within households consumption does not differ across types. From this the New Keynesian wage Phillips-curve follows as

$$\pi_t^w = \beta E_t \{ \pi_{t+1}^w \} - \lambda_w \hat{\mu}_t^w$$

with

$$\hat{\mu}_t^w = \hat{w}_t - \hat{p}_t - \phi \hat{n}_t - \gamma \left((1 - \lambda) \hat{c}_t^A + \lambda \hat{c}_t^N \right)$$

and $\lambda_w \equiv \frac{(1 - \beta \theta_w)(1 - \theta_w)}{\theta_w(1 + \phi \epsilon_w)}$ and where hats over lower case letters indicate log deviations of the variables from their respective steady states and where $\hat{\mu}_t^w$ is the deviation of the wage markup from its steady state.

The fact that Ricardian and rule-of-thumb households' real wages and employment are linked by the trade unions provides an important transmission mechanism by which consumption decisions by one type of household affects the other type of household. For example, an increase in Ricardian households' consumption increases both households' employment and the aggregate marginal rate of substitution and the real wage to the extent that wages can be re-set. This will cause an increase of rule-of-thumbers' consumption as well.

3.1.4 Unemployment

[To be added: Just like in Galí (2011): Unemployment rate proportional to wage markup so it doesn't change the dynamics of the model]

3.2 Government

The two countries' governments have two anti-cyclical fiscal stabilization tools to deal with asymmetric shocks. The first one is a variation in taxes at the national level, the second one a transfer mechanism between households in both economies.

In order to allow for purely national stabilization policies, we introduce a taxation rule and a government budget constraint while aggregate government spending G is assumed to be constant. Per-capita lump sum taxes T_t are determined by the rule

$$T_t = G + \psi_y (Y_t^H - Y^H) + \psi_d A_t / P_t^H$$

where A_t is the level of period t government debt and G the steady state level of government spending and ψ_j with $j \in (y, d)$ coefficients determining the strength of the reaction of government revenues to changes in the level of

debt and output deviations from the steady state.¹⁰ For anti-cyclical fiscal policies, we have to set $\psi_y > 0$ so that taxes are increased when output increases and that taxes fall when output falls. Dividing both sides by Y^H , and assuming a steady state with $A = 0$, we get an expression for the percent deviations of taxes relative to steady state GDP from its steady state as a function of the percent deviations of output from steady state:

$$\widehat{t}_t = \psi_y \widehat{y}_t^H + \psi_d A_t / (P_t^H Y^H)$$

where $\widehat{t}_t \equiv \widehat{T_t/Y^H}$. The evolution of government debt is determined by the budget constraint

$$(1 - \lambda)A_t = (1 + R_t)(1 - \lambda)A_{t-1} + G - T_t$$

Government consumption absorbs the same bundle of goods as private consumers, but the weight for goods imported by the government $\omega^{H,g}$ is allowed to differ from that of private consumers. The aggregate government goods index is therefore

$$G_t = \left\{ (1 - \omega^{H,g})^{\frac{1}{\sigma}} (G_t^H)^{\frac{\sigma-1}{\sigma}} + (\omega^{H,g})^{\frac{1}{\sigma}} (G_t^F)^{\frac{\sigma-1}{\sigma}} \right\}^{\frac{\sigma}{1-\sigma}}$$

and the resulting demand equations

$$G_t^H(i) = \frac{(1 - \omega^{H,g})}{1 - n} \left(\frac{P_t^H(i)}{P_t^H} \right)^{-\epsilon} \left(\frac{P_t^H}{P_t^g} \right)^{-\sigma} G_t \quad (5)$$

$$G_t^F(i) = \frac{\omega^{H,g}}{n} \left(\frac{P_t^F(i)}{P_t^F} \right)^{-\epsilon} \left(\frac{P_t^F}{P_t^g} \right)^{-\sigma} G_t \quad (6)$$

where P_t^g is the government consumption price index

$$P_t^g = \left((1 - \omega^{H,g}) (P_t^H)^{1-\sigma} + \omega^{H,g} (P_t^F)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

which equals P_t when $\omega^{H,g} = \omega^{H,p}$. However, in our benchmark parameterizations we assume a complete home-bias, i.e. $\omega^{H,g} = 0$. For the foreign government corresponding equations apply.

The transfer we employ in our model economy works as follows: Foreign consumers share foreign output deviations from the steady state with domestic consumers and vice versa. The per capita transfer Tr_t^H home consumers receive from foreign consumers then is:

$$Tr_t^H = \phi_{tr} [(Y_t^F - Y^F) - (Y_t^H - Y^H)]$$

¹⁰In a model with shocks affecting the flexible price output level, a straightforward alternative would be taxes reacting to the the output gap measured in terms of output deviations from the flexible price output.

with ϕ_{tr} determining the degree to which output fluctuations are shared. Transfers are zero in the steady state and, of course, we have

$$(1 - n)Tr_t^H + nTr_t^F = 0$$

Noting that $n/(1 - n) = Y^F/Y^H$, we can write

$$\frac{Tr_t^H}{Y^H} = \phi_{tr} \left[\frac{n}{1 - n} \hat{y}_t^F - \hat{y}_t^H \right]$$

The transfer relative to steady state GDP is thus proportional to the differential by which the two countries grow beyond or below their respective steady states.¹¹ When the home economy's output growth relative to trend growth falls below the foreign country's output growth relative to trend growth, it receives a transfer from the foreign country. This could boost aggregate demand in the home economy and depress it in the foreign economy and thereby reduce both the volatility of output and consumption and the asymmetry of the business cycles.

Such a transfer mechanism has benefits both from a theoretical and a political perspective: First, if transfers are related to relative deviations from efficient output, efficient deviations from a long run trend would not cause transfers. In our model this would imply that output fluctuations driven by productivity shocks would cause transfers only to the extent that, in terms of the New Keynesian model, the output gap would not be closed. The output gap in the New Keynesian model is the gap between actual and natural output. The latter is the output that we would observe under flexible prices which is constrained efficient in that the only inefficiency is the monopolistic competition in goods and labor markets. The transfer would thus simply correct the inefficiency related to the rigidity of prices and wages and is therefore welfare enhancing.

Second, if constructed in this way, relative deviations from the countries' respective (possibly stochastic) trend *growth* are the point of reference. These transfers then would not offset per-capita income differences and differences in trend growth. They are thus purely cyclical instruments and countries with strong trend growth would not be "held back" by slow growth countries. This is certainly a strong argument relevant in a political debate as the transfer does not reduce a country's incentive to increase its productivity and to boost its growth trajectory.

¹¹As we abstract from productivity changes, the steady state output is the constrained efficient level of output. If we did allow for productivity shocks and trend productivity growth, the efficient level of output would change, the transfer would have to be adjusted to this efficient level. But this would be merely a technical fix.

3.3 Aggregate demand

Aggregate demand for good i , $Y_t^H(i)$, is the sum of domestic and foreign private and government demand:

$$Y_t^H(i) = \left(\frac{P_t^H(i)}{P_t^H} \right)^{-\epsilon} \left[(1 - \omega^{H,p}) \left(\frac{P_t^H}{P_t} \right)^{-\sigma} C_t + (1 - \omega^{H,g}) \left(\frac{P_t^H}{P_t^g} \right)^{-\sigma} G_t \right] \\ + \left[\frac{n}{1-n} \omega^{F,p} \left(\frac{P_t^H}{\varepsilon_t P_t^*} \right)^{-\sigma} C_t^* + \frac{n}{1-n} \omega^{F,g} \left(\frac{P_t^H}{\varepsilon_t P_t^{*,g}} \right)^{-\sigma} G_t^* \right]$$

Defining $Y_t^H \equiv \left[(1-n)^{-\frac{1}{\epsilon}} \int_n^1 (Y_t^H(i))^{\frac{\epsilon-1}{\epsilon}} di \right]^{\frac{\epsilon}{\epsilon-1}}$, one can show that

$$Y_t^H(i) = (1-n)^{-1} \left(\frac{P_t^H(i)}{P_t^H} \right)^{-\epsilon} Y_t^H \quad (7)$$

3.4 Firms

Home firm i produces output $Y_t(i)$ with the production function

$$Y_t(i) = Z_t N_t(i) \quad (8)$$

where $N_t(i) = \left(\int_0^1 N_t(z, i)^{1-\frac{1}{\epsilon_w}} dz \right)^{\frac{\epsilon_w}{\epsilon_w-1}}$ is firm i 's employment index and where Z_t is the total factor productivity that is assumed to be the same across firms and which in logs follows the autoregressive process $\ln Z_t = \rho^Z \ln Z_{t-1} + \varepsilon_t^Z$ where ε_t^Z is a white-noise shock term. The firm's demand for labor input of type z , $N_t(z, i)$, is

$$N_t(z, i) = \left(\frac{W_t(z)}{W_t} \right)^{-\epsilon_w} N_t(i)$$

for all $z \in [0, 1]$ and $i \in [n, 1]$. The firm's period t profits are

$$\Pi_t(i) = P_t^H(i) Y_t(i) - W_t N_t(i),$$

which, when maximized, takes account of world demand (7) and the production function (8). Assuming price setting à la Calvo, with price stickiness parameter θ_p , the objective is $V_t(i)$,

$$\max_{P_t(i)} V_t(i) = \sum_{k=0}^{\infty} \theta_p^k E_t \{ Q_{t,t+k} \Pi_{t+k}(i) \}$$

where $Q_{t,t+k} \equiv \beta E_t \left\{ \frac{C_t^A}{C_{t+1}^A} \frac{P_t}{P_{t+1}} \right\}$ is the Ricardian household's discount factor and the log-linearized optimality condition can be shown to be:

$$p_t^{Ho} = \mu^p + (1 - \beta\theta_p) \sum_{k=0}^{\infty} (\beta\theta_p)^k E_t \{ \psi_{t+k} \} \quad (9)$$

where $\psi_{t+k} = \log(W_{t+k}/Z_{t+k})$ is the log marginal cost function in period $t+k$ of those firms that reset their price in period t and that have not reset the price between t and $t+k$. Because of the linear production function the marginal cost function is scale invariant so that all firms, no matter at what point in time they change their price, have the same marginal costs. Finally, $\mu^p \equiv \log \frac{\epsilon}{\epsilon-1}$ is the optimal log price markup.

3.5 Aggregate prices and aggregate supply

As is standard in the literature, the New Keynesian Phillips curve,

$$\pi_t^H = \beta E_t \{ \pi_{t+1}^h \} - \lambda_p (\mu_t^p - \mu^p)$$

which determines domestic inflation $\pi_t^H \equiv p_t^H - p_{t-1}^H$, is derived from equation (9) and the expression for the evolution of the aggregate domestic price index,

$$p_t^H = \theta_p p_{t-1}^H + (1 - \theta_p) p_t^{Ho}$$

with average price markup $\mu_t^p \equiv p_t^H - \psi_t$ and $\lambda_p \equiv \frac{(1-\theta_p)(1-\beta\theta_p)}{\theta_p}$.

3.6 Monetary policy

Under a flexible exchange rate, the domestic central bank follows the following Taylor-type rule

$$R_t = \beta^{-1} \left(\frac{P_t^H}{P_{t-1}^H} \right)^{\phi_\pi}$$

An according rule applies for the foreign central bank. After having formed a currency union, the common central bank targets the weighted average of both countries' domestic inflation rates:

$$R_t^U = \beta^{-1} \left(\left(\frac{P_t^H}{P_{t-1}^H} \right)^{1-n} \left(\frac{P_t^F}{P_{t-1}^F} \right)^n \right)^{\phi_\pi}$$

4 Simulations

We now employ this model to illustrate the different stabilization properties of fiscal policy and transfers for various scenarios. In this section, we present simple impulse responses for asymmetric demand shocks to illustrate the mechanics of the model and briefly discuss results for a productivity shock. In section 5 we introduce a welfare metric that allows a normative comparison of different policies for different scenarios.

The demand shock is modelled as a shock to the time preference rate of Ricardian households. The goal is to analyse how the volatility of output and consumption and the co-movement of these variables differ across scenarios and what various stabilization policies can achieve. We start with a benchmark scenario of a flexible exchange rate and independent central banks in both economies, then turn to the case of a currency union with a fixed exchange rate and a common central bank. Next we increase the degree of trade integration to see whether asymmetric shocks will cause less volatility and incur less asymmetric responses. Then we turn to national fiscal stabilization policies and a transfer system between the two countries under a lower degree of integration. Finally we briefly discuss these policies in a currency union for a productivity shock.

4.1 Calibration

The parameter values used in the simulation exercises below are summarized in Table 1. We assume time periods to be quarters so we use the standard value 0.99 for the discount factor β , for the consumption utility function we assume log utility, i.e. $\gamma = 1$. For the choice of the inverse Frisch elasticity ϕ and the elasticity of substitution between labor types ϵ_w , we follow Galí (2011) who showed that for a model with nominal wage rigidity of the kind we assumed above, unemployment is proportional to the wage markup and that a steady state unemployment rate of 5 percent is consistent with $\epsilon_w = 4.52$ and $\phi = 5$. This implies an average wage markup of 28 percent and a Frisch elasticity of 0.2. Using the result of Campbell and Mankiw (1989), we assume that half of all households do not optimize intertemporally, i.e. $\lambda = 0.5$. For ψ , the parameter determining the strength of the risk premium, we follow Bergin (2006) who estimated it to be 0.004. We assume a relatively short-lived shock with $\rho = 0.75$ and a half life of 2 to 3 quarters.

While we assume the home economy to make up 10 percent of the monetary union, i.e. $n = 0.1$, private consumption has a strong home bias with $\omega^{H,p} = 0.15$ in the baseline calibration which corresponds to the level of several countries in the euro area as we showed in section 2. We set the elas-

ticity of substitution σ to 1 while for the scenario 2 with deeper integration we increase both the foreign goods weight $\omega^{H,p}$ to 0.3, which Nakamura and Steinsson (2011) found for US regions which we regard as a natural benchmark for a monetary union, and σ to 2 which was also used by Nakamura and Steinsson (2011) and Obstfeld and Rogoff (2005). And we also follow Nakamura and Steinsson (2011) in setting $\omega^{F,p} = \omega^{H,p}(1 - n)/n$ for the fraction of total demand for home consumption goods relative to total demand for consumption goods to be equal to the home economies relative size $1 - n$. For home and foreign government spending we assume a complete home bias, i.e. $\omega^{H,g} = \omega^{F,g} = 0$ and a steady state government spending to GDP ratio G/Y of 0.2. For the government revenue equation we set $\psi_y = 0.2$ in scenario 3 and zero otherwise so that taxes increase by 0.2 percent for an increase in GDP of one percent while taxes react to increases in government debt with $\psi_d = 0.1$.

β	γ	ϕ	$\omega^{H,p}$	$\omega^{H,g}, \omega^{F,g}$	$\omega^{F,p}$	σ	ϵ
0.99	1	5	0.15 (0.3)	0	0.017 (0.033)	1 (2)	9
ϵ_w	θ_p	θ_w	ψ_y	G/Y	ϕ_π	ψ_d	$1 - n$
4.52	0.5	0.5	0 (0.2)	0.2	1.5	0.1	0.1
ρ^a	ρ^Z	ψ	λ	ϕ_{tr}			
0.75		0.004	0.5	0.2			

Table 1: Parameters used for the simulations

The elasticity of substitution between goods produced in the same country, ϵ , is set to 9 which corresponds to a steady state price markup of 12.5 percent. Prices and wages are re-set on average every second quarter, so that $\theta_p = \theta_w = 0.5$, and the central bank reacts to inflation with the standard Taylor coefficient $\phi_\pi = 1.5$.

4.2 Scenario 1: From Flexible Exchange Rates to Currency Union

Figures 6 and 7 show the impulse responses to an increase in home aggregate demand that is induced by an increase in the Ricardian households' consumption for a scenario where each country has its own monetary policy and where both countries are linked by a flexible nominal exchange rate (solid

lines). Furthermore, Figures 6 and 7 show results for a scenario of a fixed exchange rate and a common monetary policy (dashed lines), the monetary union setting.

Under flexible exchange rates, consumption increases due to the shock and with it output, real wages, marginal costs and domestic inflation. In reaction to their increased income, rule-of-thumb consumers increase spending, too, and in reaction to the increased inflation, the central bank increases the nominal interest rate which appreciates the currency, and improves the terms of trade. As a consequence, the increase in domestic consumption is muted because Ricardian consumers face a higher real rate of interest, and net exports decrease thereby muting the increase in employment and real wages and thereby also stabilizing rule-of-thumb-consumers' consumption.

In the foreign economy two effects work in opposite direction: The increased domestic demand and the deteriorated terms of trade increase aggregate demand for foreign goods and foreign employment, which exerts upward pressure on real wages thereby increasing rule-of-thumbers' consumption. However, the central bank reacts to counter the inflationary effects by increasing its interest rate thereby reducing the foreign Ricardian households' consumption and thereby indirectly rule-of-thumb-households' consumption. As the foreign economy is large and the fraction of imported goods assumed to be small, the second effect dominates the first with respect to consumption which falls while output and employment increase. These effects are small when compared with the effects in the domestic economy.

The reaction of the central banks and the appreciation of the currency thus provide an effective stabilization tool from the perspective of the home economy while in foreign the increase of the interest rate allows the increase in net exports to be cushioned to some extent by a reduced domestic demand.

Next we turn to a scenario where Home and Foreign form a currency union by fixing the nominal exchange rate between them and setting up a common central bank that now sets the short term interest rate as a weighted average of the two countries' target variables. The central bank's response to the increase in demand is now much smaller than in the previous scenario as the increase in inflation enters only with a small weight into the central bank's target and the appreciation of the nominal exchange rate non-existent. The real appreciation is smaller because the nominal exchange rate does not change at all and because prices and wages are sticky. This implies a greater deterioration of the trade balance than under flexible exchange rates as can be seen from the much larger reduction of the net foreign asset position. The equilibrium increase in home consumption and output is therefore much larger in this scenario.

From the perspective of the foreign economy, the increase of the inter-

est rate is larger than in the previous scenario and the real depreciation much smaller. This implies that the economy now experiences a recession rather than a boom as Ricardian households reduce consumption by more and thereby generate a reduction in employment and income for rule-of-thumbers who therefore also decrease spending.

The two countries' business cycles thus move in opposite direction in response to the demand shock rather than the same as under flexible exchange rates. Furthermore, the volatility of output, employment and consumption is clearly larger. Stabilization through monetary policy is thus a blunt tool in the presence of asymmetric shocks and it even causes an asymmetric response of business cycles. The currency area thus looks a lot less like an optimal currency area than before its installation.

4.3 Scenario 2: Currency Union with Deeper Integration

Next we increase the fraction of foreign produced goods in the domestic consumption index from 0.15 to 0.3 and the elasticity of substitution between domestic and foreign goods, σ , from 1 to 2 to increase it to the US benchmark (see Nakamura and Steinsson, 2011). We interpret this as an increase in trade integration that may be related to the fact that the monetary union boosts trade (the "Rose effect").¹²

Figures 8 and 9 show the results for a currency union as above (solid lines) and for the scenario of deeper integration (dashed lines). One can see that the impulse responses for output, consumption and employment are quite similar to the case of less integrated goods markets under flexible exchange rates. Integration thus leads to a reduction in employment and consumption volatility in response to the shock in a monetary union.¹³ The mechanism behind the similar adjustments is, of course different. It is not the interest rate and exchange rate responses that allow the muted domestic consumption and output responses but rather the direct demand effect for foreign goods rather than domestic goods that results in a positive co-movement of domestic and foreign output and a reduced effect on domestic demand.

Policies that increase the degree of integration can thus be regarded as important steps to build an optimum currency area. However, as long as the

¹²One could interpret the increase in the elasticity of substitution as a consequence of trade integration: When markets are more integrated it is conceivable that countries will increasingly trade similar goods and consumers will react more sensitive to relative price changes. Of course, the opposite might happen and countries' specialization increase and the elasticity of domestic and foreign goods decline.

¹³For the seminal work on this see McKinnon (1963).

degree of economic integration in a currency union like the euro area is not large enough to offset the asymmetric effects of asymmetric shocks and since such policies are unlikely to result in a quick change of market structures, other adjustment mechanisms are needed, at least for the time being.

4.4 Scenario 3: Currency Union with National Fiscal Policies

The natural candidate for a stabilization tool is national fiscal policies. As Ferrero (2009) demonstrated in his model, the optimal fiscal policy at the national level within a currency area is one that allows government budget deficits to offset asymmetric shocks and thereby government debt to fluctuate over the business cycle. However, this optimality result was based on the assumption of perfect capital markets. The run on government debt markets in the recent crisis shows that there are times when such an optimal policy stance is clearly infeasible. And even before the crisis, as we demonstrated in section 2, the degree of financial market integration remains incomplete. Furthermore, in normal times national fiscal stabilization can only work to the extent that Ricardian equivalence effects are not at play.

In our model, despite the existence of rule-of-thumb-consumers, the fact that the governments' creditors are domestic households, Ricardian equivalence effects do matter. Any increase in a government's indebtedness will be regarded as an indication of future tax increases that will cause offsetting effects on the side of Ricardian households that reduce the effectiveness of stabilization efforts. Even the possibility of handing this additional debt on to foreign households does not change this as ultimately, the debt will have to be repaid. We show that national fiscal stabilization does work, but its effectiveness is constrained by the existence of Ricardian effects to the extent that they are implemented by variations in taxation.

This is illustrated in Figures 10 and 11 by the impulse responses for a tax increase in response to the increase in output caused by the increase in domestic demand. The home Ricardian household's consumption does not change relative to the scenario without the tax increase because he does not regard this policy as a transfer of wealth as the higher taxes are refunded to him immediately via a reduction of his bond-holdings vis-à-vis the government. The tax increase only has an effect on aggregate consumption and output by its effect on rule-of-thumb consumers.

In order to illustrate what could happen in a scenario in which changes in the level of government debt change perceptions about the risk of a sovereign default as in the current crisis, we can also allow the risk premium to be

affected by the level of government debt as well:

$$R_t = R_t^* - \psi (\exp(B_t) - 1) + \psi_A (\exp(A_t) - 1)$$

In reality the relationship between government debt and the risk premium is clearly not a time and state invariant linear function as suggested by this equation. We cannot address this issue in our model, but we can plug in an arbitrary number for ψ_A in order to understand qualitatively the mechanism at play¹⁴: When the government raises taxes after the shock without spending the receipts as we assumed, it implies a fall of government indebtedness (or rather a negative government debt in our case with zero debt in the steady state). This lowers the risk premium and the nominal interest rate below the level without the premium and thereby boosts the Ricardian households' consumption. This, in turn, raises employment, the real wage and therefore rule-of-thumbers' consumption too. The change in the perceived default risk thus reduces the effectiveness of the national anticyclical tax policy even further. However, the conclusion that an expansionary (instead of a contractionary) tax response has a contractionary effect does not necessarily hold: Reducing taxes increases rule-of-thumbers' consumption while the implied higher interest rate reduces Ricardian households' consumption. These effects work against one another and it depends on their relative size in which direction output and aggregate consumption will move.

4.5 Scenario 4: Currency Union with Transfers Between Countries

A tool that is not subject to Ricardian equivalence effects and risk premia related to government debt is a the transfer between countries introduced above that does not affect government indebtedness. In order to make the national fiscal stabilization scenario quantitatively comparable with the fiscal transfer scenario, we set $\phi_{tr} = \psi_y = 0.2$. The impulse responses, presented together with the currency union reference scenario without transfers in Figures 12 and 13, show that the divergence of output and consumption across countries is now muted, their paths now look very similar to the paths under flexible exchange rates and under deeper integration. The fact that the Ricardian households' consumption reacts strongly to the transfer (when compared with the scenario without transfers) is due to the fact that these households do not regard it as temporary. Rather, it works like an insurance in that the resources that the Ricardians regard as available is no longer determined

¹⁴We do not show figures in order not to overwhelm the reader, but simply state the effect and offer to send the figures upon request.

by the present discounted value of current and future domestic output but rather a weighted average of the present discounted value of domestic and foreign output. Any asymmetric changes in output therefore have a muted effect on Ricardian households' consumption response.

In order to compare the effectiveness of both policies (transfer payments vs. national fiscal policies), one can compare the theoretical variances of employment, output and consumption in the home country. For a responsiveness of 0.2 for both policy rules (used for the impulse responses), the volatility caused by the shock in the presence of transfer payments amounts to roughly 85% of the volatility caused if fiscal policy is effective instead (The values are identical for employment and output and almost identical for consumption). Interestingly, the ratio between the induced volatility in both scenarios falls for a higher responsiveness of both policies: For $\phi_{tr} = \phi_y = 0.4$, volatility with transfers in effect corresponds to about 76% of the volatility caused in the competing scenario of national fiscal policy.

With a higher responsiveness of both policies, the implications of their different transmissions in the economy are of course amplified: For national fiscal policy, the portion of the increase in per-capita taxation which affects Ricardian households is rendered ineffective due to the Ricardian equivalence. On the other hand, the additional amount of transfers caused by a higher responsiveness operates towards stabilizing the system without such constraints, thereby raising the relative effectiveness of this policy.

As the transfer mechanism is constructed as a transfer between households across the monetary union rather than between governments, it very much mimics an unemployment insurance. An unemployment insurance has the advantage that it acts in a quasi-automatic and immediate fashion: When incomes fall due to temporary unemployment, households receive a transfer without delay, thereby quickly stabilizing aggregate demand. And as unemployment insurance schemes are only designed to support short-term or medium-term unemployment, any increase in long-term unemployment related to a decline in trend growth is not covered. And this is exactly what our model implies.

The alternative, a transfer between governments, would be much more difficult to implement. It would require the difficult task to determine the state of the business cycle in real time. This is difficult because it is almost impossible to differentiate efficient from inefficient fluctuations in real time. Furthermore, transfers between governments intended to affect aggregate demand are likely to suffer from the same time lags as discretionary spending programs.

One way of interpreting this transfer mechanism is to regard the effect of the shock on the foreign economy as an externality (in this case a nega-

tive one) that the foreign economy is exposed to. The transfer ensures the domestic economy internalizes this externality. Furthermore, the transfer is "self-financed" by the effect of the shock on the domestic economy in that it simply reverses the increase in output due to the shock. In the next section, we will have a look at the effects of the shock from a welfare perspective.

4.6 Productivity shock

A negative productivity shock reduces output and increases employment, a well-established result in the New-Keynesian literature.¹⁵ Both the tax policy and the transfer reduce the fall in output and boost employment and again the effects are stronger for the transfer. The volatility of output and employment are thus shifted in opposite directions by both policies.

5 Welfare Analysis

In order to compare the different scenarios in their effect on the countries' welfare, we employ the following welfare function \mathbb{W}_t that is a weighted average of the Ricardian household's intertemporal utility function and an intertemporal utility function of the rule-of-thumb consumers:

$$\mathbb{W}_t \equiv \mathbb{E}_t \sum_{k=0}^{\infty} \beta^k \left\{ \begin{array}{l} (1 - \lambda) \frac{(C_{t+k}^A)^{1-\gamma}}{1-\gamma} + \lambda \frac{(C_{t+k}^N)^{1-\gamma}}{1-\gamma} \\ -(1 - \lambda) \frac{(N_{t+k}^A)^{1+\phi}}{1+\phi} - \lambda \frac{(N_{t+k}^N)^{1+\phi}}{1+\phi} \end{array} \right\} \quad (10)$$

We thus assume that the rule-of-thumb consumers' consumption and employment can be evaluated from an intertemporal perspective even though they do not use this perspective for their consumption choice.

In the appendix we show that when employing a second order approximation to \mathbb{W}_t for the case of log utility, one can express the welfare loss of business cycle fluctuations, expressed as a fraction of steady state consumption, as a function of the unconditional variance of the log of employment¹⁶:

$$\mathbb{W}_t - \mathbb{W} = -\frac{(1 + \varphi) N^{1+\phi}}{2} \text{Var}(n_t)$$

¹⁵Figures are available from the authors upon request.

¹⁶The variance of consumption drops out of this expression for the special case of log utility.

The relative welfare gain (in percent) of moving from a scenario A to a scenario B, denoted as Δ_t^{AB} , is therefore¹⁷

$$\Delta_t^{AB} = 100 * \left(\frac{\text{Var}_B(n_t)}{\text{Var}_A(n_t)} - 1 \right)$$

where $\text{Var}_i(n_t)$ with $i \in (A, B)$ is the variance of employment under scenario i . Table 2 presents these gains relative to the benchmark currency union scenario for the scenarios shown in section 4 (note that a negative sign indicates a welfare gain compared to the benchmark):

Δ_t^{AB}				
Scenario				
(1)	(2)	(3)	(4)	(2)-(4)
Fl. Exch. Rate	Deeper Integr.	Nat. Fisc. Policy	Transfers	combined
-78.9	-61.4	-23.1	-17.8	-71.9

Table 2: Welfare gains compared to currency union benchmark scenario

Table 2 tells the same story as the impulse response function presented above: The benchmark currency union incurs significant welfare costs in terms of employment volatility both when compared to a flexible exchange rate scenario and when compared to a currency union with a high degree of goods market integration, fiscal stabilization and fiscal transfers. The biggest welfare gains within the currency union arrangement are to be expected from a deepened integration of goods markets while a system of transfers allows much larger gains compared to fiscal stabilization measure at the national level. Note, however, that in this specification we did not assume any risk premia related to the level of government debt which would further increase the relative advantage of the transfer mechanism. Lastly, when deeper integration is combined with national fiscal stabilization and the transfer mechanism, welfare in the monetary union is close to the welfare under flexible exchange rates. Further increasing the degree of integration, fiscal stabilization and the fiscal transfer mechanism can even improve welfare beyond the level under flexible exchange rates.

¹⁷Note that using this welfare measure, the time preference shock drops out as it affects any two scenarios in exactly the same way. For that reason we did not take account of it in equation (10).

For the demand shock, the transfer mechanism thus clearly dominates the tax policy when the goal is to maximize welfare, i.e. minimize employment volatility. In contrast, for the productivity shock the tax policy dominates. However, as is well-known from the empirical New Keynesian literature (see e.g. Smets and Wouters, 2003), the demand shock is of much bigger importance for overall volatility in the euro area so that a transfer is likely to be a necessary instrument to reduce overall volatility.

In light of these results one can certainly ask why one should not simply abandon the monetary union and return to a world of flexible exchange rates which obviously delivers the highest levels of welfare as long as the degree of integration has not increased and accommodative policies are not in place. But one should not forget that we focused on only one aspect of monetary integration, volatility, which has to be assessed jointly with other aspects. One such aspect could be a boost to growth (*add references here, e.g. Baldwin*) and then the trade-off between a positive level effect and a negative volatility effect would be the criterion on which an entry to or an exit from a monetary union would have to be evaluated.

6 Conclusion

We show that a currency union formed by economies that are not perfectly integrated may experience large volatility and asymmetric business cycles when these economies are hit by asymmetric shocks. We propose a transfer mechanism between the members of the union that can offset these asymmetric effects and argue that this might be a feasible policy option until deeper trade (and possibly financial and labor market) integration is accomplished. Furthermore, we show that such a transfer mechanism is more effective than fiscal stabilization measures at the national level as Ricardian equivalence effects and risk premia related to sovereign default do not arise.

The mechanism looks very much like an insurance scheme that offsets the effects on consumption caused by deviations of output from trend relative to other member economies' output deviations from trend. When one country booms while another country contracts, a transfer from the booming to the depressed country sets in. Under the assumption of these asymmetric shocks being equally and identically distributed across countries, the net-payments over time will be zero. There is thus no permanent transfer between countries.

The euro area, which is clearly in need for new business cycle stabilization tools but which lacks strong support for deeper political union with a European authority equipped with spending and taxing powers that might be used as a stabilization tools at the national level, this last aspect might make it

politically implementable: When the mechanism implies no net transfers on average over time, but a reduced volatility of employment and consumption, everyone is better off. On average, no money is transferred to “Brussels” by richer economies.

One obvious candidate for a real world equivalent of such a mechanism is an unemployment scheme that just re-distributes resources across the monetary union.

What we cannot answer in this framework is whether, on the one hand, asymmetric shocks have been and can be expected to be the major driving forces of business cycles or, on the other hand, whether common shocks had different effect on member states. This purely empirical question will have to be answered in future research.

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A Appendix

A.1 Welfare Function

One can show that a utility function of the form $U(C_t, N_t)$ is approximately

$$U(C_t, N_t) - U(C, N) = U_C C \left(\begin{array}{l} \left(\widehat{c}_t + \frac{1}{2} \left(1 + \frac{U_{CCC}}{U_C} \right) \widehat{c}_t^2 \right) \\ + \frac{U_{NN}}{U_C} \left(\widehat{n}_t + \frac{1}{2} \left(1 + \frac{U_{NNN}}{U_N} \right) \widehat{n}_t^2 \right) \end{array} \right)$$

where we neglected terms of an order higher than two (see Galí, 2008). Using a weighted average of the home country's Ricardian and rule-of-thumb consumers' utility as a planner's objective function,

$$\begin{aligned} \mathbb{W}_t^H &\equiv \mathbb{E}_t \sum_{k=0}^{\infty} \beta^k \left\{ \begin{array}{l} (1-\lambda) \frac{(C_{t+k}^A)^{1-\gamma}}{1-\gamma} + \lambda \frac{(C_{t+k}^N)^{1-\gamma}}{1-\gamma} \\ - (1-\lambda) \frac{(N_{t+k}^A)^{1+\phi}}{1+\phi} - (1-\lambda) \frac{(N_{t+k}^N)^{1+\phi}}{1+\phi} \end{array} \right\} \\ &= \mathbb{E}_t \sum_{k=0}^{\infty} \beta^k \left\{ \begin{array}{l} (1-\lambda) \frac{(C_{t+k}^A)^{1-\gamma}}{1-\gamma} + \lambda \frac{(C_{t+k}^N)^{1-\gamma}}{1-\gamma} \\ - \frac{(N_{t+k})^{1+\phi}}{1+\phi} \end{array} \right\} \end{aligned}$$

and using the above result (appropriately adjusted), we get

$$\mathbb{W}_t^H = \mathbb{E}_t \sum_{k=0}^{\infty} \beta^k \left\{ U(C, N) + U_C C \left[\begin{array}{l} \left((1-\lambda) \widehat{c}_{t+k}^A + \lambda \widehat{c}_{t+k}^N \right) \\ + \frac{1}{2} \left(1 + \frac{U_{CCC}}{U_C} \right) \left((1-\lambda) (\widehat{c}_{t+k}^A)^2 + \lambda (\widehat{c}_{t+k}^N)^2 \right) \\ + \frac{U_{NN}}{U_C} \left(\widehat{n}_t + \frac{1}{2} \left(1 + \frac{U_{NNN}}{U_N} \right) \widehat{n}_{t+k}^2 \right) \end{array} \right] \right\}$$

Taking the limit $\beta \rightarrow 1$ and ignoring constant terms, we have

$$\frac{\mathbb{W}_t^H - \mathbb{W}^H}{U_C C} = \left[\begin{array}{l} \frac{1}{2} \left(1 + \frac{U_{CCC}}{U_C} \right) \left((1-\lambda) \text{Var}(c_t^A) + \lambda \text{Var}(c_t^N) \right) \\ + \frac{1}{2} \frac{U_{NN}}{U_C} \left(\left(1 + \frac{U_{NNN}}{U_N} \right) \text{Var}(n_t) \right) \end{array} \right]$$

This describes the volatility induced domestic welfare loss in terms of steady state consumption.

With log utility $U_C C = 1$ and $U_{CCC}/U_C = -1$, this term reduces to

$$\mathbb{W}_t^H - \mathbb{W}^H = -\frac{(1+\phi) N^{1+\phi}}{2} \text{Var}(n_t)$$

as $\frac{U_{NNN}}{U_N} = \frac{-\phi N^{\phi-1} N}{-N^{\phi}} = \phi$. When comparing two model specifications, denoted as A and B, one can determine the percent change in welfare associated

with moving from specification A to B, denoted as Δ_t^{AB} :

$$\begin{aligned} \Delta_t^{AB} &= 100 * \frac{-\frac{(1+\varphi)N^{1+\phi}}{2} \text{Var}_B(n_t) + \frac{(1+\varphi)N^{1+\phi}}{2} \text{Var}_A(n_t)}{-\frac{(1+\varphi)N^{1+\phi}}{2} \text{Var}_A(n_t)} \\ &= 100 * \left(\frac{\text{Var}_B(n_t)}{\text{Var}_A(n_t)} - 1 \right) \end{aligned}$$

where $\text{Var}_A(n_t)$ is associated with the variance of n_t associated with specification A.

A.2 Impulse Responses

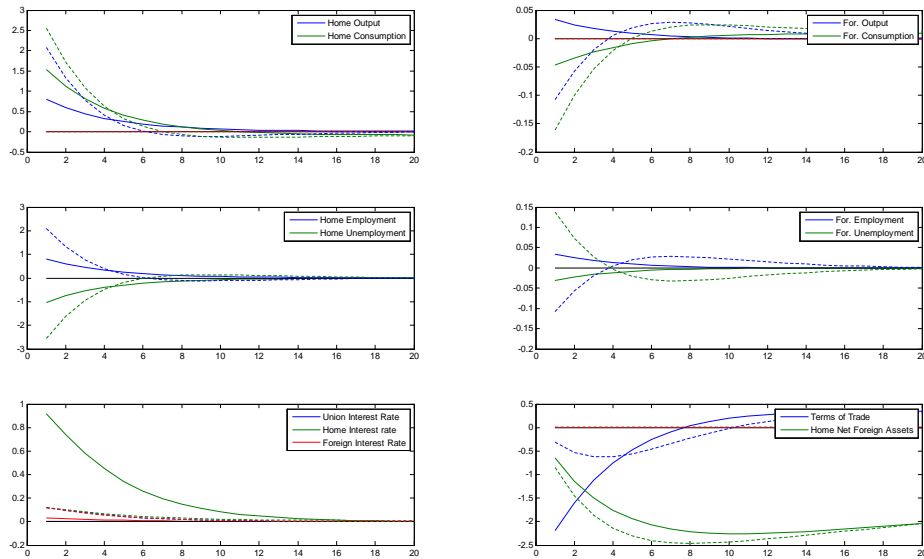


Figure 6: Time preference shock under flexible exchange rates (solid lines) and currency union (dashed lines)

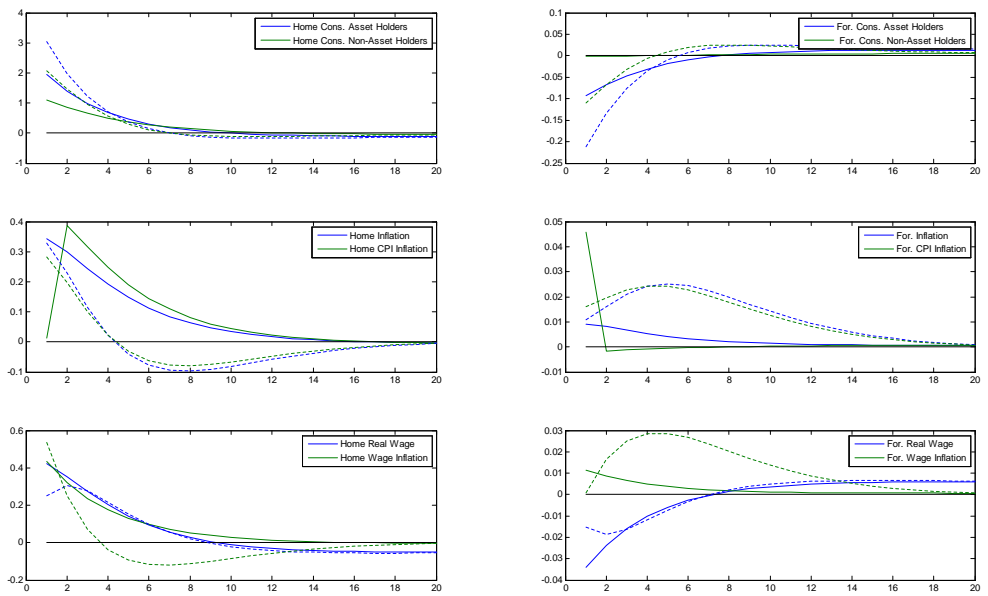


Figure 7: Time preference shock under flexible exchange rates (solid lines) and currency union (dashed lines)

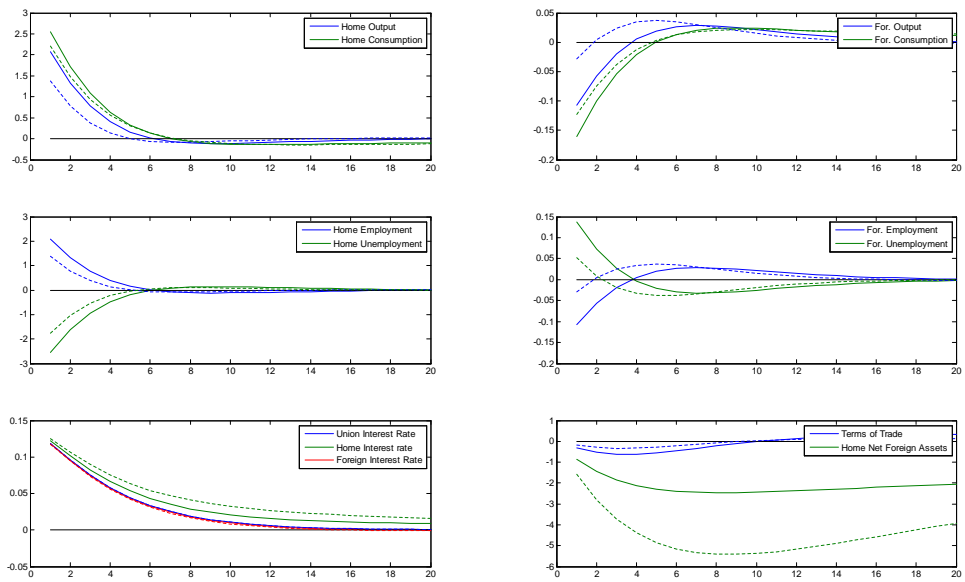


Figure 8: Time preference shock in a currency union with little integration (solid lines) and deeper integration (dashed lines)

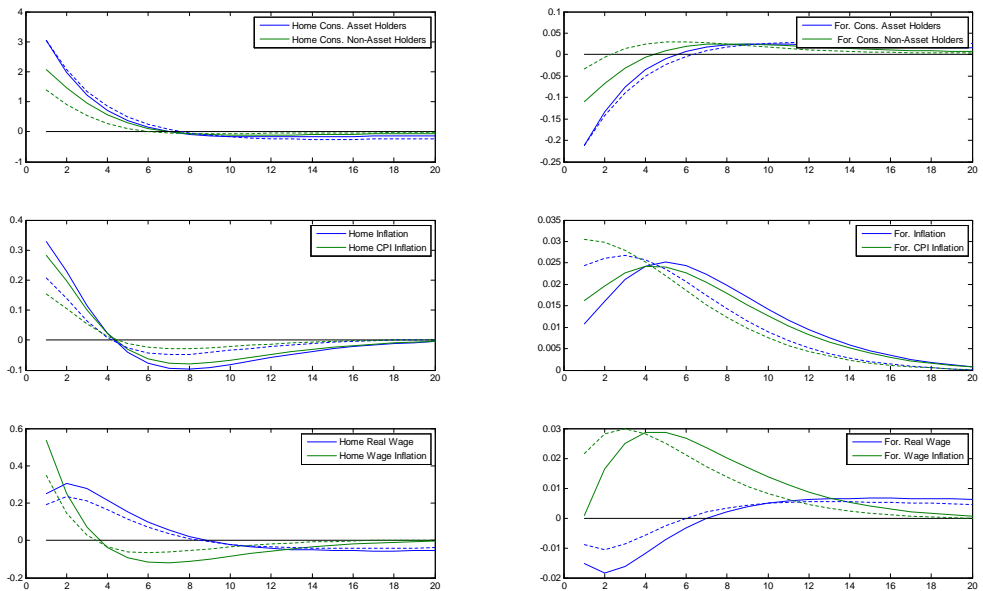


Figure 9: Time preference shock in a currency union with little integration (solid lines) and deeper integration (dashed lines)

Dropbox/Transfer Union/Text/M53KXA0T.wmf

Figure 10: Time preference shock in a currency union without (solid lines) and with national anticyclical fiscal policies (dashed lines)

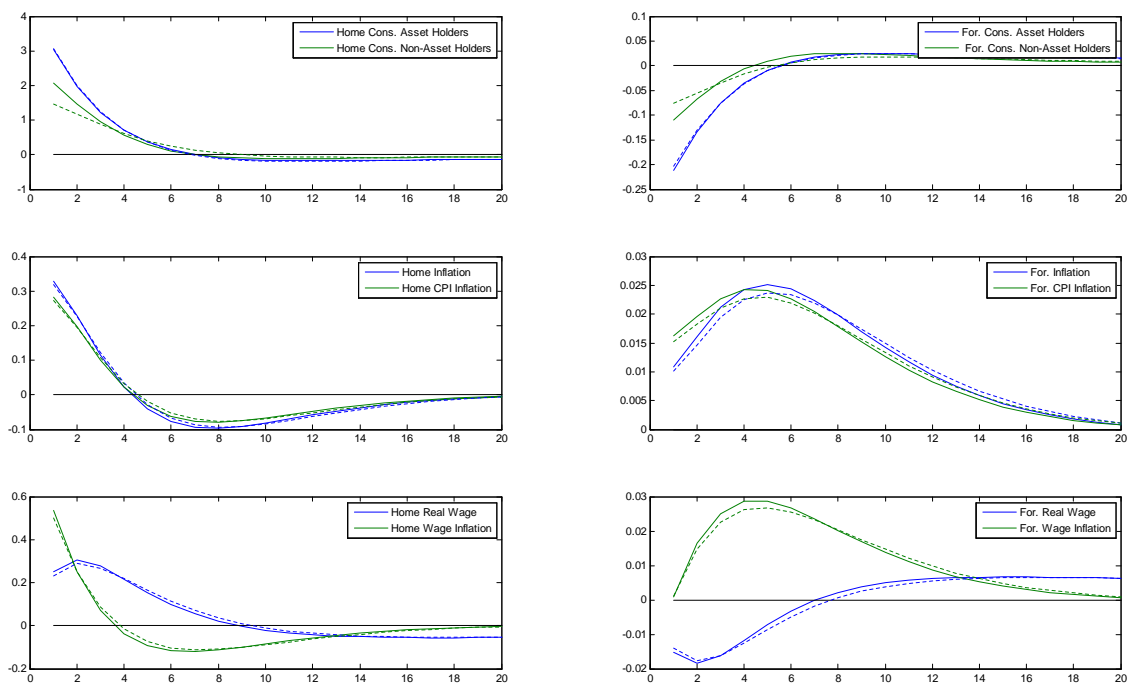


Figure 11: Time preference shock in a currency union without (solid lines) and with national anticyclical fiscal policies (dashed lines)

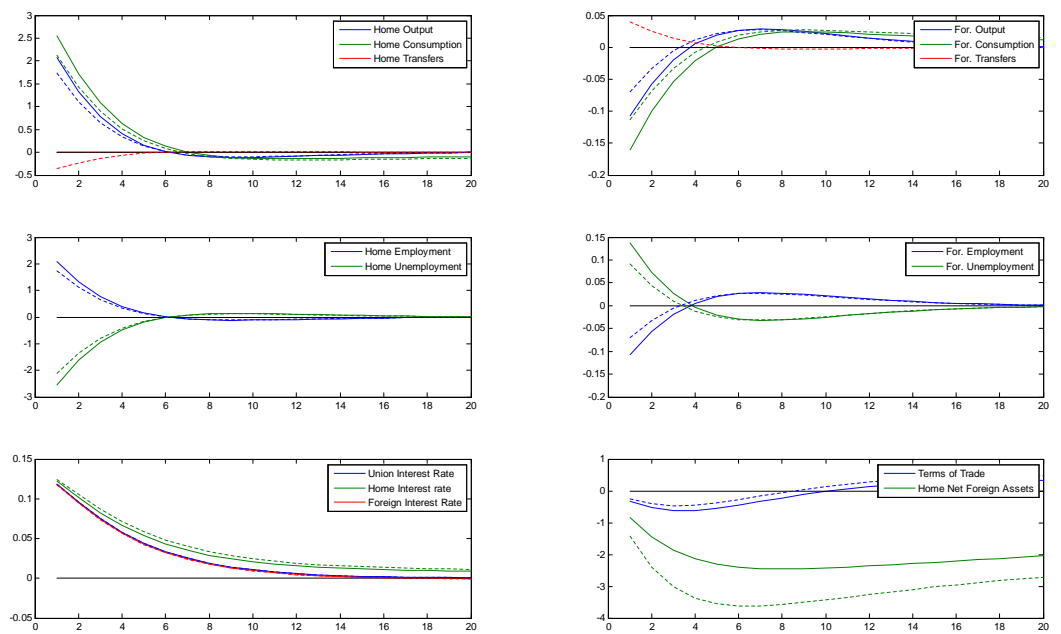


Figure 12: Time preference shock in a currency union without (solid lines) and with transfers (dashed lines)

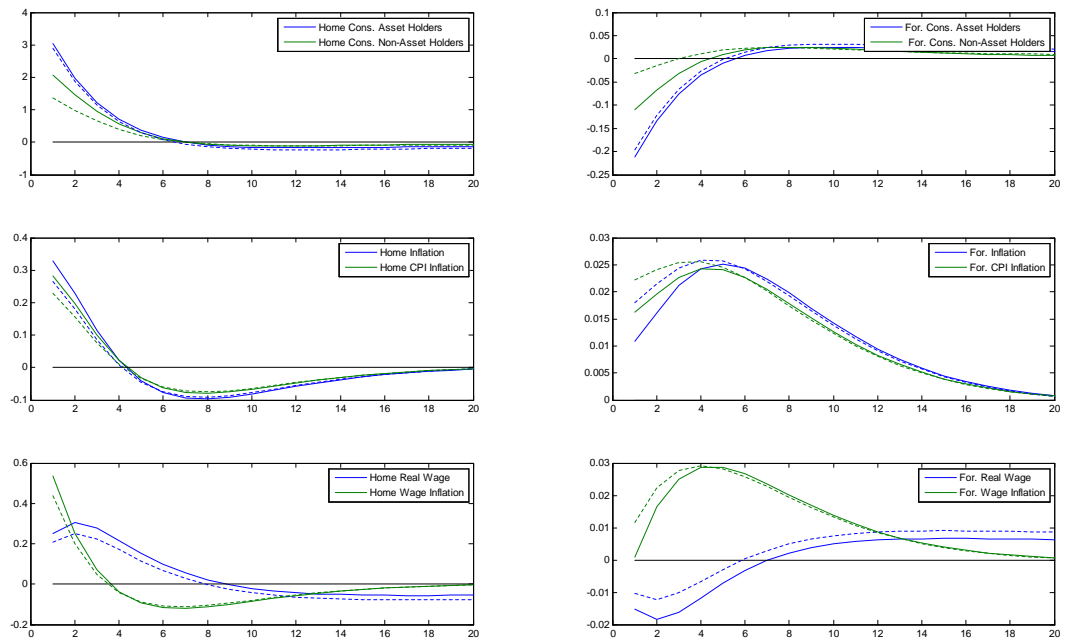


Figure 13: Time preference shock in a currency union without (solid lines) and with transfers (dashed lines)