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Fiscal transfers in a two-level fiscal framework: stabilizing properties according to the fiscal instrument

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Abstract

In a two-country extit{Dynamic and Stochastic General Equilibrium} (DSGE) model, we document the stabilizing properties of fiscal transfers between currency union members according to the nature of the fiscal instrument used with these transfers. To do this, we model a two-level fiscal framework for the monetary union in which the central authority collects one share of national fiscal revenues and determines how these revenues are redistributed among countries following a simple fiscal transfer rule. We assume that the central authority is allowed to decide how the recipient economy use these funds. The main result of this paper is that the stabilizing properties of fiscal transfer schemes strongly depend on the fiscal instrument and on the nature of the idiosyncratic shocks which hit member states. Transfers to households and VAT are more effective to stabilize macroeconomic differentials between both economies of the currency union when asymmetric demand shocks occur while the labor income tax and the social protection tax are more effective in the case of an asymmetric productivity shock. This article then participates to the debate about the way fiscal policy should be structured within the Euro Area. Indeed, we argue within this article for the implementation of a fiscal transfer mechanism taking into account the nature of the fiscal instrument and the nature of idiosyncratic shocks.

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1 Introduction

After achieving the single market and the implementation of a currency area, some economists argue nowadays that the next step would be to achieve a fiscal union for the Euro Area. The term "fiscal union" can relate to very different elements, such as the sovereign debt pooling, the creation of an economic government for the Eurozone or the implementation of fiscal transfers among member states.

This paper contributes to this debate by focusing on the stabilizing properties of a fiscal transfer mechanism within a monetary union. This idea is quite old, the MacDougall report in 1977 suggested already the creation of such a stabilizing tool for the future European Monetary Union. However, fiscal governance within the Euro Area has not evolved significantly, albeit a strengthening of the Stability and Growth Pact following the sovereign debt crisis. In this article, we consider a central authority which manages the fiscal transfers and allocates fiscal funds by conditioning the use of these additional fiscal revenues (to increase public expenditure or to cut taxes). To achieve this goal, the presence of a central fiscal authority seems to be necessary, even if we do not discuss in this article to which currently existing European institution this mission should be given (for instance the European Commission) or whether a new institution should be created (an economic government for the Euro Area as advocated by the "federalists").

The 2008 crisis has revealed the strong economic heterogeneity that exists between the Euro Area members, who have reacted very differently to the crisis episode. The sovereign debt crisis has emphasized the structural heterogeneity between member states in terms of competitiveness, external disequilibrium and public debt management.

In response to the existence of structural heterogeneity and of idiosyncratic shocks, many economists argue for the implementation of a risk-sharing mechanism through a fiscal transfer scheme. Such a fiscal transfer mechanism is already present in some fiscal unions, for instance in the US and Canada, or in federal countries like Germany or Switzerland. Several papers have attempted to estimate the stabilizing abilities of these insurance mechanisms, most of them for the USA and Canada.[1] If results vary according to the studies, fiscal transfer schemes would reduce the output growth rate differential between members by 20 % on average.

In recent years, the new-Keynesian framework has been used for investigating different facets of such insurance mechanisms. Evers (2012) for instance analyzes the stabilizing properties of different transfer rules according to the variables considered: transfers based on a differential of consumption, output or employment among others. Kim and Kim (2013) investigate the welfare effects of such transfers. The main finding is that in the absence of borrowing constraints, the transfers can reduce agents' welfare while the transfers are unambiguously welfare-enhancing when such financial constraints occur. Briefly speaking, a transfer scheme is fruitful when the financial markets cannot ensure a full risk-sharing within

[1] See for instance Sachs and Sala-i-Martin (1992), Von Hagen (1991), Italianer and Pisani-Ferry (1994), Goodhart and Smith (1993), Bayoumi and Masson (1995) or Melitz and Zummer (1999).

the monetary union.

Surprisingly, while transfers can be used in very different ways, such as increasing different sorts of expenditure or cutting taxes, the literature generally neglects this point. In most papers, transfers are either used as direct transfers to households, like in Fahri and Werning (2012) or as public consumption (Okano (2010), Kim and Kim (2013) or Evers (2012)) but the link between the use of the transfer and the effectiveness of the scheme is generally neglected. This is surprising since different sorts of spending and different sorts of taxes are available in the governments' tool kit and that the effects of fiscal policy in general very depends on the tools used by the governments. This is even more astonishing that Bajo-Rubio and Diaz-Roban (2003) highlighted already this statement: *"Only Majocchi and Rey (1993) propose that their discretionary mechanism would be financed in an ad hoc manner by the countries concerned, and that the amounts to be paid would be conditioned in order to assure its consistency with the Community's objectives. The rest of studies do not examine this issue, although they recognize that the degree of stabilization attained will depend, in part, on how the funds are used".*

One notable exception is Evers (2006) where the author investigates explicitly the stabilizing properties of transfer schemes according to the nature of the transfers. In a medium-scale DSGE model, transfers between both economies are either transfers between home and foreign households, either inter-governmental transfers corresponding simply on a shift of public consumption between both states. One interesting element of this paper is that it focuses on the relative stabilizing properties of both kind of spending according to the nature of the idiosyncratic shocks which occur within the monetary union. In the case of a demand shock introduced as a preference shock for the union-wide consumers towards the tradable goods produced in one economy of the union, Evers (2006) shows that intergovernmental transfers are fully efficient and remain the level of welfare similar to the welfare at the steady-state, thanks to a shift in demand that compensates the first shift in demand induced by the shock. Therefore, public consumption-based transfers can stabilize fully consumption, production and employment in both economies. In the case of a supply shock, Evers (2006) found that both kinds of transfers are necessary to achieve an efficient assurance. Transfers to households are necessary since the labor income is no longer the same between the two economies because of the inflation differential engendered by the productivity shock.

In this paper we follow Evers (2006) since we focus on the stabilizing properties of a fiscal transfer mechanism in a monetary union prone to asymmetric demand and supply shocks. The added value of this work is twofold. First, I introduce in the model different types of spending and taxes which can be used by the recipient government within the fiscal transfer scheme: social transfers to households and three different taxes: a VAT, a labor income tax and a social protection tax. Second, and more importantly, we do not consider only stabilization of output but also look at the differential between member states in terms of inflation, term of trade, unemployment and welfare.

One current challenge within the Euro Area is to deal with increasing macroeconomic imbalances and to provide effective policy answers to this macroeconomic issue. We will see

throughout this paper that a federal transfer mechanism is able to reduce inflation differential between economies and therefore to help to reduce current account imbalances between economies. However, we will see that the reduction in the term of trade is possible if the "good" fiscal instruments are used within the fiscal transfer scheme.

The model represents a monetary union with two symmetric economies. The modeling of each economy follows standard medium-scale DSGE models. We introduce a fiscal union in which coexist national fiscal policies, a central budget and fiscal transfers between both countries. The contribution of this paper is to test the effectiveness of a transfer mechanism to stabilize output and inflation differentials according to how the recipient uses the transfers and according to the nature of the idiosyncratic shock.

Main results can be summarized as follows: 1) effects on output differential of fiscal transfer schemes differ greatly according to the fiscal instrument and the nature of shocks 2) in some cases fiscal transfers amplify inflation differential between economies and 3) the introduction of a passive monetary policy does not change significantly these results.

The rest of the paper is organized as follows: a second section presents the key assumptions of the model and the fiscal union into details. A third section describes the simulations and results and a fourth section concludes.

2 The new-Keynesian framework

2.1 Description of the model

The model is a standard medium-scale DSGE model with structural foundations *à la* Smets and Wouters (2007).[2] The model represents a monetary union with two identical countries. Ricardian and non-Ricardian households are introduced in the model. Their utility function follows Jaimovich and Rebelo (2009) which allows for a smoothed wealth effect on labor supply. Rigidity on prices and nominal wages are introduced *à la* Calvo (1983). The labor market structure follows Gali, Smets and Wouters (2012): a labor force participation decision is derived from households maximizing-utility framework and the steady state of the model is characterized by the presence of unemployment. For the supply side, we model two sectors in each country: one part of intermediate firms produce *tradable* goods while the rest of firms produce *non-tradable* goods. Firms are identical in terms of technology and behavior across sectors but will not face the same demand according to the evolution of relative prices between sectors. While households can consume both domestic and foreign tradable goods, we assume no capital flow between countries.

2.2 Introduction of the fiscal union

The fiscal union introduced in this paper allows for the coexistence of national governments and of a central authority. Different policy scenarios can be introduced thanks to this

[2]See Appendix for a presentation of the main equations and assumptions of the model.

modeling. For instance, a fully decentralized case in which the two national governments implement fiscal policy without any intervention at the central level. The other polar case is the fully centralized case in which fiscal receipts are levied entirely at the central level and then used in different ways. Finally, with alternative calibrations, we can also implement scenarios where both levels coexist. For our purposes, we need to use the case in which the central authority levies one share of national fiscal revenues in order to implement fiscal transfers across countries.

A fiscal transfer mechanism could be implemented without the direct action of a central/federal authority. We could imagine in the Euro Area the implementation of an automatic rule which do not necessitate the existence of a central government. However, our proposal in this article is to introduce a discretionary component in the fiscal transfer scheme. Indeed, transfers received by national economies must be spent in a particular manner: transfers to households or to use these transfers to cut a set of taxes.

Variables with a superscript "H" correspond to the home economy, those with a superscript "F" to the foreign country and finally variables with a superscript "EMU" concern the central government and aggregate variables for the EMU.

National governments

The budget constraint of the home economy can be expressed as, in nominal terms:

$$(1-\tau^{EMU})[(P_t^H C_t^H)\tau_t^{c,H} + (W_t^H N_t^H)(\tau_t^{w,H} + \tau_t^{sp,H})] + T_t^H = Tr_t^H \tag{1}$$

and similarly for the foreign economy:

$$(1-\tau^{EMU})[(P_t^F C_t^F)\tau_t^{c,F} + (W_t^F N_t^F)(\tau_t^{w,F} + \tau_t^{sp,F})] + T_t^F = Tr_t^F \tag{2}$$

In the budget constraint of the home country, P_t^H defines the consumer price index for the domestic households, C_t^H consumption in the home economy, W_t^H is the nominal wage and N_t^H represents employment. In Equations (1) and (2) appear the different fiscal instruments introduced in the model, for the home economy. Tr_t^H are social transfers to households.[3] $\tau_t^{c,H} \in [0;1]$, $\tau_t^{w,H} \in [0;1]$ and $\tau_t^{sp,H} \in [0;1]$ are respectively VAT, a labor income tax and a social protection tax. VAT $\tau_t^{c,H}$ impacts the optimal decision of Ricardian households in terms of consumption and influence the level of consumption of non-Ricardian households. The labor income tax $\tau_t^{w,H}$ has no impact on Ricardian households but determine labor income of *rule-of-thumbs* consumers. Furthermore, the labor income tax impacts labor supply and then unemployment and the wage dynamic.[4] Finally, $\tau_t^{sp,H}$ is paid by firms. As shown in Appendix, the evolution of this tax rate alters marginal costs and thus competitiveness of

[3] As shown in Appendix, the model incorporates both Ricardian and *rule-of-thumbs* households. Therefore, transfers to households directly influence the disposable income of *rule-of-thumbs* consumers and thus their level of consumption.

[4] Indeed, we follow Gali, Smets and Wouters (2012) who relate wage dynamic to unemployment. See Appendix for a presentation of the framework.

firms in our two-country structure. Firms in the tradable and the non-tradable sectors are taxed equally.

$\tau^{EMU} \in [0;1]$ defines the level of taxation by the central authority on national fiscal revenues. The central autorithy levies fiscal receipts from national fiscal revenues. This way to implement fiscal revenues for the central authority would be realistic for the Euro Area. Indeed, contributions of national budgets on the European budget is the VAT-based own resources.

In addition, T_t^H and T_t^H denote transfers from the central autority to, respectively, the home and the foreign government. The ammount of transfers for each economy are set by the central government as described later on in this section.

For simplicity purposes, we do not allow for national public deficits. When the model is simulated with demand and supply shocks in the next section, macroeconomic variables (P_t^H, C_t^H, W_t^H and N_t^H) evolve accordingly. To ensure that the budget constraint is satisfied at each point of time, one fiscal instrument must to be adjusted. In simulations, we thus compare the different scenarios in which each fiscal instrument is used in turn to ensure a balanced budget. Therefore, in each case fiscal transfers will take part in the adjustment of the considered fiscal instrument. In other terms, during downturns where national fiscal revenues are decreasing, fiscal transfers help to reduce the necessary adjustment of the fiscal instrument.

The central government

The central government collects a share of the national fiscal revenues and therefore has the following budget constraint:

$$\tau^{EMU}[(P_t^H C_t^H)\tau_t^{c,H}+(P_t^F C_t^F)\tau_t^{c,F}+(W_t^H N_t^H)(\tau_t^{w,H}+\tau_t^{sp,H})+(W_t^F N_t^F)(\tau_t^{w,F}+\tau_t^{sp,F})] = T_t^{EMU} \tag{3}$$

where T_t^{EMU} defines the total budget of the central authority. If $\tau^{EMU} = 1$, the whole tax receipts are gathered at the central level. At the opposite if $\tau^{EMU} = 0$, the fiscal policy is fully decentralized. In the case where $0 < \tau^{EMU} < 1$, both levels coexist.

The central government allocates the transfers to both economies such as:

$$T_t^H = \frac{T_t^{EMU}}{2} - Tr_t^{EMU} \tag{4}$$

and

$$T_t^F = \frac{T_t^{EMU}}{2} + Tr_t^{EMU} \tag{5}$$

with

$$\frac{Tr_t^{EMU}}{\bar{Tr}^{EMU}} = \left(\frac{Y_t^H}{Y_t^F}\right)^{\alpha^{y,tr}} \tag{6}$$

with $\alpha^{y,tr} \in [0;1[$. Consequently, the central fiscal authority allocates transfers to national governments by taking into account the evolution of output in both economies.

Monetary Policy

Monetary policy is introduced through a standard Taylor rule. The monetary authority sets the nominal interest rate following this version of the Taylor rule:

$$R_t = (R_{t-1})^{\rho^r}(Y_t^{EMU})^{\rho^y}(\Pi_t^{EMU})^{\rho^\Pi} \tag{7}$$

with Y_t^{EMU} and Π_t^{EMU} output and inflation at the monetary union level. ρ^r describes the inertia of the interest rate rule, ρ^y and ρ^Π define the weight given by the monetary authority to the stabilization of output and inflation respectively.

3 Calibration of the model, description of the simulations and results

Calibration of the fiscal block

In this section are presented the calibration of the fiscal side of the model. For the other economic parameters, their values are presented in Appendix alongside the description of the model.

$\tau^{EMU} = 0.3$ is one of the key parameters in our fiscal setup since it sets to size of the federal fiscal policy in our model. Since our proposal is related to the future of the fiscal integration within the Euro Area, we introduce a size for the central authority close to the US case in order to document the stabilizing properties of fiscal transfers if the Euro Area introduced fiscal transfers of a similar size. In fact, the US system of fiscal transfers is different from our model. Indeed, the US federal government levies taxes directly on US citizens and not on fiscal revenues of national states. Federal government expenditure towards local states are mainly direct transfers to households through social security and Medicaid and grants to state and local governments. In recent years, grants from the federal government to state and local governments account for roughly the third of state and local government revenues (Laubach, 2005). In this sense, we calibrate τ^{EMU} such as the central authority levies 30 % of national fiscal revenues.

In addition, we set $\alpha^{y,tr} = 0.2$. With this value, the fiscal transfer scheme (according to the fiscal instrument at work) reduces output differential fluctuations by 20% on average between both countries.[5] A fiscal transfers mechanism which reduces around 20% of GDP

[5]In results section, however, we show that the fiscal transfers scheme allows for a stabilization of output

growth differential is in line with existing studies on the US (Bayoumi and Masson (1995), Melitz and Zummer (1999)).

For the Taylor rule, different versions of a DSGE model have been estimated for the Euro Area (Forni, Monterforte and Sessa (2009), Gali, Smets and Wouters (2012), Giovannini, Hohberger, Ratto and Vogel (2019) among others). These different estimates argue for a high degree of inertia and we set $\rho^r = 0.9$. Parameters values for the stabilization of GDP are quite low, we follow Gali, Smets and Wouters (2012) with $\rho^y = 0.19$ and $\rho^{\Pi} = 1.5$ is an average value with regard to existing studies. In Results section, we also consider a more passive monetary policy for which $\rho^y = 0$ and ρ^{Π} is slightly higher than 1.

Simulation methodology

For the different scenarios, we consider two types of exogenous disturbances in each country (shocks are idiosyncratic). First, a demand shock is introduced in each economy which corresponds to a shock on Ricardian households' consumption. Second, a supply shock in each economy corresponds to a total factor productivity (TFP hereinafter) shock in both tradable and non-tradable sectors. In equation (23) exogenous disturbances on Ricardian consumption are a standard AR(1) process with an AR(1) parameter equals to 0.6. Equation (33) describes the TFP shock which occurs in both sectors of an economy. The AR(1) parameter is equally set to 0.6 for simulations. All exogenous disturbance are 1% shocks.

A first-order approximation of the model is used for simulations. The model is simulated over 10000 periods with a random draw of either demand or supply shocks in both countries and second moments of the variables are computed for comparison between the different scenarios.

For each type of shock (demand ans supply exogenous disturbances), we compare the stabilizing properties of the different fiscal instruments. For instance, in the case of transfers to households, equations (1) and (2) become:

$$(1-\tau^{EMU})[(P_t^H C_t^H)\tau^{c,H} + (W_t^H N_t^H)(\tau^{w,H} + \tau^{sp,H})] + T_t^H = Tr_t^H \tag{8}$$

and

$$(1-\tau^{EMU})[(P_t^F C_t^F)\tau^{c,F} + (W_t^F N_t^F)(\tau^{w,F} + \tau^{sp,F})] + T_t^F = Tr_t^F \tag{9}$$

All national fiscal instruments are constant except one fiscal intrument (in this example, transfers to households). Therefore, the considered fiscal instrument adjusts at each period to ensure national government budget constraints are satisfied. We then compare variance of key macroeconomic variables in the case where the fiscal transfer mechanism is at work (with T_t^H and T_t^F in equations (8) and (9)) with the case where no fiscal transfers arise.

differential from 0% to roughly 30%, according to the fiscal instrument and the kind of idiosyncratic shocks.

3.1 Main results

Transmission channels of idiosyncratic shocks

In order to understand the differentiated effects of fiscal transfers according to the nature of the fiscal instrument and to the nature of idiosyncratic shocks, this is necessary to present briefly the response of the economy in the case of idiosyncratic demand and TFP shocks. Figures (1) and (2) in Appendix present the impulse response functions of key variables in the case of a negative demand shock and of a negative TFP shock in the domestic economy.

This is important to notice that the response of prices and term of trade differ according to the nature of the shock. In the case of a drop in consumption of Ricardian households in the domestic economy, output of both economies is negatively affected. The decrease in domestic economic activity is predominant but the lower consumption by domestic households impacts also negatively the demand faced by foreign firms in the tradable sector. Unemployment rise in both countries, which leads to lower wages and non-Ricardian consumption. These negative demand effects decrease inflation in a greater extent in the domestic economy. As a consequence, the term of trade $\frac{P_t^F}{P_t^H}$ increases which consists in an amelioration of home firms competitiveness.

When a negative TFP shock occurs in the domestic economy, it affects negatively marginal costs of domestic firms so that domestic prices increase. The degradation of the term of trade, which implies a negative price competitiveness effect for domestic firms, generates a shift in demand towards foreign tradable firms. Consequently, output and prices increase in the domestic economy.

Stabilizing properties of fiscal transfers

In tables (1) to (8) are displayed variances for each scenario. We document the effects on variance of 5 key indicators: the output differential (simply the difference between home and foreign outputs at each period), the inflation differential (home inflation minus foreign inflation), the unemployment differential (home unemployment minus foreign unemployment), the real exchange rate (the term of trade in equation (19)) and the welfare differential (domestic households' welfare minus foreign households' welfare). We compute welfare in a standard manner, such as, for domestic households:

$$Welf_t^H = U(C_t^H, N_t^H) + Welf_{t+1}^H \tag{10}$$

ΔVar in tables (1) to (8) is the most important measure since it represents the rate of change of variances for all variables between simulations with and without the fiscal transfer mechanism. A negative value for Δvar indicates that variance of the variable is lower when the fiscal transfer scheme is implemented. Finally, in each table these results are displayed in the case of an active monetary policy ($\rho^r = 0.9$, $\rho^y = 0.19$ and $\rho^\Pi = 1.5$) and in the case of a more passive monetary policy ($\rho^r = 0.9$, $\rho^y = 0$ and ρ^Π slightly above one).

	Active monetary policy			Passive monetary policy		
Variable	Transfers	No transfer	Δ var.	Transfers	No transfer	Δ var.
Output differential	0,0017	0,0023	-0,295920	0,0016	0,0023	-0,296010
Inflation differential	0,0002	0,0002	-0,222490	0,0002	0,0002	-0,224630
Unemp. differential	0,0016	0,0024	-0,304801	0,0016	0,0023	-0,304562
Real exchange rate	0,0044	0,0051	-0,133974	0,0031	0,0037	-0,168294
Welfare differential	0,018661	0,019139	-0,025007	0,000146	0,000180	-0,190336

Table I: Variances with demand shocks and transfers to households

	Active monetary policy			Passive monetary policy		
Variable	Transfers	No transfer	Δ var.	Transfers	No transfer	Δ var.
Output differential	0,000042	0,000054	-0,233291	0,000041	0,000053	-0,239114
Inflation differential	0,000051	0,000047	0,081512	0,000051	0,000047	0,082960
Unemp. differential	0,000220	0,000215	0,022575	0,000220	0,000215	0,023503
Real exchange rate	0,000322	0,000278	0,158386	0,000273	0,000226	0,207845
Welfare differential	0,149606	0,143406	0,043234	0,000162	0,000239	-0,325138

Table II: Variances with supply shocks and transfers to households

Firstly, we observe that the stabilizing effect of fiscal transfers on output differential differs greatly according to the fiscal instrument and to the nature of shocks, from close to 0 in the case of the social protection tax with demand shocks to roughly 30% when TFP shocks occur and that fiscal transfers are used through the labor income and social protection taxes. Secondly, transfers to households and VAT are effective to stabilize output in the case of idiosyncratic demand shocks. Indeed, rising transfers or cutting VAT help to reduce the negative shifts in demand in both economies. At the opposite, the labor income tax and the social protection tax are unable to stabilize efficiently output differential in the case of demand shocks but are highly effective in the case of supply shocks. A change in the social protection tax impacts directly the supply side of the economy through firms marginal cost. The labor income tax is a more complex case since it generates both demand and supply effects. For instance, a cut in the labor income tax has a positive effect on non-Ricardian consumption. In addition, a decrease in labor income tax increases marginal utility of labor for both types of households and has a positive and significant effect on labor force participation. The implied rise in unemployment puts downward pressures on nominal wages and consequently on firms marginal costs. This supply-side effect is predominant which makes the social protection tax more effective in the case of idiosyncratic TFP shocks.

	Active monetary policy			Passive monetary policy		
Variable	Transfers	No transfer	Δ var.	Transfers	No transfer	Δ var.
Output differential	0,0021	0,0029	-0,281042	0,0028	0,0039	-0,292199
Inflation differential	0,0003	0,0004	-0,257831	0,0004	0,0005	-0,288471
Unemp. differential	0,0021	0,0029	-0,279687	0,0027	0,0038	-0,288854
Real exchange rate	0,0270	0,0281	-0,037813	0,0092	0,0109	-0,154900
Welfare differential	0,044489	0,044741	-0,005636	0,091338	0,094494	-0,033393

Table III: Variances with demand shocks and VAT

	Active monetary policy			Passive monetary policy		
Variable	Transfers	No transfer	Δ var.	Transfers	No transfer	Δ var.
Output differential	0,0032	0,0043	-0,257450	0,0032	0,0044	-0,256633
Inflation differential	0,0053	0,0049	0,073587	0,0053	0,0050	0,072635
Unemp. differential	0,0212	0,0208	0,017399	0,0213	0,0209	0,016585
Real exchange rate	0,0549	0,0480	0,142621	0,0583	0,0520	0,121186
Welfare differential	0,307338	0,308191	-0,002769	0,362752	0,371020	-0,022283

Table IV: Variances with supply shocks and VAT

Beyond different outcomes in terms of output stabilization, one important result that must be highlighted is that the different fiscal instruments have quite different effects on inflation differential and thus on the term of trade. To use VAT and transfers to households when idiosyncratic demand shocks occur reduces variance of inflation differential by respectively 22% and 26%. This result is straightforward. A decline in demand puts downward pressures on prices. A rise in transfers to households or a cut on VAT helps to reduce this decline in prices and then the inflation differential between the two economies. Demand-based fiscal instruments are effective to reduce inflation differential in the case of demand shocks. At the opposite, these fiscal instruments increase volatility of the inflation differential and of the term of trade in case of TFP shocks. Indeed, in the case where one country faces an idiosyncratic negative productivity shock, the rise in marginal cost puts upward pressures on prices. Accordingly a rise in transfers to households or a drop in VAT rate amplifies this rise in inflation.

	Active monetary policy			Passive monetary policy		
Variable	Transfers	No transfer	Δ var.	Transfers	No transfer	Δ var.
Output differential	0,032	0,035	-0,07030968	0,0328	0,0353	-0,07029
Inflation differential	0,000037	0,000037	0,00422	0,000037	0,000037	0,004
Unemp. differential	0,0856	0,0765	0,11834	0,0856	0,0765	0,11834
Real exchange rate	0,000748	0,000824	-0,09150	0,000742	0,00081	-0,09339
Welfare differential	0,00286	0,00311	-0,07991	0,00286	0,00311	-0,07971

Table V: Variances with demand shocks and labor income tax

	Active monetary policy			Passive monetary policy		
Variable	Transfers	No transfer	Δ var.	Transfers	No transfer	Δ var.
Output differential	0,0802	0,1206	-0,3351	0,0819	0,1232	-0,3351
Inflation differential	0,0058	0,0065	-0,1116	0,00584	0,00656	-0,1100
Unemp.	0,0202	0,0198	0,0206	0,0202	0,0197	0,0211
Real exchange rate	0,9668	1,2292	-0,2134	0,9697	1,2280	-0,2103
Welfare differential	2,1081	2,0866	0,0102	5,3941	5,7901	-0,0683

Table VI: Variances with supply shocks and labor income tax

As mentioned previously, the labor income tax has supply-side effects through a significant impact on labor supply and wages dynamic. Ability to reduce inflation differential and term of trade volatility is more mixed in the case of demand shocks. However, labor income tax is effective to reduce price volatility when productivity shocks occur. A decrease in labor income taxation rises marginal productivity of labor and puts downward pressures on wages and thus on firms marginal costs. Consequently, to decrease labor income tax in the case of negative productivity shocks allows to reduce upward pressures on prices.

	Active monetary policy			Passive monetary policy		
Variable	Transfers	No transfer	Δ var.	Transfers	No transfer	Δ var.
Output differential	0,03610	0,03519	0,0257533	0,03610	0,03519	0,0257
Inflation differential	0,00012	0,00004	0,211	0,00012	0,00004	2,1296
Unemp. differential	0,0754	0,0771	-0,0224	0,075	0,077	-0,0224
Real exchange rate	0,00115	0,00093	0,2337	0,00115	0,00093	0,2347
Welfare differential	0,0031	0,0031	0,0048	0,0031	0,0031	0,0048

Table VII: Variances with demand shocks and social protection tax

Social protection tax is able to impact significantly firms marginal cost. As a consequence, this fiscal instrument is effective to reduce inflation differential volatility in the case of TFP shocks but increases volatility in the case of demand shocks.

The introduction of a passive monetary policy does not change significantly the aforementioned results. In most of cases, a passive monetary policy amplifies the welfare-enhancing effects of fiscal transfers.

	Active monetary policy			Passive monetary policy		
Variable	Transfers	No transfer	Δ var.	Transfers	No transfer	Δ var.
Output differential	0,1037	0,1542	-0,3272	0,1030	0,1533	-0,3276
Inflation differential	0,0071	0,0079	-0,1066	0,0070	0,0079	-0,1107
Unemp. differential	0,0236	0,0241	-0,0221	0,0232	0,0237	-0,0217
Real exchange rate	1,3238	1,6379	-0,1917	1,3241	1,6394	-0,1923
Welfare differential	O,4207	0,423	-0,0067	O,44093	0,443850	-0,0065

Table VIII: Variances with supply shocks and social protection tax

4 Conclusion

The main result of this paper is that the stabilizing properties of a fiscal transfer mechanism strongly depend on the way the recipient economy uses the transfers. Transfers to households and VAT are more effective to stabilize macroeconomic differentials in a monetary union when asymmetric demand shocks occur while the labor income tax and the social protection tax are more effective in the case of asymmetric supply shocks.

This paper argues for the implementation of a fiscal transfer mechanism in the Euro Area. This kind of fiscal transfers improve the macroeconomic stabilization within (non-optimal) currency unions. More importantly, this paper shows that the central authority (the European commission for example in the case of the Euro Area) should urge the member states as to the use of these fiscal transfers in order to increase the effectiveness of the fiscal transfers scheme. Especially, if one motivation to implement a fiscal transfer mechanism in the Euro Area is to help reducing macroeconomic imbalances within European member states, a central authority should take into account the fiscal instruments at work.

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A Impulse response functions: idiosyncratic demand and TFP shocks

Figure 1: Impulse response functions following a negative demand shock in the domestic economy

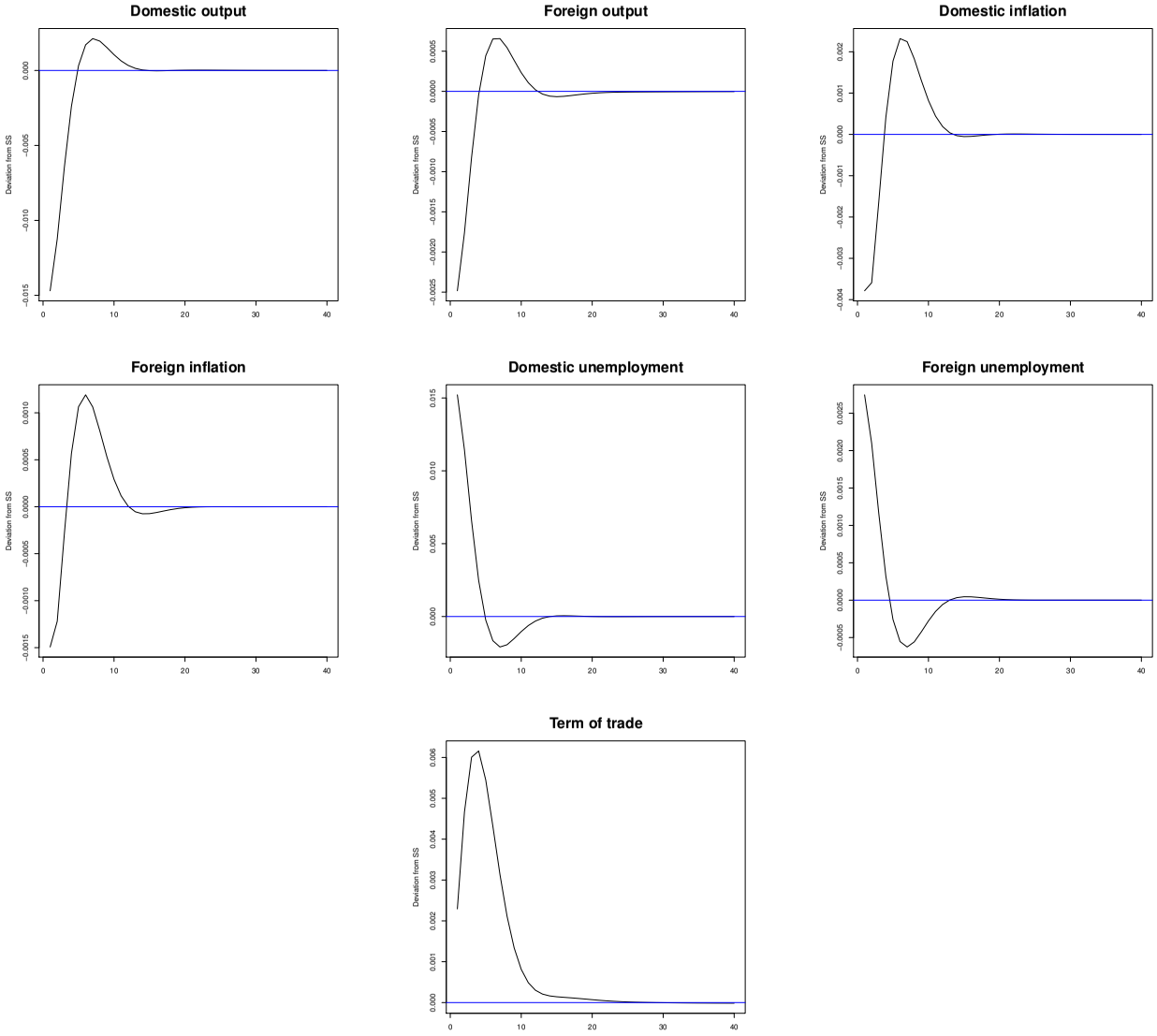
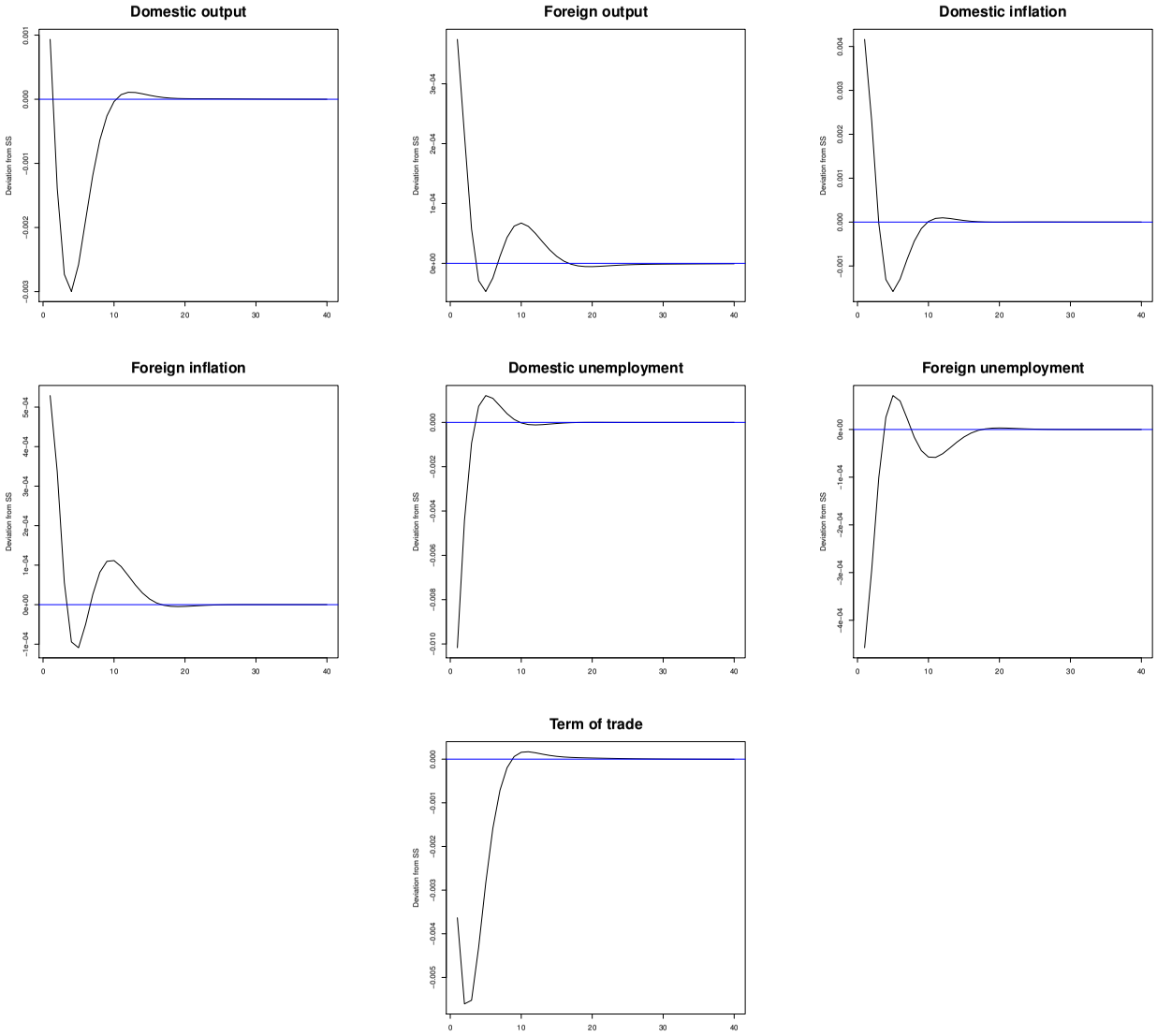


Figure 2: Impulse response functions following a negative TFP shock in the domestic economy



B Description of the model

We present in this section the key assumptions and equations of the model. Since we assume that both countries are symmetric, we only describe here the domestic economy and the international relationships.

B.1 Monetary union and definitions of demands

The model describes a monetary union composed of two similar economies. Home country size is s and $(1-s)$ for the foreign economy.

Definition of consumption functions

Let C_t^i defines the total consumption of households in country i for $i, j = H, F$ with $i \neq j$. Aggregate consumption is composed by a basket of 3 goods. For instance, a domestic household consumes domestic tradable and non-tradable goods but also foreign tradable goods. Aggregate consumption is represented by a standard CES function such as:

$$C_t^i = [\gamma^{\frac{1}{\epsilon}}(C_t^{T,i})^{\frac{\epsilon-1}{\epsilon}} + (1-\gamma)^{\frac{1}{\epsilon}}(C_t^{NT,i})^{\frac{\epsilon-1}{\epsilon}}]^{\frac{\epsilon}{\epsilon-1}} \tag{11}$$

with:

$$C_t^{T,i} = [\lambda^{\frac{1}{\zeta}}(C_t^{i,i})^{\frac{\zeta-1}{\zeta}} + (1-\lambda)^{\frac{1}{\zeta}}(C_t^{i,j})^{\frac{\zeta-1}{\zeta}}]^{\frac{\zeta}{\zeta-1}} \tag{12}$$

$C_t^{T,i}$ defines the consumption of tradable goods by the households in country i, $C_t^{NT,i}$ the consumption of non-tradable goods and finally $C_t^{i,i}$ and $C_t^{i,j}$ define respectively the home consumption of home and foreign tradable goods. Moreover, $\gamma \in [0;1[$ denotes the share of tradable goods, $\epsilon \in [0;1[$ the elasticity of substitution between tradable and non-tradable goods, $\lambda \in [0;1[$ the share of home-produced goods in the total basket of tradable goods and $\zeta \in [0;1[$ the elasticity of substitution between home and foreign tradable goods.

Importantly, demand for each type of goods will evolve during simulations according to relative prices. In each country i for $i, j = H, F$ with $i \neq j$, demand addressed by households to firms are represented by the following equations:

$$C_t^{i,i} = \lambda\gamma \left(\frac{P_t^{i,i}}{P_t^{T,i}}\right)^{-\zeta} \left(\frac{P_t^{T,i}}{P_t^i}\right)^{-\epsilon} C_t^i \tag{13}$$

$$C_t^{i,j} = (1-\lambda)\gamma \left(\frac{P_t^{i,j}}{P_t^{T,i}}\right)^{-\zeta} \left(\frac{P_t^{T,i}}{P_t^i}\right)^{-\epsilon} C_t^i \tag{14}$$

$$C_t^{NT,i} = (1-\lambda)\gamma \left(\frac{P_t^{NT,i}}{P_t^i}\right)^{-\epsilon} C_t^i \tag{15}$$

$C_t^{i,i}$ and $C_t^{i,j}$ respectively define the home consumption of home and foreign tradable

goods and $C_t^{NT,i}$ the consumption of non-tradable goods by households in country i.

A similar definition of the different price index is given with CES functions. P_t^i corresponds to the consumer price index in country i for $i, j = H, F$ with $i \neq j$ (the index introduced in the maximization process of households) and is expressed as:

$$P_t^i = [\gamma(P_t^{T,i})^{1-\epsilon} + (1-\gamma)(P_t^{NT,i})^{1-\epsilon}]^{\frac{1}{1-\epsilon}} \tag{16}$$

with:

$$P_t^{T,i} = [\lambda(P_t^{i,i})^{1-\zeta} + (1-\lambda)(P_t^{j,i})^{1-\zeta}]^{\frac{1}{1-\zeta}} \tag{17}$$

$P_t^{T,i}$ defines the price index of tradable goods for the consumer in country i, $P_t^{NT,i}$ the price index of non-tradable goods and finally $P_t^{i,i}$ and $P_t^{j,i}$ define respectively the price index of home and foreign tradable goods bought by households in country i.

Finally, we can express the union-wide price index as:

$$P_t^{EMU} = (P_t^H)^s (P_t^F)^{(1-s)} \tag{18}$$

The term of trade between both countries can be defined as the price ratio between the two countries:

$$S_t = \frac{P_t^F}{P_t^H} \tag{19}$$

B.2 Households

Ricardian households

Similarly to Gali, Smets and Wouters (2012), we introduce preferences *à la* Jaimovich and Rebelo (2009), an utility function which allows for a smoothed wealth effect of consumption on labor supply.

Utility function for Ricardian households is defined as:

$$U_t^{R,i} = \xi_t^b \left(log\tilde{C}_t^{R,i} - \frac{\Delta_t^{R,i} N_t^{R,i 1+\phi}}{1+\phi} \right) \tag{20}$$

where: $\tilde{C}_t^{R,i} = C_t^{R,i} - h\bar{C}_{t-1}^{R,i}$ defines Ricardian consumption adjusted by habit formation with $\bar{C}_{t-1}^{R,i}$ the aggregate past consumption and h the degree of habit formation. ϕ is the inverse of the Frisch elasticity of labor supply.

$$\Delta_t^{R,i} = Z_t^{R,i} / \tilde{C}_t^{R,i} \tag{21}$$

$$\text{with} \quad Z_t^{R,i} = (Z_{t-1}^{R,i})^{1-\nu} (C_t^{R,i} - hC_{t-1}^{R,i})^{\nu} \tag{22}$$

Following, Jaimovich and Rebelo (2009), definitions of $\Delta_t^{R,i}$ and $Z_t^{R,i}$ allows to introduce a smoothed wealth effect of consumption on labor supply. ν defines the degree of wealth effect in labor supply decision.

ξ_t^b is the demand shock introduced in this model which impacts optimal decision by Ricardian households. ξ_t^b follows an AR(1) process such as:

$$\xi_t^b = (\xi_{t-1}^b)^{\rho^b} exp(\epsilon^b) \tag{23}$$

ρ^b defines the duration of the shock, we set $\rho^b = 0.6$.

As in standard DSGE models, Ricardian households can save through riskless assets, invest in capital they loan to firms and supply labor.

Equation for capital accumulation is defined as:

$$K_t^{R,i} = (1-\delta)K_{t-1}^{R,i} + \left[1 - S\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right)\right] I_t^{R,i} \tag{24}$$

with:

$$S\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right) = \frac{\kappa}{2}(I_t^{R,i}/I_{t-1}^{R,i} - 1)^2 \tag{25}$$

where $K_t^{R,i}$ is accumulated capital by Ricardian households, $I_t^{R,i}$ is private investment. As in standard DSGE models, a cost related to changes in investment level is introduced through the function $S\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right)$ where κ is a fixed cost. δ defines the depreciation rate of capital.

Optimization by households gives a standard Euler equation:

$$\frac{U_{C,t-1}^{R,i}}{U_{C,t}^{R,i}} = \beta(1+R_{t-1})\frac{P_{t-1}^i(1+\tau_{t-1}^{c,i})}{P_t^i(1+\tau_t^{c,i})} \tag{26}$$

where $U_{C,t}^{R,i}$ defines marginal utility of consumption for Ricardian households, $\tau_t^{c,i}$ is the aforementioned VAT rate and β a discount factor.

Investment dynamic is set by the two following equations:

$$\begin{aligned}\mu_t^{R,i}P_t^i = \Omega_t^{R,i}&\left(1 - S\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right) - S'\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right)\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right)\right)\\ &+\beta E_t\Omega_{t+1}^{R,i}\left(S'\left(\frac{I_{t+1}^{R,i}}{I_t^{R,i}}\right)\left(\frac{I_{t+1}^{R,i}}{I_t^{R,i}}\right)^2\right)\end{aligned} \tag{27}$$

$$\Omega_t^{R,i} = \beta E_t[\mu_{t+1}^{R,i}R_{t+1}^{K,i} + \Omega_{t+1}^{R,i}(1-\delta)] \tag{28}$$

where $\mu_t^{R,i}$ and $\Omega_t^{R,i}$ are the Lagrangian multipliers with respect to respectively the budget constraint and the capital accumulation constraint.

Finally, Labor supply decision $L_t^{R,i}$ is defined by:

$$(1-\tau_t^{w,i})\frac{W_t^i}{P_t^i} = Z_t^{R,i}(L_t^{R,i})^{\phi} \tag{29}$$

where appears the labor income tax $\tau_t^{w,i}$.

B.2.1 Non-Ricardian households

Non-Ricardian households do not optimize their level of consumption over time. They simply consume all their disposable income, composed by their labor revenue (net of labor income tax) and of government transfers, such as:

$$(1+\tau_t^{c,i})P_t^i C_t^{NR,i} = (1-\tau_t^{w,i})W_t^i N_t^{NR,i} + Tr_t^i \tag{30}$$

Rule-of-thumb households have the same utility function than Ricardian households and formulate a similar labor supply, such as:

$$(1-\tau_t^{w,i})\frac{W_t^i}{P_t^i} = Z_t^{R,i}(L_t^{NR,i})^{\phi} \tag{31}$$

B.3 Firms

In this economy, tradable and non-tradable sectors share the same technology. For each sector, firms produce differentiated goods in a monopolistic competition environment. Moreover, we assume that the nominal wage is similar in both sectors. However, prices can differ across sectors. We assume that in both sectors firms use the same type of capital. Consequently, the aggregate capital accumulated by households K_t^i is allocated in both sectors such as $K_t^i = K_t^{T,i} + K_t^{NT,i}$.

Following equations describe the tradable sector but, as said previously, the non-tradable sector in both countries are similar. Firms share the same technology given by:

$$Y_t^{T,i} = \xi_t^{A,T,i}(K_t^{T,i})^{\alpha}(N_t^{T,i})^{1-\alpha} \tag{32}$$

where $K_t^{T,i}$ is the private capital, $N_t^{T,i}$ the level of labor and $\alpha \in]0;1[$ the output elasticity of capital.

$\xi_t^{A,T,i}$ is the TFP in the tradable sector. The TFP exogenous innovation is defined as an AR(1) process:

$$\xi_t^{A,T,i} = (\xi_{t-1}^{A,T,i})^{\rho^a} exp(\epsilon^{A,T,i}) \tag{33}$$

where ρ^a defines the duration of the productivity shock.[6] A similar TFP shock is introduced for firms evolving in the non-tradable sector.

The profit of the representative firm in nominal terms is given by:

$$\Pi_t^{T,i} = P^{T,i}Y_t^{T,i} - (1+\tau_t^{sp,i})W_t^i N_t^{T,i} - R_t^{K,i}K_t^{T,i} \tag{34}$$

where appears the social protection tax paid by firms $\tau_t^{sp,i}$. We assume that the government does not differentiate the level of taxation between both sectors.

Maximizing the profit function (34) with respect to $N_t^{T,i}$ and $K_t^{T,i}$ according to (32) yields the following optimal input choice:

$$K_t^{T,i} = \frac{\alpha}{1-\alpha}(1+\tau_t^{sp,i})\frac{W_t^i}{R_t^{K,i}}N_t^{T,i} \tag{35}$$

And the marginal cost $MC_t^{T,i}$ can be expressed as:

$$MC_t^{T,i} = \frac{((1+\tau_t^{sp,i})W_t^i)^{1-\alpha}(R_t^{K,i})^{\alpha}}{\xi_t^{A,T,i}\alpha^{\alpha}(1-\alpha)^{1-\alpha}} \tag{36}$$

As shown in equations (35) and (36), $\tau_t^{sp,i}$ influences substitution between capital and labor and, more importantly, impacts firms marginal cost.

B.4 Price setting

Nominal rigidity on prices is introduced à la Calvo (1983). Accordingly, only a fraction $(1-\theta^p)$ are allowed to reset their price at each period. In absence of re-optimization, we assume an automatic indexation of current price on past inflation. The level of price stickiness does not differ among countries and among sectors.

B.5 Definition of unemployment and wage setting

We defined previously labor supply decisions for Ricardian and non-Ricardian households. We can thus define total labor force participation such as:

$$L_t^i = L_t^{R,i} + L_t^{NR,i} \tag{37}$$

In this model, we simply define unemployment as the difference between the labor force participation L_t^i and aggregate employment N_t^i such as:

[6] We assume the same duration for shocks in the tradable and non-tradable sectors but also in the foreign country.

$$U_t^i = L_t^i - N_t^i \tag{38}$$

We assume that both Ricardian and non-Ricardian households receive the same nominal wage W_t^i. Following Calvo (1983), workers can only reoptimize their nominal wage in each period with a probability $(1 - \theta^w)$, regardless the number of periods since they last reoptimized. In this model, when a worker cannot reoptimize his nominal wage, there is a partial indexation of the nominal wage on past inflation, the degree of indexation being defined by the parameter γ^w.

We follow Gali, Smets and Wouters in which the nominal wage-setting is directly linked to changes in unemployment. Indeed, wage inflation dynamic is based on fluctuations of the effective mark-up for workers MU_t^i expressed as:

$$MU_t^i = \frac{W_t^i}{P_t^i} - MRS_t^i \tag{39}$$

This mark-up is defined as the difference between the the real wage $\frac{W_t^i}{P_t^i}$ and the marginal rate of substitution between consumption and labor given by MRS_t^i:

$$MRS_t^i = -\frac{U_{N,t}^i}{U_{C,t}^i} = Z_t^i N_t^{i\phi} \tag{40}$$

After some algebras, we find that:

$$\frac{W_t^i}{P_t^i} - MRS_t^i = \phi U_t^i \tag{41}$$

This modeling introduces a micro-foundation of the original Phillips curve, *i.e.* the link between nominal wages and unemployment.

B.6 Aggregate variables and market clearing conditions

In each country i we can define aggregate variables and the market clearing conditions.

Total employment N_t^i is defined as:

$$N_t^i = N_t^{T,i} + N_t^{NT,i} \tag{42}$$

Total consumption C_t^i is given by:

$$C_t^i = C_t^{R,i} + C_t^{NR,i} \tag{43}$$

Total demand for goods addressed to tradable firms $Y_t^{T,i}$ and to non-tradable firms $Y_t^{NT,i}$ are defined as:

$$Y_t^{T,i} = C_t^{T,i} + C_t^{T,j} + \gamma I_t^{T,i} \tag{44}$$

$$Y_t^{NT,i} = C_t^{NT,i} + (1-\gamma) I_t^i \tag{45}$$

$$I_t^R = I_t^{T,i} + I_t^{NT,i} \tag{46}$$

Total output Y_t^i is defined as:

$$Y_t^i = Y_t^{NT,i} + Y_t^{T,i} \tag{47}$$

Finally, output of the union Y_t^{EMU} is defined as:

$$Y_t^{EMU} = Y_t^H \frac{P_t^H}{P_t^{EMU}} + Y_t^F \frac{P_t^F}{P_t^{EMU}} \tag{48}$$

C Parameter calibration

Parameters which describe the monetary union structure (share of tradable and non-tradable goods, elasticity of substitution between goods etc...) are taken from Rabanal (2009) in which is estimated a close version of this model for Spain and the rest of the Euro Area. The modeling of each economy follows closely Gali, Smets and Wouters (2012). Accordingly, we calibrate parameters with respect to posterior means of their estimated model for the Euro Area.

Parameter	Value	Description	Source
Monetary union structure			
γ	0.51	Share of tradable goods	Rabanal (2009)
ϵ	0.75	Elasticity of substitution T and NT goods	Rabanal (2009)
λ	0.16	Share of home-produced goods in the tradable goods basket	Rabanal (2009)
ζ	0.52	Elasticity of subst. between home and foreign tradable goods	Rabanal (2009)
s	0.5	Size of the home economy	Assumption
Households preferences			
n^R	0.3	Share of Ricardian households	standard
h	0.65	Habit formation	Gali et al. (2012)
phi	4,65	Frish elasticity of substitution	Gali et al. (2012)
ν	0.1	Degree of wealth effect on labour supply	Gali et al. (2012)
β	0.995	Discount factor	standard
Price and wage setting			
θ_p	0.5	Price rigidity	Gali et al. (2012)
γ_p	0.5	Indexation of prices on past inflation	Gali et al. (2012)
θ_w	0.5	Wage rigidity	Gali et al. (2012)
γ_w	0.16	Indexation of wages on past inflation	Gali et al. (2012)
Investment and capital			
κ	6	Constant investment cost	Gali et al. (2012)
δ	0.025	Depreciation of private and public capital	standard
α	0.3	Share of capital in the production function	standard
Monetary policy			
ρ^y	0.19	Output elasticity of the Taylor rule	Gali et al. (2012)
ρ^π	1.5	Inflation elasticity of the Taylor rule	Average value for the Euro Area
ρ^r	0.9	Degree of smoothing of the Taylor rule	Gali et al. (2012)
Shocks			
ρ^a	0.6	Duration of TFP shocks	Assumption
ρ^b	0.6	Duration of demand shocks	Assumption

Table IX: Calibration of the model