Fiscal and Monetary Policy in the Enlarged European Union

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Abstract

I build a quantitative two-country DSGE model of the European Union (EU) and investigate whether there are welfare gains from fiscal policy cooperation between the new EU members and the Euro Area (EMU). I find that fiscal policy cooperation is welfare-reducing for both groups of countries. This result depends on a realistic assumption about the presence of foreign ownership of firms in the new EU countries. When there is no foreign ownership in the new EU countries, the Euro Area is indifferent between cooperating and not cooperating but the new EU members still prefer not to cooperate their fiscal policy with the EMU.

Keywords: Fiscal policy cooperation; Foreign ownership of firms; Fiscal-monetary interactions; Enlarged European Union; Central and Eastern European countries

JEL classification: E63; F42

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1 Introduction

In May 2004, the European Union (EU) enlarged once more and now includes two different groups of countries. ¹ Most of the incumbent EU members renounced their sovereign monetary policies in favor of a single, supranational monetary policy and constitute the European Economic and Monetary Union (EMU). The second group are the new EU members who are expected to join the monetary union once they have met the exchange rate criterion and successfully participated in the Exchange Rate Mechanism (ERM2). ² While the EMU countries do not have national monetary policies available, the new EU members are focusing on the exchange rate and cannot freely use monetary policies for stabilization purposes. Therefore, fiscal policies have become increasingly more important stabilization tools in the EU.

At least two issues arise when considering how to conduct fiscal policies in the EU. First, it is important that the EU governments avoid large budget deficits to be able to facilitate stabilization policy and price stability. Second, national fiscal policies can cause international spillovers since the EU countries are highly interdependent. ³ The Maastricht Treaty and the Stability and Growth Pact in particular were introduced to ensure prudent fiscal policies of the EU member states. However, it remains an open question how the Stability and Growth Pact should be structured since some of the EU members have failed to adhere to its rules. ⁴

In light of the above discussion, I ask the question whether it is desirable that the EU governments cooperate on their fiscal policies. More specifically, I take into account the environment of the enlarged EU and investigate whether fiscal cooperation between the new EU members and the EMU countries is welfare-improving. The contribution of my paper is

¹Without loss of generality I concentrate on two groups of countries within the EU: the EMU countries and the newly admitted Central and Eastern European countries (CEEC). I do not differentiate among countries within a group.
²They also have to satisfy other Maastricht criteria to be admitted to the monetary union.
³See for example Giuliodori and Beetsma (forthcoming) who show some existence of fiscal spillovers and thus potential room for fiscal cooperation in the EU.
⁴For general discussion, see for example The Economist (2003, 2004). For a discussion tailored to the new EU members, see Gerald et al. (2004).
threelfold. First, I develop a quantitative business cycle model which matches the dynamics of Central and Eastern European countries and the Euro Area. I use this model to analyze fiscal and monetary policy in the EU and provide an explanation about the desirability of fiscal cooperation. Second, I incorporate a realistic assumption about the presence of foreign ownership of the firms that has not yet been included in studies of Central and Eastern European countries. Conclusions about desirability of fiscal policy cooperation depend on this assumption.\(^5\) Third, formal studies of the new EU countries have focused on their monetary issues during the transition period to the EU but have abstracted from fiscal policy.

In building the model, I follow Laxton and Pesenti (2003), Natalucci and Ravenna (2003), Devereux (2002), Devereux et al. (2004), Ghironi and Rebuici (2001), and Galí and Monacelli (2005). These are examples of two-country models where one country is large and the other one is much smaller.\(^6\) In my model, the large (foreign) economy represents the EMU and the smaller (home) country represents the new EU members. Each country has a fiscal and a monetary authority. The home central bank supports a fixed exchange rate. The other three policymakers conduct stabilization policy by use of policy rules and I assume that they can commit to the rules. Each government uses government consumption as a fiscal instrument and adjusts the instrument in response to its GDP movements. The foreign central bank follows a Taylor-type interest rate rule. When governments cooperate on fiscal policies, each government chooses the response parameter to its GDP to maximize the unconditional expectation of a weighted average of home and foreign households’ utility (welfare), taking the behavior of the foreign central bank as given. The foreign central bank chooses its response parameters to inflation and GDP to maximize the unconditional expec-

\(^5\)CEE countries rely heavily on foreign (mainly European) capital to finance catching up with the incumbent EU members. As a consequence, the presence of foreign ownership in new EU countries is substantial. The foreign share in equity capitalization has ranged from 20\% to 80\% in many Central and Eastern European countries during the period 1997-2003, while the share of CEE countries in equity capitalization in incumbent EU members is negligible. See Table 2.

\(^6\)The first three papers are tailored to Central and Eastern European countries. The structure of my model resembles these models but includes some new elements that are necessary (fiscal policy) and appealing (foreign ownership) when studying the need for fiscal cooperation in the EU.
tation of foreign households’ welfare, taking the behavior of the governments as given. In a non-cooperative game, each player takes the actions of the other two players as given and chooses response parameter(s) in its rule to maximize the welfare of its own households. All players act simultaneously.

To understand how foreign ownership affects results, I first analyze a benchmark model with no foreign ownership. When governments cooperate on their fiscal policies, they choose response parameters to GDP to maximize a weighted average of home and foreign welfare with the relative sizes of the economies as weights. The government of the large economy is indifferent between cooperating and not cooperating on fiscal policy with the government of the smaller economy. On the other hand, the government of the smaller country prefers not to cooperate because under fiscal cooperation each government chooses the parameter in its fiscal rule to stabilize shocks mainly in the large country.

Fiscal cooperation is even less desirable in the empirically more realistic model where foreign households own home firms. In this case, home households no longer receive state-contingent dividend income so their ability to insure themselves is reduced. Most of the variables in the smaller country become more volatile (e.g. private consumption, GDP). Therefore, both governments are more active in stabilizing the smaller economy when they cooperate and this makes government purchases in both countries more volatile. More aggressive fiscal policies have adverse effects on private non-tradable consumption in both countries.\(^7\) There is also a shift towards stabilizing shocks that affect both countries when governments cooperate. Thus, the foreign non-tradable technology shock is not absorbed as efficiently and introduces more volatility into foreign tradable consumption. As a consequence, foreign overall private consumption is more volatile and welfare in the large economy is reduced. In the small country, less volatile prices translate into less volatile tradable private consumption so that overall private consumption is slightly less volatile when governments cooperate. However, more volatility in labor supply and government purchases dominate

\(^7\text{Government purchases non-tradable goods.}\)
and home welfare is also lower under fiscal cooperation. Foreign central bank cushions the negative effect of fiscal policies on private consumption but its actions are not sufficient to make fiscal policy cooperation desirable.

My work relates to the literature on monetary and fiscal policy interactions and the literature on optimal taxation which provide insights on whether there are gains from policy cooperation or not. My model is similar to Quadrini (forthcoming) in the sense that capital market liberalization plays a role in the desirability of fiscal cooperation. In his model, equilibrium with tax cooperation reproduces the outcome of the model without capital mobility which is welfare-inferior to the case of capital market liberalization. His results crucially depend on governments’ inability to commit to future policies while I assume that policymakers can commit.

The inability of policymakers to commit is also the reason for counterproductive policy cooperation in Rogoff (1985), Kehoe (1989) and Canzoneri and Henderson (1991). If policymakers could commit in their models, cooperation would be beneficial. Beetsma and Bovenberg (1998), Beetsma et al. (2001) and Eichengreen and Ghironi (2002) show more examples of counterproductive cooperation which is limited to a subset of players. They consider a monetary union and decentralized fiscal policies and show how the adverse reaction of a common central bank to fiscal cooperation can reduce welfare for some or all of the players. However, cooperation is the preferred outcome if it is extended to all players.

Other contributions in the literature are Dixit and Lambertini (2001, 2003) and Eichengreen and Ghironi (2002) who show that there is no need for fiscal cooperation in a monetary union when all players agree on their goals. In this case they can reach their bliss points. However, it follows from Chari and Kehoe (2004) that the cooperative and the non-cooperative equilibria may not be the same under the same objectives. Jensen (1996) shows that fiscal cooperation may be disadvantageous if monetary cooperation lacks credibility with the private sector but is welfare-improving when central banks adhere to a rule. Lombardo and Sutherland (2004) conclude that fiscal cooperation may be welfare-reducing
if monetary policies are set non-cooperatively. Mendoza and Tesar (2005) find gains from fiscal cooperation but the gains are very small.

The rest of the paper is organized as follows. Section 2 outlines a two-country model of the European Union. In section 3 I describe the solution method and selection of parameters. In Section 4 I present the transmission mechanism and dynamic properties of the model. I explain the results about fiscal cooperation is Section 5. Section 6 concludes.

2 A general equilibrium model of the European Union

2.1 Overview of the economic environment

To mimic the structure of the enlarged EU and in particular the nature of the newly admitted members, I take into account some of the key features of these countries. One of them is the presence of foreign ownership of the firms. Central and Eastern European countries rely heavily on foreign (mainly European) capital to finance catching up with the rest of the EU. As a consequence, the presence of foreign ownership in the new EU countries is substantial. This feature is not present in other models of accession countries. Second, intermediate goods represent a substantial part of imports of these countries. For example, intermediate goods account for 60% of all Slovene imports and above 50% of Czech and Hungarian imports, making them very exposed to external shocks. Third, domestic tradable goods are exported and consumed by domestic households. Fourth, non-tradable sector is important and most of the government purchases are on non-tradable goods. Taking all of the above into consideration provides more flexibility to match the data and more realistic interdependencies between the Central and Eastern European countries and the Euro Area.

\footnote{Many and even more of the countries' characteristics that I use in my model are incorporated in the models of accession countries mentioned in the Introduction.}

\footnote{McCallum and Nelson (2000) show that intermediate goods as imports improve model dynamics.}
The theoretical framework that I use for my analysis is a micro-founded dynamic stochastic general equilibrium model. The foreign country in the model is designated to fit the EMU and the home country represents an aggregate of the new EU members. In each country there are households, firms, fiscal authority (government) and monetary authority (central bank). Foreign variables are indexed by a star.

Households in both countries are infinitely lived and have preferences over consumption, real money balances, labor supply, and government purchases. Each household consumes domestic final non-tradable goods, domestic final tradable goods and imported final tradable goods. Each household supplies homogenous labor to domestic firms producing final non-tradable goods and to domestic firms producing intermediate tradable goods. Labor is perfectly mobile between the sectors within a country. The labor market is perfectly competitive and labor is immobile internationally. Households trade short-term nominal bonds. There are two bonds, home and foreign, denominated in home and foreign currency, respectively. Only the foreign denominated bond is traded internationally.

The ownership structure of the firms and the equity share trade is as follows: in all the cases all but intermediate sector firms are locally-owned, i.e. home households own home firms and foreign households own foreign firms. Since the presence of foreign ownership in the new EU countries is substantial, I assume that owners of home and foreign intermediate firms are foreign households who trade home and foreign equity shares and receive dividends from home and foreign intermediate sector firms.\textsuperscript{10}

Each country produces three types of goods: final non-tradable goods, final tradable goods and a continuum of differentiated intermediate tradable goods. The final non-tradable goods are produced by perfectly competitive firms using domestic labor as input. They can be consumed by households and by the government. The firms which produce the final tradable goods operate in a perfectly competitive environment. Their goods are produced by combining domestic and imported intermediate goods and are used for private consumption.

\textsuperscript{10}The sector that is exclusively foreign-owned is only one out of three sectors. This assumption is thus not an extreme assumption about the extent of foreign presence.
Each intermediate tradable good is produced by a single firm in a monopolistically com-
petitive environment. The input used in production of each intermediate good is domestic
labor. The intermediate goods are used in the production of the final tradable goods. In
the intermediate sector, there are nominal rigidities in the form of a quadratic cost of price
adjustment.

Government conducts stabilization fiscal policy. Government spending falls on final non-
tradable goods and is financed through tax revenues and seigniorage. The central bank
in each country is instrument independent of the government. The foreign central bank
conducts monetary policy by employing an interest rate rule and the home central bank
supports a fixed exchange rate.

2.2 Households and their trading opportunities

2.2.1 Utility function

Home consumer $j$'s utility function has the following form:

$$U^j_t \equiv E_t \sum_{i=0}^{\infty} \beta^i \left[ A_{C,t} \left( \frac{C^j_{t+i}}{1 - \sigma} \right)^{1 - \sigma} + \left( \frac{G^j_{t+i}}{1 - \sigma_g} \right)^{1 - \sigma_g} + \left( \frac{M^j_{t+i}}{P^j_{t+i}} \right)^{1 - \phi} - A_{L,t} \left( \frac{L^j_{t+i}}{1 + \psi} \right)^{1 + \psi} \right],$$

where labor supply equals $L_t = L_{N,t} + L_{X,t}$, and labor is homogenous and perfectly mobile
between the sectors within the country, $C_t$ is the consumption basket, $P_t$ is the consumption
price index, $M_t$ are nominal money balances, and $G_t$ are government purchases. $\sigma > 0,$
$\sigma_g > 0,$ $\chi \geq 0,$ $\phi > 0,$ $\psi > 0$. $\beta$ is the discount factor, $\frac{1}{\sigma}$ is the elasticity of intertem-
poral substitution of private consumption, $\frac{1}{\phi}$ is the elasticity of substitution of real money
balances and $\frac{1}{\psi}$ is labor supply elasticity. $A_{C,t}$ is a preference shock and $A_{L,t}$ is a shock to
labor disutility. Home consumers are indexed by $j \in [0, a)$ and $a$ is the relative size of the
home country. Foreign households’ utility function is similar to the home one and foreign households are indexed by \( j^* \in [a, 1] \).

### 2.2.2 Intra-temporal allocation of consumption

Total consumption, \( C^j_t \), is a composite index of non-tradable and tradable consumption baskets, \( C^j_{N,t} \) and \( C^j_{T,t} \), respectively:

\[
C^j_t = \left(1 - \varphi_t\right)^{\frac{1}{\mu}} \left(C^j_{N,t}\right)^{\frac{\mu-1}{\mu}} + \left(\varphi_t\right)^{\frac{1}{\mu}} \left(C^j_{T,t}\right)^{\frac{\mu-1}{\mu}} \right)^{\frac{1}{\mu-1}}, \tag{2}
\]

where \( 0 \leq \varphi_t \leq 1 \) is the share of tradable consumption in the consumption basket and \( \mu > 0 \) is the elasticity of substitution between non-tradable and tradable consumption. The (log of) tradable goods’ weight in consumption, \( \varphi_t \), is subject to an autocorrelated disturbance term around the steady state mean. This shock represents shifts in home residents’ preferences from non-tradable to tradable goods. \( C^j_N \) is a basket of final non-tradable goods produced by perfectly competitive firms.

Consumption index of tradable goods is defined as:

\[
C^j_{T,t} = \left[\omega^\frac{1}{\eta} \left(C^j_{F,t}\right)^{\frac{\eta-1}{\eta}} + (1 - \omega)^\frac{1}{\eta} \left(C^j_{F^*,t}\right)^{\frac{\eta-1}{\eta}} \right]^\frac{\eta}{\eta-1}, \tag{3}
\]

where \( 0 \leq \omega \leq 1 \) is the share of home tradable consumption and \( \eta > 0 \) is the elasticity of substitution between home and foreign tradable goods. \( C^j_F \) and \( C^j_{F^*} \) are baskets of home and foreign final tradable goods also produced by perfectly competitive firms.

The definitions of the consumption preferences imply:

\[
P_t = \left(1 - \varphi_t\right) \left(P_{N,t}\right)^{1-\mu} + \varphi_t \left(P_{T,t}\right)^{1-\mu} \right)^{\frac{1}{1-\mu}},
\]

\[
P_{T,t} = \left[\omega \left(P_{F,t}\right)^{1-\eta} + (1 - \omega) \left(P_{F^*,t}\right)^{1-\eta} \right]^\frac{1}{1-\eta},
\]
where $P_N$ and $P_T$ are the prices of non-tradable and tradable consumption baskets, respectively, and $P_F$ and $P_{F*}$ are the prices of home and foreign baskets of final tradable goods, respectively.

The demands for baskets $C_{T}^{j}$ and $C_{N}^{j}$ are:

$$C_{T,t}^{j} = \varphi \left( \frac{P_{T,t}}{P_t} \right)^{-\mu} C_t^{j},$$  \hspace{1cm} (4) 

$$C_{N,t}^{j} = (1 - \varphi_t) \left( \frac{P_{N,t}}{P_t} \right)^{-\mu} C_t^{j},$$  \hspace{1cm} (5) 

and the demands for home and foreign baskets of final tradable goods are:

$$C_{F,t}^{j} = \omega \left( \frac{P_{F,t}}{P_{T,t}} \right)^{-\eta} C_{T,t}^{j},$$  \hspace{1cm} (6) 

$$C_{F*,t}^{j} = (1 - \omega) \left( \frac{P_{F*,t}}{P_{T,t}} \right)^{-\eta} C_{T,t}^{j}.$$  \hspace{1cm} (7) 

Foreign households solve a similar problem.

### 2.2.3 Inter-temporal optimization

The budget constraint for household $j$ in the home country is:

$$M_{t+1}^j + B_{t+1}^j + \varepsilon_t B_{t+1}^{*,j} + P_t \xi_{B_{t+1}^{*,j}}^j \left( \frac{\varepsilon_t B_{t+1}^{*,j}}{P_t} - \frac{\xi_{B_{t+1}^{*,j}}^j}{P} \right)^2 + P_t C_t^{j} + P_t T_t^{j} \leq M_{t+1}^j - (1 + i_t) B_t^j + \varepsilon_t (1 + i_t^*) B_t^{*,j} + \left( (1 - \tau_t^j) \left( W_{N,t} L_{N,t}^{j} + W_{X,t} L_{X,t}^{j} \right) \right) + P_t TCT_t^j.$$

Home household $j$ consumes, $C_t^{j}$, pays net lump-sum taxes, $T_t^{j}$, and receives wage income net of labor income tax, $(1 - \tau_t^j) \left( W_{N,t} L_{N,t}^{j} + W_{X,t} L_{X,t}^{j} \right)$. Home household $j$ holds domestic money, $M_t^j$, and home and foreign bonds, $B$ and $B^*$, denominated in home and foreign
currency, respectively, where $B_{j+1}$ is the stock of home bonds held by household $j$ entering period $t+1$ and $B_{*,j+1}^*$ is the stock of foreign bonds held by household $j$ entering period $t+1$. $\varepsilon_t$ is the nominal exchange rate in units of home currency per one unit of foreign currency. The short-term nominal interest rates $i_t$ and $i_t^*$ are paid at the beginning of period $t$ and are known at time $t-1$. Only the foreign bond is traded internationally. There are intermediation costs for households entering the international bond market. In particular, households face convex cost of holding foreign bonds in quantities different from the steady state level. The revenue from the intermediation is rebated to households as a lump-sum transaction cost transfer, $TCT^j_t$. In equilibrium, the rebate equals $TCT^j_t = \xi^* \left( \frac{\varepsilon_t B_{*,j+1}^*}{P_t} - \left( \frac{\varepsilon_t B_{*,j}^*}{P_t} \right)^2 \right)$.

Each household chooses labor supply, bond and money holdings, and consumption path to maximize expected lifetime utility (1) subject to the budget constraint (8). The first order conditions with respect to labor are:

\[(1 - \tau^L_t) w_{N,t} = (1 - \tau^X_t) w_{X,t} = \frac{A_{L,t} \left( L_t^j \right)^\psi}{A_{C,t} \left( C_t^j \right)^{-\sigma}}, \quad (9)\]

where $w_{N,t} \equiv \frac{W_{N,t}}{P_t}$ and $w_{X,t} \equiv \frac{W_{X,t}}{P_t}$ are real wages in the final non-tradable sector and intermediate sector, respectively. The first order conditions with respect to home and foreign bond holdings are:

\[A_{C,t} \left( C_t^j \right)^{-\sigma} = \beta (1 + i_{t+1}) E_t \left[ \frac{P_t}{P_{t+1}} A_{C,t+1} \left( C_{t+1}^j \right)^{-\sigma} \right], \quad (10)\]

\[A_{C,t} \left( C_t^j \right)^{-\sigma} \left[ 1 + \xi B^* \left( \frac{\varepsilon_t B_{*,j+1}^*}{P_t} - \left( \frac{\varepsilon_t B_{*,j}^*}{P_t} \right)^2 \right) \right] = \beta (1 + i_{t+1}) E_t \left[ \frac{\varepsilon_{t+1}}{P_{t+1}} A_{C,t+1} \left( C_{t+1}^j \right)^{-\sigma} \right]. \quad (11)\]

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11 The intermediation costs are introduced to guarantee that net bond positions follow a stationary process and economies converge asymptotically to a steady state. See Schmitt-Grohé and Uribe (2003) on this and other approaches on how to pin down the steady state values of bonds.

12 I assume that intermediaries are perfectly competitive and owned by domestic households.
This first order condition accounts for a reduced return on lending to foreigners and increased cost of borrowing from foreigners due to the intermediation costs.

Unlike home households, foreign households trade only foreign bonds but in addition to foreign bonds they also trade equity shares in home and foreign intermediate sector firms. Their budget constraint is presented in the Appendix. The first order conditions with respect to home and foreign shares are:

\[
A^*_C(t) \left( C^*_{t+1} \right)^{-\sigma} = \beta E_t \left[ \frac{P^*_t \left( (1 - \tau^*_t) D^*_t + V^x_{t+1} \right)}{V^x_t} A^*_C(t+1) \left( C^*_{t+1} \right)^{-\sigma} \right],
\]

(12)

\[
A^*_C(t) \left( C^*_{t+1} \right)^{-\sigma} = \beta E_t \left[ \frac{\varepsilon_t P^*_t \left( (1 - \tau^*_t) D^*_t + V^x_{t+1} \right)}{\varepsilon_{t+1}^* P^*_t} A^*_C(t+1) \left( C^*_{t+1} \right)^{-\sigma} \right],
\]

(13)

where \( V^x \) and \( V^{x*} \) denote the price of the equity shares in home intermediate firm \( x \) and the price of the equity shares in foreign intermediate firm \( x^* \), respectively. \( D^x \) and \( D^{x*} \) are the dividends paid by home and foreign firms \( x \) and \( x^* \), respectively.

### 2.3 Asset market clearing

In equilibrium, households and firms are symmetric so that \( B^j_{t+1} = B_{t+1}, B^*_{t+1} = B^*_t; B^{x,j*}_{s,t+1} = B^*_{s,t+1} \), and \( \int_0^a S^x_{s,t+1} dx = a S^x_{s,t+1} \) and \( \int_0^1 S^{x*}_{s,t+1} dx = (1-a) S^{x*}_{s,t+1} = S^{x*}_{s,t+1} \). \( S^x_{s,t+1} \) are equity share holdings of foreign household \( j^* \) in home firm \( x \) and \( S^{x*}_{s,t+1} \) are equity share holdings of foreign household \( j^* \) in foreign firm \( x^* \). The market clearing conditions for home and foreign bonds are:

\[
\int_0^a B_{t+1} dj = 0,
\]

(14)

\(^{13}\)See Appendix for explanation of notation.
\[
\int_0^a B_{t+1}^* dj + \int_a^1 B_{s,t+1}^* dj^* = 0.
\] (15)

The market clearing conditions for home and foreign equity shares are:

\[
\int_a^1 S_{*,t+1}^* dj^* = \int_0^a 1dx,
\] (16)

\[
\int_a^1 S_{*,t+1}^* dj^* = \int_0^1 1dx^*.
\] (17)

2.4 Intermediate goods sector and its ownership structure

Home intermediate good \( x \in [0,a) \) is produced by a monopolistically competitive firm that uses the following linear technology:

\[
Y_{X,t}^x \equiv A_{X,t}^x L_{X,t}^x,
\] (18)

where \( A_{X,t} \) is productivity shock common to all producers and \( L_{X,t}^x \) is homogenous labor used in the production of good \( x \). The firms producing intermediate goods face nominal rigidities. Following Rotemberg (1982), the nominal rigidities are in the form of a quadratic cost of price adjustment.

The home firm \( x \) maximizes the present discounted value of the dividends, \( d_s^x \),

\[
\max_{\{p_s(x), L_{X,s}^x\}} E_t \left( \sum_{s=t}^{\infty} \Omega_s^x d_s^x \right)
\] (19)

subject to

\[
d_s^x = (1 - \tau_t) \frac{p_s(x)}{P_s} Y_{X,s}^x - \frac{W_{X,s}}{P_s} L_{X,s}^x - \frac{\kappa}{2} \left( \frac{p_s(x)}{p_{s-1}(x)} - 1 \right)^2 \frac{p_s(x)}{P_s} Y_{X,s}^x
\] (20)
and

\[ Y_{X,s}^x = Y_{X,s}^D = Y_{X,s}^x. \] (21)

Since foreign households own home intermediate sector firms, the discount factor for the home firm \( x \) is \( \Omega^x_s = \beta^{s-t} \frac{A_X,s}{C,t} \left( \frac{C^*}{C^t} \right)^{-\sigma} \) for \( s = t, t+1, t+2, \ldots \) and \( \tau \) is the tax rate on the firm’s revenues.

The first order condition with respect to labor is:

\[ \lambda^x_t = \frac{w_{X,t}}{A_{X,t}}, \] (22)

which implies that the Lagrange multiplier on constraint (21), \( \lambda^x_t \), is equal to the real marginal cost. The first order condition with respect to the price implies a price which is set as a markup over nominal marginal cost:

\[ p_t(x) = \Psi^x_t P_t \lambda^x_t, \] (23)

where the markup equals

\[ \Psi^x_t = \frac{\theta Y^x_{X,t}}{(\theta - 1) Y^x_{X,t} \left[ (1 - \tau_t) - \frac{\kappa}{2} \left( \frac{p_t(x)}{p_{t-1}(x)} - 1 \right)^2 \right] + \kappa \Theta_t}, \]

with

\[ \Theta_t \equiv Y^x_{X,t} \frac{p_t(x)}{p_{t-1}(x)} \left( \frac{p_t(x)}{p_{t-1}(x)} - 1 \right) - E_t \left[ \Omega^x_{t+1} Y^x_{X,t+1} \frac{P_{t+1}(x)}{P_t(x)} \left( \frac{p_{t+1}(x)}{p_t(x)} \right)^2 \left( \frac{p_{t+1}(x)}{p_t(x)} - 1 \right) \right]. \]

In symmetric equilibrium, \( p_t(x) = P_{X,t} \). Foreign firms solve a similar problem and the law of one price holds: \( P_{X,t} = \varepsilon_t P^x_{X,t}, P^*{X,t} = \varepsilon_t P^*{X,t} \).
2.5 Production of final goods

2.5.1 Production of final non-tradable goods

There is a continuum of symmetric perfectly competitive home firms on the interval \( n \in [0, a) \) producing home final non-tradable good \( N \). The output of a representative firm at time \( t \) is denoted by \( Y_{N,t} \) and is produced with the following linear technology:

\[
Y_{N,t} \equiv A_{N,t} L_{N,t},
\]

(24)

where \( A_{N,t} \) is a productivity shock common to the producers of the home non-tradable good and \( L_{N,t} \) is homogenous labor used in the production of the home non-tradable good. Taking the price of labor, \( W_N \), as given, the firm chooses labor, \( L_{N,t} \), to minimize its costs subject to the production function. The first order condition for the firm is:

\[
RP_{N,t} = \frac{w_{N,t}}{A_{N,t}},
\]

(25)

where \( w_{N,t} \equiv \frac{W_{N,t}}{P_t} \) is real wage in the non-tradable sector and \( RP_{N,t} \equiv \frac{P_{N,t}}{A_{N,t}} \) is the price of good \( N \) in units of consumption basket. Foreign firms solve a similar problem.

2.5.2 Production of final tradable goods

There is a continuum of symmetric perfectly competitive home firms on the interval \( f \in [0, a) \) producing home final tradable good \( F \) with the following constant elasticity of substitution production function:

\[
Y_{F,t} \equiv \left[ \gamma \left( X_t \right)^{\frac{\epsilon-1}{\epsilon}} + (1 - \gamma) \left( X^*_t \right)^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}},
\]

(26)

where \( Y_{F,t} \) is the amount of home final tradable good produced by a representative firm at time \( t \). The home final tradable good \( F \) is produced using two intermediate goods: a basket
$X$ of home tradable differentiated intermediate goods and a basket $X^*$ of foreign tradable differentiated intermediate goods. $\epsilon > 0$ is the elasticity of substitution between home and foreign intermediate goods and $0 \leq \gamma \leq 1$ is the share of home intermediate goods in the production of the home final tradable good.

Baskets of home and foreign intermediate goods are defined as follows:

\[
X_t \equiv \left( \frac{1}{a} \right)^{\frac{\theta}{\theta - 1}} \int_{0}^{a} (X_t(x))^{\theta-1} dx^{\theta-1}, \tag{27}
\]

\[
X^*_t \equiv \left( \frac{1}{1-a} \right)^{\frac{1}{\theta}} \int_{a}^{1} (X^*_t(x^*))^{\theta-1} dx^*^{\theta-1}, \tag{28}
\]

where $\theta > 1$ denotes the elasticity of substitution among intermediate goods and $x$ and $x^*$ denote home and foreign varieties of intermediate goods. The definition of the production function implies:

\[
P_{F,t} = \left[ \gamma (P_{X,t})^{1-\epsilon} + (1 - \gamma) (P_{X^*,t})^{1-\epsilon} \right]^{\frac{1}{1-\epsilon}}
\]

and the definitions of the baskets of intermediate goods imply:

\[
P_{X,t} = \left[ \left( \frac{1}{a} \right)^{1} \int_{0}^{a} (p_t(x))^{1-\theta} dx \right]^{\frac{1}{1-\theta}},
\]

\[
P_{X^*,t} = \left[ \left( \frac{1}{1-a} \right)^{1} \int_{a}^{1} (p_t(x^*))^{1-\theta} dx^* \right]^{\frac{1}{1-\theta}},
\]

where $P_X$ and $P_{X^*}$ are the price indices of home and foreign baskets of intermediate goods and $p_t(x)$ and $p_t(x^*)$ are the prices of varieties $x$ and $x^*$.

The representative firm’s demands for baskets $X$ and $X^*$ are:

\[
X_t = \gamma \left[ \frac{P_{X,t}}{P_{F,t}} \right]^{-\epsilon} Y_{F,t}, \tag{29}
\]
\[ X_t^* = (1 - \gamma) \left[ \frac{P_{X,t}^*} {P_{F,t}} \right]^{-\epsilon} Y_{F,t} \]  

(30)

and the demands for individual goods \( x \) and \( x^* \) by the representative firm are:

\[ X_t(x) = \frac{1}{a} \left[ \frac{p_t(x)} {P_{X,t}} \right]^{-\theta} X_t, \]  

(31)

\[ X_t^*(x^*) = \frac{1}{1 - a} \left[ \frac{p_t(x^*)} {P_{X^*,t}} \right]^{-\theta} X_t^*. \]  

(32)

Foreign producers solve a similar problem. The law of one price holds in the final tradable sector:

\[ P_{F,t} = \varepsilon_t P_{F,t}^{*}, \quad P_{F,t}^{*} = \varepsilon_t P_{F,t}^{*}. \]

2.6 Goods and labor market clearing

Market clearing conditions are as follows. Non-tradable goods can be consumed by households and government:

\[ \int_0^a Y_{N,t} dn = \int_0^a C_{N,t} dj + a G_t. \]  

(33)

Final tradable goods are consumed by home and foreign households:

\[ \int_0^a Y_{F,t} df = \int_0^a C_{F,t} dj + \int_a^1 C_{F,t}^* dj^* \]  

(34)

and intermediate goods are used in production of home and foreign final tradable goods. Markets clear for each variety \( x \):

\[ Y_{X,t}^x = \int_0^a X_t(x) df + \int_a^1 X_{*,t}(x) df^*. \]  

(35)

Labor market clearing requires:
\[ \int_0^a L_{N,t}dj + \int_0^a L_{X,t}dx = \int_0^a L_{N,t}dn + \int_0^a L_{X,t}dx. \] (36)

Similar market clearing conditions hold for foreign goods and labor.

2.7 Fiscal and monetary policy

2.7.1 Government and fiscal policy

Government is not productive and public spending falls on final non-tradable goods and is denoted by \( G \), which is per capita government consumption. Government finances its consumption through lump-sum taxes imposed on consumers, taxes imposed on intermediate sector firms, labor income taxes, dividend income taxes, and seigniorage revenue. The government is required to balance its budget in every period.\(^{14}\) Tax rates are taken as given and are calibrated to the EU data. The government uses the ratio of government consumption to GDP as its instrument and pursues stabilization policy. Fiscal policy is specified in terms of the following rule.\(^{15}\)

\[ g_t = (\frac{GDP_t}{GDP^*})^{f_{GDP}} \epsilon_t^{f_p}, \] (37)

where \( g_t = \frac{RP_{N,t}G_t}{GDP^*} \), \( f_{GDP} \) is the feedback parameter on GDP gap with respect to the steady state, and \( \epsilon_t^{f_p} \) is an exogenous shock to fiscal policy. This fiscal rule reflects an output gap stabilization motive and is motivated by empirical literature.\(^{16}\) Foreign fiscal policy is specified in a similar way.

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\(^{14}\)The government’s budget constraint is in the Appendix.

\(^{15}\)Beetsma and Jensen (2002) show that this class of fiscal rules performs well in their model.


Galí and Perotti (2003) find empirical evidence that fiscal policies had been more and more countercyclical in the EMU for the period 1980 until 2001 and that spending policies have had more important role as a countercyclical tool, as opposed to the revenue policies, while the Government of Slovenia, for example, announced it would be using fiscal policy for stabilization purposes after fixing the exchange rate to euro in summer 2004.
2.7.2 Central bank and monetary policy

The home central bank issues home nominal money. Monetary policy in the home economy supports a fixed exchange rate,\textsuperscript{17} which is in line with the requirement of the membership in the Exchange Rate Mechanism prior to joining the monetary union.

The foreign central bank issues foreign nominal money. Foreign monetary policy is endogenous and specified in terms of an interest rate rule:

\[ 1 + i_{t+1}^* = (1 + i_t^*)^{m_{t}^i} (1 + \pi_t^*)^{m_{CPI}^i} \left( \frac{GDP_{t}^*}{GDP_{t}^*} \right)^{m_{GDP}^i} \epsilon_{t}^{mp}, \]

where \( m_{t}^i, m_{CPI}^i, \) and \( m_{GDP}^i \) are feedback parameters on previous period interest rate, CPI inflation and GDP gap, respectively, and \( \epsilon_{t}^{mp} \) is an exogenous shock to monetary policy.

3 Solution and parameterization of the model

3.1 Solution of the model and the steady state

Variables are expressed in real aggregate per capita terms. The model cannot be solved analytically. Thus I find the rational expectations equilibrium of the log-linearized approximation around the steady state. I employ the solution method for solving nonlinear dynamic discrete-time stochastic models provided by Uhlig (1999) and find the recursive equilibrium law of motion using the method of undetermined coefficients. The steady state for the benchmark model with no foreign ownership has analytical solution but I use numeric methods to solve for the steady state of the model with foreign ownership of home intermediate firms.

\textsuperscript{17}See Benigno et al. (2002) for details on how to fix the exchange rate.
3.2 Parameterization

The home economy in this model represents the new EU members and the foreign economy is designated to be the EMU. Thus, the size of the home country relative to the foreign economy, \( a \), is set to 5 percent. The discount factor, \( \beta \), equals 0.99 which implies an annual real interest rate of around 4 percent. In line with the literature, the inverse of the elasticity of intertemporal substitution of consumption, \( \sigma \), is equal to 2. Following Laxton and Pesenti (2003), the inverse of labor supply elasticity, \( \psi \), is set to 2.5. I assume logarithmic utility of government consumption so that \( \sigma_g = 1 \).

The share of the home tradable consumption in the tradable consumption basket, \( \omega \), and the share of the home intermediate goods in production of final tradable goods, \( \gamma \), are equal to \( a \). The share of tradable consumption in the consumption basket, \( \varphi \), equals 55 percent as in Natalucci and Ravenna (2003).

The elasticity of substitution between non-tradable and tradable consumption, \( \mu \), is set to 0.5 as in Stockman and Tesar (1995) and the elasticity of substitution between home and foreign tradable goods, \( \eta \), is set to 1.5. \( \epsilon \) is the elasticity of substitution between home and foreign intermediate goods and is set to 0.5. The last two parameters are taken from Natalucci and Ravenna (2003). \( \theta \) denotes the elasticity of substitution among intermediate goods. I set \( \theta = 11 \), which together with the revenue tax of 0.2 implies a markup of 1.375. The price adjustment cost parameter, \( \kappa \), is set to 77, as estimated by Ireland (2001) for the US economy. All parameters for financial transaction costs are set to 0.01, which is standard in the literature.

I treat tax rates as parameters and take their values from Quadrini (forthcoming) and Mendoza and Tesar (2005). The tax rate on revenue, \( \tau \), equals 20 percent. The tax rate on

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18 The model is calibrated to the EMU and the Czech Republic’s data.
19 The new members’ share of GDP in the EU’s total GDP is around 5 percent.
20 Martins et al. (1996) estimate the average markup for manufacturing sector at 1.2 for the OECD countries. Some authors suggest that the range between 1.2 and 1.7 is reasonable. See Morrison (1994) and Domowitz et al. (1988).
21 Ghironi et al. (2003) set these parameters to 0.025 to match reasonable persistence of net foreign assets.
labor income is set to 37 percent and the tax rate on dividends to 25 percent. The steady state share of government purchases in GDP is calibrated to 18 percent.

Foreign monetary policy parameters are set as estimated by Smets and Wouters (2003). The degree of interest rate smoothing, \( m^*_i \), is set to 0.95. The interest rate response to inflation, \( m^*_{CPI} \), equals 1.65 and the interest rate response to GDP, \( m^*_{GDP} \), is set to 0.14. I assume that the home central bank supports a fixed exchange rate, which is in line with the ERM2, and keep this assumption across all model specifications.\(^{22}\) Gali and Perotti (2003) estimate different specifications of fiscal rules for the Euro Area. Their spending rule for the period after the introduction of the Maastricht Treaty indicates that primary spending-to-potential output ratio reacts to output gap with the coefficient of 0.04 and that there is a high persistence of the fiscal instrument; the persistence parameter is estimated to be 0.8. I approximate historic foreign fiscal policy by setting the reaction coefficient to the output gap to zero and incorporate high persistence coefficient on past instrument with an AR(1) fiscal shock. There are no empirical studies on fiscal policy rules for the new EU members. Without loss of generality, I assume that also the new EU members have not been using their fiscal policies as a stabilization tool until recently. Natalucci and Ravenna (2003) and Devereux (2002) estimate government spending for the Czech Republic and Estonia as AR(1) processes with the persistence parameters 0.7 and 0.8, respectively.

4 The effects and transmission of shocks and dynamic properties of the model

To understand how the model’s transmission mechanism works, I first analyze impulse responses of macroeconomic variables to a technology shock. I also investigate the effects of a

\(^{22}\)Some of the new EU members have already fixed their exchange rate to euro in order to satisfy the exchange rate criterion to enter the monetary union. However, past policies in most of these countries did not have a regime of a fixed exchange rate but I assume the exchange rate to be fixed in order to be consistent across model specifications and for simplicity.
fiscal shock in order to show how fiscal policy actions in one country affect the variables in the other economy. This analysis is conducted for historic monetary and fiscal policies.

4.1 Foreign technology shock

I choose to analyze impulse responses of variables in both economies to a foreign technology (and later fiscal) shock because home country only marginally affects the large economy and most of the spillovers flow from the large to the small country.

Figures 1 and 2 present impulse responses to a one-percent increase in foreign intermediate sector productivity. To understand the implications of the assumption about the foreign ownership of the home intermediate sector firms, I show impulse responses for a benchmark model without foreign ownership (solid line) and the model where home intermediate sector firms are exclusively foreign-owned (dashed line).

A positive productivity shock in the foreign intermediate sector increases output of foreign intermediate goods, reduces labor supply, and increases the wage rate in this sector. The increase in productivity dominates the effect of higher wages so that marginal costs decrease. As a consequence, the relative price of the foreign intermediate goods falls. The markup increases to preserve profitability and the dividends are higher. This is reflected in an increase of the foreign share price.

The productivity shock in the foreign intermediate sector transmits to other sectors in the foreign economy and also to the home economy. The shock directly transmits to the foreign firms which produce final tradable goods and use intermediate goods in their production. They enjoy lower foreign input prices and therefore expand production of the final tradable goods. The relative prices of the foreign final tradable goods decrease and the quantity demanded by home and foreign households increases. Foreign households also demand more non-tradable goods which increases labor demand and wages in the foreign non-tradable sector. The foreign relative price of the non-tradable goods is consequently higher.
At the same time the original shock transmits to the home economy. The home final tradable sector expands for the same reason as the foreign final tradable sector (foreign inputs have higher weight in production of final tradable goods) and the home relative price of the final tradable goods decreases. There is an initial boom in the home intermediate sector coming from higher home and foreign demand because both, home and foreign inputs are required in production of final tradable goods. After the initial positive effect on the home intermediate sector, demand for home inputs decreases (prices are higher at home). Labor dynamics at home follow output dynamics in the home intermediate sector. Higher demand for inputs initially results in higher demand for intermediate labor and higher wages. Since labor is perfectly mobile between the two sectors, it flows to the intermediate sector. Initially, home non-tradable output declines but once the positive effect in the intermediate sector is reversed, labor in the intermediate sector is lower and output in the non-tradable sector expands. The home relative price of the non-tradable goods increases.

As a consequence of a positive productivity shock in the foreign intermediate sector home and foreign GDP and private consumptions expand. Foreign CPI inflation almost does not responds due to the opposite dynamics of prices of tradable and non-tradable goods, while home CPI inflation increases because prices of tradable and non-tradable goods both increase. As a result, the real exchange rate, which is defined as $RE_t = \frac{\varepsilon_t P_t^*}{P_t}$, declines (nominal exchange rate is fixed). Home households initially borrow from foreign households but they later accumulate foreign bonds because the shock results in higher expansion in the home country.

4.2 Foreign fiscal shock

Figures 3 and 4 present impulse responses to a one-percent increase in foreign fiscal shock. A demand shock in the form of an increase of foreign government purchases-to-GDP ratio increases demand for labor and output in the foreign non-tradable sector. Government
consumption crowds out private non-tradable consumption and this cushions the foreign wage rate and the relative price of the non-tradable goods from a large increase. Higher wages in the non-tradable sector attract labor from the intermediate sector and thus the wage in the intermediate sector increases as well. Consequently, supply of foreign intermediate goods falls and demand adjusts. Because of the opposite dynamics of labor cost and markup in the foreign intermediate sector the relative price of the foreign inputs almost does not change. Intermediate goods are inputs in production of final tradable goods, which decreases in both countries. In the foreign economy, the relative price of the final tradable goods stays almost the same. Foreign private consumption falls mainly due to the crowding out effect which prevents foreign GDP from a significant expansion.

The shock transmits to the home economy because supply of foreign intermediate goods drops and so does the production of home inputs. This reduces supply of home and foreign final tradable goods. The relative price of the home final tradable goods increases. Labor in the home country reallocates to the non-tradable sector because of lower labor demand and wages in the intermediate sector. Higher labor supply in the non-tradable sector increases production and reduces wages and relative prices in this sector. Overall home private consumption decreases because the consumption of the final tradable goods is lower and almost all of new non-tradable goods are consumed by the government which crowds out private non-tradable consumption. Home GDP decrease.

Home CPI inflation decreases because the main components of the home CPI inflation (home prices of non-tradable goods and foreign prices of tradable goods) are lower. On the other hand, foreign CPI does not change since all foreign prices stay almost constant. The real exchange rate is thus driven by home prices and increases.

4.3 Estimates of macroeconomic variability

The previous section analyzed only the responses of variables in the two economies to a given shock. Here I investigate how the model behaves when the two countries are hit by all shocks
at once. In order to do so, I need to make some assumptions about stochastic processes. Empirical evidence on productivity shocks shows high persistence and positive correlation across countries.\textsuperscript{23} In my model, productivity shocks follow AR(1) processes. I set the persistence parameters of all productivity shocks to 0.9. Productivity shocks between different sectors within a country are perfectly correlated as in Natalucci and Ravenna (2003) and Laxton and Pesenti (2003). All other shocks are independent of each other. The monetary shock in the foreign interest rate rule is a iid process. The persistence parameters of the preference shocks, labor disutility shocks and shocks to shifts in preferences between non-tradable and tradable goods are set to 0.7, 0.9 and 0.9, respectively. I choose the standard deviations of the shocks to match some of the moments of macroeconomic variables given historic economic policies and baseline parameter values. The details on stochastic processes are in Table 3.

The second moments of the model (with foreign ownership) and the values from the data are presented in Table 4. The model generates almost twice as much variability in GDP in the new EU members compared to the Euro Area and the absolute values of the standard deviations of GDP are consistent with the variability in historic data. For the Czech Republic, the model performs well in the sense that all of the GDP components are more volatile than GDP itself. However, exports and imports in the model are less volatile than their historic counterparts. This may be explained by the fact that there is no capital/investment in my model. Investment is the most volatile component of the GDP and since investment goods are not part of exports and imports in my model, the volatility of exports and imports may be understated. The government expenditure is more volatile in the model than in historic data.\textsuperscript{24} There is a trade-off between matching the volatility of government purchases and matching the rest of the variables in this exercise.

The CPI inflation rate is more volatile and the interest rate is somewhat less volatile

\textsuperscript{23}See for example Backus et al. (1992).

\textsuperscript{24}The variability of government expenditure directly enters the welfare function used in the policy experiments. I thus correct for the fact that the variability of government purchases is too high by adjusting the weight on government purchases in the welfare function.
than in the data. This could be due to the monetary regime that I assume for the smaller economy in the model. In order to mimic the current arrangement of the institutions in the new EU member states and to keep the strategic games among policymakers as simple as possible, I assume that the smaller economy supports a fixed exchange rate regime. However, historic moments are based on a monetary regime that is not a fixed exchange rate regime.

For the Euro Area, the CPI inflation and the interest rate are less variable in the model because of the assumption of an inflation-targeting regime, which is similar to the model properties of Laxton and Pesenti (2003). While data suggest less variability of GDP components than that of the GDP itself for the Euro Area, the model generates about the same volatility for each of them.

The dynamic properties of the model can be partially compared to the model of Laxton and Pesenti (2003) and Natalucci and Ravenna (2003). The model of Natalucci and Ravenna (2003) performs better in terms of the CPI inflation rate and the interest rate. Given that I assume a fixed exchange rate regime (and they do not) this is not surprising. As for the other variables, the model performs at least as well as their model. I cannot compare the dynamics for the Euro Area to Natalucci and Ravenna (2003) since they assume that the rest of the world is exogenous and do not model the second country.

The model in Laxton and Pesenti (2003) is a highly sophisticated model with many realistic ingredients which I do not include in my model. Therefore, the overall performance of their model in matching the second moments is better. Nonetheless, both models fail to match the dynamics of the CPI inflation rates and the interest rates. As explained above, the lower volatilities of exports and imports in my model compared to the historic data may be a consequence of the lack of investment in the model. Finally, the real exchange rate is much better matched in my model compared to Laxton and Pesenti (2003).
4.4 The role of foreign ownership

Table 5 presents the standard deviations of selected variables for the model with foreign ownership of firms in the home economy (Foreign) and for the model without foreign ownership of home firms (Local). The volatility of most variables in the home economy is higher in the model where foreign households own home firms compared to the model without foreign ownership (higher volatility can also be inferred from some impulse responses). When foreign households own home intermediate sector firms home households no longer receive state-contingent dividend income and their ability to insure themselves and smooth consumption is thus reduced. Home households can insure themselves against the risk of the firms only through labor supply. As a consequence, home private consumption, along with most other variables, is more volatile when foreign households own home intermediate sector firms. On the other hand, home labor effort and imports are slightly less volatile in the model with foreign ownership of home firms.

Comparison of the second moments of selected variables between the model with and without foreign ownership of firms in the home economy reveals that the two models perform similarly in matching the second moments of the data. The model with foreign ownership performs better in matching the volatilities of consumption, exports and the real exchange rate even though both models understate the volatilities of these three variables, while the dynamics of the government expenditure, the CPI inflation rate and imports are better matched in the model without foreign ownership. In both models, the volatility of the government expenditure and the CPI inflation rate is overstated compared to the data while the volatility of imports is understated. The real GDP may be better matched in the model with foreign ownership given the fact that Laxton and Pesenti (2003) estimate the standard deviation of the Czech GDP at 2 percent. The ownership structure in the home economy has negligible effects on the foreign economy.

\footnote{One should keep in mind that the standard deviations of the shocks are chosen to match the moments and are not estimates from the data. The estimated standard deviations of shocks may imply a different conclusion about the relative performance of the two models.}
5 Design of fiscal and monetary policy

So far I have assumed that fiscal and monetary policies are conducted by use of historic empirical rules. Such specification is useful because it helps us understand how shocks are transmitted to macroeconomic variables and provides basis for empirical evaluation of the underlying model.

In this section I turn to the core question of my analysis: Are there gains from fiscal cooperation between the new and the incumbent members of the European Union? Before I answer this question, I specify the goals of fiscal and monetary authorities and the structure of the policymakers’ strategic games.

I assume that policymakers choose stabilization policy, i.e. reaction parameters in their policy rules, to maximize unconditional expectation of households’ welfare and that they can commit to the rules. Given the class of rules considered, such fiscal and monetary policies are optimal. I use numeric optimization to solve for optimal policies. The welfare function is derived as a second-order Taylor approximation to the utility function and can be expressed in each period $t$ as:

$$W_t = -\frac{1}{2}\sigma_C^{1-\sigma} var(\hat{C}_t) - \frac{1}{2}\psi^{1+\psi} var(\hat{L}_t) - \frac{1}{2}\sigma_g^{1-\sigma_g} var(\hat{G}_t),$$

(39)

where $\hat{C}$, $\hat{L}$, and $\hat{G}$ are the steady state values of consumption, labor and government purchases and hats denote percentage deviations from the steady state.

The definitions of strategic games among the policymakers are as follows. Non-cooperative game: Each government chooses its reaction parameter to GDP to maximize the unconditional expectation of households’ welfare, taking the behavior of the other government and the foreign central bank as given. The foreign central bank chooses response parameters to inflation and GDP to maximize the unconditional expectation of the foreign households’ welfare, taking the behavior of the governments as given. All parameters are chosen simul-
taneously. Fiscal cooperation: The two governments act as a "single" policymaker and each choose its response parameter to GDP to jointly maximize the unconditional expectation of a weighted average of home and foreign welfare, taking the behavior of the foreign central bank as given. The weights in the joint welfare function are the relative sizes of the countries. The foreign central bank chooses parameters in its rule to maximize the unconditional expectation of the foreign households’ welfare, taking the behavior of the governments as given. All policymakers act simultaneously.

5.1 Optimal fiscal and monetary policies and the desirability of fiscal cooperation in the EU

5.1.1 Benchmark model without foreign ownership

To understand how foreign ownership of the firms affects fiscal and monetary policy and fiscal cooperation, I first analyze a benchmark case without foreign ownership. Table 1 presents optimal fiscal and monetary reaction coefficients to GDP and inflation and the associated welfare losses for the models with and without foreign ownership.

<table>
<thead>
<tr>
<th></th>
<th>$f_{GDP}$</th>
<th>$f^*_{GDP}$</th>
<th>$m^*_{CPI}$</th>
<th>$m^*_{GDP}$</th>
<th>$L$</th>
<th>$L^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign Ownership</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-cooperation</td>
<td>-0.925</td>
<td>-27.998</td>
<td>1.648</td>
<td>80.00</td>
<td>13.853</td>
<td>0.963</td>
</tr>
<tr>
<td>Cooperation</td>
<td>-1.137</td>
<td>-41.606</td>
<td>1.363</td>
<td>80.01</td>
<td>13.972</td>
<td>0.970</td>
</tr>
<tr>
<td>No Foreign Ownership</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-cooperation</td>
<td>-0.179</td>
<td>-28.098</td>
<td>1.723</td>
<td>80.44</td>
<td>8.574</td>
<td>0.946</td>
</tr>
<tr>
<td>Cooperation</td>
<td>-0.306</td>
<td>-28.017</td>
<td>1.720</td>
<td>80.00</td>
<td>8.578</td>
<td>0.945</td>
</tr>
</tbody>
</table>

Result 1 Optimal policies are countercyclical and call for more aggressive stabilization of output gap than historic policies.
It is optimal for the foreign fiscal and monetary authorities to respond strongly to output gap and this is consistent with a less aggressive home fiscal policy. The home country benefits from stabilization policy of the foreign country for two reasons: First, it is a small open economy with strong trade links to the foreign country and thus very exposed to anything that happens in the large economy. When foreign policymakers stabilize their own economy they also reduce volatility in the home country. Second, the home economy supports a fixed exchange rate and therefore "imports" foreign monetary policy.\footnote{Foreign expansionary monetary policy increases home GDP.}

**Result 2** The home country is better off in the non-cooperative equilibrium and the foreign economy prefers fiscal cooperation.

In a world with a small and a large country, one would expect that policy cooperation may not matter for the large economy but could make sense for the small country. The results in the benchmark model support this intuition and the large economy is more or less indifferent between cooperating and not cooperating its fiscal policy with the smaller country. Moreover, the large economy almost does not change its policy when it cooperates with the small country. The small country, on the other hand, pursues a more aggressive fiscal policy when it internalize its (small) spillovers on the large economy.\footnote{The change in the home fiscal policy’s response is small because the externalities from home to foreign country are almost negligible.} As a result, the home country is worse off in the cooperative equilibrium since in this equilibrium the focus is on maximizing foreign welfare and stabilizing shocks in the large economy.\footnote{Both governments choose their policies to mainly maximize foreign welfare. The foreign central bank is maximizing foreign welfare and there is no home central bank that would maximize its households’ well-being.}

### 5.1.2 Model with foreign-owned home intermediate sector firms

I now turn to empirically more relevant case where I assume that foreign households are exclusive owners of the home intermediate sector firms and investigate the differences in
optimal policies and fiscal cooperation with respect to the benchmark model with no foreign presence in the smaller country.\textsuperscript{31}

**Result 3** *Home fiscal policy is more aggressive compared to the benchmark model.*

Most of the variables in the home economy are more volatile in the model with exclusive foreign ownership in the home intermediate sector compared to the benchmark case.\textsuperscript{32} Therefore, it is optimal for home fiscal policy to play a more active stabilization role. The difference in the volatility of the foreign economy’s variables between the two models is negligible so that foreign fiscal policy remains almost the same in the non-cooperative equilibrium.

**Result 4** *Foreign fiscal policy is more aggressive in the cooperative equilibrium compared to the benchmark model.*

As in the benchmark model, when governments cooperate, they choose parameters in their rules to maximize a weighted average of home and foreign welfare. However, variables in the home economy are more volatile and foreign fiscal policy causes bigger spillovers on the small country in the model with foreign ownership.\textsuperscript{33} This is the reason why foreign fiscal policy in more aggressive under fiscal cooperation and now contributes to the stabilization of shocks in the home economy.

**Result 5** *Foreign monetary policy’s reaction to inflation is smaller under fiscal cooperation.*

The importance of foreign central bank’s inflation stabilization under fiscal cooperation is reduced. This can be explained by analyzing some impulse responses.\textsuperscript{34} Contractionary

\textsuperscript{31}Home firms producing final goods remain locally-owned.
\textsuperscript{32}See the explanation in the section on transmission mechanism.
\textsuperscript{33}See impulse responses in the section on transmission mechanism.
\textsuperscript{34}See Figure 5.
monetary policy triggers expansionary foreign fiscal policy and reduces foreign consumption. This consumption reduction is magnified by the expansionary fiscal policy. Under fiscal cooperation, the foreign government reacts stronger to monetary actions and thus the indirect effect of foreign fiscal policy on foreign private consumption is larger. But because foreign monetary authority chooses its policy parameters to maximizes foreign households’ utility and households dislike consumption variability, it is optimal for the foreign central bank not to respond as strongly to inflation as under the non-cooperative fiscal game.

**Result 6** *Both countries are better off in the non-cooperative equilibrium.*

In the model with foreign ownership of home firms in the intermediate sector home households do not receive state-contingent dividend income and their ability to insure themselves is reduced. Most of the variables in the smaller country become more volatile (private consumption, GDP). Therefore, both governments are more active in stabilizing the smaller economy when they cooperate and government purchases in both countries are more volatile.

Foreign fiscal rule is successful in stabilizing GDP in the large economy but it introduces excessive volatility in foreign private consumption when governments cooperate fiscal policies. The non-tradable private consumption becomes more volatile because government consumption, which is on non-tradable goods, is more volatile. Foreign tradable private consumption is also more volatile under fiscal cooperation. More volatility comes from the foreign technology shock in the non-tradable sector. This is not surprising since under fiscal cooperation, the weight shifts to stabilizing shocks which affect both countries.\(^{35}\) The foreign non-tradable technology shock increases volatility of foreign inputs and consequently the volatility in the production of the foreign final tradable goods. Thus, foreign tradable consumption is more volatile.\(^{36}\) The foreign central bank cushions the effect of more volatile

\(^{35}\)Foreign technology shock in the non-tradable sector does not affect quantities in the home economy.

\(^{36}\)Recall that most of final tradable consumption is on foreign goods.

Also, increased volatility in foreign non-tradable consumption does not come from the foreign non-tradable technology shock. The non-tradable private consumption is more volatile because of more aggressive fiscal policy.
foreign government purchases on foreign private consumption. However, higher volatility of government purchases has the dominant effect on foreign private consumption. Private consumption is by far the most important component of welfare and therefore foreign households are worse off under fiscal cooperation.

The interaction between fiscal policy and private consumption in the home economy is qualitatively the same as in the foreign country. More volatile government purchases translate into more volatile non-tradable private consumption. On the contrary, home tradable private consumption is less volatile under fiscal cooperation. Most of home tradable private consumption is on foreign goods and the production of those goods is more volatile. However, there is a key difference between foreign and home prices and less volatility in home prices translates into less volatility of quantities consumed. Another factor which determines the volatility of home private consumption is the foreign central bank which chooses its policy parameters to maximize foreign welfare. Nonetheless, the foreign central bank has a positive effect on home private consumption (for the same reason as in the foreign economy). The overall effect of fiscal cooperation on home private consumption is positive but the reduction in volatility is very small. This small welfare-improving effect is not enough to counterbalance more volatility in labor supply and government purchases and also home households are worse off under fiscal cooperation.

5.2 Some sensitivity analysis

5.2.1 Elasticity of intertemporal substitution of government purchases

The estimates of the inverse of the elasticity of intertemporal substitution of government consumption, \( \sigma_g \), are not readily available. I assume logarithmic utility of government purchases in the benchmark calibration, which implies a weight of 0.5 on government purchases in the welfare function.\(^{37}\) I reduce this weight to 0.3 which implies the relative weight of 0.2

\(^{37}\)The weight on consumption is around 1.5.
on government purchases compared to private consumption. As a consequence, the stabilization role of home government is increased but foreign policies are very similar to the case of logarithmic preferences over government consumption. Both countries are still better off in the non-cooperative equilibrium.

5.2.2 Weights in the joint welfare function

The question of weights in the joint welfare function is of political nature and one could object to almost any selection of the weights. The literature on fiscal cooperation usually assumes that the weights in the joint welfare function are equal to the relative sizes of the countries. The results reported above follow such specification. However, I conduct a sensitivity analysis with respect to the weights and find that qualitative results do not change if the two countries have equal weight in the joint welfare function.

5.2.3 All policymakers cooperate

The model I use incorporates some realistic assumption about the conduct of economic policies in the European Union. I assume that the new EU members participate in the ERM (by supporting a fixed exchange rate) and are not yet members of the monetary union. Thus, there is no explicit policy cooperation between the monetary authorities of the new EU members and the EMU. I also assume that fiscal and monetary policies are set in a non-cooperative fashion which is the case in the EU. Therefore, the results presented above should not be surprising and are consistent with the literature.

For completeness, I also solve the model in which all policymakers cooperate on their policies.\textsuperscript{38} It is interesting that a cooperation among the three "active" players, namely the two governments and the foreign central bank, is not enough to make both countries better

\textsuperscript{38}Such specification is not close to the current arrangement in the EU/EMU.
off compared to the non-cooperative solution and the solution where only the governments cooperate. However, both countries are better off when all four policymakers cooperate. In this case, I assume that the home central bank conducts stabilization policy and follows an interest rate rule similar to the foreign central bank’s rule.

6 Conclusions

In this paper I study how fiscal policies should be conducted in the enlarged European Union. I find that there is room for fiscal stabilization but there is no need for the national governments of the new EU members and the EMU members to cooperate on their fiscal policies. In fact, fiscal cooperation is welfare-reducing for both groups of countries. An important factor which contributes to this result is the presence of foreign ownership of firms in the new EU members. When there is no foreign ownership in the new EU members, the EMU is indifferent between cooperating and not cooperating but the new EU members still prefer not to cooperate on fiscal policy with the EMU.

In this paper I assume that the two countries have national monetary policies. In the future, the new EU countries will have to join the monetary union (EMU). It would thus be of interest to analyze the need for fiscal cooperation between the two groups of countries considered in this paper when they constitute a monetary union. In this case, a single central bank would have a different role and would interact differently with the national governments. I leave this extension for future research.

References


[34] Quadrini, V., forthcoming. Policy commitment and the welfare gains from capital market liberalization. European Economic Review.


Appendix

Foreign household $j^*$’s budget constraint is:

\[
M_t^{j^*} + B_{s,t+1}^{j^*} + P_t \left( \frac{S_{s,t+1}^{j^*}}{P_t^*} - \frac{B_s^{j^*}}{P^*} \right)^2 + \int_0^1 V_t^{x^*} S_{s,t+1}^{x^*} dx^* + \int_0^a V_t^z S_{s,t+1}^{z^*} dx^* + P_tC_t^{j^*} \\
\leq M_{t-1}^{j^*} + (1 + i^*_t) B_{s,t}^{j^*} + \int_0^1 \left( \left( 1 - \tau_t \right) D_t^{x^*} + V_t^{x^*} \right) S_{s,t}^{x^*} dx^* + \\
\left( 1 - \tau_t \right) \left( W_{N,t}^{x^*} L_{N,t}^j + W_{X,t}^{x^*} L_{X,t}^j \right) - P_t^{T} T_{t}^{j^*} + P_t^{T} T Ct_t^{j^*} + \int_0^a \left( \left( 1 - \tau_t \right) D_t^{x^*} + V_t^{x^*} \right) S_{s,t}^{x^*} dx^*.
\]

(A-1)

As opposed to home households, foreign consumers buy and trade equity shares in home and foreign intermediate sector firms and do not hold home bonds. $B_s^{j^*}$ denotes foreign bonds held by foreign consumers, $S_{s,t}^{x^*}$ are shares in foreign firm $x^*$ held by a foreign consumer entering period $t$ and $S_{s,t}^{x^*}$ are shares in home firm $x$ held by a foreign consumer entering period $t$. The price of shares of foreign firm $x^*$ is denoted by $V_t^{x^*}$ and the price of shares of home firm $x$ is denoted by $V_t^x$. Foreign households receive dividends on foreign and home shares, $D_t^{x^*}$ and $D_t^x$, respectively. They pay dividend tax at the rate of $\tau_t^D$ and $\tau_t^{P^*}$.

Home government’s budget constraint is:

\[
\int_0^a P_{N,t} G_t dn = \int_0^a P_t T_t dj + \tau_t \int_0^a p_t(x) Y_{X,t}^x dx + \int_0^a \left( M_t^j - M_{t-1}^j \right) dj \\
+ \tau_t \int_0^a \left( W_{N,t} L_{N,t}^j + W_{X,t} L_{X,t}^j \right) dj + \tau_t^D \int_0^a D_t S_{s,t}^{x^*} dx^*.
\]

(A-2)
### Table 2: Foreign Share of Equity Market Capitalization in CEEC

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
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<th></th>
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<tbody>
<tr>
<td>Slovenia</td>
<td>-</td>
<td>8.86</td>
<td>7.98</td>
<td>7.77</td>
<td>10.51</td>
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<td>Estonia</td>
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<td>Latvia</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>54.00</td>
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### Table 3: Assumptions About Stochastic Processes

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<tr>
<th></th>
<th>Standard Deviation</th>
<th>Persistence Parameter</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Home</td>
<td>Foreign</td>
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<td>Productivity</td>
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<tr>
<td>Marginal Utility of Consumption</td>
<td>0.0387</td>
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<tr>
<td>Marginal Disutility of Labor</td>
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<tr>
<td>Preference Shifter</td>
<td>0.0089</td>
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</tr>
<tr>
<td>Government/GDP</td>
<td>0.0032</td>
<td>0.0010</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>-</td>
<td>0.0032</td>
</tr>
</tbody>
</table>
Table 4: Macroeconomic Variability of the Czech Republic and the Euro Area

<table>
<thead>
<tr>
<th></th>
<th>Czech Republic</th>
<th></th>
<th>Euro Area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Historic</td>
<td>Model</td>
<td>Historic</td>
</tr>
<tr>
<td>Standard deviation (in %)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real GDP</td>
<td>1.87</td>
<td>1.74</td>
<td>1.01</td>
<td>1.0*</td>
</tr>
<tr>
<td>Consumption</td>
<td>2.23</td>
<td>2.29</td>
<td>1.02</td>
<td>0.8*</td>
</tr>
<tr>
<td>Government Expenditure</td>
<td>4.66</td>
<td>2.6*</td>
<td>1.08</td>
<td>0.6*</td>
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<tr>
<td>CPI Inflation</td>
<td>2.39</td>
<td>1.08</td>
<td>0.25</td>
<td>0.56</td>
</tr>
<tr>
<td>Short-Term Interest Rate</td>
<td>0.36</td>
<td>0.47</td>
<td>0.36</td>
<td>0.98</td>
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<tr>
<td>Employment</td>
<td>0.91</td>
<td>-</td>
<td>0.63</td>
<td>1.16</td>
</tr>
<tr>
<td>Exports</td>
<td>2.33</td>
<td>3.9*</td>
<td>-</td>
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</tr>
<tr>
<td>Imports</td>
<td>2.14</td>
<td>4.1*</td>
<td>-</td>
<td>3.1*</td>
</tr>
<tr>
<td>Real Exchange Rate</td>
<td>3.05</td>
<td>3.1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: The model’s variables are detrended with HP filter. Estimates of historic standard deviations that are taken from Laxton and Pesenti (2003) are marked by a star. The rest of estimates for the Czech Republic are taken from Natalucci and Ravenna (2003) and for the Euro Area they are taken from Fagan et al. (2005). Data in Laxton and Pesenti (2003) are detrended with HP filter using the smoothness parameter of 1600. The time period for the Euro Area data is from 1970Q1 to 2002Q4 and for the Czech Republic from 1973Q1 to 2002Q4. In Natalucci and Ravenna (2003) all series are logged (except for interest and inflation rates) and HP filtered. Data are per capita and seasonally adjusted. Time span for the Czech Republic is 1994Q1 to 2003Q1. In Fagan et al. (2005), variables are expressed in per capita terms and logged (except for inflation and interest rates). They are seasonally adjusted and HP filtered.
Table 5: Macroeconomic Variability in the Model with and without Foreign Ownership

<table>
<thead>
<tr>
<th></th>
<th>Czech Republic</th>
<th></th>
<th>Euro Area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Foreign</td>
<td>Local</td>
<td>Foreign</td>
<td>Local</td>
</tr>
<tr>
<td>Standard deviation (in %)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real GDP</td>
<td>1.87</td>
<td>1.64</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td>Consumption</td>
<td>2.23</td>
<td>1.95</td>
<td>1.02</td>
<td>1.02</td>
</tr>
<tr>
<td>Government Expenditure</td>
<td>4.66</td>
<td>3.96</td>
<td>1.08</td>
<td>1.08</td>
</tr>
<tr>
<td>CPI Inflation</td>
<td>2.39</td>
<td>2.23</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Short-Term Interest Rate</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>Employment</td>
<td>0.91</td>
<td>0.97</td>
<td>0.63</td>
<td>0.63</td>
</tr>
<tr>
<td>Exports</td>
<td>2.33</td>
<td>2.21</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Imports</td>
<td>2.14</td>
<td>2.27</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Real Exchange Rate</td>
<td>3.05</td>
<td>2.88</td>
<td>-</td>
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</tr>
</tbody>
</table>

Note: Foreign refers to the model with foreign ownership of intermediate sector firms in the home economy. Local refers to the model in which all firms are locally-owned, i.e. there is no foreign ownership of firms in the home economy.
Figure 1: Impulse Responses of Foreign Variables to Foreign Intermediate Technology Shock
Figure 2: Impulse Responses of Home Variables to Foreign Technology Shock
Figure 3: Impulse Responses of Foreign Variables to Foreign Fiscal Shock
Figure 4: Impulse Responses of Home Variables to Foreign Fiscal Shock

- Intermediate output
- Final tradable output
- Price of final tradable goods
- Intermediate labor
- Non-tradable labor
- Non-tradable output
- Price of non-tradable goods
- Consumption
- Final tradable consumption
- Government consumption
- Non-tradable consumption
- CPI inflation
- Real exchange rate

No foreign ownership
Foreign ownership
Figure 5: Explaining Why Monetary Policy is Looser Under Fiscal Cooperation