Stability and Eurozone membership: Should a small transition country join?

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October, 2013

Abstract

In the last years, Baltic countries joined or prepare to join the European Monetary Union. Accession comes in a time, were trading share between these countries and the Eurozone are declining. From a theoretical point of view, the optimality of currency unions depends on bilateral trade between it's members. In this paper it is shown, that countries might benefit from a currency union as an alternative to fixed exchange rates. Using a DSGE model of a small country and a currency union, it is shown that membership in the union is beneficial to a fixed exchange rate system without a common monetary policy in terms of output and price stability. This result is robust even if trading shares decline significantly.

Keywords: EU Eastern enlargement, remittances, international migration, computable equilibrium model


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1 Introduction

Estonia, as the first of the Baltic states, joined the European Monetary Union (EMU) in 2011, Latvia will follow in 2014 and Lithuania is expected to introduce the Euro in the near future. In a period of macroeconomic disturbances and declining trading shares with the Eurozone, it is somehow surprising that the Baltic states stick to their accession plans. Poland, a neighboring country with a much higher trading share with the Eurozone, postponed accession to an indefinite point in time\(^1\). According to the literature on the optimality of currency areas, we would expect countries to let their exchange rates float as at least some degree of exchange rate volatility seems to be optimal to be able to stabilize the economy against asymmetric macroeconomic shocks. This is especially true if factor mobility and bilateral trade between members is low. The economic reason for the Baltic countries still willing to join the monetary union might be grounded in the importance of fixed exchange rate regimes for transition economies. Based on the literature on the optimum degree of exchange rate volatility, trade and exchange rate regimes, we know that exchange rate volatility increases the risk premium of trade contracts denominated in foreign currency. More general, costs of cross-border transactions of goods and capital increase. Additionally, transition economies have had a significantly higher inflation rate than the median of developed countries. A pegged exchange rate, therefore, might be a good strategy to reduce inflationary expectations and to stabilize exports. If this is true, the decision transition economies face is rather between pegging the exchange rate and joining a currency union, than between fixed and flexible exchange rate regimes.

Bleaney and Fielding (2002) find evidence that, indeed, the average inflation rate of developing countries with a pegged exchange rate is lower than that of the 28 flexible-rate developing countries in the sample. The variance of output and inflation, however, was significantly higher for countries with a fixed exchange rate compared to countries with a floating one. In a paper on transition economies, Markiewicz (2006) gets similar results. According to this literature, a monetary authority in a developing or transition economy faces a trade-off when choosing an exchange rate regime. A fixed system allows for a lower mean average inflation at the cost of a higher volatility in prices and output. Clerc et al. (2011) build a theoretical model explaining this trade-off found in the empirical literature. If different countries have a different degree of credibility of their monetary authority, it might be beneficial to delegate monetary policy to another country. In such a world, countries that suffer an inflation bias might be able to eliminate this bias overnight by simply joining a monetary union. A comparison between flexible and fixed exchange rate systems, therefore, should include an inflation bias to include all costs and benefits of both system. Clerc

\(^1\)Membership in EMU is compulsory for members of the European Union, only Denmark and the United Kingdom bargained a opt-out clause. The time of accession, nevertheless, depends on the fulfillment of the Maastricht-criteria. Sweden showed, after a defeat in a public poll, that these criterias can be used to prevent accession. It is possible for member states to postpone their accession to EMU for an indefinite time.
et al. (2011) find that a fixed exchange rate system might be justified even in cases where the inflation bias is low and business cycles are not a-synchronized.

Calvo and Reinhart (2002) support this proposition by developing the “fear of floating” hypothesis. The credibility of the monetary authority might be so low that there is a “fear of floating” preventing countries to apply flexible exchange rates. In some extreme cases, pegged exchange rates are chosen even if a floating exchange rate regime is officially announced. Tambakis (2007) shows in a Barro-Gorden model that, depending on the record of the central bank, “fear of floating” can be welfare improving. This might be especially true for Baltic countries suffering from hyperinflation in the beginning of the 1990s.

In this paper, therefore, the stabilization properties of a fixed exchange rate system are compared with those of a currency union. For a small transition economy, it can be beneficial to join a monetary union if the macroeconomic stability is higher than it is with unilateral pegged exchange rates. Based on the work of Gali and Monacelli (2005), a two-country model of a monetary union is set-up, where one country is small compared to the other. The central bank of the big country conducts monetary policy using a Taylor rule, while the central bank of the small country pegs the exchange rate. The model implies that a small country can benefit from the participation in a monetary union in terms of a higher stability of prices and output. The stability of output is even higher, if trading shares with union members are low.

Naturally, this paper is not the only one addressing the benefits of a common monetary policy. A branch of the literature analyzes the optimal monetary and fiscal policy in a monetary union based on the Gali and Monacelli (2008) model. Those papers usually have a multicountry framework with infinitesimally small but identical countries forming a monetary union. The object of investigation usually are coordination problems that arise because of a monetary policy that is organized at the level of the union and fiscal policies organized within the sovereignty of each of the countries. In such a framework, the efficiency of fiscal policy in stabilizing against country-specific shocks is essentially for the benefits of a common currency. While in many cases such an approach might be favorable, for the case of a small transition economy, a two-country approach with a big currency union and a small open economy seems to be a better fit. Because of the size of such an economy, the impact of fiscal policies on the rest of the currency union is limited. We focus, therefore, on monetary policy, only.

The remainder of the paper is structured as follows. In the second chapter, the trade integration of Baltic countries is described shortly and some explanations for declining trading shares with the Eurozone are given. The model economy and the DSGE setting is described in chapter 3, while in chapter 4 the calibration of the model and the results of the simulation exercise are discussed. The simulation is done for four different settings, a low share of foreign goods in the consumption basket of households, a high share and the cases of foreign shocks without and with shock correlation. The last section concludes.
2 Trade

The integration of the Baltic countries into the international trading system took place right after independence in the 1990s. Openness increased sharply and peaked in the beginning of the 2000s at over 80 per cent. During the last years, it stabilized at about 70 per cent. The geographical structure of trade changed during this time from distant EU-15 countries to neighbouring countries like Sweden, Finland and Russia. The Baltic countries are part of two trade areas. Since 1992, the council of the Baltic sea has stated aims at reducing barriers to trade and capital movement in this area. In 2000, the member states signed the Bergen Action Plan foremost to reduce technical barriers to trade by increasing conformity in standards and certification requirements. A second treaty, the Moscow action plan, signed in 2002, aimed at an increased protection of property rights.

The second trade area is the European union (EU). Through the creation of a common market for goods, labour and capital, the EU is fostering trade integration among its member states. As Price and Worgotter (2011) point out, the initial boost in exports with EU-15 countries previous to EU-accession was followed by a much smaller increase in the years thereafter. Other EU-8-countries like Poland, the Czech Republic or Slovakia experienced a long-lasting increase in export market shares. Some countries, like Sweden or Finland, are part of both regional integration areas. Trade among those countries and the Baltic states is steadily increasing. Today, the main trading partners of Baltic countries are Finland, Germany, Russia and Sweden, with only Germany being member of EMU.

Throughout the last two decades, we see a decline in the share of Eurozone among trading partners of Baltic countries. Only in May 2004, there is a strong increase in imports due to EU-membership (figure 1). A reason for this phenomenon is, beside statistical reasons, that transaction costs were abolished predominantly for exports prior to EU-membership. Some restrictions still applied for imports prior to accession. After those restrictions were abolished, imports increased sharply, but are falling ever since.

Similar to imports, one can see a steady fall in the Eurozone’s share of exports. During the 2000s, Baltic states and especially Estonia were sending the lion-share of their products to the Eurozone. Already in 2001, the export share began to shrink with a major drop in 2006. The reasons for this development are not easy to understand. The division of trade is not much different from the trade structure of other OECD countries; the 51 per cent share of intermediate goods is slightly lower than the OECD average, while capital (20 per cent) and consumer goods (21 per cent) nearly meet the OECD average. The division of production, however, follows a characteristic pattern in post-socialist countries. These countries are producing labour-intensive, while developed countries are producing capital-intensive. Labour-intensive products might be easily substituted by countries closer to the centre of the Eurozone like Poland, the Czech Republic, Slovakia and Slovenia. Additionally, as Russia’s economy is recovering, old trade links might be renewed and the agreement between Russia and
Figure 1: Imports from Eurozone countries


Figure 2: Exports to Eurozone countries

other CBSS countries aiming to protect property rights and reducing transaction costs might have fostered trade among CBSS members.

3 The model

To analyze the impact of different fixed exchange rate regimes, I combine the small open economy model of Gali and Monacelli (2005) with the money demand scheme of Woodford (2007). For the currency-union setting I add a common monetary policy framework for the currency union. The Gali and Monacelli model has several advantages for our research question. First, it is tractable and, second, it is designed to analyze different Taylor rules which is also done in this paper. Third, it assumes that exports of the small open economy play no major role in the consumption bundle of households in the rest of the currency union. That is an assumption which is close to be true for Baltic countries and the rest of the currency union. The monetary demand framework of Woodford is added to reflect the fact that there might be currency substitution in post-socialist countries. Households have an incentive to hold some foreign money in order to buy specific goods for whom the seller is not willing to accept national currency. Finally, I assume a common monetary policy for the currency union, where the monetary authority maximizes welfare of all households in the currency union. This contrasts with the case of fixed exchange rates where the central bank maximizes the welfare of domestic households, only.

3.1 The domestic economy

The domestic economy is a small New Keynesian open economy that is linked to the rest of the world through trade in goods and assets. By assumption, the big country consumes no goods from the domestic economy, the degree of openness of the economy is given by $0 < \alpha < 1$.

3.2 The representative household

The small open economy consists of a representative infinitely-lived household seeking to maximize an intertemporal utility function, where $C$ denotes the consumption of a variety of home and foreign produced goods, $N$ denotes the time spent working and $M, M^*$ denote the demand for domestic and foreign money.

\[
E \sum_{t=0}^{\infty} \beta^t \left[ \frac{(C_t^{1-\sigma} - 1)}{1-\sigma} + \frac{(N_t^{1-\varphi} - 1)}{1-\varphi} \right] + \lambda^*_m \left( \frac{(M_t^{1-\sigma_m} - 1)}{1-\sigma_m} \right) + \lambda_m \left( \frac{(M^*_t^{1-\sigma_m} - 1)}{1-\sigma_m} \right),
\]

(1)

The consumption index $C_t$ for home $C_{H,t}$ and foreign $C_{F,t}$ produced goods is defined by
\[ C_t = \left[ (1 - \alpha)^{\frac{\eta}{\alpha}} C_{H,t}^{\frac{\eta}{\alpha}} + \alpha\frac{\eta}{\alpha} C_{F,t}^{\frac{\eta}{\alpha}} \right]^{\frac{1}{\eta}}, \]  

while \( C_{H,t} \) and \( C_{F,t} \) are indexes of \( i \) varieties

\[ C_{H,t} = \left( \int_0^1 C_{H,t}(i) \frac{d}{di} \right)^{\frac{1}{\eta}} ; C_{F,t} = \left( \int_0^1 C_{F,t}(i) \frac{d}{di} \right)^{\frac{1}{\eta}}. \]  

The household maximizes consumption subject to a sequence of intertemporal budget constraints

\[ \int_0^1 [P_H(t)C_{H,t}(i) + P_F(t)C_{F,t}(i)] di + \Delta_t M_t + \Delta_t^* M_t^* + E_t (Q_{t,t+1} D_{t+1}) \leq D_t + W_t N_t + T_t \]  

where \( P_F(t) \) and \( P_H(t) \) denote the price indexes of home and foreign produced goods and \( D_{t+1} \) is the nominal payoff in period \( t + 1 \) of a portfolio held in period \( t \). The household receives wages \( W_t \) and has to pay lump-sum taxes \( T_t \). Notice that all variables are expressed in units of the domestic currency, \( Q_{t,t+1} \) is the stochastic discount factor for nominal payoffs and \( \Delta_t = \frac{r_t - r^m_t}{1 + r_t} \) and \( \Delta_t^* = \frac{r_t - r^* m_t}{1 + r_t} \) are the interest-rate differentials between assets and foreign and domestic money \( M_{F,t}, M_{H,t} \).

Solving the intertemporal optimization problem we derive four first order conditions:

\[ \Lambda_t = C_t^{-\sigma} \]
\[ E_t \pi_{t+1} = E_t \pi_{t+1} \]

and

\[ \frac{M_{H,t}}{P_t} = \lambda^\sigma m C_{H,t}^{\frac{\sigma}{\Delta^m_t}} \]
\[ \frac{M_{F,t}}{P_t^*} = \lambda^\sigma m C_{F,t}^{\frac{\sigma}{\Delta^* m_t}} \]  

where \( Q_{t,t+1} = \beta \Lambda_{t+1}/\Lambda_t \) equals the stochastic discount factor and \( \pi_t = P_t/P_{t-1} \) defines the gross inflation rate. The optimal demand for each category of goods yields the functions:

\[ C_{H,t} = (1 - \alpha) \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} C_t ; C_{F,t} = \alpha \left( \frac{P_{F,t}}{P_t} \right)^{-\eta} C_t \]  

and optimum demand for each variety \( i \) of goods follows the two functions:

\[ C_{H,t}(i) = \left( \frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\eta} C_{H,t} ; C_{F,t}(i) = \left( \frac{P_{F,t}(i)}{P_{F,t}} \right)^{-\eta} C_{F,t} \]
Combining two first order conditions (5) and taking conditional expectations yields the standard consumption Euler equation

$$\beta R_t E_t \left( \frac{C_{t+1}}{C_{t+1}} \right)^{-\sigma} = E_t (\pi_{t+1}).$$

where the price of a riskless one-period bond denotes $R_{t}^{-1} = E_t \{Q_{t,t+1}\}$.

### 3.3 International risk sharing and uncovered interest parity

The assumption of perfect securities markets implies that a first order condition analogous to (5) must exist in the foreign country which results in

$$\beta \left( \frac{C_{t+1}}{C_{t+1}} \right)^{-\sigma} \left( \frac{e_t}{\pi_{t+1}^{e_{t+1}}} \right) = Q_{t,t+1}.$$  

It is now possible to combine the first order condition of the home and foreign country together with the definition of the real exchange rate to get a simple relationship between home and foreign consumption depending on the terms of trade.

$$C_t = \varphi C^*_t Q^\frac{1}{\sigma}$$

The assumption of complete financial markets, furthermore, implies that a riskless bond issued in foreign currency has an equilibrium price in domestic currency of $e_t R^*_{t-1} = E_t \{Q_{t,t+1} \xi_{t+1}\}$. By combining the foreign and domestic bond pricing equation one obtains the uncovered interest parity equation.

$$E_t \{Q_{t,t+1} [R_t - R^*_t (\xi_{t+1}/\xi_t)]\} = 0$$

### 3.4 The representative intermediate goods-producing firm

There is a continuum of monopolistic producers on the unit interval indexed by $i$, where each firm produces according to a linear production function

$$Y_t(i) = A_t N_t(i).$$

It is assumed, that technology $A_t$ follows an AR(1) process so that $\log A_t = \rho \log A_{t-1} + \varepsilon_t$. The nominal marginal costs are, therefore, equal to

$$MC = \frac{W_t}{\partial A_t}.$$  

Gali and Monacelli (2005) refer to the parameter $\vartheta$ as an employment subsidy with the properties $\log \vartheta \equiv - \log (1 - \tau)$. If this parameter is set to $\vartheta = 1/\varepsilon$ it guarantees a flexible price welfare optimum of employment and prices.
During each period \( t = 0, 1, 2, \ldots \), the producer \( i \) sells \( Y_t(i) \) units of the retail good at the nominal price \( P_t(i) \). Let \( Y_t \) denote the composite of individual goods which is described by the CES aggregator of Dixit and Stiglitz:

\[
Y_t = \left[ \int_0^1 Y_t(i)^{(\epsilon-1)/\epsilon} \, di \right]^{\epsilon/(\epsilon-1)},
\]

(15)

where \( \epsilon \) with \( \epsilon > 1 \) is the elasticity of substitution across differentiated goods.

The demand curve which each producer \( i \) is facing is given by

\[
Y_t(i) = \left[ \frac{P_{Ht}(i)}{P_{Ht}} \right]^{-\epsilon} Y_t,
\]

(16)

where \( P_t \) is the aggregate price index

\[
P_{Ht} = \left[ \int_0^1 P_{Ht}(i)^{1-\epsilon} \, di \right]^{1/(1-\epsilon)}
\]

(17)

for all \( t = 0, 1, 2, \ldots \). As in Calvo, only a randomly and independently chosen fraction \( 1 - \nu \) of the firms in the retail sector is allowed to set their prices optimally whereas the remaining fraction \( \nu \) adjust their prices by charging the steady-state inflation rate adjusted price of the previous period. Hence, a retail firm \( i \), which can choose price in period \( t \), chooses the price \( P^*_t(i) \) to maximize

\[
E_t \sum_{j=0}^{\infty} (\beta \nu)^j \beta t+j \left[ \left( \frac{P^*_{Ht}(i)}{P_{Ht+j}} \right)^{-\epsilon} Y_{t+j} \left( \frac{P^*_{Ht}(i)}{P_{Ht+j}} - MC_{t+j} \right) \right],
\]

(18)

where \( \beta t+j \) is the discount factor used by the firms and \( MC_t \) is the real marginal costs. The optimum price setting strategy is

\[
P^*_{Ht}(i) = \frac{\epsilon}{(\epsilon - 1)} \left[ \frac{1}{\sum_{j=0}^{\infty} (\nu \beta)^j E_t(\lambda t+j P^*_{Ht+j} Y_{t+j} MC_{t+j})} \right].
\]

(19)

3.5 Consumption and output

In the rest of the currency union, households have similar preferences as their small open economy counterparts. They consume a bundle of goods produced in the small open economy denoted by \( C_H \). Market clearing, therefore, requires for all \( i \in [0, 1] \) and all \( t \)

\[
Y_t(i) = \frac{C_{H,t}(i) + C^*_H(i)}{(P_{H,t}(i)/P_{H,t})^{-\eta}} \left[ \left( 1 - \alpha \right) \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} C_t + \alpha \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} Y^*_t \right]
\]

(20)

\[
= \left( \frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\epsilon} \varphi Y \left[ \left( 1 - \alpha \right) \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} Q^2 t + \alpha \left( \frac{P_{H,t}}{P_t} \right)^{-\eta} \right].
\]
The second equation follows from (7) and (8) and analogous equations from the rest of the currency union, while the third equation uses equation (11) and the assumption of zero net exports in the steady state. This assumption requires \( \alpha \phi = \alpha \). We derive the equation for aggregate output by plugging (20) into (15).

\[
Y_t = \varphi Y^*_t S^0_t \left[ (1 - \alpha) Q^0_t + \alpha \right]
\]

3.6 The log-linearized model

The log-linearized version of the model is derived through a first-order Taylor approximation. From utility maximization we get the intratemporal optimality condition for labor supply, which takes the form:

\[
w_t - p_t = \sigma c_t + \varphi n_t.
\]

The log-linearized Euler equation can be derived from (9)

\[
c_t = E_t \{ c_{t+1} \} - \frac{1}{\sigma} \left( r_t - E_t \{ \pi_{t+1} \} - \rho \right),
\]

and money demand 6

\[
m_{Ht} - p_t = \frac{\sigma_m}{\sigma} y_t + \frac{1}{(1 - \alpha)} \left( \alpha \frac{\sigma^*_m}{\sigma} y^*_t + \frac{1 - \bar{\Delta}}{\bar{\Delta}} \sigma_m (\hat{r}_t - \hat{r}^-_m) \right).
\]

Lower case variables, in general, denote the logs of the respective variables while \( \rho = -\log \beta \) denotes the log of the time-discount rate, \( \pi_t \equiv p_t - p_{t-1} \) denotes the log CPI inflation and the log differential in interest rates on assets and money \( \bar{\Delta} = 1 - \beta (1 - \bar{r}_m) \). The price of a consumption good bundle \( p_t \) consists of prices for home produced goods \( p_{H,t} \) and goods produced in the rest of the currency union \( p_{F,t} \). The log interest rate differential is given by

\[
\hat{r}_m = \log (1 + \hat{r}_m / 1 + \hat{r}^-_m) \text{ with } \hat{r}_t \text{ being the steady-state zero inflation interest rate.}
\]

\[
p_t = \alpha p_{H,t} + (1 - \alpha) p_{F,t}
\]

Now we can substitute foreign produced goods for the terms of trade

\[
s_t \equiv p_{F,t} - p_{H,t}
\]

and get

\[
p_t = p_{H,t} + (1 - \alpha) s_t.
\]

It follows that domestic CPI inflation \( \pi_t \) and CPI inflation of home produced goods \( \pi_{H,t} \) is interrelated according to

\[
\pi_t = \pi_{H,t} + (1 - \alpha) \Delta s_t.
\]
As the rest of the currency union is large compared to the small open economy, the weight of those goods is negligible in the consumption basket of households living in the rest of the currency union. The corresponding equation for foreign CPI inflation and foreign CPI inflation for foreign produced goods, therefore, is assumed to be \( \pi^* = \pi^*_{F,t} \).

We know from the law of one price that \( P_{F,t}(i) = \xi P^*_{F,t}(i) \) for all \( i \in [0,1] \). Integration over all varieties leaves us with \( P_{F,t} = \xi P^*_{F,t} \) or \( p_{F,t} = \epsilon_t + p_t^* - p_{H,t} \).

By using the log-linearized version of the real exchange rate \( Q = \xi \frac{P^*}{P_t} \), it follows that

\[
q_t = s_t + p_{H,t} - p_t = \frac{1}{\alpha} s_t.
\]

By using the real exchange rate, equation (10) and equation (11) one can link consumption abroad, consumption at home and the terms of trade

\[
c_t = c_t^* + \left( \frac{1-\alpha}{\alpha} \right) s_t. \tag{24}
\]

As we have assumed complete financial markets, we can log-linearize the uncovered interest parity (12) around a perfect-forecast steady-state and get

\[
r_t - r_t^* = E_t \{ \Delta e_{t+1} \}. \tag{25}
\]

The log-linearized uncovered interest rate condition can now be combined with the definition of the terms of trade (22) to get

\[
s_t = (r_t^* - E_t \{ \pi^*_{t+1} \}) - (r_t - E_t \{ \pi^*_{H,t+1} \} + E_t \{ s_{t+1} \}) \tag{26}
\]

Modigliani and Gali (2001) show that the terms of trade can be pinned down uniquely in the perfect forecast steady-state. Due to this fact, the stationarity of the model and other driving forces is given. This implies that \( E_T \{ s_T \} = 0 \) and, therefore, that (26) can be solved forward to get

\[
s_t = E_t \left\{ \sum_{k=0}^{\infty} \left[ (r^*_{t+k} - \pi^*_{t+k+1}) - (r_{t+k} - \pi^*_{H,t+k+1}) \right] \right\}. \tag{27}
\]

If we now log-linearize equation (19) around the steady state, we can derive the New Keynesian Phillips Curve

\[
\pi_{H,t} = \beta E_t \pi_{H,t+1} + \frac{(1-\nu)(1-\nu\beta)}{\nu} mc_t. \tag{28}
\]

Marginal costs \( mc \) are derived using a log-linear first order approximation of (14).

\[
mc = -\vartheta + w_t - a_t - p_{H,t} = -\vartheta + (w_t - p_t) + (p_t - p_{H,t}) - a_t = -\vartheta + \sigma c_t + \varphi a_t + \alpha s_t - a_t = -\vartheta + \sigma y^*_t + \varphi y_t + s_t - (1+\varphi) a_t \tag{29}
\]
As we did for the small open economy, we can derive consumption and output of the rest of the currency union by log-linearizing the Euler-equation and using the market clearing condition \( y^*_t = c^*_t \).

\[
y^*_t = E_t \{ y^*_t+1 \} - \frac{1}{\sigma} (r^*_t - E_t \{ \pi^*_t+1 \} - \rho)
\]

(30)

Rewriting (21) using a log-linearized first order approximation gives

\[
y_t = y^*_t + \frac{1 + \alpha (2 - \alpha) (\sigma \eta - 1)}{\sigma} s_t.
\]

(31)

Substituting \( s_t \) in equation (29) with equation (31), we get the marginal costs in terms of world output and productivity.

\[
mc_t = -\vartheta + \left( \frac{\sigma}{\omega_{\alpha}} + \varphi \right) y_t + \sigma \left( 1 - \frac{1}{\omega_{\alpha}} \right) y_t - (1 + \varphi) a_t
\]

Now we are using the link between home and foreign consumption (24) to substitute for \( s_t \) and get an expression for domestic consumption as weighted average of home and foreign production.

\[
c_t = \frac{1}{\omega_{\alpha}} [\alpha y_t + (1 - \alpha)y^*_t]
\]

(32)

Finally, we use equation (32), (31) and (23) to get a function of domestic output in terms of domestic real interest rates and world output.

\[
y_t = E_t \{ y_{t+1} \} - \frac{\omega_{\alpha}}{\sigma} (r_t - E_t \{ \pi_{H,t+1} \} - \rho) + (\omega_{\alpha} - 1)
\]

(33)

### 3.7 Equilibrium Dynamics

For analytical reasons, Gali and Monacelli (2005) showed a presentation of the model in terms of the output gap. The output gap \( \tilde{y}_t \) is measured as deviation of (log) output \( y_t \) from its natural level \( \bar{y}_t \). The natural level, is defined as the equilibrium level of output, where nominal rigidities are absent. In New Keynesian models, this is usually the case if marginal costs are constant over time and defined as \( mc \equiv -\mu \). In this paper properties of flexible exchange rate regimes is not shown. That’s why a similar approach is used to keep the results comparable.

As the rest of the currency union is subject to Calvo price setting, we can use an equation similar to (28) and rewrite it in terms of a deviation of real marginal costs from their natural level

\[
\pi^*_t = \beta E_t \{ \pi^*_{t+1} \} + \lambda \hat{mc}^*_t
\]

(34)

where \( \hat{mc}^*_t = mc^*_t + \mu \) and \( \lambda \equiv \frac{(1-\theta)(1-\beta\theta)}{\beta} \). The marginal costs for the rest of the currency union evolve analogously to (29), with the only difference that the share of goods from the small open economy is negligible for the rest of the currency union.
where $\vartheta^* = -\log(1 - \tau^*)$ is a logarithmic function of the employment subsidy $\tau^*_t$. Analogous to the rest of the currency union, we can rewrite equation (28) for the small open economy in terms of the deviation of marginal costs from their natural level

$$\pi_{H,t} = \beta E_t \{\pi_{H,t+1}\} + \lambda \hat{mc}_t$$

(36)

The differences between the Philips curve of the rest of the currency union (34) and that of the small open economy (36) is rooted in the marginal cost equations (35) and (29). For the small open economy, marginal costs increase in terms of trade while marginal costs of the rest of the currency union are unaffected by changes in terms of trade.

As $mc_t^* = -\mu$ we can use (35) to derive the natural level of output in the rest of the currency union as a function of constants and the AR(1) process of technology

$$\tilde{y}_t = \Omega_0 + \Gamma_0 a_t^*$$

with $\Omega_0 = \frac{\vartheta^* - \mu}{\sigma + \varphi}$ and $\Gamma_0 = \frac{1 + \varphi}{\sigma + \varphi}$. Using this equation, it is easy to derive a simple relationship between the deviation of marginal costs from their natural level and the natural level of output $\hat{mc}_t^* = (\sigma + \varphi) \tilde{y}_t^*$. Now we are able to replace $\hat{mc}_t^*$ in (34) to get the New Keynesian Philips curve

$$\pi^*_t = E_t \{\pi^*_{t+1}\} + \kappa_0 \tilde{y}_t^*$$

(37)

where $\kappa_0 = \lambda (\sigma + \varphi)$. Rewriting equation (30) in terms of the output gap gives us

$$\hat{y}_t = E_t \{\hat{y}_{t+1}\} - \frac{1}{\sigma} \left( r^*_t - E_t \{\pi^*_{t+1}\} - \varpi^*_t \right) ,$$

where $\varpi^*_t \equiv -\sigma (1 - \rho_a^* \Gamma_0 a_t^* + \rho$ is referred to as the natural or Wicksellian expected real interest rate.

A similar New Keynesian Phillips curve can be derived for the small open economy. Analogous to case of the rest of the currency union, we use the definition of marginal costs under flexible prices and equation (29) to derive the natural level of output

$$\hat{y}_t = \Omega_\alpha + \Gamma_\alpha a_t + \Theta_\alpha \tilde{y}_t^*$$

where $\Omega_\alpha \equiv \frac{\omega_\alpha (\vartheta^* - \mu)}{\sigma + \varphi \omega_\alpha}$, $\Gamma_\alpha \equiv \frac{\omega_\alpha (1 + \varphi)}{\sigma + \varphi \omega_\alpha}$ and $\Theta_\alpha \equiv \frac{\sigma (1 - \omega_\alpha)}{\sigma + \varphi \omega_\alpha}$. The relation between the real marginal cost and output gap is given by

$$\hat{mc}_t^* = \left( \frac{\sigma}{\omega_\alpha + \varphi} \right) \hat{y}_t$$
which we can use with equation (36) to derive the New Keynesian Phillips curve for the small open economy

\[ \pi_{H,t} = \beta E_t \{ \pi_{H,t+1} \} + \kappa_\alpha \tilde{y}_t, \]

where \( \kappa_\alpha \equiv \lambda \left( \frac{\omega}{\omega_\alpha} + \varphi \right). \) Again we can rewrite the output equation (33) in terms of the output gap

\[ \tilde{y}_t = E_t \{ \tilde{y}_{t+1} \} - \frac{\omega_\alpha}{\sigma} (r_t - E_t \{ \pi_{H,t+1} \} - \pi_{R,t}), \]

with the Wicksellian interest rate of the small open economy is

\[ r_{R,t} \equiv -\frac{\sigma(1+\varphi)(1-\rho_\alpha)}{\sigma + \varphi \omega_\alpha} \Delta \pi_{H,t+1} + \rho. \]

### 3.8 Monetary Policy

In this model, the central bank of the currency union conducts monetary policy using a modified Taylor rule (Taylor and Woodford, eds, 1999). We distinguish between two cases. First, we have a fixed exchange rate regime where the small open economy pegs its exchange rate. In this setting, there exists no common monetary policy. The central bank targets price and output stability only for the rest of the currency union.

\[ r_t = \rho r_{t-1} + \rho_y \hat{y}^*_t + \rho_\pi \pi^*_t + \epsilon_{r_t}. \quad (38) \]

Second, we have a currency union with a common monetary policy. In this case, the central bank targets inflation and output stability for the whole currency union.

\[ r_t = \rho r_{t-1} + \rho_y [\delta \hat{y}^*_t + (1-\delta) \hat{y}_t] + \rho_\pi (\delta \pi^*_t + (1-\delta) \pi_t) + \epsilon_{r_t}, \quad (39) \]

where \( \delta \) weights the size of the economy and \( \epsilon_{r_t} \sim i.i.d. N(0, \sigma_{r_t}^2) \) is a shock to monetary policy. The degree of interest rate smoothing \( \rho_r \) and the reaction coefficients to inflation and output, \( \rho_\pi \) and \( \rho_y \), are all positive.

### 4 Simulation Results

In this section, the impact of a technology shock on the stability of output and inflation of a small open economy is illustrated. The model is calibrated according to the specification of Gali and Monacelli (2005, 2008). The preferences of the household with regard to labor provision is set to \( \varphi = 3 \) which implies a labor supply elasticity of \( \frac{1}{3} \) and a steady-state markup of \( \mu = 1.2 \). The elasticity of substitution between goods of the same origin is \( \epsilon = 6 \). If we choose \( \beta = 0.99 \) this corresponds with an annual return of a riskless asset of 4 per cent. The persistence parameter of the AR(1) technology shock is set to \( \rho = \rho_\alpha = 0.99 \).

In order to let monetary policy affect the terms of trade, the elasticity of substitution between home and foreign goods is set to \( \eta = 1.5 \). The share of
home goods in the consumption bundle of the small open economy is set to \( \alpha = 0.1 \) in section 4.2 and of \( \alpha = 0.8 \) in section 4.1.

4.1 High share of foreign goods

In this scenario, the impact of different monetary policy regimes is analyzed for the case of a small open economy where the consumption bundle of households contains only a small fraction of foreign goods. According to the theory of optimum currency areas, fixed exchange rates are most harmful in such a setting.

Following the literature on real business cycles (King and Rebelo, 1999), the AR(1) process for labor productivity of the small open economy is given by 
\[
a_t = \rho a_{t-1} + \epsilon_t
\]
with \( \rho \) measuring the persistence of shocks and \( \epsilon_t \) describing the shock in \( t \). An increase in productivity strongly increases the natural level of output in the small open economy. Due to a rise in demand, prices for domestic goods are increasing. The impact of an increase in domestic prices relies on the share of home goods in the consumption bundle of households \( \alpha \) and the share of firms \( \nu \) able to adjust prices in period \( t \).

As prices are sticky, production is increasing at a fraction of natural or flexible-prices output, only. The output gap in figure 4, therefore, shows a negative sign. In a model with flexible exchange rates, the central bank would now adjust the interest rate to narrow the output-gap and to reduce inflation according to a Taylor rule. Gali and Monacelli (2005, 2008) show the optimum, welfare improving monetary policy in such a setting. In this model, however, we compare two exchange rate regimes where the monetary authority has to consider the stability of output and inflation of the two countries. In a fixed exchange rate regime, the monetary authority conducts monetary policy independent of the small open economy (broken line in figure 4). In a currency union (continuous line in figure 4) the monetary authorities Taylor rule includes the small open economy. The weight compared to the rest of the currency union, however, is small.

In terms of price stability, the currency union is clearly beneficial compared to fixed exchange rates. The output gap, however, remains nearly unaffected. A reason for the small effect of the regime switch on output is due to the tiny share of goods produced and consumed in the small open economy. The lion-share of goods is sold to the rest of the currency union and subject to sticky prices there. The regime switch from fixed exchange rates to the currency union, is not affecting monetary policy in the rest of the currency union, much. The impact of a switch in exchange rate regimes on the adjustment of output to a labor productivity shock, therefore, is limited.

4.2 Low share of foreign goods

Now we switch to the case where we have a high share of goods produced and consumed in the currency union. As we know from the optimum currency area literature, adjustment costs should be high in the absent of labor mobility.
Figure 3: a Domestic shock

Output

Inflation
As we see in figure 4 the impact of the productivity shock on inflation is, as expected, four times higher compared to the case of a small share of foreign goods in the consumption basket (figure 4.2).

In this setting, membership in the currency union increases the stability of prices by roughly one fourth and reduces the output gap by a significant amount. The small open economy has, therefore, an incentive to join the monetary union. This result is somehow surprising, as recommendations from the optimum currency area literature would suggest flexible exchange rates to be beneficial. Remember, that in the case of a small transition or developing country, there might be reasons to fix exchange rates in order to increase credibility. If a small open economy chooses such a strategy, it is better in terms output and price stability to join a currency union.

4.3 Foreign shock

If we have a shock in the rest of the currency union, this shock is transmitted to the small open economy through the exchange rate channel by changing the real exchange rate between domestic and foreign goods. An increase in
labor productivity in the currency union increases output and reduces prices. If we have fixed exchange rates, the terms of trade are worsening, reducing the demand for domestic goods.

A second channel, the income channel, works in the opposite direction. As the households in the rest of the currency union experience reducing prices and increasing wages, they can spend more on the consumption of goods from the small open economy. The effect of an increase in labor productivity in the currency union on output in the small open economy is, therefore, ambiguous and depends on the parameter values chosen.

In our model, the increase in labor productivity increases demand for goods in the small open economy and, therefore, widens the output gap.

Figure 5: Foreign shock

As can be seen in figure 5, a regime switch from fixed exchange rates to a currency union increases price stability and reduces the output gap. Again, joining the currency union is beneficial for the small open economy.
4.4 Correlation of shocks

Up to this point, we have focused on asymmetric shocks, where only one country either the small country or the rest of the currency union was affected by a labor productivity shock. If, however, business cycles synchronize between Eurozone member countries, shocks should be correlated. In the economic literature on currency unions, a common business-cycle is seen as beneficial, since monetary policy should be easier to conduct and a better fit among member states is possible. As there are clear benefits in having a common business cycle, there is a strong interest in the question, whether a currency union fosters synchronization. From a theoretical point of view, integration processes like an increase in trade, factor movement and consumption behavior should increase a co-movement of cycles, while a deeper specialization on different branches might foster asymmetries (Paul Krugman, 1993). If one accepts the view that integration processes increase synchronization, this gives rise to a phenomenon called the endogenous optimality of currency unions and would justify the creation of non-optimal currency unions (Grauwe and Mongelli, 2005).

The empirical findings, however, are ambiguous. In general, trade seems to foster synchronization as is seen by the creation of NAFTA (Frankel and Rose, 2001; Clark and van Wincoop, 2001; Pace, 2013; Crespo-Cuaresma and Fernandez-Amador, 2013) as is monetary integration (Fatás, 1997) and an increase in financial relations (Imbs, 2006). For EMU, however, there is no clear evidence for an increase in synchronization.

In figure 6 we see the output-gap and inflation of the small open economy experiencing a foreign shock. As we know from chapter 4.3, the broken line indicates fixed exchange rates and the continuous line a currency union. In both cases we abstract from shock-correlation. For the dotted and broken line as well as for the dotted line, indicating the currency union and fixed exchange rates, instead, the correlation of shocks is given by $\rho_{\alpha, os} = 0.5$. As the transmission of the shock is stronger in this case, the output gap widens and inflation increases. The difference between fixed exchange rates and the currency union, nevertheless, remains the same. Membership in the currency union is still beneficial, an endogenous increase in business-cycle synchronization, however, would shrink this effect.

\[\text{[see Haan et al. (2008) for a survey]}\]
Figure 6: Foreign shock

![Graph showing Output and Inflation over time](image-url)
5 Conclusions

In 2011, Estonia joined the monetary union and in January 2014 Latvia is about to follow. As trade of the Baltic states with Eurozone countries is shrinking, questions about the optimality of this decision evolve. As we know from Woodford (2007), a small open economy is always able to conduct an independent monetary policy which results in a higher stability of output and higher welfare if applying a flexible exchange rate regime. Welfare effects are even stronger, if trading shares of those two countries are small. Countries with a low share of foreign products in consumption, therefore, should have an incentive to choose a flexible exchange rate regime.

Transition and developing countries, nevertheless, to a large extent choose fixed or quasi fixed exchange rates. Bleaney and Fielding (2002) show that this, indeed, coincides with a higher stability of prices. As it is shown, a higher stability of prices with fixed exchange rates is due to a non-optimum monetary policy imposed by the central bank of the rest of the currency union. A national central bank of a small open economy would maximizing welfare by accepting a higher inflation rate in order to stabilize output. According to Clerc et al. (2011), the reason for a central bank not to chose welfare improving flexible exchange rates might be a credibility problem, as economic actors fear higher inflation rates. In such an environment, flexible exchange rates might not be an option and countries choose a fixed exchange rates regime.

For the Baltic countries, however, this leaves them with two options; to keep fixed exchange rates or to join EMU. As we have shrinking trade shares, one might think that there is an incentive to remain with fixed exchange rates. As we showed in this paper, this is quite not true. Membership in the currency union is always beneficial in terms of macroeconomic stability. The benefits of joining a monetary union, however, is increasing with a declining share of foreign goods in the consumption basket of domestic households. The decision of Baltic countries to join the monetary union, therefore, is a second best solution in an environment were there is a fear of floating.

References


