EXCHANGE RATE REGIMES FOR THE NEW MEMBER STATES OF THE EUROPEAN UNION‡

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and

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Abstract

This paper combines theoretical and empirical analysis to derive the desirable exchange rate regimes for eight of the new Member States of the EU in their current run-up to EMU. The theoretical model takes into account the size of the internal market distortions and technological gaps of these countries, and assumes forward-looking behaviour of both firms and households. In the empirical part, SVAR models are estimated in order to extract variances and covariances between shocks to these economies and to the euro area, which are necessary to compute individual social losses and derive the optimal regimes.

The main result is that the choice varies depending on the institutional and structural features of each economy, and on the likely source and nature of economic shocks to which it is exposed. Thus, at present, a flexible exchange rate regime, coupled with an inflation targeting arrangement in monetary policy, is recommended for the Czech Republic, Latvia and Cyprus. A rapid participation in the ERM2 is advised for the remaining countries analysed here, although with different exchange rate arrangements. Hungary, Poland, the Slovak Republic and Slovenia should participate under the flexibility stipulated by the Maastricht Treaty. Estonia is advised to maintain its currency board with respect to the euro. Interestingly, the results for each country seem to conform to the general prescriptions that one would derive from the theory of optimal currency areas.

Given that parameters and the nature of shocks evolve endogenously, it is expected that increased policy coordination within the enlarged EU will make the Czech Republic, Latvia and Cyprus eligible for ERM2 participation in the near future.

Keywords: EU enlargement, exchange rate systems, SVAR, European monetary integration.

JEL Clasification: F41, F42, C31

1. Introduction

One important issue for the new Member States (NMS hereafter) of the EU is the choice of the exchange rate regime that will allow them to participate successfully in the EMU process[1]. In fact, in the run up to the euro, the NMS countries are free to choose their exchange rate system within the limits imposed by general principles of monetary policy coordination inside the EU and by the ERM2[2].

Some recent contributions have analysed the pros and cons of several exchange rate options without backing the analysis with an economic model. Not surprisingly, the authors reach different conclusions and make distinct (and to some extent contradictory) propositions. For instance, Buiter and Grafe (2002) conclude that EMU membership should be as early as possible for each country and that a derogation or waiver of the Maastricht requirements would be desirable for this purpose. In contrast to this precise prescription for a rapid and irrevocable monetary union, Schnabl (2002) simply advises to widen as much as possible the group of countries that use the euro as the central standard in the exchange rate policy and in the external transactions. However, in this informal euro club, exchange rate adjustments would be allowed to accommodate differences in national productivity growth and other real shocks. The idea that differences in structural and institutional conditions require distinct exchange rate strategies by the NMS countries was already stated by Cork, Beaumont, van Elkan and Iakova (2000), Szapáry (2000), and Backé and Wójcik (2002).

[1] Participation in the EMU **process** is compulsory for all member states, and has to be differentiated from the EMU itself, or the adoption of the euro, which is the natural end for those countries that comply with the Maastricht criteria.

[2] The Maastricht Treaty contains only two references to exchange rate arrangements, based on the principles of monetary cooperation and mutual surveillance: a) the exchange rate mechanism of any country in the EU is a matter of common interest, and b) exchange rate stabilisation, that is, avoiding realignments, is one of the convergence criteria in the process of European monetary unification, and is required to countries that participate in the ERM2.

Ca'Zorzi and De Santis (2003) is, to our knowledge, the first theoretical approach to this issue. The authors use a simple Barro and Gordon (1983) model, in the line of the time inconsistency literature, to derive the implications of several exchange rate arrangements for the inflation rate of both the accession countries and the euro members, along the different phases leading to EMU.

The main purpose of this paper is to investigate the appropriate exchange rate regimes for the NMS, using theoretical and empirical analysis. On the theoretical side, we use a model that specifies conveniently the differences in the countries' economic structures[3]. In our opinion, this is a necessary feature because the Central and Eastern European countries that have acceded to the EU are progressing at different speeds towards a market economy and still exhibit important differences in trade and economic structures. On the empirical side, for each country we compute the social losses corresponding to the three exchange rate arrangements considered in the analysis, in order to derive the optimal solution. As these calculations require statistical information about the external shocks that hit each country and the euro zone, we previously estimate structural VARs to extract the necessary values of variances and covariances of shocks in the whole extended area (except for Lithuania and Malta for reasons of data availability).

Our model builds on Gerlach and Smets (2000), Svensson (2000) and Detken and Gaspar (2003). The main differences with these approaches are that we incorporate market distortions that generate inflation bias, and adapt the model to three different exchange rate regimes. Furthermore, we take into account a deterministic variation of the real exchange rate of the NMS countries vis-à-vis the euro area in order to capture Balassa Samuelson effects created by the catching-up process.

We will analyse three possible exchange rate regimes: a) flexible exchange rate coupled with inflation targeting in the monetary policy, b) ERM2, and c) currency board with respect to the euro. The first one, is valid for the pre-Maastricht phase in which NMS countries have still not joined the ERM2, and permits to use monetary and exchange rate policies with more autonomy to adjust the economy. The second one is the system envisaged by the European Commission for countries that are in the Maastricht stage and make efforts to complain with the convergence criteria. The third one is compatible with both phases but, given that their rules are stricter than those of the ERM2, we will assume that the countries deciding to adopt the currency board with respect to the euro also want to participate in the Masstricht phase[4].

The paper is organised as follows: in section 2 we set the model and solve it for each of the three exchange rate regimes. In section 3 we estimate structural VARs to extract the nature and statistical moments of external shocks to each NMS and to the euro area as a whole. In section 4 we present calculations of social losses and derive the appropriate exchange rate regime for each country. Finally, section 5 provides the main conclusions and derives policy prescriptions.

2. Output, inflation and social losses.

The main lines of our theoretical approach follows Detken and Gaspar (2003), adapted to take into account the rigidities and the technological gap in the markets of the NMS and the possibility of different exchange rate regimes.

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[3] The necessity to take into account the structural features of the countries when choosing the appropriate exchange rate regime was already pointed by Corker, Beaumont, van Elkan and Iakova (2000)

[4] As regulated by the Amsterdam Council Resolution of June 1997, ERM2 requires a central parity with the euro agreed with the euro countries, and two ± 15% bands around this parity. However, cohabitation in the ERM is permitted with a fairly broad range of exchange rate arrangements. The exchange rate regimes that

2.1 Flexible exchange rate regime

The model is composed of the following equations:

$$L = \frac{1}{2} E_t \left\{ \sum_{j=0}^{\infty} \beta^j \left[\pi_{t+j}^2 + \lambda \left(y_{t+j} - k \right)^2 \right] \right\} \tag{1}$$

$$\pi_t = \alpha y_t + \beta E_t \pi_{t+1} + \varepsilon_t \tag{2}$$

$$y_t = -\varphi \left[i_t - E_t \pi_{t+1} \right] + E_t y_{t+1} + \delta \left(s_t - p_t \right) + d_t \tag{3}$$

$$i_t = E_t s_{t+1} - s_t + \tau_t \tag{4}$$

Equation (1) is a standard central bank's intertemporal loss function that penalises deviations of inflation and output gap from their targets. The inflation differential, π_t, is defined with respect to the socially desired rate, while the (log of) output gap, y_t, is calculated with respect to the long run or potential level which is normalised to zero. The parameter k is an indicator of markets rigidities and technological gaps of the NMS with respect to the euro countries. E_t is the rational expectations operator in period t, β is the discount factor and λ is the relative weight attached to output variability[5].

Equation (2) is the aggregate supply in the spirit of the New keynesian Phillips curve. It may be derived assuming, as in Calvo (1983), that firms maximise the difference between expected marginal revenue and unit costs, and that only a fraction of them is allowed to adjust prices each period. Equation (3) indicates that the aggregate demand

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are clearly excluded are: parities not mutually agreed, crawling pegs, and pegs to currencies different from the euro.

[5] This weight is related negatively to the aversion to inflation variability.

depends negatively on the real interest rate and positively on both the real exchange rate and the output expected for the next period. The domestic price level, p_t, and the nominal exchange rate, s_t, are measured in logs. The latter is defined as the price in domestic currency of a unit of foreign currency. The foreign price level and the foreign nominal interest rates are normalised to zero. The expected output in the aggregate demand is due to consumption smoothing reasons by households that maximise an intertemporal utility function under budget restrictions[6]. Equations (2) and (3) contain stochastic shocks which are assumed stationary AR processes: $\varepsilon_t = \rho\varepsilon_{t-1} + \xi_t$ and $d_t = \vartheta d_{t-1} + \upsilon_t$, with $0 \leq \rho \leq 1$ and $0 \leq \vartheta \leq 1$. The supply shock is deemed to capture everything affecting marginal costs and/or changes in firms' productivity, and the demand shock represents shifts in autonomous private and public expenditures.

Equation (4) is the uncovered interest parity condition including a stochastic country risk premium, τ_t. The risk premium as well as ξ_t and υ_t are assumed uncorrelated i.i.d. variables.

In is assumed that the private sector forms expectations on prices taking into account the information available at that time. Then the output shock is realised, and the central bank utilises this information to set its monetary policy. It uses the interest rate as the policy instrument according to an optimal simple rule that we obtain solving the model. Assuming that the central bank cannot commit to a state-contingent rule of the inflation rate, and consequently takes expectations as given, the first order condition is obtained by minimizing the loss function with respect to the output gap and the inflation rate, subject to the aggregate supply:

[6] See, for instance, Fraga, Goldfajn and Minella (2003)

$$\underset{\pi_t, y_t}{Min} Z = \frac{1}{2} E_t \left\{ \sum_{j=0}^{\infty} \beta^j \left[\pi_{t+j}^2 + \lambda \left(y_{t+j} - k \right)^2 \right] \right\} + l\left(\pi_t - \alpha y_t - \beta \pi_{t+1} - \varepsilon_t \right)$$

The result is.

$$y_t = \frac{-\alpha}{\lambda} \pi_t + k \quad (5)$$

Substituting this expression in (2) and solving by forward iterations, we obtain:

$$\pi_t = \frac{\lambda}{\lambda(1-\beta\rho)+\alpha^2} \varepsilon_t + \frac{\lambda}{\lambda(1-\beta)+\alpha^2} \alpha k \quad (6)$$

$$y_t = \frac{-\alpha}{\lambda(1-\beta\rho)+\alpha^2} \varepsilon_t + \frac{\lambda(1-\beta)}{\lambda(1-\beta)+\alpha^2} k \quad (7)$$

These expressions indicate that there are two kind of factors, supply shocks and market rigidities that, in the short run, push inflation and the output gap out off their long run levels. As times goes on, the impacts of the supply shock disappear progressively, but the tracks of market rigidities remain permanently in both variables. In this framework we can talk of both inflation and output biases. The inflation bias increases with the weight attached to output stabilisation in the loss function and decreases with the slope of the aggregate supply. The output bias is also influenced positively by the weight on output variability, and negatively by the slope of the aggregate supply.

The influence of market rigidities on output is a new result compared to what we know from the Barro and Gordon (1983) model and can be explained taking into account the forward-looking nature of firms. When an exogenous supply shock hits the economy, rational agents, who know how national authorities react, revise their expectations and forecast correctly the new inflation rate of the next period. However, since forward-looking agents discount their expected value with the factor β (lower than one), a new gap is created between the current and the presently valued rate of inflation, leading firms to increase output as required by equation (2). As can be easily verified, if no discount were applied to inflation expectations (β = 1), market rigidities would not create any output bias and the inflation bias would reach a higher level.

Let us now find the equilibrium values of the nominal exchange rate and interest rate. For that purpose, take into account that in (3) p_t may be replaced by $(\pi_t + p_{t-1})$. Thus, introducing (6) and (7) in (3), we get:

$$(\varphi i_t - \delta s_t) = \left[\varphi\rho + \frac{\alpha}{\lambda}(1-\rho) - \delta \right] \phi \varepsilon_t + d_t - \delta p_{t-1} - \psi\phi k \tag{8}$$

where $\phi = \dfrac{\lambda}{\lambda(1-\beta\rho)+\alpha^2} > 0$, and $\psi = [(1-\beta) - \lambda(\varphi - \delta)](1-\beta) \lesseqgtr 0$

Equation (8) is the locus of points (i_t , s_t) available to domestic authorities for achieving the desired level of output gap. To obtain the equilibrium values of these variables, equation (8) must be combined with equation (4). Therefore, we have a two equations system with forward expectations in the exchange rate. Applying, for instance, the method of undetermined coefficients, we obtain:

$$s_t = \left\{ 1 - \frac{\alpha(1-\rho)}{\lambda[\varphi(1-\rho)+\delta]} \right\} \phi\varepsilon_t - \frac{1}{\varphi(1-\vartheta)+\delta} d_t + \frac{\varphi}{\varphi+\delta} \tau_t + p_{t-1} - \frac{\psi\phi}{\delta} k \tag{9}$$

$$i_t = \left\{ \frac{\alpha(1-\rho)^2}{\lambda[\varphi(1-\rho)+\delta]} + \rho \right\} \phi\varepsilon_t + \frac{(1-\vartheta)}{\varphi(1-\vartheta)+\delta} d_t + \frac{\delta}{\varphi+\delta} \tau_t \qquad (10)$$

As can be seen, market rigidities have an ambiguous effect on the nominal exchange rate because the sign of ψ is undetermined, unless we know the parameters of the model. However, market distortions do not have any influence on the nominal interest rate. It can also be verified that if β equals 1, the impact of k on the exchange rate disappears.

Given that the inflation rate given by (6) is probably too high compared to the rate of inflation prevailing in the euro countries, several methods have been proposed in the literature to reduce it. Because the central banks of the NMS have not gathered sufficient credibility so far to overcome the time-consistency problem of their announcements, we will refer only to solutions that are time consistent in the present stage of economic integration. These solutions are (stable) optimal combinations (π_t, y_t) with lower or null inflation bias. Three ways have been suggested in the literature.

a) The first one consists of undertaking structural adjustments to reduce progressively the market distortions in the NMS. If these measures are successful and k tends to zero, market distortions, and the inflation bias created by them, disappear progressively (see formula (6)). However, this process requires a very long period of time because actions are slow, and also because the technological gap and market distortions which are still present in the NMS are important as a result of their old planned economy era. For this reason, the adjustments oriented towards this objective, in place in each NMS since the beginning of the 1990s, must be pursued with complementary actions.

b) The second solution is the Rogoff (1985) proposition, according to which the government should delegate the monetary policy to an independent central bank, and select a governor or board having lower output-stabilisation preferences than the society. In terms of our model, this means that the weight λ in the loss function of the central bank must be lower than the preferred by society. As can be seen in (6), as λ lowers, both the inflation bias, and the inflationary impact of the supply shock go down. However, this solution has two problems. First, for certain values of the parameters, the central banker in the NMS should be much more inflation conservative than the Governor of the ECB. This feature is not easily believable. Second, from (7) it follows that with a lower value of λ the sensitivity of the output gap to domestic supply shocks increases, making output more volatile

c) The third solution is inflation targeting. Svensson (1997) shows that the inflation bias may be eliminated by assigning the central bank a specific and explicit inflation target lower than the rate socially preferred. The problem may be solved as follows. Expression (5) was obtained assuming that the rate of inflation socially preferred is zero. If the central bank receive the mandate to obtain π^b (instead of zero), the expression would be:

$$y_t = \frac{\alpha}{\lambda}\left(\pi - \pi^b\right) + k \qquad (5')$$

Given that in the case where market distortions do not exist equation (5) would be $y_t = -\alpha\pi_t / \lambda$, it is clear from (5') that the appropriate value for π^b to obtain the latter expression is:

$$\pi^b = \frac{-\lambda}{\alpha} k,$$

The inflation gap that is now in the loss function is ($\pi + \lambda k/\alpha$).

Inflation targeting has the advantages of eliminating the inflation bias completely without increasing the variability of output. But it has the well known lack of credibility problem if the average inflation obtained is systematically over the targeted rate. For this reason, we will assume that the authorities of countries adopting this exchange rate are less conservative and target an inflation that allows some inflation bias.

2.2 Floating within the bands of the ERM2, and inflation targeting

During this phase, a pre-announced rate of inflation is more credible than in other periods even though the target is not time-consistent. The reason is that the chosen rate belongs to an institutional plan of rapid economic convergence with the euro countries, and the penalty that the authorities would pay in the case of non fulfilment, is considered very high. In fact, we can assume that domestic authorities target an inflation rate, π^M, that is within the limit permitted (π_d percent over the inflation rate of the euro zone, π^f) by the Maastricht criteria:

$$\pi_t = \pi^M \leq (\pi^f + \pi_d) \qquad (6'')$$

Introducing the inflation target in the aggregate supply (equation (2)), we obtain the output gap:

$$y_t = \frac{1-\beta}{\alpha}\pi^M - \frac{\varepsilon_t}{\alpha} \qquad (7'')$$

From a dynamic point of view, and assuming again that changes in the real exchange rate are given exogenously, the required (equilibrium) variation in the nominal rate is $\hat{s}_t = \pi^M - \pi^f + \hat{q}_t$. Given that both rates of inflation are exogenous as well, developments of the real exchange rate are an important determinant of the change in the nominal exchange rate. For the reasons explained above, the catching-up process ($\hat{q}_t < 0$) will contribute to appreciate the NMS currencies. However, since the probability that the exchange rates reach the appreciating upper band of the ERM2 is small, we will assume that real appreciations are accommodated within the ERM2[7].

2.3 Currency board into the ERM2

As explained above, this exchange rate regime is also compatible with the Maastricht criteria. The requirement to be satisfied is that the countries adopting this regime maintain the central (fixed) rate during at least two years before passing the convergence exam.

Under this system, the nominal exchange rate of the NMS with respect to the euro countries is fixed, that is, $s_t = \bar{s}$, and the interest rate differential equals the risk country premium, $i_t = \tau_t$. The relationship between the domestic and foreign rates of inflation may be explained as follows. If we denote q_t the equilibrium level of the real exchange rate, in such a way that an increase in q_t indicates a real depreciation of the home currency, the domestic and foreign inflation rates are linked through the following relationship:

[7] Kovács (2002) estimated the size of the Balassa Samuelson effects in five Central and Eastern European countries and found that the real convergence of these countries should not endanger the fulfilment of the Maastricht criteria.

$$\pi_t = \pi_t^f - \hat{q}_t$$

This equation determines the domestic rate of inflation because both π_t^f and $\hat{q}_t$ are considered exogenous for each NMS country. We assume, indeed, that the variation of the real exchange rate is determined outside the model by real factors, among which Balassa-Samuelson effects are the most relevant, and that foreign inflation is also given because of the small country assumption that we apply to each NMS with respect to the euro area.

Therefore, using (6) with foreign parameters to determine π_t^f, and taking into account that for the euro countries $k = 0$, the current and expected inflation rates rate in NMS become equal to:

$$\pi_t = \frac{\lambda_f}{\lambda_f(1-\beta\rho)+\alpha_f^2}\varepsilon_t^f - \hat{q}_t \qquad (6')$$

$$E_t\pi_{t+1} = \frac{\lambda_f}{\lambda_f(1-\beta\rho)+\alpha_f^2}\rho\varepsilon_t^f - E_t\hat{q}_{t+1}$$

As can be seen, under a currency board, inflation in the NMS depends on both the impact of shocks affecting the euro zone and real exchange rate variations mainly determined by the catching-up process. Inflation no longer depends on shocks hitting the domestic country. This result agrees with the idea that in a pure currency board regime domestic authorities cannot use their monetary policy to stabilize the economy.

Combining the last two equations with the domestic aggregate supply, the output gap equation for the NMS becomes:

$$y_t = \frac{1}{\alpha}\left[\frac{\lambda_f(1-\rho\beta)}{\lambda_f(1-\rho\beta)+\alpha_f^2}\varepsilon_t^f + \left(\beta E_t \hat{q}_{t+1} - \hat{q}_t\right) - \varepsilon_t\right] \tag{7'}$$

It follows that the domestic output gap depends on both foreign and domestic supply shocks, and on the expected variation in the real exchange rate changes.

Note that if supply shocks are symmetric $(\varepsilon_t = \varepsilon_t^f)$ and aggregate supplies have the same slope, i. e. $\alpha = \alpha_f$, the impact on inflation and output gap is the same as for the euro area, except for the variations introduced by real exchange developments. If supply shocks are only country-specific to NMS, inflation would no vary and the effects of those shocks on the domestic output gap would be equal to 1/α times the size of the shock, ε_t.

In sum, both domestic inflation rate and output gap have strong dependence on foreign shocks and real exchange rate developments. If the latter are strong enough, complying with the inflation criteria could be in danger.

Equation (4) determines the nominal interest rate:

$$i_t = \tau_t \tag{4'}$$

This is an additional proof that the central bank cannot use the monetary policy for stabilisation purposes. As a result, national authorities must use fiscal policy to obtain the equilibrium output gap. The appropriate fiscal measure, g_t^F, could be derived from (3) and (7') by inserting that variable as an additional demand factor, and making $s_t = \bar{s}$ in those relationships.

Table 1 summarises the economic effects of each exchange rate arrangement included in this study. In order to compute the effects of each exchange rate arrangement using the social loss function, we substitute the endogenous values of the inflation spread and the output gap corresponding to each exchange rate arrangement (equations of the first two rows of table 1) into the loss function (equation (1)). As can be seen, computation if social losses require the estimation of a structural VAR to extract the nature of shocks and the values of their principal statistical moments. Given that in the VAR analysis residuals are white noise, our formulas must be adapted by assuming that supply shocks are i.i.d. disturbances. This implies that in the relevant formula of table 2, the autoregressive coefficient ρ equals zero. Taking into account this statistic property and computing for an infinite horizon as expressed by formula (1), for each exchange rate regime we obtain the following results:

Flexible exchange rate

$$L_t = \frac{A^2}{2(1-\beta)}\left(1+\frac{\alpha^2}{\lambda}\right)\sigma_\varepsilon^2 + \frac{1}{2(1-\beta)}\left\{B^2\alpha^2 + \lambda\left[B(1-\beta)-1\right]^2\right\}k^2 \qquad (11)$$

$$A = \frac{\lambda}{\lambda+\alpha^2}, \qquad B = \frac{\lambda}{\lambda(1-\beta)+\alpha^2}$$

ERM2

$$L_t = \frac{\lambda}{2\alpha^2(1-\beta)}\sigma_\varepsilon^2 + \frac{\alpha^2+\lambda(1-\beta)^2}{2(1-\beta)\alpha^2}\left(\pi^M\right)^2 + \frac{\lambda}{2(1-\beta)}k^2 - \frac{\lambda}{\alpha}\pi^M k \qquad (12)$$

Currency board arrangement

$$L_t = \frac{A_f\left(\alpha^2+\lambda\right)}{2\alpha^2\left(1-\beta\right)}\sigma^2_{\varepsilon^f} + \frac{\lambda}{\alpha^2}\sigma^2_{\varepsilon} - \frac{A_f\lambda}{\alpha^2\left(1-\beta\right)}\sigma_{\varepsilon,\varepsilon^f} + \frac{1+\lambda\left(1-\beta\mu\right)^2}{2\alpha^2\left(1-\beta\mu^2\right)}\hat{q}_t^2 + \frac{2\lambda k}{\alpha}\hat{q}_t + \frac{\lambda}{\left(1-\beta\right)}k^2 \qquad (13)$$

$$A_f = \frac{\lambda_f}{\lambda_f + \alpha_f^2}$$

where f denotes the euro zone, $\hat{q}_t$ is the rate of real appreciation of the domestic currency, and μ is the autocorrelation coefficient of $\hat{q}_t$

Equation (11) indicates that the social loss depends on the size (variance) of domestic supply shocks and on the magnitude of the internal market distortions. The flexible exchange rate arrangement shelters the country from foreign shocks and in principle it seems appropriate for economies that a) are hit by relatively small and uncorrelated (asymmetric) supply shocks with respect foreign shocks, and b) have relatively small internal market distortions.

According to equation (12), domestic social loss depends on three factors: the inflation spread imposed by the Maastricht criteria, the variance of domestic supply shocks and internal market distortions. The last factor has much less influence than in each of the two preceding exchange rate arrangements. For this reason, free floating coupled with (credible) inflation targeting within the ERM2 appears particularly suited to countries that need to enhance the credibility of their monetary policy framework.

Equation (13) reveals that the variances of both shocks, domestic and foreign, influence the loss function. This is a natural result since the authorities that adopt this exchange rate regime cannot use monetary and exchange rate policies to smooth cyclical fluctuations. There are two additional features of this exchange rate arrangement that are worth noting. First, the covariance between domestic and foreign supply shocks has a negative impact on the domestic loss function. The direct implication is that the system is more desirable if symmetric supply shocks are probable, whereas it poses a number of risks if asymmetric or country-specific supply shocks are thought to be likely. Secondly, for normal values of the aggregate supply slope, internal distortions (and/or a technological gap) have a lower impact on the social loss under a currency board than under a free float regime.

The preceding equations are complex enough to draw a rapid and simple diagnosis about the exchange rate system that suits better any given country. It seems clear, however, that the result depends on the structural features of the countries, such as the degree to which they are exposed to asymmetric shocks, the way the economy adjusts to those shocks, and the size of the inflation bias. The latter, in turn, depends on the importance of the internal distortions and on the conservatism of the central banker. In other words, there is no "one-case-fits-all" exchange rate regime that NMS should uniformly adopt in their run-up to the EMU membership. To obtain a definite diagnosis it is necessary to compute the expected loss under each type of exchange rate regime.

In order to make formulas (11) to (13) operative and compute social losses for each NMS, we need to estimate the variances and covariances of both domestic and foreign supply shocks, and assign values to the incumbent parameters. We undertake the first task in the next section, and leave the second one for section 4 of this paper.

3. Demand and Supply shocks in euro zone and the NMS

In this section we proceed to estimate a Structural Vector Autorregresive model (SVAR) in order to extract demand and supply shocks in the Euro Zone and in NMS countries. For this purpose we follow the methodology of Bayoumi and Eichengreen (1993a), (1993b), which in turn is rooted in Blanchard and Quah (1989). Although the focus of these last authors was on the effects of shocks on output and employment, the analysis may be easily extended to the effects in output and prices[8]. The approach relies on the neoclassical synthesis model according to which a) a permanent expansionary shock in demand increases both the price and the output levels in the short run, but only the price level in the long run, and b) a positive supply shock leads to positive output and negative price effects in both, the short and the long run.

During the initial step, we recover demand and supply shocks for both individual NMS countries and the euro area, as well as calculate correlation coefficients between them. In the second phase, we compute impulse responses to unit demand and supply shocks, and look at the size and sign of their correlation coefficients[9].

The standard aggregate supply and demand model assumes that the variations of (the log of) output and (the log of) price level, Δy_t, and Δp_t, respectively, can be written as a function of contemporaneous and lagged changes of these variables. The bivariate SVAR system is:

$$\Delta y_t = A_{10} + A_{11}\Delta p_t + A_{12}(L)\Delta y_{t-1} + A_{13}(L)\Delta p_{t-1} + \ldots + \varepsilon_{dt}$$

$$\Delta p_t = A_{20} + A_{21}\Delta y_t + A_{22}(L)\Delta y_{t-1} + A_{23}(L)\Delta p_{t-1} + \ldots\ldots + \varepsilon_{st}$$

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[8] This approach was also used to analyse shocks symmetry in Bayoumi (1992) and Bayoumi and Eichengreen (1993 a,b).

The two error terms, ε_{dt} and ε_{st}, represent demand and supply shocks and are assumed to be white noise and uncorrelated. For the simplified case where there would be only one lag, the previous two equations could be expressed in reduced form as:

$$\begin{bmatrix} 1 & -A_{11} \\ -A_{21} & 1 \end{bmatrix} \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} A_{10} \\ A_{20} \end{bmatrix} + \begin{bmatrix} A_{12}(L) & A_{13}(L) \\ A_{22}(L) & A_{23}(L) \end{bmatrix} \begin{bmatrix} \Delta y_{t-1} \\ \Delta p_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{ot} \end{bmatrix} \quad (14)$$

Rearranging the system we have,

$$\begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} B_{10} \\ B_{20} \end{bmatrix} + \begin{bmatrix} B_{12}(L) & B_{13}(L) \\ B_{22}(L) & B_{23}(L) \end{bmatrix} \begin{bmatrix} \Delta y_{t-1} \\ \Delta p_{t-1} \end{bmatrix} + \begin{bmatrix} \eta_{1t} \\ \eta_{2t} \end{bmatrix}$$

(15)

where the elements Bij and the error terms η_{1t} and η_{2t} are derived from (14). L is the lag operator. Given that the vector with the elements η_{1t} and η_{2t} is derived by multiplying the vector $(\varepsilon_{d1t}, \varepsilon_{st})$' by the inverse of the coefficient matrix on the left-hand side of (14), both η_{1t} and η_{2t} are composed of the shocks ε_{dt} and ε_{st}. To identify demand and supply shocks we first estimate the SVAR model (15) in order to generate the error term, and then we apply the Blanchard and Quah (1989) decomposition to derive the shocks.

[9] We use data for eight NMS: Czech Republic, Poland, Hungary, Cyprus, Slovak Republic, Slovenia, Latvia

This methodology is applied to eight NMS and to the euro area as a whole. Since we want to concentrate on a period that is devoid of the structural effects during the years of transition, the observed period is relatively short. To overcome this difficulty and dispose of series long enough to estimate our SVAR we use monthly observations starting in 1997:01 or in the first month after that date from which data is available. The Industrial Production Index (IPI) approximates the output variable, and the Harmonised Consumer Price Index (HCPI) is taken as the price index. Both data come from the *Chronos data*-base of Eurostat, and the length of samples varies slightly from one country to another depending on the starting and ending months for which data was available. The sample periods are: Cyprus (1999:04-2003:10), Czech Republic (1998:03-2003:09), Estonia (1999:02-2003:10), Hungary (1998:02-2003:09), Latvia (1997:02-2003:10) Poland (1997:02-2003:09), Slovak Republic (1999:06 2003:10), Slovenia (1998:07-2003:10), and Euro Zone (1997:09-2003:10). The Akaike information criterion was applied to derive the appropriate lag length of the variables. In the majority of our estimations the optimal length was eight months.

Figures 1 and 2 depict the derived demand and supply shocks for the Euro area and for each of the NMS. The main descriptive statistics are reported in table 2. As can be seen, there are noticeable differences among the countries. As far as demand shocks are concerned, the smaller variances correspond to the euro zone, followed by the Czech Republic, Latvia, Poland and Cyprus, whereas the highest value corresponds to Slovenia. With regards to supply shocks, which matter most for our analysis, the lowest values are found for Slovenia, the euro zone, the Czech Republic, Estonia and Poland, and the highest corresponds to Hungary. We do not find any pattern or relationship linking the size (of the variance) of shocks with the economic characteristics of the countries, such as the type of exchange rate arrangement, openness, GDP growth, degree of trade integration with the EU, etc.

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and Estonia. Lithuania and Malta are not included because the available set of data is not long enough.

Comparing correlation coefficients, between individual NMS and the euro zone, for the same type of shock, we can carry out a more accurate analysis of shocks similarities between countries. Tables 3 and 4 show the results for demand and supply shocks respectively. Concerning demand shocks, most correlation coefficients of individual NMS indicate that shocks in these countries are not linked to the euro zone, given that the sign is negative; only the correlation coefficient of Poland (0.2412) and Cyprus (0.116) with the euro area has a positive sign. Regarding supply shocks, the correlation between NMS and the euro zone, presents a much better picture. The overall number of positive coefficients amounts to five, and the best figures are exhibited by Hungary (0.166), Slovenia (0.166), Estonia (0.140) and Poland (0.131). Three NMS countries, Latvia (-0.120), Cyprus (-0.087), and the Czech Republic (-0.086), demonstrate negative correlations with the euro area.

These differences in behaviour between the two groups of the NMS mainly respond to internal structural factors and/or to the degree of economic integration with the euro zone. Thus, whereas Hungary and Estonia are well advanced in establishing a market economy and restructuring their industrial sector– with the help of foreign ownership or participations- other countries of the second group, such as Latvia and the Czech Republic lay behind in the transition process[10]. Incomplete transition increases the risk of adverse supply shocks and magnifies the effects of shocks on the domestic economy. The negative correlation in supply shocks in the case of Cyprus with the Euro area may be explained by different reasons. For this small Mediterranean island, a less pronounced integration with the Euro zone, mainly due to geographical factors, is probably the most relevant determinant.

As far as the correlation coefficients among shocks identified within the group of NMS are concerned, some clusters may be discerned. With respect to the demand side, Slovenia exhibits ties with Latvia (0.183) and with the Slovak Republic (0.137).

Regarding the supply side, Hungary has noticeable links with Poland (0.302), with Slovenia (0.205) and also with the Slovak Republic (0.152).

Our results go in the same directions as previous findings, although with quantitatively lower correlation coefficients due the fact that our observations are monthly instead of quarterly. Using a similar VAR methodology with quarterly observations, Fidrmuc and Korhonen (2003) and Horvath (2000) also classified the NMS countries into two groups and the first, consisting of positive correlations, included Hungary, Estonia, Slovenia and Poland. Frenkel and Nikel (2002) included the Czech Republic in the first group at the expenses of Poland. However, this change is probably due to a transcription error since within the two matrixes (tables 2 and 3) showing the results for correlation coefficients in that work, the rows corresponding to the Czech Republic have exactly the same numbers (including signs) as those of Estonia. The negative sign in the correlations of the Czech Republic with the whole Euro Zone, or with individual core countries of this area, is an invariable result in the empirical literature on this subject.

Korhonen (2001) arrived at similar conclusions using a structural VAR and monthly indicators of industrial production, but restricting its computations to correlation of impulse responses.

Finally, Babetski, Boone and Maurel (2003) used a different methodology in order to enlarge the sample and get an insight on the evolution of the coefficients. They computed time varying correlation coefficients and arrived at the conclusion that, contrary to demand shocks which exist within an ongoing process of convergence, supply shocks do not seem to converge in the NMS countries with respect to the euro area.

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[10] The industrial sector in the Czech Republic has been affected by several banking crises along the ten last years.

By analysing the consequences of shocks for the desired exchange rate system of a country or set of countries with respect to a more advanced economic area, it is important to investigate the way as different economies respond to the same type of shocks. If responses of output and prices, and/or their velocity of adjustment, are markedly different in each economy, even a symmetric shock may cause important disequilibria between countries and therefore call for flexibility in the exchange rate. For this reason it is important to analyse the dynamics of the adjustments in the NMS and in the euro area. To perform this analysis, we computed impulse-response functions for a positive one-unit demand and a positive one unit supply shock.

Tables 4A and 4B show the correlation coefficients of the output and price responses, respectively, to demand shocks in the NMS countries and the euro area[11]. The calculations reveal that both output and price responses to demand disturbances are positively correlated between each NMS and the euro zone, with much higher coefficients in the responses of prices. Tables 5A and 5B provide the same calculations for supply shocks and reveal a marked difference in the case of Cyprus. In fact, this is the only country that exhibits a negative correlation with respect to the euro zone, probably as a result of its lower degree of economic integration with this area as argued above. The remaining seven countries show high synchronisation with the Euro zone in both types of responses. For output responses, the coefficients range between 0.51 (Estonia) and 0.65 (Latvia), and for price responses the correlation is even stronger, going from 0.81 (Estonia and Slovenia) to 0.99 (Latvia).

Overall, the degree of synchronisation between the NMS and the Euro area in the dynamic responses to shocks is higher than that of shocks themselves, with the exception of Cyprus. The reason is that, in general, the more advanced economies in the transition process dispose of appropriate mechanisms facilitating dynamic adjustments.

4. Social losses

In order to compute social losses for the each NMS country, and for each exchange rate arrangement, we assign here numerical values to the parameters k_i, α_i, and λ_i. The calculus is carried out following the same procedure as Ca'Zorzi and De Santis (2003), and the results are reported in table 6.

Our data are monthly, and come from *Chronos* of Eurostat. Malta and Lithuania were excluded due to a lack of recent data . The period of analysis is not uniform across countries; it varies according to data availability, but in most cases ranges from 1997-01 till 2003-10. Therefore, it covers a phase that is devoid of the main transformations and structural reforms of the transition episode, which are not representative of the current situation. Taking averages over almost seven years gives a representation of the supposedly starting equilibrium values

The first column of table 3 shows the average annual rate of real appreciation of the currency of each country with respect to the euro. We will assume that these rates reflect equilibrium changes responding not only (although mostly) to Balassa-Samuelson effects, but also to other real factors, such as industrial shifts between sectors. The expected real exchange-rate changes for the coming years are obtained by applying an autoregressive coefficient equal to 0.8 to the values of column 1, under the assumption that real exchange rate developments of these countries with respect to the euro area vanish as the catching up process goes ahead.

The second and third columns display the average output growth and inflation rate of the NMS over the indicated sample. We will consider that these two sets of values

[11] We do not present here the graphical representation of the functions for reason of space. It is available from the authors upon request.

correspond to the initial equilibrium rate of inflation and the potential output rate, respectively. The forth column shows the value of internal market distortions of each country and is computed in the same manner as in Ca'Zorzi and De Santis (2003). Thus, we assume that this index may be approximated by the gap between the growth rate which would allow a rapid convergence with the euro area and the trend growth presented in column two. Also we define rapid growth as the rate necessary to catch up by 20 percent per capita GDP with respect to per capita GDP of the euro area in the next ten years[12].

The forth column shows the inflation bias obtained as the difference between the equilibrium inflation rate and the inflation rate that would prevail in the case of no distortions. We will assume that the latter is 2 percent not only for each NMS, but for the euro zone as well.

In the fifth column we have computed the weight attached to output stabilisation (λ) for three possible slopes of the aggregate supply. Recent empirical studies for the euro zone point out that, for a time horizon of two years, the output response to changes in monetary policy is between 1,8 and 6 times larger than the price response, which corresponds to aggregate supply slopes between 1/1.8 and 1/6. Slopes increase with the time horizon, and it seems reasonable to assume α = 1/1.6 for a horizon between two and three years after the shock[13]. Since no comparable evidence exists for the NMS, we decided -as Ca'Zorzi and De Santis (2003)- to conduct a sensitivity analysis by considering three alternative values for the aggregate supply slope: the same value as in the euro area (α = 0.62), twice this value (α = 1.24) and half (α = 0.31). For each of these values, λ can be derived endogenously from the expression corresponding to the inflation bias. Thus,

[12] This assumption implies that in the absence of distortions in the poorer countries would grow faster in order to achieve convergence in GDP per capita with the euro area, and consequently this is in accordance with the general statement of the β-convergence theory.
[13] See Ca'Zorzi and De Santis (2003), p. 25, and the references cited there.

$$\lambda = \frac{I\alpha^2}{\alpha k - I(1-\beta)}, \quad \text{where } I \text{ is the inflation bias.}$$

According to this expression, the larger the internal distortions, the more conservative (lower value of λ) the central banker needs to be to obtain a certain inflation rate. It also indicates that, all other things constant, lower inflation biases are associated with more conservative central bankers. As a general result in our numerical exercise, relatively low parameters λ (higher conservatism) provide relatively low inflation levels.

In order to compute social losses for each NMS country and for each exchange rate regime, we introduce the values of parameters from table 3, and the values of variances and covariances of supply shocks obtained from our estimated structural VAR, into the formulas (11), (12) and (13). We assume $\beta = 0.95$ in each country, and $\alpha_f = 0.62$ $\lambda_f = 0.4$. The last two values are in accordance to some recent estimates in the empirical literature. Finally, we assume that $\pi^M = 3$. This implies that the objective rate of inflation for the potential participants in the ERM2, during their last phase towards the EMU, is one percent over the rate targeted by the European Central Bank. The results are presented in table 7 for the three slopes assigned to domestic aggregate supplies.

As can be seen, the results are robust to different values of aggregate supply slopes in each country. The optimal exchange rate arrangement appears very clear-cut for each country independently of the scenario assumed, except for Latvia where the solution might be different for a very flat aggregate supply. We believe that the exchange rate arrangement that is assigned to each country in our numerical exercise may be rationalised by structural factors and economic considerations, even though some of these factors have not been explicitly taken into consideration in our model. Let us then give economic interpretation to our results.

For the Czech Republic the best choice is a flexible exchange rate regime. Our analysis indicates that the exchange rate choice for this economy is not related to any lack of credibility in its monetary policy. In fact, this rate of inflation has followed a pronounced downward trend since 1999, and now satisfies the Maastricht criteria. The inflation targeting strategy adopted in January 1998 has been very successful in this respect[14]. We believe that the economic problems lie instead in the real side of the economy. As explained above, this country exhibits vulnerability to asymmetric demand and supply shocks, with respect to the euro area, and this makes the exchange rate a useful tool of economic policy as stressed by the theory of optimal currency areas. The main sources of idiosyncratic shocks to this country are a rigid functioning of labour markets, accompanied by a relatively slow labour productivity growth, and chronic weaknesses of the banking sector. During the transition years, these problems triggered capital outflows –which have been largely liberalised- and have forced the country to abandon more controlled exchange rate regimes[15].

Our analysis points to the convenience of a flexible exchange rate regime for Latvia, except for the case of a very flat aggregate supply, for which a conventional peg to the euro is advised. The reason for advising higher flexibility in the exchange rate, compared to the rigid peg to a basket of currencies, currently in force in this country, also lies in real factors. Latvia exhibits asymmetric demand and supply shocks with respect to the euro zone, probably as a result of its relatively low trade integration with this area. In fact, trade with EMU countries as a share of GDP, that may be considered

[14] Inflation targeting is commonly thought a substitute for nominal exchange rate anchors in monetary and exchange rate policies.
[15] The Czech Republic abolished its Deutsche mark and US dollar-based currency basket in May 1997, and has, since then, floated its currency.

an indicator of idiosyncratic shocks probability, hardly overcomes 30 per cent. This index is lower than half the levels in the remaining NMS countries, except for Poland.

The arguments in favour of a flexible exchange rate regime in Cyprus are even stronger than for Latvia, since the degree of economic integration of this country with respect to the euro area is lower. Our empirical analysis reveals indeed that this country is affected by asymmetric supply shocks with respect to the euro zone as a whole.

The results of table 7 strongly recommend a rapid participation of Hungary, Poland, The Slovak Republic and Slovenia in the ERM2, under the limited flexibility regulated by the Masstrich Treaty. The reasons for this stricter exchange rate arrangement, compared to the regime prescribed to the Czech Republic for instance, are of both monetary and real nature. On the one hand, all these countries need the ERM2 monetary credibility to reduce their current inflation bias and/or to prop up the inflation rate at the low level recently reached[16]. Actual participation in the ERM2, and in particular the policy coordination and surveillance that this mechanism imposes, will further enhance the credibility of NMS countries macroeconomic policies and, in general, eliminate any significant monetary policy bias. On the other hand, since asymmetric supply shocks with respect to the euro zone are not likely in these four countries –as has been confirmed by our VAR analysis-, the nominal exchange rate is less necessary for real adjustments[17].

Our analysis assigns to Estonia the same exchange rate regime that prevails in this country since 1992, that is, a currency board. This solution is compatible with participation in the ERM2, and may be also justified for economic reasons. First, since this country is very small and open, especially with respect to the euro zone, its exchange rate is not a useful tool for macroeconomic adjustment. Secondly, its supply

[16] Only Poland and Slovakia exhibit now rates of inflation under 4%, which is a low figure compared to the high levels reached in 2000 (more than 10% in each country).
[17] The share of trade of these countries with the euro area goes from 61.7% (Poland) to 69,5% (Hungary).

shocks are positively correlated with those of the euro zone, probably because of the high degree of economic integration that this country has achieved with this area. Thirdly, its fixed exchange rate has been backed so far by strong monetary and fiscal policies and flexible wages; furthermore, participation in the ERM2 will enhance the credibility of these policies. Finally, the experience provided by the transition years of this country indicates that possible current account deficits may be financed with foreign direct investment inflows.

5. Conclusions

In this paper we have examined the desirable exchange rate arrangements for eight of the recently acceded EU economies, along to their current run-up to EMU. To this purpose, in the theoretical part of the paper we have used a macroeconomic model for an open economy that includes two ingredients especially convenient for our task. Firstly, its social loss function includes internal market distortions and/or a technological gap of the domestic country with respect to the euro area. This is especially useful to investigate the inflation bias in countries that have still not finished the transition phase to a full-fledged market economy. Secondly, it assumes forward-looking behaviour of both firms and households. This feature has important implications for the stabilisation effects of macroeconomic policies.

In the empirical part of the paper we have estimated SVAR models in order to extract variances and covariances between shocks to each new Member State (NMS) and to the euro zone, which are necessary to compute individual social losses under each exchange rate arrangement. Our main result is that the optimal choice varies depending on the institutional and structural features of each economy, and on the likely source and nature of economic shocks to which it is exposed with respect to the whole euro area.

Interestingly, the results for each country seem to conform to the general prescriptions that one would derive from the theory of optimal currency areas.

The recommended exchange rate systems are as follows: the Czech Republic should maintain its managed flexible exchange rate with respect to the euro, coupled with its current inflation targeting arrangement. The reason may be that this country is still hit by asymmetric shocks and needs to both complete its transition process and improve the functioning of the labour market. The same exchange rate is prescribed for Latvia and Cyprus. In these cases, the rationale would lie mainly on the asymmetric nature of their supply shocks, which in turn might be provoked by their relatively low degree of economic integration with the euro area.

Our analysis suggests that Hungary, Poland, the Slovak Republic and Slovenia should participate in the ERM2, under the flexible conditions stipulated by the Maastricht Treaty, as soon as possible. The explanation is twofold. On the one hand, these countries still need a credible inflation anchor (that can be provided by the institutionally regulated Maastricht criteria); and, on the other, they can easily adopt the ERM2 discipline since the nature of their supply shocks is essentially symmetric with respect to the euro zone. Finally, for Estonia we derived a currency board with respect to the euro, which is in fact the system in force in this country since 1992. Nowadays it could be maintained and reinforced within the ERM2. Again, this choice may be rationalised taking into account several economic features of this country that make the exchange rate a non-desirable tool for economic policy adjustments. The most relevant are: small size but high degree of openness with the euro area, and relatively high flexibility of its labour market. These characteristics could, in turn, justify the positive correlation of the supply shocks of this country with respect to the euro area.

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Appendix: Tables and Figures

Table 1. Economic effects of exchange rates arrangements.

Economic effects of exchange rate arrangements		
Flexible exchange rate	**Currency board**	**ERM2**
$\pi_t = \frac{\lambda}{\lambda(1-\beta\rho)+\alpha^2}\varepsilon_t + \frac{\lambda}{\lambda(1-\beta)+\alpha^2}\alpha k$	$\pi_t = \frac{\lambda_f}{\lambda_f(1-\beta\rho)+\alpha_f^2}\varepsilon_t^f - \hat{q}_t$	$\pi_t = \pi^M \leq (\pi^f + \pi_d)$
$y_t = \frac{-\alpha}{\lambda(1-\beta\rho)+\alpha^2}\varepsilon_t + \frac{\lambda(1-\beta)}{\lambda(1-\beta)+\alpha^2}k$	$y_t = \frac{1}{\alpha}\left[\frac{\lambda_f(1-\rho\beta)}{\lambda_f(1-\rho\beta)+\alpha_f^2}\varepsilon_t^f + (\beta E_t\hat{q}_{t+1} - \hat{q}_t) - \varepsilon_t\right]$	$y_t = \frac{1-\beta}{\alpha}\pi^M - \frac{\varepsilon_t}{\alpha}$
$s_t = \left\{1 - \frac{\alpha(1-\rho)}{\lambda[\varphi(1-\rho)+\delta]}\right\}\phi\varepsilon_t - \frac{1}{\varphi(1-\vartheta)+\delta}d_t + \frac{\varphi}{\varphi+\delta}\tau_t + p_{t-1} - \frac{\psi\phi}{\delta}k$	$s_t = \bar{s}$	$s_t = \frac{-(1-\rho)}{\alpha[(1-\rho)\varphi+\delta]}\varepsilon_t - \frac{1}{\varphi(1-\vartheta)+\delta}d_t + \frac{\varphi}{\delta+\varphi}\tau_t + p_{t-1} + \frac{(\varphi+\delta-1)}{\delta}\pi^M$
$i_t = \left\{\frac{\alpha(1-\rho)^2}{\lambda[\varphi(1-\rho)+\delta]} + \rho\right\}\phi\varepsilon_t + \frac{(1-\vartheta)}{\varphi(1-\vartheta)+\delta}d_t + \frac{\delta}{\varphi+\delta}\tau_t$	$i_t = \tau_t$	$i_t = \frac{(1-\rho)^2}{\alpha[(1-\rho)\varphi+\delta]}\varepsilon_t + \frac{1}{\varphi(1-\vartheta)+\delta}d_t + \frac{\varphi}{\delta+\varphi}\tau_t + \pi^M$

Table 2:Descriptive statistics: Demand and Supply shocks

Demand Shocks

	Mean	*Variance*
EZ	$2.18\ 10^{-3}$	$1.74\ 10^{-6}$
Poland	$1.38\ 10^{-3}$	$1.37\ 10^{-4}$
Czech Republic	$1.53\ 10^{-3}$	$6.44\ 10^{-5}$
Latvia	$2.28\ 10^{-3}$	$1.21\ 10^{-4}$
Chypre	$1.58\ 10^{-3}$	$1.61\ 10^{-4}$
Estonia	$1.88\ 10^{-3}$	$2.62\ 10^{-4}$
Hungary	$1.58\ 10^{-3}$	$6.76\ 10^{-4}$
Slovak Republic	$1.88\ 10^{-3}$	$2.19\ 10^{-4}$
Slovenia	$-2.81\ 10^{-3}$	$4.76\ 10^{-3}$

Supply Shocks

	Mean	*Variance*
EZ	$-2.64\ 10^{-4}$	$3.08\ 10^{-5}$
Poland	$-8.95\ 10^{-4}$	$6.76\ 10^{-5}$
Czech Republic	$-7.03\ 10^{-4}$	$2.55\ 10^{-5}$
Latvia	$-2.88\ 10^{-4}$	$1.18\ 10^{-4}$
Cyprus	$7.59\ 10^{-4}$	$1.04\ 10^{-4}$
Estonia	$-6.36\ 10^{-4}$	$4.39\ 10^{-5}$
Hungary	$1.61\ 10^{-4}$	$2.92\ 10^{-4}$
Slovak Republic	$-1.18\ 10^{-4}$	$1.58\ 10^{-4}$
Slovenia	$2.68\ 10^{-4}$	$1.32\ 10^{-5}$

Table 3(A): Correlation coefficients of Demand Shocks

	EZ	*Poland*	*Czech Republic*	*Latvia*	*Cyprus*	*Estonia*	*Hungary*	*Slovak Republic*	*Slovenia*
EZ	1	-	-	-	-	-	-	-	-
Poland	0.2412	1	-	-	-	-	-	-	-
Czech Republic	-0.046	-0.272	1	-	-	-	-	-	-
Latvia	-0.005	0.220	-0.052	1	-	-	-	-	-
Cyprus	0.116	-0.029	0.075	-0.163	1	-	-	-	-
Estonia	-0.070	0.099	0.128	0.188	-0.145	1	-	-	-
Hungary	-0.011	0.101	0.089	-0.116	-0.160	-0.107	1	-	-
Slovak Republic	-0.069	-0.057	-0.091	0.111	-0.080	-0.100	0.223	1	-
Slovenia	-0.041	0.107	-0.067	0.183	-0.012	-0.168	0.029	0.137	1

Table 3(B): Correlation coefficients of Supply Shocks

	EZ	*Poland*	*Czech Republic*	*Latvia*	*Cyprus*	*Estonia*	*Hungary*	*Slovak Republic*	*Slovenia*
EZ	1	-	-	-	-	-	-	-	-
Poland	0.131	1	-	-	-	-	-	-	-
Czech Republic	-0.086	-0.226	1	-	-	-	-	-	-
Latvia	-0.120	0.095	0.141	1	-	-	-	-	-
Cyprus	-0.087	-0.251	-0.144	0.041	1	-	-	-	-
Estonia	0.140	0.059	0.116	0.110	0.079	1	-	-	-
Hungary	0.166	0.302	-0.098	-0.095	-0.078	0.022	1	-	-
Slovak Republic	0.067	-0.011	-0.1037	-0.180	0.087	-0.183	0.1524	1	-
Slovenia	0.166	0.171	-0.045	-0.109	0.120	0.085	0.205	0.065	1

Table 4(A):Correlation coefficients of Impulse Response Functions of Output response to Demand Shocks

	EZ	*Poland*	*Czech Republic*	*Latvia*	*Cyprus*	*Estonia*	*Hungary*	*Slovak Republic*	*Slovenia*
EMU	1	-	-	-	-	-	-	-	-
Poland	0.0364	1	-	-	-	-	-	-	-
Czech Republic	0.5671	0.6850	1	-	-	-	-	-	-
Latvia	0.2129	-0.2564	-0.3448	1	-	-	-	-	-
Cyprus	0.1999	0.5199	0.2328	0.3523	1	-	-	-	-
Estonia	0.1299	0.8169	0.6933	-0.1250	0.4845	1	-	-	-
Hungary	0.5047	0.5353	0.7174	-0.1692	0.4226	0.6559	1	-	-
Slovak Republic	0.2417	0.6309	0.7829	-0.3499	0.3620	0.7127	0.6721	1	-
Slovenia	0.1471	0.8387	0.5588	0.1501	0.7090	0.8236	0.4725	0.6184	1

Table 4(B): Correlation coefficients of Impulse Response Functions of Price response to Demand Shocks

	EZ	*Poland*	*Czech Republic*	*Latvia*	*Cyprus*	*Estonia*	*Hungary*	*Slovak Republic*	*Slovenia*
EMU	1	-	-	-	-	-	-	-	-
Poland	0.7776	1	-	-	-	-	-	-	-
Czech Republic	0.8651	0.6084	1	-	-	-	-	-	-
Latvia	0.8567	0.9391	0.7144	1	-	-	-	-	-
Cyprus	0.4438	0.2278	0.7327	0.2882	1	-	-	-	-
Estonia	0.4328	0.5479	0.2249	0.5786	0.074	1	-	-	-
Hungary	0.7385	0.9161	0.6525	0.8732	0.2959	0.4609	1	-	-
Slovak Republic	0.7212	0.8176	0.5850	0.8783	0.2290	0.6249	0.7873	1	-
Slovenia	0.4328	0.3857	0.2947	0.2727	0.1923	0.1633	0.2525	0.086	1

Table 5(A): Correlation coefficients of Impulse Response Functions of Output response to Supply shocks

	EZ	*Poland*	*Czech Republic*	*Latvia*	*Cyprus*	*Estonia*	*Hungary*	*Slovak Republic*	*Slovenia*
	1	-	-	-	-	-	-	-	-
Poland	0.5556	1	-	-	-	-	-	-	-
Czech Republic	0.5618	0.9743	1	-	-	-	-	-	-
Latvia	0.6467	0.9689	0.9192	1	-	-	-	-	-
Cyprus	-0.7956	-0.1922	-0.1707	-0.2979	1	-	-	-	-
Estonia	0.5163	0.9146	0.9703	0.8383	-0.1331	1	-	-	-
Hungary	0.5335	0.9422	0.9916	0.8727	-0.1190	0.9791	1	-	-
Slovak Republic	0.5710	0.9803	0.9711	0.9541	-0.2116	0.9147	0.9431	1	-
Slovenia	0.5163	0.1735	0.1594	0.1752	-0.4535	0.1633	0.1314	0.1945	1

Table 5(B): Correlation coefficients of Impulse Response Functions of Price response to Supply shocks

	EZ	*Poland*	*Czech Republic*	*Latvia*	*Cyprus*	*Estonia*	*Hungary*	*Slovak Republic*	*Slovenia*
EMU	1	-	-	-	-	-	-	-	-
Poland	0.9594	1	-	-	-	-	-	-	-
Czech Republic	0.9092	0.5614	1	-	-	-	-	-	-
Latvia	0.9890	0.7419	0.2266	1	-	--	-	-	-
Cyprus	-0.2536	0.5416	0.1206	0.3206	1	-	-	-	-
Estonia	0.8101	0.2501	0.5504	-0.0400	0.0156	1	-	-	-
Hungary	0.8631	0.4914	0.4503	0.3986	0.2276	0.7077	1	-	-
Slovak Republic	0.9608	0.2703	0.6323	0.033	0.093	0.6239	0.3202	1	-
Slovenia	0.8107	0.2501	0.5504	-0.0400	0.0156	1	0.7077	0.6239	1

Table 6. The baseline scenario

	$\hat{q}_i$	*Rate of Output growth*	*Rate of inflation*	k_i	*Inflatio n bias*	$\alpha=0.31$ λ_i	$\alpha=0.62$ λ_i	$\alpha=1.24$ λ_i
Cyprus	-1.24	0.84	3.37	2.2	1.37	0.21	0.41	0.79
Czech Republic	-4.11	3.63	2.41	1.1	0.41	0.12	0.24	1.04
Estonia	-2.90	9.78	3.71	0.9	1.71	0.85	1.39	2.55
Hungary	-4.21	8.09	8.48	0.8	6.48		14.44	14.92
Latvia	-4.12	2.95	3.34	1.4	1.34	0.37	0.64	1.24
Poland	-3.72	5.09	7.17	1.4	5.17	2.83	3.26	5.38
Slovak Republic	-3.41	6.11	8.00	1.4	6.00	4.30	4.01	6.43
Slovenia	-1.12	2.06	7.24	0.9	5.24	29.59	6.80	9.44

Table 7. Social losses

Latvia	*Scenario 1*	*Scenario 2*	*Scenario 3*
Flexible exchange rate	**24.635**	**28.555**	**40.337**
Currency Board	24.159	34.697	58.201
ERM2	113.75	98.585	110.28

Cyprus	*Scenario 1*	*Scenario 2*	*Scenario 3*
Flexible exchange rate	**26.312**	**36.869**	**54.953**
Currency Board	30.092	49.415	86.197
ERM2	96.186	105.720	124.147

Hungary	*Scenario 1*	*Scenario 2*	*Scenario 3*
Flexible exchange rate	-	430.13	462.92
Currency Board	**-**	185.92	196.17
ERM2	-	**135.08**	**158.82**

Poland	*Scenario 1*	*Scenario 2*	*Scenario 3*
Flexible exchange rate	276.25	298.26	342.29
Currency Board	118.74	137.09	220.31
ERM2	**113.77**	**133.72**	**178.01**

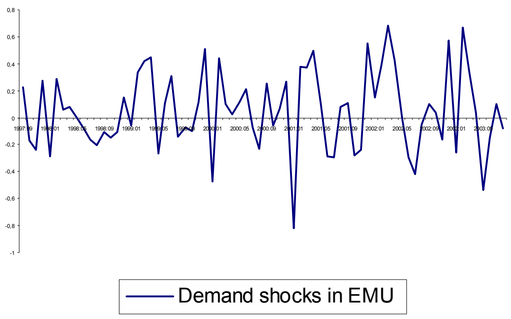
Slovak Republic	*Scenario 1*	*Scenario 2*	*Scenario 3*
Flexible exchange rate	367.79	387.50	446.98
Currency Board	160.82	157.03	253.02
ERM2	**126.119**	**143.785**	**195.192**

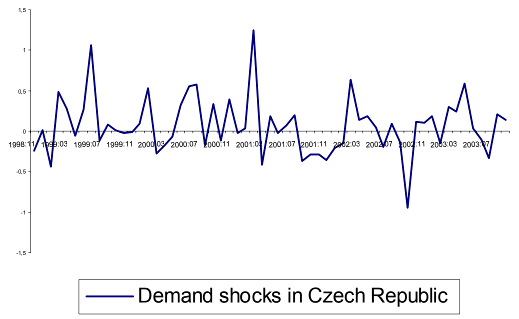
Slovenia	*Scenario 1*	*Scenario 2*	*Scenario 3*
Flexible exchange rate	275.42	290.04	319.86
Currency Board	483.59	119.48	162.45
ERM2	**141.27**	**119.44**	**147.29**

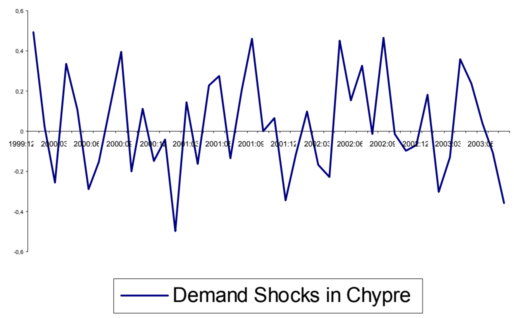
Czech Republic	*Scenario 1*	*Scenario 2*	*Scenario 3*
Flexible exchange rate	**2.879**	**4.407**	**19.640**
Currency Board	13.014	15.695	34.775
ERM2	90.455	91.767	99.968

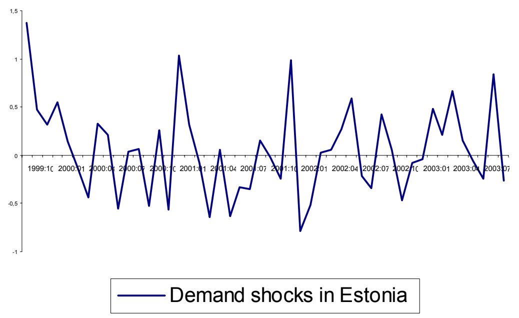
Estonia	*Scenario 1*	*Scenario 2*	*Scenario 3*
Flexible exchange rate	32.561	37.232	50.954
Currency Board	**23.373**	**32.147**	**46.770**
ERM2	91.475	96.020	105.47

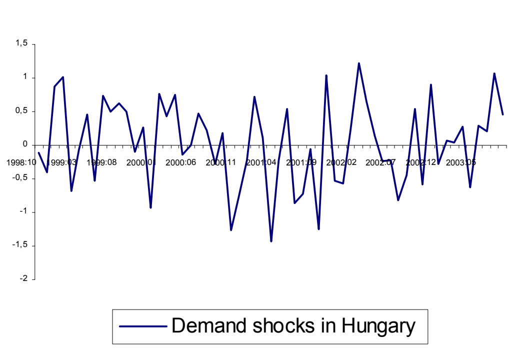
Figure 1: Demand Shocks in the euro zone and the NMS

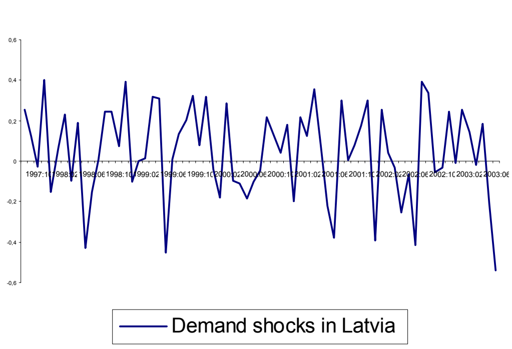


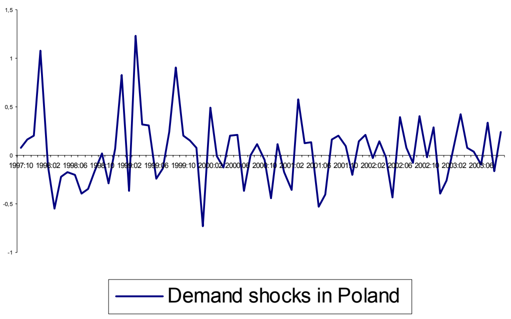


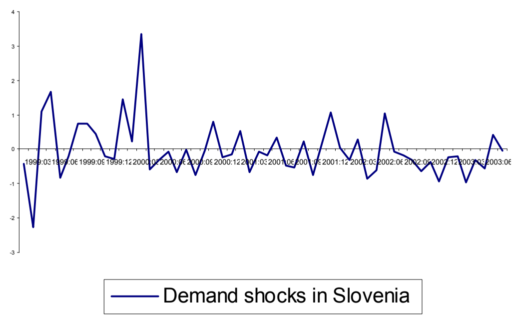









Demand shocks in Poland


Demand shocks in Slovenia

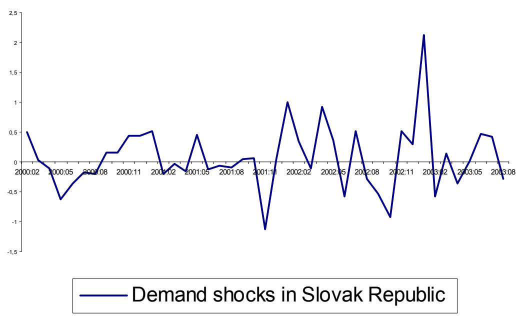
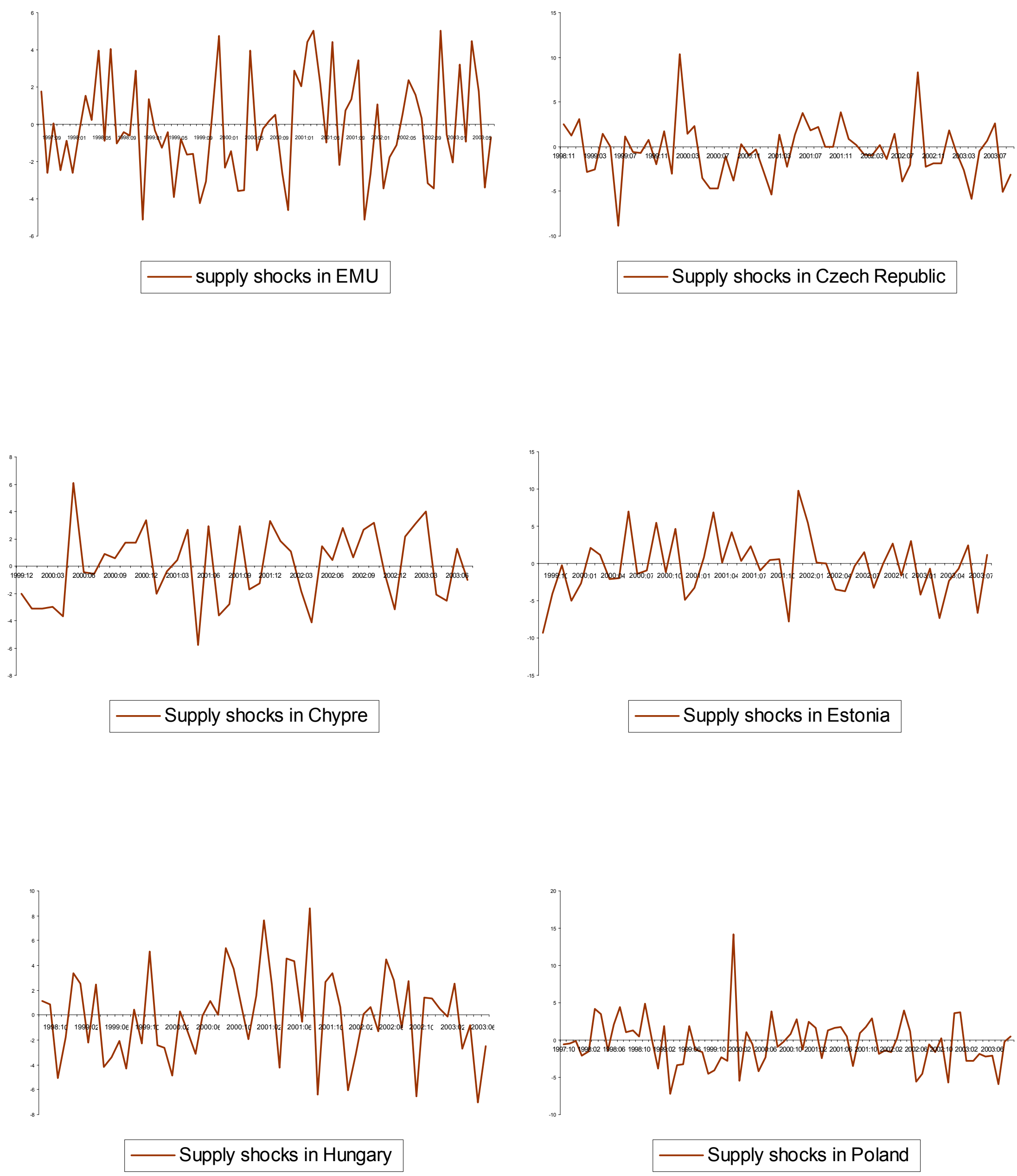
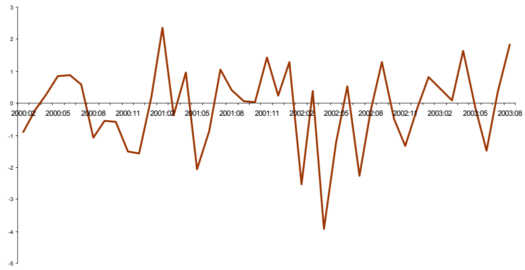

Demand shocks in Slovak Republic

Figure 2: Supply Shocks in the euro zone and NMS



Supply shocks in Latvia

Supply shocks in Slovenia



Supply shocks in Slovak Republic