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Monetary Convergence and Risk Premiums in the EU Accession Countries

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Abstract

This study examines the impact of various monetary policy regimes on the ability to lower inflation and exchange rate risk premiums in the EU accession countries as they undergo monetary convergence to the eurozone. It proposes a monetary policy framework of *flexible targeting of relative inflation risk premium* that is believed to be credible and useful for managing these two categories of risk. A model of inflation and exchange rate risk premiums within the context of inflation targeting is developed. Recent trends in these risk premiums in Hungary, the Czech Republic and Poland are tested by employing the threshold ARCH (TARCH) model.

The candidate countries for accession to the European Union (EU) and, at a later date, to the European Monetary Union (EMU) are presently revising their economic policies in the direction that will enable them to establish a framework of a competitive market system, compatible with the one prevailing in the EU. Modifications in monetary and exchange rate regimes in these countries are crucial for their successful monetary convergence to the eurozone.

The key assumption underlying this analysis is that the candidate countries for the EU/EMU accession need to demonstrate capability to manage risk premiums, particularly the inflation risk premium (IRP) and the exchange rate risk premium (ERP), as a necessary prerequisite for their successful monetary convergence. They need to adopt an appropriate monetary policy that will facilitate management of these risk premiums in the most effective way. The IRP is broadly consistent with the concept of real interest rate. It is technically defined as a percentage deviation between the average short-term market interest rate (such as a three-months T-bill rate) and the average headline inflation forecast (CPI-based) in a given period of time. Stability of the ERP is assessed on the basis of the average deviation of the nominal exchange rate from its dynamic trend.

This study proposes a system of *flexible targeting of relative inflation risk premium*, which is believed to be effective for lowering IRP first and subsequently reducing ERP in the economies converging to the eurozone. The regime of flexible targeting of relative IRP is defined as a policy framework whose primary objective is to contain domestic IRP vis-à-vis the one prevailing in the euro area with an auxiliary commitment to reducing ERP. Such a policy approach differs from the convergence criteria prescribed by the Maastricht Treaty, that require achieving a pre-determined level of inflation and exchange rate stability within an arbitrarily set band of permitted fluctuations. By focusing on IRP rather than on the level of headline inflation this paper also underscores the importance of minimizing economic and social costs on the road to price stability. These costs associated with the recessionary effects of high real interest rates are exacerbated if the policy lacks credibility; thus disinflation requires a very tight monetary policy. This in turn hinders economic growth and deteriorates unemployment, and therefore impairs real convergence that is indispensable for achieving structural changes. Hence, minimizing IRP is essential to a successful convergence. So is minimizing ERP that is believed to be more useful for exchange rate stability than the application of a numerical band for permitted nominal rate fluctuations around a central parity rate as implied by the Maastricht criteria.

The empirical part of this paper investigates the nexus between IRP and ERP in Poland, Hungary and the Czech Republic. These three countries are expected to join the EU on May 1, 2004 and the EMU two years later. They are selected on the basis of the relatively larger size of their economies among the remaining seven official EU candidates, the level of their financial markets development as well as their choice of monetary policy regime that is based on direct inflation targeting (DIT) with flexible exchange rates. By committing to DIT, they have been pursuing disinflation sometimes at the cost of a very high IRP that can be mitigated by departing from strict inflation targeting (SIT) toward flexible inflation targeting (FIT). As prescribed by Orlowski (2001), FIT is a monetary regime that combines a predominant target of low inflation with a conditional target of exchange rate stability.[1] For these reasons, a system of flexible targeting of relative IRP is proposed for managing IRP and ERP. Interactions between these two risk premiums are tested for the period January 1995–March 2002. The threshold autoregressive conditional heteroscedasticity TARCH(p,q) model is employed in order to correctly capture time varying volatility in the data as well as the asymmetry of volatility. It shall be noted that IRP and ERP assume strict conditions that may not hold up in the data, i.e. constancy of ex-ante real interest rates and absence of real exchange rates.

Section 1 sets out specific technical definitions and the analytical model reflecting interaction between IRP and ERP. A graphical display of this interaction leads to formulation of the model of uncovered real interest rate parity in Section 2. Section 3 contains the empirical analysis of these risk premiums. Concluding remarks follow in Section 4.

1. IRP-ERP model

The relationship between inflation and exchange rate risk premiums and choices of various monetary policy regimes is derived from an extensive theoretical discussion and empirical examination in the recent literature. The traditional approach to policies aimed at targeting inflation, or price stability, has focused on the volatility of output as a subsequent result, or cost, of reducing volatility of inflation (Svensson, 1999a). Nonetheless, a number of recent studies have emphasized the impact of inflation targeting on volatility of both real and nominal exchange rates. Specifically, Haldane (1997) presents compelling evidence that the inflation-targeting framework is likely to aggravate stability of exchange rates. In a similar vein, several models have focused on pass-through effects of currency depreciation on inflation (via rising import prices), as initiated by Ball's (1999) seminal study. Drawing on Ball's model, Eichengreen (2001) proves that possible shocks to pass-through effects are by their nature only transitory and they do not require active policy responses. Active responses are likely to amplify the volatility of output and inflation. These findings are essentially in line with the classic Mundell-Fleming model, which implies that flexible exchange rates are superior to fixed rates if an economy is affected predominantly by foreign real shocks. Such policy models allow for designing a central bank's reaction (or loss) function focusing on the tradeoff between volatility of inflation and exchange rates.[2]

Recent monetary policy models and empirical studies seem to reinforce the emphasis on the relationship between volatility of inflation and exchange rates. Among them, Gali and Monacelli (2002) demonstrate that the policy of inflation targeting as compared to price level (CPI) targeting or an exchange rate peg entails a substantially larger volatility of both nominal and real exchange rate. Similar results are proven empirically by Golinelli and Rovelli (2001) for the transition economies. These authors demonstrate that a strong determination to dampen inflation, particularly in the case of Poland, contributes to trend real and nominal appreciation of domestic currencies. In addition, Neumann and von Hagen (2002) show empirically that the recent inflation targeting policies practiced by several central banks have not aggravated volatility of output. These central banks have not been too successful in taming inflation relative to other central banks that have focused on money growth targets, but have contributed to substantial gains in monetary credibility. More conclusive empirical results are found for the transition economies. Among others, Bofinger and Wollmershäuser (2001 and 2002) prove strong connections between exchange rate volatility, inflation and changes in the monetary conditions index (MCI) in these countries. Consequently, they propose a monetary policy regime based on flexible exchange rate targeting. In a similar vein, Leitemo (2002) presents compelling evidence on a link between inflation persistence and exchange rate stability in the transition economies. While investigating the nexus between disinflation and exchange rate volatility in these economies, Orlowski (2001) develops a model exposing a tradeoff between IRP and ERP.

Hence, the empirical literature supports the relationship between disinflation and exchange rate volatility in the transition economies. This holds true at least for the countries that have departed from currency pegs and have applied DIT regimes with flexible exchange rates.[3] Such transition-related policy adjustments almost unavoidably exacerbate exchange rate volatility. The empirical literature points out that it is prudent to devise a reaction function for monetary policy that would combine the goals of lowering inflation and reducing exchange rate volatility. I, thereby, follow up on this premise.

As assumed in this study, a successful monetary convergence of the EU/EMU candidates to the eurozone ought to focus on their ability to manage both IRP and ERP. In an advanced scenario, monetary policies that are aimed at lowering both risk premiums need to be autonomous and forward-looking. Accession countries observe the current real interest rate, $i_t^d - \pi_t^d$, which is equal to the real interest rate target set at $i^*_{t+\tau/t} - \pi^*_{t+\tau/t}$. By assumption, the target real interest rate is equal to the forecasted real interest rate of the common currency bloc. Typically, the current real interest rate is higher than the target real rate by the parameter of Φ_t, which embeds the adjustment and credibility factor. The procedure can be expressed as an IRP equation:

$$i_t^d - \pi_t^d = i^*_{t+\tau/t} - \pi^*_{t+\tau/t} + \Phi_t \tag{1}$$

where i_t^d is the domestic (short-term market) interest rate, π_t^d is domestic headline inflation at time t, $i^*_{t+\tau/t}$ is the target for domestic interest rate set for the next τ-periods ahead and consistent with the corresponding inflation target $\pi^*_{t+\tau/t}$, and Φ_t is IRP prevailing at time t.

Equation (1) can be expressed in terms of the risk premium:

$$\Phi_t = \left(i_t^d - i^*_{t+\tau/t}\right) - \left(\pi_t^d - \pi^*_{t+\tau/t}\right). \tag{2}$$

In this form, in the open-economy framework with forward-looking expectations IRP represents the difference between the interest rate differential and the inflation differential, both of which account for some future targets that are consistent with the corresponding variables forecasted for the common currency bloc. Moreover, aligning purely domestic IRP with the one expected to prevail in the common currency bloc is warranted by the conditions identified in the recent literature on ‘dollarization’ as prerequisites for entry into a common currency area. Specifically, Alesina and Barro (2001) emphasize that a successful entry into a common currency area requires well-established co-movements between key monetary variables of the candidate and of the common currency bloc.

ERP can be derived from the simplified version of the purchasing power parity condition (PPP) in an open economy that is pursuing active convergence to the common currency area. Accordingly, the inflation target for this economy $\pi^*_{t+\tau/t}$ is consistent with the forecasted inflation in the common currency area (the eurozone) and the exchange rate target $e^*_{t+\tau/t}$ is conditional upon the inflation target. Under these circumstances, ERP is defined by Ψ_t in the following equation

$$e_t - e^*_{t+\tau/t} = \pi^d_t - \pi^*_{t+\tau/t} = \Psi_t. \quad (3)$$

In order to ensure full consistency between monetary policy instruments and goals, ERP needs to satisfy also the international Fischer effect (IFE) condition

$$e_t - e^*_{t+\tau/t} = i^d_t - (i^*_{t+\tau/t} + \Psi_t) \quad (4)$$

The monetary policy instrument rule derived from (2) can be specified as

$$i^d_t = i^*_{t+\tau/t} - \pi^*_{t+\tau/t} + \pi^d_t + \Phi_t \quad (5)$$

The inflation targeting instrument rule (5) reflects a forward-looking SIT system in an open economy in which target variables for interest rates and inflation become exogenous. The interest rate rule (5) inserted into (4) gives

$$e_t - e^*_{t+\tau/t} + \Psi_t = \pi^d_t - \pi^*_{t+\tau/t} + \Phi_t. \quad (6)$$

The relationship between ERP and IRP, shown in Equation (6), reflects policy choices in the forward-looking setting since policy monitoring focuses on the differences between current inflation and exchange rates and their respective target levels for the τ-periods ahead. Placing this relationship in the framework of monetary convergence to the common currency area implies that the current exchange rate e_t is expected to converge to the exchange rate target $e^*_{t+\tau/t}$ and the current inflation π^d_t will be moving closer to the inflation target $\pi^*_{t+\tau/t}$. In order to accomplish these tasks, the candidates will have to focus on improving policy credibility and the overall stability of their financial system that in turn will eradicate both ERP (Ψ_t) and IRP (Φ_t).

This study proposes that a proper sequencing of such policy should follow a two-step process, which at the initial stage relies on minimizing the IRP and reducing it to a predetermined target $\bar{\Phi}_{t+\tau/t}$. Only later when this target is fully accomplished, monetary policymakers will be able to proceed to an advanced stage by redirecting their efforts onto reaching the exchange rate target $\bar{\Psi}_{t+\tau/t}$. In practical terms, these tasks may be accomplished by applying a policy convergence process that begins with SIT, followed by a combination of inflation targeting with some attention to exchange rate stability within the FIT framework, and ends with full euroization.

Taking into consideration the proposed sequence of monetary convergence, policy makers will need to devise corresponding rules for strict and flexible forward-looking inflation targeting regimes. The interest rate rule within the SIT forward-looking framework can be derived from Equation (5) and prescribed as

$$i^d_t - i^*_{t+\tau/t} = \pi^d_t - \pi^*_{t+\tau/t} + \Phi_t. \quad (7)$$

Within this policy framework, the central bank will adjust the difference between the current interest rate and the implied target rate for monetary convergence. The difference is based exclusively on the deviation between the actual and the target inflation, taking into consideration the prevailing IRP. This premium can be lowered as monetary policy gains credibility in financial markets perception. Once the prevailing Φ_t converges to the IRP target $\bar{\Phi}_{t+\tau/t}$ that is required for accession to the common currency bloc, policy makers may decide to switch to the FIT framework that gradually pays more attention to the exchange rate stability. Subsequently, the instrument rule can be modified as

$$i_t^d - i_{t+\tau/t}^* = \delta\left(\pi_t^d - \pi_{t+\tau/t}^* + \Phi_t\right) + (1-\delta)(e_t - e_{t+\tau/t}^* + \Psi_t) \quad (8)$$

The forward-looking FIT regime will initially begin by assigning a larger weight δ to the deviation of actual inflation from the forecast, or convergence target level. If IRP falls to the satisfactory level, the central bank will increase the policy emphasis on the exchange rate stability target (by reducing δ). Realistically, the new targeting formula will enable the monetary authority to reduce ERP to the level that will ensure a smooth entry to a common currency bloc.

2. Uncovered real interest rate parity perspective

The process of monetary convergence that begins from SIT and is followed by FIT becomes perhaps more lucid and easier to interpret if it is presented graphically (Figure 1).[4]

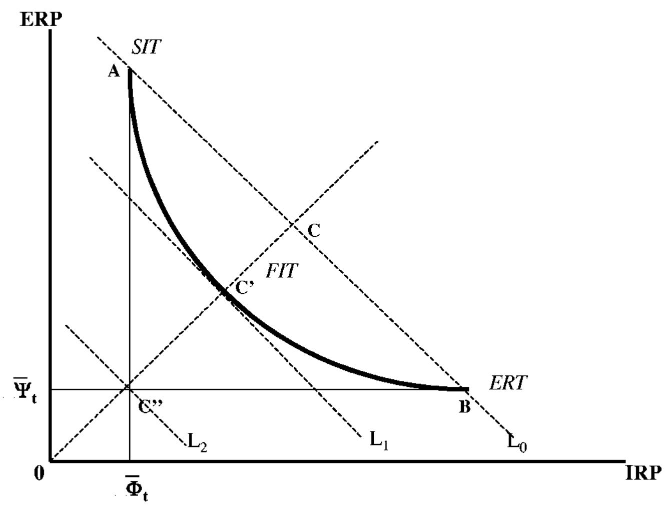

Figure 1. The Inflation Risk Premium (IRP) and the Exchange Rate Risk Premium (ERP) in the Direct Inflation Targeting (DIT) vs. Exchange Rate Targeting (ERT) Framework.

In the scenario outlined in Figure 1, the monetary convergence process begins at point A, at which SIT is aimed solely at curbing IRP to the target level $\bar{\Phi}_t$. This might be consistent with the entry target to the common currency area $\bar{\Phi}_{t+\tau/t}$. However, the initial containment of inflation may result in large variability of the exchange rate, i.e. in a large and excessive ERP. To resolve this issue, the central bank will change its policy approach to the proposed flexible targeting of relative IRP in hope to contain both IRP and ERP. If the combination of IRP and ERP settles at point C, a high degree of both risk premiums is reached. Point C is located on the same credibility locus L_0 as the initial point A, thereby both points are located along the worst possible credibility scenario in the presented model. Point C epitomizes a policy failure to reduce both risk premiums. The proposed policy becomes partially successful in lowering ERP and IRP when point C′ is reached, since this point is located on a greater credibility locus L_1. Ideally, flexible targeting of relative IRP will help finalize the convergence process if both premiums are reduced to C″ thus to the respective target levels at $\bar{\Phi}_t$ and $\bar{\Psi}_t$. Point C″ lies on the L_2 locus that reflects best possible credibility gains, which satisfy the entry into the common currency area. By assumption, although the origin (point 0) of this ERP-IRP tradeoff reflects a fully successful convergence of both risk premiums to their respective levels that prevail within the common currency area, their $\bar{\Phi}_t$ and $\bar{\Psi}_t$ targets can be ultimately viewed as sufficient for a formal accession.

It can be further noted that the diagonal line OC might be identified as an *uncovered real interest rate parity* condition. Any point below this line provides incentives to invest in the domestic market; while points above it promote investment in foreign assets.

3. Interdependence between IRP and ERP in EU candidate countries

The model presented above may provide useful guidance for monetary convergence to a common currency area. The empirical investigation raises the issues of whether there is:

1. a path-dependent relationship between both risk premiums
2. a simultaneous decline in both the IRP and the ERP that would prove a successful pursuit of monetary convergence to the eurozone.

In this paper, the relationship between Φ_t and Ψ_t assumes a quadratic functional form in order to capture possible marginal effects of changes in ERP on IRP. Such effects are likely to prevail if, for instance, a central bank changes the rate of crawling devaluation within a soft peg currency regime and, correspondingly, adjusts a short-term nominal interest rate target. Similar marginal effects may also take place when possible speculative attacks on domestic currency entail sudden, deep depreciation, which in turn prompts the central bank to raise interest rates. The marginal effects of changes in Ψ_t on Φ_t are likely to be found in Poland (until mid-1998) and Hungary (until October 2001) due to prevalence of crawling devaluation. As a result, the examined relationship becomes

$$\Phi_t = \beta_0 + \beta_1 \Psi_t + \beta_2 \Psi_t^2 + \xi_t \tag{9}$$

Since both variables represent two diverse components of financial risk, it seems appropriate to evaluate volatility of both the exchange rate of euro expressed in national currencies, and IRP. For the purpose of empirical investigation, the exchange rate volatility is captured as a variance between the actual e_t and its trend-value $\bar{e}_t$ (estimated with the Hodrick-Prescott filter). The volatility of IRP is based on real interest rate differentials relative to Germany (as a dominant eurozone economy). The empirical tests use contemporaneous variables only, since the preliminary tests have shown that the underlying monetary policies in the three examined countries lack a forward-looking behavior. In addition, interest rates in the model are adjusted for trend-fitted inflation rates $\hat{\pi}_t$ (computed with the Hodrick-Prescott filter), in order to eliminate the impact of transitory shocks to both domestic and foreign inflation. Taking these assumptions into consideration, the empirically tested model can be stated as

$$\left(i_t^d - i_t^* - \hat{\pi}_t^d + \hat{\pi}_t^*\right) = \beta_0 + \beta_1(e_t - \bar{e}_t) + \beta_2(e_t - \bar{e}_t)^2 + \xi_t \tag{10}$$

The relationship specified by (10) is tested with TARCH(p,q). The conditional variance in this model is specified as

$$\begin{aligned} \sigma_t^2 = \omega &+ \alpha_{11}\xi_{t-1}^2 + \alpha_{12}\xi_{t-2}^2 + \cdots + \alpha_{1q}\xi_{t-q}^2 + \gamma\xi_{t-1}^2 d_{t-1} \\ &+ \alpha_{21}\sigma_{t-1}^2 + \alpha_{22}\sigma_{t-2}^2 + \cdots + \alpha_{2p}\sigma_{t-p}^2 \end{aligned} \tag{11}$$

The q-order ARCH terms $\alpha_{1q}\xi_{t-q}^2$ reflect the impact of 'news', or 'surprises', from the previous periods (up to the q-order) on the volatility of relative IRP as a quadratic function of ERP. If the estimated ARCH coefficients are statistically significant and greater than 1, the previous period shocks in the tested model are likely to be destabilizing. By comparison, the GARCH terms $\alpha_{2p}\sigma_{t-p}^2$ demonstrate the impact of *the forecast variance* from the previous periods (up to the p-order) on the current *conditional variance*, or volatility, in the series. Thus the GARCH terms allow for measuring the degree of persistency in the volatility of risk premiums. If the detected GARCH effects are statistically significant, the policy makers face a serious problem of high persistency in the volatility of IRP, which may impair their efforts to lower financial risk. The value of GARCH coefficient close to 1 implies that convergence of the forecasts of conditional variance (volatility) to the steady state is slow and staggered. This may pose a serious problem for monetary authorities that want to successfully converge to a common currency area. The remaining component in Equation (11) is the TARCH asymmetric term $\gamma\xi_{t-1}^2 d_{t-1}$ where d_{t-1} is a dummy variable assuming a value of 1 for all the observed negative shocks $(\xi_{t-1}\langle 0)$ and zero for the positive ones.

The asymmetric term allows for measuring the impact of imbalance between the 'good' news $(\xi_{t-1}\langle 0)$ and the 'bad' news $(\xi_{t-1}\rangle 0)$ about the volatility of relative IRP in the previous period. The good news (the negative shocks) has an impact of α_{1q} on the conditional variance, while the bad news has an impact of $\alpha_{1q}+\gamma$, thus a strong positive leverage effect γ implies importance of large positive shocks to the volatility of relative IRP. The asymmetric effect becomes more pronounced if γ is positive, which suggests that the observed volatility shocks are likely to aggravate trend-volatility of relative IRP. Adversely, if γ is negative, there is a dampening effect on the conditional variance induced by bad news. This might stem, for instance, from expected deliberate, yet effective, policy responses to destabilizing shocks.

Before analyzing the outcome of the TARCH(p,q) process, it is necessary to introduce the actual levels and volatility of IRP relative to Germany in the three examined countries. This information is crucial for understanding the nature of interactions between IRP and ERP and provides insights about the economic and social burden of achieving disinflation and the degree of monetary policy restrictiveness. The mean relative IRPs computed for Poland, Hungary and the Czech Republic on the basis of three-months T-bill rates and trend-fitted CPI inflation rates, as well as their standard deviations are shown in Table 1.

The average IRP relative to Germany was by far the highest for Poland. As a result of a very tight monetary policy and a downright commitment to disinflation within SIT, Poland's real interest rates have exceeded those of Germany by almost 4.5 percent. In addition, they have displayed the highest degree of variability, raising doubts about the overall policy effectiveness and suggesting rather low policy credibility. In a sharp contrast, IRP for Hungary has been lower than for Germany, although it has been quite volatile. The negative relative IRP stems undoubtedly from the crawling peg regime with a narrow band that Hungary pursued until October 2001, although in June 2001 it introduced DIT. This arrangement allowed the National Bank of Hungary (NBH) to micromanage the relationship between IRP and ERP quite effectively without raising economic and social costs.

Based on the above information one may suspect that the Polish-style SIT, which pays little attention to exchange rate variability, is likely to weaken the

Table 1. Inflation Risk Premiums (relative to Germany) and Their Variability in Poland, Hungary and the Czech Republic (January 1995–March 2002).

	Average Φ_t	Standard deviation of Φ_t
Czech Republic	0.070	2.349
Poland	4.436	4.339
Hungary	−0.054	1.539

Source: Own calculations; based on the IMF: International Financial Statistics and national data.

Table 2. TARCH(1,1) estimation results of (10) and (11) for the Czech Republic.

	Coefficient	Standard error	z-statistics	Prob.
β_0	0.029	0.059	0.490	0.624
β_1	−0.903	2.968	−0.304	0.761
β_2	−107.93	192.24	−0.561	0.575
Variance Equation (11)				
ω (constant term)	0.150	0.032	4.610	0.000
α_1 (ARCH(1) term)	1.740	0.536	3.249	0.001
$\gamma = (\xi_t(0) *$ ARCH(1)	−1.572	0.548	−2.866	0.004
α_2 (GARCH(1) term)	−0.050	0.074	−0.678	0.498
AIC = 1.630 SIC = 1.830 DW = 2.070				

Notes: all domestic and German variables are in first-differenced terms since they are all non-stationary at their levels; exchange rates are stated in logs of domestic currency values of one euro; AIC = Akaike Information Criterion, SIC = Schwartz Information Criterion, DW = Durbin-Watson d-statistics.

Source: Own calculations based on the IMF: International Financial Statistics and national data.

relationship between the two risk premiums. In contrast, the Czech FIT that pays attention to the stability of the (fully flexible) exchange rate and Hungary's traditional commitment to exchange rate stability may in fact strengthen the link between both risk premiums. These hypothetical assumptions are broadly confirmed by the TARCH(p,q) specification discussed below for each of the three countries.

3.1. The Czech Republic

The output from TARCH(p,q) estimation of Equations (10) and (11) is shown in Table 2. The presented evidence suggests that the impact of news about volatility in the previous period on the conditional variance (volatility) of relative IRP is strong, as implied by the significant first-order ARCH term. This effect indicates that the conditional variance of IRP has been in fact driven by surprises in the sample period. Moreover, because the value of the ARCH coefficient is greater than 1, there is an explosive growth in the conditional variance, apparently stemming from several episodes of shocks that are observed in the sample period (January 1995–March 2002). These episodes are identified below.

The asymmetric term γ coefficient is significantly negative, which proves that the bad news (positive shocks) had a strong, suppressing impact on volatility of the relative IRP. This finding implies that the observed positive shocks in the investigated period were accompanied by expectations of active policy responses. In other words, any recently observed shocks to IRP were promptly corrected by interest rate adjustments, thus the examined series followed a path of effective 'fine-tuning'. Moreover, since the absolute value of the asymmetric coefficient is greater than 1, it can be argued that the policy responses aimed at correcting the observed shocks have been quite effective.

Another favorable development is the lack of a significant first-order GARCH (1) effect.[5] This shows that volatility of the relative IRP in the Czech Republic has not been persistent. Nevertheless, three strong shocks to the GARCH variance are detected.[6] The first one, rather moderate shock (residual = 3.86) took place in August 1997. It resulted from policy tightening that followed speculative attacks on the Czech Koruna in July 1997 triggered by the contagion effect from the Asian financial crisis. In response, the Czech monetary authority was forced to abandon a currency peg (with a plus-minus 0.5 percent band and without crawling devaluation) and opt for a floating exchange rate system instead. The abandoned currency peg contributed to a sizeable real appreciation of the Koruna and, subsequently, to a deepening current account deficit that was accompanied by strong inflows of short-term speculative capital (Brada and Kutan, 1999). The second, more pronounced shock (residual = 7.06) is detected in February 1998, one month after the introduction of DIT by the Czech National Bank (CNB). It stemmed from the Czech government raising administratively regulated prices of energy, fuel, transportation and other controlled items that elevated inflation expectations and jeopardized effectiveness of the new DIT policy. CNB was forced to respond by raising interest rates in February, and again in May 1998 (Matoušek and Taci, 2002). The May increase induced the third, very strong shock to the GARCH variance (residual = 22.11). The tight monetary policy throughout 1998 and the resulting high real interest rates directly contributed to the upsurge of IRP in relation to ERP. Nevertheless, the decisive policy responses were effective, as implied by the significant negative coefficient of the γ asymmetric term reported in Table 2.

In sum, the TARCH(1,1) results of (10) and (11) for the Czech Republic suggest that the interplay between relative IRP and ERP has been strongly affected by 'surprises' and by asymmetric shocks during the sample period. At the same time, the actual average IRP in the Czech Republic relative to Germany has become quite negligible, which suggests that the monetary convergence to the eurozone may well be on the right track. However, susceptibility to ARCH effects, or surprises, and high instability of the actual IRP pose problems for the future. These problems need to be dealt with prior to an entry to the eurozone.

3.2. Poland

Seemingly different, if not adverse interactions between IRP and ERP are observed for Poland. As Table 3 shows, the ARCH(q) effects are almost entirely negligible; there is only a mild significance of the fifth-order ARCH coefficient. Thus evidently, the news about volatility of IRP from previous periods does not affect the current period volatility of the tested IRP-ERP model. The apparent weakness of the ARCH terms is not surprising due to the fact that the National

Table 3. TARCH(1,5) estimation results of (10) and (11) for Poland.

	Coefficient	Standard error	z-statistics	Prob.
β_0	0.164	0.129	1.272	0.204
β_1	−4.926	4.968	−0.992	0.321
β_2	−97.645	194.06	−0.503	0.615
Variance Equation (11):				
ω (constant term)	0.406	0.203	2.005	0.045
α_{11} (ARCH(1) term)	0.179	0.222	0.804	0.421
α_{12} (ARCH(2) term)	−0.013	0.143	−0.009	0.928
α_{13} (ARCH(3) term)	0.043	0.103	0.416	0.678
α_{14} (ARCH(4) term)	−0.042	0.086	−0.489	0.625
α_{15} (ARCH(5) term)	−0.096	0.004	−1.488	0.137
$\gamma = (\xi_t(0) *$ ARCH(1)	−0.308	0.228	−1.350	0.177
α_2 (GARCH(1) term)	0.538	0.260	2.070	0.039
AIC = 2.691 SIC = 3.005 DW = 1.462				

Notes: all domestic and German variables are in first-differenced terms since they are all non-stationary at their levels; exchange rates are stated in logs of domestic currency values of one euro; AIC = Akaike Information Criterion, SIC = Schwartz Information Criterion, DW = Durbin-Watson d-statistics.

Source: Own calculations based on the IMF: International Financial Statistics and national data.

Bank of Poland (NBP) has continuously applied a very tight monetary policy. The degree of restrictiveness of Poland's monetary policy has been consistent with the precepts of SIT, accompanied by fully flexible exchange rates, that has been applied there since January 1999 (Orlowski, 2001). The determination to dampen inflation coupled with a benign neglect of exchange rate fluctuations result in consistently high real interest rates and a fairly stable exchange rate path. These high and predictable real interest rates have allowed Poland to cushion any contagion effects of the Asian and the Russian financial crises. Consequently, since speculative attacks on the Polish Zloty have been averted, the currency has displayed a remarkably low volatility during the sample period. It can be argued further that the ambiguous ARCH effect seems to suggest that the exchange rate channel of monetary policy transmission operates within some unspecified, indeterminate time lags.

In a sharp contrast to the Czech case, there is no ample evidence of asymmetric effects in Poland as implied by the insignificant γ term. However, again contrary to the Czech situation, the first-order GARCH term in Poland is significant and is also moderately persistent, as implied by the value of the α_{21} coefficient reaching 0.54. Arguably, the previous period forecast variance of relative IRP seems to have some impact on its current volatility. However, further investigation of shocks to the GARCH variance does not reveal their recognizable presence, which reaffirms evidence of high monetary stability and effective resistance to contagion effects of external financial crises. The only meaningful, although by all means mild shock can be observed for April 1995 (residual = 1.32). It coincides with the official decision to widen the band of permitted currency fluctuations in an effort to enact an exchange rate regime based on a crawling band in place of the previous hard peg.

The observed TARCH (1,5) terms confirm that Poland's monetary policy has been consistently tight and seemingly independent of exchange rate fluctuations. Since the resulting high average relative IRP is harmful to economic growth and employment (18 percent unemployment rate at the end of 2002), the monetary policymakers will be well advised to find effective ways of lowering and stabilizing IRP and ERP. The proposed policy framework of flexible targeting of relative IRP may be a viable policy choice for achieving these crucial goals of monetary convergence to the eurozone without inflicting an economic and social burden.

3.3. Hungary

Yet another combination of TARCH effects is observed in Hungary. Table 4 shows a very pronounced, although mildly persistent GARCH(1) term, in addition to a negligible ARCH(1) reaction and the lack of asymmetric responses. The clear impact of the previous period forecast variance on the volatility of relative IRP (the GARCH(1) term) is ostensibly stronger in Hungary than in Poland. Quite remarkably, the GARCH(1) effects are similar in both countries in spite of two different monetary policy regimes. While Poland applied DIT in January 1999, Hungary had not done so until June 2001, when it replaced the system of

Table 4. TARCH(1,1) estimation results of (10) and (11) for Hungary.

	Coefficient	Standard error	z-statistics	Prob.
β_0	0.013	0.075	0.170	0.865
β_1	10.957	7.292	1.503	0.133
β_2	285.70	134.88	2.118	0.034
Variance Equation (11)				
ω (constant term)	0.078	0.041	1.895	0.058
α_1 (ARCH(1) term)	0.343	0.269	1.271	0.204
$\gamma = (\xi_t(0) *$ ARCH(1)	−0.104	0.286	−0.365	0.715
α_2 (GARCH(1) term)	0.530	0.151	3.497	0.001
AIC = 2.099 SIC = 2.300 DW = 2.157				

Notes: all domestic and German variables are in first-differenced terms since they are all non-stationary at their levels; exchange rates are stated in logs of domestic currency values of one euro; AIC = Akaike Information Criterion, SIC = Schwartz Information Criterion, DW = Durbin-Watson d-statistics.

Source: Own calculations based on the IMF: International Financial Statistics and national data.

exchange rate targeting based on crawling devaluation with a narrow band of permitted currency fluctuations (2.25 percent around the central parity rate of the Hungarian Forint against the Euro). The significant GARCH(1) effect proves that the changes in volatility of the relative IRP as a function of ERP are quite sensitive to its volatility in the previous period. However, these responses have been well balanced, as the shocks to the GARCH variance are rather uneventful. There is only one, relatively mild turbulence (residual of +2.07) observed for July 1995. These stable reactions indicate that interaction between both risk premiums in Hungary has been successfully coordinated. This is not surprising since the NBH has always emphasized strong commitment to achieving price stability and simultaneously to lowering exchange rate variability. This policy stance is quite different from the DIT conduct in Poland and the Czech Republic that has been, at least recently, accompanied by a 'benign neglect' approach to the floating exchange rate.

Moreover, the mean equation displayed in Table 4 proves that in Hungary, in contrast to Poland and the Czech Republic, the marginal effect β_2 of changes in ERP on IRP is significant. This may stem from high sensitivity of IRP to changes in the rate of crawling devaluation. Apparently, real interest rates in Hungary were quite responsive to marginal changes in ERP, which proves perseverance of a fairly good alignment between nominal interest rates, inflation expectations, and shocks to the forint value of the euro. Another noteworthy effect shown in Table 4 is that the sum of ARCH and GARCH terms (=0.87) is fairly close to unity, which indicates that the volatility shocks are persistent, so that the forecasts of the conditional variance in fact do converge, albeit slowly, to the steady state. Therefore, the interactions between the dynamic changes in both risk premiums are becoming better defined.

In sum, the above empirical results for the three countries prove that sensitivity of IRP to changes in ERP is stronger for Hungary than for Poland or the Czech Republic. The estimated ARCH coefficients are more significant for the Czech Republic than for Hungary and certainly for Poland, which proves that the Czech volatility of IRP was largely driven by 'surprises' during the sample period. Since the value of ARCH(1) coefficient in the Czech case is greater than 1, the impact of surprises has been quite destabilizing. In contrast, the GARCH(1) effects assume quite opposite patterns and intensity. They are more pronounced for Poland and Hungary, while undetectable for the Czech Republic. The asymmetric effects are quite strong for the Czech Republic, mild for Poland and nearly absent for Hungary. This underscores the lack of uniformity in the interactions between IRP and ERP.

The diversity of the empirically tested reactions between both risk premiums requires more extensive research that goes beyond the boundaries of this study. Nonetheless, the obtained differences can be at least partially explained by the divergent monetary regimes that are highlighted in this exercise; they may also stem from differences in the level of advancement of financial markets and institutions in these countries.

4. Concluding remarks

This study stresses the importance of lowering the inflation risk premium and the exchange risk premium as primary objectives for the EU candidates on their proposed path of monetary convergence to the eurozone.

The presented empirical tests show that the candidate countries have not been seemingly successful in lowering both categories of risk premiums at the same time. It is because the monetary authorities of all three countries have placed a strong emphasis on reaching the goal of price stability and by doing so, they indeed aggravated exchange rate volatility. Their policy efforts have been additionally impaired, as they felt compelled to respond to strong contagion effects of international financial crises. Such actions resulted in elevated IRP in these countries, particularly in 1997 and 1998. The empirical evidence shows significant differences in ARCH, GARCH and asymmetric coefficients, which imply that the environment of monetary policies in the three examined countries is seemingly diverse. Thereby, monetary authorities of these countries need to adopt optimal policies that are tailored to their specific circumstances as policy prescriptions that are based on standardized approaches to monetary convergence seem rather out of place here.

The proposed framework of flexible targeting of relative IRP is an expedient venue for tailoring appropriate monetary convergence process. It is likely to result in lowering IRP and ERP as it emphasizes a balanced combination of both targets: the disinflation and the exchange rate stability.

The presented model shows that a simultaneous reduction in both premiums poses a challenge to monetary policymakers as it entails certain tradeoffs and requires proper sequencing of monetary policy. Specifically, the aim to reduce IRP to the level prevailing in a common currency area may entail monetary policy easing, which in turn exacerbates exchange rate volatility.

A proper policy sequencing for the transition economies requires a two-step process that involves placing emphasis on disinflation, or minimizing IRP, first, and only later giving more consideration to exchange rate stability. The accession countries should begin the convergence process by applying SIT. Once a satisfactory level of price stability is achieved, they might consider a monetary regime based on targeting a low level of IRP. This will demonstrate policy commitment not only to lowering inflation, but also to reducing real interest rates, thus to minimizing economic and social costs of such policy. In order to reduce IRP to the level prevailing in the euro area, the candidates may apply a *flexible* policy approach that is to set a supporting conditional target of exchange rate stability. Against this background, the policy becomes consistent with the proposed model of flexible targeting of relative IRP. Such approach can be reasonably expected to enable the candidates to reduce simultaneously the IRP and the ERP.[7] In addition, a reliance on forward-looking behavior along with realizing gains in policy credibility is also essential to a successful convergence, as the overall stability will contribute to reaching this goal.

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Notes

1. This approach to flexible inflation targeting differs from the more traditional view expressed, for example, by Svensson (1999a), that combines low inflation and output stability targets.
2. Various forms of central bank reaction function are proposed and exhaustively examined by Svensson (1999b).
3. See Orlowski (2002) for a detailed description of direct inflation targeting policies in the Czech Republic, Poland and Hungary.
4. The presented model is an updated and extended version of the one initially proposed in Orlowski (2001).
5. Only the first-order GARCH effects are statistically significant and thus reported for the three examined countries.
6. This can also be seen by plotting the estimated conditional variances and observing the dates of surprises visually. Due to space constraints, the graphical presentation of exact distributions of the GARCH variance is omitted here; yet, the scope and the timing of major shocks in this series are discussed in the text for each of the examined countries.
7. The presented policy recommendations may be feasible for the candidate countries with fairly well developed financial markets, such as Poland, Hungary and the Czech Republic, while they may not be suitable for smaller states (i.e., the Baltic Countries) that are advised to pursue currency board arrangements on their path to the euro instead. It is because inflation-targeting policies require proper signals about the behaviour of monetary variables, which can be extracted from advanced and competitive financial markets. In addition, implementation of such policies can be only exercised through open market operations that cannot be performed effectively in underdeveloped financial markets.

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