The Monetary Independence Hypothesis: Evidence from the Czech Republic, Hungary and Poland*

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Empirical evidence on the validity of the monetary independence hypothesis for a group of advanced accession countries (the Czech Republic, Hungary and Poland) is presented. In particular, we employ Dynamic Conditional Correlation Multivariate GARCH (DCC-MGARCH) models to estimate the degree of (time-varying) correlation in interest rates shocks with respect to two leading economies, Germany and the US, under different exchange rates regimes. The results are mixed: while the dynamic behaviour of the correlations in interest rate shocks in the Czech Republic appears consistent with theory, no evidence concerning the validity of the monetary hypothesis is found for Hungary and Poland.

Introduction

For long the monetary independence hypothesis has served as the main framework to think about monetary policy under different exchange rate regimes. Under floating exchange rate regimes, countries are free to choose their optimal level of inflation and interest rates. Under fixed exchange rate regimes, in turn, countries are forced to import the monetary policy from abroad.

A recent line of literature, however, argues that this standard textbook proposition that flexible exchange rate arrangements allow to retain monetary independence with domestic interest rates being used as an economic policy instrument does not really hold for emerging markets (see for example Frankel 1999, Hausmann et al. 1999). Contrary to theoretical considerations as well as empirical evidence for industrialized economies, interest rates in emerging markets with more flexible exchange rate systems have been found to react much more to foreign interest rate shocks (and shocks to international risk premium) than interest rates in those emerging markets which operate hard forms of exchange rate regimes. The argument is that, due to credibility problems, strong inflation pass-through of exchange rates and/or wide-spread currency substitution, emerging countries cannot effectively utilize interest rates and nominal exchange rates to absorb shock stemming from abroad. Emerging market economies can be seen as an example of the so called "fear of floating"- even if they officially declare their exchange rates systems as floating, they try to limit the movements of their currencies (Calvo and Reinhart, 2002, Hausmann et al. 2000). In other words, de jure flexible exchange rate systems become de facto fixed

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ones[1]. If flexibility of exchange rates is merely an illusion, emerging market economies would be well advised to officially adopt some form of fixed exchange rate regimes since it would allow them to reap additional benefits of pre-commitment, namely reduced currency (and default) risk premium and, hence, lower interest rates stimulating investments and growth in the economy.

The observed "fear of floating" behavior of many emerging countries has given rise to the emergence of many voices encouraging these countries to introduce rigid forms of exchange rate regimes such as currency boards or to unilaterally adopt a foreign currency. Financial considerations regarding the choice of exchange rate regime have started to dominate "structural" concerns, entrenched in the Optimum Currency Area (OCA) theory. This being the more so, as the OCA criteria have been claimed to be endogenous (Frankel and Rose, 1999).

The main aim of the present paper is to examine whether there is empirical support for the monetary independence hypothesis in advanced accession countries. In doing so, we concentrate on a group of four advanced accession countries, namely the Czech Republic, Hungary and Poland[2]. Our paper differs from other studies in two main respects. First, we take a closer look at Central European accession countries that have been so far neglected in the analysis of the monetary independence hypothesis. As these countries have frequently changed their exchange rate regimes over the last decade they represent a fertile ground for this kind of analysis. Furthermore, these countries are taking part in the E(M)U integration process and our study can thus shed some light on the role of this process on the effectiveness of exchange rate polices in providing monetary independence in these countries. Second, we employ a new modeling strategy, a DCC Multivariate GARCH that allows us to trace the change of the degree of monetary independence over time and across countries on real time basis. This is a considerable improvement since the analyses done so far have restricted to estimating non time-varying point estimates for a given period of time.

The outline of the reminder of this paper is as follows. In section two, we present an overview of theoretical and empirical literature on the monetary independence hypothesis. In section three the dataset used for the empirical analysis is presented, together with the econometric methodology. The modeling strategy will be based on the estimation of Multivariate GARCH models (MGARCH models) with time-varying correlations across error terms for daily data on interest rates. More precisely, a dynamic correlation structure in the spirit of the models in Engel (2002) will be used in order to obtain estimations of the correlation dynamics. Section four presents and interprets the results obtained, and section five concludes.

2. Monetary Independence Hypothesis: Theory and Empirical Research

The monetary independence hypothesis can be traced back to Friedman (1953), who argued that flexible exchange rates would allow countries to pursue independent monetary policies as well as adjust easily to eliminate payments imbalances and offset changes in their international competitiveness (and that profit-maximizing speculators would on average tend to stabilize the rate at its long-term equilibrium value rather then destabilize it). In order to illustrate the argument underlying the monetary independence hypothesis, let us consider the simplest version of the uncovered interest rate parity (UIP) condition. If there are no capital controls, default risk, or any other country specific risk premia, then

$$i_t - i_t^* = E(\Delta e_{t+1} | \Omega_t) + rp_t \qquad (1)$$

where i_t is the domestic interest rate, i_t^* is the "world" interest rate level, $E(\cdot)$ is the expectation operator, Ω_t is the information available up to period t, e_t is the log of the exchange rate and rp_t is the currency risk premium. In absence of currency risk premium, if exchange rates are eternally fixed, i.e. $E(\Delta e_{t+1} | \Omega_t) = 0$, domestic interest rates are equal to foreign interest rates. Under a floating exchange rate regime, in turn, e_t is allowed to vary and domestic and foreign interest rates are independent from each other, with the exchange rate doing the job of making the UIP condition hold.

The empirical literature on the monetary independence hypothesis seems to be less straightforward in its conclusions. In principle, there are only few papers that directly address this issue[3]. Hausmann et al. (1999) were among the first ones that kicked off this research agenda. They assess the

[1] It can be argued that if de jure flexible regimes are de facto fixed ones due to the authorities' fear of floating, it is rather a wrong exchange rate classification that leads to the rejection of the monetary independence hypothesis than the invalidity of the hypothesis in itself. Since the recognition of this problem a great deal of research has been devoted to developing new statistical methods of discerning true exchange rate regimes (see for example Levy-Yeyati and Sturzenegger (2000)). On the other hand, however, the empirical approach of testing the monetary independence hypothesis adopted for example in Hausmann et al (2000) or Borensztein et al (2001) – both reported in details in the next section – which is based on comparing floating countries with currency baord/dollarized countries seems to be able to deal with this problem – currency board or dollarization regimes are certainly immune to the possible difference between de jure and de facto exchange rate regimes.

[2] Our choice of countries reflects the availability of data, rather than any form of self-selection bias.

[3] We abstract here from those studies that analyze monetary independence in a specific context of the credibility of target zones (see for example Edison and MacDonald, 2000).

performance of alternative exchange rate regimes in Latin America relative to the benefits they are theoretically supposed to deliver. In particular, they test whether flexible systems allow for better cyclical management, more monetary autonomy and improved control of the real exchange rate. The authors find that flexible exchange rate regimes have not permitted a more stabilizing monetary policy, and actually pro-cyclical monetary measures were incentivated in flexible exchange rate regimes. Moreover, flexible regimes have resulted in higher real interest rates and smaller financial systems and – the most importantly from the point of view of this piece of research – greater sensitivity of domestic interest rates to movements in international rate. Furthermore, flexible exchange rates tend to promote wage indexation.

Similar results are reported in Frankel (1999). Among other things Frankel (1999) analyses the sensitiveness of interest rates of several emerging markets to US Federal Funds and concludes counties with floating or intermediate regimes (Mexico after 1994 and Brazil before mid-1998) show much higher interest rate response than countries with less flexible exchange rate regimes, such as Argentina, Hong Kong or Panama. Latin American interest rates are found to be more sensitive to US interest rates when the country has loose dollar peg that when it has a tight peg.

Frankel et al. (2000, 2002) and Borensztein et al. (2001) look at different country groups in order to gauge possible differences in terms of deviations from the monetary independence hypothesis. Frankel et al. (2000) explores the empirical regularities concerning the sensitivity of local interest rates to international interest rates, and how it is affected by the countries' choice of exchange rate regime. The paper uses a reduced-form empirical approach to compute both panel and single-country estimates for a large sample of developing and industrialized economies during 1970-1999. The full sample estimates appear to support the conventional wisdom: more rigid currency regimes tend to exhibit higher transmission of interest rates than more flexible regimes, and the former typically possess lower interest rates on average that the latter. However, a closer analysis of the 1990s shows that in most cases one cannot reject full transmission, even for countries with floating regimes. Only large industrial countries can benefit or choose to benefit form independent monetary policy. During the 1990s interest rates in European countries are fully sensitive to German interest rates, but insensitive to US interest rates. In a follow-up to these results, Frankel et al. (2002) confirm the conclusions above: only a couple of large industrial countries can choose their own interest rates in the long run. Additionally, using dynamic estimates they show that interest rates of countries with more flexible regimes adjust more slowly to changes in international rates, implying some capacity for monetary independence.

Borensztein et al. (2001) compare the impact of shocks to US interest rates on domestic interest rates in a group of 4 countries coming from different regions, namely Hong Kong and Singapore from Asia and Argentina and Mexico from South America, and resort to different exchange rate regimes. An additional value added of the study is that it also takes into account the effects of shocks to international risk premium on interest rates in the countries under study. Their results for two Asian economies are in line with the theoretical proposition: interest rates in Hong Kong (currency board) react much more to US interest rate shocks and shocks to international risk premium that interest rates in Singapore (flexible exchange rate). The results are less clear-cut in the comparison of Argentina (currency board) and Mexico (flexible exchange rate): while interest rates (and the exchange rate) in Mexico seem to react less to US interest rate shocks, they react about the same to bond spread shocks, in addition to a significant impact on the exchange rate.

In a recent study, Fratzscher (2002) analyzed the trade-off between exchange rate flexibility and monetary policy autonomy. Looking at a set of open emerging markets and ERM countries he found no systematic link between exchange rate flexibility and monetary independence. Additionally, the Fed is found to be the dominant force in world capital markets, although the importance of ECB has been increasing and that a Euro bloc has formed in Europe.

From the above we see that most of the empirical research dealing with the monetary independence hypothesis focused mainly on emerging markets from Latin America, and to a lesser extent from Asia. The new evidence against the monetary independence that is found in this set of countries has been then used for policy prescription regarding the choice of the exchange rate regime in other emerging countries, including those from Central and Eastern Europe. Very little research on monetary independence hypothesis has been done for CEE accession countries. Fratzscher (2002) in his broad set of countries looked only at two CEE countries, the Czech Republic and Poland. Habib (2002) addressed the issue monetary independence hypothesis in CEE, although only indirectly. He studies the impact of external factors on daily exchange rates and short-term interest rates in the Czech Republic, Hungary and Poland. He finds that both exchange rates and interest rates are not influenced by short-term German interest rates. However, shocks to emerging market risk premium seem to have an impact on exchange rates in the countries under study.

A somewhat closer inspection suggests, however, that CEE accession countries do differ in some respects from many other emerging market economies, in

particular from those of Latin American. This is important, because after all, policy prescriptions on the choice of the monetary regime in the widest sense should be geared to country characteristics. Most accession countries have made substantial headway towards achieving macroeconomic stability. In contrast to many Latin American countries where new currencies have been introduced repeatedly after failing monetary reforms, accession countries have essentially remained, with relatively minor and temporary slippages, on the basic stabilization track since the early stages of the transition process. As a result, the credibility of the monetary authorities and the confidence in national currencies has been on the rise, whereas inflation has been on a firm falling path[4]. Consequently, the use of foreign currencies in cash transactions has fallen substantially and is now much less prevalent in most accession countries than it is in Latin American countries. The same is true for household deposits where the share of forex-denominated deposits is relatively low and falling at least in the Central European accession countries (see for example Reininger and Schardax, 2001). This implies that the "fear of floating" argument is of lesser relevance in applicant countries, with Poland – which de jure operates a managed float but de facto pursues a free float strategy – being the most obvious case. Likewise, the "peso problem" is less acute and the "original sin" hypothesis does not or not fully apply as long-term financing in domestic currency is increasingly becoming available in accession countries and this is true, with some variation among individual accession countries, both for the government securities and the corporate and household credit markets. Furthermore, there is little evidence that devaluation is contractionary in Central and Eastern European accession countries. Consequently, many features upon which proposals in favor of abolishing the domestic currency rest do not, or to a much lesser extent than in other emerging market economies, exist in the candidate countries of Central and Eastern Europe.

It seems reasonable to suggest that the prospects of EU integration have played and will continue to play a fundamental role in this respect. The external constraints that result from fulfilling the conditions for EU accession are helping to solve the commitment problem of monetary and fiscal authorities and constitute an anchor for macroeconomic discipline, for institution-building/reinforcement and for structural reforms. In particular, it has fostered the creation of domestic institutions dedicated to price stability, as legal provisions on central bank independence have been strengthened substantially.

[4] For a more extended analysis of the disinflation performance of the Central and Eastern European EU accession countries see Backé et al. (2002).

3. A framework for modeling time-varying correlations in presence of time-varying volatility

This section presents the data used in the estimations and the econometric framework used in order to obtain time-varying correlations for interest rate shocks. The analysis uses daily data, and models simultaneously dynamic correlations and time-varying volatilities following the framework recently proposed by Engle (2002).

3.1. Data description

The countries considered in the study are the Czech Republic, Hungary and Poland. Germany and the USA serve as the foreign countries. The data frequency is daily and the time series differ across countries and variables. The longest time series spans from January 1994 to February 2003. In the study, we use inter-bank money market rates with maturity of 3 months as a short term interest rate. In order to avoid results driven purely by aggressive disinflationary policies in CEECs, we concentrate on real interest rates. The real interest rates are constructed by deflating the nominal rates by the year-on-year monthly CPI inflation; we use ex post inflation rates. All data on interest rates are taken from Bloomberg and DataStream. In case of Poland and Hungary time series on 3 months inter-bank rates are sourced from the National Bank of Poland and the National Bank of Hungary. Data on inflation rates for our Central and Eastern European countries are taken from the Vienna Institute for International Economic Studies. Inflation rates for Germany and the USA are sourced from the Eurostat and the Federal Labor Statistics respectively.

One interesting feature of our data is that is allows us to analyze the issue of the monetary independence hypothesis in two different frameworks. First, we make cross-country comparisons, as all of the countries differ in terms of their exchange rates regimes. Second, we analyze the property of each country's time series independently. All three countries under study have been changing their exchange rate regimes in the course of the last decade quite often. However, their exchange rate policies have been characterized by a continuous drive towards more flexible arrangements. Currently the Czech Republic resorts to a managed float, Poland to a free float and Hungary employs an ERM2-cum +/-15% exchange rate band. Table 1 summarizes the development of the exchange rate arrangements adopted in the Czech Republic, Hungary and Poland since 1993.

High data frequency allows us to look analyze periods with different exchange rate regimes in each country without experiencing a dramatic loss of

Table 1. *Exchange Rate Regimes in the Czech Republic, Hungary and Poland in 1993-2003*

Date	Exchange Rate Regime	Band	Monthly Devaluation	Basket /Reference Currency
		Czech Republic		
Since January 1993	Fixed	+/-0.5%	NO	DM 65%, USD 35%
February 1996	Fixed	+/-7.5%	NO	-
27 May 1997	Managed floating	NO	NO	NO, euro main trading currency
				on fx market
		Hungary		
Since 16 March 1995	Crawling Peg	+/-2.25%	1.9%	USD 30%, ECU 70%
01 January 2000	-	-	-	EUR 100%
04 May 2001	Crawling Band	+/-15%	0.2%	-
01 September 2001	Wide-band fixed peg	+/-15%	NO	-
		Poland		
Since May 1995	Crawling Band	+/-7%	1.2%	USD 45%, DM 35%, GBP 10%, FRF 5%,
				CHF 5%
26 February 1998	-	+/-10%	0.8%	-
28 October 1998	-	+/-12.5%	-	-
01 January 1999	-	-	-	EUR 55%, USD 45%
25 March 1999	-	+/-15%	0.3%	-
12 April 2000	Free floating	NO	NO	NO, dollar main trading currency
				on fx market

Source: Habib (2002), respective central banks.

degrees of freedom. Figures 1, 2 and 3 give information on the different exchange rate regimes for the countries in our sample. In case of the Czech Republic, a fixed exchange rate periods goes from the early nineties to May 26, 1997 and the managed float exchange rate regime was active from 27 May, 1997 to 2003.

In the case of Poland, four periods can be identified. Period 1 (crawling peg): from the early nineties to May 1995. Period 2 (crawling band): from May 1995 to April 11, 2000; Period 3 (crawling band without interventions) from August 1, 1998 to April 11, 2000; Period 4 (free float): from April 12, 2000 to 2003.

For Hungary, a crawling peg/band period spans from the early nineties to May 12, 2001, and an ERM2-cum band has been used from October 1, 2001 to 2003.

Figure 1 *Exchange Rate of the Czech Crown against Euro and Regimes Shifts*

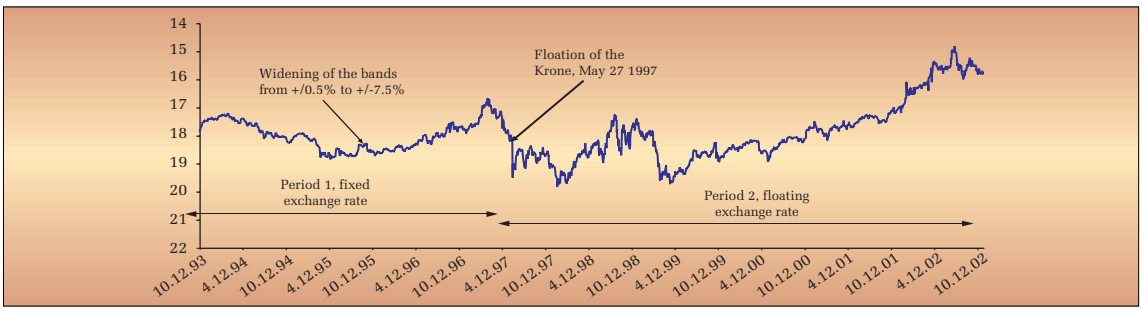


Figure 2 *Exchange Rate of the Polish Zloty against Euro and Regimes Shifts*

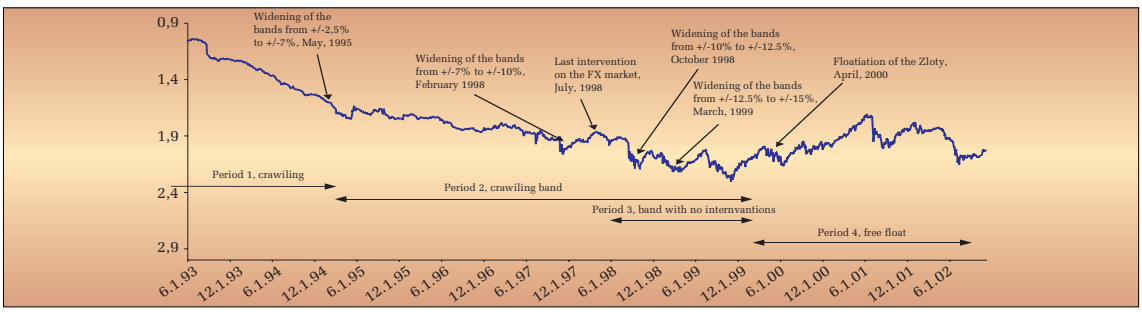
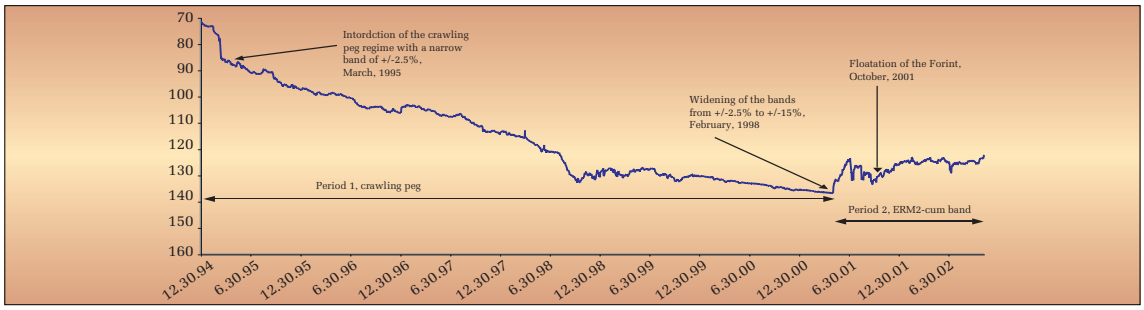


Figure 3. *Exchange Rate of the Hungarian Forint against Euro and Regimes Shifts*



3.2. The econometric framework: DCC-MGARCH models

MGARCH models (see e.g. Kroner and Ng, 1998, for an overview) present a natural analytical framework for studying shock correlations under time-varying volatility. The model used here in order to analyze the monetary independence hypothesis in terms of interest rate volatility contagion for interest rates in CEECs is the Dynamic Conditional Correlation MGARCH (DCC-MGARCH) model developed in Engle (2002) and Engle and Sheppard (2001).

Consider, for example, the bivariate vector $r_t = (r_{1t} r_{2t})'$ composed by, say, interest rates in country 1 and country 2. Δr_t is said to follow a DCC-MGARCH with mean reversion in conditional correlations if

$$\Delta r_t \left| \Omega_{t-1} \sim N(\vec{0}, D_t R_t D_t), \right. \qquad (2)$$

$$D_t^2 = diag\{\theta_1, \theta_2\} + diag\{\lambda_1, \lambda_2\} \circ \Delta r_{t-1} \Delta r_{t-1}' + diag\{\eta_1, \eta_2\} \circ D_{t-1}^2, \qquad (3)$$

$$R_t = diag\{Q_t\}^{-1} Q_t diag\{Q_t\}^{-1}, \qquad (4)$$

$$Q_t = S\{1 - \alpha - \beta\} + \alpha \varepsilon_t \varepsilon_{t-1}' + \beta Q_{t-1}, \qquad (5)$$

where $\varepsilon_t = D_t^{-1} \Delta r_t$ are the standarized errors, S is their unconditional correlation matrix, $\circ$ is the Hadamard product and it is assumed that $\alpha + \beta < 1$. The specification given by (2)-(5) implies that a typical element $[Q_t]_{ij}$ of Q_t can be written as

$$[Q_t]_{ij} = [S]_{ij} + \alpha(\varepsilon_{i,t-1}\varepsilon_{j,t-1} - [S]_{ij}) + \beta([Q_{t-1}]_{ij} - [S]_{ij}),$$

that is, for $\alpha+\beta < 1$, the correlations are modeled as a mean reverting process around the unconditional correlation matrix. The mean reversion process in (5) can be generalized to contain more lags of $\varepsilon_t \varepsilon_t'$ and Q_t in a straightforward manner. The parameters in the model (2)-(5) can be estimated by maximum likelihood, although Engle (2002) proposes simpler estimation methods for high-dimensional DCC-MGARCH models that yield consistent but inefficient estimates of the parameters in the specification of the dynamic correlation.

In principle, the specification of the dynamic conditional correlation given by (5) is only one of the many possible dynamic structures that can be imposed to the conditional correlations in a DCC-MGARCH. The choice of a mean reverting specification is based on the positive results reported in Engle (2002) for the mean reverting model in experiments with different correlation structures. The mean reverting structure performs well even if the underlying process for the correlations is discontinuous, as could be the case for exchange rate regime changes. Notice that for the case $\alpha+\beta = 1$, the correlation structure collapses to

$$[Q_t]_{ij} = (1-\beta)(\varepsilon_{i,t-1}\varepsilon_{j,t-1}) + \beta[Q_{t-1}]_{ij} \qquad (6)$$

which implies that the time varying correlations can be calculated by applying an exponential smoother with parameter β to the correlations observed in the standardized residuals. For more details concerning specification and estimation of DCC-MGARCH models, see Engel (2002) and Engle and Sheppard (2001).

4. Interest Rate Contagion and the Monetary Independence Hypothesis in CEECs: Empirical Results

When modeling time-varying correlations in interest rates of CEECs against German and US interest rates, we followed a systematic strategy. First, we removed the linear structure potentially existing between interest rate changes in CEECs and in the two foreign countries considered by estimating simple bivariate VAR models in first differences for pairs of real interest rates corresponding to the country of interest and, alternatively, Germany and the US[5]. The DCC-MGARCH

[5] In all cases, the lag length of the VAR model was chosen as to minimize the Schwarz information criterion for lags ranging between one and ten. The results of the individual VAR models are available from the authors upon request.

Table 2. *DCC-MGARCH estimates: Czech Republic*

Czech Republic - Germany		
Parameter	**Estimate**	**Std. Error**
α	0.0052***	0.0005
β	0.9929***	0.0010
Log-Likelihood	-4939.386	
LR test statistic	14.1741	(p-value: 0.0002)
H_0: α + β = 1		
Czech Republic - US		
Parameter	**Estimate**	**Std. Error**
α	0.0016***	0.0001
β	0.9956***	0.0001
Log-Likelihood	-5317.007	
LR test statistic	>1000	(p-value: 0.0000)
H_0: α + β = 1		

estimations were thus done using the residuals of this estimation. A model such as (2)-(5) was then fitted to the bivariate series of residuals following the estimation strategy proposed by Engle (2002). The maximum likelihood estimators of the parameters α and β in (5) were retrieved making use of the sample covariance structure of the normalized residuals from individual GARCH(1,1) models fitted to the VAR residuals. The results of the estimation of α and β for all pairs of interest rates are presented in Tables 2, 3 and 4, together with the result of likelihood ratio tests for H_0: $\alpha + \beta = 1$. For those pairs of interest rates where the null of integratedness could not be rejected, a model such as (2)-(4) (6) was estimated. The data give support to the integrated model for Hungary against Germany and the US and for Poland against Germany. The null of $\alpha + \beta = 1$ is strongly rejected for the rest of the cases. These models are reported in Table 2, 3, 4.

Figures 4, 5, 6, 7, 8 present the estimated time varying correlations for all countries, using the statistically significant models presented in Tables 2, 3, and 4. In all cases estimations are based on 3 months real inter-bank rates.

Figure 4 reports results for the correlation of interest rate shocks between the Czech Republic and Germany. The results presented here seem to confirm the validity of the monetary independence hypothesis: the level of the correlation in interest rate shocks has on average decreased after the introduction of a floating exchange rate in May 1997 (note that Fratzscher (2002)

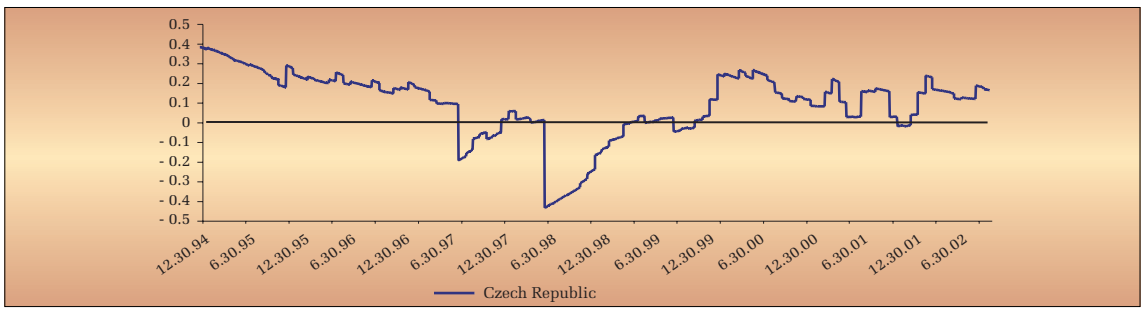
Table 3. *DCC-MGARCH estimates: Hungary*

Hungary - Germany		
Parameter	**Estimate**	**Std. Error**
α	0.0015	0.0020
β	0.9940***	0.0106
Log-Likelihood	-3400.110	
LR test statistic	0.2530	(p-value: 0.6150)
H_0: α + β = 1		
Integrated model:		
Parameter	**Estimate**	**Std. Error**
β	0.0020	0.0014
Log-Likelihood	-3875.064	
Hungary - US		
Parameter	**Estimate**	**Std. Error**
α	0.0010***	0.0001
β	0.9999***	0.0001
Log-Likelihood	-3736.210	
LR test statistic	0.0032	(p-value: 0.9546)
H_0: α + β = 1		
Integrated model:		
Parameter	**Estimate**	**Std. Error**
β	0.0062***	0.0009
Log-Likelihood	-3527.189	

Table 4. *DCC-MGARCH estimates: Poland*

Poland - Germany		
Parameter	**Estimate**	**Std. Error**
α	0.001179**	0.000560
β	0.997285***	0.002785
Log-Likelihood	-4400.862	
LR test statistic	0.406226	(p-value: 0.5239)
H_0: α + β = 1		
Integrated model		
Parameter	**Estimate**	**Std. Error**
β	0.0017***	0.0003
Log-Likelihood	-4401.819	
Poland - US		
Parameter	**Estimate**	**Std. Error**
α	0.0010***	0.0001
β	0.9961***	0.0001
Log-Likelihood	-4683.190	
LR test statistic	427.2423	(p-value: 0.0000)
H_0: α + β = 1		

Figure 4. *Correlation estimates: Czech and German interest rate shocks (January 1994 - February 2003)*



finds the opposite). The figure reveals quite interesting dynamics, though. The correlation decreased sharply and turned negative just before the outbreak of the crisis in May 1997, as pressure of the financial markets made domestic conditions dominate the development of interest rates on the Czech money market. The correlation remained negative during the turbulent time of 1997 and 1998, when a wave of emerging market crises hit the world economy[6]. In 1999 it turned positive but it remained on a lower level than before 1997 since then.

Figure 5 reports results for the correlation of interest rate shocks between Poland and Germany.

[6] Whether the negative correlation was a result of contagion from other emerging markets or just a result of domestic factors is an open issue and should be subject to further research.

Figure 5. *Correlation estimates: Polish and German interest rate shocks (January 1994 - February 2003)*

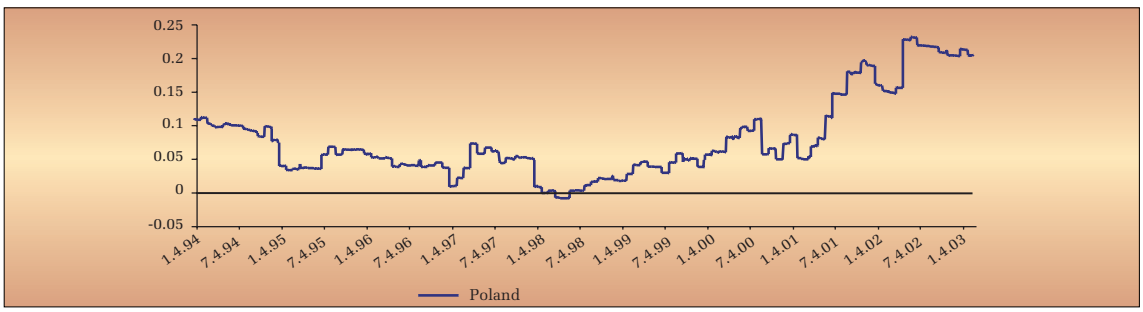
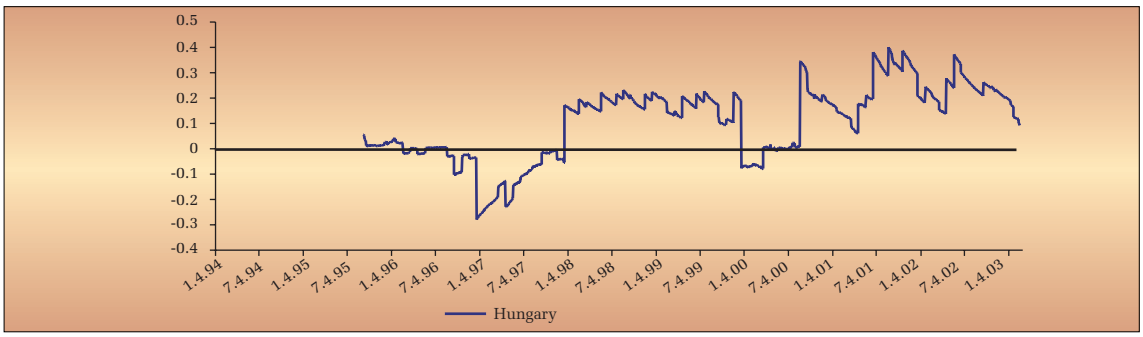


Figure 6. *Correlation estimates: Hungarian and German interest rate shocks (January 1994 - February 2003)*



Here, in opposition to the Czech case, our correlation estimates are always positive and quite stable. However, the case of Poland seems to provide evidence against the monetary independence hypothesis and confirm the alternative hypothesis as put forward by Hausmann (1999) and Frankel (1999). Since mid-1998, when the Polish National Bank, stopped intervening on the foreign exchange market and widened the fluctuation band to +/-10%, the degree of sensitivity of domestic interest rates to movements in international rates increased (Fratzscher (2002) found a similar result). Furthermore, the upward trend increased dramatically with the introduction of a pure free float at the beginning of 2000.

Figure 6 reports results for the correlation of interest rate shocks between Hungary and Germany. Similarly to the case of the Czech Republic, we can observe a negative correlation in the crisis year 1997. However, it turned positive already in 1998 and have remained so since than. In the case of Hungary it is much less straightforward than in the case of the Czech Republic and Poland to discern from the dynamics of the correlation a clear regime shift. It appears that the correlation was on average lower between 1998 and 1999 as compared to the period between 2000 and the beginning 2003, when a change of currency basket to 100% EURO and a widening of the fluctuation band from +/-2.5% to +/-15% took place, but as the estimates are quite volatile one should take this result with due caution.

So far we have looked at the dynamics of correlation of individual countries. Figure 7 allows making cross-country comparisons of the level of the correlations. An interesting picture emerges from this figure. We can see that the level of correlation for Hungary has been on average higher than for the Czech Republic and Poland. This was the more so after 1997, when both the Czech Republic and Poland increased the flexibility of their exchange rate regimes substantially. Given, that Hungary resorted to a more rigid exchange rate regime during that period it would lend some support for the monetary independence hypothesis.

All results presented above concerned correlation of interest rate shocks against Germany. Given that the Czech Republic, Hungary and Poland are closely linked with the German market (or general EU market) via trade and capital flows, the choice of Germany as a reference country was a natural one. As a double check, we also performed our analysis with the US federal fund rates as a reference series. Figure 8 reports the results for the correlation of real interest rate shocks between the Czech Republic, Hungary and Poland and the US federal fund rates. The comparison of Figure 8 with Figure 7 reveals that the US interest rates have been on average less important for the CEE accession countries than German ones. Moreover, the correlation estimates against US decreased for all countries over the last years. This suggests a continued integration and

Figure 7 *Correlation estimates: German interest rate shocks (January 1994 - February 2003)*

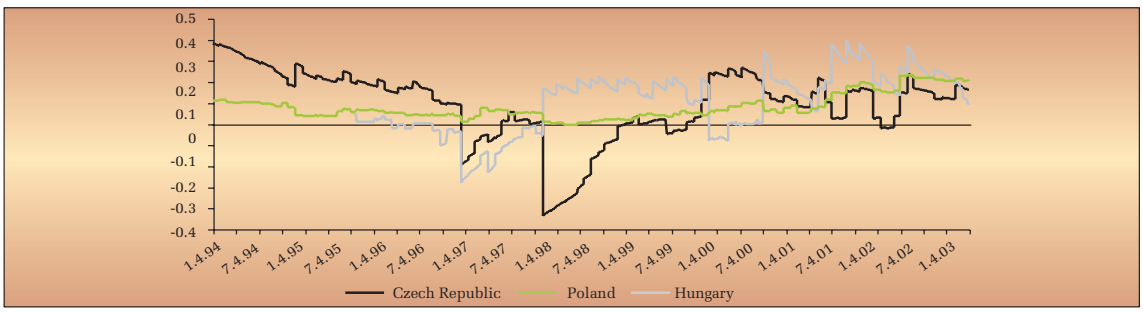
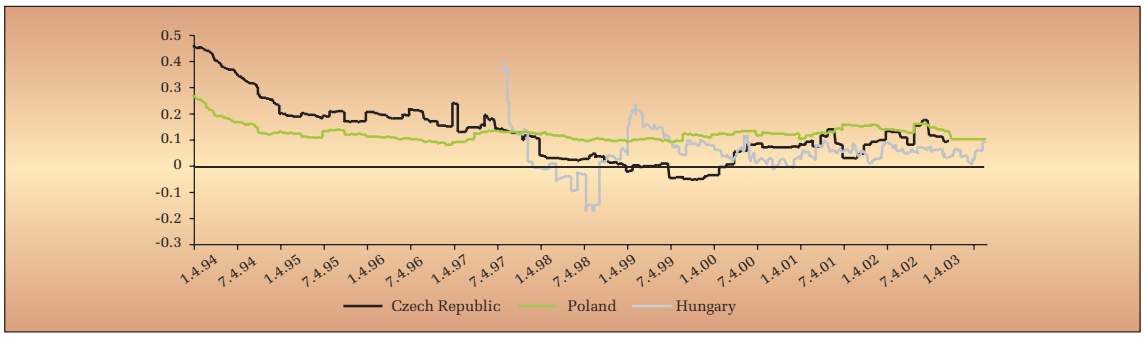


Figure 8 *Correlation estimates: US interest rate shocks (January 1994 - February 2003)*



convergence of the CEE markets with the EU. The results are in line with Fratzscher (2002) who points out an increasing importance of ECB on world capital markets and a formation of a Euro bloc in Europe.

5. Conclusions

We have examined the validity of the monetary independence hypothesis for a group of advanced accession countries: the Czech Republic, Hungary and Poland. We employed Dynamic Conditional Correlation Multivariate GARCH models to estimate the degree of time-varying correlation in shocks to the real interest rate with respect to two leading economies, Germany and the US, under different exchange rates regimes. There are several findings to stem from our study.

First, our results show that none of the countries under study could enjoy full monetary independence, in the sense that our correlation estimates where different from zero and positive almost throughout the whole period, only with some exceptions, mainly during a turbulent crisis time around 1997 and 1998. This result is consistent with the fact that all of these countries are small and open economies well integrated with the world economy. This result is in line with Frankel et al. (2000) who show that in most cases one cannot reject full transmission, even for countries with floating regimes and than only large industrial countries can benefit from independent monetary policy.

Second, we identified a clear tendency concerning the fact that the degree of monetary independence depends on the choice of the reference country. For example, we showed that the importance of US interest rates for the CEE accession countries has been on average lower (and decreasing over time) than that of German ones, as the CEE markets have been continuously integrating with the EU and becoming a part of a Euro bloc as identified by Fratzscher (2002). Moreover, our DCC-correlation estimates for CEE interest rate shocks against Germany were much more responsive to exchange rate regime shifts than those against the US.

Third, when looking at Germany as a reference country, our estimations showed that the degree of the monetary independence did vary with the degree of the flexibility of the exchange rate regime employed. Our cross-country comparisons of the level of the correlation against Germany provided evidence for the validity of the monetary independence hypothesis: the level of correlation for Hungary that resorted to a rigid exchange rate regime has been on average higher over the last several years than for Poland and the Czech Republic which used more flexible regimes.

Concerning individual country correlation dynamics over time, the link between exchange rate flexibility and monetary independence is more difficult to discern. The case of the Czech Republic seems to support the conventional wisdom: correlation between the Czech and foreign interest rates tended to decrease with the increase of the exchange rate flexibility. The case of Poland instead seems to confirm an alternative hypothesis: the degree of sensitivity of domestic interest rates to movements in international rates increased with the introduction of more flexible exchange rate regimes. The case of Hungary also provided some weak evidence against the monetary independence hypothesis although results for this country should be taken with due caution due to a large volatility of the estimates.

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