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**Working Papers in Economics and Statistics**

2012-21

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# Dirty Floating and Monetary Independence in Central and Eastern Europe – The Role of Structural Breaks[1]

Thomas Windberger[2] Jesus Crespo Cuaresma[3] Janette Walde[4]

**Abstract**

Obtaining reliable estimates of the volatility of interest rates and exchange rates is a necessary condition to evaluate issues related to monetary independence and fear of floating. In this paper we use methods which explicitly account for structural breaks in the volatility dynamics in order to assess monetary independence in the Czech Republic, Hungary and Poland. Our results indicate that the explicit modelling of structural breaks in volatility estimates can lead to striking differences concerning the evidence of monetary independence in Central and Eastern Europe. The results based on volatility estimates which account for regime change tend to indicate that the Czech Republic, Hungary and Poland have had a significant degree of monetary independence in the last decade.

**Keywords:** Fear of floating, monetary independence, structural break, change-point model.

**JEL Classifications:** F31, C22, C11.

[1]The authors would like to thank Gary Koop and Joon-Hui Yoon for kindly providing us their codes on structural break estimation.

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# 1 Introduction

In the last decades, Central and Eastern European (CEE) economies have made enormous steps towards economic integration with the European Union (EU) and the European Monetary Union (EMU). In the framework of monetary integration, assessing the degree of monetary independence of CEE countries is an important step to be taken in order to evaluate the potential costs of further steps of CEE countries towards becoming members of EMU. From a theoretical point of view, the loss of independent monetary policy is the main cost of joining a currency union and thus its measurement is arguably the most relevant piece of information to assess the prospects and challenges of a country which aims to join EMU.

Exchange rate regimes play a particularly important role as a monetary institution when it comes to measuring monetary independence. Recently, following the seminal contribution by Calvo et al. (2002) (see also Levy-Yeyati and Sturzenegger (2005)), a growing literature on the *fear of floating* phenomenon has developed. This strand of literature examines empirically whether *de jure* flexible exchange rate regimes behave as *de facto* fixed exchange rate regimes, that is, whether monetary authorities use monetary policy instruments to prevent excessive exchange rate movements. Many empirical studies assess this issue for emerging economies. Frankel et al. (2004), for example, explore whether the choice of exchange rate regimes affects the sensitivity of local interest rates to international interest rates. In most cases, they cannot reject full transmission of international interest rates in the long run. They find that only a small number of countries is able to choose its own interest rate, with the other countries subject to their decisions.

CEE economies are a particularly interesting case to study in this respect, since their recent monetary history is marked by different exchange regimes both across countries and in time. Table 1 presents a brief account of the exchange rate regimes in the three countries of our analysis for the last two decades, as well as other important episodes which affected their exchange rate. The variability of exchange rate arrangements both across countries and over time implies that CEE countries have been used as some kind of "monetary laboratory" to test different economic theories related to exchange rate arrangements. For this group of economies, however, there are mixed results on the degree of monetary independence they enjoy, as well as on whether they can be characterized by fear of floating (see for instance the results in Crespo-Cuaresma and Wójcik (2006)).

In this paper, we reassess the degree of monetary independence and fear of floating in the Czech Republic, Hungary and Poland. In particular, we concentrate on the interaction between the volatility of interest rates and exchange rates and we focus on the role that the estimation of these unobservable quantities play in the results concerning the existence of monetary independence in CEE countries. We use Bayesian methods based on Koop and Potter (2007) to extract estimates of the volatility of exchange rates and interest rates in the presence of potential structural breaks in their dynamics. Explicitly assessing the existence of structural change in the dynamics of interest rate and exchange rate volatility appears particularly important in a framework which is marked by changes in exchange rate regimes and changes in monetary policy strategies. We show that modelling regime change explicitly appears necessary when dealing with data from emerging economies and that the results concerning monetary independence and fear of floating depend strongly on whether structural breaks are allowed for in the

Table 1: Exchange rate regimes in the Czech Republic, Hungary and Poland

| Country and date | Exchange rate regime |
|---|---|
| Czech Republic | |
| January 1993–1996 | Fixed |
| 27 May 1997 | Managed floating |
| April 2000–2010 | Free Floating |
| Hungary | |
| 16 March 1995 | Crawling peg |
| January 2000–2001 | Fixed peg |
| 04 May 2001 | Crawling band |
| 01 September 2001 | Wide-band fixed peg |
| October 2001–June 2003 | Attack on upper part of band |
| June 2003–February 2008 | Devaluation and abolishment of band |
| After February 2008 | Floating freely with euro as reference currency |
| Poland | |
| May 1995– April 2000 | Crawling peg |
| Since 12 April 2000 | Free floating |

data generating process of interest rates and exchange rates. We find no significant evidence of foreign interest rate volatility spillovers once that structural breaks are allowed in the volatility estimates. We conclude that the evidence of monetary dependence found in several other studies may be due to the fact that they use volatility estimates that do not take into account regime changes.

The paper is structured as follows. Section 2 presents a brief account of the literature on fear of floating and monetary independence in CEE countries. Section 3 presents the econometric method used for the estimation of the volatility, together with the results concerning monetary independence. Section 4 concludes.

# 2 Fear of floating and monetary independence in CEE countries

Since the seminal paper of Calvo et al. (2002), the term *fear of floating* has been used to characterize a situation where the announced intention to float a currency was not honoured in deeds as well as in words. In their view, fear of floating can be seen as a result of lack of central bank credibility, a high pass-through of exchange rates to prices and inflation targeting. Recently, other theoretical frameworks to this phenomenon have been developed. Bigio (2010), for instance, proposes an alternative framework where the central bank is unsure about the effects of exchange rate manipulations for lack of knowledge whether or not the favourable effect of an exchange rate depreciation on exports is outbalanced by the negative effect stemming from unfavourable balance sheet influences. In this context, an overestimation of the balance sheet effect may trigger fear of floating behaviour.

In recent decades, the choice of exchange rate regimes has been a particularly intensely discussed policy issue in CEE countries. From a macroeconomic point of view, fixed exchange rates have often been seen as a favourable condition for long-run economic growth. Recent literature, such as Schnabl (2008), finds evidence that a stable exchange rate tends to be associated with a higher income growth rate. In context to the CEE economies, De Grauwe and Schnabl (2008) find that fixing the exchange rate to the euro has been related to a higher growth potential. Several studies assessed empirically the degree of monetary independence of the CEE countries we deal with in this paper, as well as its relationship with exchange rate regimes. Frömmel and Schobert (2006) confirm that in the Polish and Hugarian case, de facto and de jure regimes coincide, while in the case of the Czech republic, they find evidence of an implicit euro targeting within a certain band, thereby mirroring the ERM II without actually participating. However, according to Égert and Komárek (2006), the Czech National Bank stopped intervening in the foreign exchange market after September 2002. Crespo-Cuaresma and Wójcik (2006) use dynamic conditional correlation models in the framework of multivariate GARCH models to estimate the relationship between interest rate movements and exchange rate regimes. They find heterogeneous results across the three countries we analyze here.

In a related piece of research, Giannellis and Papadopoulos (2011) try to answer the question as to what sources exchange rate volatility may be traced back (see also the work by Fidrmuc and Horváth (2008)). They find that the volatility of the Polish and the Hungarian exchange rate can be explained through the effect of the interest rate differential and stock markets, while in the Czech case no such relationship is found. This implies that exchange rate volatility in the Czech Republic is mostly a function of domestic innovations.

When required, these studies obtain estimates of the volatility of interest rates and exchange rates using simple rolling-window dispersion measures or time-varying volatility estimates based on univariate or multivariate conditional heteroskedastic models. The issue of potential structural breaks in the dynamics of the volatility series is not directly assessed in this literature, in spite of the importance of such a feature when modelling exchange rate dynamics (see Zeileis et al. (2010)). An exception is the work by Kóbor and Székely (2004), who use a Markov regime switching model for the exchange rate volatility in an effort to shed some light on the question whether an increase in volatility and spillover is a result of structural changes or just a normal market outcome. They find that whenever the exchange rate is in an appreciation phase, the exchange rate volatility tends to be lower, whereas the reverse is true for a depreciation of the exchange rate. Apart from using a very reduced time span (2001-2003) and different econometric methods, their estimation framework differs from ours in several aspects. On the one hand, they allow for a less flexible dynamic model, with only two regimes (high and low volatility), whereas we allow for an endogenous estimation of the optimal number of regimes. On the other hand, we take a fully Bayesian approach based on Koop and Potter (2007), as opposed to the frequentist framework in Kóbor and Székely (2004).

# 3 Estimating exchange rate and interest rate volatility in the presence of structural changes

## 3.1 The methodological framework

Let $y_t$ be our variable of interest, that is, either interest rate the exchange rate changes. Following Koop and Potter (2007), we assume the following specification for the variable

$$y_t = y_t^- \phi_m + \exp(\sigma_m/2)\epsilon_t, \tag{1}$$

where $\epsilon_t \sim N(0,1)$ and the $(k+1)$ state vector $\theta_m = [\phi_m, \sigma_m]$ satisfies the transition equation

$$\phi_m = \phi_{m-1} + U_m \tag{2}$$
$$\sigma_m = \sigma_{m-1} + u_m \tag{3}$$
$$\tag{4}$$

where $U_m \sim N(0, V)$, $u_m \sim N(0, \eta)$ and the k-dimensional vector $y_t^-$ is given by $(y_{t-1}, \ldots, y_{t-k})$. Our interest is to obtain the posterior distribution of the volatility of the variable, $\sigma_m$. The potentially different regimes are indexed by $m$ in the model, and the structure imposed by (2) and (3) assumes that the effect of recent regimes on the current regime is stronger than that of regimes which took place longer ago. This hierarchical structure makes it possible to design a Gibbs sampling mechanism that allows us to recover the posterior distribution of the parameters in the specification using Bayesian estimation methods. Following Koop and Potter (2007), a Wishart prior is imposed on $V^{-1}$ and a Gamma prior is imposed on $\eta^{-1}$.

The model setting is completed by assuming a prior distribution on regime duration, $d_m$. In particular, a hierarchical prior is assumed, where $d_{m-1} \sim$Po$(\lambda_m)$, where Po$(\lambda_m)$ is a Poisson distribution with mean $\lambda_m$ and in turn $\lambda_m$ is assumed to follow a Gamma distribution. This implies a marginal prior for $d_m$, $p(d_m)$, which is negative binomial. This setting allows for the posterior to be obtained using standard Markov Chain Monte Carlo methods after fixing a maximum number of states, $M$. The methods used by Chib (1996) can be used to draw from the posterior conditional distributions and thus reconstruct the full posterior distribution. Koop and Potter (2007) present the Gibbs sampling method in full detail.

The Bayesian techniques for change point modelling provided by Yoon (2009) and Yoon and AitSahlia (2011) can be used to make inference on the probability of regime change. In our empirical application we allow the number of regimes to be in the set $\{1, 2, \ldots, 5\}$ and, following Yoon and AitSahlia (2011), use Bayes factor comparison in order to decide for the optimal number of states in the specification.

## 3.2 Data and estimation results

We use weekly data for changes in the 3 month interbank rate and the exchange rates vis-a-vis the euro for the Czech Republic, Hungary and Poland, as well as interest rate data for Germany, which will serve as a euro area benchmark. The data span the period January 7, 2002

until February 7, 2011 and they are obtained from the Thomson Datastream dataset.[1] Using these series, we estimate the time-varying volatility of interest rates and exchange rates using the method outlined above, and obtain estimates using standard GARCH models, which will serve as a benchmark to evaluate the role of the volatility estimation procedure in the results concerning fear of floating.

We use similar prior structures for the estimation of structural break models as those in Koop and Potter (2007). In Figure 1 we present the empirical volatility of the series used, together with the volatility estimates from our structural break model and that implied by a standard GARCH(1,1) model. Comparing GARCH estimates to the volatility estimation using the structural break model, it can be noticed that GARCH estimates tend to imply higher and more volatile levels of the standard deviation of the corresponding variables. This is particularly clear in the case of the German interest rate. As would also be suggested by the interest rate parity, there is a strong correlation between volatility hikes in the interest rate and the exchange rate for all countries in our sample. The recent financial crisis is visible in increased volatility for a prolonged period of time after late 2008 or early 2009.

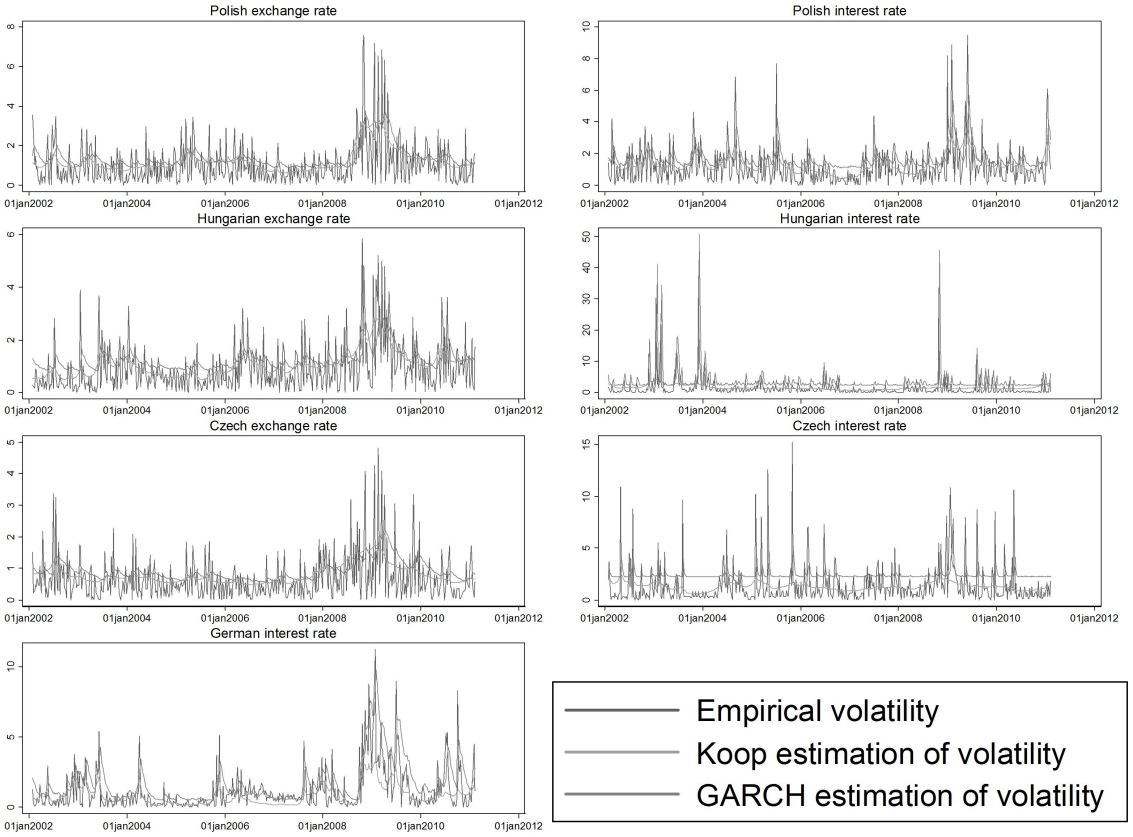


Figure 1: Empirical volatility, estimates from GARCH model and from the structural break specification

[1]The Datastream series codes are PRIBK3M, FIBOR3M, HNIBK3M, POIBK3M, CZECBSP, HNECBSP and POECBSP

In order to illustrate the features of volatility estimates using the methods by Koop and Potter (2007), we present in Figure 2 the posterior probability of being in each one of the three regimes (using the method by Yoon (2009), top panel) as well as volatility estimates using the GARCH model and the structural break model (bottom panel) for the Hungarian exchange rate. The model with three regimes was deemed optimal based on Bayes factor comparison. The three regimes correspond to a low volatility regime ($s_1$ in Figure 2), a high volatility regime ($s_2$ in Figure 2) and a medium volatility regime ($s_3$ in Figure 2). The Hungarian exchange rate features at least one prolonged phase of increased volatility around 2009. Compared to the volatility estimation based on the structural break model, the GARCH estimation lags volatility spikes by one period and strongly overstates the volatility in low volatility regime, such as $s_1$. The volatility estimate based on structural models smooths potential outliers and does not allow them to affecting the estimated standard deviation strongly. Exchange rate volatility as estimated by both procedures are very high in the end of 2006 and then again during the financial crisis in 2009. Interestingly, both hikes in volatility coincide with increases in the Hungarian interest rate.

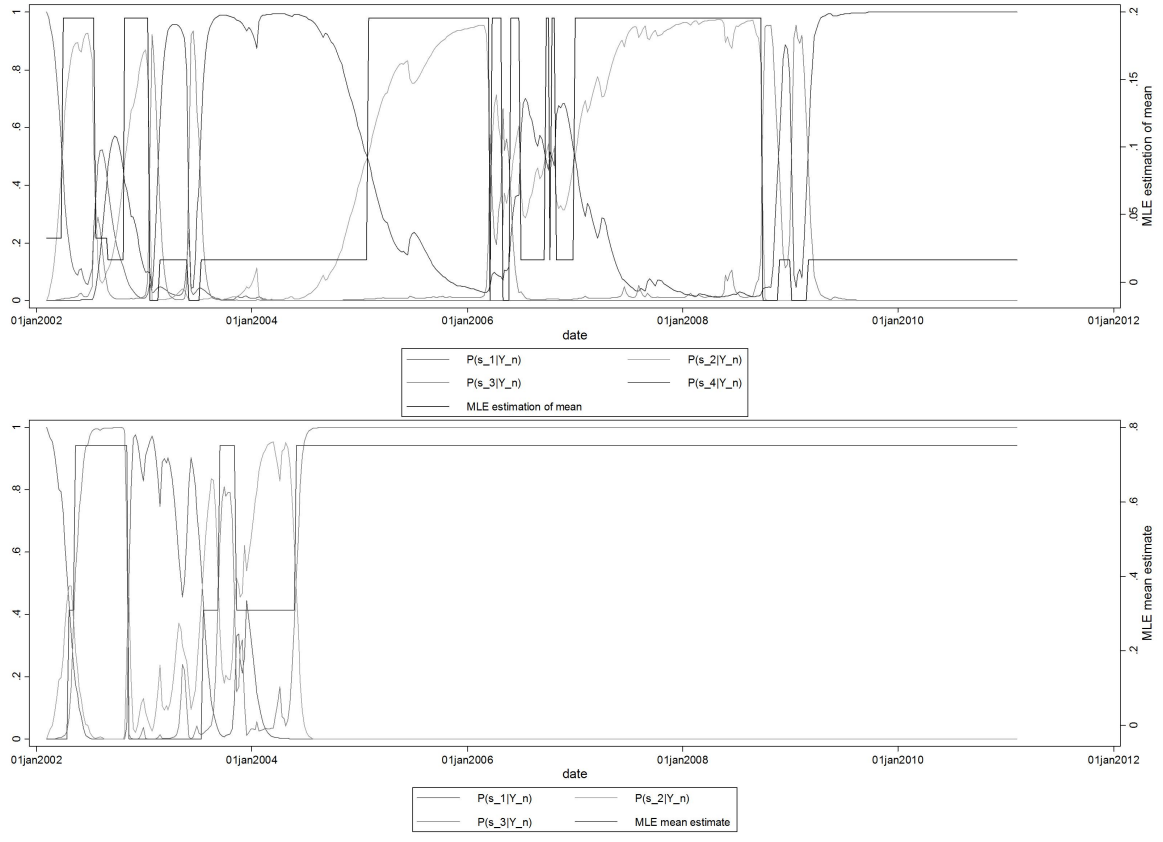


Figure 2: Estimated probability of being in a certain state ($s_1$, $s_2$ and $s_3$), GARCH volatility estimates and volatility estimates based on the structural break model

Before turning to the analysis of the causal structure of volatility changes between Germany and our set of countries, we start by analyzing the correlation structure of interest rate and exchange rate volatility in our sample of CEECs. Table 2 presents the correlation between interest rate and exchange rate volatility in each country for volatility estimates based on the

structural break model, as well as for GARCH estimates. The correlation is estimated for the pre-crisis period, ranging from the beginning of the sample up to August 2007, and for the post-crisis period, which ranges until the end of the available data.

Table 2: Bivariate correlations between exchange rate and interest rate volatility by estimation method

| | **Czech Republic** | **Hungary** | **Poland** |
|---|---|---|---|
| Pre-crisis period | | | |
| Structural break | -0.007 | 0.300 | -0.006 |
| GARCH | 0.033 | 0.293 | 0.068 |
| Post-crisis period | | | |
| Structural break | 0.253 | -0.028 | -0.016 |
| GARCH | 0.267 | 0.112 | 0.427 |

To the extent that fear of floating plays a role in the countries of the sample, we should observe a negative correlation between interest rate volatility and exchange rate volatility. This negative correlation would mirror the use of interest rate policy actions to stabilize the exchange rate. The results in Table 2 do not indicate sizeable fear of floating effects in this respect. Furthermore, important differences in correlation depending on the method used to extract the time-varying volatility measure are observable for the post-crisis period, in particular for the case of Poland. The correlation of volatility measures based on models including structural breaks appear small and negative, while the correlation based on GARCH estimates is high and positive. The flexibility of the structural break model to trace changes in volatility such as those that may be triggered by the global financial crisis implies that the results based on this method may be more credible than the one based on standard GARCH specifications.

## 3.3 Assessing foreign volatility spillovers

We start by assessing the (Granger-)causality structure between the volatility of German interest rates and the volatility of interest rates in CEE countries. We build simple bivariate vector autoregressive (VAR) models for these two variables and perform Granger causality tests to discern whether changes in the volatility of German interest rates significantly affect changes in the volatility of interest rates in CEE countries. The results are presented in Table 3 in the form of p-values of the Granger causality tests for the full estimation period, as well as for the pre-crisis period, which is defined to range between February 2002 and July 2007. We concentrate in evaluating the causality structure in this subsample for two reasons. First, the differential effects of the crisis across countries, as well as the timing of such effects, may affect the result of causality tests. Second, to the extent that the method of volatility estimation based on models with structural breaks can account at least partly for the changes in parameters that may be implied by the reaction to the crisis, one would expect the results to be more reliable for this methodology than for other volatility extraction techniques. For the purpose of comparison, we perform the tests using the volatility estimates of the structural break model (SB estimates) and based on standard GARCH models (GARCH estimates).

The results presented in Table 3 give clear evidence of the potential problems involved in pursuing empirical inference on monetary (in)dependence issues without taking into account

Table 3: Granger causality tests (p-values)

| | Full sample | | Pre-crisis period | |
|---|---|---|---|---|
| | GARCH estimates | SB estimates | GARCH estimates | SB estimates |
| $\sigma^i_{GER} \rightarrow \sigma^i_{CZ}$ | 0.010 | 0.735 | 0.477 | 0.497 |
| $\sigma^i_{GER} \rightarrow \sigma^i_{HUN}$ | 0.208 | 0.252 | 0.005 | 0.125 |
| $\sigma^i_{GER} \rightarrow \sigma^i_{PL}$ | 0.001 | 0.627 | 0.477 | 0.016 |

P-values for Granger causality tests based on VAR models for $\sigma^i_{GER}$ and $\sigma^i_k$ for $k = CZ, HU, POL$ with one lag. Full sample: 28/01/2002-07/02/2011, pre-crisis period: 28/01/2002-30/07/2007.

structural changes when evaluating the estimates of the second moment of monetary variables. The results concerning monetary independence in terms of whether the volatility of German interest affects the volatility of interest rates in CEE countries differ radically depending on whether structural changes are taken into account in the estimation of the volatility. The causality tests for standard GARCH estimates based on the full sample give evidence that the volatility of interest rates in the Czech Republic and Poland are affected by the volatility of the interest rate in the euro area, while Hungary would enjoy a certain degree of monetary independence in this respect. Surprisingly, when basing our inference only on the pre-crisis period, these results revert completely. Conclusions based on these tests after trimming the observations after August 2007 would assess that monetary independence is a characteristic of the Czech Republic and Poland, with interest rate volatility in Hungary significantly reacting to changes in the volatility of German interest rates.

The results based on volatility estimates which take into account the existence of regime change in the parameters of the model, on the other hand, appear more robust than those based on the GARCH counterparts, and differ strongly from these. Based on the full sample, the Granger causality tests for the estimates of the structural break model indicate that monetary independence is a widespread characteristic of the three CEE economies under study. The only country for which the crisis period appears to have an effect on this conclusion is Poland, for which monetary independence (as defined through the result of the test) was not significantly present prior to mid 2007, but appears to be the rule if the full sample is used. This result is not surprising given the differential effect that the crisis has had on the Polish economy as compared to the rest of Europe.

Taking structural breaks into account, the evidence for monetary independence of the Czech Republic, Hungary and Poland is strong. On the other hand, ignoring structural breaks by using standard estimation techniques leads to very different results. Given the fact that the financial crisis (and eventually other institutional changes in transition countries, such as changes in exchange rate regimes) is usually claimed to have strongly affected the level and dynamics of monetary variables, taking structural breaks explicitly into account seems more reasonable in order to assess monetary independence using recent data.

# 4 Conclusions

We reassess the empirical evidence concerning monetary independence for the Czech Republic, Hungry and Poland using structural break methods for the estimation of exchange rate and interest rate volatility. In the case of fear of floating, a negative correlation between interest and exchange rate volatility is expected to exist. However, the strength of the correlation does not suggest strong fear of floating in these countries. If structural breaks are accounted for in the estimation of the volatility measures used for the assessment of foreign volatility spillover effects, we find evidence that monetary independence is in place in the countries of our sample. We show that the conclusion that would have been drawn from using simple GARCH estimates would be in most cases the opposite one. Our results suggest that failing to take structural breaks into account strongly increases the risk of misguided policy and policy interpretation, and that this is especially true concerning monetary independence.

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Working Papers in Economics and Statistics

2012-21

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Dirty floating and monetary independence in Central and Eastern Europe - The role of structural breaks

**Abstract**
Obtaining reliable estimates of the volatility of interest rates and exchange rates is a necessary condition to evaluate issues related to monetary independence and fear of floating. In this paper we use methods which explicitly account for structural breaks in the volatility dynamics in order to assess monetary independence in the Czech Republic, Hungary and Poland. Our results indicate that the explicit modelling of structural breaks in volatility estimates can lead to striking differences concerning the evidence of monetary independence in Central and Eastern Europe. The results based on volatility estimates which account for regime change tend to indicate that the Czech Republic, Hungary and Poland have had a significant degree of monetary independence in the last decade.

ISSN 1993-4378 (Print)
ISSN 1993-6885 (Online)