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Transmission of Monetary Policy
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EDITORIAL

Central banks need to regularly evaluate the functioning of the monetary transmission mechanism in order to form their strategy for maintaining price stability. An inadequate understanding of how monetary policy affects the economy increases the risks of missing inflation targets. This edition of the Research Bulletin presents five articles that analyse various important policy issues related to monetary transmission.

The first article analyses whether inflation dynamics have changed over time in Central Europe. It finds that the inflation process becomes more forward-looking only if the inflation targeting regime gains in credibility. The second article examines whether central banks in Central Europe carry out monetary policy in an asymmetric manner. The results are mixed, although some evidence for asymmetry with respect to financial instability is found. To prevent instability, central banks prefer looser policy than standard macroeconomic models would imply. The third article specifically looks at the monetary transmission changes in the Czech Republic. The results indicate that the reaction of economic agents to monetary policy has increased over time. The fourth article quantitatively surveys the literature on the transmission lags of monetary policy. The economy responds to monetary policy faster in Central and Eastern European EU member countries than in large economies. Greater trade openness and a lower degree of financial development are found to be key factors associated with faster monetary policy transmission. The fifth article quantitatively surveys the literature on how monetary policy affects prices. It shows that empirical studies which find that more restrictive monetary policy fails to deliver price stability are likely to be misspecified. It proposes a general framework that researchers should follow in order to reduce the risks of misspecification of this model.

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Changes in Inflation Dynamics Under Inflation Targeting? Evidence from Central European Countries[1]

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Understanding the nature of short-term inflation dynamics poses a major challenge for monetary policy. The traditional Phillips curve postulated that there is a stable trade-off between inflation and economic activity. Consequently, taming inflation was deemed to be costly in terms of output loss. However, a better understanding of the role of expectations has changed the perceptions of monetary policy conduct. Since inflation is believed to be affected not only by current and past monetary policy measures, but also by the commitment to future monetary policy actions, a credible monetary policy that anchors inflation expectations can achieve disinflation at no cost in terms of real output. This concept of inflation dynamics was formalised into the New Keynesian Phillips curve (NKPC), which emerged during the 1990s. Its main ingredient is a forward-looking inflation term tracking the effect of inflation expectations on the current value of inflation.

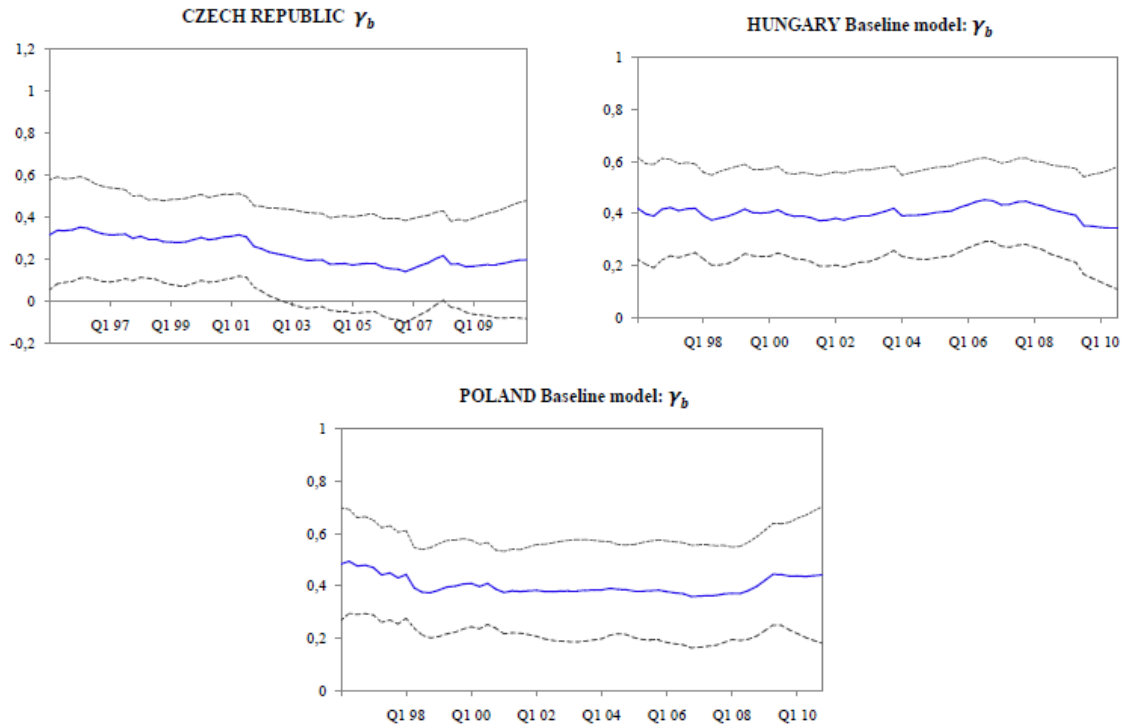
The NKPC was proposed as a structural model of inflation dynamics (Galí and Gertler, 1999; Galí et al., 2001), in the sense that it is a result of an optimisation process at the micro level and thus is invariant to policy changes. In practice, however, there are numerous reasons why the nature of the inflation process can evolve over time. Importantly, the implementation of a stable monetary policy regime with a clearly defined nominal anchor can stabilise inflation and reduce its persistence and variability through anchored inflation expectations (Benati et al., 2008). Macroeconomic changes can in turn feed back to the microeconomic environment (Fernández-Villaverde and Rubio-Ramirez, 2007). The countries in Central Europe went through a series of structural changes where both macroeconomic and microeconomic factors might have played a role in triggering changes in inflation dynamics during the last two decades. There are a few studies that aimed to test the NKPC for Central European countries in a conventional time-invariant setting (e.g. Franta et al., 2007; Vašíček, 2011). These studies conclude that inflation is more persistent in Central European than in developed countries and that external factors are arguably more important than domestic ones. Based on this evidence, however, it is very difficult to draw any conclusion related to the effects of monetary policy on the temporal and cross-country variation in the inflation process.

[1] This article is based on Baxa et al. (2012).

Our study (Baxa et al., 2012) aims to provide some evidence on inflation dynamics in three central European countries that have adopted inflation targeting (the Czech Republic, Hungary and Poland). We estimate a so-called time-varying parameter model with stochastic volatility using Bayesian techniques. Our objective is to shed some light on potential changes in the overall inflation dynamics, such as inflation persistence, and the characteristics of microeconomic behaviour, such as the frequency of price changes.

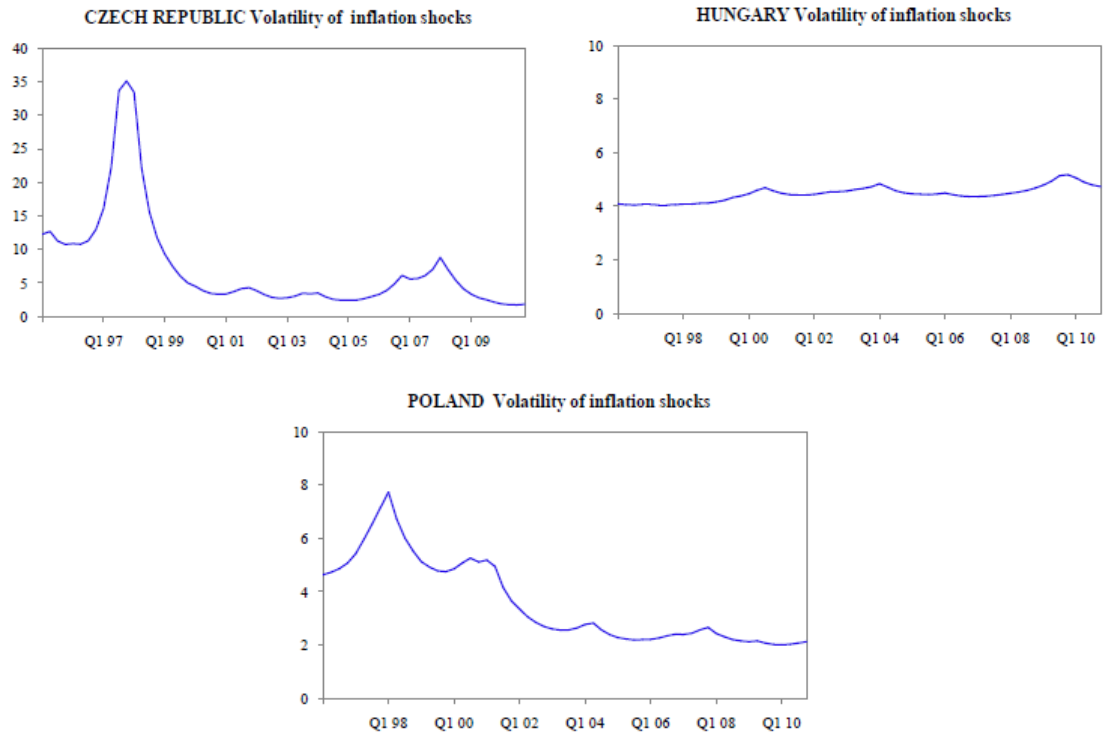
We find that the nature of the inflation process differs notably across the selected central European countries. Although the forward-looking component dominates the inflation dynamics in all three countries, which is a sign of (at least partially) anchored inflation expectations, inflation is considerably less persistent in the Czech Republic than in Hungary and Poland. The fact that persistence has been constantly decreasing in the former can be seen in Figure 1, which depicts the time-varying coefficient on the lagged inflation term.

Figure 1. Measures of intrinsic inflation persistence



In addition, the volatility of inflation shocks (Figure 2) decreased quickly a few years after the adoption of inflation targeting in the Czech Republic and Poland, while it remains rather stable in Hungary even ten years after inflation targeting was adopted. These results suggest that inflation expectations do matter, but they seem to be particularly well anchored in the Czech Republic and Poland, while this is less true for Hungary.

Figure 2. Volatility of inflation shocks



Moreover, the overall (reduced-form) estimates of the inflation process allow us to obtain an estimate of the average single price spell. It varies between two and three quarters, which is slightly below the value of around four quarters found for the Eurozone (Klenow and Malin, 2011). We find that the pricing behaviour of firms has been subject to change across time. In particular, the length of price fixation has been increasing over time. This seems to reflect the fact that economic agents take into account the overall macroeconomic environment when making price-setting decisions. Indeed, we find a negative relationship between the average length of fixation and both the inflation rate and its volatility. This is consistent with economic intuition suggesting that in a situation of higher and more volatile inflation it becomes more complicated for economic agents to distinguish changes in relative prices from changes in the overall price level (Lucas, 1972) and the price change is triggered more often.

We also find that the share of backward-looking price setters, i.e. firms who simply adjust their prices for observed inflation rather than in a forward-looking fashion, is changing smoothly, with a predominantly downward-sloping trend. However, the value varies substantially across countries, with an estimated range of between 20% and 50%. According to our results, it seems that this characteristic of price setting is driven mainly by long-term factors such as increasing competition, decreasing administered prices and the learning capacity of price setters (rather than by the current macroeconomic environment).

Our findings have some noteworthy policy implications. Previous research argues that the implementation of a stable monetary policy regime with a well-defined nominal anchor such as inflation targeting contributed to a decrease of inflation persistence in the most developed countries. Although all three countries under study officially adopted inflation targeting a decade ago, inflation persistence has not changed considerably in Poland and Hungary and has remained at high levels when compared to the Czech Republic or developed countries. In addition, for

Hungary the volatility of inflation shocks remains high. This could be related to the fact that inflation targets in these countries are less credible and economic agents chiefly take into account observed inflation levels rather than the inflation target. This is arguably linked to the role of the exchange rate in monetary policy. Indeed, Hungarian monetary policy has paid special attention to exchange rate movements and expectations, and the exchange rate channel was considered the most efficient channel of monetary policy transmission (Vonnak, 2008).

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Is Monetary Policy in the New EU Member States Asymmetric?[2]

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There is a vast amount of empirical research on the way central banks handle interest rate setting. Since Taylor (1993), researchers have been estimating Taylor rules, as they seem to characterise well the interest rate setting of central banks. Estimated monetary policy rules typically take a linear form, assuming that monetary policy responds symmetrically to economic developments. The theoretical underpinning of the linear policy rule is the linear-quadratic (LQ) representation of macroeconomic models, with the economic structure assumed to be linear and the policy objectives to be symmetric, as represented by a quadratic loss function (e.g. Clarida et al., 1999). However, when the assumptions of the LQ framework are relaxed, the optimal monetary policy can be asymmetric. Asymmetric monetary policy implies that the monetary policy rule, which is a schematisation of the policy reaction function, is nonlinear.

Departures from the LQ framework involve two different sources of policy asymmetry. The first source lies in nonlinearities in the economic system. A common example of such nonlinearity is a steeper inflation-output trade-off when the output gap is positive. Such convexity of the Phillips curve (e.g. due to wage rigidity) implies that the inflationary effects of excess demand are larger than the disinflationary effects of excess supply. This can oblige optimising central bankers to behave asymmetrically (Dolado et al., 2005). However, asymmetric monetary policy can also be related to genuinely asymmetric preferences of central bankers. While central banks in the past were prone to inflation bias due to a preference for high employment or uncertainty about its natural level (Cukierman, 2000), reputation reasons can drive central banks, especially those pursuing inflation targeting (IT), to have an anti-inflation bias, which means that they respond more actively when inflation is high or exceeds its target value (Ruge-Murcia, 2004).

A few empirical studies have provided evidence that the monetary policy setting of major central banks may really be characterised as asymmetric. Asymmetric preferences have been found to affect the decisions of the Bank of England (Taylor and Davradakis, 2006), the US Fed (Dolado et al., 2004) and the European Central Bank (Surico, 2007).

Our study (Vašíček, 2011, 2012) provides extensive testing for the existence of asymmetric monetary policy in three Central European countries that have adopted the IT framework: the Czech Republic, Hungary and Poland. There are diverse empirical strategies for testing for monetary policy asymmetry. They typically consist of estimation of a monetary policy rule that includes some nonlinear feature. We employ two empirical frameworks: (i) a framework based on an underlying structural model that modifies the LQ framework, which allows discrimination between sources of policy asymmetry but is conditioned by the specific model setting; and (ii) a flexible econometric framework where monetary policy is allowed to switch between two regimes according to a threshold variable.

[2] This article is based on Vašíček (2011, 2012).

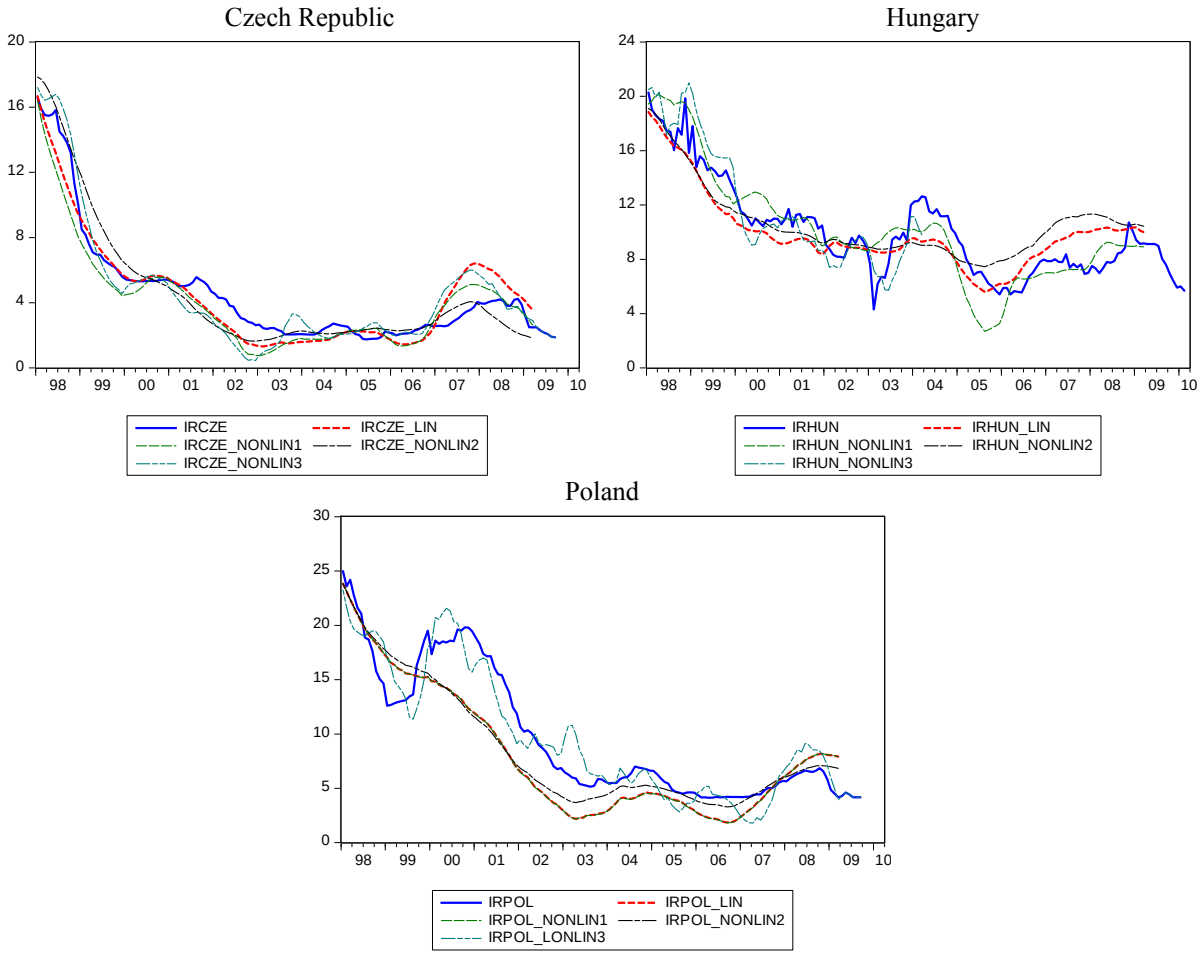
The first framework includes additional terms that track policy asymmetries in an otherwise linear monetary policy rule (Clarida et al., 1998, 2000), where the short-term interest rate is assumed to be sluggishly adjusted to expected inflation and the current output gap. To test for asymmetries we include (i) an interaction term of inflation and the output gap (tracking the nonlinear trade-off between inflation and output), (ii) the conditional inflation variance (tracking asymmetric preferences in terms of inflation) and (iii) the deviation of the actual interest rate from its equilibrium value (tracking asymmetric preferences vis-à-vis the deviation of the actual interest rate from its long-term value).

According to our results, the last factor is identified as the main source of asymmetry, i.e. for all three countries we reveal a preference to limit the deviation of the current interest rate from its equilibrium value. The positive values of the estimated coefficient found for the Czech Republic and Hungary reflect a distaste for actual interest rates exceeding the equilibrium value, which might indicate a preference for avoiding economic contraction. On the other hand, the negative value found for Poland may be a sign that the Polish National Bank was resistant to keeping interest rates too low, which may be understood as an indication of a strong preference for price stability over economic fluctuations. In addition, the short-term interest rate responds significantly to the conditional inflation variance in the Czech Republic, which suggests that the Czech National Bank handled inflation in an asymmetric manner, and in particular that it acted more decisively when the inflation target was overshot in order to support the disinflation process and anchor inflation expectations. Yet this result seems to be mainly driven by the period of disinflation of 1998–1999, when inflation was the most volatile. Šmídková (2008) and a collection of articles published in a special issue of the Czech Journal of Economics and Finance (2008) provide a detailed account of the first ten years of inflation targeting in the Czech Republic.

To shed more light on the economic significance of the previous statistical results, it seems instructive to compare the relative performance of symmetric versus asymmetric descriptions of monetary policy. Figure 1 compares the short-term interest rate (the dependent variable of all specifications) with the in-sample forecast from the benchmark linear model (Clarida et al., 1998, 2000) with the three nonlinear alternatives tested above. The results clearly suggest that the in-sample forecast from at least one nonlinear model tracks the interest rate dynamics better than the one from the linear model, but the differences are not substantial most of the time. These findings demonstrate that a salient feature of policy asymmetry is that it pops up only in some specific periods.

The previous methods of inference on policy asymmetry rest on a specific assumption about the structure of the economy and the central bank's loss function. An alternative is not to stick to any model underlying the asymmetry and simply allow the response coefficients in the policy rule to switch between two regimes according to the evolution of a threshold variable (Hansen, 2000). We test three different threshold variables: inflation, the output gap and the domestic financial stress index provided by the IMF (EM-FSI). In the last case, we try to uncover whether central banks alter their consideration of common policy targets in the face of local financial instability and whether they directly adjust policy rates according to the degree of financial stress in the economy.

Figure 1. In-sample forecast of linear vs. nonlinear monetary policy rule



Notes: IR… is the short-term interest rate, IR…_LIN is the in-sample forecast from the linear policy rule, IR…_NONLIN1 is the in-sample forecast from the nonlinear policy rule (i) with the interaction term of inflation and the output gap, IR…_NONLIN2 is the in-sample forecast from the nonlinear policy rule (ii) with the conditional inflation variance, and IR…_NONLIN3 is the in-sample forecast from the nonlinear policy rule (iii) with the squared terms of inflation and output gap and the deviation of the actual interest rate from its equilibrium value.

Financial stress turns out to be the most significant threshold variable. Notably, we are able to identify rather different patterns of interest rate setting in low and high financial stress regimes. The common periods of high stress for the three countries include the Russian crisis starting in August 1998 and the global financial crisis peaking in late 2008. Our evidence suggests that central bankers in the Czech Republic and Poland decrease policy rates when they face high financial stress and temporarily disregard their inflation targets. On the contrary, in the low financial stress regime the strongest interest rate response can be found for expected inflation. Interestingly, Hungary seems to be the opposite case; the interest rate was increased in the face of increasing financial stress. This seems to be related to the fact that the main driver of overall financial stress in Hungary was depreciation of the forint. Therefore, it is plausible that Hungarian monetary policy faced this challenge by means of interest rate increases.

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Evaluating Changes in the Monetary Transmission Mechanism in the Czech Republic[3]

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We examine the monetary transmission mechanism in the Czech Republic. In general, we are interested in how the monetary policy conducted by the Czech National Bank affects economic activity and whether it contributes to price stability, i.e. how the monetary transmission works. More specifically, we examine whether the monetary transmission mechanism changes over time. The Czech Republic has experienced a number of large structural changes in its economy, from those related to the transition towards a market-oriented economy in the early 1990s, through phenomena such as the adoption of inflation targeting and banking sector restructuring, to recent events related to the global financial crisis. Naturally, these landmarks may well have affected the way monetary policy affects the economy.

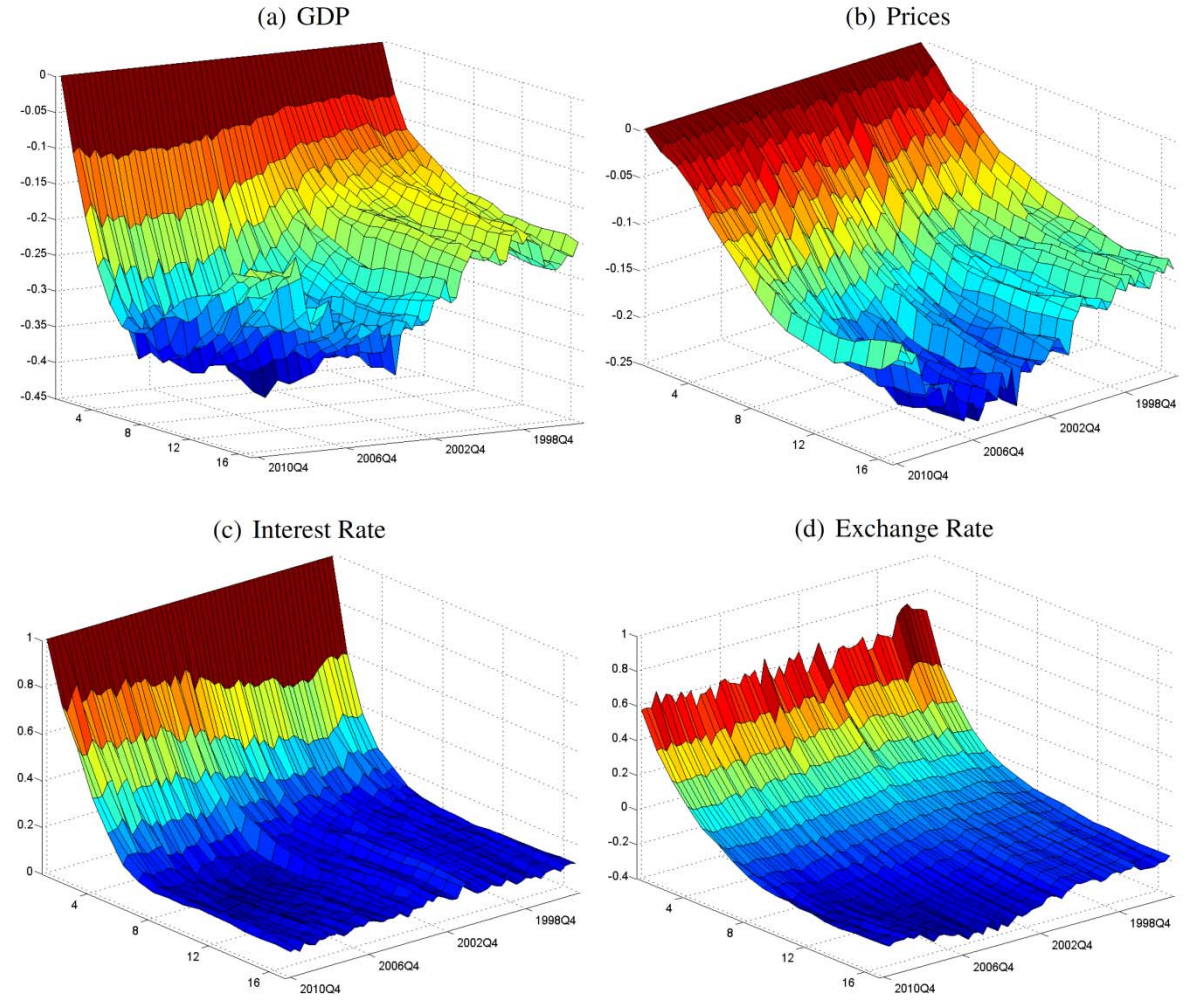
For this reason, we employ a Bayesian vector autoregression model with time-varying coefficients and stochastic volatility. This type of model is particularly suited to examining how the economic system evolves over time. More specifically, it is a very flexible approach suitable for capturing changes in macroeconomic relationships. On the other hand, this flexibility comes at the cost of considerable uncertainty regarding the results.

We construct the model and include some basic economic variables in it following Mojon and Peersman (2001). Our baseline model focuses on the macroeconomic sector and the short-term nominal interest rate, the nominal effective exchange rate and output, and a price level is included. Next, we extend our model and include some financial variables, i.e. the lending rate and credit. The choice of these two variables is motivated by the fact that the Czech financial sector is dominated by banks. In consequence, our extended model also sheds light on the relative importance of financial shocks for the macroeconomic environment (e.g. Alessi, 2011). Taking into account the set of variables and our modelling strategy, it can be asserted that the modelling framework represents a "macroeconomic" level view of monetary transmission. So, it cannot provide answers relating to the importance of various channels of the transmission of monetary policy. It is worth noting that given that the Czech Republic is heavily exposed to international trade, we examine how the economy responds to changes not only in the interest rate but also in the exchange rate.

[3] This text is based on Franta et al. (2011). A shortened version with updated results is available in Franta et al. (2013).

The success of these types of vector autoregressive model crucially depends on the so-called identification scheme, i.e. how well we identify the effects of monetary policy independently of other contemporaneous developments in the economy. We use the type of model introduced in Primiceri (2005); the main difference from the seminal paper is in the identification scheme employed. We tailor our identification scheme to the specificities of the Czech economy, especially its large openness to international trade.

Figure 1. Time-varying impulse responses to a 100 basis point interest rate shock

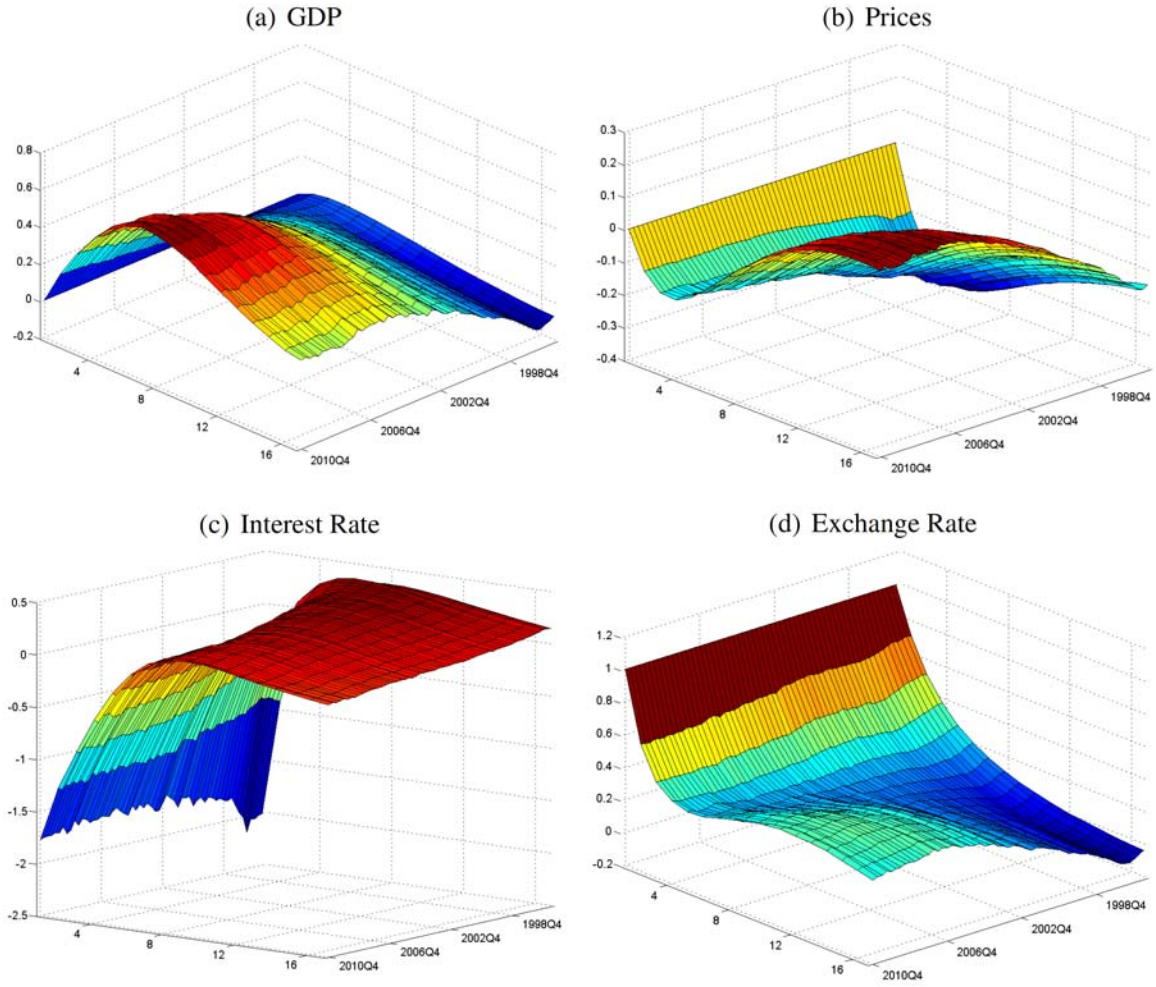


Note: Horizontal axes indicate the period for which the impulse response is computed (1996Q1–2010Q4) and the horizon of the response (the length of the horizon is 16 quarters). The vertical axis indicates the magnitude of the response to the shock. By convention, the shock stemming from the variable is assumed to be an increase in the value of that variable.

Our results suggest that output and prices have become increasingly responsive to interest rate shocks (i.e. monetary policy actions), probably reflecting financial sector deepening and the overall economic development of the Czech economy (Figure 1). The responsiveness of output and prices to interest rate shocks did not increase further during the recent global financial crisis, but remained largely constant at the pre-crisis level. Therefore, we do not find evidence that the effect of monetary policy on the aggregate economy declined during the crisis at the aggregate level. Clearly, this does not imply that some specific transmission channel could not have

weakened during the crisis. In addition, it is worth noting that the results are surrounded by some margin of uncertainty, and if we drew accompanying confidence intervals it would be far from easy to show the changes in the transmission mechanism in a statistically significant way.

Figure 2. Time-varying impulse responses to a 1% exchange rate shock



Note: Horizontal axes indicate the period for which the impulse response is computed (1996Q1–2010Q4) and the horizon of the response (the length of the horizon is 16 quarters). The vertical axis indicates the magnitude of the response to the shock. By convention, the shock stemming from the variable is assumed to be an increase in the value of that variable.

We find that exchange rate pass-through has weakened somewhat over time (Figure 2), i.e. the economy seems to respond less to exchange rate shocks. Using our model, we cannot answer the question about the sources of this weakening directly. However, we think that the decreasing importance of exchange rate shocks over time is likely to be associated with improved credibility of inflation targeting in the Czech Republic and anchored inflation expectations.

As we noted, we extend our baseline macroeconomic model to include financial variables. Using this extended model, our results show that the effect of credit on the aggregate economy is stronger in an environment of a less stable financial system. More specifically, our results indicate that the effect of credit on GDP and prices is more sizeable around the year 2000, when

the Czech banking sector was in the process of restructuring. On the other hand, we fail to find evidence that the effects of the credit shock are stronger during the current financial crisis. But this is probably not so surprising given that the Czech financial system has remained largely stable during the crisis, with a well-capitalised and liquid banking sector. This supports our finding that a negative financial shock (of identical magnitude) is more harmful to the economy when the financial system is not stable than otherwise.

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Transmission Lags of Monetary Policy: A Meta-Analysis[4]

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Policymakers need to know how long it takes before their actions fully transmit to the economy and what determines the speed of transmission. A common claim about the transmission mechanism of monetary policy is that it has "long and variable" lags (Friedman, 1972). Our paper quantitatively surveys empirical studies that investigate the effects of monetary policy on the price level. We refer to the horizon at which the impact on prices becomes the strongest as the transmission lag, and collect 198 estimates from 67 published studies. The estimates of transmission lags in our sample are indeed variable, and we examine the sources of this variability. The meta-analysis approach allows us to investigate both how transmission lags differ across countries and how different estimation methodologies within the model framework affect the results. Meta-analysis is a set of tools for summarising the existing empirical evidence; it has been regularly employed in medical research, but its application has only recently spread to the social sciences, including economics (Stanley, 2001). By bringing together evidence from a large number of studies that use different methods, meta-analysis can extract robust results from a heterogeneous literature.

Several researchers have previously investigated the cross-country differences in monetary transmission. Ehrmann (2000) examines 13 member countries of the European Union and finds relatively fast transmission to prices for most of the countries: between 2 and 8 quarters. Only France, Italy and the United Kingdom exhibit transmission lags between 12 and 20 quarters. In contrast, Mojon and Peersman (2003) find that the effects of monetary policy shocks in European economies are much more delayed, with the maximum reaction occurring between 16 and 20 quarters after the shock. Concerning cross-country differences, Mojon and Peersman (2003) argue that the confidence intervals are too wide to draw any strong conclusions, but they call for further testing of the heterogeneity of impulse responses. Boivin et al. (2008) update the results and conclude that the adoption of the euro contributed to lower heterogeneity in monetary transmission among the member countries.

Cecchetti (1999) finds that for a sample of advanced countries transmission lags vary between 1 and 12 quarters. He links the country-specific strength of monetary policy to a number of indicators of financial structure, but does not attempt to explain the variation in transmission lags. In a similar vein, Elbourne and de Haan (2006) investigate 10 new EU member countries and find that the maximum effects of monetary policy shocks on prices occur between 1 and 10 quarters after the shock. These articles typically look at a small set of countries at a specific point in time; in contrast, we collect estimates of transmission lags from a vast literature that provides evidence

[4] This article is based on Havránek and Rusnák (2012).

for 30 different economies during several decades. Moreover, while some of the previous studies seek to explain the differences in the strength of transmission, they remain silent about the factors driving transmission speed.

Our results suggest that the cross-country variation in monetary transmission is robustly associated with differences in the level of financial development. To explain the variation of results between different studies for the same country, the frequency of the data used is important: the use of monthly data makes researchers report transmission faster by 4 months, holding other things constant. This is in line with Ghysels (2012), who shows that responses from low- and high-frequency models may indeed differ due to mixed-frequency sampling or temporal aggregation of shocks.

The key result of our meta-analysis is that a higher degree of financial development translates to slower transmission of monetary policy. The finding can be interpreted in the following way. If financial institutions lack opportunities to protect themselves against unexpected monetary policy actions (due to either low levels of capitalisation or low sophistication of financial instruments provided by the less developed financial system), they need to react immediately to monetary policy shocks, thus speeding up the transmission. In financially developed countries, in contrast, financial institutions have more opportunities to hedge against surprises in monetary policy stance, causing greater delays in the transmission of monetary policy shocks. This reasoning is in line with the so-called lending view of monetary transmission, which suggests that financial intermediaries play a crucial role in the transmission of monetary policy (Cecchetti, 1999). More generally, our results imply that monetary transmission may slow down as the financial system of new EU member countries develops, since financial innovations allow banks to protect better against surprise shocks in monetary policy.

Table 1. Transmission lags differ across countries

Large developed economies		New EU members	
Economy	Average transmission lag	Economy	Average transmission lag
United States	42.2	Poland	18.7
Euro area	48.4	Czech Republic	14.8
Japan	51.3	Hungary	17.9
Germany	33.4	Slovakia	10.7
United Kingdom	40.4	Slovenia	17.6
France	51.3		
Italy	26.6		

Notes: The table shows the average number of months to the maximum decrease in prices taken from all the impulse responses reported for the corresponding country. We only show results for countries for which the literature has reported at least five impulse responses.

Our results also suggest that countries more open to international trade experience faster monetary transmission. This finding is in line with the exchange rate channel of monetary policy. Following a contractionary monetary policy shock, the exchange rate appreciates through the uncovered interest parity condition. As a result, imported goods become less expensive, amplifying the drop in the aggregate price level caused by monetary tightening (Dennis et al., 2007). The estimated relation between the speed of monetary transmission and central bank independence varies across different specifications in our analysis, but in a companion paper

(Rusnák et al., 2013) we find that monetary policy is more powerful if the central bank enjoys more independence, which corresponds with the findings of Rogoff (1985). The estimated lag in the transmission of monetary policy in the Czech Republic is about 15 months. That is, the transmission of monetary policy seems to be much faster in the Czech Republic than in the core of the euro area (where the average reaches 25–50 months), and it is also slightly faster than, for example, in Poland and Hungary. The results for individual countries are summarised in Table 1.

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How to Solve the Price Puzzle? A Meta-Analysis[5]

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We investigate the effects of monetary policy on the price level. This important question of monetary economics still can be considered one of the most debatable ones when we consider the empirical evidence. Common sense and canonical macro models put forward that prices should fall after an unexpected hike in interest rates, but empirical results are often at odds with the theory. About half of articles using vector autoregressions (VARs) to examine the monetary transmission mechanism suggest that following an increase in interest rates prices actually rise – at least in the short run. Starting with Sims (1992), various explanations of the "price puzzle" have been suggested, ranging from model misspecifications of VARs (Giordani, 2004; Bernanke et al., 2005) to models that try to explain the observed rise in prices theoretically (Barth and Ramey, 2002; Rabanal, 2007).

The often encountered price puzzle thus seems to question either the capability of VAR models to accurately recognise unexpected restrictions of monetary policy, or the ability of monetary policy to manage the price level in the short term, or both. Academic researchers have published many empirical studies focusing on this topic. One might therefore ask what general finding the literature suggests. The methodology typically used to address such questions is meta-analysis, a quantitative method of research synthesis (Smith and Huang, 1995; Stanley, 2001; Disdier and Head, 2008; Card et al., 2010; Chetty et al., 2011). Contrary to narrative literature surveys, meta-analysis addresses possible publication selection concerns: the preference of authors, editors or referees for results that are statistically significant or consistent with the theory, a bias that has become an important issue in empirical research (DeLong and Lang, 1992; Card and Krueger, 1995; Ashenfelter and Greenstone, 2004; Havranek and Irsova, 2011).

Meta-analysis allows researchers to investigate how the results reported depend on the study design and to account for the effects of misspecifications. Meta-analysis is also able to produce a synthetic study with ideal parameters, such as the maximum amount of data or a consensus best-practice methodology, and, in our case, to provide a best guess of the genuine effect of monetary policy on prices. Additionally, meta-analysis allows us to examine how monetary transmission is influenced by various country characteristics. We try to gather all published articles studying the effects of monetary policy by using vector autoregressions and collect estimates of price reactions together with their confidence intervals. We examine the extent of publication selection, the

[5] The article is based on Rusnák et al. (2013).

effect of model misspecification and the determinants of the differences in the strength of the monetary transmission mechanism over time and across different countries.

We study the effect of monetary policy shocks on the price level by systematically reviewing the estimates of price reactions from published VAR studies on monetary transmission. Altogether, we gather price reactions published by 103 researchers for 31 countries and link the estimates to characteristics reflecting the design of studies and the structural characteristics of different countries. State-of-the-art meta-analysis tools are used to estimate the genuine effect of an interest rate tightening on prices implied by the literature while correcting for potential publication selection and model misspecifications encountered in primary studies.

We show how meta-analysis is able to uncover various factors that cause the price puzzle. Our results suggest some evidence of publication selection against the price puzzle, and the selection appears to be greater for responses at longer horizons. This result is in line with Doucouliagos and Stanley (2012), who find that publication selection appears to be stronger for research topics with smaller theory competition. Macroeconomists seem to be unanimous about the effects of monetary policy on prices in the long run: prices should ultimately decline after an increase in the interest rate. In contrast, less agreement exists when one considers the effects of monetary policy in the short run because of the cost channel, for instance. Published results frequently display the price puzzle for the short term; on the other hand, results suggesting the price puzzle for the long run would be more difficult to publish.

Moreover, our results suggest that the price reactions reported in the literature are systematically influenced by study characteristics and country-level structural differences. Study characteristics seem especially significant for the short-run response. When researchers find the price puzzle, they typically do not include commodity prices and a measure of potential output, and employ recursive identification in their VAR model specifications. When these misspecifications are accounted for, the price reaction derived from the entire literature becomes hump-shaped, with no evidence of the price puzzle. The maximum decline in the price level after a one-percentage-point interest rate increase is roughly 0.3%.

Finally, we find that the long-run response of prices is systematically influenced by country-level structural characteristics. The long-run effect of monetary policy is smaller in countries with high average inflation, probably because high inflation hinders the central bank's credibility. The effect is more powerful in more open economies, in countries where the central bank enjoys greater independence, and in countries with lower average economic growth. On average, the decline in prices after an interest rate hike is rather persistent and does not disappear within three years.

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Baxa, J., Horváth, R. and Vašíček, B. (2013): How Does Monetary Policy Change? Evidence on Inflation Targeting Countries. *Macroeconomic Dynamics*, forthcoming.

Dybczak, K. and Galuščák, K. (2013): Changes in the Czech Wage Structure: Does Immigration Matter? *Czech Journal of Economics and Finance*, forthcoming.

Franta, M., Horváth, R., and Rusnák, M. (2013): Evaluating the Changes of Monetary Transmission Mechanism in the Czech Republic. *Empirical Economics*, forthcoming.

Havránek, T. and Iršová, Z. (2013): A Meta-Analysis of Bank Efficiency Measurement in Transitional Countries. *Transformations in Business and Economics*, forthcoming.

Havránek, T. and Iršová, Z. (2013): Determinants of Bank Performance in the CEE and USA: A Data Envelopment Analysis. *Transition Studies Review*, forthcoming

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CNB Research Open Day

The ninth CNB Research Open Day will be held in the Czech National Bank's Commodity Exchange (Plodinová Burza) building on **Monday, 13 May 2013**. This half-day conference will provide an opportunity to see some of the best of the CNB's current economic research work, to learn about the CNB Call for Research Projects 2014 and to meet CNB researchers informally.

Please note that places will be subject to availability owing to the limited capacity of the conference facility. To secure your place please register at www.cnb.cz, direct link: http://www.cnb.cz/en/research/seminars_workshops/research_open_day_2013_form.html

Programme

Monday, 13 May 2013
The Czech National Bank's Commodity Exchange (Plodinová Burza) building,
Senovážné nám. 30, Praha 1

8.30	Registration & Morning Coffee
9.00	Introduction and ERD Award 2013: Kamil Janáček, Bank Board Member, CNB
9.10	CNB Research in 2013, Kateřina Šmídková, Executive Director, ERD, CNB
	Chair: Kateřina Šmídková
9.20	"*Tracking Monetary-Fiscal Interactions Across Time and Space*," by Michal Franta, Jan Libich and Petr Stehlík
9.40	Discussion: Jacopo Cimadomo, European Central Bank
9.55	Q&A
10.05	"*Assessing the Impact of Fiscal Measures on the Czech Economy*," by Róbert Ambriško, Jan Babecký, Jakub Ryšánek and Vilém Valenta
10.25	Discussion: Jan in't Veld, European Commission
10.40	Q&A
10.50	Coffee
	Chair: Michal Franta
11.15	"*Does Central Bank Financial Strength Matter for Inflation? An Empirical Analysis*," by Soňa Benecká, Tomáš Holub, Narcisa Liliana Kadlčáková and Ivana Kubicová
11.35	Discussion: Diego Moccero, European Central Bank
11.50	Q&A
12.00	"*Dynamic Stress Testing: The Framework for Testing Banking Sector Resilience Used by the Czech National Bank*," by Adam Geršl, Petr Jakubík, Tomáš Konečný and Jakub Seidler
12.20	Discussion: Martin Summer, Oesterreichische Nationalbank
12.35	Q&A
12.45	Lunch (ground floor)
14.00	Information Meeting for Prospective Authors of CNB Research Projects (ground floor)

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