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Monetary Policy Challenges in a Low-Inflation Environment

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EDITORIAL

As a consequence of the Global Financial Crisis (GFC) inflation has dropped sharply worldwide. The low levels of inflation have persisted since then due in part to the recent fall in oil prices. Such circumstances represent a new situation for central bankers, who have usually been concerned with the opposite problem – how to respond to persistently high inflation. Challenging times for policy makers usually mean very exciting times for researchers, and this is what research departments in central banks are experiencing at the moment. Many new research questions relating to the prolonged period of low inflation have appeared, and the current issue of the Bulletin aims to introduce some of them which CNB researchers are currently investigating.

The first article is an interesting contribution to the growing literature on expectations assumed in macroeconomic models. The GFC proved that expectations of economic subjects are definitely not rational. Moreover, expectations management has become a very important monetary policy tool when inflation is low and the interest rate is stuck near zero. The authors discuss one possible channel through which the departure from the assumption of rational expectations can affect the conduct of monetary policy.

The second article focuses on the effect of euro area monetary policy on several neighbouring economies. Importantly, the authors distinguish between conventional measures and the unconventional measures that were launched to deal with the impaired monetary policy transmission mechanism and very low inflation in the euro area.

Finally, the third and fourth articles return to one of the most important relationships of the macroeconomy – the Phillips curve. Both articles discuss an appropriate measure of inflation to be used in investigating the link between economic activity and inflation. The fourth article also examines the appropriateness of various measures of economic activity. Furthermore, the articles touch upon the issue of stability of the Phillips relationship, which is a question of utmost importance in estimating the impact of changes in economic activity on the currently observed low inflation.

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Adverse Effects of Monetary Policy Signalling[1]

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The theoretical foundations of the adverse effects of monetary policy signalling have been established recently as progress has been made in the literature on the role of information frictions in monetary policy. If information frictions exist, monetary policy actions send out informative signals to private agents about the current and future state of the economy. This "updating channel" can act against the intended monetary policy measure and reduce its effects on inflation and output. In the extreme case, inflation expectations might even rise after an interest rate hike, in sharp contrast to the common understanding of interest rate transmission. Therefore, the existence of the updating channel might explain the empirically observed "price puzzle".

To illustrate the possibility of these adverse effects taking place, we use a very standard New Keynesian "three-equation" setup based on Clarida, Gali and Gertler (1999), extended such that there are two sectors in the economy. One sector consists of fully rational agents, who know the model and are able to form rational forecasts. The other sector captures the behaviour of partially rational agents, who are not able to form expectations based on the rational expectations solution of the model, but rather form "naïve", backward-looking expectations. Still, the partially rational agents observe the actions of the central bank and can update their naïve expectations by filtering the information contained in interest rate decisions.

Following a forward-looking Taylor rule, the central bank by conducting its monetary policy signals its forecast of inflation and the output gap. Observing the short-term interest rate, the partially rational agents update their expected inflation and output and adjust their behaviour accordingly, which may counteract the intended monetary policy adjustment.

Model simulations show that a restrictive monetary policy shock makes the partially rational agents in the economy believe that the output gap and inflation will be higher than expected, counter-intuitively increasing the current consumption of partially rational households and raising the prices of partially rational retailers, thereby reducing the strength of transmission of monetary policy. In some model specifications this adverse effect might even lead to reversed transmission of monetary policy, where overall inflation and output rise with a monetary policy contraction.

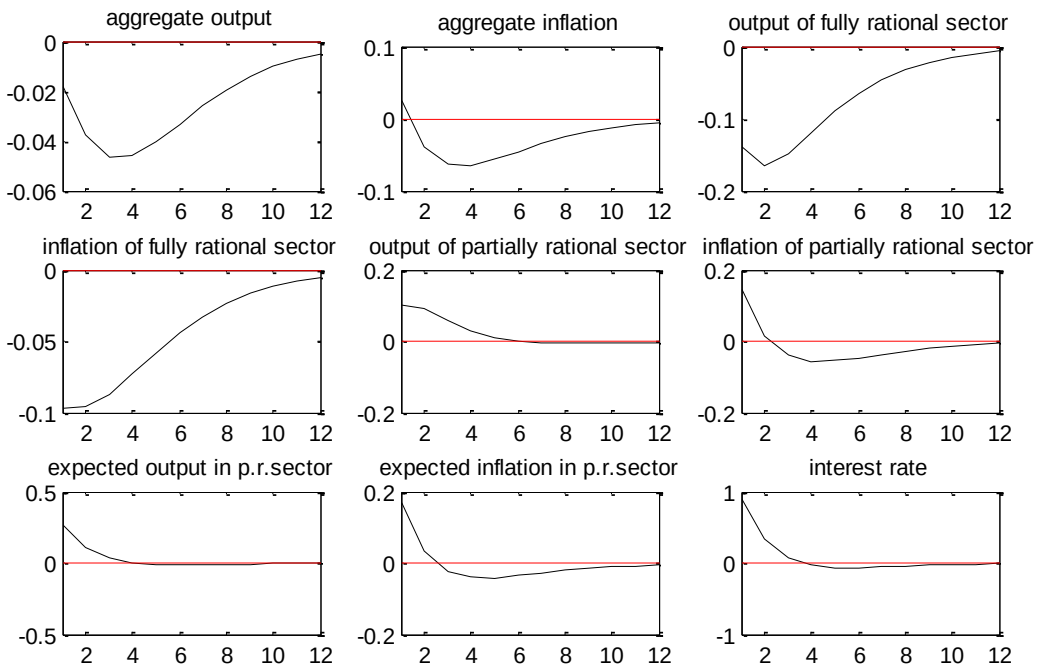
Assuming equal shares of fully rational and partially rational agents and an unexpected shock to the interest rate (see Figure 1), the partially rational agents interpret the shock as a systematic reaction of the central bank to expected inflation and output. Therefore, in the case of a contractionary monetary policy shock, the partially rational agents expect higher inflation and

[1] This article is based on Filáček and Matějů (2014).

output. In contrast, the fully rational agents interpret the increase in interest rates as a shock to the monetary policy rule and expect lower inflation and output.

Figure 1. Impulse response functions to monetary policy shock

(per cent deviations from the steady state)

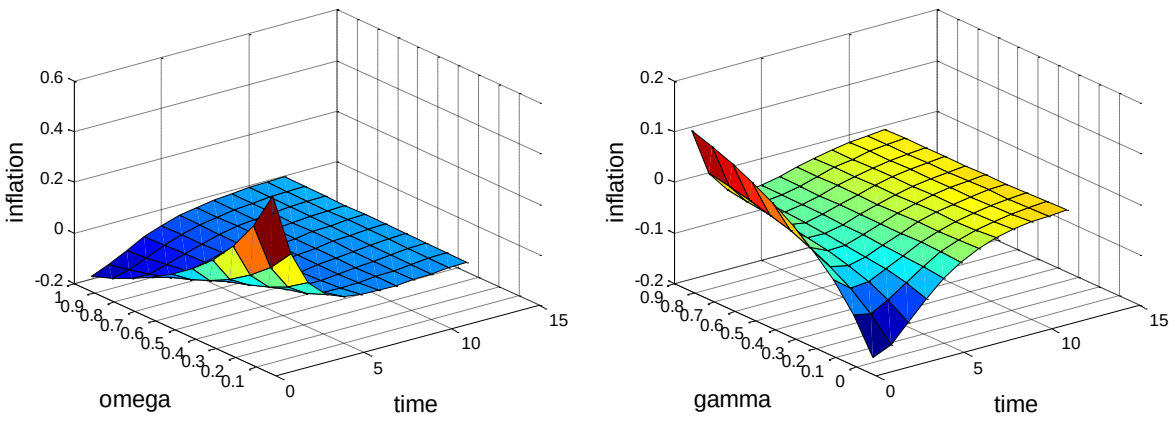


The overall effect of the monetary policy shock on the economy (aggregate inflation and output) depends heavily on the share of fully rational agents in the economy. The left-hand chart in Figure 2 shows the impulse response function for inflation as the share of fully rational agents (omega) varies between zero and one. The impulse response function for output has a similar pattern. When almost all agents are partially rational (Ω = 0.01), inflation and output rise immediately after a contractionary monetary policy shock, as the partially rational agents expect higher inflation and output. In the opposite case of all agents being fully rational, inflation and output decline after a monetary policy contraction. In the baseline model (equal shares of fully rational and partially rational agents; as also presented in Figure 1), our simulations reveal a conventional reaction of the economy to the monetary shock, although the initial reaction of inflation is slightly positive (the "price puzzle").

Another important parameter of our model is the learning speed of partially rational agents (gamma; see the right-hand chart in Figure 2). When these agents form their expectations based solely on the currently observed inflation and output (γ = 0), inflation and output conventionally decline in reaction to a monetary policy tightening, as the partially rational agents do not react to the monetary policy signal. However, when the partially rational agents put more weight on the monetary policy signal, inflation rises in the first period and then falls to slightly negative values, i.e. the adverse effects of the updating channel are strong.

Figure 2. Sensitivity of monetary policy shock responses to parameters

(per cent deviations from the steady state)



To contrast these theoretical results with the observed data, we measure the adverse effects of monetary policy signalling on a panel of selected OECD countries, including both small open inflation-targeting countries and large economies (the US and the euro area). We estimate how an unexpected change in the monetary policy rate affects private expectations about inflation and output.

Our results suggest that the updating channel does exist, i.e. inflation expectations increase in reaction to an unexpected interest rate hike. Using different specifications of the monetary policy surprise we show that the positive correlation between unanticipated interest rate changes and adjustments of inflation expectations is robust and stable across all specifications. The updating channel is present even when we control for the effect of published central bank forecasts. This result can be interpreted as meaning that the information contained in the unanticipated interest rate decision complements the information contained in the forecast. Surprisingly, the degree of central bank transparency does not influence the strength of the updating channel. This might be explained by two opposing effects. Higher transparency reduces the effects of surprising monetary policy actions on expectations on the one hand, but on the other makes surprises less likely, and therefore once they appear, they might have more pronounced effects.

The results for output expectations are consistent with the standard functioning of monetary transmission. The updating channel does not appear to be strong in the case of output, possibly because the central banks in our sample react mainly to inflation. Another explanation may be that cost-push shocks are more frequent than demand shocks. However, this result is consistent with the model results, as output expectations fall after an interest rate hike for a broad range of parameters.

Overall, we have illustrated the possibility of adverse effects of monetary policy signalling in a theoretical model and documented the presence of these effects in the data. However, we have not proposed any way of mitigating or counteracting the adverse effects of the updating channel. In addition, further empirical research is needed to explore which factors determine the strength of the updating channel.

References

Clarida, R., Gali, J. and Gertler, M. (1999): The Science of Monetary Policy: A New Keynesian Perspective. *Journal of Economic Literature*, 37(4), 1661–1707.

Filáček, J. and Matějů, J. (2014): Adverse Effects of Monetary Policy Signalling. CNB Working Paper No. 13/2014.

Spillover of the ECB's Monetary Policy outside the Euro Area: How Different is Conventional from Unconventional Policy?[2]

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Since the global financial crisis the ECB, like other central banks, has adopted a variety of unconventional measures to avoid a meltdown of the financial sector. The importance of individual ECB instruments in monetary policy transmission has been constantly evolving over time, in line with economic developments. Although it would be hard to argue that there is a consensus on the effectiveness of these policies, most studies concur that the direct impact on the euro area banking sector has been positive, with boosts to financial markets too, and that the measures implemented have averted an even steeper economic decline.

Yet the policies implemented by major central banks such as the ECB might pose a challenge to other countries. The international spillover of monetary policy is not limited to unconventional measures, but the size and discretional nature of unconventional instruments make the transmission of unconventional policy effects less straightforward from the cross-country perspective. On globally integrated financial markets, investors have been looking for more secure investments or for higher yields, leading to capital flows and pressures on the exchange rate, as well as surges in stock markets.

Despite the importance of knowing the impact of the monetary policies of large central banks across the globe, the evidence on the size of this spillover effect is largely limited to the effects of US monetary policy easing. A summary of these results indicates that the various stages of quantitative easing by the Fed have had quite different impacts. The types of monetary policies followed by the countries affected, and even more so the development of their financial markets, determine to a great extent whether stock market surges occur, surges that are associated with massive capital inflows and appreciation of domestic exchange rates. On the other hand, much less evidence has been established about the cross-border macroeconomic impact.

The spillover of ECB policies is a major policy question given the close economic links between the euro area and its neighbouring countries. However, the empirical evidence on the importance of transmission of ECB policies abroad is limited. We therefore examine the transmission of ECB monetary policy shocks to three Central European countries (the Czech Republic, Hungary and Poland), two euro opt-out countries (Sweden and the UK) and Denmark (an ERM II participant).

[2] This article is based on Babecká Kucharčuková et al. (2014).

Most notably, we aim to take into account both conventional and unconventional policies, but we also distinguish between the effects of each.

The main issue turns out to be how to measure the ECB monetary policy stance once short-term policy rates are close to the zero lower bound (ZLB) and various types of unconventional measures start appearing in sequence. Furthermore, these new measures are often targeted at specific segments of the financial market. Numerous techniques have been developed to measure the unconventional policies implemented by the US Fed at the ZLB. Most papers try to mimic the usual interest rate tool with a proxy that allows them to overcome the ZLB on nominal short-term interest rates, sometimes referred to as a shadow rate. A first group exclusively looks at interest rates: Chen et al. (2012) use the spread between government and corporate bonds, while Krippner (2014) and Wu and Xia (2014) use the term-structure and a yield curve model. A second group of studies, for example Lombardi and Zhu (2014), accumulates different balance sheet items and interest rates into a single measure with a factor model.

The use of methods based purely on interest rates turns out to be problematic for the euro area, given the more limited use of corporate bond issues and therefore the absence of market based spreads. Moreover, interest rate heterogeneity across the euro area member states since the global financial crisis is further magnified when cross-country differences in maturity structure are taken into account. Therefore, building on Lombardi and Zhu (2014), we calculate a monetary conditions index (MCI) that synthetises euro area monetary conditions based on a factor model of monetary policy indicators. The model incorporates 14 variables, including interest rates, monetary aggregates, selected ECB balance sheet items and the exchange rate. The index covers the period from January 2000 to July 2015.

The factor model suggests that two common factors are able to explain the bulk of the variability in the 14 series. The first factor, which explains around 62% of the total variability, closely follows the policy interest rate of the ECB and thus can be deemed to represent mainly conventional measures. This is not surprising given that interest rates were in use as the main policy instrument most of the time. The second factor explains around 22% of the total variability and is mostly associated with developments in the ECB's balance sheet and tracks mostly unconventional measures. The remaining third factor explains around 16% of the variability in the data and is driven mainly by developments in monetary aggregates. There does not seem to be a direct link between this factor and conventional or unconventional measures. The orthogonality between the first and second factor reflects the fact that unconventional measures are used as a substitute for the conventional one. Therefore, the first factor records most of the dynamics of ECB policy until 2008, whereas the second factor starts varying significantly only after 2007. The MCI tracking the overall monetary conditions in the euro area is then computed as the weighted average of the estimated factors (normalised to fit the 3-month Euribor).

Figure 1 plots the MCI and the 3-month Euribor. The MCI tracks the interest rate instrument closely in normal times, basically until September 2008.[3] From 2008 onwards we observe significant deviations of the MCI from the 3-month Euribor. At the onset of the global financial crisis, the sharp fall in interest rates and the enhanced liquidity support provided by the ECB

[3] This is not surprising given that in the pre-crisis period no additional measures affecting the size or composition of the ECB's balance sheet were in use and the monetary transmission mechanism (affecting the dynamics of monetary aggregates) was functioning well.

soften the monetary conditions. Policy then became tighter as the amount of full allotment tenders at fixed rate (via main refinancing operations and long-term financing operations with extended eligible collateral) started to decrease. As from mid-2011 we observe an easing of the monetary conditions related to the implementation of the Securities Market Programme (SMP) and the Long-Term Refinancing Operations (LTRO) programme (see also Figure 2 below). Conversely, from mid-2012 onwards (curiously since Mario Draghi's "whatever it takes" statement) we observe a quite significant tightening of the monetary conditions in the euro area. The significant decrease in the ECB's balance sheet due to prepayments of LTRO loans and the maturing of securities purchased within the Covered Bonds Purchase Programme (CBPP) and the SMP drive this significant jump in the second factor and consequently the whole MCI. By contrast, the announcement of the Outright Monetary Transactions (OMT) programme at that time significantly reduced yields on sovereign bonds but did not alter most of the remaining variables approximating the overall monetary conditions in our factor analysis. From the very construction of the MCI it is apparent that the gradual impairment of monetary policy transmission did lead to a tightening of the overall monetary conditions in the euro area.[4] Finally, since 2014 we observe significant policy easing following the implementation of targeted LTRO, fully-fledged quantitative easing and also the weakening of the euro.[5]

Figure 1. Monetary conditions index and the 3-month Euribor

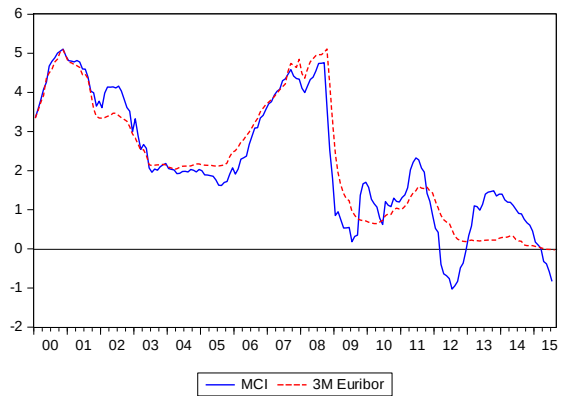
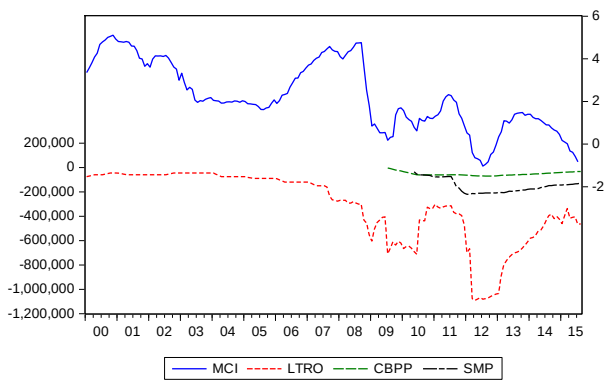


Figure 2. Monetary conditions index (right-hand scale) and volume of the ECB's main unconventional programmes (billions of euros, inverse, left-hand scale)



As the index reflects monetary policy developments in the euro area well, we use it to examine the spillover of ECB policies. We examine small open economies that are mostly recipients of the exogenous shocks generated by ECB policy. It can also be reasonably assumed that any shock affecting these economies will not be transmitted to the euro area. To account properly for the direction of the causality, we estimate a block-restricted structural VAR model in the spirit of Kim (2001), Canova (2005) and Maćkowiak (2007). The endogenous block of the VAR consists

[4] Orphanides (2014) and Fisher (2013) have made a similar argument: the ECB did not react to shifts in risk taking in markets and so made policy tighter than expected.

[5] Studies using term structure or yield curve models find a greater easing of the monetary policy conditions than our model does. For instance, the Wu and Xia (2014) shadow rate update for the euro area in 2015 is about 0.4–1.2 pp lower than our MCI estimates for the same period. The ECB shadow rate is even more negative in recent estimates by Krippner (2014).

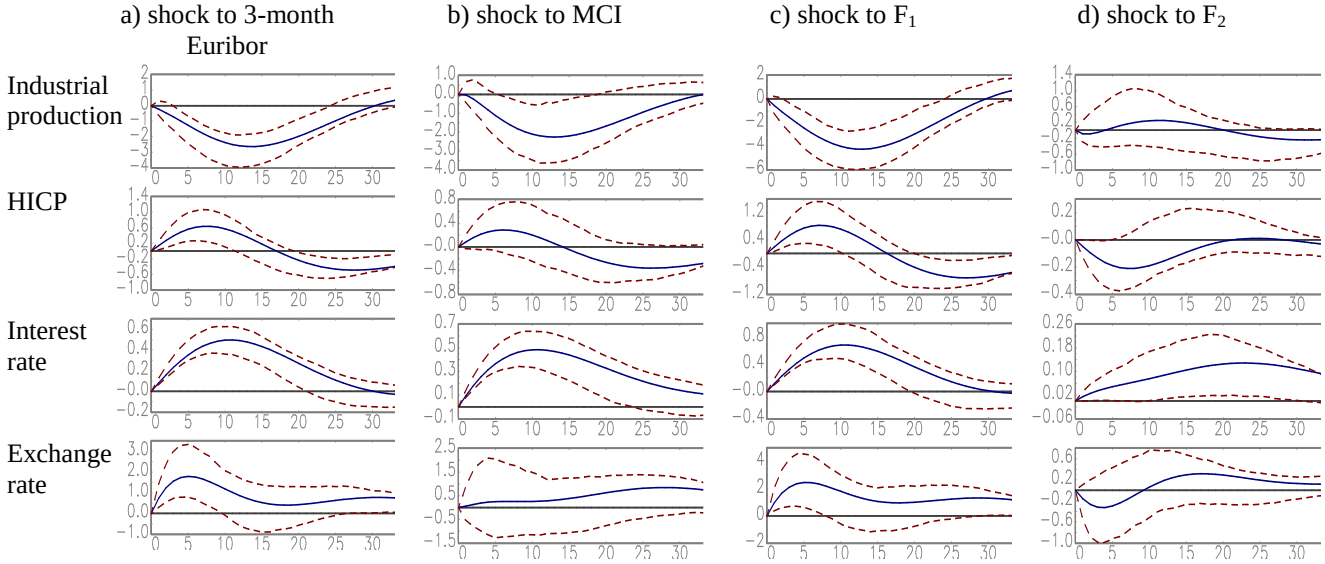
of four domestic variables: industrial production, inflation, the 3-month interbank interest rate and the exchange rate of the domestic currency vis-à-vis the euro. The exogenous block contains euro area industrial production, inflation and the monetary instrument. In order to distinguish between conventional and unconventional policies, we perform additional estimations where we decompose the monetary conditions index in the two factors that are related mostly to unconventional and conventional policies.

The impulse responses for the euro area suggest that our index does indeed represent an intuitive synthetic measure of ECB monetary policy. The responses to conventional policies are similar to those obtained in a classical structural VAR analysis using only the short-term interest rate. An expansionary shock to policy raises inflation and boosts output for some time. The second insight regarding the euro area is that the responses of output and inflation to unconventional measures are rather different. While inflation reacts much more strongly, the effect on output is much more muted, indicating that management of inflation expectations has been an important part of ECB policy.

The impulse responses for the six countries outside the euro area suggest that ECB monetary policy shocks have important spillover effects on their economies. In Figure 3 below we show the results for the Czech Republic, plotting the responses for all endogenous variables following alternative measures of the monetary policy shock: the standard 3-month Euribor, the overall index of monetary conditions (MCI), its first factor tracking mainly conventional measures (F1) and its second factor capturing mainly unconventional measures (F2). A monetary tightening as measured by the 3-month Euribor leads to a quick drop in industrial production like in the euro area, a delayed drop in inflation (the price responses feature first a pronounced price puzzle) and an almost immediate depreciation of the Czech koruna. These responses are partially intermediated by the endogenous response of domestic short-term interest rates, which is almost immediate (panel a). The transmission is not very different when the MCI is used instead, a notable exception being the exchange rate response, which ceases to be statistically significant (panel b). This suggests that the CZK/EUR exchange rate responds only when the ECB sticks to the standard interest rate tool, which is confirmed when one looks at the responses to the shock in the first factor (panel c). The spillover of an unconventional policy shock tracked by the second factor is rather different. While the drop of Czech inflation is very quick, on a par with the reaction of euro area inflation, there is no response of Czech industrial production or the koruna exchange rate. This might be related to the lack of an intermediating role of the domestic interest rate (panel d).

The results for the other five countries can be summarised as follows. A conventional monetary policy tightening by the ECB implies an industrial output contraction in all of them. On the other hand, the inflation and exchange rate responses are much more differentiated across countries. Likewise, the unconventional measures of recent years have not affected all the other economies in the same way either. While all exchange rates vis-à-vis the euro respond quickly, their signs differ across countries. Notably, following an unconventional monetary policy easing by the ECB, the Hungarian forint and Polish zloty depreciate, while the Swedish kroner and the UK pound appreciate. The longer-term real economic effect on industrial production and consumer price inflation is in turn much less general and relatively weak.

Figure 3. Impulse responses of macroeconomic variables of the Czech Republic



Our findings suggest that the monetary policy of the ECB spills over to neighbouring non-euro area economies. The implications of this external shock for the domestic economy should therefore be accounted for in policy choices in non-euro area countries. However, in contrast to conventional ECB policies, the unconventional policies of the ECB do not (so far) seem to have had a generalised economic impact on all non-euro area neighbours. This might be due to the fact that most of these measures were aimed at specific segments of the euro area financial system. However, this might change in the future with the implementation of fully fledged quantitative easing and its impact on the euro area macroeconomy.

References

Babecká Kucharčuková, O., Claeys, P. and Vašíček, B. (2014): Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? CNB Working Paper No. 15/2014.

Canova, F. (2005): The Transmission of US Shocks to Latin America. *Journal of Applied Econometrics*, 20, 229–251.

Chen, Q., Filardo, A., He, D. and Zhu, F. (2012): International Spillovers of Central Bank Balance Sheet Policies. BIS Papers 66–16.

Fisher, P. (2013): Reflections on the Meaning of "Risk Free". BIS Working Paper No. 72.

Kim, S. (2001): International Transmission of U.S. Monetary Policy Shocks: Evidence from VARs. *Journal of Monetary Economics*, 48, 339–372

Krippner, L. (2014): Term Structure Modeling at the Zero Lower Bound: A Practitioner's Guide. Palgrave-Macmillan (forthcoming).

Lombardi, M. and Zhu, F. (2014): A Shadow Policy Rate to Calibrate US Monetary Policy at the Zero Lower Bound. BIS Working Paper No. 452.

Maćkowiak, B. (2007): External Shocks, U.S. Monetary Policy and Macroeconomic Fluctuations in Emerging Markets. *Journal of Monetary Economics*, 54, 2512–2520.

Orphanides, A. (2014): ECB Policy and Fed Normalization. CEPR Policy Insight No. 74, November.

Wu, J. C. and Xia, F. D. (2014): Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound. NBER Working Paper No. 20117.

Inflation and Output Comovement in the Euro Area: Love at Second Sight?[6]

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We investigate the comovement between inflation and output in the euro area. The motivation is to investigate the relative importance of supply and demand shocks and if the slack in output and employment is reflected in inflation in the euro area. We define supply shocks as shocks that induce a negative correlation between output and inflation, and demand shocks as those that imply strongly positive comovement of output and inflation. In agreement with Summers (1986) and Cooley and Ohanian (1991), we argue that a check for positive and stable comovement between inflation and output may constitute a simple and powerful test for or against supply side-driven business cycles. Further, an analysis of the comovement of output and inflation is a crucial step for understanding the short-term Phillips curve.

Careful treatment of inflation is crucial for our exploration of its comovement with output. Inflation dynamics are considered along three dimensions – long-run, cyclical and short-term variations. The long-run dynamics of inflation should be aligned with the central bank's inflation target, which anchors long-term inflation expectations. In the case of the ECB, the target has been constant and explicit since 1999, which simplifies the analysis. If long-run inflation expectations deviate from the inflation target in a significant way, it can hardly be argued that this is due to medium-lived cyclical fluctuations. The cyclical dynamics of inflation are presumably greatly affected by persistent demand, productivity and various forms of cost-push shocks. Short-term variations are also present in the usual measures of consumer price inflation – annualised quarterly growth rates. They arise from mis-measurements, quasi-seasonal effects, complex patterns of relative price changes and so on. In general, one does not always expect the high-frequency variation of prices to be fully explained by economic theory. The subject of our analysis is the comovement of output and the cyclical component of inflation.

Therefore, we choose a flexible trimmed mean as our measure of underlying inflation. Trimmed mean inflation removes extreme movements in prices, thus mitigating the effects of a cross-sectional price growth distribution with thick tails. The trimmed mean rate of inflation is defined as the average rate of inflation after "trimming" away a certain percentage of the distribution of price changes at both ends of that distribution. This measure is calculated by ordering the price

[6] This article is based on Andrle et al. (2013).

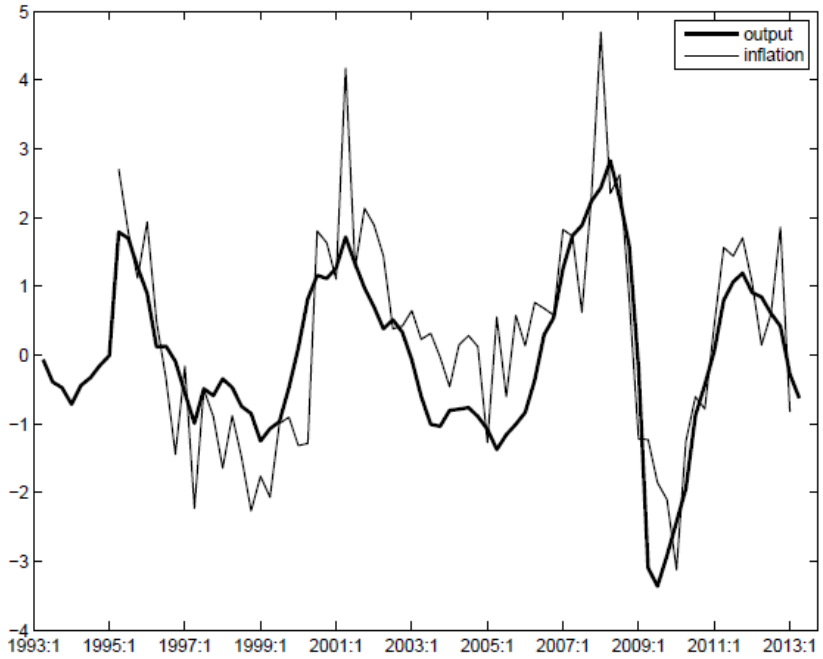
changes for all CPI items from lowest to highest, trimming away those that lie below the left trim and above the right trim, and then calculating the weighted average inflation rate from the remaining set of price changes (see, for example, Bryan and Cecchetti 1993, for more details on trimmed mean inflation). These left and right percentiles can be symmetric or asymmetric, but a criterion is needed to indicate what percentiles are to be removed.

We choose the cross-correlation of trimmed mean inflation with output at cyclical frequencies as our criterion for setting the optimal percentiles to trim. Why have we chosen comovement with real activity as a criterion for the estimation of underlying inflation? It is an attempt to find evidence in favour of a Phillips correlation: the output cycle should have a relationship with underlying inflation. Our underlying inflation is chosen to be well predicted by output and can thus be an indicator of demand-pull inflation.

We look at what are the optimal in-sample trimming percentage and frequency bands to find the relationship between output and inflation. The optimal trimming percentage is [48; 28]. For a reduced sample running only up to 2007:1, the optimal trim is [37; 21]. If the optimisation is carried out using symmetric trims, the optimum is reached at 38. However, the gains after the 10th percentile are very modest. It thus seems that median inflation is a relatively robust measure of inflation given the data and aggregation structure used.

Our baseline results suggest a tight link between underlying inflation and the output cycle in the euro area during 1995–2012. As expected, inflation lags behind the output cycle according to our results. The mean lag is one quarter. For better visualisation, the output cycle is computed using the bandpass filter designed by Christiano and Fitzgerald (1999); see Figure 1. Underlying inflation is scaled to the output variance and lagged by one quarter to align the average phase of the two series. The positive correlation is suggestive of the prominence of demand-driven business cycles, with supply shocks operating mostly at low or very high frequencies. The results hold for the in-sample calculations, to which the optimal trimmed mean measure of underlying inflation and the measure of the output cycle were calibrated, as well as for the median inflation.

Figure 1. Output and inflation cycles



Note: In the figure, the inflation cycle is lagged by one quarter and re-scaled to have identical variance to the output cycle.

We performed a series of sensitivity checks, especially with respect to trimming percentages and the sample period. The comovement is robust with respect to deviations from the optimal trimming percentage. Median inflation and a variety of trimmed mean inflation measures also display cyclical comovements with output.

The sample available for the computation of the trimmed means is relatively short, so the question of whether our results also apply to a longer historical sample is a relevant one. The answer is yes – the strength of demand-pull inflation is also significant in the period from 1970 to 2005. Using synthetic data for the euro area compiled for the AreaWide Model (AWM) database (see Fagan et al., 2001), updated until 2005 Q4, we also find strong and positive comovement of output and the consumption deflator at business cycle frequencies.

To guard ourselves against circular reasoning we also performed a "placebo" sampling test. This test checks whether our procedure could have generated the reported comovement. The results of the test reject this possibility.

The close comovement of output and inflation is highly suggestive of the dominance of demand factors in the euro area business cycle. Structural models that do not capture the comovement between output and inflation at business cycle frequencies will have a hard time interpreting euro area developments. The various flavours of technology shocks used in recent general equilibrium models will not do, since they imply negative comovement of output and inflation. The results in this paper are in line with those found in Andrle et al. (2015) about the importance of demand fluctuations in advanced countries and comovement of output and inflation. That said, we do not deny that numerous supply-side and policy factors shape the dynamics of the economy at low and high frequencies.

References:

Andrle, M., Brůha, J. and Solmaz, S. (2015): On the Sources of Business Cycles: Implications for DSGE Models. CNB draft under project B4/13, previous version presented at the EEA Annual Congress, Mannheim, 2015.

Andrle, M., Brůha, J. and Solmaz, S. (2013): Inflation and output comovement in the Euro Area: Love at second sight? CNB Working Paper No. 7/2013.

Bryan, M. and Cecchetti, S. (1993): Measuring Core Inflation. NBER Working Paper No. 4303.

Christiano, L. and Fitzgerald, T. (1999): The Band Pass Filter. Technical Report, NBER Working Paper No. 7257.

Cooley, T. and Ohanian, L. (1991): The Cyclical Behavior of Prices. *Journal of Monetary Economics*, 28(1), 25–60.

Fagan, G., Henry, J. and Mestre, R. (2001): An Area-wide Model (AWM) for the Euro Area. Technical Report, ECB Working Paper No. 42.

Summers, L. (1986): Some Skeptical Observations on Real Business Cycle Theory. Federal Reserve Bank of Minneapolis Quarterly Review, Fall: 23–27.

Inflation and the Steeplechase between Economic Activity Variables[7]

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The link between economic activity and price inflation regained importance as the global financial crisis caused a significant decline in economic activity elsewhere, while the decline in inflation was much less general. This has been attributed variously to long-term inflation expectations being firmly anchored at pre-defined inflation targets (e.g. IMF, 2013) or a flatter Phillips curve, implying a weakening of the trade-off between inflation and unemployment (Matheson and Stavrev, 2013). On the contrary, in recent years we have witnessed generalised economic rebounds with a substantial price slump, which cast further doubt on the validity of the Phillips curve.

The empirical research on the inflation-real activity nexus has faced a number of uncertainties, namely (i) uncertainty about the appropriate variable for tracking real economy activity, (ii) uncertainty about whether the relationship between economic activity and inflation is linear or state-dependent, (iii) uncertainty about whether the relationship between the two variables changes permanently over time due to structural changes in the economy and monetary policy, and finally (iv) uncertainty about the appropriate measure of inflation that can be reasonably linked to economic activity. All these choices might influence the estimates of the strength of the inflation-real activity relationship, as shown by Mavroeidis et al. (2014).

We aim to address the first three uncertainties in a consistent manner, focusing on the United States and the other G7 countries over the decades (according to data availability). To find a closer link between inflation and economic activity, we need to deal with the fact that the inflation series shows an apparent trend that is arguably driven by non-business cycle factors such as the credibility of monetary policy. We use an unobserved component model with stochastic volatility (UC-SV) to obtain a stochastic trend that we remove from the inflation series. Therefore, we assume that real economic activity can affect inflation only at business cycle frequencies (the inflation gap). Drawing on the estimated inflation gap, we investigate the explanatory potential of a number of variables that traditionally represent economic activity in the literature on the Phillips curve or the New Keynesian Phillips curve: the output gap, real unit labour costs, growth of the employment rate and the short-term unemployment rate. Additionally, following the recent contribution by Stock and Watson (2010), we also include the unemployment recession gap, which measures the difference between the current unemployment

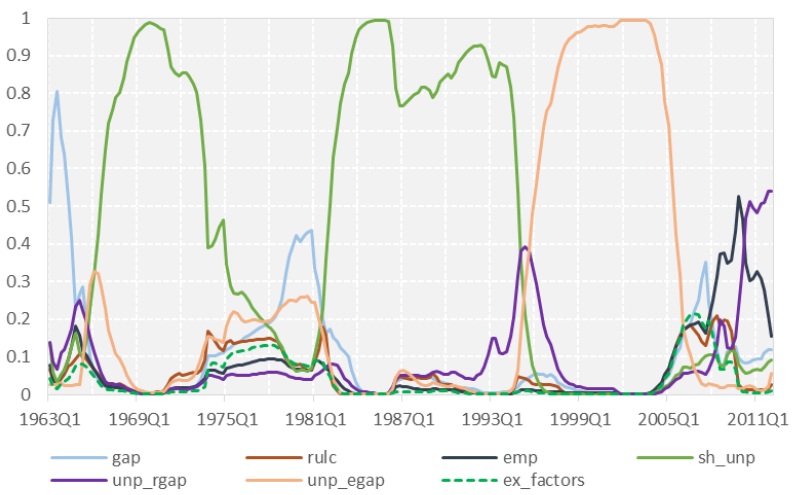
[7] This article is based on Baxa et al. (2013).

rate and the minimum observed over the past three years. The unemployment recession gap in fact stresses the role of periods with increasing unemployment while attenuating the role of others. To account also for periods of a decreasing unemployment rate, we add its counterpart, the unemployment expansion gap. Finally, variables representing external shocks, namely oil prices and the nominal effective exchange rate, also take part in our steeplechase.

All these variables are fed through a procedure called dynamic model averaging (Raftery et al., 2010), which marries the flexibility of the time-varying parameter framework with a model-uncertainty treatment conceptually close to Bayesian model averaging. In particular, we assume the existence of a single "true" model in each period, which can switch over time. The probability that the model in question is "true" at a given point in time is reflected in the posterior model probabilities. In effect, we can select variables that best describe recent inflation gap developments in each period and even allow for time-varying strength of the relationship between these variables and inflation.

Our results show that inflation does respond to economic activity, but the explanatory potential of different measures of economic slack varies across time and space and no measure of economic activity clearly dominates in all countries or over the whole sample. The output gap is often outperformed by unemployment-related variables such as the short-term unemployment rate, the unemployment expansion gap and the unemployment recession gap. For the sake of brevity, we only show headline results for the US economy, but we document that a similar pattern can be observed across other economies as well. Figure 1 presents the posterior model probabilities of individual models for the US. The results point to the importance of the model-switching approach in accounting for changes in inflation drivers in the context of the inflation-activity nexus, alongside the traditionally considered parameter instability. In the US case, short-term unemployment seems to dominate the other measures of economic slack in explaining the inflation gap. This implies that inflation pressures generated by the real economy should be assessed in a highly complex environment. No measure should be granted prominence *a priori*.

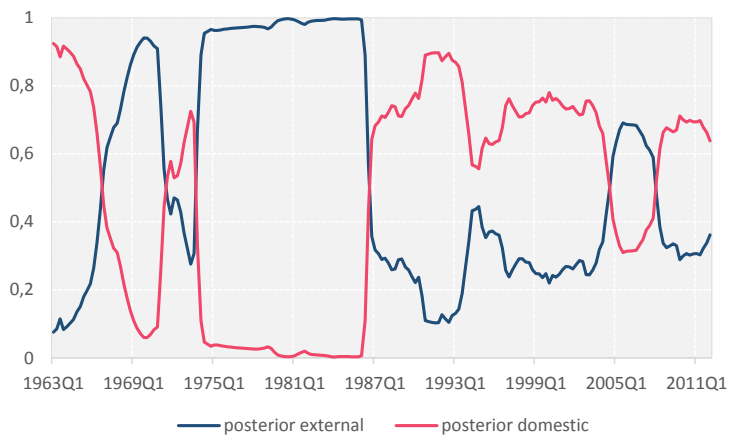
Figure 1. Posterior model probabilities, US



Note: *gap* = output gap; *rulc* = real unit labour costs, y-o-y changes; *emp* = employment, y-o-y changes; *sh_unp* = short-term unemployment, *unp_rgap* = unemployment recession gap ($unp\_rgap_t = unp_t\text{-}min(unp_t{:}unp_{t\text{-}11})$); *unp_egap* = unemployment expansion gap ($unp\_egap_t = unp_t\text{-}max(unp_t{:}unp_{t\text{-}11})$); *ex_factors*: oil prices (y-o-y) and real effective exchange rate (y-o-y changes).

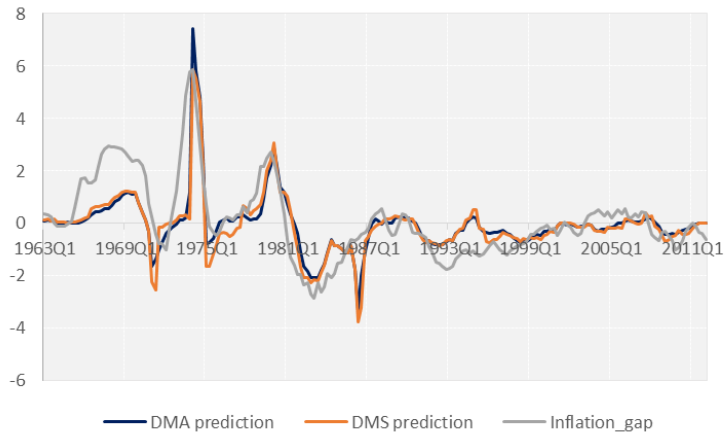
In addition, our results highlight the importance of including foreign factors, although their relevance also varies over time. In particular, there are long periods when (exogenous) foreign factors are significant inflation drivers. Nevertheless, it should be noted that when used in isolation foreign factors outperform measures of domestic activity only in a few rare cases. Thus they have only additional rather than leading explanatory power for fitting and predicting the inflation gap. Whereas Figure 1 sums the probabilities of the models whether they contain external variables or not (for example, the model probability of the output gap corresponds to the sum of the probabilities of models with the output gap only and the model with the output gap and the two external variables), Figure 2 shows the cumulative posterior probabilities of all the models with and without foreign variables. It is notable that in some specific periods, such as the oil shocks of the 1970s, the foreign sources of inflation clearly dominate.

Figure 2. Relative importance of domestic vs. foreign inflation drivers, US



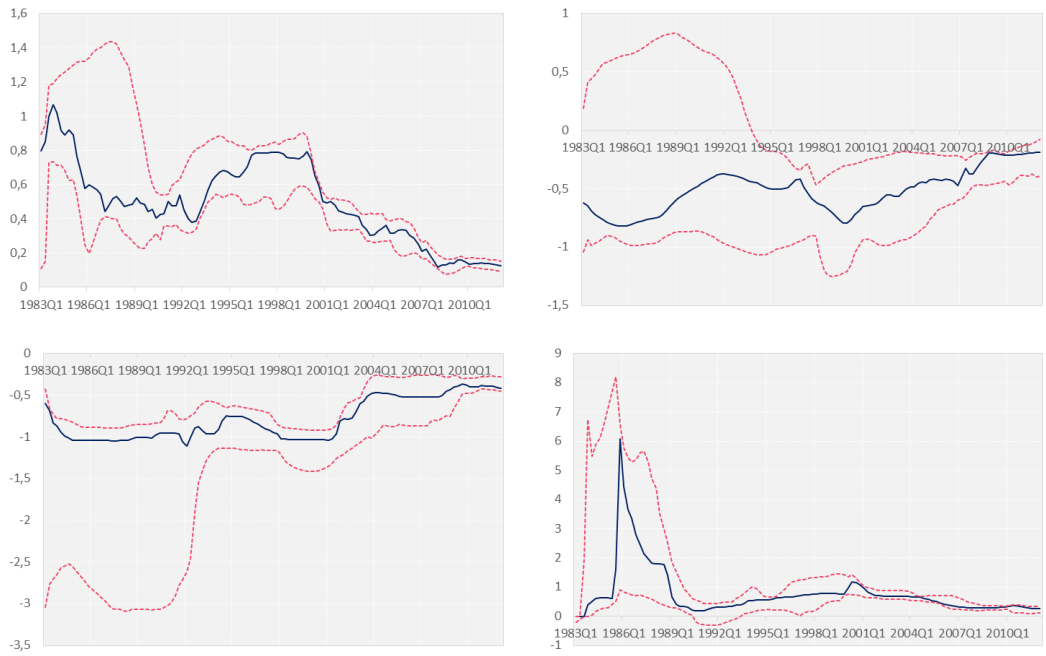
So far we have been dealing with the relative importance of various measures of economic activity in explaining the inflation gap by means of the posterior probabilities of various models. Now we turn to assessing the overall importance of domestic economic activity in explaining the inflation gap. Figure 3 compares the DMA and DMS (an alternative to DMA) pseudo out-of-sample predictions of the inflation gap over time. It suggests that the impact of economic activity on inflation is relatively robust, as most of the major inflation upturns and downturns are well explained by the real economy variables. However, these results also confirm that the relationship between inflation and economic activity is rather complex and cannot be traced by a Phillips curve depending on a single measure of economic activity and assuming a stable and linear relationship between inflation and economic activity. Therefore, this nexus can only be seen when a more subtle approach that explicitly accounts for the uncertainty of this relationship is used. This implies that macroeconomic models working with some version of the Phillips curve should ideally take such complexity into account.

Figure 3. Inflation gap vs. DMA/DMS predictions, US



On the other hand, we also document a weakening of the inflation-activity relationship (i.e. a flattening of the Phillips curve) in recent decades that is robust both across activity measures and across countries. Figure 4 plots the medians of the time-varying coefficients of four selected measures of domestic slack for G7 countries, showing a clear pattern of decline in the response coefficient. Although there is still no consensus on whether these developments should be attributed to structural changes in the economy or to monetary policy, the fact that inflation has become the only target variable of most central banks supports the hypothesis that monetary policy contributed to some degree to the weakening of the trade-off. Besides, this flattening is conditional on inflation expectations remaining anchored in most countries. There is no guarantee that a flat Phillips curve would persist if inflation expectations were to break away from (more or less explicit) inflation targets.

Figure 4. Time-varying coefficients of various measures of economic activity, medians for G7 countries



Note: output gap (upper left), short-term unemployment (upper right), unemployment recession gap (lower left), unemployment expansion gap (lower right). The intervals represent the 25%–75% quantiles.

References

Baxa, J., Plašil, M. and Vašíček, B. (2013): Inflation and the Steeplechase Between Economic Activity Variables. CNB Working Paper No. 15/2013.

IMF (2013): The Dog That Didn't Bark: Has Inflation Been Muzzled or Was It Just Sleeping? Chapter 3 in World Economic Outlook (April 2013).

Matheson, T. and Stavrev, E. (2013): The Great Recession and the Inflation Puzzle. *Economics Letters*, 120(3), 468–472.

Mavroeidis, S., Plagborg-Møller, M. and Stock, J. H. (2014): Empirical Evidence on Inflation Expectations in the New Keynesian Phillips Curve. *Journal of Economic Literature*, 52(1), 124–188.

Raftery, A., Kárny, M. and Ettler, P. (2010): Online Prediction Under Model Uncertainty via Dynamic Model Averaging: Application to a Cold Rolling Mill. *Technometrics*, 52(1), 52–66.

Stock, J. H. and Watson, M. W. (2010): Modeling Inflation After the Crisis. NBER Working Paper No. 16488.

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Ambriško, R., Babecký, J., Ryšánek, J. and Valenta, V. (2015): Assessing the Impact of Fiscal Measures on the Czech Economy. *Economic Modelling*, 44(C), 350–357.

Angelini, P., Clerc, L., Cúrdia, V., Gambacorta, L., Gerali, A., Locarno, A., Motto, R., Roeger, W., Van den Heuvel, S. and Vlček, J. (2015): Basel III: Long-term Impact on Economic Performance and Fluctuations. *Manchester School*, 83(2), 217–251.

Audzei, V. and Brázdik, F. (2015): Monetary Policy and Exchange Rate Dynamics: The Exchange Rate as a Shock Absorber. *Czech Journal of Economics and Finance*, 65(5),391–410.

Babecký, J., Havránek, T., Matějů, J., Rusnák, M., Šmídková, K. and Vašíček, B. (2014): Banking, Debt, and Currency Crises in Developed Countries: Stylized Facts and Early Warning Indicators. *Journal of Financial Stability*, 15(C), 1–17.

Babecký, J., Havránek, T., Matějů, J., Rusnák, M., Šmídková, K. and Vašíček, B. (2013): Leading Indicators of Crisis Incidence: Evidence from Developed Countries. *Journal of International Money and Finance*, 35(C), 1–19.

Babecký, J. and Havránek, T. (2014): Structural Reforms and Growth in Transition: A Meta-Analysis. *Economics of Transition*, 22(1), 13–42.

Babecký, J., Komárek, L. and Komárková, Z. (2013): Convergence of Returns on Chinese and Russian Stock Markets with World Markets: National and Sectoral Perspectives. *National Institute Economic Review*, 223, R16–R34.

Babecký, J., Komárek, L. and Komárková, Z. (2013): Financial Integration at Times of Financial Instability. *Czech Journal of Economics and Finance*, 63(1), 25–45.

Baxa, J., Horváth, R. and Vašíček, B. (2014): How Does Monetary Policy Change? Evidence on Inflation Targeting Countries. *Macroeconomic Dynamics*, 18(3), 593–630.

Baxa, J., Horváth, R. and Vašíček, B. (2013): Time-Varying Monetary-Policy Rules and Financial Stress: Does Financial Instability Matter for Monetary Policy? *Journal of Financial Stability*, 9(1), 117–138.

Baxa, J., Plašil, M. and Vašíček, B. (2015): Changes in Inflation Dynamics under Inflation Targeting? Evidence for Central European Countries. *Economic Modelling*, 44(C), 116–130.

Beck, R., Jakubik, P. and Piloiu, A. (2015): Key Determinants of Non-performing Loans: New Evidence from a Global Sample, *Open Economies Review*, 26(3), 525–550.

Bulíř, A., Čihák, M. and Šmídková, K. (2013): Writing Clearly: The ECB's Monetary Policy Communication. *German Economic Review*, 14(1), 50–72.

Calice, G., Miao, R.H., Štěrba, F. and Vašíček, B. (2015) Short-term determinants of the idiosyncratic sovereign risk premium: A regime-dependent analysis for European credit default swaps. *Journal of Empirical Finance*, forthcoming.

Cimburek, J. and Řežábek, P. (2013): Currency in Circulation: Reaction in Crises (in Czech). *Český finanční a účetní časopis*, 2013(3), 62–72.

Claeys, P. and Vašíček, B. (2014): Measuring Bilateral Spillover and Testing Contagion on Sovereign Bond Markets in Europe. *Journal of Banking and Finance*, 46(C), 151–165.

Clerc, L., Derviz, A., Mendicino, C., Moyen, S., Nikolov, K., Stracca, L., Suarez, J. and Vardoulakis, A. (2014): The 3D Model: a Framework to Assess Capital Regulation. *Economic Bulletin and Financial Stability Report Articles*, Banco de Portugal.

Clerc, L., Nikolov, K., Derviz, A., Stracca, L., Mendicino, C., Suarez, J., Moyen, S. and Vardoulakis, A. (2014): Macroprudential Capital Tools: Assessing Their Rationale and Effectiveness. *Financial Stability Review*, Banque de France, 18(April), 183–194.

De Haan, J., Hoeberichts, M.,, Šmídková, K., Vašíček, B., Vermeulen, R. and Žigraiová, D. (2015): Financial Stress Indices and Financial Crises. *Open Economies Review*, forthcoming.

Derviz, A. (2014) Collateral Composition, Diversification Risk, and Systemically Important Merchant Banks. *Journal of Financial Stability*, 14(C), 23–34.

Dybczak, K. and Galuščák, K. (2013): Changes in the Czech Wage Structure: Does Immigration Matter? *Czech Journal of Economics and Finance*, 63(2), 108–128.

Feldkircher, M., Horváth, R. and Rusnák, M. (2014): Exchange Market Pressures during the Financial Crisis: A Bayesian Model Averaging Evidence. *Journal of International Money and Finance*, 40(C), 21–41.

Frait, J. and Komárková, Z. (2013): Loan Loss Provisioning in Selected European Banking Sectors: Do Banks Really Behave in a Procyclical Way? *Czech Journal of Economics and Finance*, 63(4), 308–326.

Frait, J. and Tomšík, V. (2014): Impact and Implementation Challenges of the Basel Framework for Emerging, Developing and Small Economies. *Comparative Economic Studies*, 56(4), 493–516.

Franta, M., Baruník, J., Horváth, R. and Šmídková, K. (2014): Are Bayesian Fan Charts Useful? The Effect of Zero Lower Bound and Evaluation of Financial Stability Stress Tests. *International Journal of Central Banking*, 10(1), 159–197.

Franta, M., Horváth, R. and Rusnák, M. (2014): Evaluating the Changes of the Monetary Transmission Mechanism in the Czech Republic. *Empirical Economics*, 46(3), 827–842.

Fungáčová, Z. and Jakubík, P. (2013): Bank Stress Tests as an Information Device for Emerging Markets: The Case of Russia. *Czech Journal of Economics and Finance*, 63(1), 87–105.

Galuščák, K., Hlaváč, P. and Jakubík, P. (2015): Household Resilience to Adverse Macroeconomic Shocks: Evidence from Czech Microdata. *International Review of Applied Economics*, forthcoming.

Geršl, A. and Brechler, J. (2014): Political Legislation Cycle in the Czech Republic. *Constitutional Political Economy*, 25(2), 137–153.

Geršl, A., Jakubík, P., Konečný, T. and Seidler, J. (2013): Dynamic Stress Testing: The Framework for Assessing the Resilience of the Banking Sector Used by the Czech National Bank. *Czech Journal of Economics and Finance*, 63(6), 505–536.

Geršl, A., Jakubík, P., Kowalczyk, D., Ongena, S. and Peydro, J. L. (2015): Monetary Conditions and Banks' Behaviour in the Czech Republic. *Open Economies Review*, 26(3), 407–445.

Geršl, A. and Jašová, M. (2014): Measures to Tame Credit Growth: Are They Effective? *Economic Systems*, 38(1), 7–25.

Geršl, A., Jašová, M. and Zápal, J. (2014): Fiscal Councils and Economic Volatility. *Czech Journal of Economics and Finance*, 64(3), 190–212.

Geršl, A., Komárková, Z. and Komárek L. (2015): Liquidity Stress Testing with Second-Round Effects: Application to the Czech Banking Sector. *Czech Journal of Economics and Finance*, forthcoming.

Geršl, A. and Lešanovská, J. (2014): Explaining the Czech Interbank Market Risk Premium. *Economic Systems*, 38(4), 536–551.

Geršl, A. and Seidler, J. (2015): Countercyclical Capital Buffers and Credit-to-GDP Gaps: Simulation for Central, Eastern and Southeastern Europe. *Eastern European Economics*, forthcoming.

Hainz, C., Horváth, R. and Hlaváček, M. (2014): The Interest Rate Spreads in the Czech Republic: Different Loans, Different Determinants? *Economic Systems*, 38(1), 43–54.

Hampl, M. (2013): The Case of European Monetary Integration and its Former Hegemon. *German Economic Review*, 14(1), 2–14.

Hausenblas, V., Kubicová, I. and Lešanovská, J. (2015): Contagion Risk in the Czech Financial System: A Network Analysis and Simulation Approach. *Economic Systems*, 39(1), 156–180.

Havranek, T, Horvath, R, Irsova, Z, and Rusnak, M.(2015): Cross-Country Heterogeneity in Intertemporal Substitution. *Journal of International Economics*, 96, 100–118.

Havránek, T., Horváth, R. and Valíčková, P. (2015): Financial Development and Economic Growth: A Meta-Analysis. *Journal of Economic Surveys*, 29(3), 506–526.

Havránek, T. and Iršová, Z. (2013): A Meta-Analysis of Bank Efficiency Measurement in Transitional Countries. *Transformations in Business and Economics*, 12(2), 163–183.

Havránek, T. and Iršová, Z. (2013): Determinants of Bank Performance in Transition Countries: A Data Envelopment Analysis. *Transition Studies Review*, 20(1), 1–17.

Havránek, T., Iršová, Z., Janda, K., Zilberman, D. (2015): Selective Reporting and the Social Cost of Carbon. *Energy Economics*, 51, 394–406.

Havránek, T. and Kokeš, O. (2015): Income Elasticity of Gasoline Demand: A Meta-Analysis. *Energy Economics*, 47(C), 77–86.

Havránek, T. and Rusnák, M. (2013): Transmission Lags of Monetary Policy: A Meta-Analysis. *International Journal of Central Banking*, 9(4), 39–76.

Havránek, T. and Sedlaříková, J. (2014): A Meta-Analysis of the Income Elasticity of Money Demand (in Czech). *Politická ekonomie*, 2014(3), 366–382.

Havránek, T. (2015): Measuring Intertemporal Substitution: The Importance of Method Choices and Selective Reporting. *Journal of the European Economic Association*, forthcoming.

Horváth, R., Rusnák, M., Šmídková, K. and Zápal, J. (2014): The Dissent Voting Behaviour of Central Bankers: What Do We Really Know? *Applied Economics*, 46(4), 450–461.

Iršová, Z. and Havránek, T. (2013): Determinants of Horizontal Spillovers from FDI: Evidence from a Large Meta-Analysis. *World Development*, 42(C), 1–15.

Jakubik, P. and Moinescu, B. (2015): Assessing Optimal Credit Growth for an Emerging Banking System. *Economic Systems*, forthcoming.

Jakubík, P. and Reininger, T. (2013): Determinants of Nonperforming Loans in Central, Eastern and Southeastern Europe. *Focus on European Economic Integration*, 3, 48–66.

Jakubík, P. and Teplý, P. (2011): The JT Index as an Indicator of Financial Stability of Corporate Sector. *Prague Economic Papers*, 2/2011, 157–176.

Jakubik, P. and Žigraiová, D. (2015): Systemic Event Prediction by Early Warning System: An Application to the Czech Republic. *Economic Systems*, forthcoming.

Janáček, K. and Komárek, L. (2012): Will US Dollar Continue As The World Most Important Reserve Currency? (in Czech). *Politická ekonomie*, 2012(1), 3–19.

Komárek, L., Komárková, Z. and Lešanovská, J. (2013): Analysis of Sovereign Risk Market Indicators: The Case of the Czech Republic. *Czech Journal of Economics and Finance*, 63(1), 5–24.

Lízal, L. and Tashpulatov, S. N. (2014): Do Producers Apply a Capacity Cutting Strategy to Increase Prices? The Case of the England and Wales Electricity Market. *Energy Economics*, 43(C), 114–124.

Mandel, M. and Tomšík, V. (2014): Monetary Policy Efficiency in Conditions of Excess Liquidity Withdrawal. *Prague Economic Papers*, 2014(1), 3–23.

Mandel, M. and Tomšík, V. (2013): Causes and Consequences of Emerging Market Central Banks' Long-Term Foreign Exchange Exposure. *Eastern European Economics*, 51(4), 26–49.

Pierluigi, B., Brůha, J. and Serafini, R. (2014): Euro Area Labour Markets: Different Reaction to Shocks? *Journal of Banking and Financial Economics*, 2(2), 34–60.

Rusnák, M., Havránek, T. and Horváth, R. (2013): How to Solve the Price Puzzle? A Meta-Analysis. *Journal of Money, Credit and Banking*, 45(1), 37–70.

Rusnák, M. (2013): Revisions to the Czech National Accounts: Properties and Predictability. *Czech Journal of Economics and Finance*, 63(3), 244–261.

Singer, M. (2013): A Comparison of the Rates of Growth of Post-Transformation Economies: What Can(not) Be Expected from GDP? *Prague Economic Papers*, 3/2013, 3–27.

Skořepa, M. and Komárek, L. (2015): Sources of Asymmetric Shocks: The Exchange Rate or Other Culprits? *Economic Systems*, forthcoming.

Skořepa, M. and Seidler, J. (2015): Capital Buffers Based on Banks' Domestic Systemic Importance: Selected Issues. *Journal of Financial Economic Policy*, forthcoming.

Skořepa, M. and Seidler, J. (2013): An Additional Capital Requirement Based on the Domestic Systemic Importance of a Bank. *Journal of Economic Sciences*, 2(3), 131–142.

Skořepa, M. (2013): Troubles in the Euro Area Periphery: The View through the Lens of a Simple Convergence-Sensitive Optimum Currency Area Index. *Czech Journal of Economics and Finance*, 63(2), 129–151.

Žigraiová, D. and Havránek, T. (2015): Bank Competition and Financial Stability: Much Ado About Nothing? *Journal of Economic Surveys*, forthcoming.

Žigraiová, D. and Jakubik, P. (2015): Systemic Event Prediction by Early Warning System: An Application to the Czech Republic. *Economic Systems*, forthcoming.

Call for Research Projects 2017

The CNB Economic Research Department will announce its regular Call for Research Projects 2017 on 15 April 2016. Follow the link: http://www.cnb.cz/en/research/research_projects.

Call for Papers: Productivity and External Rebalancing Conference

The twelfth conference of Competitiveness Research Network, jointly organised with the European Central Bank and the Czech National Bank, will be held in Prague on **21–22 April, 2016**. More information can be found at:
http://www.cnb.cz/en/research/seminars_workshops/compnet_2016.html.

Complete manuscripts (preferred) or extended abstracts should be submitted electronically in PDF format to **compnet@ecb.int** by **17 January 2016**. Authors of accepted papers will be notified by **30 January 2016**. Andrew B. Bernard (Tuck School of Business at Dartmouth) and Jan De Loecker (Princeton University) have confirmed their participation as keynote speakers.

CNB Research Open Day

The twelfth CNB Research Open Day will be held in the Czech National Bank's Commodity Exchange (Plodinová Burza, Senovážné nám. 30, Praha 1) building on **Monday, 16 May 2016**. This 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 2017 and to meet CNB researchers informally. Boris Vujčić, Governor of the Croatian National Bank, has confirmed his participation as a keynote speaker.

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