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Effects of Monetary Policy
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EDITORIAL

Monetary policy is a one of the core functions of modern central banks. The recent economic crisis – the "Great Recession", as it is sometimes dubbed – created new challenges as regards properly understanding the functioning of monetary policy and its effects and interactions with other policies. This issue of the Economic Research Bulletin presents a sample of CNB staff research that contributes to the understanding of this important and exciting research agenda.

In November 2013, during an economic slowdown and in a low inflation and low interest rate environment, the Czech National Bank introduced an exchange rate floor as an additional monetary policy measure. After more than three years, it is time to ask what its effects were and whether it fulfilled the intended goals. The first article attempts to answer these questions.

What role do house prices play in monetary policy? This interesting question has gained prominence since the beginning of the Great Recession. The authors of the second article argue that monetary policy should not ignore costs associated with owner-occupied housing and that those costs should be incorporated directly into the headline inflation measure.

CNB staff are very active in providing technical assistance to foreign central banks. I am therefore glad that this bulletin presents a relevant piece of work done in this area: a DSGE model tailored to the Serbian economy. The model described in the third article was developed jointly by Czech and Serbian experts and can be used for practical monetary policy analyses at the National Bank of Serbia.

The fourth article presents empirical research on the effects of monetary policy on the investments and financing decisions of Czech firms. The authors find evidence for asymmetric effects of monetary policy on Czech firms. They interpret this as evidence of information frictions pointing to the importance of credit channels in the Czech economy.

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An Exchange Rate Floor as an Instrument of Monetary Policy: An Ex-post Assessment of the Czech Experience

We evaluate the effects of the exchange rate floor on the Czech economy. We use two approaches: simulations with structural forward-looking macroeconomic models and empirical methods. Both methods show that the floor prevented inflation from turning negative and that it did not hurt – and probably helped – the real economy. We conclude that the introduction of the floor was a correct and successful policy action.

Jan Brůha and Jaromír Tonner
(on p. 2)

Headline Inflation Measures Shouldn't Ignore the Costs of Home Ownership

Seven out of every ten Europeans live in their own homes. Yet Europe's most important inflation measure (the harmonised index of consumer prices, HICP) excludes the costs associated with owner-occupied housing. Eurostat is currently mulling a change in this practice, one which would also make the HICP more comparable with the inflation statistics reported for the US and Japan. We argue that, in addition to being a conceptual improvement, the change would prove beneficial to the conduct of monetary and macroprudential policy.

Mojmír Hampl and Tomáš Havránek **(on p. 6)**

DSGE Model with Financial Dollarisation – The Case of Serbia

We amend a DSGE model of a small open economy by adding financial dollarisation. The model encompasses commercial banks and foreign-exchange-denominated deposits and loans. The model properties are tested to match stylised facts of dollarised economies. Specifically, the model is calibrated to the Serbian data and a model-consistent multivariate filter is used to identify unobserved trends and gaps.

Mirko Djukić, Tibor Hlédik, Jiří Polanský, LjubicaTrajčev and Jan Vlček **(on p. 11)**

The Impact of Monetary Policy on Financing of Czech Firms

One of the key monetary policy transmission channels runs through the investment and financing decisions of firms. The effects of changes in interest rates tend to be heterogeneous across firms, a fact that monetary policy must take into account. We investigate the balance sheet data of Czech firms during 2003–2011 and describe the main patterns of financing of those firms and the asymmetries of monetary policy transmission.

Ruslan Aliyev, Dana Hájková and Ivana Kubicová
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An Exchange Rate Floor as an Instrument of Monetary Policy: An Ex-post Assessment of the Czech Experience[1]

Jan Brůha[a] and Jaromír Tonner[a]

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After the outbreak of the Great Recession in 2008, the Czech National Bank gradually eased the monetary conditions by lowering its policy rate. The rate hit "technical zero" in autumn 2012, and thereafter the CNB used forward guidance to further ease the monetary conditions. This, however, was not sufficient, as the 2013 inflation forecasts were predicting that inflation would turn negative in 2014. On 7 November 2013, therefore, the CNB introduced a floor (i.e. a one-sided commitment) for the Czech koruna exchange rate as a policy instrument: it committed to keeping the Czech koruna/euro exchange rate weaker than the floor of 27 Czech koruna/euro.

The main rationale for this action was to prevent the risk of deflation in a zero-lower-bound environment where policy rates could not be lowered any further. We assess the effect of the exchange rate floor on the Czech economy – inflation and the main real aggregates.

After the floor was introduced, the Czech economy enjoyed positive growth during 2014 and 2015 (of 2.7% and 5.4% respectively). The factors said to be behind the positive growth (other than the possible effects of the weaker koruna) were a recovery in growth in the euro area, domestic fiscal policy and a fall in oil prices. The November 2013 GDP forecast was almost fulfilled in 2014, and in 2015 the actual growth was higher than predicted. On the other hand, inflation remained very low and well below the inflation target during this period. This was attributed to strong deflationary tendencies in the euro area and to a fall in food and energy commodity prices. These factors outweighed the effects of the weakening of the nominal exchange rate as well as the demand effects of the growing economy on inflation. To sum up, the dynamics of inflation were disappointing, as it remained low and below the target in the period 2014–2015, while the positive outlook for real variables materialised.

To evaluate the effects of the exchange rate floor, it is certainly not enough to do a plain comparison of what happened to inflation and the real economy after November 2013 (even relative to the then forecast). Although inflation did not hit the target, this does not mean that the floor did not increase it: without the floor, inflation may have been even lower. Similarly, the growing economy in 2014 and 2015 is not proof that the floor helped the economy, as positive

[1] This article is based on Brůha and Tonner (2017).

growth may have been achieved even without it. We therefore need to ask what would have happened had the exchange rate floor not been introduced. In other words, we need to conduct a counterfactual analysis. To do so, we employ two different approaches.

First, ex-post simulations with the official g3 structural macroeconomic forecasting model (Andrle et al., 2009) are used. The advantage of employing the structural model is that it allows for model-consistent filtration of structural shocks: the filtered shocks can be used for counterfactual simulations using a model without any constraint on the exchange rate. To achieve more robustness and to allow for the possibility of evaluating more variables, we repeat the exercise with another DSGE model, the one by Tonner et al. (2015). This alternative DSGE model has the advantage that it contains a detailed labour market block, so the effects on unemployment can also be simulated.

The exchange rate floor and the lower bound on the policy rate are inequality constraints, which are hard to simulate using linearised forward-looking models. To solve this issue, we employ the shadow-shock approach (Lindé et al., 2016), which imposes the constraints by means of expected exchange rate and policy rate shocks.

Second, we apply empirical techniques: the synthetic control method (Abadie et al., 2010) and its generalised variant (Xu, 2015). The synthetic control method (SCM) involves constructing the counterfactual as a combination of control units, i.e. countries not affected by the policy action. The weights of the combination of control countries are determined based on the pre-treatment outcomes (i.e. the outcomes before the introduction of the exchange rate floor). We follow the approach suggested by Doudchenko and Imbens (2016) and use the elastic net as an estimation technique for determining the synthetic control weights.

The generalised variant of the synthetic control method (GSCM) by Xu (2015) is able to take into the account the influence of exogenous variables. This is important, since in the sample period the Czech economy experienced a strong inflow of European structural funds that may have contributed to economic growth, while inflation was affected by deflationary tendencies in the Eurozone and by low commodity prices. The generalised variant of the method can account for these exogenous factors.

The results are the following. Both the model-based simulations and the point estimates of both the SCM and the GSCM yield positive effects of the floor on real variables and inflation. Although the SCM estimates for real macroeconomic variables are positive, no real variable passes the placebo test;[2] only core inflation does so. Hence, the SCM cannot prove that the effects were indeed positive for the real economy, but the floor worked for inflation in the intended way. The results for the GSCM are more encouraging: not only does it find both a statistically and economically positive effect on inflation, but also the effects on real variables are statistically significant.

[2] Placebo tests are reality checks in microeconometrics (Abadie et al., 2010). In the case of the SCM, the model is estimated for other countries as if they were subject to the policy intervention. If the empirical model yields a significant effect even for these countries, the estimated effects for the investigated country are unreliable.

The results are summarised in the following table, which reports the estimated effects of the FX floor, i.e. the difference between the actual and counterfactual outcomes (in percentage points). Results for other variables are given in Brůha and Tonner (2017).

	Simulation with g3 model	Simulations with model by Tonner et al. (2015)	Synthetic control method	Generalised synthetic control method
Headline inflation (2014)	1.2	1.2	0.1	0.2
Headline inflation (2015)	1.8	1.5	0.6	0.8
Real GDP growth (2014)	1.2	0.8	0.3	0.4
Real GDP growth (2015)	0.6	1.2	1.7	1.8
Real consumption growth (2014)	1.4	0.3	0.4	0.4
Real consumption growth (2015)	0.9	1.0	1.5	1.7
Unemployment rate (2014)	-	-0.3	-0.2	-0.1
Unemployment rate (2015)	-	-1.2	-0.6	-0.5

Our interpretation of the results is as follows. First, it is almost certain that the floor prevented core inflation from turning negative, and the insignificant results for headline inflation are due to the high volatility of this indicator. Second, we can be pretty confident that the exchange rate floor did not hurt the real economy. The empirical methods – in line with the simulations with structural models – suggest that the floor helped the real economy. All in all, given that there is strong evidence for positive effects on inflation, which is consistent with other studies (such as Caselli, 2017), and there is no evidence that the floor hurt the real economy, we can conclude that this policy action was successful.

It should be mentioned the methods employed – since they are linear in nature – cannot capture the possible benefits of preventing the economy from falling into a vicious deflationary spiral. The extent and magnitude of the risks and costs of deflationary spirals are currently being discussed a great deal by both academics and policymakers. This paper is salient to this issue. If one believes that the risks are real and the costs are sizeable, then the benefits of preventing deflation are much larger than indicated in this paper.

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Headline Inflation Measures Shouldn't Ignore the Costs of Home Ownership[3]

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Introduction

Statistical offices of many countries gauge the costs of home ownership by computing imputed rents, which are then included in headline inflation measures. This is the case, among others, for the US, Japan and Switzerland. In contrast, the European Union's most important inflation statistic, the HICP, excludes owner-occupied housing. The reasons are technical: imputed transactions are inconsistent with the definition of the HICP. A more complex approach based on net acquisitions is required (Eurostat 2012, 2013; also see more details and discussion in Hampl and Havranek, 2017).

Eurostat has been mulling the incorporation of owner-occupied housing into the HICP for many years now, and Europe's main inflation measure still ignores this important segment of household expenditure. Part of the controversy stems from the fact that the net acquisitions approach implies the *direct inclusion of house prices in the HICP* (along with property charges and costs of repairs and maintenance). Because house purchases involve a substantial investment component, their inclusion in headline inflation makes many commentators uneasy. Conceptually, however, homes form a special case of durable goods: they provide a claim on a stream of future services. Cecchetti (2007), for example, discusses how the long-term capital gain from house ownership is minuscule.

Macroprudential reasons for including house prices

House prices, of course, are important in their own right for financial stability. In Hampl and Havranek (2017) we argue that including them in official inflation measures can help integrate monetary and macroprudential policies. Many economists have constructed early warning systems for financial crises in which house prices play a prominent role (see, among others, Reimers, 2012; Babecky et al., 2013; Antunes et al., 2014; Laina et al., 2015; and Tölö, 2015). The prominence of house prices among the large number of potential early warning indicators has

[3] This text is based on Hampl and Havranek (2017).

led some commentators to stress the interaction between this variable and the monetary policy stance. As with many other issues in the recent discussion on macroprudential policy, however, it is perhaps not surprising that no clear consensus on the matter has yet been reached.

One stream of thought, represented, for example, by Assenmacher-Wesche and Gerlach (2010) and Svensson (2014), asserts that using monetary policy as a tool to stem an increase in house prices is too costly and detrimental to the welfare of the country. Williams (2015) conducts a meta-analysis of the empirical estimates reported in this literature and finds that a typical result implies a 1% loss in GDP associated with a 4% reduction in house prices delivered by monetary policy contraction. Often missing from the discussion, however, are the positive effects of such a policy on GDP and employment during the downturn, when traditional CPI targeting implies less easing than what would otherwise be optimal if house prices were also taken into account. In other words, it is important to highlight the symmetrical nature of inflation targeting, even if the definition of the targeted inflation series changes.

Several studies have demonstrated the usefulness of incorporating financial stability considerations (including, most prominently, house prices) into monetary policy rules under inflation targeting. For example, Aydin and Volkan (2011) provide such evidence using a structural model calibrated for Korea; they find that paying attention to house prices pays off for monetary policy in terms of smoother business cycle fluctuations as compared with conventional inflation targeting.

Conceptual reasons for including house prices

House prices are typically excluded from official inflation measures, although other goods that also provide a flow of future services (durables such as motor vehicles and washing machines) are included. There is no clear theoretical reason for such treatment; rather, it is a convention that arises from intuition and convenience. The argument supporting the conventional exclusion of house prices goes as follows: for houses, the investment component relative to the consumption component is larger than for other durables such as cars. Moreover, a portion of the house value does not depreciate (such as land) and is therefore often considered a good store of value.

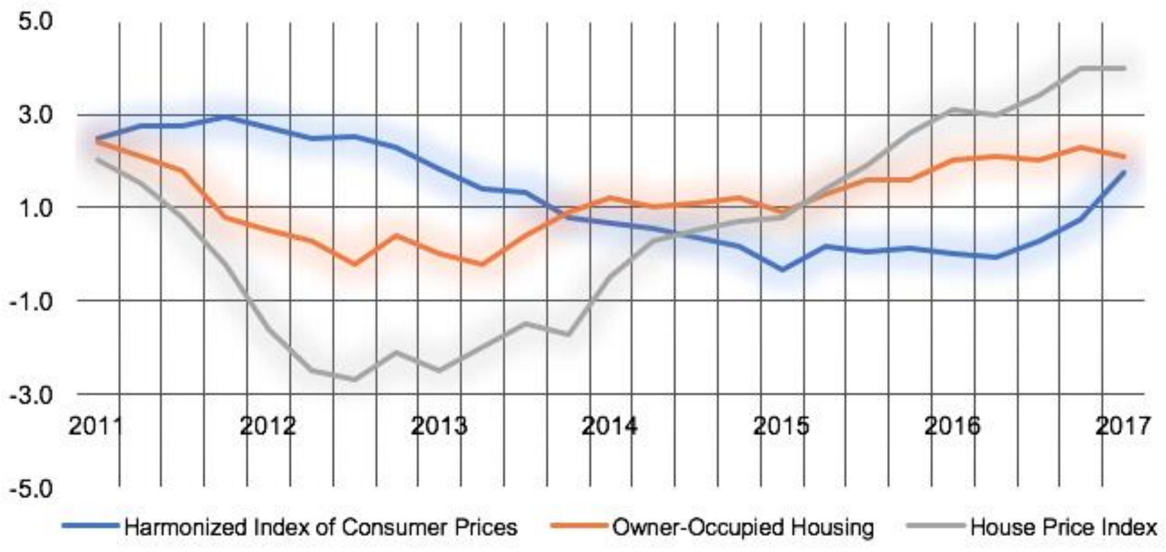
In spite of that, anecdotal evidence suggests that many households treat at least their first home purchase more as consumption than investment. Furthermore, it can be shown on theoretical grounds that the prices of all assets, including houses, stocks and bonds, should in principle be included in inflation if we are to measure properly the current cost of expected lifetime consumption instead of merely current consumption (see Alchian and Klein, 1973).

Aside from the well-known studies by Alchian and Klein (1973) and Goodhart (2001), many other authors have argued for the inclusion of house prices in the consumer price index. For example, Bryan et al. (2002) show that, for the case of the United States, the omission of house prices introduces an excluded goods bias and results in underestimation of CPI by about 0.25 percentage points annually. Diewert and Nakamura (2009) also point to the need for a more direct measure of house price inflation in the official CPI index. They suggest that the recent period of low official inflation may result from mismeasured underlying consumer prices.

Practical consequences of a change in the HICP

Figure 1 shows euro area quarterly year-on-year changes in the HICP, an index of owner-occupied housing consistent with the HICP and a pure house price index. The growth in the latter two indices was below official inflation in the period 2011–2014, while it has exceeded official inflation since 2015. It follows that the inclusion of the cost of home ownership in the HICP would probably make the monetary policy of the ECB more countercyclical. Paying more attention to the costs of home ownership would call for more expansionary policy in 2011–2013 but tighter monetary conditions from 2015 on. (A complicated issue is the weight that should be attributed to the owner-occupied housing index or the house price index, but even a modest weight of 10% could mean a difference in the HICP of up to half a percentage point in some periods.) In Hampl and Havranek (2017) we show that a similar statement also holds for Czech data.

Figure 1. Giving non-zero weight to house prices would make monetary policy in the euro area more countercyclical



Source: Eurostat; aggregate index of owner-occupied housing for the euro area computed using the weights of each country in Eurostat's construction of the harmonised index of consumer prices.

A frequent argument against the inclusion of house prices is the delay in data availability. This is a problem, but one that has been overcome by several statistical offices (Hampl and Havranek, 2017). For example, Czech headline monthly inflation includes house prices with a 1.4% weight for most regions, and with a 2.3% weight for Prague, the capital city. In addition, the Czech National Bank is probably the only central bank in the world that computes its own supplementary inflation index in which house prices get a substantial weight: 15% based on the share in consumers' expenditure. (The index, called the CPIH, is available in the Czech National Bank's latest inflation report.) In some countries, it is possible to take the data directly from the land registry, where all price information is available within a few days after property changes hands.

Conclusion

In line with Hampl and Havranek (2017), however, we do not argue that the time has come to replace the current inflation measures with broader indices that fully incorporate house prices. Rather, we consider such broader measures of inflation to be useful supplementary indicators, similar in this function to core inflation, which, in contrast, constitutes a narrower gauge than headline CPI inflation.

Among the many benefits of including the costs of home ownership in headline CPI, a prominent one is that it would bring reported growth in the CPI index closer to what most people consider *inflation* to be. In a well-known and colourfully titled paper, "Measuring inflation: the core is rotten", the President of the Federal Reserve Bank of St. Louis, James Bullard, criticises the Federal Reserve's focus on core inflation and argues for paying more attention to a broader gauge. To paraphrase Bullard's (2011) provocative statement: one immediate benefit of dropping the sole emphasis on an inflation measure that excludes the costs of home ownership would be to reconnect central banks and statistical bureaus with households and businesses who know price changes when they see them.

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DSGE Model with Financial Dollarisation – The Case of Serbia[4]

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We present a dynamic stochastic general equilibrium (DSGE) model incorporating financial euroisation.[5] The model reflects the stylised facts and macroeconomic dynamics of a small open economy subject to euroisation. In this regard, Djukić et al. (2017) respond to the growing interest in macro-financial linkages in emerging and developing market countries with financial euroisation, such as Serbia. These countries are modernising their policy frameworks by either moving towards inflation targeting (IT) or allowing for higher nominal exchange rate flexibility. However, due to financial euroisation, the common DSGE model structure and transmission channels are not sufficient to capture the effects of exchange rate dynamics on the financial wealth of households. Similarly, DSGE workhorse models omit the financial sector, banks in particular, so they are not suitable analytical tools for evaluating the effects of macro-prudential measures.

In response to the growing demand, Djukić et al. (2017) present a structural DSGE model featuring financial euroisation. They do not have the ambition to contribute to the theoretical literature introducing financial frictions within the endogenous money creation framework. On the contrary, they provide a simple approach to extending the existing DSGE workhorse model to include financial sector variables and introduce explicit banking at relatively low costs. Furthermore, the model is not designed to be a forecasting model to replace the existing QPM at the National Bank of Serbia (NBS). Rather, it should be considered an attempt to build up a model which is rich enough to analyse the macroeconomic effects of euroisation in Serbia.

The model is based on the framework of Roger and Vlcek (2011). It has been extended to incorporate several features which are not embedded in the original model. The model contains households, intermediate-goods-producing firms, final-goods-producing firms, a labour bundle, exporters, retail banks, wholesale banks and monetary and fiscal authorities. Households consume final consumption goods, save deposits at, or take loans from, commercial banks and

[4] This text is based on Djukić et al. (2017).

[5] Euroisation is a situation where a large proportion of loans and deposits are denominated in euros.

supply labour. Intermediate firms use labour and imports to produce intermediate goods. An assumption that firms finance a constant share of their production through commercial banks' loans is used to motivate demand for loans from firms. Monopolistically competitive retailers use intermediate goods to produce final goods, facing a Calvo signal to change their prices. Final goods are consumed by households and the government. Exporters are assumed to be independent of the domestic intermediate sector and face exogenous terms of trade. The monetary authority targets year-on-year inflation four periods ahead via an interest rate rule. The government finances its spending by issuing government bonds and collecting lump-sum taxes. The ratio of nominal government spending to nominal private consumption is assumed to be constant in the long run.

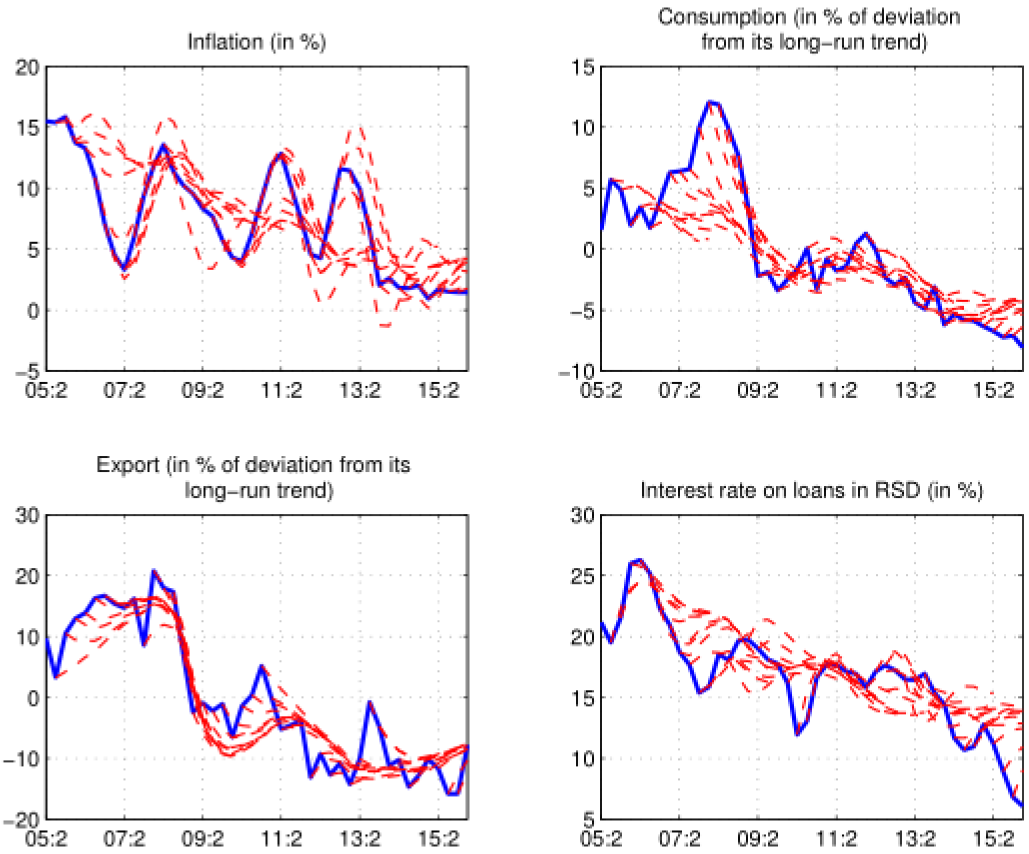
To introduce financial frictions, the model assumes two types of households – net borrowers and net lenders. Net borrowers have to finance part of their expenditures using loans, borrowing against their wage income. Commercial banks play the role of financial intermediaries, collecting deposits from households and borrowing from abroad on the liability side while extending loans on the asset side. Deposits and foreign liabilities are assumed to be perfect substitutes. Banks are subject to regulatory requirements in the model. These consist of capital requirements, approximated by the loan-to-deposit ratio. A penalty is applied to banks whenever they deviate from the loan-to-deposit ratio set by the central bank. Apart from the financial block, the structure of the model is consistent with the common DSGE workhorse for a small open economy. The paper provides a detailed description of the optimisation problems of economic agents and the corresponding first-order conditions.

The model is calibrated to match the actual data of Serbia. During the calibration phase, several criteria were used to specify the parameter values: e.g. sensitivity and impulse response analysis, expert judgement, conformity with the literature and other countries' experiences. In order to test the calibration of the model, we conducted several tests.

First, the impulse responses of the model were inspected and compared with the stylised facts. Specifically, an unexpected depreciation, an increase of the country risk premium and a hike of the central bank rate were reported and described using the model transmission mechanism. Serbia is characterised by euroisation at about 70% of total deposits and loans. Unlike banks, households and firms are not hedged against currency risks. As their revenues are mainly in dinars and most of their liabilities are in FX-indexed instruments, their financial position and wealth are affected by exchange rate dynamics. Given that households are net borrowers, there are sizeable negative effects of FX depreciation on private consumption.

Second, we filtered the actual data for Serbia using the model. In order to match the data, the model is enriched by simple equations for trends. These state that the trend in a variable converges to its steady state with some persistence. For the purpose of matching the model with the data, we used the standard Kalman filter. The standard deviations of the residuals and the measurement errors were calibrated to match the data moments and the macroeconomic story. To this end, a shock decomposition was conducted and checked for consistency with economic intuition. An application of a DSGE model to data containing consistent trends in technologies can be found in Andrle et al. (2009).

Finally, historical in-sample simulations were used to check how the model would have predicted the variables in certain past periods. In the case of non-stationary series, we focused on business cycle movements, i.e. gaps. Here, we present how the model explains inflation, the consumption gap, the export gap and the domestic lending rate. As models are just a simplification of reality, the historical simulations are far from perfect, but we can say that the variables are reasonably well predicted. We have to add, however, that the model is intended to be used not for forecasting, but rather for simulation (impulse response) purposes, so improving the calibration of the model is a task that lies ahead.



We consider the model to be a useful tool for analysing the relationships between the variables for a highly euroised economy, especially having in mind the complexity of the transmission channels in such an economy. In this regard, the model complements the existing QPM model used for forecasting at the NBS, which covers inflation in great detail but is less detailed when it comes to monetary policy channels and euroisation.

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The Impact of Monetary Policy on Financing of Czech Firms[6]

Ruslan Aliyev[a], Dana Hájková[b] and Ivana Kubicová[b]

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[b] Czech National Bank



In a perfect-information world, changes in monetary policy rates and their outlook would affect the financing decisions of firms directly and symmetrically by changing their borrowing costs. However, in reality, credit market imperfections influence bank lending and firm financing behaviour and influence the transmission of monetary policy.

The extent to which changes in monetary policy rates are transmitted to client rates depends on the functioning of financial markets, which set the financing costs for banks, and on the conditions on retail lending markets. The first part of the transmission tends to be fast and complete; the second part, however, is slower and often incomplete and tends not to be the same for all agents concerned. The heterogeneity of the impacts of monetary policy has been widely established, for example by Bernanke and Gertler (1995). One of the primary reasons for the delays and unevenness in interest rate transmission is the existence of information asymmetries among banks and client firms; a bank's imperfect knowledge about its client's economic situation increases the transaction costs and hence the borrowing costs for the client. Information frictions typically amplify the direct effects of wholesale interest rate changes. The fact that monetary policy does not influence all economic agents symmetrically is often referred to as the broad credit channel of monetary policy transmission. The effects can be due to banks and their ability to provide credit – the bank lending channel – or to the characteristics of, and information available about, potential recipients of credit – the balance sheet channel. Hence, as regards firms as prospective debtors, observable individual characteristics appear to be critical determinants of credit availability and firms' financial structure.

It is therefore important for a central bank to know how the effects of its monetary policy spread through the economy and whether there really are significant differences in impacts. In our paper, we map out these effects in the Czech Republic and analyse the financial structure of Czech firms and the impact of monetary policy on their financing decisions (Aliyev et al., 2014). The analysis is based on yearly balance sheet information for 57,000 firms from the manufacturing, construction, wholesale, retail, car repair and transport sectors in the period 2003–2011.

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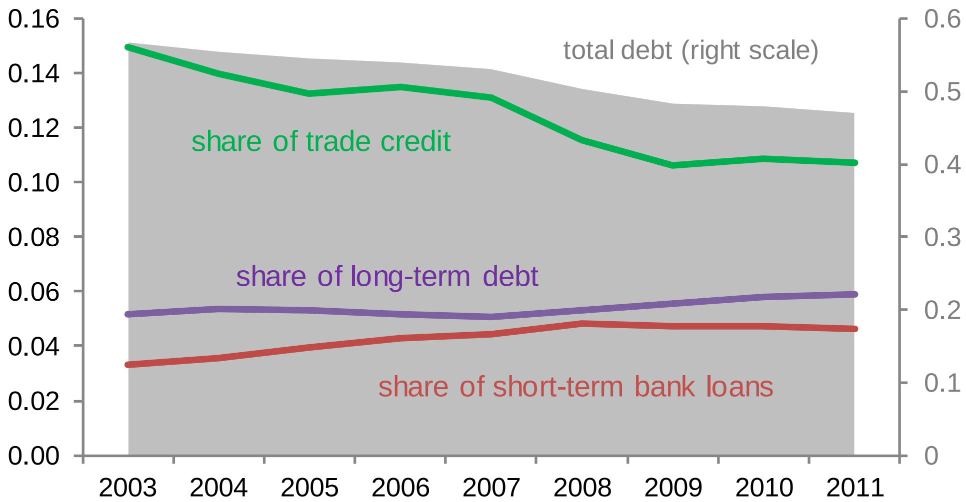
[6] This article is based on Aliyev et al. (2014).

We find that, in the period analysed, Czech firms tended to use their own and borrowed funds fairly equally. The liability side of the average balance sheet of Czech firms was almost evenly divided between debt and shareholder funds. The debt financing was mostly of a short-term nature: more than three-quarters of the total debt consisted of current liabilities. Current liabilities were made up mostly of trade credit and other current liabilities, while short-term bank loans provided a relatively small proportion of the funds. Just over half of non-current liabilities were in long-term bank debt. The data show that the financing structure of the Czech firms gradually changed towards more shareholder financing over the period analysed (Figure 1). The role of trade credit decreased somewhat over time.

Figure 1. Evolution of the average debt structure



Note: The ratios are defined as shares of total assets.

The analysis pays attention to heterogeneity among firms. The data confirm that the size and age of a firm are important determinants of its financing structure. Large firms tend to have somewhat less debt as a share of total assets, while using more long-term debt and more trade credit than small firms. Older firms have more short-term bank loans than younger firms, but less total and long-term debt and less trade credit.

A panel data analysis of the balance sheet information is used to disentangle the effects of firm-specific characteristics and the macroeconomic environment, especially interest rate developments, on the financial structure of Czech firms. Heterogeneous responses to changes in interest rates linked to firm-level characteristics would indicate the existence of the broad credit channel of monetary policy transmission. In the paper, we construct four liability-related ratios which reflect the result of the interaction between the firm and its owners and creditors regarding financial structure: the shares in total assets of total debt, short-term bank loans, trade credit and long-term debt. The variability in these ratios is analysed with respect to market interest rates (which are considered to reflect the monetary conditions the monetary policy authority wants to achieve), economic growth and firm-specific characteristics (size, age, collateral and profit). In addition, to account for the heterogeneity of the reactions of firms of different size and age, interaction terms between interest rates and these characteristics are included in the regressions.

The results indicate that higher short-term interest rates coincide with lower shares of total debt, short-term bank loans and long-term debt, in line with the interest rate channel of monetary policy transmission. At the same time, the size, age, collateral and profit of individual firms affect the way in which interest rate changes are reflected in the financing decisions of firms.

The main finding is that smaller and less profitable firms are affected more by a monetary contraction than larger and more profitable firms are. Specifically, smaller and less profitable firms reduce their external financing during periods of tight monetary policy, while larger and more profitable firms increase their external financing. The data also show that higher interest rates lead to an increase in total debt among young firms and a decrease among old firms. We also find that more collateralised firms increase their short-term bank credit and reduce their short-term trade credit when the interest rate rises. Total debt and long-term debt decrease for all firms at times of monetary contraction, but the decrease is greater for more collateralised firms.

The evidence of heterogeneity of reactions to interest rate changes depending on a firm's size, age and balance sheet position indicates the presence of informational frictions in the markets for firm financing in the Czech Republic. The heterogeneous response of firms with different balance sheet positions points to the existence of a balance sheet channel of monetary policy transmission in the Czech Republic. The observed varying response of small firms, which are more dependent on external financing, versus large firms, which are less dependent on external financing, may be an indirect indicator of the existence of a bank lending channel, with the caveat that we do not control for the supply of loans. In general, all these findings provide some evidence of broad credit channels in the Czech Republic.

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The fourteenth 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, 21 May 2018**. This conference will provide an opportunity to see some of the best of the CNB's current economic research work and to meet CNB researchers informally. Ewald Nowotny, Governor of the National Bank of Austria, has confirmed his participation as a keynote speaker.

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