



ECONOMIC RESEARCH BULLETIN

Interest Rates
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EDITORIAL

Interest rates affect everyone in the economy. They determine the price of credit and the return on savings and are the main ingredient of the monetary policy pass-through. Historically low nominal interest rates have recently posed several challenges to policy makers. The first challenge is the zero lower bound on nominal interest rates. With policy rates approaching the zero lower bound, central banks were not able to use them to stimulate the economy and fight deflation. Second, after a deep depression and long recession in many economies, the key question is when and how fast to raise the policy rate. The third challenge is to understand whether the policy rate transmission mechanism has changed. Last, but not least, it is crucial to learn the implications for macroprudential policy and for lenders and consumers. This issue of the Economic Research Bulletin presents a selection of papers by CNB staff that address those challenges.

The first article develops a methodology to evaluate the probability of interest rates hitting the zero lower bound and provides calculations for several developed countries.

The authors of the second paper introduce a semi-structural small open economy model to estimate the natural rate of interest. They find that the natural interest rate in the Czech Republic did not fall as significantly as suggested by other studies for large economies. As a result, the current monetary conditions are still on the easy side.

In the third paper the authors contribute to the debate on monetary policy transmission by decomposing the government bond spread for the Czech Republic. They find that the spread is mostly driven by money market rates, with a recent increasing role of credit risk.

The determinants of interest rates on consumer loans are studied in the fourth paper in this issue. The authors find that the main determinants of client rates in this segment are monetary policy rates and market structure.

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The Likelihood of Effective Lower Bound Events

Many advanced economies have recently experienced a period of nominal interest rates being at the effective lower bound. This has pushed central banks to use unconventional measures to deliver additional stimulus. Assessing the likelihood of interest rates being stuck at their lower bound is therefore of utmost importance for policy makers. This article proposes an empirical model to estimate the probability of being at the lower bound for a set of advanced economies.

Michal Franta
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Quantifying the Natural Rate of Interest in a Small Open Economy – The Czech Case

This article identifies the natural rate of interest in the Czech Republic as the rate consistent with real GDP being at its potential level and with inflation at the target. It is argued that in an open economy the natural rate evolves according to potential GDP growth adjusted for equilibrium real exchange rate appreciation. Using a semi-structural model, the paper finds that the natural interest rate was hovering around 1% at the end of 2017.

Tibor Hlédik and Jan Vlček
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Movements in the Czech Government Yield Curve as Seen Through the Lens of Its Components

Identifying factors behind movements in the yield curve is important for understanding monetary policy transmission. This article presents a decomposition of the Czech government curve into several economically motivated components using a dynamic factor model and the CDS spread. It finds that the long-term yield drop during the koruna floor can be attributed to portfolio investment inflows, while monetary policy anticipation has been the main contributor to the sharp rise in long-term bond yields in the post-floor period.

Michal Dvořák, Zlataše Komárková and Adam Kučera
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What Drives the Distributional Dynamics of Client Interest Rates on Consumer Loans in the Czech Republic? A Bank-Level Analysis

This article studies the bank-level distributional dynamics and factors of client interest rates on consumer loans in the Czech Republic. It shows that in recent years, most banks have started to provide new consumer loans at unprecedentedly low client interest rates. The empirical analysis then reveals that increased market competition and to some extent also accommodative monetary policy have been driving this phenomenon.

Václav Brož and Michal Hlaváček
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The Likelihood of Effective Lower Bound Events¹

Michal Franta^a

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The likelihood of the situation where nominal interest rates are stuck at their effective lower bound (ELB) and cannot be reduced further is important for both conventional and unconventional monetary policy conduct. From the point of view of conventional monetary policy carried out through interest rate changes, a higher probability of hitting the lower bound during a recession calls for more aggressive easing of monetary policy (*ceteris paribus*), whereas a higher probability of rates being at the lower bound during a boom justifies slower normalisation of rates (see, for example, Williams, 2014, and references therein). Next, if there is agreement on the optimal size of the central bank balance sheet, the speed of balance sheet normalisation from current heightened levels should reflect the medium-term probability of rates returning to the lower bound and hence the probability of returning to unconventional measures that would increase the size of the sheet again. Information on the probability of hitting the effective lower bound – the ELB risk – thus represents an important guide for policy makers.

Franta (2018) provides new estimates of the probability of an ELB event for eight advanced economies.² In addition, the paper presents estimates of the expected duration of such an event. The majority of the previous studies on the same topic drew on various calibrated models that in principle did not need ELB periods present in the data to make conclusions. Approaches based on calibrated models take data to infer on shocks that hit the economy in the observed past (given the model) and then simulate the economy employing the calibrated linear/linearised model and estimated shocks. The part of the simulated distribution of the interest rate that lies below the lower bound then defines the ELB risk. Chung et al. (2012) criticise the standard approach based on stochastic simulations and demonstrate that the calibration and linearity have a significant effect on ELB risk estimates. They use various statistical models that are fully estimated and allow for some simple form of non-linearity. However, their models are intended for short-term ELB risk estimation because they often do not possess well-defined unconditional moments that would imply sensible medium-term ELB risk estimates.

The aim of Franta (2018) is to combine the above-mentioned approaches. To that end, the paper combines stochastic simulations around equilibrium values and density forecasting reflecting current observed data. The results are therefore relevant to both the short term, where the ELB

¹ This text is based on Franta (2018).

² The following countries are the subject of the analysis: Canada, the euro area, Japan, Norway, Sweden, Switzerland, the United Kingdom and the United States.

likelihood is driven mainly by the current phase of the business cycle, and the medium term, where the ELB risk is determined mainly by equilibrium values. Dealing with both time scales in one modelling framework makes the estimates for the short and medium term consistent with each other. Furthermore, the approach addresses some of the contentious issues of the previous approaches and should theoretically deliver more accurate ELB risk estimates.

In Franta (2018), an empirical strategy is adopted and ELB risk estimates are based on recent data from advanced economies. In the estimation, the fact that many of the countries have recently experienced, or are still experiencing, nominal interest rates at their ELB is exploited. As a consequence, the ELB risk estimates have to rely less on calibrated parameters and can be based more on estimated quantities. The framework thus accounts for parameter uncertainty, which has been found to be important for realistically assessing ELB likelihood. On the other hand, the time span of the macro data capturing ELB events is still short, suggesting that it is appropriate to exploit the panel nature of that data.

Furthermore, the data-driven approach depends less heavily on assumptions about the equilibrium values of macroeconomic variables than do studies based on stochastic simulations. The assumptions about the equilibrium values enter the estimation procedure in the form of priors and are confronted with the observed data during the Bayesian estimation process. Finally, as an ELB situation implies a possibility of regime change, the modelling framework allows for change in the shock transmission mechanism and shock volatilities.

So, to quantitatively assess the occurrence of ELB events, Franta (2018) employs the mean-adjusted panel vector autoregression technique, which allows for cross-country heterogeneity, static interdependencies and threshold behaviour. Cross-country heterogeneity is especially important for the period of unconventional monetary policy, because countries employed different strategies for easing monetary policy further. Static interdependencies allow for correlation of reduced-form shocks across countries, reflecting the fact that the Global Financial Crisis spread across the advanced economies primarily through the financial markets within one quarter. The threshold behaviour is implemented through switching between two regimes, which is driven by the threshold variable. The threshold variable is the average of the average short-term interest rate across countries and the average spread between the 10y bond yield and the monetary policy rate, both lagged by one quarter. So, it combines conventional and unconventional monetary policy measures. Finally, mean adjustment is present to obtain well-behaved long-run dynamics and to incorporate out-of-data information on equilibrium values less strictly than during the calibration of the model. As a consequence, uncertainty relating to the equilibrium values is present in the ELB risk estimates and allows the role of calibration of equilibrium values to be examined in the ELB risk estimation.

Table 1. Effective lower bound risk

	2017Q1	2017Q2	2017Q3	2017Q4	2018Q1	2018Q2	2018Q3	2018Q4	MR
Canada (-0.50)	0.00	0.00	0.00	0.02	0.06	0.06	0.09	0.08	0.01
Euro area (-0.3125)	0.40	0.55	0.62	0.35	0.23	0.06	0.06	0.08	0.03
Japan (-0.0376)	0.37	0.49	0.48	0.49	0.30	0.50	0.65	0.53	0.16
Norway (0)	0.00	0.00	0.00	0.07	0.21	0.15	0.17	0.11	0.05
Sweden (-0.78)	0.53	0.37	0.43	0.52	0.47	0.13	0.17	0.20	0.03
Switzerland (-0.84)	0.23	0.52	0.46	0.29	0.31	0.32	0.30	0.21	0.04
United Kingdom (0)	0.02	0.06	0.08	0.16	0.14	0.14	0.09	0.08	0.02
United States (0)	0.00	0.01	0.10	0.24	0.26	0.22	0.19	0.16	0.06

Notes: The imposed ELB is indicated in parenthesis. MR denotes medium-term ELB risk.

The model is estimated on quarterly data over the period 1999Q1–2016Q4 and provides estimates of ELB risk in both the short and the medium term (see Table 1). It turns out that, in the short term, the ELB risk is currently (2017Q1) the highest for the euro area, Japan and Sweden and the lowest for Canada, Norway and the US. The probability of the short-term interest rate being at the ELB in 2017Q1 is driven to a great extent by whether the relevant economy was stuck at the ELB in the last quarter used for the estimation, i.e. in 2016Q4. So, for the euro area, Japan and Sweden, which are at their assumed ELBs, the ELB risk is in the range of 0.37–0.53. For the other countries, the ELB risk is lower. For Canada, Norway and the US, it is virtually zero for 2017Q1.

In the medium term, the probability of an ELB situation ranges from 0.01 for Canada to 0.16 for Japan. In terms of the time for which the economy is on average stuck at the ELB, the estimated probabilities are as follow: for Canada one quarter over the next 25 years and for Japan 3.5 years over the next 25 years. Note that the medium-term ELB risk is determined mainly by the posterior of the interest rate steady state, the assumed ELB and the estimated average size of the shocks to macroeconomic variables.

For the United States, the estimated ELB risk can be compared with the existing literature. It turns out that the ELB risks are close to the estimates provided by estimated non-linear DSGE models and attain values close to 0.05 in the medium term. Such estimates are considerably lower than those based on calibrated models and assumed equilibrium values, which range between 0.14 and 0.32. Note that the unconventional measures used in the US are reflected in the observed data employed for the estimation and are thus included in the estimated ELB risk. So, it is implicitly assumed that at the ELB the Fed would employ unconventional measures with the same intensity as observed after 2008.

A supplementary analysis in Franta (2018) suggests that the calibration of the steady-state values of macroeconomic variables can lead to ELB risk underestimation due to the fact that the calibrated value of the equilibrium interest rate is high and is assumed to be known with certainty. It is also shown that the empirical approach gains from the panel nature of the data by partially pooling country-specific information and by improving the efficiency of the estimates.

As for the expected duration of the ELB event, the highest medium-term expected duration (three quarters) is obtained for the euro area, while the lowest expected durations are observed for

Canada, Sweden and the US (just above two quarters). For the US, the medium-term expected duration is estimated to be 2.35 quarters, which is closer to the literature dealing with estimated non-linear DSGE models than calibrated linearised DSGE models.

References:

Chung, H., J. P. Laforte, D. Reifschneider and J. C. Williams (2012): Have We Underestimated the Likelihood and Severity of Zero Lower Bound Events? *Journal of Money, Credit and Banking*, 44(1), 47–82.

Franta, M. (2018): The Likelihood of Effective Lower Bound Events. CNB Working Paper No. 3/2018.

Williams, J. C. (2014): Monetary Policy at the Zero Lower Bound: Putting Theory into Practice. Hutchins Center on Fiscal & Monetary Policy at Brookings, January 2014.

Quantifying the Natural Rate of Interest in a Small Open Economy – The Czech Case³

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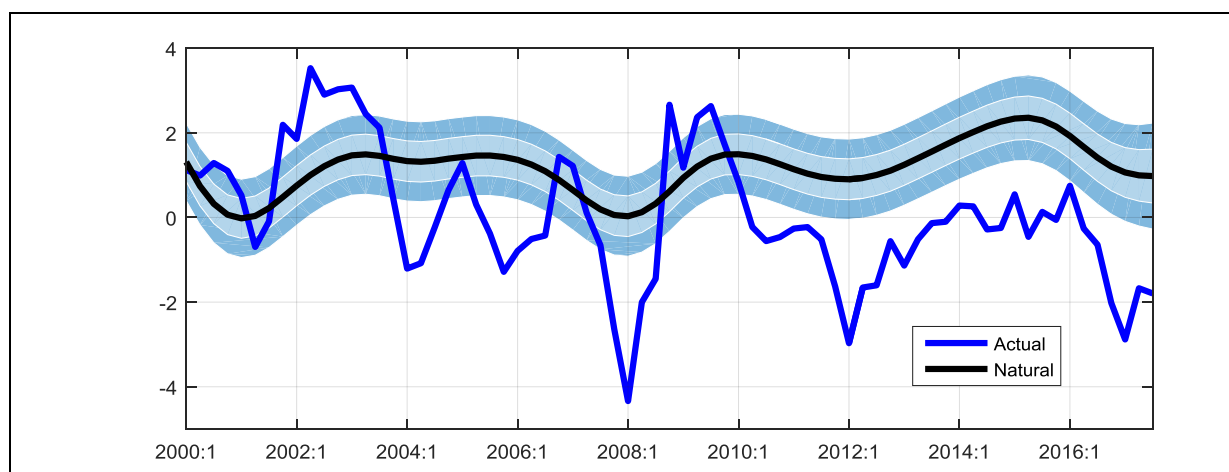


Interest rates have declined substantially since the early 1990s. The downward trend has been observed in both nominal and real interest rates, so the decline cannot be attributed solely to low and stable inflation. As central banks have started to phase out their unconventional monetary policy tools, the fundamental role of interest rates as a monetary policy instrument has been restored. In a low interest rate and suppressed inflation environment, the key policy question has been what the natural rate of interest is. The natural rate is defined as the real interest rate consistent with real GDP being at its potential level and with stable inflation at the target. If the natural rate has declined compared to its pre-crisis level, central banks will also have to keep their nominal rates lower so as not to hinder real growth. On the contrary, if the natural rate has remained at its pre-crisis level, monetary policy might be too accommodative. Hence, the question about the level of the natural interest rate is moving to the centre of policy interest.

The estimates suggest that the natural rate of interest in the Czech Republic was hovering around 1% at the end of 2017 (see Figure 1). The natural rate is identified, as described below, using a semi-structural model linking the rate with potential GDP growth adjusted for equilibrium real exchange rate appreciation. Prior to the world financial crisis in 2004–2007, the natural rate was also quite stable and close to 1% p.a. This relative stability of the natural rate was followed by a period of increased volatility despite the fact that the Czech economy was not directly hit by the financial crisis. It did, however, face lower foreign demand and a volatile nominal exchange rate in 2008–2010. The natural rate declined in the aftermath of the crisis and subsequently returned to 1%. The estimate of the natural rate of interest is obviously subject to uncertainty. The 90% and 60% confidence bands are about 200 basis points and 100 basis points wide respectively (see Figure 1). The width of the confidence bands reflects the fact that all the shocks used to match the historical data are taken into account, including those during the world financial crisis.

The actual real interest rate has been below the natural rate of interest since 2010. Therefore, the estimate suggests that the real monetary conditions are easy in their interest rate part. In fact, the Czech National Bank started to cut its policy rate in August 2008 and reached the zero bound at the end of 2012. The policy rate remained at technical zero until August 2017.

³ This article is based on Hlédik and Vlček (2018)

Figure 1. Natural interest rate with confidence bands (in percent p.a.)

Note: The solid black line is the natural rate of interest. The blue areas around the solid line depict 90% and 60% percent confidence bands. The solid blue line is the actual real rate.

Source: Hlédik and Vlček (2018)

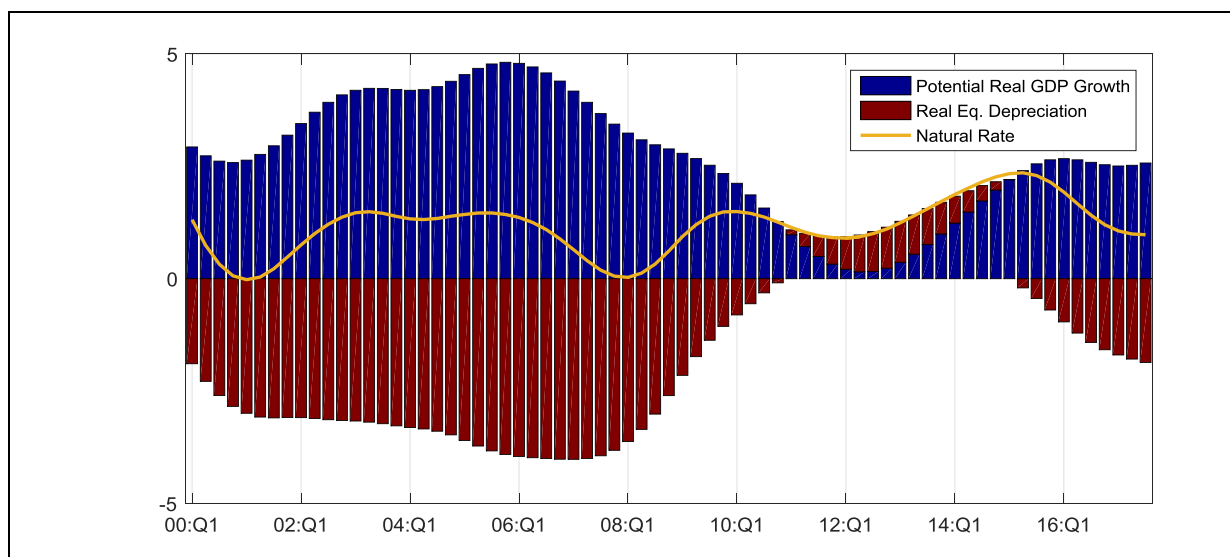
To identify the natural interest rate, this study modifies the commonly used methodology of Laubach and Williams (2003) for a small open economy in two respects. First, it is argued that the natural rate of interest in a small open economy is determined by potential GDP growth adjusted for appreciation of the equilibrium real exchange rate. Second, a semi-structural model is used, closed by a monetary policy rule to identify potential GDP growth and real appreciation and consequently the natural rate of interest.

In Laubach and Williams (2003), the Euler equation is used as the restriction to determine the natural rate. In such a case, the natural rate of interest is proportional to potential (non-inflationary) GDP growth and can deviate only temporarily from this growth through a shock. However, the common form of the Euler equation is not suitable for a small open economy with free capital flows such as the Czech Republic. While potential GDP growth accounts for capital yields from production, real exchange rate appreciation, which increases the yields on investments realised in foreign currency, must also be taken into account. Hence, in our setup, the natural rate of interest is proportional to potential GDP growth adjusted for equilibrium real exchange rate changes. In fact, there is a positive link between potential output growth and equilibrium appreciation observed in the data, called the Penn effect. Whenever a country is growing fast and converging in per capita GDP to advanced countries, real appreciation tends to accompany real growth. In our framework, the equilibrium real appreciation of the exchange rate curbs the contribution of potential GDP growth to the natural rate of interest. Without this adjustment, the natural rate of interest would be unrealistically high due to a fast potential GDP growth, especially in emerging and developing countries.

The decomposition of the identified natural rate of interest into potential GDP growth and equilibrium real exchange rate depreciation is provided in Figure 2. It shows frequent mutual compensation of the contributions of potential GDP growth and equilibrium real exchange rate appreciation to the natural rate estimate. This is the main reason why, after the outbreak of the global economic crisis in 2008, the natural rate did not fall in the Czech Republic proportionately to estimated potential GDP growth. The results show that the fall in potential GDP growth after

2008 was accompanied by a significant slowdown in real equilibrium exchange rate appreciation. That, in turn, mitigated the decline in the natural rate induced by the fall in potential GDP growth. The natural rate of interest was on an increasing trend in 2012–2015, mainly on the back of a recovery of the real economy. After the natural rate of interest reached its peak in mid-2015, it started to fall again as the equilibrium real exchange rate returned to appreciation and real growth remained robust.

Figure 2. Decomposition of the natural rate of interest (in p.p.)



Source: Hlédik and Vlček (2018)

The quantification of the natural rate clearly depends on the chosen methodology. Contrary to Laubach and Williams (2003), the structural nature of our model allows us to work with model-consistent expectations and use the full set of restrictions, i.e. model equations, determining the natural rate of interest. The model resembles the Czech National Bank's (CNB) Quarterly Projection Model (QPM) – see Benes et al. (2003). However, compared to the CNB's original QPM, the model encompasses several modifications. Specifically, headline CPI is decomposed into core inflation excluding food and energy, energy price inflation, food price inflation and change in administrative prices, and trends in relative prices are taken into account. Finally, the effects of foreign prices and exchange rate dynamics on inflation are captured using the real exchange rate, included in real marginal costs, not through import price inflation as in the CNB's QPM specification. The model is calibrated to match stylised facts of the Czech economy and transmission mechanism. The model parameterisation is verified using several simulation exercises described in Hlédik and Vlček (2018). The model is used to identify structural shocks and unobserved variables. The model filtration of the data is done by a multivariate Kalman filter (KF).

The currently low real interest rate levels around the world are challenging central banks to answer the fundamental question about the level of the natural rate of interest in order to assess the monetary policy stance and hence how easy real interest rates are. The estimates of the natural rate of interest in the Czech economy imply that it is close to 1%. This is similar to the level before the world financial crisis. Hence, the study suggests that the natural rate of interest has not

declined permanently in the Czech Republic. Despite the recent recovery of real economic activity, the natural rate has decreased from its peak in 2015 due to renewed appreciation of the equilibrium real exchange rate. Given that the actual real interest rate has been below the natural one, real interest rates are considered to have been easy since 2010.

References

Beneš, J., T. Hlédik, D. Vávra and J. Vlček (2003): The Czech National Bank's Forecasting and Policy Analysis System. chapter 4, pages 63–98. Czech National Bank. Chapter: The Quarterly Projection Model and its Properties.

Hlédik, T. and J. Vlček (2018): Quantifying the Natural Rate of Interest in a Small Open Economy – The Czech Case. CNB Working Paper No. 7/2018.

Laubach, T. and J. C. Williams (2003): Measuring the Natural Rate of Interest. *Review of Economics and Statistics*, 85(4), 1063–1070.

Movements in the Czech Government Yield Curve as Seen Through the Lens of Its Components⁴

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Introduction

The government yield curve – the term structure of interest rates on government bonds (GBs) – represents the yields demanded by financial market participants for a low-risk investment with various investment horizons. The government yield curve aggregates information about the whole economy, so it is often considered to be an indicator of the stance of the macroeconomy and expectations about its future development. The yield curve reflects market participants' expectations about future shifts in monetary policy (the cost of money) or their attitude towards various sources of risk (the cost of risk). A movement in yields is therefore driven by a change either in expectations or in the premium demanded for risk, or both.

In order to correctly infer information from the yield curve and its movements, it is necessary to correctly attribute the movements to the factors behind them. A popular approach is to identify several components of yields representing various macro-financial sources of variation and to explain yield movements by interpreting the movements in those components.

By decomposing the Czech government yield curve, the Czech National Bank obtains an insight into the sources crucial for explaining movements in Czech GB yields. Such knowledge provides an understanding of how a change in monetary policy rates transmits to longer yields. The foreign experience (Greenspan, 2005) shows that this transmission is not always straightforward and may be weakened by an opposite response of other components, e.g. a flight to safety. Understanding the components also allows the CNB to determine the level to which the yields might move at times of financial market uncertainty, which is useful in creating CNB stress test scenarios.

⁴ This text is based on Kučera et al. (2017) and Kučera et al. (2018).

Nature of Czech government yield curve components

The Czech government yield curve movements can be attributed to four basic sources (Kučera et al., 2017). The first component mirrors the “pure” expected costs of money, i.e. it incorporates expected future monetary policy. The derivation of longer yields from the expected path of short rates is called the expectations hypothesis (Campbell and Shiller, 1991). The intuition is straightforward: an investor should be indifferent between (1) investing its funds in a long-term bond for the present long-term yield and (2) investing its funds in a series of subsequent short-term bonds for the expected short-term yield. Such indifference is valid for investors which are risk-neutral, i.e. do not require a risk premium. Therefore, the first component is called the *risk-neutral yield*: the yield reflecting the expectations of risk-neutral investors about future short rates.

In practice, however, investors are risk averse and the expectations hypothesis does not hold (Campbell and Shiller, 1991). Since long-term investors “lock” their investment for a long time, they are exposed to the risk of the future evolving differently from their expectations. Therefore, they require a *term premium*, which is the second component. This explains why yield curves across the world are usually upward-sloping: the longer the maturity, the higher the term premium and yield.

The third component is called the *credit risk premium*. It reflects the premium investors demand as compensation for bearing the risk of default of the bond issuer. The fourth “catch-all” component reflects all other effects, mainly connected with the specific position of GBs in portfolios – as a safe haven asset, a collateral asset or a vehicle for speculation. Therefore, this component is referred to as the *portfolio effect*.

Czech government yield curve components between 2008 and 2017

The methodology used to obtain the components is described in Kučera et al. (2017). As the dataset, Czech GB yields and Czech koruna interest rate swaps (IRSs) are used for maturities of 1 to 15 years at a monthly periodicity over the period of 7/2003–03/2018. In both cases, zero-coupon yield curves are constructed using the Fama–Bliss bootstrap method (Fama and Bliss, 1987).

Due to the specificities of the Czech GB market, the first two components are obtained from Czech koruna interest swap rates (IRSs) instead of Czech GB yields using a dynamic term structure model.⁵ The use of IRSs implies that IRSs are considered to be a proxy for GB yields unaffected by specific events related to Czech GBs, which would otherwise lead to biased results. This approach appears to be plausible for the Czech case: as Figure 1 shows, until 2008, Czech koruna IRSs and Czech GB yields were co-moving. In the period of 2009–2013, GB yields were

⁵ In the literature, which focuses mostly on the US yield curve, the third and fourth components are considered to be a part of the term premium and the components are obtained from an affine model – for example in Duffee (2002), Kim and Wright (2005), Adrian et al. (2014) and Bauer and Rudebusch (2017). This is possible only if the third and fourth components are equal to zero for very short maturity and gradually increasing with growing maturity, just as the term premium is. This condition is not fulfilled for Czech GBs, mostly due to speculative attacks on the Czech koruna in 2016–2017. Using IRS data, we estimate the canonical affine model, the dynamic term structure model (Duffie and Kan, 1996), adjusted for the presence of the lower bound as in Krippner (2013).

mostly above IRSs of equal maturity as a consequence of high credit risk premia due to contagion from the Eurozone debt crisis. Starting in 2014, an inflow of foreign investment into Czech GBs connected with the Czech koruna currency floor led to Czech GB yields falling below IRSs. During 2018, parity has started to be restored between Czech koruna IRSs and Czech GB yields. Using IRSs therefore leads to an estimation of risk-neutral expectations and pure term premia unaffected by the credit risk and portfolio effects.

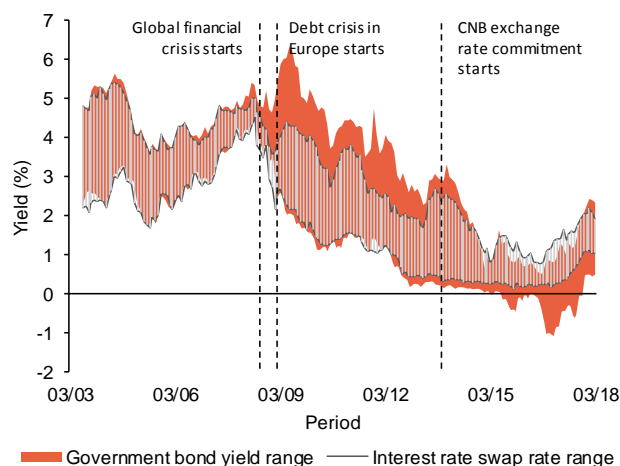
The “asset-swap” spread between Czech GB yields and Czech koruna IRSs can be split into the credit risk premium and the portfolio effect. The credit risk premium reflects the pricing of the probability of default of the Czech government. Its value is therefore inferred from the credit default swap (CDS) quotations for the Czech government.⁶ The portfolio effect is calculated as the remaining part of the spread.

The evolution of the four components of the ten-year Czech GB yield is displayed in Figure 2. Due to the limited availability of the CDS before 2008, only the results since 2008 are displayed. For most of the period, the dominant component was the risk-neutral yield, which represents the “pure” cost of money in the economy. As the Czech monetary policy rate drifted towards zero over 2008–2012, the risk-neutral yield dropped below 1%. It started rising again at the end of 2016, when expectations of monetary policy tightening started to strengthen. The term premium was roughly stable until 2014, fluctuating around 1.5%. From the end of 2014 onwards, it decreased substantially. This decrease is explained as a drop in uncertainty about the future evolution of monetary policy rates: with the exchange rate floor, the chance of imposing negative yields decreased and, on the contrary, the future lift-off of monetary policy rates was not expected to start before the floor was discontinued.

At the beginning of 2009, the credit risk premium rose from its originally low levels to 3%. This coincides with the outbreak of the Eurozone debt crisis. It soon returned back below 1%, peaked once again in 2012 and from then on decreased towards 0.5% at the end of the sample. Finally, the portfolio effect was mostly negative: except for a period of uncertainty over 2008–2009, it started decreasing substantially at the end of 2014. This was caused mostly by an inflow of foreign funds motivated by the Czech koruna floor and speculation on future currency appreciation. The portfolio inflow was most apparent in 1Y–2Y Czech GB yields (see Kučera et al., 2017), which dropped even more. After the exit from the Czech koruna floor in April 2017, investors reallocated their funds towards longer maturities. The portfolio effect of the 10Y GB yield thus remained low until the end of 2017, when it started to increase steadily as investors gradually left the market.

⁶ Due to the limited liquidity of the relevant CDS market, we adjust the quotations in terms of smoothing and by establishing certain convergence rules. See the description in Kučera et al. (2017) for details.

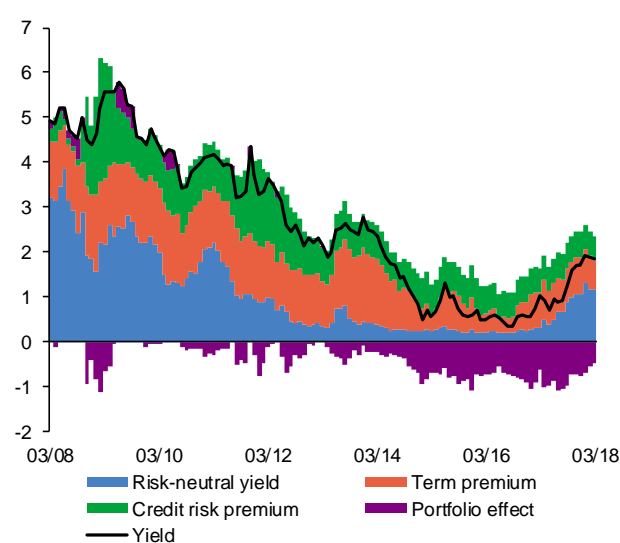
Figure 1. Ranges for zero-coupon Czech GB yields and Czech koruna IRSs (%; ranges between 1Y and 15Y maturities)



Note: Vertical lines mark the last monthly observation before the event described. The start of the global financial crisis is related to the collapse of Lehman Brothers in September 2008. The start of the debt crisis is related to the negative assessment of Greek public finances by the International Monetary Fund and the European Commission in February 2009.

Source: Bloomberg, Prague Stock Exchange, MTS Czech Republic, Thomson Reuters, authors' calculations

Figure 2. Decomposition of Czech ten-year zero-coupon government bond yield (%)



Source: Bloomberg, PSE, MTS Czech Republic, Thomson Reuters, authors' calculations

Conclusion

Knowledge of the economically-motivated components of Czech GB yields helps the CNB and market participants to correctly interpret yield curve movements. The drop in yields over 2015–2016, when the expected commencement of monetary policy normalisation was closing in, could result in a conundrum about markets' actual expectations regarding future monetary policy and the functioning of the transmission between the short and long end of the yield curve. Knowledge of the components allows the drop in yields during the floor's presence to be attributed to portfolio investment inflows rather than monetary policy. The decomposition also allows the anticipation of monetary policy rate normalisation to be identified as the main driver of the rise in long-term bond yields in the post-exit period.

Knowledge of the components also allows the sensitivity of Czech GB yields to various macroeconomic and financial shocks to be estimated. As Kučera et al. (2018) show, the upward response of yields following positive shocks to expectations about GDP and CPI is partially offset by shifts in portfolio allocation and risk pricing. This less-than-proportional response of long yields is in line with international experience (Greenspan's conundrum in the U.S. in 2005–2007 and its re-emergence since 2015) and has important implications for both monetary policy conduct and the use of the yield curve as an indicator of the business cycle. The behaviour of the portfolio effect and credit risk premia at times of financial uncertainty also suggests that Czech GBs are perceived by global markets as a risky investment rather than a safe haven (Kučera et al., 2018).

References

- Adrian, T., R. K. Crump, B. Mills and E. Moench (2014): Treasury Term Premia: 1961-Present. *Liberty Street Economics*, available at libertystreeteconomics.newyorkfed.org/2014/05/treasury-term-premia-1961-present.html
- Bauer, M. D. and G. D. Rudebusch (2017): Interest Rates under Falling Stars. Federal Reserve Bank of San Francisco Working Paper 2017-16.
- Campbell, J. Y. and R. J. Shiller (1991): Yield Spreads and Interest Rate Movements: A Bird's Eye View. *Review of Economic Studies*, 58(3), 495–514.
- Duffee, G. R. (2002): Term Premia and Interest Rate Forecasts in Affine Models. *Journal of Finance*, 57(1), 405–443.
- Duffie, D. and R. Kan (1996): A Yield-Factor Model of Interest Rates. *Mathematical Finance*, 6(4), 379–406.
- Fama, E. F. and R. R. Bliss (1987): The Information in Long-Maturity Forward Rates. *American Economic Review*, 77, 680–692.
- Joslin, S., K. J. Singleton and H. Zhu (2011): A New Perspective on Gaussian Dynamic Term Structure Models. *Review of Financial Studies*, 24(3), 926–970.
- Kim, D. H. and J. H. Wright (2005): An Arbitrage-Free Three-Factor Term Structure Model and the Recent Behavior of Long-Term Yields and Distant-Horizon Forward Rates. Federal Reserve Board Finance and Economics Discussion Series 2005-33.
- Krippner, L. (2013): A Tractable Framework for Zero-Lower-Bound Gaussian Term Structure Models. CAMA Working Paper.
- Kučera, A., M. Dvořák, L. Komárek and Z. Komárková (2017): Longer-term Yield Decomposition: An Analysis of the Czech Government Yield Curve. CNB Working Paper No. 12/2017.
- Kučera, A., M. Dvořák and Z. Komárková (2018): The Czech Government Yield Curve Decomposition at the Lower Bound. *Czech Journal of Economics and Finance*, forthcoming.

What Drives the Distributional Dynamics of Client Interest Rates on Consumer Loans in the Czech Republic? A Bank-Level Analysis⁷

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This article investigates the bank-level distributional dynamics and factors of client interest rates on consumer loans in the Czech Republic.⁸ This topic is under-researched despite the fact that consumer loans constitute a significant part of the loan portfolios of banks in the Czech Republic – around 6% of the total stock of loans and 15% of the total stock of household loans as of 2017. Moreover, non-performing consumer loans account for around 39% of all household non-performing loans (NPLs).

Given their higher NPL ratio and its greater volatility over the business cycle, consumer loans are a major source of credit risk for consumer credit providers. First, compared with mortgages, consumer loans are not collateralised, which is why there is higher loss given default (LGD) at any given probability of default (PD). Second, given that interest rates on consumer loans are higher than those on other sorts of loans, consumer credit accounts for a large part of commercial banks' margins and thus contributes to their interest income. Third, consumer loans are taken out more frequently by lower-income households, so they can have a greater influence on the balance sheets, overindebtedness, solvency and consumer behaviour of households themselves. Repayment difficulties can affect consumer credit providers more quickly than mortgage providers.

This article revisits the topic of consumer loans in the Czech Republic and attempts to provide answers to several policy-relevant questions. Do new consumer loans in the Czech Republic have a short-term or a long-term character? What does the empirical distribution of client interest rates look like? Is it normal or multimodal? It should be noted that multimodality of the distribution would effectively disqualify the mean interest rate as an appropriate location measure. Also, have there been any dynamics in the distribution in recent years? And are any trends general or specific to a few banks only? Finally, drivers of client rates on consumer loans can also be seen as

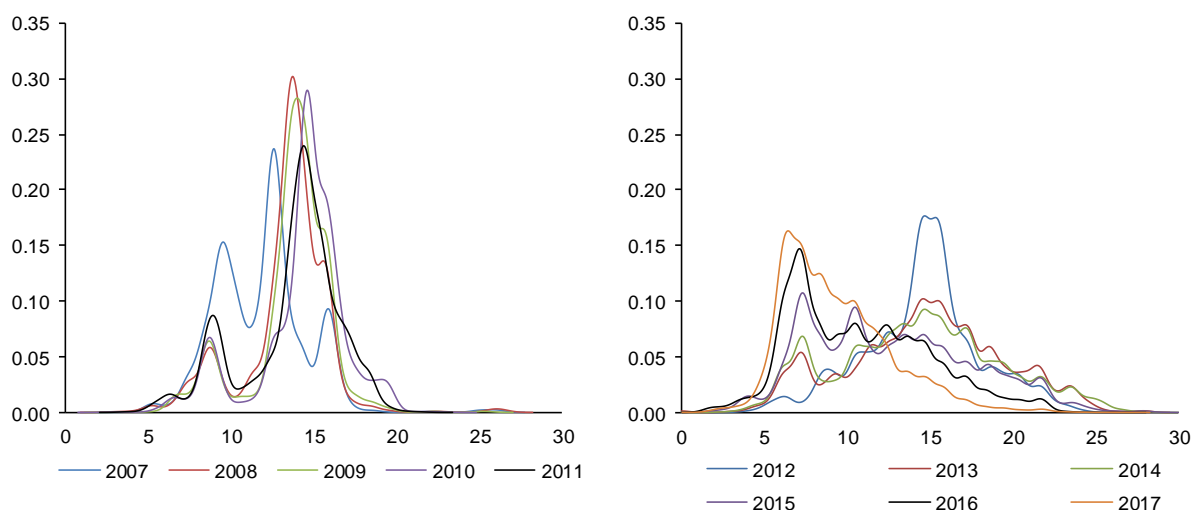
⁷ This article is based on Brož and Hlaváček (2018).

⁸ We analyse new consumer loans rather than the stock of consumer loans. This is standard in the literature in the Czech context, as client rates on new loans reflect changes in the economic environment faster than client rates on the stock of consumer loans (Horváth and Podpiera, 2012; Hainz et al., 2014; Havránek et al., 2016). We consider consumer credit in the narrower sense of specific-purpose consumer credit for goods and services for personal consumption and non-specific consumer credit; we therefore exclude bank overdrafts and debit balances on current accounts and credit card credit. We also do not consider consumer credit granted by non-banks in this article.

a natural research objective. Are client rates on consumer loans influenced by monetary policy, by changes in the underlying credit risk or by market concentration in this segment as the literature in the Czech context suggests?

Our empirical analysis has several dimensions. First, we take into account that the fixation periods of client rates on consumer loans can differ. In particular, we focus on consumer loans with the client interest rate fixed for more than five years, which currently dominate consumer credit and have exhibited multimodal distributions. Second, we conduct an analysis of the distributional dynamics of client rates on consumer loans both at the aggregate level (the entire banking sector) and at the level of individual banks. Third, in the bank-level analysis of factors of client rates on consumer loans, we employ two location measures: (i) the mean interest rate, and (ii) the interest rate which corresponds to the location of the highest mode (global maximum) of the density function of consumer loans. The latter measure can then provide a link between the analysis of the distributional dynamics and the factors of client rates on consumer loans.

Figure 1. Distributional dynamics of client rates on consumer loans with an initial rate fixation of over five years (x-axis: interest rate in per cent, y-axis: density)



Note: The density of the distribution is approximated by means of kernel density estimation with a parameter of 0.53.

Source: CNB, authors' calculations

We use detailed regulatory data on the empirical distributions of client rates on consumer loans in the sample period from 2007 to 2017. To study the yearly distributional dynamics of consumer loans, we apply kernel density estimation. The results are shown in Figure 1. Before the financial crisis in 2007, the distribution had three peaks. However, the weight shifted in 2008–2012 to a peak with higher interest rates of around 15%, possibly reflecting growth in credit risk. After disappearing in 2012, the left-hand peak at around 7% started to grow in 2013 and has in fact dominated the distribution again since 2015. At the same time, the entire distribution has become flatter, while the right-hand peak at 15% has almost vanished from the distribution.

The changes in the distribution from year to year indicate that the character of consumer loans has changed quite substantially over time. They also clearly reveal the specific and unprecedented nature of the present situation, where a structural break has evidently occurred. In Brož and

Hlaváček (2018), the authors illustrate that shifts in the distribution of interest rates to lower levels represented the prevailing trend among banks in the Czech Republic.

To analyse the factors of client rates on consumer loans using bank-level data, we employ the bootstrap-corrected least squares estimator for dynamic panel data (De Vos et al., 2015). We estimate the following regression equation:

$$\text{consrate}_{i,t} = \alpha_i + \beta_1 \cdot \text{consrate}_{i,t-1} + \beta_2 \cdot \text{IRS7Y}_t + \beta_3 \cdot \text{defrate}_{i,t} + \beta_4 \cdot \text{Herfindahl}_t + \varepsilon_{i,t}$$

where *consrate* denotes the mean or modal interest rate of bank *i* at time *t*, *IRS7Y* is the 7-year interest rate swap rate, which we use as a proxy for the effect of financial market rates, *defrate* measures credit risk, which we define as the change in NPLs 12 months ahead ($\text{defrate}_{i,t} = \Delta \text{NPL}_{i,t+12}$), *Herfindahl* is the Herfindahl index of market concentration, reflecting the level of competition, and ε denotes a white noise process. We split our sample into two periods: 2007–2011 and 2012–2017, due to a structural break in the series of the Herfindahl index and to distinguish the effects of unconventional monetary policy. The estimated coefficients are shown in Table 1.

Table 1. Analysis of the determinants of consumer credit rates

Variable	Dependent variable			
	Mean		Mode	
	Period 1 01/07–12/11	Period 2 01/12–12/17	Period 1 01/07–12/11	Period 2 01/12–12/17
Mean/mode (t-1)	0.801***	0.898***	0.680***	0.775***
IRS7Y (t)	-0.128	0.161	-0.175	0.292*
Default rate (t)	-0.076	0.113	-0.123	0.19
Herfindahl (t)	-0.001	0.057***	0.002	0.147***
No. of obs.	281	505	281	505

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively. Estimated using the bootstrap method of De Vos et al. (2015) based on 800 iterations.

Source: CNB, authors' calculations

We summarise the results as follows. First, both the mean and the mode of the interest rate distribution are strongly persistent in both time periods. However, we do not find evidence of a unit root, which supports our choice of estimation strategy. Second, none of the three factors – monetary policy, credit risk and market competition – were relevant drivers of client rates on consumer loans in the period 2007–2011, in contrast to the situation in the period 2012–2017. This means that the recent period is unprecedented, as already established in the analysis of the distributional dynamics. Third, reduced market concentration (higher market competition) – which has arguably reduced mark-ups on consumer loans – leads to lower client rates on consumer loans for both the mean and the mode in the period 2012–2017. A similar finding is presented by Van Leuvensteijn et al. (2013), who claim that increased market competition leads to better conditions for customers who take out a consumer loan. Fourth, the default rate does not seem to be a relevant factor behind the distributional dynamics of rates on consumer loans. We attribute this result to the fact that banks might have imprecisely predicted the amount of loan loss provisions required for consumer loans, partly because the recent decline in the credit risk indicator has been rapid and unprecedented.

Fifth, there is evidence of a link between the market rate and the client interest rate on consumer loans for the mode measure in the period 2012–2017. This implies that accommodative monetary policy (as IRS7Y is a proxy for monetary policy) in recent years might have contributed to the shifts of the distribution of client rates on consumer loans to lower values. The coefficient on IRS7Y is approximately 0.29, which means that the “short-run pass-through” is rather low and incomplete. This is consistent with the international literature on consumer loans (De Graeve et al., 2007; Gropp et al., 2014). However, taking into account the persistence of both the mean and the mode, we could claim that the “long-run pass-through” might be complete. Specifically, we cannot reject the null hypothesis that the sum of the coefficients on the lagged value of the mode measure and the proxy for the market rate is statistically different from 1.

Several robustness checks are conducted for the period 2012–2017. They include the use of alternative estimation strategies and the use of additional variables. The pass-through of market rates is discussed in more detail in Brož and Hlaváček (2018). While the results on the effect of market competition stay intact, the findings on the link between the market rate and client rates on consumer rates are less robust. Specifically, both in the GMM and in the fixed effects estimation (without the lagged dependent variable), the market rate has an effect only for the mean and not for the mode. Next, when the interest rate margin on mortgages is included in the model, the effect of the market rate disappears.

The results have implications both for monetary policy and for financial stability. The paper shows that the evolution of consumer loans in the Czech Republic is to a certain extent similar to that of mortgages. Specifically, the volumes of new consumer loans have been increasing rapidly in recent years, surpassing the previous high from the pre-crisis times, and the new peak might not have been attained yet. At the same time, client rates have been falling in a protracted fashion which has no precedent in the history of the Czech consumer loan market.

References

- Brož, V. and M. Hlaváček (2018): What Drives the Distributional Dynamics of Client Interest Rates on Consumer Loans in the Czech Republic? A Bank-Level Analysis. CNB Working Paper No. 6/2018.
- Brůha, J. (2011): Retail Credit Premiums and Macroeconomic Developments. Financial Stability Report 2010/2011, Czech National Bank, pp. 96–109.
- De Graeve, F., O. De Jonghe and R. Vander Venet (2007): Competition, Transmission and Bank Pricing Policies: Evidence from Belgian Loan and Deposit Markets. *Journal of Banking and Finance*, 31(1), 259–278.
- De Vos, I., G. Everaert and I. Ruyssen (2015): Bootstrap-based Bias Correction and Inference for Dynamic Panels with Fixed Effects. *Stata Journal*, 15(4), 986–1018.
- Gropp, R., C. Kok and J.-D. Lichtenberger (2014): The Dynamics of Bank Spreads and Financial Structure. *Quarterly Journal of Finance*, 4(04), 1–53.
- Hainz, C., R. Horváth and M. Hlaváček (2014): The Interest Rate Spreads in the Czech Republic: Different Loans, Different Determinants? *Economic Systems*, 38(1), 43–54.
- Havránek, T., Z. Iršová and J. Lešánovská (2016): Bank Efficiency and Interest Rate Pass-Through: Evidence from Czech Loan Products. *Economic Modelling*, 54, 153–169.
- Horváth, R. and A. Podpiera (2012): Heterogeneity in Bank Pricing Policies, The Czech Evidence. *Economic Systems*, 36(1), 87–108.
- Van Leuvensteijn, M., C. K. Sørensen, J. A. Bikker and A. A. Van Rixtel (2013): Impact of Bank Competition on the Interest Rate Pass-through in the Euro Area. *Applied Economics*, 45(11), 1359–1380.

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Andrle, M. and Plašil, M. (2018): Econometrics with System Priors. *Economics Letters*, 172, 134–137

Audzei, V. and Brázdík, F. (2018): Exchange Rate Dynamics and Their Effect on Macroeconomic Volatility in Selected CEE Countries. *Economic Systems*, forthcoming.

Babecká Kucharčuková, O., Claeys, P. and Vasicek, B. (2016): Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? *Journal of Policy Modeling*, 37(1), 1–40.

Babecký, J., Galuščák, K. and Žigraiová, D. (2017): Mechanisms of the State Dependence of Wage Setting: Evidence from a Survey of Czech Firms. *Eastern European Economics*, 55, 342–356.

Baxa, J., Plašil, M. and Vašíček, B. (2016): Inflation and the Steeplechase between Economic Activity Variables: Evidence for G7 Countries. *The B.E. Journal of Macroeconomics*, 16 (3), published online.

Brož, V. and Kočenda, E. (2018): Dynamics and Factors of Inflation Convergence in the European Union. *Journal of International Money and Finance*, 86(C), 93–111.

Brůha, J. and Kočenda, E. (2018): Financial Stability in Europe: Banking and Sovereign Risk. *Journal of Financial Stability*, 36(C), 305–321.

Bulíř, A., Hurník, J. and Šmídková, K. (2016): What Do Central Banks Know about Inflation Factors? *Open Economies Review*, 27(4), 795–810.

Fiala, T. and Havranek, T. (2017): The Sources of Contagion Risk in a Banking Sector With Foreign Ownership. *Economic Modelling*, 60(C), 108–121.

Franta, M. (2017): Rare Shocks vs. Non-Linearities: What Drives Extreme Events in the Economy? Some Empirical Evidence. *Journal of Economic Dynamics and Control*, 75(C), 136–157.

Franta, M. (2016): The Effect of Non-Linearity Between Credit Conditions and Economic Activity on Density Forecasts. *Journal of Forecasting*, 35(2), 147–166.

Franta, M., Havrlant, D. and Rusnák, M. (2016): Forecasting Czech GDP Using Mixed-Frequency Data Models. *Journal of Business Cycle Research*, 12(2), 165–185.

Franta, M., Libich, J. and Stehlík, P. (2018): Tracking Monetary-Fiscal Interactions Across Time and Space. *International Journal of Central Banking*, 14(3), 167–227.

Galuščák, K., Hlaváč, P. and Jakubík, P. (2016): Household Resilience to Adverse Macroeconomic Shocks: Evidence from Czech Microdata. *International Review of Applied Economics*, 30(3), 377–402.

Galuščák, K. and Kátay, G. (2018): Tax-Benefit Systems and Differences in Aggregate Labour Force Participation: Comparative Evidence from the Czech Republic and Hungary. *Economic Systems*, forthcoming.

Geršl, A., Komárková, Z. and Komárek, L. (2016): Liquidity Stress Testing with Second-Round Effects: Application to the Czech Banking Sector. *Czech Journal of Economics and Finance*, 66(1), 32–49.

Hájek, J. and Horváth, R. (2016): The Spillover Effect of Euro Area on Central and Southeastern European Economies: A Global VAR Approach. *Open Economies Review*, 27(2), 359–385.

Hampl, M. and Havránek, T. (2017): Should Monetary Policy Pay Attention to House Prices? The Czech National Bank's Experience. *Central Banking Journal*, 27(4), 28–37.

Havranek, T., Horvath, R. and Zeynalov, A. (2016): Natural Resources and Economic Growth: A Meta-Analysis. *World Development*, 88(C), 134–151.

- Havránek, T. and Iršová, Z. (2016): Do Borders Really Slash Trade? A Meta-Analysis. *IMF Economic Review*, 65(2), 365–396.
- Havránek, T., Iršová, Z. and Herman, D. (2018): Does Daylight Saving Save Energy? A Meta-Analysis. *Energy Journal*, 39(2), 35–61.
- Havránek, T., Iršová, Z. and Lešánovská, J. (2016): Bank Efficiency and Interest Rate Pass-Through: Evidence from Czech Loan Products. *Economic Modelling*, 54(C), 153–169.
- Havránek, T., Iršová, Z. and Schwarz, J. (2016): Dynamic Elasticities of Tax Revenue: Evidence from the Czech Republic. *Applied Economics*, 48(60), 5866–5881.
- Havránek, T., Iršová, Z. and Zeynalova, O. (2018): Measuring the Income Elasticity of Water Demand: The Importance of Publication and Endogeneity Biases. *Land Economics*, 94(2), 259–283.
- Havránek, T., Iršová, Z. and Zeynalova, O. (2018): Tuition Fees and University Enrolment: A Meta-Regression Analysis. *Oxford Bulletin of Economics and Statistics*, forthcoming.
- Havránek, T., Rusnák, M. and Sokolova, A. (2017): Habit Formation in Consumption: A Meta-Analysis. *European Economic Review*, 95(1), 142–167.
- Hejlová, H., Hlaváček, M. and Komárek, L. (2017): A Comprehensive Method for House Price Sustainability Assessment in the Czech Republic. *Prague Economic Papers*, 26(3), 269–285.
- Hlaváček, M., Novotný, O. and Rusnák, M. (2016): Analysis of the Commercial Property Prices in the Central European Countries. *Politická ekonomie*, 2016(1), 1–16.
- Hlédik, T., Holub, T. and Král, P. (2016): The Czech National Bank's Role since the Global Crisis. *Public Finance Quarterly (Hungary)*, Focus: New Central Bank Policies, 2016/1, 65–93.
- Joy, M., Rusnák, M., Šmídková, K. and Vašíček, B. (2017): Banking and Currency Crises: Differential Diagnostics for Developed Countries. *International Journal of Finance & Economics*, 22(1), 44–67.
- Kadlčáková, N., Komárek, L., Komárková, Z. and Hlaváček, M. (2016): Identification of Asset Price Misalignments on Financial Markets With Extreme Value Theory. *Emerging Markets Finance and Trade*, 52(11), 2595–2609.
- Komárek, L. and Kadlčáková, N. (2017): Foreign Exchange Market Contagion in Central Europe from the Viewpoint of Extreme Value Theory. *Prague Economic Papers*, 26(6), 690–721.
- Konečný, T. and Babecká-Kucharčuková, O. (2016): Credit Spreads and the Links between the Financial and Real Sectors in a Small Open Economy: The Case of the Czech Republic. *Czech Journal of Economics and Finance*, 66(4), 302–321.
- Malovaná, S. and Frait, J. (2017): Monetary Policy and Macroprudential Policy: Rivals or Teammates? *Journal of Financial Stability*, 32(C), 1–16.
- Malovaná, S., Hlaváček, M. and Galuščák, K. (2018): Sensitivity of Czech Households to an Interest Rate and Income Shock. Application on Microdata. *Politická ekonomie*, 66(5), 531–549.
- Malovaná, S., Kolcunová, D. and Brož, V. (2018): Does Monetary Policy Influence Banks' Risk Weights under the Internal Ratings-based Approach? *Economic Systems*, forthcoming.
- Novotný, F. (2018): Profitability Life Cycle of Foreign Direct Investment: Application to the Czech Republic. *Emerging Markets Finance and Trade*, 54(7), 1623–1634.
- Pfeifer, L., Holub, L., Pithart, Z. and Hodula, M. (2017): Interaction of Capital and Liquidity Regulation in the Banking Sector (in Czech). *Politická ekonomie*, 65(5), 525–545.
- Pfeifer, L., Holub, L., Pithart, Z. and Hodula, M. (2017): Leverage Ratio and its Impact on the Resilience of the Banking Sector and Efficiency of Macroprudential Policy. *Czech Journal of Economics and Finance*, 67(4), 277–299.

Plašil, M., Seidler, J. and Hlaváč, P. (2016): A New Measure of the Financial Cycle: Application to the Czech Republic. *Eastern European Economics*, 54 (4), 296–318.

Polák, P. (2017): The Productivity Paradox: A Meta-Analysis. *Information Economics and Policy*, 38, 38–54.

Polák, P. (2018): The Euro's Trade Effect: A Meta-Analysis. *Journal of Economic Surveys*, forthcoming.

Rusnák, M. (2016): Nowcasting Czech GDP in Real Time. *Economic Modelling*, 54(C), 26–39.

Schwarz, J. and Pospíšil, M. (2018): Bankruptcy, Investment, and Financial Constraints: Evidence from the Czech Republic. *Eastern European Economics*, 56(2), 99–121.

Skorepa, M. and Komarek, L. (2017): Real Exchange Rates: Are They Dominated by Fundamental Factors? *Applied Economic Letters*, 24(19), 1389–1392.

Žigraiová, D. and Havránek, T. (2016): Bank Competition and Financial Stability: Much Ado About Nothing? *Journal of Economic Surveys*, 30(5), 944–981.

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