What drives the distributional dynamics of client interest rates on consumer loans in the Czech Republic?

Hlaváček, Michal; Brož Václav
2018

WORKING PAPER SERIES 6

2018

Václav Brož, Michal Hlaváček

What Drives the Distributional Dynamics of Client interest Rates on Consumer Loans in the Czech Republic? A Bank-level Analysis

CNB CZECH NATIONAL BANK

WORKING PAPER SERIES

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

Václav Brož
Michal Hlaváček

6/2018

CNB WORKING PAPER SERIES

The Working Paper Series of the Czech National Bank (CNB) is intended to disseminate the results of the CNB's research projects as well as the other research activities of both the staff of the CNB and collaborating outside contributors, including invited speakers. The Series aims to present original research contributions relevant to central banks. It is refereed internationally. The referee process is managed by the CNB Research Division. The working papers are circulated to stimulate discussion. The views expressed are those of the authors and do not necessarily reflect the official views of the CNB.

Distributed by the Czech National Bank. Available at http://www.cnb.cz.

Reviewed by: Balázs Égert (OECD and Université Paris Nanterre)
Jan Brůha (Czech National Bank)

Project Coordinator: Simona Malovaná

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

Václav Brož and Michal Hlaváček *

Abstract

We study the bank-level distributional dynamics and factors of client interest rates on consumer loans in the Czech Republic. We take into account that client interest rates can have different fixation periods, focus on the consumer loans category, which exhibits multimodal client interest rate distributions, and employ an alternative measure to the mean interest rate – the mode measure. We show that in recent years, most banks in the Czech Republic have started to provide new consumer loans at unprecedentedly low client interest rates. The bank-level analysis then reveals that reduced market concentration (increased market competition) and to some extent also accommodative monetary policy and changes in the market for housing loans and mortgages have been driving this development. Our results are in line with the international literature but are novel in the Czech context.

Abstrakt

V tomto článku se zabýváme distribuční dynamikou na úrovni bank a faktory ovlivňujícími klientské úrokové sazby ze spotřebitelských úvěrů v České republice. Bereme v úvahu, že klientské úrokové sazby mohou mít rozdílně dlouhá období fixace, zaměřujeme se na spotřebitelské úvěry, které vykazují vícemodální rozdělení úrokových sazeb, a kromě průměrné úrokové sazby využíváme také alternativní ukazatel – modus. Ukazujeme, že v posledních letech většina bank v České republice začala poskytovat nové spotřebitelské úvěry za nebývale nízké klientské úrokové sazby. Z analýzy na úrovni jednotlivých bank vyplývá, že za tímto vývojem stojí snížená koncentrace trhu (vyšší konkurence na trhu) a do určité míry také uvolněná měnová politika spolu se změnami na trhu úvěrů na bydlení a hypoték. Výsledky článku jsou v souladu s mezinárodní odbornou literaturou, ale v českém kontextu jsou nové.

JEL Codes: C23, C46, E43, G21.
Keywords: Banks, client interest rates, competition, consumer loans.

* Václav Brož, Czech National Bank and Charles University Prague, vaclav.broz@cnb.cz
Michal Hlaváček, Czech National Bank and Charles University Prague, michal.hlavacek@cnb.cz
We would like to thank Evžen Kočenda, Simona Malovaná, Jan Brůha, Balázs Égert, Dominika Kolcunová, and Jan Frait for useful comments. The authors note that the paper represents their own views and not necessarily those of the Czech National Bank. All errors and omissions remain entirely the fault of the authors.

Nontechnical Summary

Consumer loans constitute a significant part of the loan portfolios of the Czech banking sector, but little is known about their evolution over time and about the factors that influence client interest rates on consumer loans. The Czech literature presents only limited evidence on both of these topics.

We analyze the bank-level distributional dynamics and factors of client rates on consumer loans with an interest rate fixation period of over 5 years, which exhibits multimodal client interest rate distributions. In our bank-level analysis, we use data in a sample period from 2007 to 2017 and assume an alternative location measure to the mean interest rate (the mean measure) – the location of the highest mode of the empirical distribution of consumer loans (the mode measure). Moreover, based on the Czech literature, we identify monetary policy, credit risk, and market concentration (market competition) as potential factors which might determine the dynamics of client rates on consumer loans. As our estimation framework, we employ the bootstrap-corrected fixed effects model of De Vos et al. (2015) for dynamic panel data. This modeling approach is the most suitable one for the specifics of our panel dataset.

We obtain two types of results. First, the results on the distributional dynamics reveal that in recent years, most banks in the Czech Republic have started to provide significantly cheaper consumer loans with long fixation periods than ever before. This trend is unprecedented in comparison with the situation before the global financial crisis and the crisis/early post-crisis period. Moreover, the protracted fall in client rates has been accompanied by a steady increase in the volume of new consumer loans. Second, the analysis of the factors of client rates on consumer loans can help us identify which factors have been driving the shifts in the distribution of client rates on consumer loans. In this sense, we show that reduced market concentration (increased market competition) and to some extent also accommodative monetary policy and changes in the market for housing loans and mortgages have contributed to the recent protracted decrease in client rates on consumer loans.

Our results are in line with the international literature but are novel in the Czech context. Further, they have implications both for monetary policy and for financial stability. Our overview of the Czech consumer loan market shows that the evolution of consumer loans is to a certain extent similar to that of housing loans and mortgages. Specifically, the volumes of new consumer loans have been increasing rapidly in recent years, surpassing the previously 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. We find that increased market competition – which puts pressure on the mark-ups of banks – has been a major driver of this development. As interest income from consumer loans accounts for a significant share of the profits of banks in the Czech Republic, continued pressure on mark-ups might pose a risk to their profitability and potentially also their capital adequacy.

1. Introduction and Motivation

In this paper, we study the bank-level distributional dynamics and factors of client interest rates on consumer loans in the Czech Republic. 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, new consumer loans account for 7% of all new loans and non-performing consumer loans account for around 39% of all household non-performing loans. However, little is known about the evolution of consumer loans over time and about the factors that influence client rates on consumer loans. In the Czech context, analyses of individual loan segments typically focus on corporate loans, housing loans, mortgages or household loans in general (Brůha, 2011; Horváth and Podpiera, 2012; Hainz et al., 2014; Havránek et al., 2016). In particular, special attention is paid to the topic of the pass-through of market interest rates to client rates in various loan segments. Consumer loans, however, are usually omitted from such analyses. One reason is their low responsiveness to the business cycle (Brůha, 2011). Another reason is the absence of a long-term relationship between client rates on consumer loans and market rates (Horváth and Podpiera, 2012; Havránek et al., 2016).

We revisit the topic of consumer loans in the Czech Republic, as there are multiple unexplored issues in this context.[1] First, policymakers might be interested in the evolution of consumer loans based on the length of the fixation of client rates, as outlined in Brůha (2011). Is there any fixation category that drives the overall dynamics of consumer loans, in terms of both the total volume and the average interest rate? If there is any dominant category, it should assume a central role in future analyses of consumer loans in the Czech Republic. Second, no author has so far analyzed the shape of the empirical distribution of client rates on consumer loans. Multimodality of the distribution would effectively disqualify the mean interest rate as an appropriate location measure. Furthermore, policymakers might be interested in tracing the precise dynamics of the empirical distribution of client rates on consumer loans. Are there any notable shifts in the empirical distribution at the aggregate level over time? Are potential trends general to the extent that they relate to a large number of banks or are they specific to few banks only? Any notable recent dynamics should then be assessed in comparison with those in previous seminal periods (the expansion of the Czech economy after accession to the European Union, the occurrence of the global financial crisis, and the protracted period of repeated recessions/very slow recovery in the post-crisis years). Finally, drivers of client rates on consumer loans can also be seen as 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? Also, such an analysis can potentially help identify what drives the distributional dynamics of client rates on consumer loans.

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 5 years. This category exhibits 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

[1] We analyze 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). In the remainder of the text, consumer loans thus refer to new consumer loans, not to the stock of consumer loans unless stated otherwise.

(global maximum) of the density function of consumer loans. We label these measures as the mean measure and the mode measure, respectively. The latter measure can then provide a link between the analysis of the distributional dynamics and the factors of client rates on consumer loans.[2]

We use detailed regulatory data on the empirical distributions of client rates on consumer loans in the sample period from 2007 to 2017 and employ two main methods in our analysis. First, to study the distributional dynamics of consumer loans, we apply kernel density estimation. Second, to analyze factors of client rates on consumer loans using bank-level data, we employ the bootstrap-corrected least squares estimator for dynamic panel data.

Our paper contributes to the current state of knowledge about the Czech consumer loan market in several ways. First, we study how the empirical distributions of client rates on consumer loans evolve over time. Such an analysis is original in the literature on consumer loans and might be of policy interest with respect to both financial stability and monetary policy. Second, we analyze which factors drive the evolution of client rates on consumer loans while (i) taking into account that client rates can have different fixation periods and (ii) using two measures of client rates – the mean and the mode measure. The use of the mode measure is novel in the literature.

The paper has the following structure. In the second section, we summarize the body of literature on consumer loans, with an emphasis on the topic of the pass-through from market rates to client rates on consumer loans. In the third section, we introduce our data and variables and formulate our working hypotheses. We continue with a fourth section in which we introduce our two main methods. The fifth section presents our results. In the sixth section, we provide concluding remarks and discuss the policy implications of our results.

2. Literature Review

In this section, we review relevant studies on the topic of the pass-through from market rates to client rates on consumer loans. However, some studies also introduce other factors – apart from monetary policy – which might influence client rates on consumer loans. Although consumer loans feature in several studies on the topic of monetary transmission in both the Czech and the international context, they are scarcely the main focus of such analyses. At the same time, to the best of our knowledge we are the first authors to study the distributional dynamics of consumer loans.[3]

2.1 Literature in the Czech Context

In the Czech context, the literature on the pass-through from market rates to client rates on consumer loans is somewhat limited. This stems from the fact that client rates on consumer loans are typically not found to be cointegrated with market rates (Horváth and Podpiera, 2012; Havránek et al., 2016). However, at the same time, the Czech literature presents some stylized facts about consumer loans and also offers several ideas about other potential factors – apart from monetary policy – which might influence client rates on consumer loans.

[2] As we assume that the mode measure is a more appropriate location measure if the distribution is non-normal.

[3] The topic of distributional dynamics, however, is established in economics. Kočenda and Valachy (2002) analyze the distributional dynamics of the ownership structures of Czech firms. Nath and Tochkov (2013) analyze the distributional dynamics of the inflation rates of the new EU member states with respect to the benchmark based on the inflation rates of countries that joined the Economic and Monetary Union in 1999.

First, Niedermayer (2008) provides an overview of the monetary transmission mechanism in the consumer loans segment in the transition and pre-crisis years in the Czech Republic (from 1990 to 2007). The growth of consumer loans was subdued in the transition years as: (i) the purchasing power of Czech consumers was low, (ii) interest rates attained values above 10%, and (iii) banks in the Czech Republic typically focused on corporate loans. This trend reversed only after the turn of the century. The Czech banking sector, having suffered severe financial difficulties that required state interventions, started to provide more consumer loans.[4] This trend was boosted by an environment of relatively low interest rates. As for the evidence on the pass-through, Niedermayer (2008) notes that monetary transmission between market rates and retail rates charged by banks can be characterized as *"slow and not complete."* Moreover, he adds that interest rates on consumer loans with shorter maturities *"adjust with a longer lag and tend to be sticky."*

Second, Brůha (2011) focuses on the evolution of credit risk premia and their interaction with macroeconomic fundamentals. However, he omits consumer loans from his analysis, as they (i) bear relatively high credit risk premia compared to housing loans and corporate loans, (ii) barely respond to the business cycle, and (iii) represent only a marginal share of the loan portfolios of banks in the Czech Republic. Further, Brůha (2011) thoroughly discusses why one should distinguish between loans based on the length of fixation of their interest rates. He applies this distinction for the analysis of corporate and housing loans in three fixation categories: (i) fixation of the interest rate for up to 1 year, (ii) fixation of the interest rate from 1 year to 5 years, and (iii) fixation of the interest rate for over 5 years. Moreover, these categories are paired with the 6-month Prague Interbank Offered Rate (6M PRIBOR), the 3-year interest rate swap (IRS3Y), and the 7-year interest rate swap (IRS7Y), respectively. We adopt the distinction based on the fixation of interest rates in our analysis, too.

Third, Horváth and Podpiera (2012) estimate the pass-through to client rates on mortgages, corporate loans, and consumer loans, using bank-level data from the period 2004–2008. The authors employ the pooled mean group estimator, which allows for heterogeneity between banks in the panel but requires client rates to be cointegrated with market rates. However, this condition is not satisfied for consumer loans. The authors attribute this result to a dominant role of credit risk and considerable market concentration in pricing of consumer loans. However, they do not distinguish between different lengths of fixation of interest rates on consumer loans; instead, they assume a pool of consumer loans with various fixation periods.

Fourth, Hainz et al. (2014) analyze the factors of interest rate spreads of corporate loans, mortgages, and consumer loans in the period 2004–2011.[5] The authors use a system generalized method of moments (GMM) estimator for a panel dataset of banks in the Czech Republic. The results show that credit risk, interest rate risk, and liquidity risk in the crisis period (2008–2011) exhibit some impact on the interest rate spreads of consumer loans. However, similarly to Horváth and Podpiera (2012), the authors do not distinguish between fixation categories.

Fifth, Havránek et al. (2016) study the pass-through to client rates of various loan categories separately in the periods before and after the global financial crisis. The authors put an emphasis on the link between the strength of the pass-through and bank efficiency, use bank-level data for various loan and deposit products, and employ the pooled mean group estimator. They can do so as they generally find evidence of panel cointegration between client rates and market rates – with the exception of consumer loans. Similarly to Horváth and Podpiera (2012), rates on consumer loans are

[4] In 2004, the growth of retail loans provided by Czech banks surpassed 30% (Vojtek and Kočenda, 2006).

[5] The spread is defined as the difference between the mean rate in a given loan segment for a given bank and the 3-month PRIBOR.

not found to be cointegrated with market rates in the panel of banks in the Czech Republic. Nevertheless, the authors do not follow Brůha (2011) and do not distinguish between different fixation categories.

Overall, the reviewed studies in the Czech context do not shed much light on the discussion of the interest rate pass-through to consumer loans and do not cover recent years. Generally, the authors do not distinguish between fixation categories as advised by Brůha (2011). Nevertheless, market competition and credit risk are identified as potential factors driving rates on consumer loans (Horváth and Podpiera, 2012).

2.2 Literature in the International Context: the European Union and Northern America

We divide the body of international studies into two strands based on their geographical focus. We review studies (i) focusing both on individual countries and on subgroups of countries from the European Union (EU), and (ii) focusing on countries in Northern America. The main aim of this section of the literature review is to broaden the set of possible approaches to modeling the pass-through to client rates on consumer loans. Also, the reviewed countries have a comparable monetary policy framework to the Czech Republic.

Starting with the first strand of literature on the EU countries, Egert and MacDonald (2009) provide an excellent overview of the topic of monetary transmission in the countries of Central and Eastern Europe (CEE). They survey numerous studies available at that time and review two approaches to modeling monetary transmission. First, the *cost of funds* approach assumes retail rates and corresponding market interest rates of a comparable maturity. Second, the *monetary policy* approach directly relates retail rates to reference rates set by the central bank. Next, the survey reveals Error Correction Models (ECMs) and Vector Autoregressive Models (VARs) as possible modeling approaches. Moreover, Egert and MacDonald (2009) provide several key insights into the pass-through to consumer loans in the pre-crisis period. First, they note that the average long-run pass-through from money market rates to a consumer lending rate is 0.51, by far the lowest figure in comparison with other retail rates (lending and deposit ones alike). Second, Egert and MacDonald (2009) claim that the interest rate pass-through to consumer loans is low and slow. This might aggravate the impact of monetary policy actions in the segment of consumer loans.

At the level of the euro area, Aristei and Gallo (2014) analyze whether the pass-through to various loan segments changed in the crisis period. They employ a vector error correction model (VECM) and show that the series of the money market rate (EURIBOR3M) and the retail rate for consumer loans are cointegrated if one allows for one structural break in the intercept. Furthermore, Aristei and Gallo (2014) report that the long-run pass-through to rates on consumer loans is significantly lower than 1, at around 0.2. The authors therefore claim that monetary authorities are unable to adequately affect rates on consumer loans. This is explained by a substantial market power of banks that exert sizable risk premia in the consumer loans segment. The short-run pass through is similarly low, implying sticky retail rates on consumer loans in the euro area (Aristei and Gallo, 2014). A comparable analysis is conducted by Gropp et al. (2014) for the euro area in the pre-crisis period. The authors use a dataset with two panel dimensions – product- and country-specific – and also show that the pass-through to client rates on consumer loans is low and slow. Thus, based on the findings of Gropp et al. (2014) and Aristei and Gallo (2014), we can conclude that the pass-through to rates on consumer loans is low in the euro area in the pre-crisis and the early crisis years alike. Finally, Van Leuvensteijn et al. (2013) study the link between bank competition and the interest rate pass-through in the euro area in the period 1999–2004. The authors find that more intense

competition (as measured by the Boone indicator) between banks leads to lower risk premia on consumer loans and at the same time to a stronger pass-through.

At the country-specific level, Fuertes and Heffernan (2009) and De Graeve et al. (2007) focus on the United Kingdom and Belgium, respectively. The former paper employs the ECM framework on a large body of various loan and deposit products. Interestingly, Fuertes and Heffernan (2009) find that for personal loans (one of their proxies for consumer loans), the pass-through exceeds 1. De Graeve et al. (2007) also employ the ECM framework on a panel of several loan and deposit products in Belgium, distinguishing them by their maturity. Again, the authors show that the pass-through to retail rates on consumer loans is low and slow, similarly to what other studies report for the pre-crisis period.

Turning to the second strand of literature on the United States and Canada, Mora (2014) analyzes the impact of the extraordinary post-crisis monetary policy measures – including quantitative easing – on retail rates. In particular, he focuses on auto loans and mortgages. Using an extensive bank-level dataset of U.S. banks, the author concludes that the policy actions of the Federal Reserve facilitated a decrease in retail rates, but the pass-through weakened in the post-crisis years. Next, Den Haan et al. (2007) also work with U.S. data and use a VAR framework to trace possible differences in the reaction of the stock of consumer loans to monetary and non-monetary shocks. In this sense, the authors find that the stock of consumer loans decreases following a hike in policy rates. On the other hand, it is not responsive to non-monetary shocks, proxied by a shock to output. Introducing spillovers of monetary policy actions into the literature on transmission of consumer loans, Den Haan et al. (2009) establish that the stock of consumer loans in Canada decreases after a monetary tightening initiated by the Federal Reserve. This is typically followed by the same action by the Bank of Canada. Similarly to the results of Den Haan et al. (2007), the stock of consumer loans reacts differently to monetary and non-monetary shocks, with the latter having a much less pronounced effect (Den Haan et al., 2009). Overall, the literature on consumer loans from the United States and Canada conveys a clear message: monetary policy actions can affect rates on consumer loans.

To sum up, there is a pattern in the international literature: most studies find that the pass-through to rates on consumer loans is low and slow. From the methodological point of view, approaches based on the error correction model prevail. This technique, however, requires data on both client rates on consumer loans and market rates to be non-stationary and cointegrated. Finally, some of the literature on the pass-through to consumer loans stresses the term-structure dimension of the analysis (De Graeve et al., 2007; Egert and MacDonald, 2009). This means that one should relate client rates on consumer loans (with a certain interest rate fixation period) to market rates of comparable maturity. We follow this recommendation in our analysis.

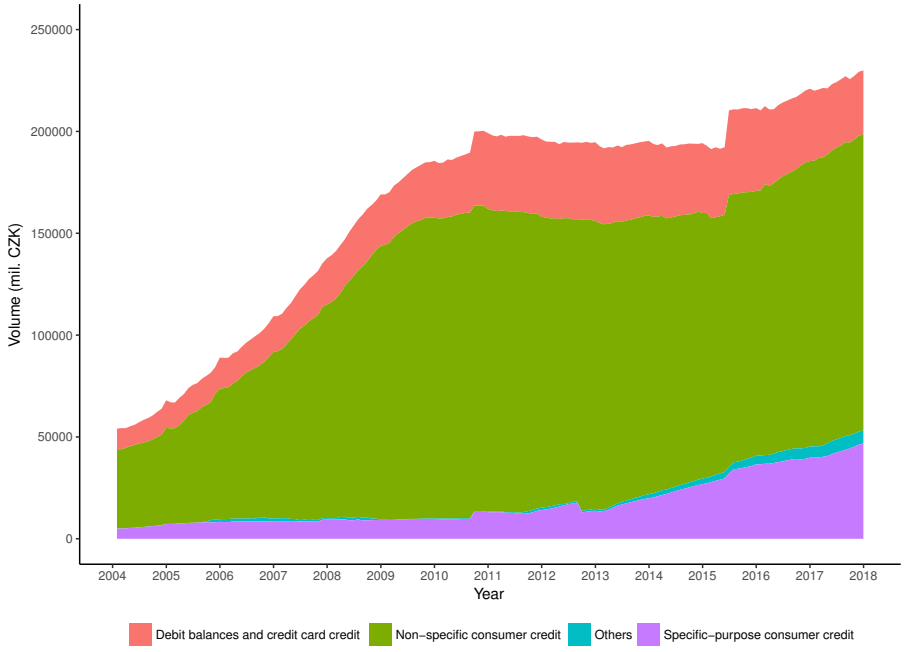
3. Data, Variables, and Hypotheses

3.1 Data and Variables

We use monthly data on the consumer loans of banks in the Czech Republic from the SNOB database maintained by the Czech National Bank (CNB). Our sample period spans from January 2007 to December 2017, constituting 132 observations in total. As such, consumer loans cover not only specific-purpose credit for goods and services (typically durables such as electronic goods,

furniture, and cars), but also non-specific credit that can be used for any purpose.[6] Figure 1 shows that consumer loans have been dominated by non-specific consumer credit, which accounted for more than 70% of all consumer loans in the past and still makes up more than one half of the total. Specific-purpose consumer credit has recently recorded the highest growth, having increased five-fold between 2008 and 2017, and now accounts for over 20% of the total stock of consumer loans. The different types of consumer loans differ considerably in terms of risk characteristics, maturity, and interest rates. These differences can lead to a multimodal distribution of client interest rates on consumer loans.

Figure 1: Structure of Consumer Loans by Loan Type, 2004–2017



Source: MtS-SUD CNB, authors' calculations

Table 1: An Illustrative Example of the Structure of the Data from the SNOB Database

Interest rate interval (in %)	Volume (in CZK millions)	Mean interest rate (in %)
1.01–2.00	173.79	1.82
2.01–3.00	198.69	2.21
3.01–4.00	1.00	3.91
4.01–5.00	26.85	4.90
5.01–6.00	1.3	5.11
Total volume/Aggregate mean interest rate	401.64	2.23

The data from the SNOB database are rich and detailed, as Table 1 shows. For a given month, we can observe the volume of new consumer loans provided by a given bank in each relevant interest rate interval. Moreover, the mean interest rate in each interest rate interval is given, as is

[6] Some definitions of consumer credit also include bank overdrafts and debit balances on current accounts and credit card credit.

the aggregate mean interest rate over all interest rate intervals.[7] The aggregate mean interest rate is the "mean measure" throughout this analysis. Further, the mean interest rate in each interval serves for the identification of the highest mode of the distribution. We label this measure as the "mode measure."[8] In the example provided by Table 1, 2.21% is the location of the highest mode of the distribution. The distinction between the mean and the mode measure constitutes the first dimension of our analysis.

Next, we conduct an analysis using both aggregate and bank-level data, which constitutes the second dimension of our analysis. The consumer loan market is relatively tight, as not all banks in the Czech Republic offer consumer loans. Specifically, we use data on 11 out of the 45 banks in the Czech Republic (as of the end of 2017). The banks in our sample cover 90% to 99% of all new consumer loans throughout 2007–2017. Their share of total new bank loans ranged from 73% to 87% (including the share of their legal predecessors). Our sample covers both universal banks and special-purpose banks focusing exclusively on consumer loans. In terms of size, we work with four large banks (out of the four large banks active in Czech Republic), two medium-sized banks (out of the five banks in this category), four small banks (out of ten banks), one foreign bank branch (out of 21 foreign bank branches), and no building societies (out of five building societies).[9]

In the third dimension of our analysis, we distinguish between three categories of consumer loans based on the length of fixation of their interest rate – up to 1 year (short), from 1 year to 5 years (medium), and more than 5 years (long). This distinction is similar to that of Brůha (2011) and also follows the approach of De Graeve et al. (2007) and Egert and MacDonald (2009). Next, we couple each fixation category with a corresponding market interest rate. We adopt the classification of Brůha (2011) and pair the fixation categories with the 6M PRIBOR, the 3-year interest rate swap (IRS3Y) and the 7-year interest rate swap (IRS7Y), respectively.[10]

Figure 2 shows the evolution of market interest rates in the period 2004–2017. The rates attained their highest values in our sample in the pre-crisis years and then decreased, reaching historical lows in 2016. In 2017, however, all three money market rates started to increase gradually.

For a start, it is useful to establish which fixation category – if any – dominates the other categories in terms of loan volumes. Figure 3 provides an overview of the evolution of the volumes of consumer loans in the three fixation categories as well as at the aggregate level (disregarding the length of fixation of the interest rate). First, consumer loans with long fixation periods (over 5 years) have been the dominant category since at least 2012. Furthermore, they have been growing at a rapid pace to unprecedented heights since that time. Second, in late 2015 or early 2016 the total volume of consumer loans topped its previous peak recorded around the onset of the global financial crisis, and a new peak has not been attained yet. Third, the evolution of consumer loans with a fixation period of between 1 year and 5 years is relatively stationary, with the exception of recent years, when a slight upward trend has been evident. The other two fixation categories (up to 1 year and

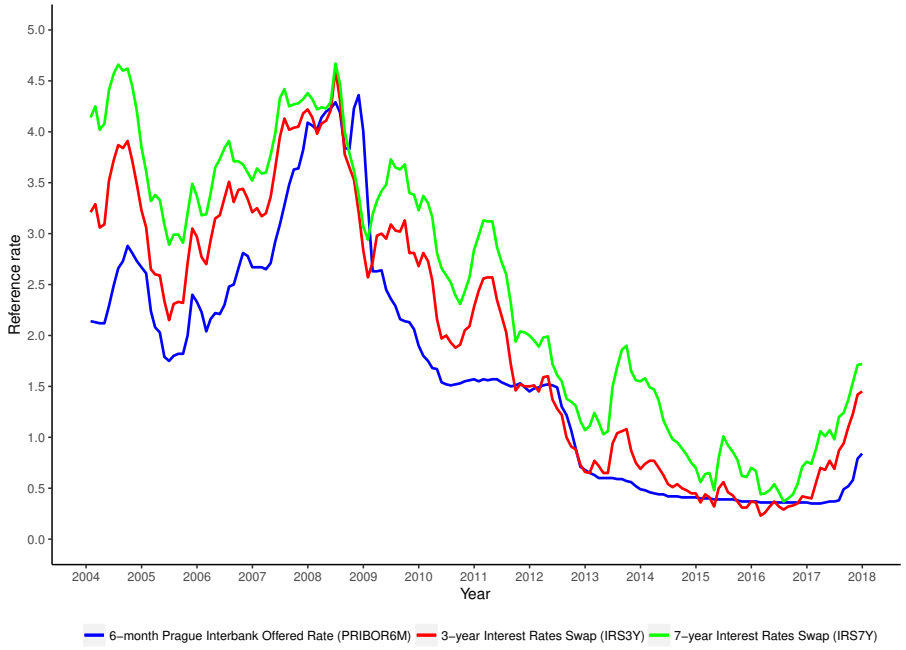
[7] Naturally the mean interest rate for each interest rate interval has to fall between the lower and upper bound of this interval.

[8] The location of the highest mode can be easily obtained from the CNB's SNOB database, using, for example, MS Excel.

[9] Large banks are those with assets accounting for more than 10% of the total assets of the banking sector, medium banks are those with assets amounting to between 2% and 10% of the banking sector balance sheet, and small banks are those with assets below 2% of banking sector assets.

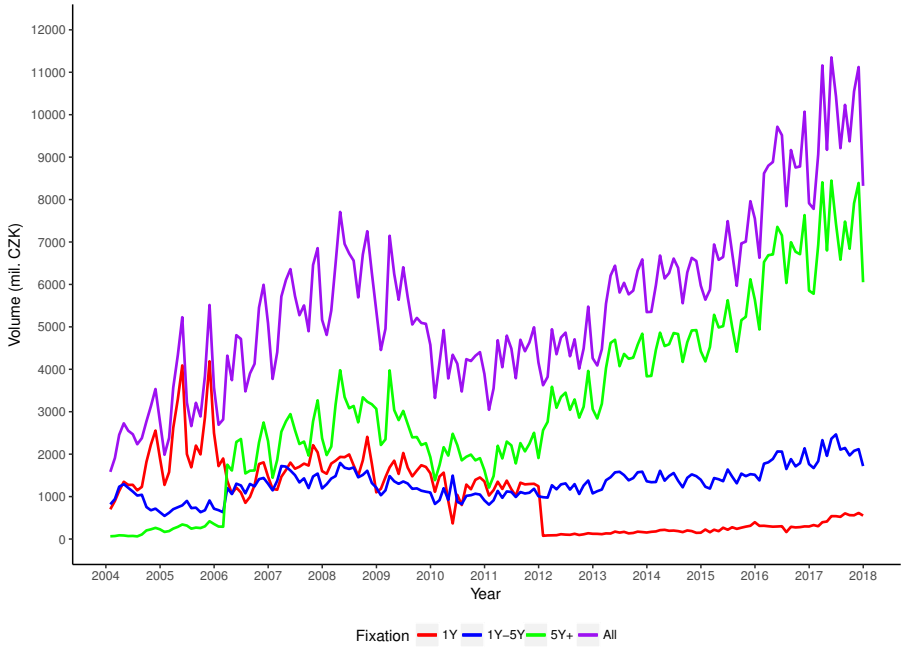
[10] Data for the reference rates are obtained from the CNB's ARAD database. We assume monthly averages.

Figure 2: Market Rates Corresponding to Various Fixation Categories, 2004–2017



Source: ARAD CNB

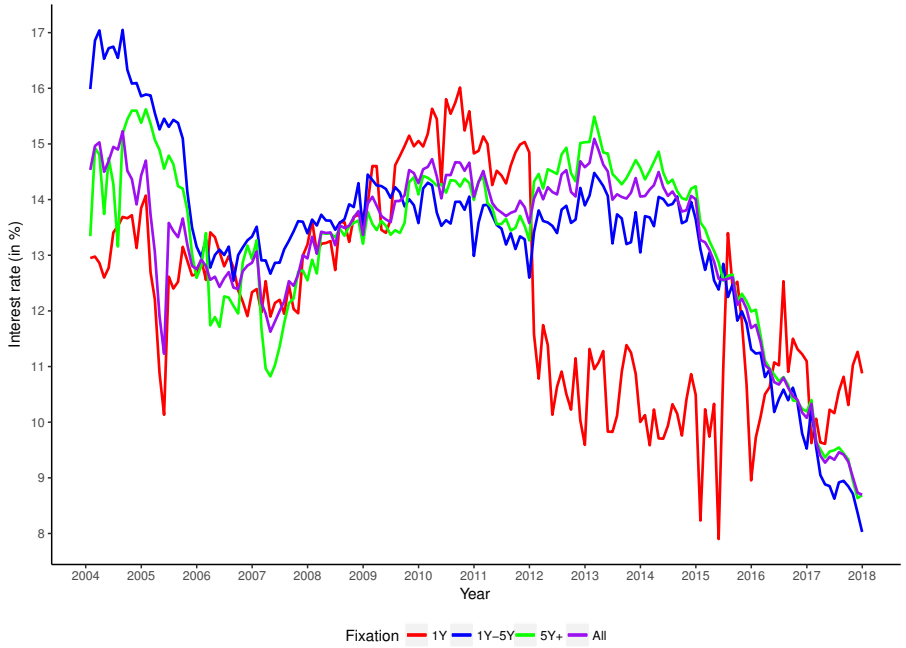
Figure 3: Volume of Consumer Loans, Various Fixation Categories, 2004–2017



Source: SNOB CNB

more than 5 years) contain clear structural breaks in January 2012 and March 2006, respectively.[11] On balance, however, consumer loans with interest rates fixed for over 5 years are the dominant category. We thus restrict our empirical analysis to them.[12]

Figure 4: Mean Interest Rates on Consumer Loans, Various Fixation Categories, 2004–2017



Source: SNOB CNB

Next, Figure 4 shows the evolution of mean interest rates for each fixation category and also the aggregate mean interest rate, disregarding the fixation categories. There has been a protracted fall in the aggregate mean interest rate since at least 2015. Clearly, this trend has been driven by a fall in the mean interest rates for the medium and long fixation categories. The decrease is sizable: mean interest rates attained values of around 14% in the period 2010–2014 but decreased to 10% recently. Given Figure 4, this development is unprecedented in comparison with previous periods for which data are available. Moreover, in the period from 2006 to 2012, mean interest rates of all fixation categories comoved in a highly synchronized fashion, with no substantial differences between them.

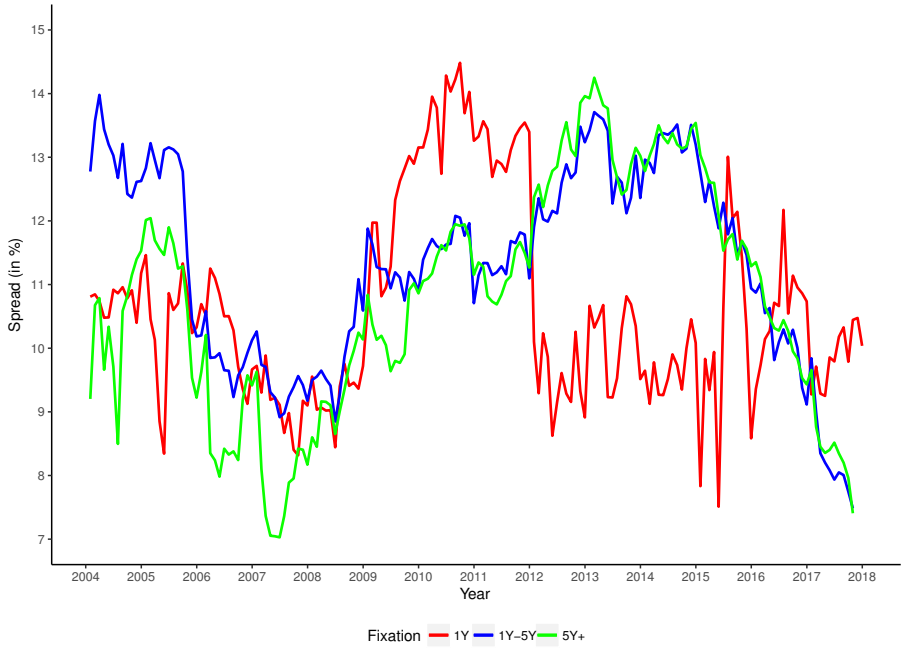
Further, Figure 5 shows the evolution of interest rate spreads.[13] Interestingly, low spreads of around 9% were attained in 2007 and 2008. Just before the start of the global financial crisis, however, both market interest rates and mean interest rates on consumer loans attained high values, as Figure 4 shows. The current situation is rather different, as both types of interest rates are near historical lows.

[11] These structural breaks are connected to the way banks report consumer loans. Both breaks occur at a time when some banks started to report the majority of consumer loans as having a fixation period of more than 5 years rather than less than 1 year.

[12] The other two categories are also omitted for the following reasons. First, the short fixation category is of minor importance as from 2017, as Figure 3 shows. Second, the medium fixation category does not exhibit multimodal distributions of client interest rates.

[13] We define interest rate spreads as the difference between the mean interest rates of a given fixation category and the corresponding market interest rate, as defined by Brůha (2011).

Figure 5: Interest Rate Spreads of Consumer Loans, Various Fixation Categories, 2004–2017



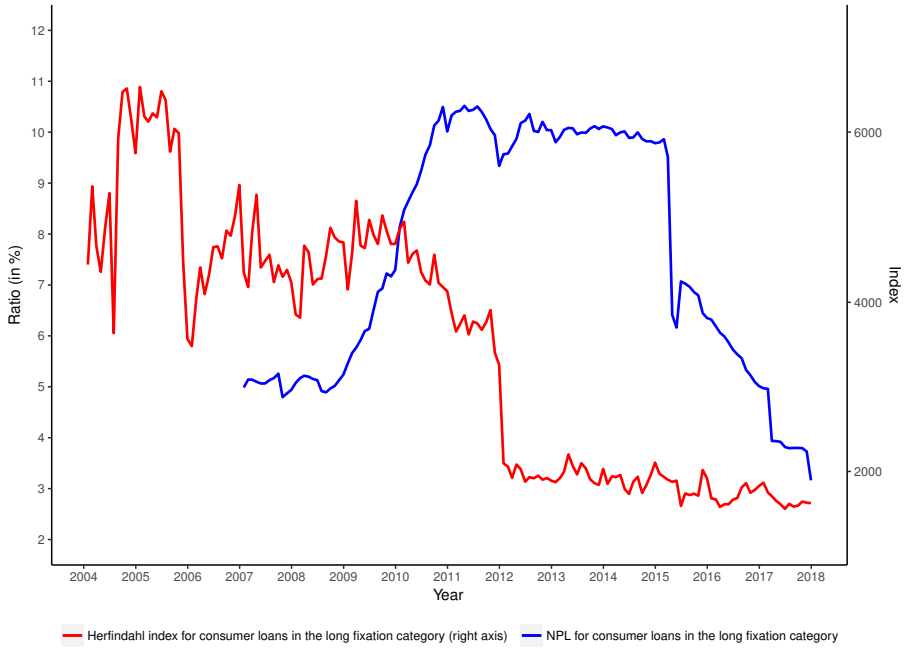
Source: SNOB CNB, ARAD CNB

Figure 6: The Mean and the Mode Measure, Long Fixation, 2004–2017

Source: SNOB CNB, authors' calculations

Next, Figure 6 shows the evolution of the mean and the mode measure for the long fixation category. In general, the mode measure is less volatile and was highly synchronized with the mean measure until 2015. Since 2015, however, the mode measure has attained significantly lower values than the mean measure. This implies that an empirical analysis with these two measures might yield different results.

Figure 7: Market Concentration and Credit Risk for Consumer Loans, Long Fixation, 2004–2017



Source: SNOB CNB, MtS-SUD CNB, authors' calculations

Finally, Figure 7 shows the evolution of two potential factors of client rates on consumer loans identified in the literature in the Czech context: the Herfindahl index – a proxy for market concentration (or market competition) in the long fixation category, and the ratio of non-performing consumer loans to total loans in the long fixation category (NPL) – a proxy for credit risk.[14] Both measures are constructed based on granular bank-level data. First, it can be seen that the quality of consumer loans with an interest rate fixation period of over 5 years has been improving dramatically since 2015. As for 2017, the ratio attained its lowest values since 2007, when the data started to be available. Both time series contain an apparent structural break: January 2012 (the Herfindahl index) and April 2015 (the NPL ratio), respectively. For the Herfindahl index, the structural break in 2012 is connected to the structural break observable in Figure 3. For the NPL ratio, the structural break in 2015 originates in the time series of the NPL ratio of one bank only.[15]

[14] The Herfindahl index is determined as the sum of the squares of the shares (in %) that individual banks in the Czech Republic attain in the market for new consumer loans in a given month. There is a well-documented inverse relationship between market concentration and market competition (Nickell et al., 1997; Dilling-Hansen et al., 2003).

[15] We omit this bank from our analysis.

3.2 Hypotheses

We formulate two major hypotheses. Hypothesis #1 is connected to the topic of distributional dynamics for consumer loans in the long fixation category. Hypotheses #2 relates to the factors driving the evolution of client rates on consumer loans in the long fixation category.

First, Figure 6 shows divergence between the mean and the mode measure since 2015 for the long fixation category. This might imply that the empirical distribution of client interest rates on consumer loans has become non-normal and has been moving to lower values in recent years. Therefore, in Hypothesis #1, we aim to explore whether or not the empirical distribution has shifted in recent years.

Hypothesis #1: The empirical distribution of client rates on consumer loans in the long fixation category has not shifted in recent years.

We conduct an analysis of the distributional dynamics of consumer loans in the long fixation category both at the aggregate level and at the level of individual banks. The latter, more granular analysis should reveal if the shifts in the empirical distribution to lower values are present for only a few banks or if there has been a common trend.

Second, we aim to examine the factors behind the evolution of client rates on consumer loans in the long fixation category. In particular, we revisit the issue of monetary transmission to rates on consumer loans. As reviewed in Section 2, there is very limited evidence on the interest rate pass-through from market rates to client rates on consumer loans in the Czech context. Nevertheless, the international literature typically shows that the pass-through to rates on consumer loans exists and is low and slow (De Graeve et al., 2007; Egert and MacDonald, 2009; Aristei and Gallo, 2014; Gropp et al., 2014). Also, we ask if credit risk (proxied by the ratio of non-performing consumer loans to total loans) and market concentration (proxied by the Herfindahl index) play a role. Horváth and Podpiera (2012) suggest that these two factors should be considered in future research on consumer loans. Finally, the association between rates on consumer loans and market competition is examined by Van Leuvensteijn et al. (2013), who find that greater market competition reduces interest rate spreads. Thus, in Hypothesis #2, we ask whether or not the factors mentioned above – market interest rates, credit risk, and market concentration – have some impact on the evolution of interest rates on consumer loans in the long fixation category.

Hypothesis #2: There are no statistically significant factors of client rates on consumer loans.

We assess Hypothesis #2 using a bank-level analysis of the Czech banking sector. We distinguish between estimates for the mean and the mode measure, as they might provide different conclusions, based on Figure 6. Moreover, the mode measure in fact enables us to explain the distributional dynamics described in Hypothesis #1 should the data be non-normal. We test for both hypotheses using the methods presented in the following Section 4.

4. Methodology

As we test two qualitatively different hypotheses, we need two modeling approaches. First, to describe the distributional dynamics of consumer loans, we employ kernel density estimation. Second, to examine the factors affecting interest rates on consumer loans at the bank level, we apply the bootstrap-corrected fixed effects model for dynamic panel data of De Vos et al. (2015).

4.1 Kernel Density Estimation

Kernel density estimation is used to approximate the density of a random variable based on a given set of data. As it is commonly used in practice, we do not review it here and refer to Greene (2003). In order to apply the kernel density estimation technique, we need to transform our dataset.[16] First, we round the gross volume in each interest rate interval to the nearest integer.[17] Second, we multiply this rounded number by the mean interest rate in the particular interval and generate *Rounded volume*∗*Mean interest rate* data points for each month in our sample.[18] Finally, we estimate the density function in each month using the data generated. In other words, as a result of the transformation, our original dataset is expanded – assuming data on *Rounded volume* as frequency weights, we obtain a sample consisting of data points on *Mean interest rate* only.[19]

An important feature of kernel density estimation is the choice of bandwidth. Our procedure is as follows: we first automatically estimate the bandwidth for each period using Silverman's rule of thumb (Silverman, 1986). Then, in order to obtain smooth transitions in the density estimates over time, we repeat the kernel exercise with the median value of the bandwidth from the original estimation. This assumption seems reasonable, as the final kernel density estimates generally reproduce well the information about the shape of the distribution in the data from the SNOB database.

4.2 The Dynamic Panel Data Model and the Estimation Framework

We analyze the factors of client rates on consumer loans in the long fixation category in the spirit of Brůha (2011) and Horváth and Podpiera (2012). Similarly to Hainz et al. (2014), we use dynamic panel data estimation. We associate the current value of a client rate on consumer loans with the current value of (i) the market interest rate to examine if there is any evidence of pass-through from market rates to client rates on consumer loans, (ii) the variable controlling for credit risk, (iii) the Herfindahl index as a measure of market concentration (or market competition), and (iv) the lagged value of the client rate on consumer loans itself to account for its persistence. Our baseline model can be formulated as follows:

$$consrate_{i,t} = \alpha_i + \beta_1 \cdot consrate_{i,t-1} + \beta_2 \cdot marketrate_t + \beta_3 \cdot defrate_{i,t} + \beta_4 \cdot Herfindahl_t + \varepsilon_{i,t}, \quad (1)$$

where *consrate* stands for either the mean or the mode measure, *marketrate* is the 7-year interest rate swap – a proxy for monetary policy, $defrate$ is a proxy for credit risk, defined as $defrate_{i,t} = \Delta NPL_{i,t+12}$, $Herfindahl$ is a proxy for market concentration (market competition), and ε denotes a white noise process. The values of the indicator of market concentration and the proxy for monetary policy are the same for all banks, while the values of the mean, the mode measure, and the default

[16] Table 1 shows that the data from the SNOB database are in fact provided in the form of a dependent variable (the volume of consumer loans in each interest rate interval) and an independent variable (the range of interest rates corresponding to a particular interval or the mean value in the particular interval). Note that such data are suitable for a curve-fitting exercise – both the dependent and the independent variable are specified.

[17] In Table 1, we round the figure of CZK 173.9 million in the 1.01%–2.00% interval to CZK 174 million.

[18] Continuing with the example using Table 1, this means that we generate 174 data points having the value 1.82.

[19] An alternative to our approach would be to estimate a density function based on interval-censored data, similarly to Braun et al. (2005). However, this approach would neglect the information on the mean interest rate in each interest rate interval.

rate in the long fixation category differ at the level of individual banks. Summary statistics of the variables used in our baseline model are shown in Table A1.[20]

Note that our model can also be seen from the following perspective. We aim to explain the variation in the client interest rate based on the variation in the risk-free rate (IRS7Y – a proxy for monetary policy), the risk premium component (the default rate – a proxy for credit risk), and the mark-up component (the Herfindahl index – a proxy for market competition).

As our modeling framework, we employ the bootstrap-corrected fixed effects method for dynamic panel data.[21] This method is an alternative to the established generalized method of moments (GMM) estimators, as it also mitigates the endogeneity problem arising from the inclusion of the lagged dependent variable (Kiviet, 1995). Based on De Vos et al. (2015), this method is suitable for our panel with relative few cross-sectional units (N = 11 banks) but a large number of time units (T = 132 months). In other words, if the ratio $\frac{N}{T}$ is close to 0, the bias stemming from the inclusion of a lagged dependent variable is small. In contrast, the GMM dynamic panel data estimators require both T to be small and N to be large (Bridges et al., 2014; Hayakawa, 2015). This condition is clearly not satisfied in our case. Furthermore, the bootstrap-corrected fixed effects estimator requires all the explanatory variables (except for the lag of the dependent variable) to be strictly exogenous.[22]

Next, we need to decide on the time span of our analysis. As data on the NPL indicator are available only since 2007, our sample period spans from January 2007 to December 2017, constituting 132 observations in total. Furthermore, we need to address the issue of an apparent structural break in the series of the Herfindahl index in January 2012, as shown by Figure 7. We also revealed earlier that this structural break is connected to the structural break in the volumes of consumer loans from Figure 3. Both structural breaks pertain to the fact that some banks started to report large volumes of new consumer loans in the long fixation category in January 2012. Moreover, similar volumes had been reported for these banks until December 2011 in the short fixation category (up to 1 year). Therefore, we decided to split our sample period into two spans: (i) from January 2007 to December 2011, and (ii) from January 2012 to December 2017. We opted for this step also because the Herfindahl index is the same for all banks in our bank-level analysis.

5. Results

We proceed in the following way in presenting our results. First, we show our findings about the distributional dynamics both at the aggregate level (the entire banking sector) and at the level of

[20] The values of 0 for the mode measure can be explained as follows: one bank did indeed provide the majority of its new consumer loans in the long fixation category without charging any interest, even for several months in a row.

[21] We do not use the pooled mean group estimator – unlike Horváth and Podpiera (2012) and Havránek et al. (2016) – for two reasons. First, we test our variables for the presence of a unit root using the Fischer test, as we have an unbalanced panel. For all the variables in our sample, we can reject the null hypothesis that all the panels contain a unit root. The p-values are virtually zero when we use any of the Inverse chi-squared, Inverse normal, Inverse logit, and Modified inverse chi-squared statistics available in Stata. Second, even if the variables were non-stationary and cointegrated, we could not use the pooled mean group estimator, as it can only be employed for panels with a similar number of cross-sectional units and time periods (Horváth and Podpiera, 2012).

[22] Moreover, the White test indicates that there is heteroskedasticity in our dataset. Therefore, error draws from the normal distribution with estimated heterogeneous (cross-section specific) variance are used by implementing the Stata package *xtbcfe*. For each estimation, 800 iterations are used. For more details on the methodology, see De Vos et al. (2015).

individual banks. Second, we display our estimation results for factors of client rates on consumer loans using bank-level data.

5.1 Distributional Dynamics of Client Rates on Consumer Loans

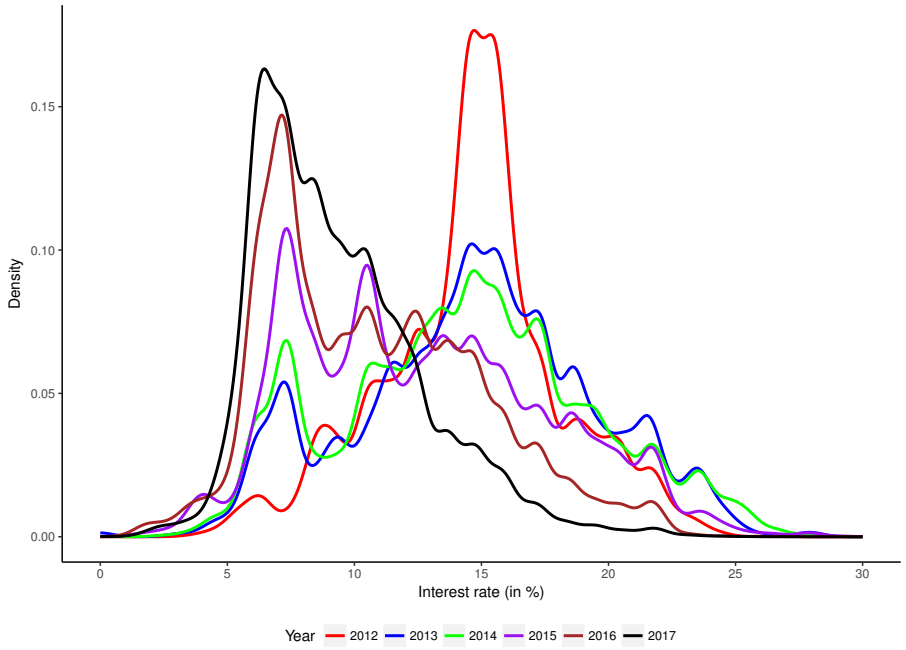
In Figure 6, we show that the mode measure has attained lower values than the mean measure at least since 2015. This suggests that the distribution of client rates might have been shifting to lower values, as stated in Hypothesis #1. In other words, it is likely that banks have started to provide loans with lower interest rates than in the period until 2015. We assess Hypothesis #1 using Figure 8, which shows the yearly distributional dynamics in the period 2012–2017. It reveals that the distribution of client rates on consumer loans in the long fixation category has become right-skewed in recent years. It also offers a detailed insight into how the mass of the distribution has migrated from higher to lower values. The dominant mode at an interest rate of around 15% gradually started to retreat in 2013/2014 and no longer exists as of 2017. On the contrary, a mode of around 7.5% has slowly started to dominate, having significantly advanced in 2016. The year 2017 can be described as one of consolidation of recent trends. First, even more consumer loans were provided at lower interest rates, as illustrated by the right-hand side of the distribution – it shifted to lower values compared to 2016. Second, the mode at around 7.5% has become more robust than in 2016. Comparing the shape of the distribution in 2013 and 2017, we again observe a change from two peaks – a smaller one at 7.5% and a large one at around 15% – to a single dominant peak at around 7.5% in a visibly right-skewed distribution. We thus reject Hypothesis #1.

It is also useful to examine the period 2007–2011 from a similar perspective. Figure 9 reveals that in this time span, the peak of the distribution corresponded to an interest rate of around 15%. This implies that the current situation is unprecedented in comparison with both the pre-crisis and the crisis/early post-crisis period. Overall, we cannot reject Hypothesis #1, as we find that the empirical distribution of client rates on consumer loans in the long fixation category has been shifting in recent years. In other words, consumer loans with long fixation periods are cheaper than ever before. Furthermore, this situation is unprecedented in comparison with both the pre-crisis and the crisis/early post-crisis period.

Next, we ask to what extent the recent trend of consumer loans being provided at lower interest rates is general. In other words, we ask if the trend of "cheaper consumer loans" relates to a large number of banks or to a few banks only. We thus turn to the bank-level evidence on distributional dynamics, using data for ten banks in the Czech Republic in the years 2015–2017.[23] The results are captured by Figures A1–A10 in the Appendix. The aggregate trend of "cheaper consumer loans" indicated by Figures 8 and 9 is not restricted to a few banks only. Quite the opposite, for five banks, we obtain evidence of "much cheaper consumer loans" – the distribution shifts visibly to lower values (Figures A4, A5, A6, A8, and A9). Further, for three more banks, we obtain evidence of "somewhat cheaper consumer loans" – the distribution shifts marginally to lower values (Figures A1, A2, and A7). Finally, for the two remaining banks, the distribution shifted marginally to higher values in 2017 compared to 2016 (Figures A3 and A10). So, the evidence from the analysis of the distributional dynamics of bank-level data shows that the trend of providing more consumer loans with lower interest rates has been rather widespread in the Czech banking sector.

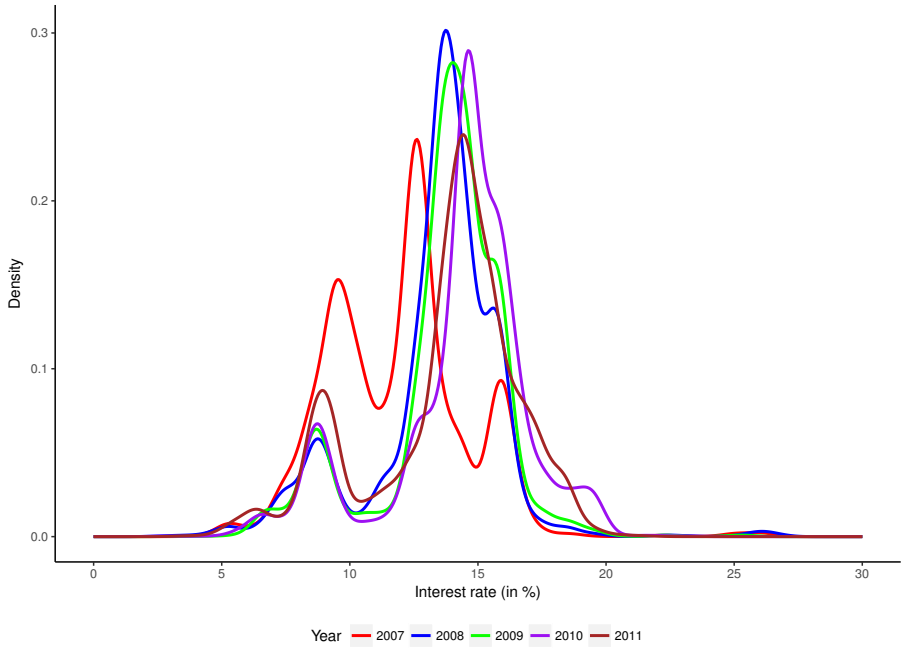
[23] We restrict the bank-level analysis to these years as some banks did not provide consumer loans with long fixation periods prior to 2015.

Figure 8: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Yearly Perspective, 2012–2017



Source: SNOB CNB, authors' calculations

Figure 9: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Yearly Perspective, 2007–2011



Source: SNOB CNB, authors' calculations

5.2 Estimation of Factors of Client Rates on Consumer Loans

In the following subsection, we analyze the determinants of client rates on consumer loans with long fixation periods using bank-level data within the specification outlined in Equation 1. As discussed earlier, we use two location measures: the mean interest rate (the mean measure) and the location of the highest mode (the mode measure) and we split our sample into two periods: 2007–2011 and 2012–2017, due to an apparent structural break in the series of the Herfindahl index (Figure 7). The estimation results for factors of client rates on consumer loans at the level of individual banks are shown in Table 2 for the period 2007–2011 and in Table 3 for the period 2012–2017.

Table 2: Factors of Client Interest Rates on Consumer Loans, Bank-level Data, 2007–2011, Baseline

	(1) Mean measure		(2) Mode measure	
	Coef.	Std. err.	Coef.	Std. err.
Mean (t-1)	0.8014***	0.0566		
Mode (t-1)			0.6803***	0.0639
IRS7Y (t)	−0.1276	0.0957	−0.1749	0.1479
Default rate (t)	−0.0761	0.1142	−0.1230	0.1777
Herfindahl (t)	−0.0011	0.0116	0.0023	0.0197
No. of observations	281		281	

Note: ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The estimation method is the bootstrap-corrected least squares estimator of De Vos et al. (2015). Standard errors are approximated with the bootstrap LSDV distribution, based on 800 replications. Explanatory variables (except for the lag of the dependent variable) are strictly exogenous, as the correlations between them and the residuals are not statistically different from zero. There is no constant in the model, as it is partialled out by the estimation method.

We summarize the results as follows. First, the location measures 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. Third, reduced market concentration (higher market competition) leads to lower client rates on consumer loans for both location measures 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. Also, CNB (2017) reports that banks in the Czech Republic providing consumer loans have been forced to reduce their mark-ups on consumer loans since 2014. Our analysis shows that higher market competition – which has reduced mark-ups on consumer loans – has contributed to a decrease of client rates on consumer loans with long fixation periods. 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 growth in the credit risk indicator has been rapid and unprecedented (Figure 7).

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

Table 3: Factors of Client Interest Rates on Consumer Loans, Bank-level Data, 2012–2017, Baseline

	(1) Mean measure		(2) Mode measure	
	Coef.	Std. err.	Coef.	Std. err.
Mean (t-1)	0.8975***	0.0384		
Mode (t-1)			0.7751***	0.0396
IRS7Y (t)	0.1614	0.1374	0.2915*	0.1739
Default rate (t)	−0.0415	0.1134	0.1896	0.1713
Herfindahl (t)	0.0572***	0.0258	0.1466***	0.0339
No. of observations	505		505	

Note: ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The estimation method is the bootstrap-corrected least squares estimator of De Vos et al. (2015). Standard errors are approximated with the bootstrap LSDV distribution, based on 800 replications. Explanatory variables (except for the lag of the dependent variable) are strictly exogenous, as the correlations between them and the residuals are not statistically different from zero. There is no constant in the model, as it is partialled out by the estimation method.

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. One can also discuss the size of the coefficients and their relationship to the literature which works with terms such as (short-run, long-run) pass-through. 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; Egert and MacDonald, 2009; Aristei and Gallo, 2014; Gropp et al., 2014). However, taking into account the persistence of the location measures, we could claim that the "long-run pass-through" might be complete. If, ceteris paribus, IRS7Y decreases by 1 percentage point, the location of the highest mode decreases by 0.29 percentage point on average in the same time period. In the next period, the original shock to the proxy for monetary policy further reduces the mode measure by approximately 0.78*0.29 = 0.23, and so on. Specifically, we cannot reject the null hypothesis that the sum of the coefficients on the variables $Mode(t-1)$ and *IRS7Y* is statistically different from 1. Overall, we find evidence that there have been significant drivers of rates on consumer loans – mostly market competition and monetary policy – in the period 2012–2017, so we reject Hypothesis #2.

5.3 Robustness Checks

We conduct several robustness checks of our results for the period 2012–2017. They include the use of an alternative estimation strategy, reflect yet another hypothesis behind the recent drop in rates on consumer loans, and discuss the pass-through of market rates in more detail. First, we employ the system GMM estimator as an alternative modeling framework to estimate Equation 1. Although we claim that the bootstrap-corrected least squares estimator should provide a more suitable framework given the specifics of our panel, GMM estimators are widely used in the literature. Furthermore, the use of principal components analysis can significantly reduce the number of instruments (Roodman, 2009). The results of the system GMM estimation are reported in Table A2. We again find, similarly to our baseline results in Tables 2 and 3, that increased market competition is the major driver behind

the distributional dynamics of client rates on consumer loans. The market rate also has an effect, although only for the mean measure.

Next, we pursue the hypothesis that the recent fall in rates on consumer loans might be connected with the situation in the market for housing loans and mortgages. Some ways in which these two markets may interact are indicated in CNB (2017). We hypothesize that *changing* conditions in the market for housing loans and mortgages might have influenced the market for consumer loans, too. Specifically, interest rate margins on mortgages might have decreased to a level where it started to be rational for banks to turn to consumer loans to generate additional interest income. Consequently, rates on consumer loans went down and taking out a consumer loan became more appealing, but at the same time consumer loans remained a vital source of interest rate income for banks. We test this hypothesis by including the change in the interest rate margin on mortgages in Equation 1.[24] The estimation method is again the bootstrap-corrected fixed effects estimator, as in the baseline estimation. The results are shown in Table A3. Market competition remains a robust driver of the distributional dynamics of consumer loans, unlike the market rate. Moreover, we find that for the mode measure, a lower interest rate margin on mortgages is associated with lower rates on consumer loans. We thus identify an additional factor – alongside market competition – that has contributed to the shift of the distribution of rates on consumer loans to lower values recently. Moreover, the combination of findings concerning the market rate and the interest rate on mortgages might indicate that the pass-through of low market rates has materialized via the market for housing loans/mortgages.

Next, we focus on the effect of the market rate in more detail. To this end, we estimate a static model without the lagged dependent variable by means of fixed effects estimation. There are two reasons why fixed effects estimation might be preferable. First, the lagged dependent variable might carry very similar information as the market rate, at least in terms of persistence.[25] Second, as stated earlier, a lending rate can be seen as simply the sum of the risk-free rate and various risk premiums. On the other hand, the lagged dependent variable may carry additional information reflecting the menu costs banks face when setting their lending rates. Also, the dynamic model might seem preferable to the static one based on Hainz et al. (2014) and Brůha (2011), who use similar models when explaining interest rate spreads. Table A4 shows the results from the fixed effects estimation. The finding of the previous estimations about the key role of market competition is maintained. There seems to be some evidence of a link between the market rate and the client rate for the mean measure. In addition, the coefficient is close to 1, which might indicate complete pass-through, as a simple t-test does not reject the hypothesis that the coefficient on IRS7Y is equal to 1. To some extent, the results from the fixed effects estimation are similar to those from the GMM estimation – the market rate only has a statistically significant effect for the mean measure, unlike in our baseline results. This finding casts some doubt on the results from the baseline estimation about the strength of the link between the market rate and the distributional dynamics of client rates. We then add the interest rate margin on mortgages to the specification. In the case of the fixed effects estimation, the coefficient on the margin is not statistically significant (Table A5), unlike for the dynamic panel

[24] We define the interest rate margin as a weighted average of interest rate margins on mortgages with interest rates fixed for up to 1 year, from 1 year to 5 years, from 5 years to 10 years, and for over 10 years. The margin itself is constructed as the difference between the average rate on new loans for a given fixation category and the market rate. In line with Brůha (2011), we assume 6MPRIBOR, IRS3Y, and IRS7Y as the market rates for the first three fixation categories and IRS15Y for the last (over 10 years) fixation category. The weights are the volumes of new consumer loans for the given fixation category.

[25] Indeed, the lagged dependent variable and the market rate are mildly positively correlated and this correlation is statistically significant. However, including both of them in the baseline estimation does not give rise to concerns about multicollinearity.

data estimation (Table A3). Otherwise, the results for the mean measure and the market competition variable hold.

Overall, we show that in recent years, most banks in the Czech Republic have started to provide new consumer loans at unprecedentedly low client interest rates. The bank-level analysis then reveals that reduced market concentration (increased market competition) and to some extent also accommodative monetary policy and changes in the market for housing loans and mortgages have been driving this development. Our results are in line with the international literature but are novel in the Czech context.

6. Conclusions

Consumer loans constitute a significant part of the loan portfolios of the Czech banking sector, but little is known about their evolution over time and about the factors that influence client interest rates on consumer loans. The Czech literature presents only limited evidence on both of these topics. We analyze the bank-level distributional dynamics and factors of client rates on consumer loans with an interest rate fixation period of over 5 years (which we denote the long fixation category). This fixation category dominates the other two fixation categories (up to 1 year and from 1 year to 5 years) in terms of volumes of new consumer loans. At the same time, we show that client rates in the long fixation category have been falling in recent years to unprecedentedly low levels. Also, interest rate spreads – measured as the difference between the mean interest rate in a particular fixation category and the 7-year interest rate swap rate – attain similarly low values as before the global financial crisis in 2007–2008. This in our view motivates research into factors which might have facilitated this development.

In our bank-level analysis, we use data in a sample period from 2007 to 2017 and assume an alternative location measure to the mean interest rate (the mean measure) – the location of the highest mode of the empirical distribution of consumer loans (the mode measure). If the empirical distribution of client rates on consumer loans is non-normal, the mean measure is an inappropriate measure for describing the shape of the distribution. Moreover, based on the Czech literature, we identify monetary policy, credit risk, and market concentration (market competition) as potential factors which might determine the dynamics of client rates on consumer loans. As our estimation framework, we employ the bootstrap-corrected fixed effects model of De Vos et al. (2015) for dynamic panel data. This modeling approach is the most suitable one for the specifics of our panel dataset.

We obtain two types of results. First, the results on the distributional dynamics reveal that in recent years, most banks in the Czech Republic have started to provide significantly cheaper consumer loans with long fixation periods than ever before. This trend is unprecedented in comparison with the situation before the global financial crisis and the crisis/early post-crisis period. Moreover, the protracted fall in client rates has been accompanied by a steady increase in the volume of new consumer loans (Figure 3). Second, the analysis of the factors of client rates on consumer loans can help us identify which factors have been driving the shifts in the distribution of client rates on consumer loans. In this sense, we show that reduced market concentration (increased market competition) and to some extent also accommodative monetary policy and changes in the market for housing loans and mortgages have contributed to the recent protracted decrease in client rates on consumer loans. The result about the beneficial impact of lower market concentration is in line with Van Leuvensteijn et al. (2013), who claim that increased market competition leads to better conditions for customers who take out a consumer loan. Furthermore, we find some evidence of a link between market rates (as a proxy for monetary policy) and client rates on consumer loans for the mode measure using

bank-level data. These results are generally in line with the international literature on interest rate pass-through (De Graeve et al., 2007; Egert and MacDonald, 2009; Aristei and Gallo, 2014; Gropp et al., 2014). However, the link between the market rate and the distributional dynamics is not particularly robust.

Our results have implications both for monetary policy and for financial stability. Our overview of the Czech consumer loan market shows that the evolution of consumer loans is to a certain extent similar to that of housing loans and mortgages. Specifically, the volumes of new consumer loans have been increasing rapidly in recent years, surpassing the previously 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. We find that increased market competition – which puts pressure on the mark-ups of banks – has been a major driver of this development. As interest income from consumer loans accounts for a significant share of the profits of banks in the Czech Republic, continued pressure on mark-ups might pose a risk to their profitability and potentially also their capital adequacy.

References

ARISTEI, D. AND M. GALLO (2014): "Interest rate pass-through in the euro area during the financial crisis: A multivariate regime-switching approach." *Journal of Policy Modeling,* 36 (2):273–295.

BRAUN, J., T. DUCHESNE, AND J. E. STAFFORD (2005): "Local likelihood density estimation for interval censored data." *Canadian Journal of Statistics,* 33(1):39–60.

BRIDGES, J., D. GREGORY, M. NIELSEN, S. PEZZINI, A. RADIA, AND M. SPALTRO (2014): "The impact of capital requirements on bank lending." *Bank of England Working Paper No. 486.*

BRŮHA, J. (2011): "Retail credit premiums and macroeconomic developments." *CNB Financial Stability Report,* 2011:96–109.

CNB (2017): "Financial Stability Report 2016/2017." Czech National Bank. ISBN 978-80-87225-72-1

DE GRAEVE, F., O. DE JONGHE, AND R. VANDER VENNET (2007): "Competition, transmission and bank pricing policies: Evidence from Belgian loan and deposit markets." *Journal of Banking & 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." *The Stata Journal,* 15(4):986–1018.

DEN HAAN, W. J., S. W. SUMNER, AND G. M. YAMASHIRO (2007): "Bank loan portfolios and the monetary transmission mechanism." *Journal of Monetary Economics,* 54(3):904–924.

DEN HAAN, W. J., S. W. SUMNER, AND G. M. YAMASHIRO (2009): "Bank loan portfolios and the Canadian monetary transmission mechanism." *Canadian Journal of Economics/Revue canadienne d'économique,* 42(3):1150–1175.

DILLING-HANSEN, M., E. S. MADSEN, AND V. SMITH (2003): "Efficiency, R&D and ownership–some empirical evidence." *International Journal of Production Economics,* 83 (1):85–94.

EGERT, B. AND R. MACDONALD (2009): "Monetary transmission mechanism in Central and Eastern Europe: surveying the surveyable." *Journal of Economic Surveys,* 23(2):277–327.

FUERTES, A.-M. AND S. A. HEFFERNAN (2009): "Interest rate transmission in the UK: A comparative analysis across financial firms and products." *International Journal of Finance & Economics,* 14(1):45–63.

GREENE, W. H. (2003): "Econometric Analysis (5th)." *Ed.. Upper Saddle River, NJ.*

GROPP, R., C. KOK, AND J.-D. LICHTENBERGER (2014): "The dynamics of bank spreads and financial structure." *The Quarterly Journal of Finance,* 4(04):1450014.

HAINZ, C., R. HORVATH, 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. LEŠANOVSKÁ (2016): "Bank efficiency and interest rate pass-through: Evidence from Czech loan products." *Economic Modelling,* 54:153–169.

HAYAKAWA, K. (2015): "The asymptotic properties of the system GMM estimator in dynamic panel data models when both N and T are large." *Econometric Theory,* 31(3):647–667.

HORVÁTH, R. AND A. PODPIERA (2012): "Heterogeneity in bank pricing policies: The Czech evidence." *Economic Systems,* 36(1):87–108.

KIVIET, J. F. (1995): "On Bias, Inconsistency, and Efficiency of Various Estimators in Dynamic Panel Data Models." *Journal of Econometrics,* 68(1):53–78.

KOČENDA, E. AND J. VALACHY (2002): "Firm ownership structures: Dynamic development." *Prague Economic Papers,* 2002(3).

MORA, N. (2014): "The weakened transmission of monetary policy to consumer loan rates." *Economic Review-Federal Reserve Bank of Kansas City.*

NATH, H. AND K. TOCHKOV (2013): "Relative inflation dynamics in the new EU member countries of Central and Eastern Europe." *Empirical Economics,* 45(1):1–22.

NICKELL, S., D. NICOLITSAS, AND N. DRYDEN (1997): "What makes firms perform well?" *European economic review,* 41(3-5):783–796.

NIEDERMAYER, L. (2008): "Notes on the monetary transmission mechanism in the Czech economy." *BIS Paper No. 35.*

ROODMAN, D. (2009): "A Note on the Theme of Too Many Instruments." *Oxford Bulletin of Economics and Statistics,* 71(1):135–158.

SILVERMAN, B. W. (1986): *Density estimation for statistics and data analysis,* volume 26 of. CRC press.

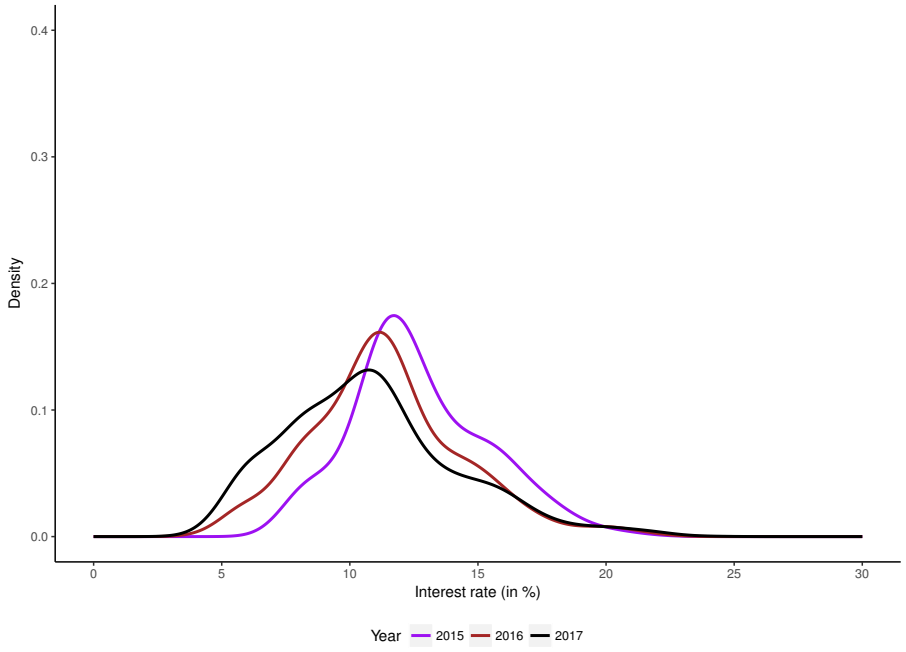
VAN LEUVENSTEIJN, M., C. K. SØRENSEN, J. A. BIKKER, AND A. A. VAN RIXTEL (2013): "Impact of bank competition on the interest rate pass-through in the euro area." *Applied Economics,* 45(11):1359–1380.

VOJTEK, M. AND E. KOČENDA (2006): "Credit-scoring methods." *Czech Journal of Economics and Finance,* 56(3-4):152–167.

WINDMEIJER, F. (2005): "A Finite Sample Correction for the Variance of Linear Efficient Two-step GMM Estimators." *Journal of Econometrics,* 126(1):25–51.

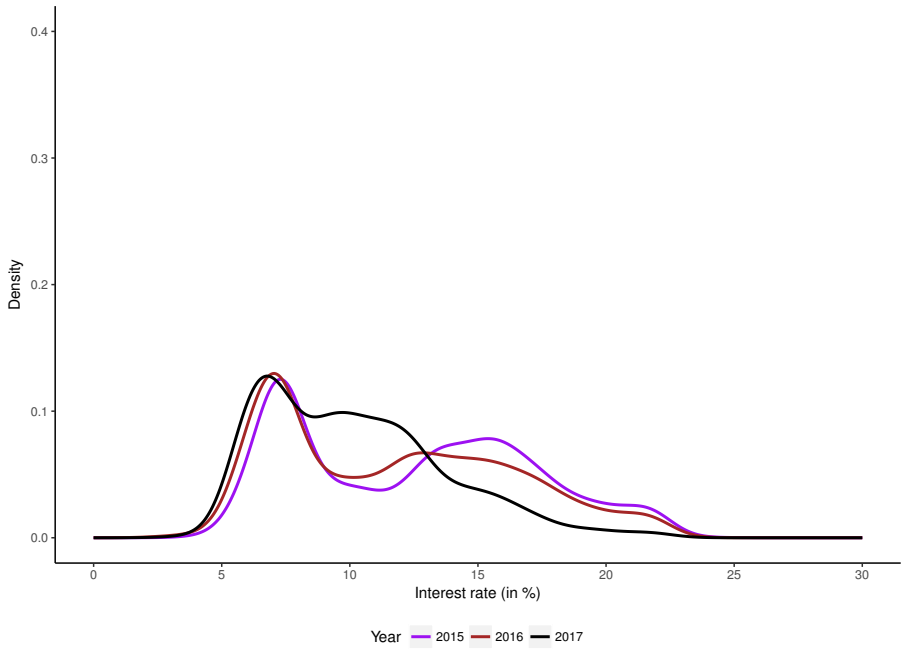
Appendix

Figure A1: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



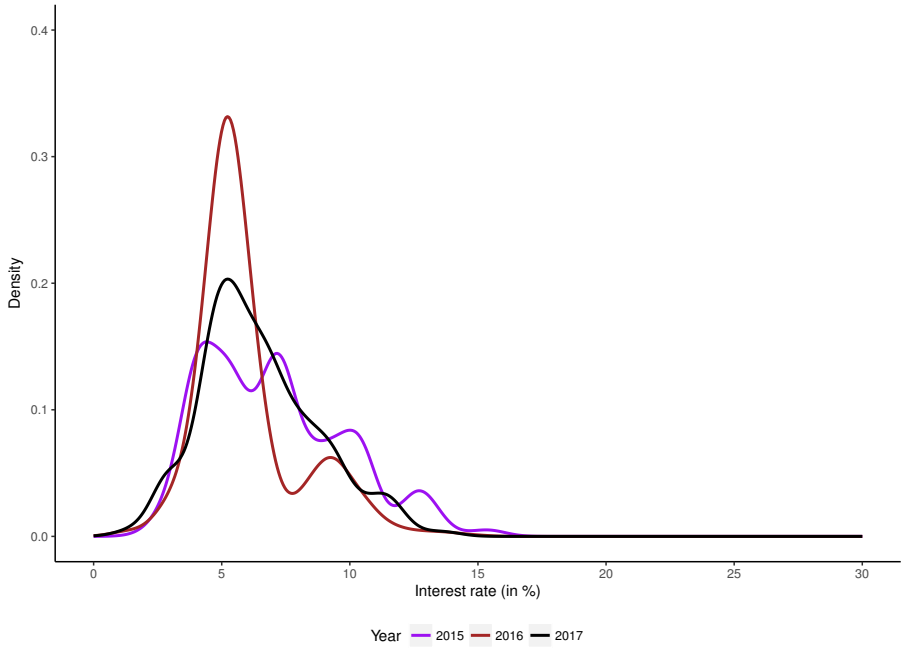
Source: SNOB CNB, authors' calculations

Figure A2: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



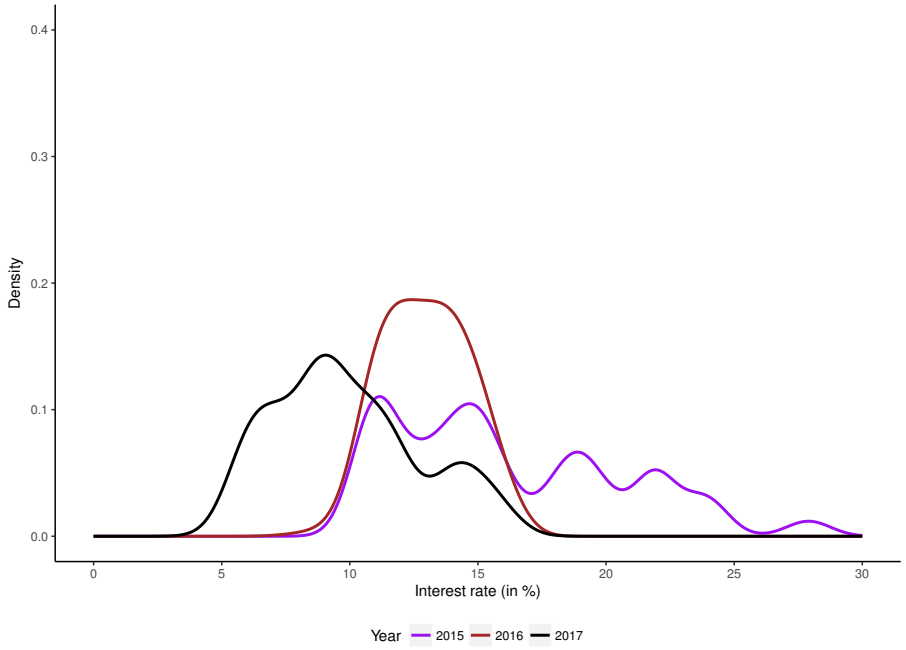
Source: SNOB CNB, authors' calculations

Figure A3: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



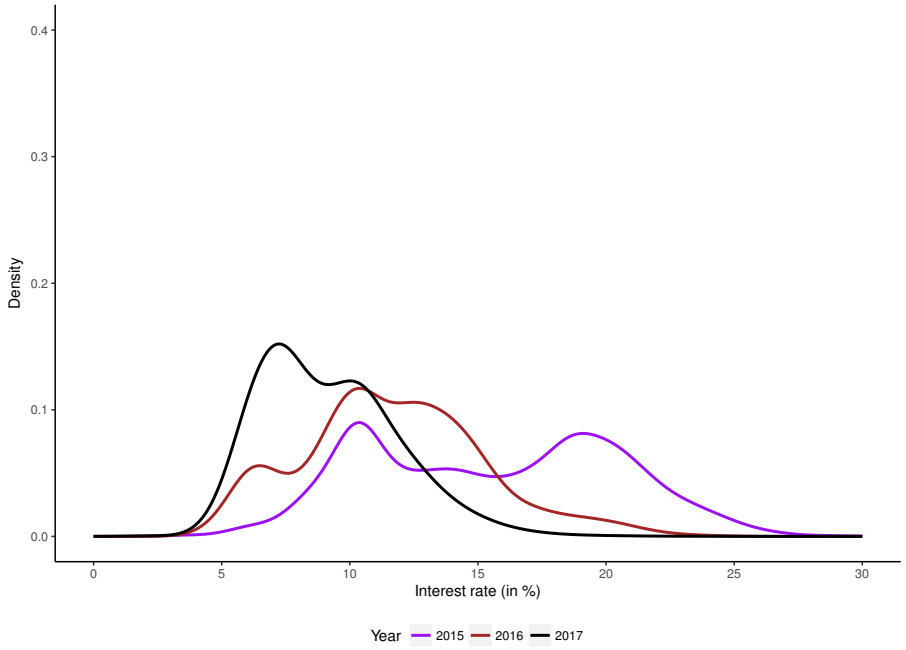
Source: SNOB CNB, authors' calculations

Figure A4: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



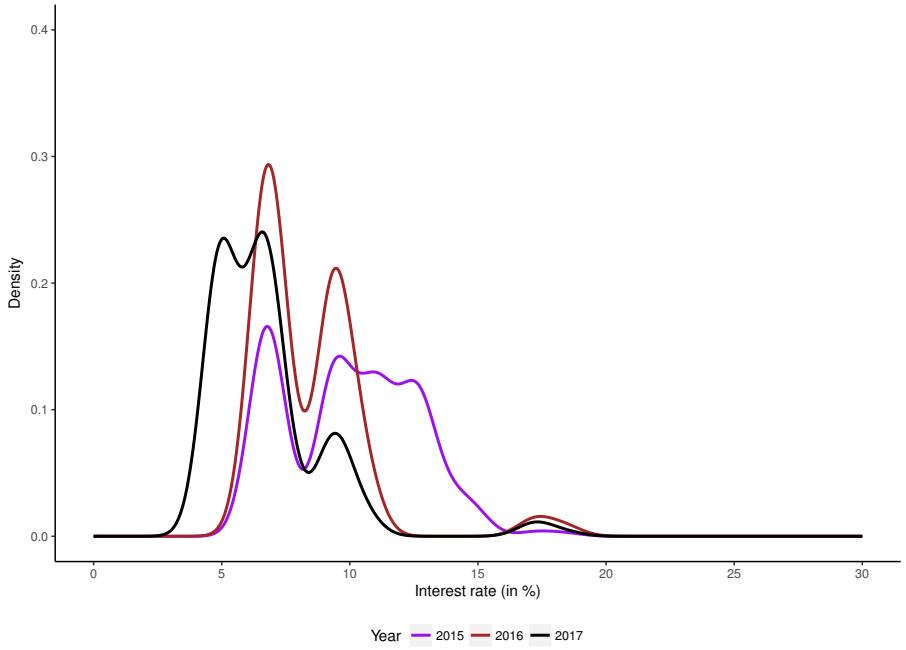
Source: SNOB CNB, authors' calculations

Figure A5: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



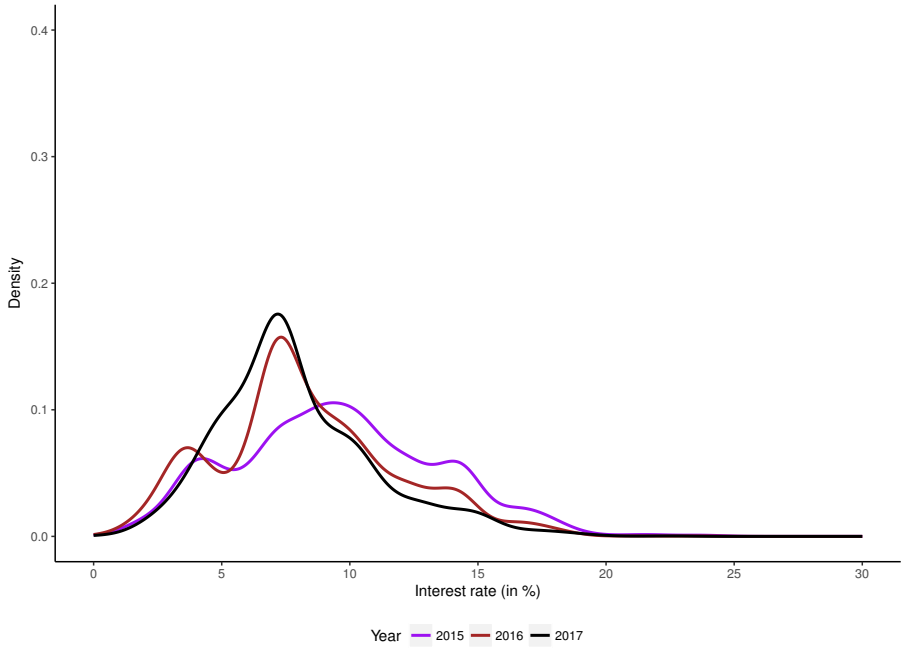
Source: SNOB CNB, authors' calculations

Figure A6: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



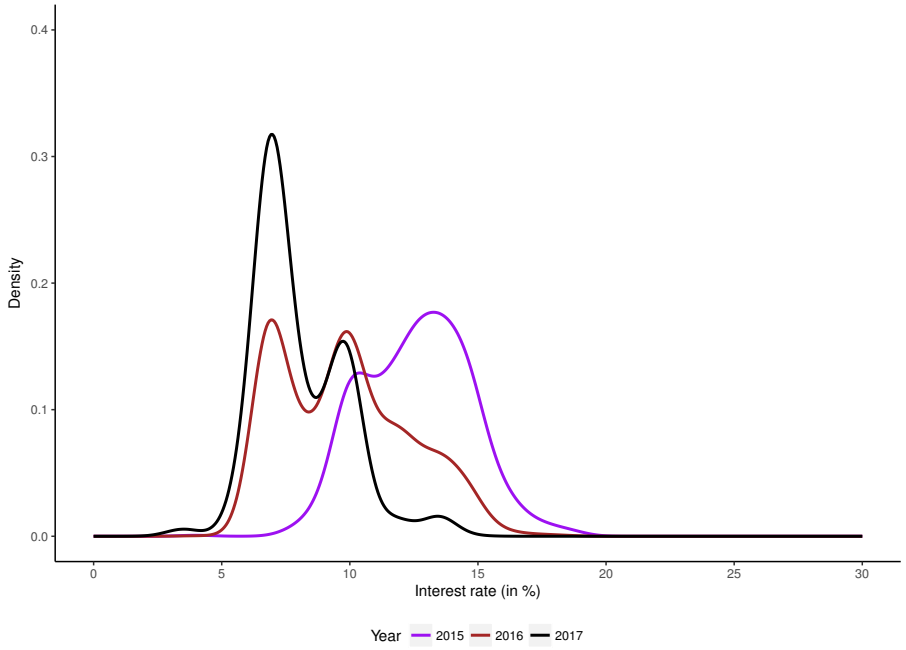
Source: SNOB CNB, authors' calculations

Figure A7: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



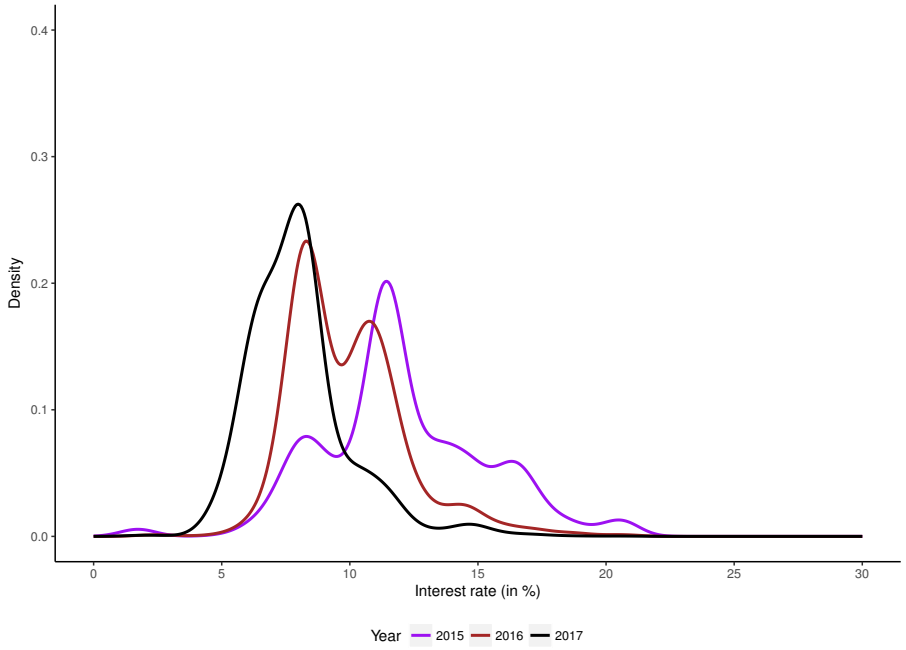
Source: SNOB CNB, authors' calculations

Figure A8: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



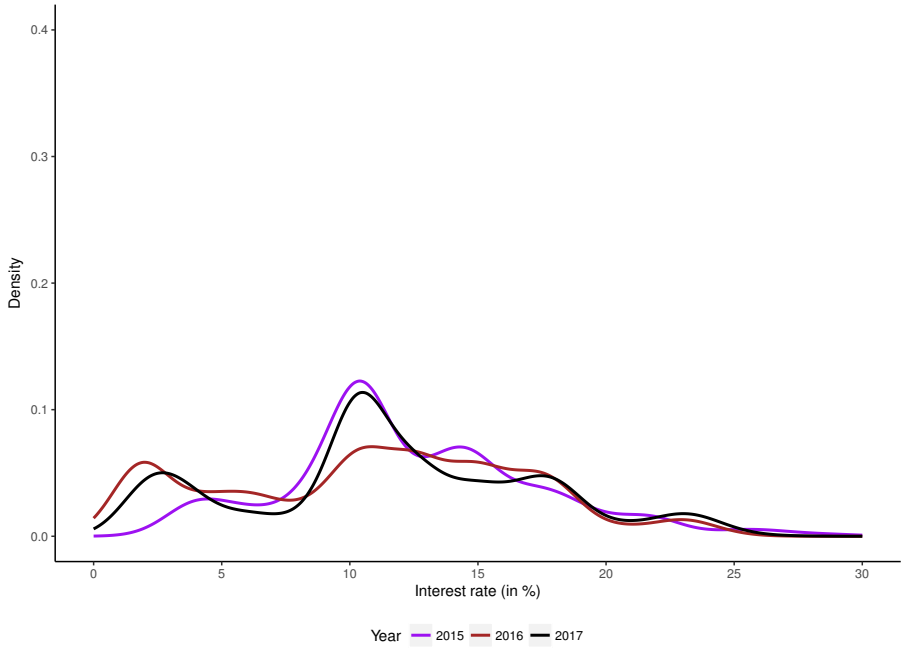
Source: SNOB CNB, authors' calculations

Figure A9: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



Source: SNOB CNB, authors' calculations

Figure A10: Distributional Dynamics of Client Rates on Consumer Loans with Long Fixation Periods, Individual Banks, 2015–2017



Source: SNOB CNB, authors' calculations

Table A1: Summary Statistics of Variables Used in the Baseline Estimation, 2007–2017

Variable	No. of observations	Mean	Std. Dev.	Min.	Max.
Mean	1007	11.23	2.84	2.70	18.86
Mode	1007	10.86	3.82	0	21.9
IRS7Y	1007	1.91	1.25	0.37	4.67
Default rate	930	0.01	5.96	-3.56	4.16
Herfindahl index	1007	39.22	17.84	22.13	74.54

Table A2: Factors of Client Interest Rates on Consumer Loans, Bank-level Data, 2012–2017, System GMM Estimation

	(1) Mean measure		(2) Mode measure	
	Coef.	Std. err.	Coef.	Std. err.
Mean (t-1)	0.9425***	0.0260		
Mode (t-1)			0.8077***	0.0771
IRS7Y (t)	0.3190**	0.1308	0.7497	0.6922
Default rate (t)	−0.0116	0.2524	−0.0336	0.5441
Herfindahl (t)	0.0102	0.0083	0.0451**	0.0227
No. of observations	505		505	
AR(2) test	0.121		0.240	
Hansen test	0.651		0.423	

Note: ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The estimation method is the system GMM estimator with instruments generated by principal component analysis. Robust standard errors are reported. Windmeijer (2005) finite-sample correction is applied to the reported standard errors. AR(2) test: Reports p-values for the null hypothesis that the errors in the first difference regression exhibit no second-order serial correlation. Hansen test: Reports p-values for the null hypothesis that the instruments used are not correlated with the residuals and hence the overidentifying restrictions are valid.

Table A3: Factors of Client Interest Rates on Consumer Loans, Bank-level Data, 2012–2017, Specification with the Interest Rate Margin on Mortgages

	(1) Mean measure		(2) Mode measure	
	Coef.	Std. err.	Coef.	Std. err.
Mean (t-1)	0.8964***	0.0377		
Mode (t-1)			0.7759***	0.0390
IRS7Y (t)	0.1331	0.1378	0.2181	0.1781
Default rate (t)	−0.0585	0.1147	0.1488	0.1726
Herfindahl (t)	0.0621**	0.0266	0.1589***	0.0352
Margin (t, difference)	0.5943	0.3980	1.5001***	0.5423
No. of observations	505		505	

Note: ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The estimation method is the bootstrap-corrected least squares estimator of De Vos et al. (2015). Standard errors are approximated with the bootstrap LSDV distribution, based on 800 replications. Explanatory variables (except for the lag of the dependent variable) are strictly exogenous, as the correlations between them and the residuals are not statistically different from zero. There is no constant in the model, as it is partialled out by the estimation method.

Table A4: Factors of Client Interest Rates on Consumer Loans, Bank-level Data, 2012–2017, Fixed Effects Estimation, No Lagged Dependent Variable

	(1) Mean measure		(2) Mode measure	
	Coef.	Std. err.	Coef.	Std. err.
IRS7Y (t)	1.2526*	0.6237	1.5500	1.0050
Default rate (t)	0.0997	0.2187	0.3131	0.2416
Herfindahl (t)	0.2758***	0.0619	0.4392**	0.1480
No. of observations	515		515	

Note: ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The estimation method is the fixed effects estimator with robust standard errors. The constant is not reported.

Table A5: Factors of Client Interest Rates on Consumer Loans, Bank-level Data, 2012–2017, Fixed Effects Estimation, No Lagged Dependent Variable, Specification with the Interest Rate Margin on Mortgages

	(1)		(2)	
	Mean measure		Mode measure	
	Coef.	Std. err.	Coef.	Std. err.
IRS7Y (t)	1.2927**	0.5640	1.6028	0.9367
Default rate (t)	0.0511	0.2994	0.3311	0.2776
Herfindahl (t)	0.2860***	0.0573	0.4497**	0.1509
Margin (t, difference)	0.3114	1.2566	0.2547	1.7196
No. of observations	515		515	

Note: ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The estimation method is the fixed effects estimator with robust standard errors. The constant is not reported.

CNB WORKING PAPER SERIES (SINCE 2017)		
6/2018	Václav Brož Michal Hlaváček	*What drives the distributional dynamics of client interest rates on consumer loans in the Czech Republic? A bank-level analysis*
5/2018	Lukáš Pfeifer Martin Hodula	*Profit-to-provisioning approach for setting the countercyclical capital buffer: The Czech example*
4/2018	Ivan Sutóris	*Asset prices in a production economy with long-run and idiosyncratic risk*
3/2018	Michal Franta	*The likelihood of effective lower bound events*
2/2018	Soňa Benecká Ludmila Fadejeva Martin Feldkircher	*Spillovers from euro area monetary policy: A focus on emerging Europe*
1/2018	Jan Babecký Clémence Berson Ludmila Fadejeva Ana Lamo Petra Marotzke Fernando Martins Pawel Strzelecki	*Non-base wage components as a source of wage adaptability to shocks: Evidence from European firms, 2010-2013*
16/2017	Oxana Babecká Kucharčuková Renata Pašalićová	*Firm investment, financial constraints and monetary transmission: An investigation with Czech firm-level data*
15/2017	Václav Brož Lukáš Pfeifer Dominika Kolcunová	*Are the risk weights of banks in the Czech Republic procyclical? Evidence from wavelet analysis*
14/2017	Jan Babecký Kamil Galuščák Diana Žigraiová	*Wage dynamics and financial performance: Evidence from Czech firms*
13/2017	Peter Claeys Bořek Vašíček	*Transmission of uncertainty shocks: Learning from heterogeneous responses on a panel of EU countries*
12/2017	Michal Dvořák Luboš Komárek Zlatuše Komárková Adam Kučera	*Longer-term yield decomposition: An analysis of the Czech government yield curve*
11/2017	Jan Brůha Michal Hlaváček Luboš Komárek	*House prices and household consumption: The case of the Czech Republic*
10/2017	Jan Brůha Oxana Babecká Kucharčuková	*An empirical analysis of macroeconomic resilience: The case of the great recession in the European Union*
9/2017	Simona Malovaná Dominika Kolcunová Václav Brož	*Does monetary policy influence banks' perception of risks?*
8/2017	Simona Malovaná	*Banks' capital surplus and the impact of additional capital requirements*
7/2017	František Brázdik Michal Franta	*A BVAR model for forecasting of Czech inflation*
6/2017	Jan Brůha Moritz Karber Beatrice Pierluigi	*Understanding rating movements in euro area countries*

	Ralph Setzer	
5/2017	Jan Hájek Roman Horváth	*International spillovers of (un)conventional monetary policy: The effect of the ECB and US Fed on non-Euro EU countries*
4/2017	Jan Brůha Jaromír Tonner	*An exchange rate floor as an instrument of monetary policy: An ex-post assessment of the Czech experience*
3/2017	Diana Žigraiová Petr Jakubík	*Updating the ultimate forward rate over time: A possible approach*
2/2017	Mirko Djukić Tibor Hlédik Jiří Polanský Ljubica Trajčev Jan Vlček	*A DSGE model with financial dollarization – the case of Serbia*
1/2017	Michal Andrle Miroslav Plašil	*System priors for econometric time series*

CNB RESEARCH AND POLICY NOTES (SINCE 2017)

1/2017	Mojmír Hampl Tomáš Havránek	*Should inflation measures used by central banks incorporate house prices? The Czech National Bank's approach*
2/2017	Róbert Ambriško Vilma Dingová Michal Dvořák Dana Hájková Eva Hromádková Kamila Kulhavá Radka Štiková	*Assessing the fiscal sustainability of the Czech Republic*

CNB ECONOMIC RESEARCH BULLETIN (SINCE 2017)

May 2018	*Risk-sensitive capital regulation*
November 2017	*Effects of monetary policy*
May 2017	*Trade and external relations*

Czech National Bank
Economic Research Division
Na Příkopě 28, 115 03 Praha 1
Czech Republic
phone: +420 2 244 12 321
fax: +420 2 244 12 329
http://www.cnb.cz
e-mail: research@cnb.cz
ISSN 1803-7070