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# What Drives the Distributional Dynamics of Client Interest Rates on Consumer Loans in the Czech Republic?*

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*Abstract*

*We study determinants of the bank-level distributional dynamics of client interest rates on consumer loans in the Czech Republic in the recent period 2014–2019 when banks started to provide new consumer loans at very low interest rates. We build on the relevant literature in terms of the selected explanatory variables as well as the methodological approach and use regulatory data that enable us to work with the mean, median and the mode of the distribution of client interest rates on consumer loans. We show that development of the market rate, the NPL ratio as well as the unemployment rate facilitated the observed distributional dynamics. Further, using a variety of variables on market competition/market concentration, our analysis reveals that the role of this determinant is limited at best. Our results, especially regarding the pass-through from market rates to consumer loan rates, are mostly in line with the international literature but are novel in the Czech context.*

## 1. Introduction and Motivation

In this paper, we focus on determinants of distributional dynamics of client rates on consumer loans in the Czech Republic in recent years (2014–2019). The topic of consumer loans in the Czech Republic is under-researched as analyses of individual segments of the Czech loan market 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). However, it deserves renewed attention in the wake of the continuing expansion of the Czech economy (CNB, 2018).[1]

From the policy perspective, there are several reasons why it is important to study the evolution and determinants of client interest rates on consumer loans and their distributional dynamics. First, given their higher non-performing loans (NPL)

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[1] Consumer loans constitute around 7% of the total stock of loans and 14% of the total stock of household loans as of January 2019. Moreover, new consumer loans account for 10% of all new loans and non-performing consumer loans account for around 27% of all household non-performing loans.

ratio, such loans are a major source of credit risk for providers of consumer loans. This credit risk is amplified by the fact that consumer loans tend to display a higher loss given default (LGD) at any given probability of default (PD), as they are not collateralized. Second, given that interest rates on consumer loans are higher than those on other sorts of loans, consumer loans account for a large part of commercial banks' margins and thus contribute to their interest income.[2] Nevertheless, the decline in client interest rates on consumer loans has been a major driver of the recent fall in banks' margins (CNB, 2017). Third, given that consumer loans are taken out more frequently by lower-income households, they can have a greater influence on the balance sheets, overindebtedness, solvency, and consumer behavior of households themselves.[3] Repayment difficulties can affect consumer credit providers more quickly than e.g. providers of loans for house purchase. Fourth, following the implementation of the Czech National Bank (CNB)'s Recommendation on the management of risks associated with the provision of retail loans secured by residential property[4], there is also a debate about whether some consumer loans are being provided in order to circumvent the loan-to-value (LTV) limit (CNB, 2018).

The contribution of the paper is constituted in the bank-level analysis of determinants of the distributional dynamics of client interest rates on consumer loans in the Czech Republic. Such an analysis has not been conducted previously and could serve as a useful policy exercise for authorities (regardless if for monetary policy or financial stability purposes) that have similar data at their disposal. We use detailed regulatory data on the empirical distributions of client interest rates on consumer loans in the sample period from 2014 to 2019.[5] In the explanatory data analysis we show that in the recent years (i) the empirical distribution of client rates on consumer loans has become right-skewed, unlike in any previous period for which data are available, (ii) this trend pertains to most banks that provide consumer loans in the Czech Republic, (iii) consumer loans are most frequently provided with the maturity over 5 years.

Next, based on the literature review, we identify several determinants that can explain the recently observed distributional dynamics of client interest rates on consumer loans. These are (i) the cost of funds that can be influenced by monetary policy (De Graeve et al., 2007; Brůha, 2011; Havránek et al., 2016), (ii) changes in the underlying credit risk (Horváth and Podpiera, 2012; Gregor and Melecký, 2018), (iii) market concentration/competition in this segment (Havránek et al., 2016; Gregor and Melecký, 2018), or (iv) macroeconomic variables such as the unemployment rate (Hainz et al., 2014). The literature review also suggests the use of error correction

[2] The high consumer credit rates are also due to higher expected losses on consumer loans. The effect of the higher margins on such loans on operating profits is thus partly offset by higher risk costs and provisioning.

[3] According to the Czech Statistical Office's Household Budget Survey, the average income of households with consumer or similar loans is 91% of that of households with mortgage loans. Brůha et al. (2017) meanwhile find that debt servicing has a negative effect on household consumption.

[4] For more information on the Recommendation, please see https://www.cnb.cz/en/financial-stability/macroprudential-policy/recommendation-on-the-management-of-risks-associated-with-the-provision-of-retail-loans-secured-by-residential-property/.

[5] We analyze new consumer loans rather than the stock of consumer loans. This is standard in the literature, as client interest rates on new loans reflect changes in the economic environment faster than client interest rates on the stock of consumer loans (Égert and MacDonald, 2009; Aristei and Gallo, 2014).

models if possible. We show that our data are cointegrated in the sample period from 2014 to 2019 and the use of the pooled mean group estimator is warranted, unlike in previous studies such as Horváth and Podpiera (2012) or Havránek et al. (2016). Thus, we are the first authors that bring forth valid estimation results on the interest rate pass-through for consumer loans in the Czech Republic.

To obtain comprehensive assessment of the research objective, we employ three types of location measures – the mean interest rate, the median interest rate and the mode interest rate which corresponds to the location of the highest mode (global maximum) of the density function of consumer loans. To ensure robustness of our results, we also assume alternative variables for market concentration/competition, including the Boone indicator (Boone, 2001).

The paper has the following structure. In the second section, we summarize the body of literature focusing on client interest rates on consumer loans and in particular on methodological approaches for analyses of their determinants. 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 main empirical method. 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 summarize which determinants could be reasonably assumed to influence on distributional dynamics of consumer loan rates.[6] Also, we review methodological approaches towards analyzing determinants of client interest rates on consumer loans.

From the methodological point of view, approaches based on the error correction model are recommended by the relevant literature. This technique, however, requires data on both client rates on consumer loans and market rates to be non-stationary and cointegrated (De Graeve et al., 2007; Horváth and Podpiera, 2012; Aristei and Gallo, 2014; Havránek et al., 2016). If these conditions are not met, an alternative approach are dynamic panel data estimators such as a system generalized method of moments (GMM) estimator (Hainz et al., 2014).

The literature mentions monetary policy as the most common factor in both the Czech and in the international context. However, some studies also introduce other factors – apart from monetary policy – which might influence client rates on consumer loans.

Basically, there are two ways how to conceptually capture the interest rate pass-through, i.e. the link between monetary policy rates and client rates – the monetary policy and the cost of funds approach (Égert and MacDonald, 2009). While the former assumes a relationship between a monetary policy rate and a client rate (without an intermediate effect of monetary policy on money market rates), the latter

[6] At the same time, to the best of our knowledge we are the first authors to study the distributional dynamics of client rates on consumer loans. 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) focus on 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.

stresses the term-structure dimension of interest rates and zooms in on the link between the market and the client rate. Crucially, market rates are assumed to be influenced by monetary policy but this relationship is not explained (Figure 2 in Égert and MacDonald, 2009). In practice, the cost of funds approach requires that client rates on consumer loans (with a certain interest rate fixation period) are related to money market rates of comparable maturity (De Graeve et al., 2007; Brůha, 2011; Havránek et al., 2016).

In the Czech context, the literature on the interest rate pass-through is somewhat limited. This stems from the fact that client rates on consumer loans are typically not found to be cointegrated with market or monetary policy rates (Horváth and Podpiera, 2012; Havránek et al., 2016; Gregor and Melecký, 2018). Horváth and Podpiera (2012) attribute this result to a dominant role of credit risk and considerable market concentration in pricing of consumer loans. Similarly, Havránek et al. (2016) state that "*consumer loan rates seem to be driven by factors other than market interest rates*". A similar view is shared by Gregor and Melecký (2018) who do not find evidence for a stable pass-through of the repo rate to a client interest rate on consumer loans. Next, Brůha (2011) notes that interest rate spreads of consumer loans barely respond to the business cycle. This is in contrast with the findings of Hainz et al. (2014) who show that unemployment rate exhibits some impact on the interest rate spreads of consumer loans. The effect of credit risk variables on client rates on consumer loans is advocated by Hainz et al. (2014) for the crisis period (2008–2011) and by Gregor and Melecký (2018) who illustrate that an increase in a credit risk indicator translates into a higher premium of client rates on consumer loans over the repo rate in the period 2004–2017.

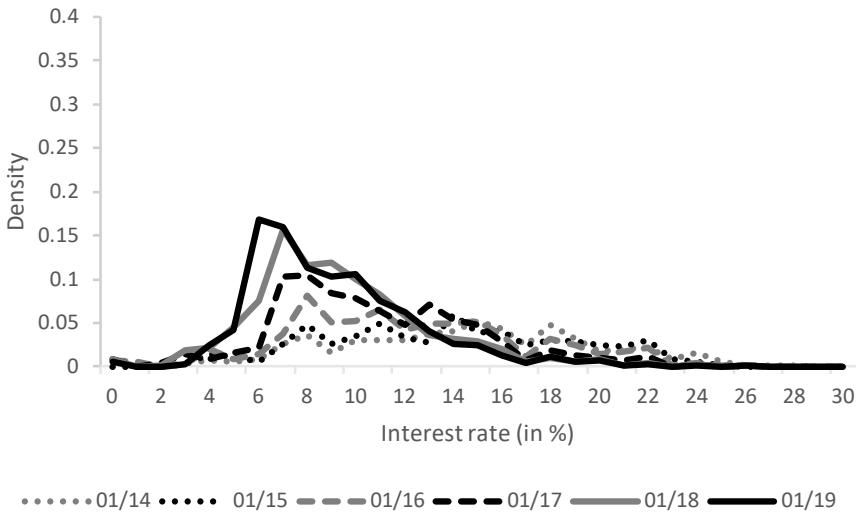
In the international context, several studies conclude that the interest rate pass-through to consumer loans is low and slow, both in the pre-crisis and the crisis period. In the pre-crisis period, Égert and MacDonald (2009) show this for the countries of Central and Eastern Europe (CEE) while De Graeve et al. (2007) and Gropp et al. (2014) deliver similar results for Belgium and the euro area, respectively. Next, Aristei and Gallo (2014) report that both the short-run and the long-run pass-through to rates on consumer loans in the euro area is significantly lower than 1 in the crisis period. The authors therefore claim that monetary authorities are unable to adequately affect rates on consumer loans as a result of a substantial market power of banks that exert sizable risk premia in the consumer loans segment. A related conclusion is presented in Van Leuvensteijn et al. (2013) who 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 between banks leads to lower risk premia on consumer loans.

To summarize, the covered literature advises to consider variables that reflect that the price of a consumer loan is composed of a risk-free rate (influenced by monetary policy) and a mark-up (potentially driven by market concentration or market competition) which also includes a risk premium (which is likely related by the asset quality of the consumer loan portfolio). Among other variables that might be considered, the use of a proxy for macroeconomic development is recommended.

## 3. Data, Variables, Hypotheses

In our analysis, we use monthly data on the consumer loans and their interest rates of banks in the Czech Republic from supervisory databases maintained by the Czech National Bank (CNB). Our sample period spans from January 2014 to January 2019, constituting 61 observations in total.

**Figure 1 Distributional Dynamics of Client Interest Rates on Consumer Loans (2014–2019, Aggregate Level)**




*Notes:* The x axis shows the levels of interest rates while the y axis shows the percentage of volume of new consumer loans in an interval of a length of 1 percentage point. The empirical distribution is plotted in a given month.

The choice of the sample period is given by the aim to explore the determinants of recent distributional dynamics of client interest rates on consumer loans. Figure 1 shows that in the period starting in January 2014, the aggregate (i.e. using data for the entire banking sector) empirical distribution of client rates on consumer loans has been gradually shifting towards lower values. A similar picture is conveyed if we distill from the distributional data three location measures – mean, median, and mode (Figure 2). All of the location measures have been decreasing for most of the period 2014–2019, before somewhat levelling off towards the end of the sample. Figures A1 and A2 then reveal that the recent development is unprecedented in comparison with the period 2004–2013 and that banks in the Czech Republic have been providing consumer loans for lowest interest rates on record in recent years.

**Figure 2 Location Measures (2004–2019, Aggregate Level)**

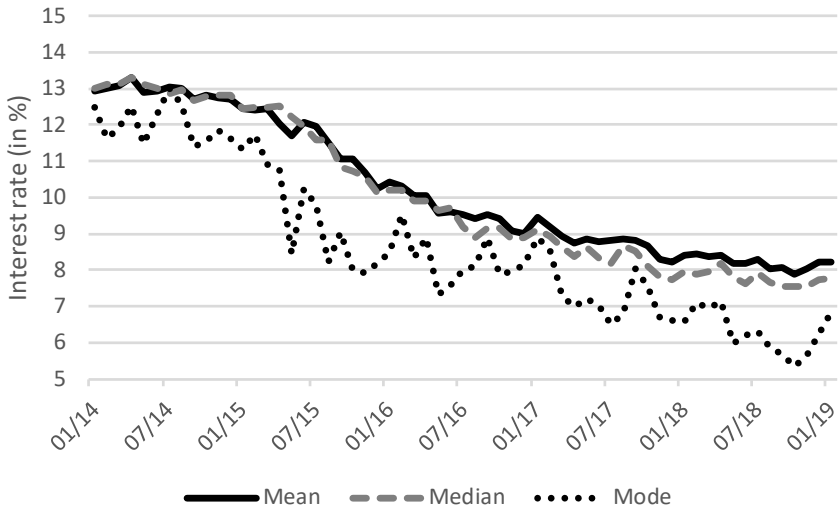
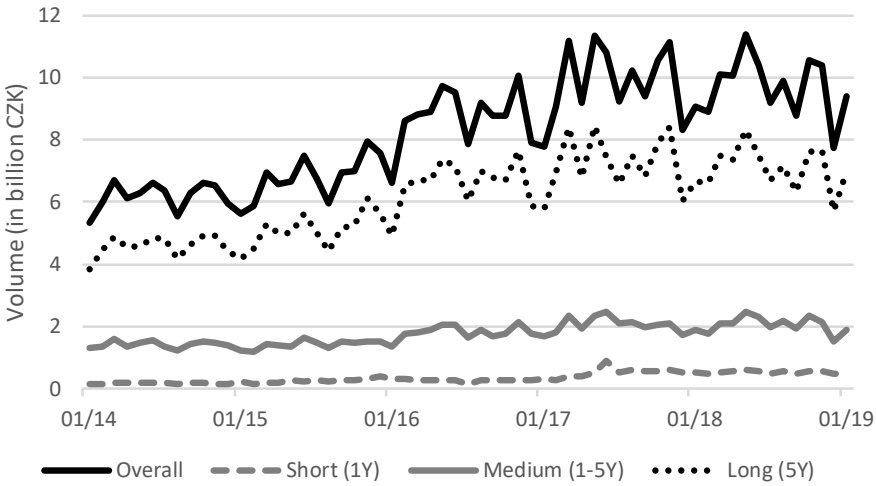



**Figure 3 Volume of Consumer Loans (2004–2019, Various Fixation Categories)**

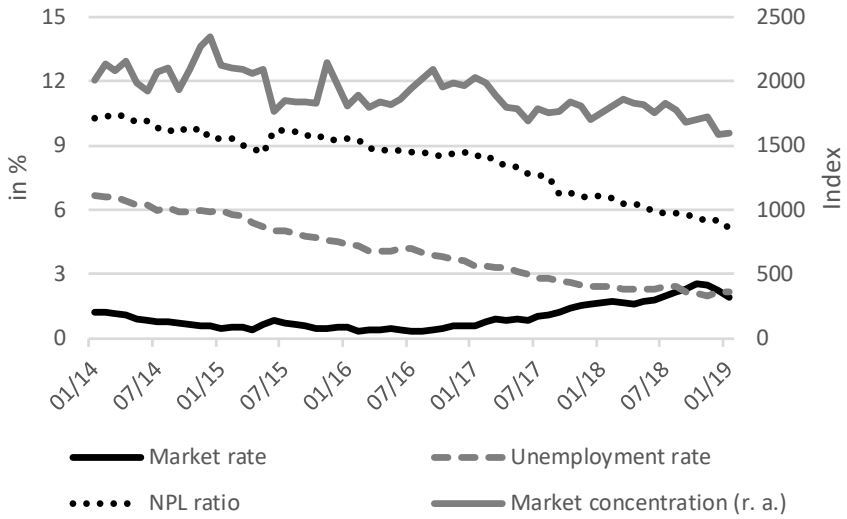



In the empirical analysis that will attempt to uncover the determinants of these distributional dynamics, we will work with data on 11 banks in the Czech Republic that provided between 96% and 99% of all consumer loans provided by banks in the period 2014–2019. Our sample covers both universal banks and special-purpose banks focusing exclusively on consumer loans. 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. The different types of consumer loans differ considerably in terms of

risk characteristics, maturity, and interest rates. However, in case of the Czech Republic, non-specific consumer loans dominate specific-purpose (e.g. cars, electronic items, furniture) credit, by a ratio of 7:3 as for January 2019. Also, most banks have exhibited a shift of the empirical distribution of client rates on consumer loans towards lower values in recent years (Figure A3), similarly as can be deduced from the aggregate picture presented by Figure 1.

Next, we illustrate in Figure 3 that most of the consumer loans have been provided in recent years with fixation (maturity) over 5 years. On the other hand, the other two categories with shorter maturities are less important. This is in contrast with the relevant literature that claims that consumer loans have a short-term character (Sander and Kleimeier, 2004; Green and Wachter, 2005). The long-term character of consumer loans implies that the cost of funds approach might be more reasonable than the monetary policy approach in explaining the evolution of client rates on consumer loans. Also, the monetary policy rate of the Czech National Bank has been kept at zero lower bound until 2017 (Gregor and Melecký, 2018). This would arguably lead to the inability of the monetary policy rate to explain variation in the client interest rates on consumer loans.[7] The cost of funds approach is also assumed by related studies such as Brůha (2011), Horváth and Podpiera (2012) and Havránek et al. (2016).

**Figure 4 Potential Determinants of Distributional Dynamics of Client Interest Rates on Consumer Loans (2004–2019)**




Further, Figure 4 shows the evolution of four potential factors of client rates on consumer loans identified in the literature in the Czech as well as the international context corresponding to the market rate, the ratio of non-performing consumer

[7] The recent study by Gregor and Melecký (2018) opted for the monetary policy approach but could not establish a cointegration relationship between a two-week repo rate and client rates on consumer loans in the Czech Republic while also assuming recent years that are a focus of our analysis.

loans, the unemployment rate, and the market concentration variable. The market rate in constructed as a weighted average of market rates corresponding to the three fixation/maturity categories, using the classification of Brůha (2011). While assuming this approach, the maturity category under 1 year is paired with the 6M Pribor (Prague InterBank Offered Rate), the category from 1 year to 5 years with 3Y IRS (interest rate swap) and the category over 5 years with 7Y IRS. The resulting weighted average of maturities is than assigned to the closest interest swap rate.[8] All variables except for the market have been decreasing in the period 2014–2019. The unemployment rate is based on the data from the Czech Statistical Office. Both the ratio of non-performing consumer loans and the market concentration variable are computed using granular bank-level data. As the market concentration variable, we assume the Herfindahl-Hirschman index, similarly to Gregor and Melecký (2018).[9] We provide summary statistics along with definitions of all variables in Table A1.

Based on the literature both in the Czech and in the international context, all four factors could have some impact on the distributional dynamics of client interest rates on consumer loans. However, the literature in the Czech context has previously mostly failed to identify any statistical significant factors of client rate on consumer loans whatsoever (Brůha, 2011; Horváth and Podpiera, 2012; Havránek et al., 2016). Still, the recent period of significant distributional dynamics (as shown by Figure 1 and A3) invites to revisit the hypothesis about the factors driving the distributional dynamics of client interest rates on consumer loans (CNB, 2018). Thus, we formulate Hypothesis #1 as follows:

*Hypothesis #1: There are no statistically significant determinants of distributional dynamics of client interest rates on consumer loans from the set of variables identified by the literature review.*

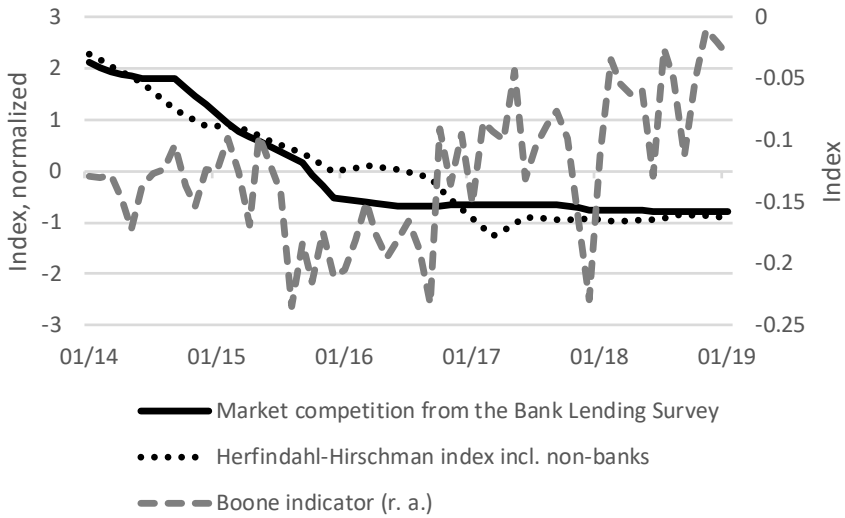
We assess Hypothesis #1 via a bank-level analysis of the Czech banking sector using the methods presented in the following Section 4. We distinguish between estimates for the mean, median, and the mode measure, as they might provide different conclusions, based on Figure 2.

Next, although some studies document an inverse relationship between market concentration and market competition (Nickell et al., 1997; Dilling-Hansen et al., 2003), this might not hold for the banking sector. According to Claessens and Laeven (2004), there is no evidence that competitiveness is negatively related to banking system concentration; the authors find that looser bank entry conditions and reduced activity restrictions on banks are the determinants of competitiveness of the banking system. This implies that we need to use a measure for market competition along with the Herfindahl-Hirschman index. Moreover, Berger et al. (2004) and Kleimeier and Sander (2017) advocate the idea of not using a single measure of bank competition to obtain more robust results.

[8] E.g. if new consumer loans of a specific bank have a fixation of 5.9 years, we assume 6Y IRS.

[9] The Herfindahl-Hirschman 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.

**Figure 5 Additional Variables for the Market Concentration and Market Competition (2004–2019)**




To increase the robustness of the results using the Herfindahl-Hirschman index[10], we use its version for the consumer loan market that is computed by the Czech National Bank and includes also concentration of the non-banking consumer loan sector. On the other hand, this measure requires interpolation as it is only provided with quarterly frequency. As for the market competition measure, we use the Boone indicator (Boone, 2001) as well as the variable capturing banks' perception of competition in the consumer loan market based on the Bank Lending Survey of the Czech National Bank. These alternative measures of market competition/market concentration are shown in Figure 5 and summary statistics are provided in Table A1. The Boone indicator is computed in line with Schaeck and Čihák (2010) at the level of individual banks. Nevertheless, it relates to all portfolios of banks in our sample, as generally, data on income and expenses are not available at a portfolio level. From Figure 5, it can be seen that the Boone indicator reveals that the Czech banking sector has become less competitive in recent years which. This is in contrast with the message for the consumer loan market conveyed by Herfindahl-Hirschman indices as well as market competition based on the Bank Lending Survey. Thus, we aim to explore how the results of the empirical analysis of determinants of distributional dynamics of client interest rates on consumer loans differ while using each of the available variables for market competition/market concentration:

*Hypothesis #2: There are no statistically significant differences of results on determinants of client interest rates on consumer loans using any of the available variables for market concentration/market competition.*

[10] Concerning the Herfindahl-Hirschman index and its reliability, see also Bos et al. (2017).

We asses Hypothesis #2 by interchanging the market concentration/market competition variable in the model presented in the next Section 4.

## 4. Methodology

As advised by the related literature covered in Section 2, we shall decide between error correction and (potentially dynamic) panel data models for the analysis that aims to explains distributional dynamics of client interest rates on consumer loans based on the properties of data concerning their (non-)stationarity.

As the error correction models are more frequently assumed and we have bank-specific data at our disposal, our intention is to use the (pooled) mean group estimator, similarly to Horváth and Podpiera (2012) or Havránek et al. (2016). The advantage of this estimator is that it allows distinguishing between long-term and short-term dynamics in explaining the determinants of distributional dynamics of client interest rates on consumer loans. Nevertheless, the primary focus of studies such as Horváth and Podpiera (2012) or Havránek et al. (2016) is to explore the existence of the interest rate pass-through between client and market rates using bank-level data. On the other hand, Gregor and Melecký (2018) use aggregate data but enrich the pass-through specification in the error correction framework using additional explanatory variables (including a variable for credit risk and market concentration), with the reference to studies such as Leroy and Lucotte (2015), Gambacorta et al. (2015), Grigoli and Mota (2017), Chileshe and Akanbi (2016) or Holton and d'Acri (2015) that also assume a set of conditioning variables in the pass-through specification. As we have regulatory bank-specific data at our disposal but assume a variety of potential determinants of distributional dynamics of client interest rates on consumer loans based on the literature review, we adopt the motivation of Gregor and Melecký (2018) and incorporate it into a framework used by Horváth and Podpiera (2012) and Havránek et al. (2016).

In order to be able to use the pooled mean group estimator, we need to conduct the following steps similarly as Havránek et al. (2016). First, we need to show that all variables that we aim to use in our analysis are non-stationary. As we have an unbalanced panel dataset at our disposal, we shall employ the Fisher test (Maddala and Wu, 1999). The core of this test is, nevertheless, composed of Augmented Dickey Fuller test. We exploit this feature of the test and before running the panel test itself, we analyze stationarity of time series for individual banks. This auxiliary analysis shows us that in the period 2014–2019, the vast majority of the time series are indeed non-stationary which is confirmed by the panel version of the test.[11]

Second, to test for cointegration of variables, we employ the Pedroni (1999) test, similarly to Havránek et al. (2016) and Van Leuvensteijn et al. (2013). Table 1 reveals the results of the test for the mean, median and mode measure – each of these variables are cointegrated with other variables (market rate, the ratio of non-performing consumer loans, the unemployment rate, the Herfindahl-Hirschman index) that we intend to use in our analysis of determinants of distributional dynamics of client interest rates on consumer loans.

[11] These results are available upon request. For testing the individual time series, we utilize the recursive lag selection of Hall (1994) and follow the testing procedure outlined in Kočenda and Černý (2015).

**Table 1 Results of the Pedroni Test, Baseline**

| Variable | *(1)* | *(2)* | *(3)* |
|---|---|---|---|
| | *Mean* | *Median* | *Mode* |
| | | **t-statistic** | |
| Augmented Dickey-Fuller | -1.85** | -5.01*** | -7.74*** |
| Modified Phillips-Perron | -1.77* | -3.27*** | -5.20*** |
| Phillips-Perron | -2.14** | -5.44*** | -6.99*** |

*Notes:* ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The null hypothesis is no cointegration while the alternative hypothesis assumes that all panels are cointegrated. The number of lags is determined by the Akaike Information Criterion, with the maximum of 12 lags (monthly data).

Third, to prefer the pooled mean group estimator over its mean group counterpart, we need to resort to the Hausman test. The pooled mean group restricts the long-run relationship to be the same for all banks in the sample, unlike the short-run dynamics that can be described by different coefficients across banks. The pooled mean group estimator is often more efficient than the mean group estimator, and the advantage gets significant when the number of panels in the data set is relatively small, which is the case with Czech data (Havránek et al., 2016). The Hausman test then explores the adequacy of the restriction on the long-run dynamics. We report its results along the estimation results in the next Section 5.

To summarize, we will estimate the error correction model via the pooled mean group estimator on data for 11 banks in the sample period 2014–2019 using the explanatory variables motivated by the literature review. The use of the chosen estimator is warranted by the fact that the data are non-stationary and cointegrated and based on the results of the Hausman test.[12] The empirical specification is as follows:

$$\Delta consrate_{i,t} = \psi \Delta mktrate_{i,t} + \theta \Delta X_{i,t} + \lambda(\Delta consrate_{i,t-1} - \beta mktrate_{i,t-1} - \gamma \Delta X_{i,t-1}) + \varepsilon_{i,t}, \quad (1)$$

where *consrate* stands for either the mean, the median or the mode measure, *mktrate* captures the cost of funds of the bank related to consumer loans and indirectly also the monetary policy stance, and the vector $X$ captures the other explanatory variables motivated by the literature review (the unemployment rate, the NPL ratio, the market concentration variable). Further, the coefficient $\lambda$ represents the speed of adjustment towards the long-run equilibrium. Should the error correction model be a reasonable specification, the estimate of this coefficient should be negative and statistically significant. Finally, parameters $\psi$ and $\beta$ describe the short-run and the long-run pass-through coefficient, similarly as in Gregor and Melecký (2018).

[12] Note that the structure of our panel (61 time period, 11 banks) does not materially differ from the one used by Horváth and Podpiera (2012) and Havránek et al. (2016).

## 5. Results

### 5.1 Baseline Results

**Table 2 Determinants of Distributional Dynamics of Client Interest Rates on Consumer Loans (2014–2019, Baseline)**

| Variable | *(1)* | | *(2)* | | *(3)* | |
|---|---|---|---|---|---|---|
| | *Mean* | | *Median* | | *Mode* | |
| | **Coef.** | **Std. Err.** | **Coef.** | **Std. Err.** | **Coef.** | **Std. Err.** |
| Long-run cointegration relationship | | | | | | |
| Market rate | 0.60*** | 0.14 | 0.69*** | 0.14 | 0.15 | 0.33 |
| NPL ratio | 0.07 | 0.07 | 0.12* | 0.06 | 0.42*** | 0.10 |
| Unemployment rate | 1.23*** | 0.09 | 1.51*** | 0.09 | 0.21 | 0.26 |
| Market concentration | -0.06 | 0.07 | -0.06 | 0.07 | 0.18 | 0.18 |
| Speed of adjustment | -0.18*** | 0.05 | -0.25*** | 0.05 | -0.38*** | 0.09 |
| Short-run dynamics | | | | | | |
| ΔMarket rate | -0.21 | 0.20 | -0.13 | 0.32 | -1.04 | 1.24 |
| ΔNPL ratio | 0.04 | 0.04 | 0.04 | 0.07 | -0.04 | 0.17 |
| ΔUnemployment rate | 0.05 | 0.16 | 0.14 | 0.32 | 0.35 | 0.61 |
| ΔMarket concentration | 0.04** | 0.02 | 0.05*** | 0.02 | 0.07 | 0.07 |
| Intercept | 0.89*** | 0.26 | 0.73*** | 0.17 | -0.27 | 0.60 |
| No. of observations | 643 | | | | | |
| Hausman test | 0.47 | | 0.41 | | 0.15 | |

*Notes:* ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The estimation method is the pooled mean square estimator of Pesaran et al. (1999) based on the reported results of the Hausman test that helps to decide between the pooled mean square and the mean square estimator.

The results of the baseline estimation are shown in Table 2 for all of the mean, the median and the mode measure. First, the results of the Hausman test indicate that the pooled mean group estimator should be indeed preferred over the mean group estimator as the p-value is higher than 0.05 – we cannot reject the null hypothesis that the restriction on the coefficients capturing the long-run dynamics is valid. Second, we note that the coefficients on the error correction component (describing the speed of adjustment of variables towards the long-run equilibrium) is negative and statistically significant at the 1% level. This ex post vindicates the choice of the error correction framework which was recommended by the literature and supported by the tests concerning the (non-)stationarity and cointegration of variables (included in the model as advised by the literature in Section 2).

Third, we note that the results are somewhat different for the three location measures. While most of the short-term coefficients are statistically insignificant, the

estimated coefficients of the long-run cointegration relationship reveal that there are some statistically significant determinants of distributional dynamics of client interest rates in the Czech Republic in the period 2014–2019. This results in a rejection of Hypothesis #1. Specifically, the market interest rate, representing the cost of funds related to consumer loans and indirectly also the monetary policy stance, affects the mean and the median client interest rate on consumer loans, which were at the same time strongly influenced also by the decreasing unemployment rate. Moreover, the median client interest rate on consumer loans was also significantly affected also the evolution of the credit risk indicator – the ratio of non-performing consumer loans to total consumer loans. This was also the case of the mode of the empirical distribution of client interest rates on consumer loans while there were no other statistically significant determinants of the evolution of this measure.

Overall, if we assume the evolution of the three location measures captured in Figure 2, we can claim that the market rate and the unemployment rate affect rather the upper parts of the distribution (the mean and also the median) while the credit risk indicator influences rather the lower parts of the distribution of client interest rates on consumer loans (the mode). Nevertheless, the observed distributional dynamics of the client interest rates on consumer loans in the period 2014–2019 in the Czech Republic might be contributed to all of the three determinants: the decreasing unemployment rate coupled with a benign evolution of credit risk and relatively low, albeit slightly increasing market rates, facilitated this development. Moreover, the results on the short-run dynamics of the market concentration variable (the Herfindahl-Hirschman index) reveal that decreasing market concentration might have contributed to a decrease in the client interest rate on consumer loans in the short-run. If we allow for some link between market concentration and market competition – as brought forth by Gregor and Melecký (2018) – we could interpret this as an effect of temporary marketing campaigns that are designed to win over consumers on the market.

In terms of alignment of our results with the authoritative literature covered in Section 2, we are the first authors that provide valid results regarding the pass-through of market rates to client interest rates on consumer loans using the data for the Czech Republic. Specifically, although the short-term coefficients on the market rate are statistically insignificant for all three location measure, the estimated coefficients of the market rate in the long-run cointegration relationship are 0.60 and 0.69 for the mean and the median measure, respectively. These values indicate an incomplete pass-through and are slightly higher than the value of 0.51 reported by Égert and MacDonald (2009) for CEE countries in the pre-crisis period. Moreover, we can also compute the mean adjustment lag that is defined in our context as the gap in the movement of the market rate and the client interest rate on consumer loans. This can be determined as the ratio:

$$\frac{(short\text{-}term\ coefficient\ on\ the\ market\ rate - long\text{-}term\ coefficient\ on\ the\ market\ rate)}{error\ correction\ coefficient}. \qquad (2)$$

As the short-term coefficients are statistically insignificant, we only assume the long-term ones. The resulting values (in months) are 2.8 and 3.33 for the median and the mean measure, respectively. Note that these values are comparable with the values

reported by Havránek et al. (2016). Generally, our results concerning the strength and speed of the pass-through are mostly in line with the prevailing view in the literature that the pass-through to client interest rates on consumer loans is low and slow (De Graeve et al., 2007; Égert and MacDonald, 2009; Aristei and Gallo, 2014; Gropp et al., 2014).

### 5.2 Additional Variables on Market Concentration/Market Competition

The results of the estimations using the alternative variables for market concentration/market competition are presented in Table 3. Generally, the effect of market concentration on the short-run dynamics of client interest rates on consumer loans from the baseline estimation does not seem to be robust, resulting in a rejection of Hypothesis #2. In case of the Boone indicator, this might be caused by the fact that it cannot be determined for the consumer loan market only and thus we need to work with its version over all banks' portfolios. However, most of the other results regarding the relevance of the market rate, the unemployment rate, and the NPL ratio for the long-run evolution of client interest rates on consumer loans remain intact. Interestingly, the estimation using the market competition variable based on the Bank Lending Survey suggests that market competition is positively linked with the client interest rate on consumer loans in the long-run. However, this result is not supported by any other evidence. However, on balance we find that concentration or competition in the consumer loan market seems to be a less relevant determinant of distributional dynamics of client interest rates on consumer loans in the Czech Republic in the period 2014–2019 than the market rate, the unemployment rate, and the credit risk indicator.

**Table 3 Determinants of Distributional Dynamics of Client Interest Rates on Consumer Loans (2014–2019, Alternative Variables Concentration/Market Competition)**

| *Market competition/ concentration variable* | *Herfindahl-Hirschman index including non-banks* | | | | | | *Boone indicator* | | | | | | *Competition based on the Bank Lending Survey* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | *(1)* | | *(2)* | | *(3)* | | *(1)* | | *(2)* | | *(3)* | | *(1)* | | *(2)* | | *(3)* | |
| | **Mean** | | **Median** | | **Mode** | | **Mean** | | **Median** | | **Mode** | | **Mean** | | **Median** | | **Mode** | |
| | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. | Coef. | Std. Err. |
| Long-run cointegration relationship | | | | | | | | | | | | | | | | | | |
| Market rate | 0.53*** | 0.18 | 0.75*** | 0.20 | -0.17 | 0.44 | 1.35*** | 0.29 | 0.76*** | 0.15 | 0.02 | 0.35 | 0.40** | 0.20 | 0.22 | 0.20 | -0.42 | 0.54 |
| NPL ratio | 0.09 | 0.08 | 0.12* | 0.07 | 0.39*** | 0.11 | 0.22** | 0.10 | 0.13** | 0.06 | 0.41*** | 0.10 | 0.04 | 0.06 | 0.09 | 0.06 | 0.32*** | 0.11 |
| Unemployment rate | 1.02*** | 0.23 | 1.53*** | 0.25 | 0.14 | 0.60 | 0.52** | 0.22 | 1.39*** | 0.12 | 0.35 | 0.22 | 1.05*** | 0.20 | 0.98*** | 0.20 | 0.22 | 0.55 |
| Concentration / Competition | 0.29 | 0.45 | -0.17 | 0.50 | 0.35 | 1.14 | -101.38 | 71.39 | -24.22 | 40.43 | -6.85 | 94.20 | 0.24 | 0.22 | 0.63*** | 0.23 | 0.50 | 0.62 |
| Speed of adjustment | -0.20*** | 0.05 | -0.26*** | 0.05 | -0.40*** | 0.09 | -0.16*** | 0.05 | -0.25*** | 0.05 | -0.39*** | 0.09 | -0.20*** | 0.05 | -0.28*** | 0.06 | -0.42*** | 0.09 |
| Short-run dynamics | | | | | | | | | | | | | | | | | | |
| ΔMarket rate | -0.23 | 0.21 | -0.16 | 0.33 | -0.88 | 1.23 | -0.38 | 0.23 | -0.16 | 0.31 | -0.88 | 1.24 | -0.29 | 0.25 | -0.18 | 0.33 | -0.97 | 1.12 |
| ΔNPL ratio | 0.03 | 0.04 | 0.04 | 0.07 | -0.03 | 0.16 | 0.04 | 0.04 | 0.04 | 0.07 | -0.04 | 0.15 | 0.05 | 0.04 | 0.06 | 0.07 | -0.02 | 0.13 |
| ΔUnemployment rate | 0.05 | 0.14 | 0.09 | 0.29 | 0.37 | 0.60 | 0.01 | 0.13 | 0.15 | 0.38 | 0.55 | 0.54 | 0.05 | 0.14 | 0.15 | 0.32 | 0.19 | 0.69 |
| ΔConcentration / Competition | 0.56 | 0.51 | 0.78 | 0.76 | -0.70 | 1.71 | 1.33 | 5.97 | 6.44 | 12.89 | 26.46 | 25.36 | 0.82 | 0.53 | 0.37 | 0.59 | 2.37 | 2.65 |
| Intercept | 0.23** | 0.11 | 0.93*** | 0.21 | -0.08 | 0.57 | 0.48** | 0.21 | 0.45*** | 0.13 | 0.93* | 0.56 | 0.97*** | 0.26 | 1.31*** | 0.27 | 1.93*** | 0.53 |
| No. of observations | 643 | | | | | | 643 | | | | | | 643 | | | | | |
| Hausman test | 0.88 | | 0.87 | | 0.06 | | 0.30 | | 0.13 | | 0.20 | | 0.15 | | 0.59 | | 0.10 | |

*Notes:* ***, **, and * denote statistical significance at the 1, 5, and 10% level, respectively. The estimation method is the pooled mean square estimator of Pesaran et al. (1999) based on the reported results of the Hausman test that helps to decide between the pooled mean square and the mean square estimator.

## 6. Conclusion

Consumer loans constitute a non-negligible part of the loan portfolios of the Czech banking sector, having considerable implications for its credit risk and profitability. However, little is known about the shape of the empirical distribution of client interest rates, its dynamics over time and about the determinants that influence client interest rates on consumer loans as the literature in the Czech context presents only limited evidence these topics. Thus, we analyze the determinants of bank-level distributional dynamics of client rates on consumer loans between 2014–2019 when client rates have attained very low levels.

In our bank-level analysis, we use data on three location measure – mean, median, and mode – to capture the distributional dynamics in a comprehensive manner. Moreover, based on the relevant literature, we identify the market rate (as a proxy for the cost of funds related to consumer loans and indirectly also to monetary policy stance), the credit risk indicator (the proxy for the asset quality, potentially driving the risk premium), the unemployment rate (the macroeconomic control), and market concentration/market competition (influencing banks' mark-ups) as potential factors which might determine these dynamics. As our estimation framework, we employ the pooled mean group estimator, similarly to Horváth and Podpiera (2012), Van Leuvensteijn et al. (2013) and Havránek et al. (2016). This modeling approach is the most suitable one for the specifics of our panel dataset as we have non-stationary and cointegrated data.

In terms of our results, we find that the observed distributional dynamics of the client interest rates on consumer loans in the period 2014–2019 in the Czech Republic might be contributed to the decreasing unemployment rate coupled with a benign evolution of credit risk and relatively low, albeit slightly increasing market rates. Moreover, we find some evidence that decreasing market concentration might have contributed to a decrease in the client interest rate on consumer loans in the short-run.

However, the link between the market competition/market concentration and the distributional dynamics is not particularly robust as we illustrate using three additional variables. On the other hand, we are the first authors in the Czech context that obtain valid results regarding the interest rate pass-through from market rates to client interest rates on consumer loans. Specifically, we find some evidence of a link between market rate and client interest rates on consumer loans for the mean and the median measure. Moreover, the results regarding the strength and the speed of the pass-through are mostly in line with the international literature on interest rate pass-through (De Graeve et al., 2007; Égert and MacDonald, 2009; Aristei and Gallo, 2014; Gropp et al., 2014).

Our results might have implications both for monetary policy and for financial stability as we document that the recent distributional dynamics can be contributed to a combination of benign development regarding the macro-financial conditions in the Czech Republic. Moreover, client interest rates on consumer loans most likely remain at historically lowest levels despite a recent increase in market rates due to a continuing positive development regarding the unemployment rate and the credit risk of consumer loans. At the same time, the market competition/market concentration does not seem to influence client interest rates on consumer loans. This implies that

profits from consumer loans can continue to contribute to a solid profitability of banks in the Czech Republic which also has potentially positive implications for their capital adequacy.

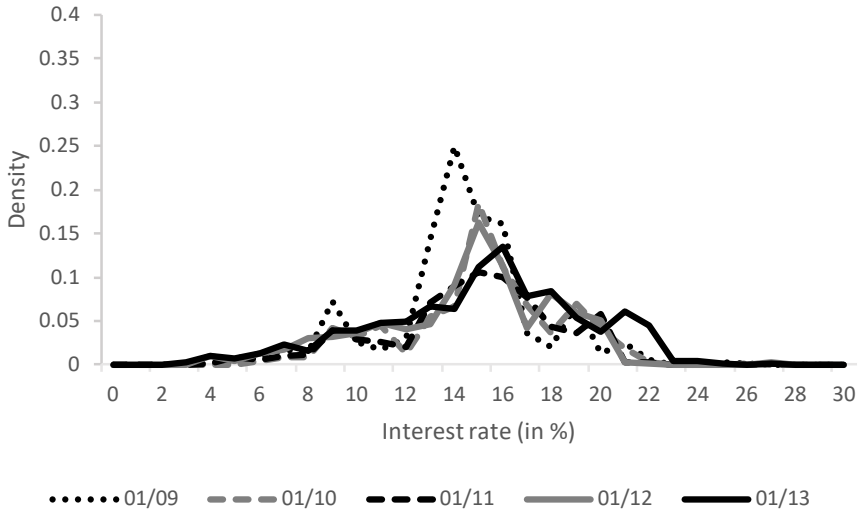
# APPENDIX

**Table A1 Summary Statistics and Description of Variables Used in The Empirical Analysis**

| *Variable* | *Description* | *Bank-specific?* | *Number of observations* | *Mean* | *Std. Dev.* | *Min.* | *Max.* |
|---|---|---|---|---|---|---|---|
| Mean | The mean interest rate of the distribution of client interest rates on consumer loans in a given month | Yes | 654 | 10.15 | 2.90 | 4.95 | 18.31 |
| Median | The median interest rate of the distribution of client interest rates on consumer loans in a given month | Yes | 654 | 9.94 | 3.04 | 4.37 | 18.9 |
| Mode | The interest rate that corresponds to the global maximum of the distribution of client interest rates on consumer loans in a given month | Yes | 654 | 8.58 | 3.65 | 0.00 | 21.9 |
| Market rate | The weighted average of market rates corresponding to volumes of new consumer loans provided in a given fixation category according to Brůha (2011) in a given month | Yes | 654 | 1.01 | 0.63 | 0.20 | 2.60 |
| NPL ratio | The ratio of non-performing consumer loans to total consumer loans | Yes | 654 | 8.25 | 5.10 | 0.81 | 22.11 |
| Herfindahl-Hirschman index | The index of concentration of the consumer loan market computed as the sum of squares of market shares of individual banks in the sample | No | 654 | 19.08 | 1.61 | 15.92 | 23.50 |
| Unemployment rate | The unemployment rate computed by the Czech Statistical Office | No | 654 | 4.09 | 1.47 | 2.00 | 6.70 |
| Herfindahl-Hirschman index incl. non-banks | The measure of concentration of the consumer loan market that includes both banks and non-banks, computed by the Czech National Bank | No | 654 | 11.06 | 0.65 | 10.24 | 12.53 |
| Boone indicator | The measure of competition in the banking sector computed in line with Schaeck and Čihák (2010) | Yes | 654 | -0.01 | 0.05 | -0.02 | -0.00 |
| Market competition based on the Bank Lending Survey | The measure of competition in the consumer loan market based on the Bank Lending Survey of the Czech National Bank, computed as the cumulative sum of the changes of perception of the banking sector concerning the competition in the consumer loan market | No | 654 | 0.00 | 1.00 | -0.80 | 2.11 |

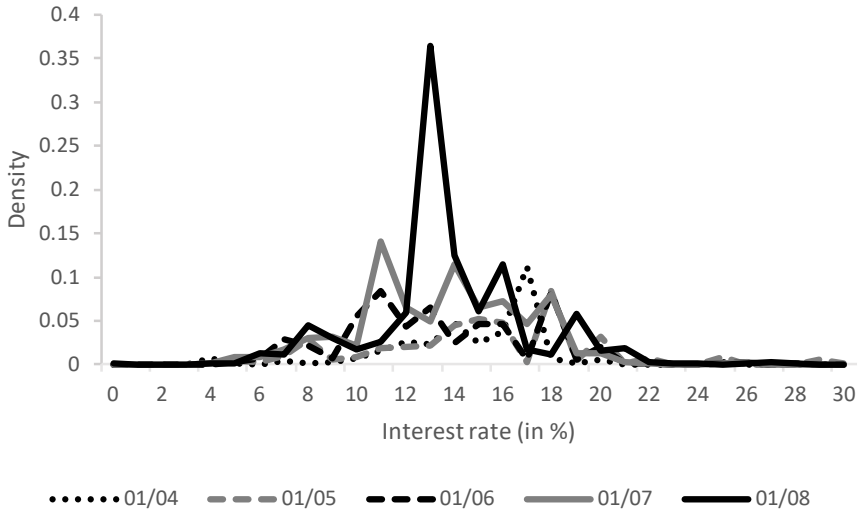
*Notes:* The data source, if not stated otherwise, is the Czech National Bank.

**Figure A1 Distributional Dynamics of Client Interest Rates on Consumer Loans (2009–2013, Aggregate Level)**



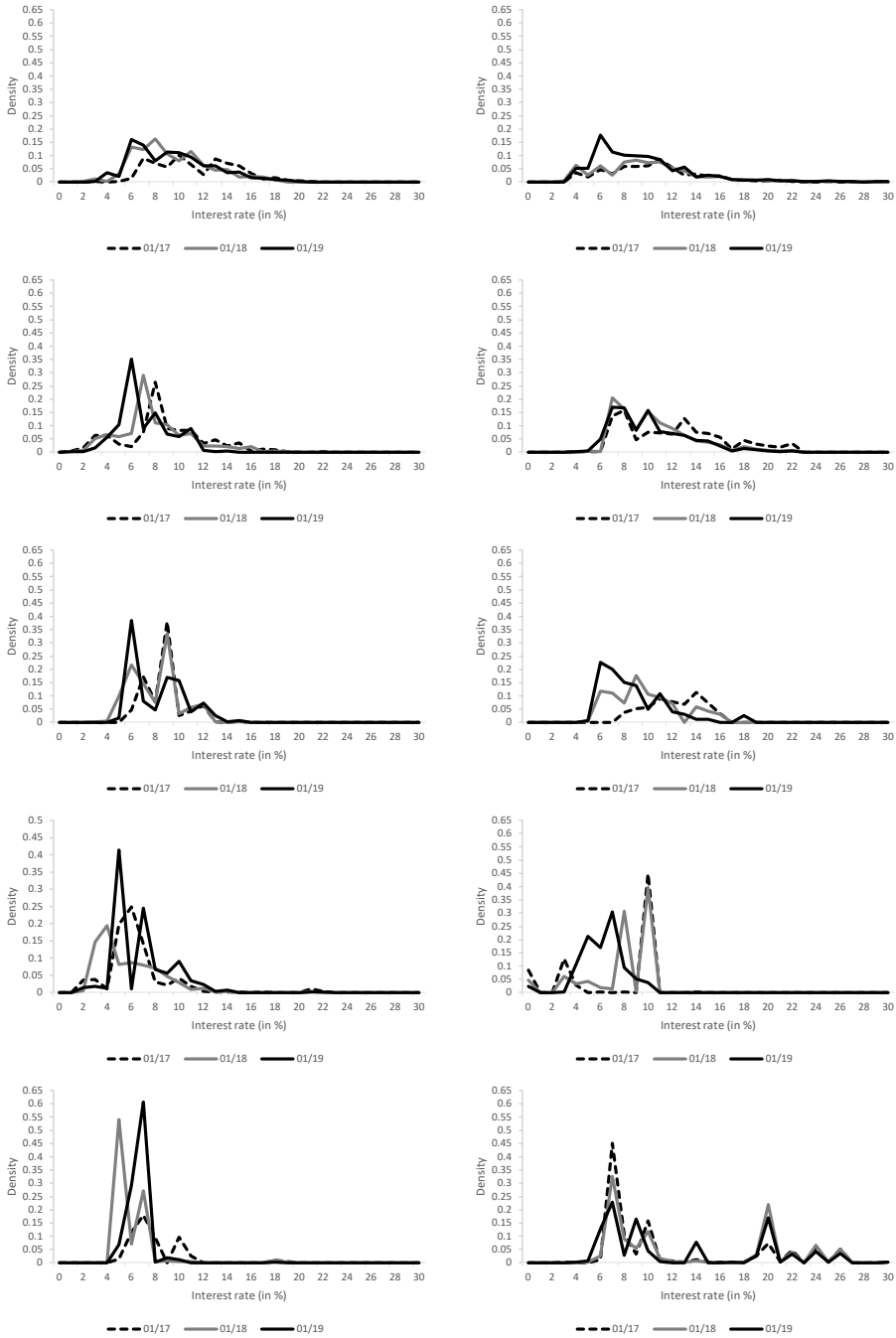

*Notes:* The x axis shows the levels of interest rates while the y axis shows the percentage of volume of new consumer loans in an interval of a length of 1 percentage point. The empirical distribution is plotted in a given month.

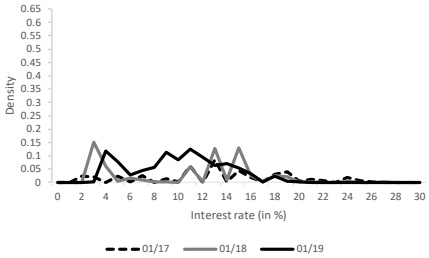
**Figure A2 Distributional Dynamics of Client Interest Rates on Consumer Loans (2004–2008, Aggregate Level)**




*Notes:* The x axis shows the levels of interest rates while the y axis shows the percentage of volume of new consumer loans in an interval of a length of 1 percentage point. The empirical distribution is plotted in a given month.

**Figure A3 Distributional Dynamics of Client Interest Rates on Consumer Loans (2017–2019, Individual Banks)**




0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Density
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Interest rate (in %)
01/17
01/18
01/19

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