Heterogeneity in Bank Pricing Policies: The Czech Evidence*

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ABSTRACT

In this paper, we estimate interest rate pass-through from money market to bank retail rates using various heterogeneous panel cointegration techniques to address bank heterogeneity. Based on our micro-level data from the Czech Republic, the results indicate that the nature of interest rate pass-through differs across the banks in the short-term (rendering estimators that constrain coefficients across groups to be identical inconsistent) and becomes homogeneous across banks only in the long-term supporting the notion of law of one price. Mortgage rates and firm rates typically adjust to money market changes, but often less than fully in the long run. Large corporate loans have smaller mark-up than small loans. Consumer rates have a high mark-up and do not exhibit relationship with money market rates even in the long-run. Next, we examine how bank characteristics determine the nature of interest rate pass-through in the cross-section of Czech banks. We find again evidence for relationship lending, as banks with a stable pool of deposits smooth retail rates and require higher spread as compensation. Large banks are not found to price their products less competitively. Greater credit risk increases the vulnerability to money market shocks. This suggests that in case of financial distress, such as in the current global financial crisis, the money market shocks are likely to have a stronger effect on bank retail pricing policies.

Keywords: monetary transmission, financial structure, bank pricing policies
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1 Introduction

Understanding the effectiveness of monetary transmission is crucial for central banks in order to pursue their policies. Central banks typically exert a strong influence on short-term interest rates, which in turn affect the commercial bank's pricing policies and subsequently, the financing conditions of corporate and household sector.

In this paper, we examine how money market rate, which is typically largely driven by monetary policy rate, affect retail bank interest rates (e.g. interest rate pass-through) during the period January 2004 – December 2008 and which factors matter for the nature of pass-through based on bank-level data. Bank-level data seem to be preferable for this kind of exercise for two main reasons. First, recent theoretical and empirical research has emphasized that the speed of adjustment in dynamic relationships (e.g. how fast is money market rate shock absorbed in retail rate in our case) observed at the aggregate/macroeconomic level may be affected by aggregation bias (see Granger, 1980, and Zaffaroni, 2004) and due to the fact that idiosyncratic shocks will tend to disappear when a substantial number of series are aggregated (Altissimo, Mojon and Zaffaroni, 2009).[1] This suggests that there is a risk that the estimates based on aggregate data may underestimate the speed of interest rate pass-through. Second reason for preferring bank-level data over aggregate data is that it allows us to examine the determinants of the nature of interest rate pass-through.

A characteristic feature of this paper is accounting for bank heterogeneity in a comprehensive manner. A typical study within this stream of literature introduces bank heterogeneity only via bank dummy, but otherwise forces all banks to react identically to the money market shocks.[2] This is, as we show, an inadequate assumption leading to inconsistent estimates of the speed of interest rate pass-through. Therefore, we introduce more general framework to account for heterogeneity in a fuller manner.

In terms of results, we find that the nature of interest rate pass-through differs across the banks in the short-term (rendering estimators that impose common slopes inconsistent). On the other hand, pricing policies are found homogeneous in the long-term supporting the notion that the

[1] See also Bernanke and Blinder (1992), who show that it is impossible to identify a bank lending channel based on macroeconomic time series.

[2] De Graeve et al. (2007) seem to be an exemption. Contrary to De Graeve et al. (2007), we apply different econometric estimator.

law of one price prevails in the long-run (see Gambacorta, 2008, for similar evidence on Italian banks).

The estimations performed show the existence of an equilibrium-restoring relationship for all categories of retail rates on deposits, corporate loans and household loans except the consumer loans. Retail rates typically adjust to money market changes relatively fast, but often less than fully in the long run. Our estimates suggest that for corporate rates it takes typically only one month on average until the banks pass money market rate changes through. The results indicate that large corporate loans have smaller mark-up than small loans. Consumer rates have a high mark-up and do not exhibit relationship with money market rate even in the long-run. We also examine how financial structure influences the nature of interest rate pass-through in the cross-section of Czech banks. We find evidence for relationship lending. Banks with a stable pool of deposits smooth retail rates and require a higher spread as a compensation for interest rate stability (this is in line with US evidence, see Berlin and Mester, 1999). Credit risk is found to increase the spread and also to increase the sensitivity to money market shocks. This suggests that in case of financial distress, such as in the current global financial crisis, the money market shocks are likely to have a stronger effect on bank retail pricing policies.

The paper is structured as follows. In section 2, we briefly discuss the related literature. Section 3 describes our data. Section 4 introduces our empirical framework. We use three heterogeneous panel data estimators to shed light on the nature of interest rate pass-through. Section 5 presents our results. Section 6 offers the concluding remarks. Appendix with data description and additional results follows.

2 Related Literature

Numerous papers dealing with interest rate pass-through have emerged over the past two decades. Hannan and Berger (1991) and Neumark and Sharpe (1992) focus on an analysis of the US banking sector. Cross-country studies to reveal and explain the similarities and differences among the interest rate pass-through mechanisms in various countries were pioneered by Cottarelli and Kourelis (1994) and Borio and Fritz (1995). The eventual adoption of common currency mounted the interest in the monetary transmission across the euro area countries (see Mojon, 2000; Bondt, Mojon and Valla, 2005; de Bondt, 2005). Typically, these studies evaluate the nature of interest rate pass-through within the error-correction framework. Namely, they

focus on the long-term relationship between retail and money market rate, the short-term response of retail rate to a change in money market rate and the speed of adjustment.

The stylized fact of these studies is that there is sluggish adjustment of retail rates, but over the long-term horizon the pass-through from policy interest rate or money market rates to retail rates is often complete (see de Bondt, 2005, for recent survey within this stream of literature) but not always (De Graeve et al., 2007). Several theories have been put forward to account for the sluggishness of retail rates. First, switching costs such as the costs to acquire the information may be a hindrance to adjust the retail rate instantaneously (Sharpe, 1997). Second, asymmetric information costs are likely to be present in banking sector. Consequently, the banks may not increase the lending rates in response to a shock proportionately, as they may attract customers with more risky activities (adverse selection problem). Another observation drawn from the results is that consumer rates are found to react the most slowly, as asymmetric information costs seem to be the most pertinent in this market segment.

Next, several studies investigate the asymmetries in the interest rate pass-through, i.e. whether retail rates react differently according to the sign or size of money market change or according to whether the retail rate is above or below its equilibrium value inferred from the error-correction mechanism. The evidence on the asymmetries is mixed. While some studies document asymmetric adjustment of retail rates to money market rates (Scholnick, 1996, Gropp et al. 2007), others fail to find evidence for asymmetry (Sander and Kleimeier 2004, 2006). More specifically, bank retail interest rates have been found to react differently according to whether the money market interest rates were rising or falling (or were located under or above the ”equilibrium” interest rate) or not to have a proportional reaction to changes of different sizes in the money market rates. The non-linear reaction of banks can be backed by various theoretical explanations related to nominal rigidities, transaction costs, market structure or asymmetric information problems (De Graeve et al., 2007).

Several contributions focus on the question of which factors are behind the heterogeneity in interest rate pass-through. Sander and Kleimeier (2004, 2006) estimate single-country error-correction models for several European countries and report that market concentration, bank performance, foreign bank participation, macroeconomic environment and monetary policy regime matter for the convergence of interest rate pass-through across the countries. Similarly, using a novel measure of competition Leuvensteijn et al. (2008) document that the degree of

competition matters for interest rate pass-through in the euro area with higher competition inducing bank retail pricing policies to be more in line with money market conditions. Gropp et al. (2007) concentrate on the determinants of bank spreads in the euro area and find that spread are driven by bank soundness, credit risk and interest rate risk. The speed of interest rate pass-through is also affected by the degree of competition and financial innovations. De Bondt (2005) and De Bondt et al. (2005) find that the interest rate pass-through speeded up after the introduction of euro. Gambacorta (2008) shows that heterogeneity of bank pricing policies in Italy is influenced by liquidity, capital adequacy and relationship lending, but these factors are important only in the short run.

Different approach to model the interest rate pass-through is proposed in De Graeve et al. (2007). Their empirical framework accounts for the bank heterogeneity in a fuller manner, as it allows both heterogeneity in the slopes and constant in the regression. They estimate the average long run pass-through using Philips and Moon (1999) estimator and for the average short-run pass-through (including the speed of adjustment) they apply random coefficient estimation method (Swamy, 1970). Different slope coefficients allow banks to react differently to the changes in the money market rates and they show that this is indeed the case. This signalizes that the estimators that impose common slope (identical reaction of the banks) are inconsistent. De Graeve et al. (2007) find that interest rate pass-through in the Belgian market is often incomplete and the adjustment of retail rates to money market changes is typically symmetric (with an exemption of large deviations from the equilibrium interest rate). Similarly to Gambacorta (2008), their results indicate certain evidence for relationship banking and that well capitalized and liquid banks are less prone to money market changes. We follow De Graeve et al. (2007) and model banking sector as heterogeneous. On the other hand, we apply different heterogeneous nonstationary panel estimators and in addition to De Graeve et al. (2007) also investigate a larger set of determinants of interest rate pass-through.

The enlargement of EU in 2004 and 2007 and the perspective of joining the monetary union gave rise to further interest in the monetary transmission of the new EU member states. Egert and MacDonald (2009) survey the characteristics of the monetary transmission, and in particular the interest rate channel in these countries as it results from the up-to-date research at the country level. There are few studies addressing interest rate transmission in the Czech Republic. All these studies make use of aggregate data, namely the averages of retail interest rates as published by the Czech National Bank. Crespo-Cuaresma, Egert and Reininger (2004) include the Czech Republic

in a study meant to unveil the interest rate pass-through in the Czech Republic, Hungary and Poland during the period 1994 – mid-2003. They focus on three retail rates (household deposit rates, enterprise new loans rate with maturity less than 12 months and enterprise new loan rate with maturity more than 12 months). They find an incomplete pass-through for all rates and confirm the existence of an equilibrium relationship between the analyzed retail rates and the 12 month money market rate. Recursive estimates show a general upward trend of long-run elasticities, albeit still having the values under unity. The short-term pass-through seems not to be in the focus of the paper.

Egert, Crespo-Cuaresma and Reininger (2007) also account for the Czech Republic when studying the pass-through within a panel of five Central and Eastern European countries and compare it with the pass-through in selected euro area countries during the period 1994-2005. This time the authors use a larger spectrum of retail rates, which include both data on retail rates on stock of loans and those applied to newly extended loans. They find no significant pass-through for the aggregate household loans and a more pronounced (even close to unity) pass-through for long-term corporate loans than for short-term corporate loans.

Tieman (2004) includes the Czech Republic when analyzing the interest rate pass-through in Romania and several other Central European countries using the data from January 1995 to February 2004. The data for the Czech Republic envisage average monthly short- and long-term loan rate (both for outstanding loans and new loans) and deposit rate. The long-term pass-through for outstanding loans is below unity both for short- and long-term rate. When using the rates on newly issued loans, the results show a pass-through close to unity for short-rate and a significantly under unity pass-through for long-rates. Regarding the immediate pass-through, only in the case of short rate for newly issued loans a significant reaction can be observed. In general, all previous studies based on aggregate data suggest that the long-run pass-through is incomplete in the Czech Republic. A survey of monetary transmission in Central Europe is available in Egert and MacDonald (2009) and the description of the Czech monetary policy is available in Borys Morgese et al. (2009).

3 Data

We conduct individual analyses regarding the money market rates pass-through to interest rates on new loans granted to non-financial sector and to household sector, and to newly set deposits over the period January 2004 – December 2008 (note that earlier micro-level data are not available due to changes in reporting of interest rates). We make use of bank-level contract-based

interest rates. We consider the bank-level data for all commercial banks for which data are available. In this respect, we use a panel of 18 commercial banks for the analysis pertaining to loans to non-financial sector, 13 commercial banks for the analysis on loans to household sector and 20 commercial banks for the analysis on deposits.[3] In general, these banks grant more than 95% of loans in the Czech Republic. The source of all our data is internal Czech National Bank dataset on banks containing detailed financial statements of banks and its lending activity.

For money market rates, we use PRIBOR1M, PRIBOR3M, PRIBOR6M and PRIBOR1Y. Out of these PRIBOR rates, we choose the one with highest correlation with given bank retail rates for our regression analysis (see Table 3A in the Appendix).

According to EU regulations, the data concerning the loans to non-financial sector are distinguished according to loan amount and time span for which the interest rate is fixed, respectively; data concerning the loans to household are split on loans for consumption purchases and for mortgage, respectively, while data regarding the deposits is displayed according to the maturity of deposits. For convenience, we provide below the categorization of loans and deposits in tables.

Categorization of loans to non-financial sector (firms)

Small loan, floating rate	Loan amount up to 30 millions Czech crowns, rate floating or fixed up to 1 year
Small loan, fixed rate	Loan amount up to 30 millions Czech crowns, rate fixed more than 1 year
Large loan, floating rate	Loan amount more than 30 millions Czech crowns, rate floating or fixed up to 1 year
Large loan, fixed rate	Loan amount more than 30 millions Czech crowns, rate fixed more than 1 year

Categorization of loans to households

Mortgage rate	Loan for house or flat purchase
Consumer rate	Loan for households, typically for the goods for long-term consumption

Categorization of deposits

SR deposit rate	Deposits with maturity above one day and less than two years
LR deposit rate	Deposits with maturity above two years

All the loans are in domestic currency and the loans in foreign currencies are excluded. Note that foreign currency lending is, contrary to other Central and Eastern European countries, is quite

[3] There has been one acquisition during our sample period and we decided to drop these observations for simplicity. Note that all the banks are privatized well before our sample starts and the share of foreign ownership is about 97% (Financial Stability Report 2008/2009).

limited. The share of foreign currency lending for households and firms stands around 0.5% and 20%, respectively (Financial Stability Report, 2008/2009).

Both weighted average and median bank specific interest rate are included in our analysis. Weighted average rate is typically used in other studies in this stream of literature (as these are reported by central banks or statistical offices), as median rate is not readily available and has to be constructed from individual contract-level data.

Given that a normality test performed on the monthly distributions – the skewness/kurtosis test (conceptually similar to the Jarque-Bera test) – systematically rejected the hypothesis of normality, we choose to use the median as a representative statistic for the monthly retail interest rates, which we use in regressions. Note that median interest rates can be calculated, as our underlying dataset contains almost individual contract-level data (in general, we have available information on all the loans granted in the Czech Republic, only contracts with identical characteristics are grouped together). To our knowledge, evidence based on median retail interest rates is missing in the literature.

In consequence, we have a panel of bank-level data for each of the retail rates mentioned above. We test these panel data for non-stationarity. The Hadri (2000) panel unit root test, which tests the stationarity in heterogeneous panels and has the null hypothesis of stationarity in any of the series in the panel, strongly rejects the null in favor of a unit root. The results are available upon request. We have chosen to base our conclusion about the (non-)stationarity on this test as the results were the most unambiguous. The other tests suitable to a heterogeneous panel such as Im, Pesaran and Shin, 2003 or Fisher type tests give mixed results contingent on including or not individual specific trends. The loss of power of these test in the case of individual specific trends are included is well documented in literature (see Baltagi and Kao, 2000). At the same time, we employ Pedroni (1999) residual cointegration test to test for panel cointegration between the retail rates and the money market rates to which the respective retail rates are the most correlated (see Table 3A in the Appendix). With the exception of consumer retail rates, in all cases the null of 'no cointegration' is rejected.[4]

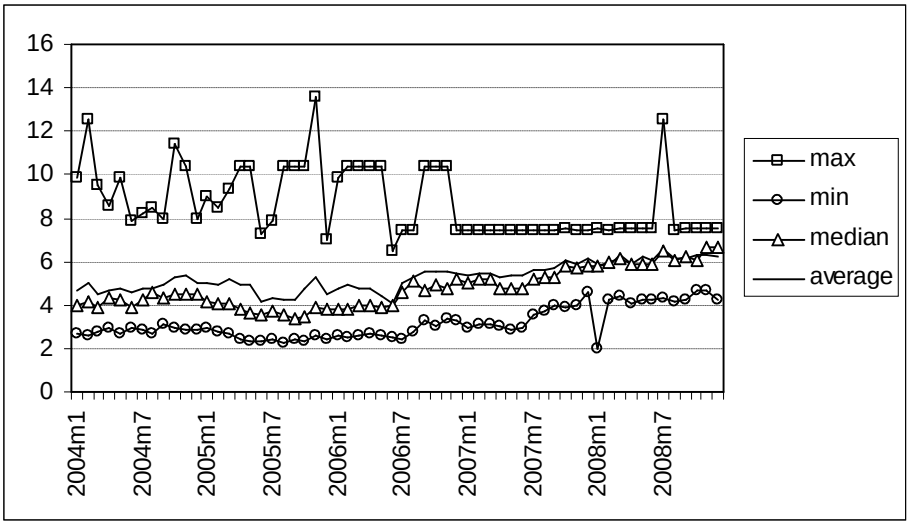
The descriptive statistics (Table 1A and 2A) and selected figures (Figure 2A-8A) are available in the Appendix. It is evident that mortgage rate is lower than consumer rate, which is in line with

[4] The results of these tests are available upon request.

that consumer rates are perceived to be more risky. As concerns the corporate loans, small loans exhibit higher rate than large loans, which reflects higher monitoring unit costs for small loans (typically granted to small firms) and, at the same time loans with longer fixation period are more expensive than loans of similar size, but with floating interest rate. This suggests that banks charge less to customers that are willing to accept more risk. Figures 2A-8A show the link between weighted average and median bank-specific rates for respective loan categories. Clearly, the average and median rates are strongly correlated in most cases, but certain differences between them are apparent, especially for higher rates granted to more risky customers. Figure 1 presents the developments of median, average, minimum and maximum interest rates for the loan category – small loan with floating interest rate. It suggests a great variation in terms of interest rates across different banks. For example, the difference between minimum and maximum interest rate on small loans with floating interest rate in January 2004 was more than 7 percentage points.

Figure 1 – Interest Rate Heterogeneity across Banks: An Example

Maximum, minimum, median and average



Note: The figure presents maximum, minimum, median and average lending rate for the category - small loan with floating interest rate - over time and documents large bank heterogeneity in terms of the interest rate charged for the largely identical product by the different banks.

Next, data on bank characteristics were collected in order to assess the underlying factors affecting the nature of interest rate pass-through.

Bank characteristics

$Size_{i,j}$	Assets of i-th bank/median bank assets
$Inefficiency_{i,j}$	Costs/income
$Liquidity_{i,j}$	Liquid assets/assets
$Capital\ Adequacy_{i,j}$	Capital/ risk-weighted assets
$Deposit_{i,j}$	Deposits/(deposit and non-deposit funding)
$Credit\ Risk_{i,j}$	Non-performing loans/assets

4 Empirical Methodology

A straightforward underlying link to connect the money market rates to retail rates, the so-called "cost of funds/marginal cost" approach (de Bondt, 2005), emerges from the fact that banks are borrowing on the money market to secure their lending. The theoretical underpinnings to this "mark-up" model is provided by Freixas and Rochet (2008), whose model imply that in a imperfectly competitive environment the long-term relationship between retail and money market rate can be expressed as $br = mr + \mu$, where br stands for bank retail rate, mr represents money market rate and μ denotes the spread.

Whether the lending rates follow one-to-one the moves in the market rates depends on numerous factors such as the demand elasticity with respect to the retail rates, market power or the presence of asymmetric information. In the same line of reasoning, the link between deposits and money market rates emerges from the fact that banks can either borrow on the money market or from depositors to fund their lending activities, so either way, the money market rate or the deposit rate could represent the marginal cost for the bank, and this brings about their interlinking. In addition, the depositors can choose to either deposit money with banks or invest in securities. In consequence, it might appear that different retail rates are more linked to some market rates that to others and this fact is obviously contingent on the term structure.

The link between the market rates and retail rates – the interest rate pass-through – is typically evaluated within the error correction framework given the non-stationarity of the bank-level retail rates panels and market rate as described by the equation (1).

$$\Delta br_{i,t} = \sum_{j=0}^{q-1} \alpha_0 \Delta mr_t + \sum_{j=1}^{p-1} \alpha_1 \Delta br_{t-1} + \beta_{0,i}(br_{i,t-1} - \beta_1 mr_{t-1} - \mu) + \varepsilon_{it} \qquad (1)$$

Where br_{it} denotes the i-th bank retail interest in time t, mr_t represents the money market rate and μ is the constant that assesses the spread of retail rates over money market rates. Eq. (1)

captures both the long term and short-term dynamics of the money market pass-through to retail interest rates. The long term pass-through is described by the coefficient β_1. If $\beta_1 = 1$, the pass-through is regarded as complete. The coefficient α_0 reflects the short-term dynamics, while the coefficient β_0 stands for the speed of adjustment. Hendry (1995) asserts that $(\beta_1 - \alpha_0)/\beta_0$ indicates the mean adjustment lag at which the market rate is fully passed through to bank rate.

In our study, we employ three heterogeneous panel data estimators to shed light on the interest rate pass-through and to deal with bank heterogeneity in a comprehensive manner. We apply 1) mean group estimator (Pesaran and Smith, 1995) and 2) pooled mean group estimator (Pesaran, Shin and Smith, 1999). These estimators are designed for "large N, large T" panels where N and T are of the same order of magnitude (see Pesaran, Shin and Smith, 1999). Our N – i.e. the number of banks – is typically around 18 and T – i.e. the time dimension - is equal to 60. Thus we have employed these methods on two shorter spans (Jan.2004 – Jun.2006 and July 2006 – December 2008) in order to have N and T of similar order of magnitude. As a consequence, we evaluate, if the transmission changes over time. 3) We estimate the long-run relationship, namely the coefficients β_1 and μ by dynamic OLS (DOLS) as put forward by Stock and Watson (1993) and the short-term specification by Swamy's (1970) random coefficient.

Note that even for sub-samples our sample size is thus largely similar to the original application of Pesaran et al. (1999), where they study consumption dynamics in the OECD countries with N=24 and T=32. As concerns the time coverage, our results indicate (see the section 4 of this paper) that the speed of interest rate pass-through is rather high, so the full adjustment of retail rates to money market rates is realized several times.

While in the case of mean group estimator all the coefficients are allowed to vary freely across the banks, pooled mean group estimator and DOLS-Swamy's random coefficient estimator allows intercepts, short-run coefficients and error variances to vary freely, but the long-run coefficients are constrained to be identical. In the following we describe our employed methodology formally.

Mean group estimator:

$$\Delta br_{i,t} = \sum_{j=0}^{q-1} \alpha_{0,i} \Delta mr_t + \sum_{j=1}^{p-1} \alpha_{1,i} \Delta br_{t-1} + \beta_{0,i} (br_{i,t-1} - \beta_{1,i} mr_{t-1} - \mu_i) + \varepsilon_{it} \qquad (2)$$

Pooled mean group estimator:

$$\Delta br_{i,t} = \sum_{j=0}^{q-1} \alpha_{0,i} \Delta mr_t + \sum_{j=1}^{p-1} \alpha_{1,i} \Delta br_{t-1} + \beta_{0,i} (br_{i,t-1} - \beta_1 mr_{t-1} - \mu) + \varepsilon_{it} \quad (3)$$

By employing mean group estimator and pooled mean group estimator we aim, apart from having a picture of the monetary transmission on the sub-periods, also to find out whether the law of one price holds and consequently we could carry on estimations under this assumption for the entire period through the third methodology that we have described. Pooled mean group estimator assumes bank pricing policies to be heterogeneous in the short-run. Therefore, $\alpha_{0,i}$ and $\beta_{0,i}$ may differ from bank to bank, but β_1 and μ are identical for all banks. Mean group estimator is less restrictive and allows the coefficients to differ bank by bank even in the long run (therefore, we obtain bank-specific spread, μ_i, and bank-specific long-term pass-through, $\beta_{1,i}$). On the other hand, mean group estimator is less efficient. We employ Hausman test to assess whether the long run slope homogeneity condition holds.

As mentioned, for the entire time span, January 2004-December 2008 we employ the third methodlogy (DOLS-Swamy, thereafter). We choose DOLS for the following reasons.[5] Kao and Chiang (2000) investigates the finite sample properties of OLS, Fully Modified OLS (FMOLS) of Pedroni (2000) and Philips and Moon (1999) and DOLS, respectively and conclude that OLS estimator has a non-negligible bias in finite sample, the FMOLS does not improve over OLS in general and that DOLS may be more promising than OLS and FMOLS for the estimation of panel cointegration.

The DOLS estimator for heterogeneous panels, $\hat{\beta}$, can be obtained by running the following regression (Kao and Chiang, 2000):

$$br_{it} = \mu_i + mr_t' \beta + \sum_{j=-q_i}^{q_i} c_{ij} \Delta mr_{t+j} + \upsilon_{it} \quad (4).$$

So, besides a bank-dummy to account for the fixed heterogeneity and the contemporaneous level of the explanatory variable, it adds leads and lags of its first differences. Practically, we chose a maximum of 4 lags and leads and eliminated further the insignificant variables.

[5] Next, we also investigated whether there are any asymmetries in interest rate pass-through, but failed to find any systematic evidence for asymmetry. These results are available upon request.

Concerning the short-term dynamics, Swamy's (1970) random coefficient model seizes the dynamic heterogeneity. The estimated coefficients are a weighted average of the bank specific coefficients where the weights are based on the estimated covariances (Swamy, 1970). In addition, when performing the estimations, the short-term specification was enriched with bank-dummy for fixed heterogeneity, the lags of the differenced money market rates and the lags of differenced retail rates.

Estimation of the pass-through represents the first part in our analysis. In the second part, we study which factors contribute to the heterogeneity of interest rate pass-through (in some sense, this is similar to the two-step approach pursued in Kashyap and Stein, 2000).[6] Note that there are two basic approaches how to investigate the role of bank characteristics for interest rate pass-through. First approach analyzes the determinants (bank characteristics) of estimated parameters from interest rate pass-through regressions (such as one in the Eq. (1)). Second approach includes the bank characteristics directly into the interest rate pass-through regression. These two approaches are related in a sense that they both investigate how bank characteristics matter for interest rate pass-through, but it is noteworthy that they aim to tackle two distinct issues. While the first approach examines, how bank characteristics matter for, for example, long-term pass-through, second approach investigates whether bank characteristics matter for the changes of bank retail rates (i.e. the dependent variable in Eq. (1)). In this paper, we opt for the first approach and leave the second one for further research.

The set of determinants consists of bank characteristics and is in line with De Graeve et al. (2007). Nevertheless, we include a fuller set of determinants to provide additional insights into the nature of interest rate pass-through. First, we investigate the determinants of spread, μ_i,[7] estimating the following regression for all loan products stacked together:

$$\mu_{i,j} = f\left(capital_i, size_i, deposits_i, inefficiency_i, creditrisk_i\right) \qquad (3)$$

j and *i* stand for *j*-th loan product and *i*-th bank, respectively. $Capital_i$ stands for the capital adequacy (capital over risk-weighted assets). Positive link between $capital_i$ and spread can be expected according to Ho and Saunders (1981). Their dealership model predicts positive

[6] A related stream of research investigates the effect of monetary policy shocks on bank lending. Recent evidence on Central and Eastern European countries is available in Matoušek and Sarantis (2009).
[7] Spread as well as long-term pass-through estimates come from the mean group estimates.

relationship, as net interest rate margins should increase the capital base as the exposure to risk increases. On the other hand, Brock and Franken (2003) claim that less capitalized banks have the motivation to accept more risk (associated with higher spread) in order to receive higher returns. Analogously, more capitalized banks invest more cautiously, as there is more capital at risk (Brock and Franken, 2003).

We include the bank size to proxy for the industry structure. The effect of $size_i$ (the ratio between one bank's assts and the median assets of banks) is not clear-cut. On the one hand, larger banks may exercise market power and charge higher rates. For example, Berger (1995) notes that banks with a large market share may price its products less competitively. On the other hand, bank size may reflect its efficiency as well and thus, the ability to offer smaller spread (Claeys and Vander Vennet, 2008).

Next, we include the variable, $deposits_i$, to assess the possible effects of relationship lending. The hypothesis that originally Berlin and Mester (1999) raise is that banks with a stable pool of deposits will smooth market shocks (thus, its retail rates) for customers and as a compensation for stable retail interest rates will maintain a higher spread. In line with De Graeve et al. (2007), $deposits_i$ is calculated deposits over deposit and non-deposit funding.

We include $inefficiency_i$ [8] (costs over income) to investigate we include inefficiency to investigate the hypothesis whether less efficient banks charge larger spread and thus, pass their inefficiency onto the customers. The effect of $creditrisk_i$ (non-performing loans over assets[9]) is expected to be positive, as more risky loan portfolio is typically associated with higher yield (Wong, 1997, Gambacorta, 2008). The definitions of explanatory variables are available in the data section.

Similarly, the determinants of long-term pass-through, $\beta_{1,i}$, are examined:

$$\beta_{i,j} = f\left(liquidity_i, capital_i, size_i, deposits_i, inefficiency_i, creditrisk_i\right) \qquad (4)$$

[8] We appeal to a simplistic measure of *inefficiency* as an analysis of frontier efficiency (see Berger and Humphrey, 1997, for a survey) is not among the aims of this paper.

[9] We are aware of the fact that this measure is rather backward-looking proxy of credit risk, but on the other hand this measure is bank-specific. Credit default swap on bank debt data that would be more forward-looking indicator are unfortunately available only for few large banks.

In addition to our four aforementioned explanatory variables, we include also $liquidity_i$ that stands for the ratio of liquidity over assets. Less liquid and less capitalized banks are more prone to market shocks and thus are likely to exhibit fuller long-term pass-through (Kashyap and Stein, 2000). Larger banks may use their market power and react less to market conditions (Berger, 1995). Banks with larger credit risk are likely to be more vulnerable to market conditions.

Note that, similarly to De Graeve et al. (2007), $\beta_{i,j}$, differs across the banks *i* and across the loan products, *j*. However, it has to be mentioned that we use mean group estimator is used for this exercise (which is less efficient than pooled mean group estimator, but this does not influence the estimated coefficients), as we find that the estimated parameters do not differ statistically significantly according to the Hausman test results in Table 6A in Appendix.

It is worth emphasizing that examining the determinants of pass-through in a cross-section of the banks, we use bank-specific averages over the sample period. As argued by De Graeve et al. (2007), this is possible, because the bank characteristics considered are largely structural and typically do not change substantially over time such as market position.

Following De Graeve et al. (2007), we do not investigate the determinants of short-term reaction of retail rates to money market rates, as they find that these are driven by largely same factors as for the long-term pass-through. To deal with heteroscedasticity arising from bank and products heterogeneity, De Graeve et al. (2007) opt for the generalized least squares estimator. In contrast to them, we deal with these issues employing the robust regression (see Rousseeuw and Leroy, 1987). In addition, we include the dummy variables for different loan products and a dummy for building societies, but fail to find it significant once bank characteristics are included.[10]

4 Results

Pooled mean group estimates are provided in Table 1 and Table 2 for the sub-period Jan 2004 – Jun 2006 and the sub-period Jul 2006 – Dec 2008, respectively. The DOLS-Swamy estimates for the full sample (Jan 2004 – Dec 2008) are presented in Table 3 and Table 4.

The pooled mean group estimates in Table 1 and 2 indicate that retail rates typically adjust to money market changes relatively fast, but often less than fully in the long run. This is in line with

[10] The consumer loans estimates are excluded from the analysis of determinants of interest rate pass-through due to its lack of cointegration with money market rates.

evidence for Belgian market by de Greave et al. (2007) as well as with previous evidence based on the Czech data by Egert, Crespo-Cuaresma and Reininger (2007). Mortgage rates adjust fully to money market rate shocks in about 2-3 month. Consumer rates exhibit high mark-up that corresponds with the fact that consumer loans are typically more risky than other types of loans. Consumer rates are not found to have long-term relationship with money market rates.[11] Our supposition for this finding is that the market is rather concentrated and at the same time, much less important for the banks in comparison to the market for mortgages.

The short-term reaction of corporate loans with floating interest rate is faster than of household rates and has a large value suggesting that most of money market shocks are absorbed within a month. The short-term reaction of corporate loans with fixed interest rate is insignificant. Large loans exhibit typically smaller mark-up than small loans. This may suggest some relationship lending; we deal with this issue more comprehensibly below.

The results in Table 1 based on 2004:1-2006:6 data are similar to those presented in Table 2 (based on 2006:7-2008:12 data) except that the long-term pass-through seem to decrease somewhat in a later period. The results based on average rates are in most cases similar to those based on median rates and are available upon request. As for this latter period, we also introduce a "global financial crisis" dummy in the long-term equation to investigate, if the spread between money market and retail rate increases statistically significantly during in the period of financial distress (dummy variable takes the value of one in 2008:1-2008:12 and alternatively 2008:6-2008:12, zero otherwise). Dummy variable is never found to be significant, albeit for certain interest rates on corporate loans the corresponding p-values are between 0.11-0.15.

The mean group estimates, as presented in Table 4A and 5A in Appendix, typically confirm our previous findings based on the pooled mean group estimator, except the fact that standard errors are sometimes larger. This is in line with the results on Hausman test, which is reported in Table 6A in Appendix.[12] Except for few cases, we do not reject the null hypothesis that pooled mean group estimator is more efficient than mean group estimator. This allows us to assume homogenous long-run slopes, which implies that banks exhibit homogenous pricing behavior in the long-term, hence supporting the notion of law of one price.

[11] The results confirm the cointegration test findings, namely that we cannot reject the null hypothesis that there is not is a cointegration relation between the policy induced rates and consumer rates.

[12] See Pesaran et al. (1999) and Blackburne and Frank (2007) for Hausman test within the context of pooled mean group and mean group estimation techniques.

We also test for the coefficients equality across the individual banks and reject the null of common slope coefficients in the short-term for all loan categories. This implies that short-term reaction of retail interest rates to money markets shocks is heterogeneous, i.e. it differs bank by bank. The results are reported in Table 7A in Appendix. Therefore, panel data estimators that impose common slope, which is typical for this stream of literature with the exemption of few studies (De Graeve et al., 2007), are likely to be inconsistent. Our findings are also in line with Gambacorta (2008), who finds that bank pricing policies are heterogeneous in the short-term, but homogenous in the long-run in a sample of Italian banks.

Table 1 – Interest Rate Pass-Through Estimates:
Pooled Mean Group Estimator, 2004:1-2006:6, Median Rate

	Pooled mean group estimates				
Household rates	$\alpha_{0,i}$	$\beta_{0,i}$	β_1	μ	Mean adjustment lag
Mortgage rate	0.18	-0.23***	0.90***	2.44***	3 months
	(0.27)	(0.09)	(0.22)	(0.51)	
Consumer rate	-0.66	-0.41***	0.33	6.46***	---
	(0.75)	(0.13)	(0.58)	(1.30)	
Firm rates					
Small loan, floating rate	0.73**	-0.35***	0.86***	1.90***	1 month
	(0.32)	(0.07)	(0.11)	(0.22)	
Small loan, fixed rate	-0.26	-0.30	0.73***	3.22***	3 months
	(0.60)	(0.30)	(0.16)	(0.40)	
Large loan, floating rate	0.87*	-0.51***	1.24***	0.24	1 month
	(0.53)	(0.10)	(0.11)	(0.22)	

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Mean adjustment lag is calculated as $(\beta_1 - \alpha_0)/\beta_0$. The resulting number is rounded. Mean adjustment lag is calculated only for the series that have significant long-run relationship.

Table 2 – Interest Rate Pass-Through Estimates:
Pooled Mean Group Estimator, 2006:7-2008:12, Median Rate

	Pooled mean group estimates				
Household rates	$\alpha_{0,i}$	$\beta_{0,i}$	β_1	μ	Mean adjustment lag
Mortgage rate	0.03	-0.19**	0.36***	3.87***	2 months
	(0.16)	(0.08)	(0.09)	(0.24)	
Consumer rate	0.15	-0.45***	0.31	6.31***	---
	(0.37)	(0.14)	(0.19)	(0.49)	
Firm rates					
Small loan, floating rate	0.58***	-0.15***	0.77***	2.83***	1 month
	(0.12)	(0.06)	(0.06)	(0.23)	
Small loan, fixed rate	-0.10	-0.29***	0.57***	2.98***	2 months
	(0.88)	(0.09)	(0.12)	(0.41)	
Large loan, floating rate	0.45**	-0.50***	0.96***	0.56***	1 month
	(0.18)	(0.08)	(0.04)	(0.15)	

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Mean adjustment lag is calculated as $(\beta_1 - \alpha_0)/\beta_0$. The resulting number is rounded. Mean adjustment lag is calculated only for the series that have significant long-run relationship.

Table 3 – Interest Rate Pass-Through Estimates:
DOLS-Swamy Estimator, 2004:1-2008:12, Median Rate on Loans

Household rates	$\alpha_{0,i}$	$\beta_{0,i}$	β_1	μ	Mean adjustment lag
Mortgage rate	-0.13	-0.34**	0.62***	3.2***	2 months
	(0.23)	(0.11)	(0.03)	(0.09)	
Consumer rate	0.2	-0.4***	-0.33	12.04***	---
	(1.13)	(0.12)	(0.20)	(0.44)	
Firm rates					
Small loan, floating rate	0.70**	-0.54***	0.94***	2.50***	1 month
	(0.15)	(0.11)	(0.06)	(0.15)	
Small loan, fixed rate	0.52	-0.49***	0.95***	2.85***	1 month
	(0.44)	(0.2)	(0.9)	(0.3)	
Large loan, floating rate	0.90***	-0.53***	0.81***	0.17***	< 1 month
	(0.27)	(0.1)	(0.03)	(0.1)	
Large loan, fixed rate	0.90	-0.80***	0.78***	2.40***	< 1 month
	(2.2)	(0.27)	(0.08)	(0.22)	

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Mean adjustment lag is calculated as $(\beta_1 - \alpha_0)/\beta_0$. The resulting number is rounded.

Table 4 – Interest Rate Pass-Through Estimates:
DOLS-SWAMY Estimator, 2004:1-2008:12, Median Rate on Deposits

Deposits rates	$\alpha_{0,i}$	$\beta_{0,i}$	β_1	μ	Mean adjustment lag
Maturity up to 2 years	0.66***	-0.61***	0.93***	-0.35***	< 1 month
	(0.09)	(0.09)	(0.02)	(0.03)	
Maturity above 2 years	0.68	-0.28*	0.47***	1.06	< 1 month
	(0.63)	(0.14)	(0.06)	(0.18)	

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Mean adjustment lag is calculated as $(\beta_1 - \alpha_0)/\beta_0$. The resulting number is rounded.

Table 3 and 4 present the results of the DOLS-Swamy methodology applied for the period 2004:1-2008:12. Regarding the results concerning loans (see Table 3), the error correction coefficient, so called 'speed of adjustment', is significant and negative in all cases considered showing the presence of a mechanism to bring back the retail rates to long-term equilibrium. For the retail rates to non-financial corporates, all four rates have a long-run pass through parameter (β_1) significant, but the long-run transmission is complete only for small loans. The fact that for large loans the long term parameter is smaller than one, hence incomplete pass through, may indicate the presence of relationship lending between banks and clients in case of large loans.

Regarding the immediate pass-through, α_0, within one-month, we notice positive and highly significant coefficients for the loan categories with floating retail rates both for small and large loans confirming that the floating rates follow very closely the money market rates. 70% of the transmission for small loans and 90% for large loans takes place within month. On the other

hand, the retail rates, which are set for more than one year do not react/respond within one month. The constant term in the equilibrium relation indicates the mark-up of the bank imbedding the competitive conditions in the market, risk, the elasticity of the demand, regulatory factors or maturity (de Bondt, 2005). Similarly to the results for the sub-periods in Table 1 and 2, the results indicate that large loans exhibit smaller mark-up than small loans.[13] Table 4 presents the estimates of interest rate pass-through for deposit rates. There is a clear error-correcting mechanism for both categories and the speed of interest rate pass-through seem to be high.

The interest rates on mortgage loans have a long-term coefficient significant but suggesting an incomplete transmission. Within one month, the mortgage loans do not respond to policy induced loans. The results for the interest rates on consumer loans confirm the findings from Table 1 and 2 and the results reveal a very high mark-up signalizing the perceived high risk associated with this type of loans.

In the context of the global financial crisis, we also followed the coefficients for the period January 2008-December 2008 in comparison with the coefficients for the whole period under observation to capture any difference in the pass-through.[14] Regarding the corporate loans with floating rates we can notice a slightly smaller pass through for small loans and a smaller speed of adjustment for large loans. In the case of loans with the fixed rates, we do not see any significant difference. The only difference in the case of household loans, i.e. mortgage loans, pertains also to the speed of adjustment, namely a lower speed of adjustment. In the context of decreasing market rates, these finding could signalize banks' reluctance to follow the money rates as a result of strengthened bank prudence and the aim to avoid projects involving moral hazard.[15]

It is noteworthy that our results envisaging the interest rates on loans to non-financial sector are not fully comparable with the literature, in particular with those studies for the euro area (i.e de

[13] For the category large loans with fixed rate we have only data for 7 banks (similarly for deposits with maturity above two years), as many small banks grant this type of loans only from time to time. Therefore, the estimates for this category are provided only in Table 3 and not Table 1 and 2. We apply pooled mean group estimator in Table 1 and 2, which relies on the assumption of large N and large T, which is obviously not met for N=7. The share of corporate loan rate with fixed interest rate is not high and amounts only about 10% (Financial Stability Report, 2007). Therefore, the results on loans with floating rates are much more important from the macroeconomic perspective. Next, we also estimate the interest rate pass-through with data on 3 large banks only, but do not find any systematic differences.

[14] Practically, we have tested whether the coefficients for the period 2008:1-2008:12 are somehow different from the results envisaging the whole span.

[15] An analysis of average standard deviation over large banks' standard deviations of monthly distributions show an increasing trend in the second part of 2008 for floating rates. This is likely to indicate that banks are differentiating between clients as a result of deterioration in borrowers' risk profiles and increasing bank prudence. The results are available upon request.

Bondt, 2005) because our data are not structured according to maturity of loans (as the data used in most of previous literature), but according to the time span for which the interest rate is fixed, as the current EU standards require.

Table 5 – Determinants of Interest Rate Pass-Through,
Cross-section of Czech Banks, Robust Regression, 2004:1-2006:6

	Dependent variable	
	Spread	LT PT
Liquidity	-0.04*	0.03*
	(0.02)	(0.02)
Capital Adequacy	-0.08*	-0.12
	(0.04)	(0.22)
Inefficiency	0.48	-0.56
	(0.91)	(2.25)
Deposits	5.25***	-2.59***
	(1.67)	(0.64)
Bank Size	-0.08**	0.03***
	(0.03)	(0.01)
Credit Risk	2.01	0.28**
	(2.69)	(0.13)
Adjusted R-squared	0.45	0.43

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. LT PT stands for the long-term pass-through, $\beta_{1,i}$. Spread, μ_i, is a constant from error correction equation.

We present the results on how bank characteristics influence the nature of interest rate pass-through in Table 5. We have chosen to apply the robust regression instead of more typical ordinary least squares, as the sample size is not large and we have spotted some outliers among the bank characteristics. Following Goodall (1983), the tune for robust regression is chosen to be 7.

We provide the results on the determinants of spread as well as the long-term pass-through. The choice of determinants follows de Graeve et al. (2007), who analyze the determinants of pass-through in the Belgian market. In addition to their set of explanatory variables, we also include credit risk as the additional potential determinant of interest rate pass-through.

As concerns the spread, we find that more capitalized banks charge lower spread. This contrasts with the prediction of Ho and Saunders (1981) dealership model, where net interest rate margins should increase the capital base as the exposure to risk increases. Our finding is rather in line with the hypothesis raised by Brock and Franken (2003), who put forward that less capitalized banks have the motivation to accept more risk (associated with higher spread) in order to receive higher

returns. Analogously, more capitalized banks invest more cautiously, as there is more capital at risk (Brock and Franken, 2003). Banks exhibit larger spread, if their funding depends more heavily on deposits (our proxy for relationship lending). This complies with the hypothesis put forward by Berlin and Mester (1999) that the banks with a stable pool of deposits smooth market shocks for customers and as a compensation for stable retail interest rates maintain higher spread. Indeed, our results for the long-term pass-through support this supposition, as we find that $deposit_{i,j}$ have a negative effect on the long-term pass-through, i.e. evidence that banks provide loan rate smoothing. Large banks set lower margins, which is suggestive of economies of scale (see Horvath, 2009, on related evidence on which factors drive net interest margin of Czech banks). Inefficiency[16] and credit risk are found to increase the spread, but their effects are not statistically significant (if we use credit risk as single regressor, it becomes significant). All in all, the results show that bank financial characteristics affect the spread.

As regards the long-term pass-through, the evidence suggests that there is certain loan rate smoothing, as the variable $deposit_{i,j}$ has a negative sign. In other words, the results imply that the bank with a greater degree of relationship lending smoothes the loan rates more (Berlin and Mester, 1999 and Gambacorta, 2008) and broadly supports the findings of Geršl and Jakubík (2009) on the relationship banking in the Czech Republic. Nevertheless, this result stands in contrast to evidence on Belgium, which do not find relationship lending significant (De Graeve et al., 2007). The results also indicate that large banks' pricing policies are more sensitive to money market shocks in comparison to small banks. Interestingly, the effect of liquidity is positive, which is at variance with Kashyap and Stein (2000) and Pruteanu-Podpiera (2007) findings that less liquid banks are more vulnerable to market conditions (see also De Graeve et al., 2007, that find a negative effect of liquidity). We hypothesize that this finding is due to high liquidity that the Czech banks maintained during our sample period (see Financial Stability Report, 2007). Greater credit risk increases the sensitivity to money market shocks. This suggests that in case of financial distress, such as in the current global financial crisis, the money market shocks are likely to have a stronger effect on bank retail pricing policies.

5 Concluding Remarks

In this paper, we estimate interest rate pass-through from money market to bank retail rate using various heterogeneous panel cointegration techniques to address bank heterogeneity. Based on

[16] The results on inefficiency should rather be taken with caution, as the result may be due to the overly simplistic (although commonly used) measure of the inefficiency we use.

our data from the Czech Republic, the results indicate that interest rate pass-through differs across the bank (rendering estimators that impose common slope parameters inconsistent) in the short-term and the pricing becomes homogeneous in the long-term supporting the notion of law of one price (see Gambacorta, 2008, for similar evidence on Italian banks). Mortgage rates and firm rates typically adjust to money market changes relatively fast, but less than fully in the long-run (this is in line with Belgian evidence by de Greave et al. 2007). Large corporate loans have smaller mark-up than small loans. Consumer rates have a high mark-up and do not exhibit cointegration relationship with money market rates.

We also investigate how bank characteristics influence the nature of interest rate pass-through in the cross-section of Czech banks. There is evidence for relationship lending, as banks with a stable pool of deposits smooth retail rates and require higher spread as compensation. We find no evidence that large banks price their products less competitively. Greater credit risk increases the vulnerability to money market shocks. This suggests that in case of financial distress, such as in the current global financial crisis, the money market shocks are likely to have a stronger effect on bank retail pricing policies.

In terms of future research, we propose the following direction for empirical investigation. Small open economy such as the Czech Republic, which is in a process of integration into the European Union structures exhibits very high penetration of foreign banks. In consequence, the euro area money market interest rates and not only domestic rates might be important for determination of domestic bank retail interest rates, too. Nevertheless, our results (available upon request) suggest that euro area money market rates do not matter for Czech interest rate pass-through. This probably reflects the fact that the loans are typically granted in a domestic currency (for example, there are virtually no mortgages granted in foreign currency, see Financial Stability Report, 2007). On the other hand, we believe that in countries with substantial borrowing in foreign currencies such as in Hungary or in Baltic countries, foreign money market rates may be a vital determinant of domestic money market rates, too.

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APPENDIX

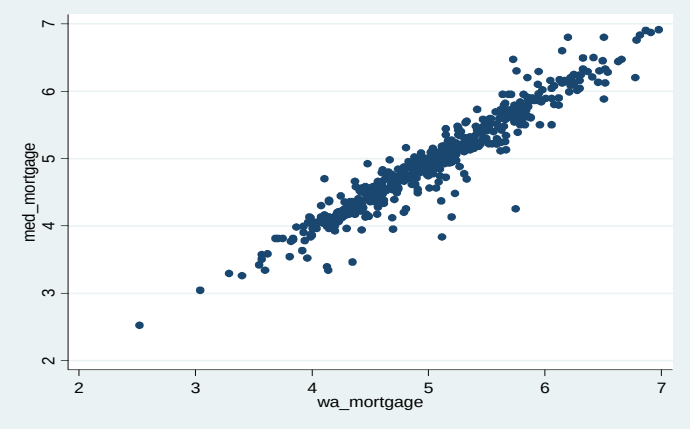
DESCRIPTIVE STATISTICS

HOUSEHOLDS

Table 1A – Descriptive Statistics

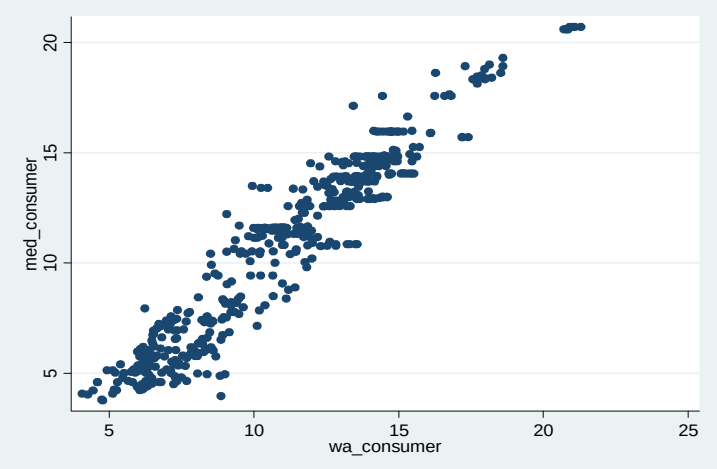
Interest rate	Mean	St. Dev.	Min	Max
Mortgage – weighted average	5.04	0.71	2.52	6.98
Mortgage – median	4.94	0.76	2.52	6.91
Consumer – weighted average	11.05	3.55	4.07	21.31
Consumer – median	10.78	4.10	3.76	20.70

Figure 2A – Mortgage rates– Bank-Specific Average vs. Median Rates



Note: med stands for median rates, wa for weighted average rates

Figure 3A – Consumer rates – Bank-Specific Average vs. Median Rates

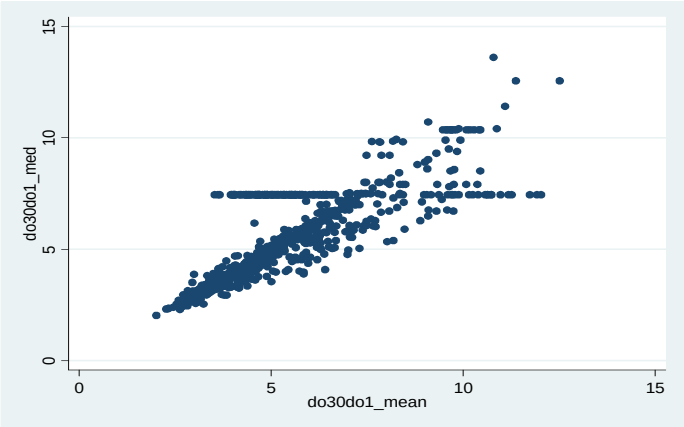


Note: med stands for median rates, wa for weighted average rates

Table 2A – Descriptive Statistics

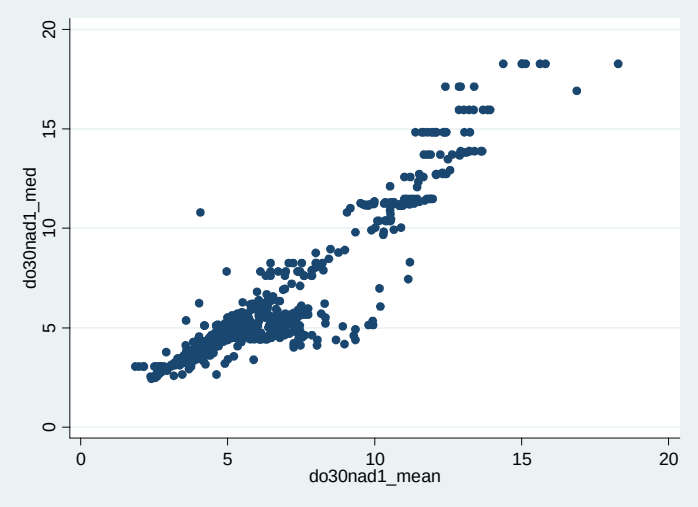
Interest rate	Mean	St. Dev.	Min	Max
Small loan, floating rate - median	5.25	1.88	2.02	13.6
Small loan, floating rate - weighted average	5.22	1.89	0.29	12.53
Small loan, fixed rate – median	6.16	3.25	2.43	18.27
Small loan, fixed rate – weighted average	6.46	2.75	1.86	18.29
Large loan, floating rate – median	3.98	1.28	1.10	15.94
Large loan, floating rate – weighted average	4.08	1.23	0.66	15.02
Large loan, fixed rate – median	4.50	1.26	2.00	10.47
Large loan, fixed rate - weighted average	4.57	1.20	.44	9.77
Short-term deposits	2.10	0.72	0.80	4.83
Long-term deposits	2.47	0.88	0.50	4.60

Figure 4A – Small Loans, Floating Rate – Bank-Specific Average vs. Median Rates



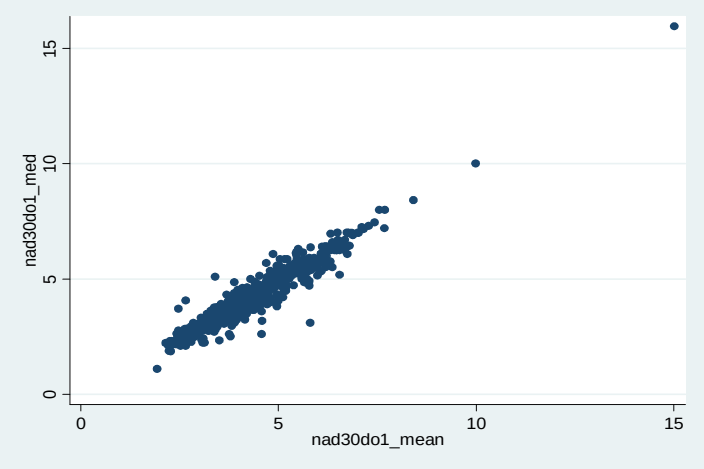
Note: med stands for median rates, mean for weighted average rates

Figure 5A – Small Loans, Fixed Rate – Bank-Specific Average vs. Median Rates



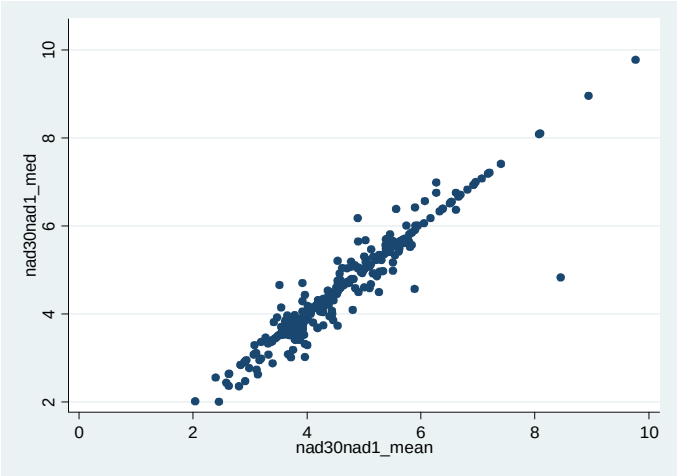
Note: med stands for median rates, mean for weighted average rates

Figure 6A – Large Loans, Floating Rate – Bank-Specific Average vs. Median Rates



Note: med stands for median rates, mean for weighted average rates

Figure 7A – Large Loans, Fixed Rate – Bank-Specific Average vs. Median Rates



Note: med stands for median rates, mean for weighted average rates

Figure 8A – Money Market Rates

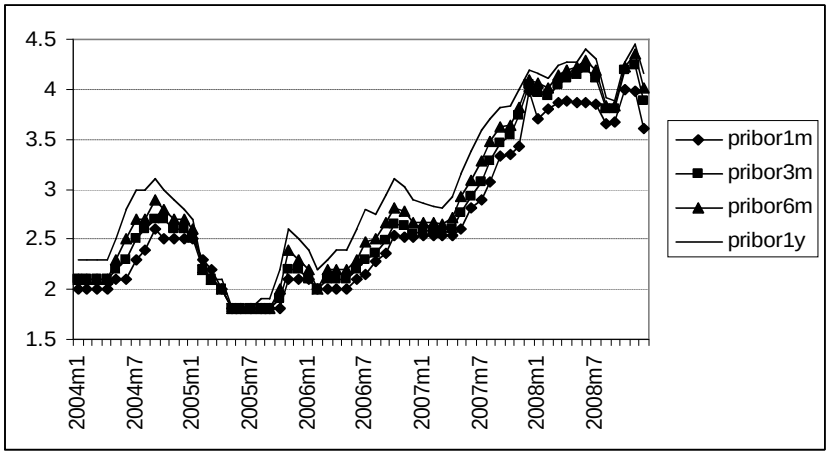


Table 3A – Average correlations with market rates of different maturities

Bank rates	1MPRIBOR	3MPRIBOR	6MPRIBOR	1YPRIBOR
Deposit rates				
Maturity up to 2 years	0.932	0.921	0.91	0.876
Maturity over 2 years	0.600	0.614	0.61	0.611
Loan rates				
Non-financial sector				
Up to 30mil CZK				
floating and fixed to 1y	0.816	0.811	0.801	0.779
fixed more than 1y	0.594	0.602	0.607	0.614
More than 30mil CZK				
floating and fixed to 1y	0.685	0.681	0.68	0.67
fixed more than 1y	0.598	0.599	0.557	0.555
Household sector				
Mortgage loans	0.617	0.614	0.602	0.583

Table 4A – Interest Rate Pass-Through Estimates: Mean Group Estimator, 2004:1-2006:6, Median Rate

	Mean group estimates				
Household rates	$\alpha_{0,i}$	$\beta_{0,i}$	$\beta_{1,i}$	μ	Mean adjustment lag
Mortgage rate	0.21	0.34***	1.59	0.67	---
	(0.24)	(0.10)	(1.49)	(4.55)	
Consumer rate	-0.39	0.82***	-27.1	76.4	---
	(1.18)	(0.22)	(27.3)	(66.5)	
Firm rates					
Small loan, floating rate	0.73**	0.35***	0.86***	1.90***	1 month
	(0.32)	(0.07)	(0.11)	(0.22)	
Small loan, fixed rate	-0.29	0.48	0.39	4.99***	---
	(0.65)	(0.32)	(0.37)	(0.40)	
Large loan, floating rate	2.31**	1.02***	5.32	-12.02	---
	(1.14)	(0.11)	(4.44)	(13.72)	

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Mean adjustment lag is calculated as $(\beta_1 - \alpha_0)/\beta_0$. The resulting number is rounded. Mean adjustment lag is calculated only for the series that have significant long-run relationship.

Table 5A – Interest Rate Pass-Through Estimates: Mean Group Estimator, 2006:7-2008:12, Median Rate

	Pooled mean group estimates				
Household rates	$\alpha_{0,i}$	$\beta_{0,i}$	β_1	μ	Mean adjustment lag
Mortgage rate	0.17	0.29***	0.88	2.95*	2 months
	(0.12)	(0.10)	(0.62)	(1.79)	
Consumer rate	0.05	0.66***	-2.09	16.24***	---
	(0.49)	(0.20)	(1.64)	(5.70)	
Firm rates					
Small loan, floating rate	0.65***	0.63***	1.02***	1.81***	1 month
	(0.09)	(0.09)	(0.11)	(0.58)	
Small loan, fixed rate	-0.30	0.68***	0.75**	4.19***	2 months
	(0.66)	(0.09)	(0.29)	(0.95)	
Large loan, floating rate	0.54***	0.85***	0.77***	1.69***	1 month
	(0.16)	(0.07)	(0.15)	(0.63)	

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Mean adjustment lag is calculated as $(\beta_1 - \alpha_0)/\beta_0$. The resulting number is rounded. Mean adjustment lag is calculated only for the series that have significant long-run relationship.

Table 6A – Interest Rate Pass-Through, Hausman test, 2004:1-2006:6
(H0: Pooled mean group estimator is more efficient)

	Hausman statistic	P-value		Hausman statistic	P-value
Mortgage - median	3.11	0.21	Small loan, floating rate - median	1.28	0.52
Mortgage - average	1.86	0.39	Small loan, floating rate - average	6.97**	0.03
Consumer - median	9.16**	0.01	Small loan, fixed rate - median	3.14	0.21
Consumer - average	7.33*	0.03	Small loan, fixed rate - average	1.54	0.46
Large loan, fixed rate - median	2.12	0.35	Large loan, floating rate - median	3.27	0.20
Large loan, fixed rate - average	1.86	0.39	Large loan, floating rate - average	4.27	0.11

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively.

Table 7A – Do Bank Pricing Policies Differ in the Short-Term?
Wald Test of Equality of Coefficients, 2004:1-2006:6
(H0: Bank Pricing Policies are Homogeneous in the Short-Term)

	$\alpha_{0,i}$	$\beta_{0,i}$
Household rates		
	32.65**	62.19***
Mortgage - median	(0.02)	(0.00)
	9.59	117.33***
Consumer - median	(0.56)	(0.00)
Firm rates		
	14.49	100.64***
Small loan, floating rate - median	(0.75)	(0.00)
	4.03	34.24***
Small loan, fixed rate - median	(0.40)	(0.00)
	16.45	107.50***
Large loan, floating rate - median	(0.62)	(0.00)
	6.42	1.45
Large loan, fixed rate - median	(0.18)	(0.81)

Note: ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Null hypothesis is that all coefficients across banks are equal. The test statistic is distributed as chi-square with *n-1* degrees of freedom. Test statistic with p-value in the brackets is presented.