

NBP Working Paper No. 179

Interest rate pass-through in Poland. Evidence from individual bank data

Ewa Stanisławska



NBP Working Paper No. 179

Interest rate pass-through in Poland. Evidence from individual bank data

Ewa Stanisławska

Ewa Stanisławska – Economic Institute, Narodowy Bank Polski; Ewa.Stanislawska@nbp.pl

Opinions expressed in the paper are those of the author and should not be interpreted as a view of the Narodowy Bank Polski. The author would like to thank to Anna Sznajderska and Tomasz Łyziak for their comments and discussions, and to Norbert Cieśla for explaining issues related to the dataset. The author is responsible for all mistakes and omissions.

Print:
NBP Printshop

Published by:
Narodowy Bank Polski
Education & Publishing Department
ul. Świętokrzyska 11/21
00-919 Warszawa, Poland
phone +48 22 653 23 35
www.nbp.pl

ISSN 2084-624X

© Copyright Narodowy Bank Polski, 2014

Contents

Abstract	4
1. Introduction	5
2. Review of literature	8
2.1. Sluggishness of interest rate transmission	8
2.2. Heterogeneity in interest rate transmission across individual banks	10
3. Data description	15
3.1. Interest rates	15
3.2. Individual bank characteristics	18
4. Interest rate transmission in the short- and long-run	21
4.1. Long run relationship	21
4.2. Short run adjustment	24
5. Individual bank characteristics and interest rate pass-through	31
5.1. Results from two-step procedure	31
5.2. Results from one-step procedure	35
6. Conclusions	39
References	42
Appendix 1. Results of cointegration tests	47
Appendix 2. Result of estimation of the ECM equation (3) – two step procedure	48
Appendix 3. Result of estimation of the ECM equation (4) – one step procedure	54

Abstract

The paper employs on individual bank data with aim to analyse interest rate pass-through from money market rates to banks' deposits and lending rates. In the first step, the speed and completeness of interest rate adjustment is assessed. As the sample covers period prior to and after the outburst of the financial crisis, some comparisons of interest rate transmission process in these periods are made. In the second step, the influence of individual banks characteristics, like size, strength of deposit base, quality of credit portfolio, etc., on the features of interest rate transmission is examined. It seems that their impact is not strong, as they affect rather the speed of adjustment than its scale in the long term.

JEL Classification: E52, E43, G21

Keywords: interest rates pass-through, monetary policy transmission mechanism, interest rate channel

1. Introduction

Interest rate channel of monetary policy operates in two steps. Firstly, monetary policy decisions are transmitted to the money market rates and subsequently from the money market rates to banks' retail rates. The first stage is usually efficient, as the adjustment is typically quick and complete. This paper focuses on the second step of this transmission process. The underlying assumption of the analysis is that banks set their interest rates in relation to the marginal cost of funding which is approximated by the money market rate. Usually, the relevant market rate is chosen – for a given retail rate – based on the highest correlation or on maturity matching.

As documented in the literature, there is a considerable sluggishness in the interest rates adjustment and, in many cases, even in the long run the pass-through is not complete. Moreover, imperfections in the interbank market might result in that some banks transmit monetary policy decisions more efficiently than others. The aim of this paper is twofold. Firstly, I want to assess basic features of the interest rate transmission process to deposit and lending rates in the Polish banking system. As the sample covers period of money market disturbances resulted from the global financial crisis, some conclusions are made about changes in the pass-through after this event. Secondly, I test whether the interest rate pass-through is affected by some individual banks' features. Namely, these are bank characteristics related to the credit view on the monetary policy transmission, like bank's size, liquidity and capital position, as well as to bank's refinancing strategy (from non-financial sector deposits or from the money market), to kind of relations with clients (relationship banking) and to quality of credit portfolio.

The analysis is conducted with use of standard panel econometric methods, like cointegrating techniques and error correction models. The novelty of the paper lies in presenting new piece of evidence on this subject for the Polish economy. Most of

the research on interest rate pass-through in Poland has been done on aggregated level (e.g. Wróbel and Pawłowska 2002, Égert 2004, Demchuk *et al.* 2012, Sznajderska 2012). Analysing panel data give a little bit different perspective on interest rate transmission. Rather than delivering estimate of pass-through to (weighted) average deposit and lending rates in the banking sector, it attempts to provide average pass-through across banks. The other advantage of using panel data is that it delivers more accurate estimates of parameters due to larger number of observations and more variability (e.g. Hsiao 2006). The only study employing individual bank data was conducted in 2003 (see: Chmielewski 2003). Since then the Polish economy underwent several changes, like growing importance of the financial system, introducing constant inflation target by the Monetary Policy Council, accession to the EU, etc., which most likely affected interest rate transmission.¹ Therefore, the need to update these results is well-grounded. Moreover, in the part of the paper devoted to heterogeneity of interest rate pass-through, a larger set of bank indicators is taken under consideration. The second contribution of the paper is to assess changes in the interest transmission since the outbreak of the financial crisis. As presented in Demchuk *et al.* (2012), the crisis strongly disturbed functioning of the money market and some long run relationships between money market rates and banks' retail rates have become unstable. As now more time has passed since the beginning of the financial crisis, more in-depth analysis is possible.

The structure of the paper is the following. First section contains short review of related literature. It is followed by description of the data applied. The study employs individual bank statistics on interest rates of various deposit and credit products. The third section presents results on long- and short-term pass-through obtained based on the full sample period, as well in two sub periods marked out by beginning of the severe phase of the financial crisis after collapse of Lehman Broth-

¹ For synthetic description of structural characteristics of the Polish economy (and their development over time) affecting monetary transmission mechanism see Kapuściński *et al.* (2014).

ers. The completeness of interest rate transmission and the speed of adjustment are assessed. The forth section focuses on heterogeneity of interest rate pass-through across banks. Two approaches are taken: assuming homogeneity in the long run adjustment and allowing for dependency of the long-run multipliers on investigated individual bank features. The last section concludes.

2. Review of literature

2.1. Sluggishness of interest rate transmission

The empirical evidence on sluggishness of interest rate pass-through to retail rates is well documented – see e.g. Cottarelli and Kourelis (1994), Borio and Fritz (1995), Gigineishvili (2011), Saborowski and Weber (2013) for cross country comparisons; Mojon (2000), de Bondt (2002), Sander and Kleimeier (2004), Sørensen and Werner (2006) for results for the euro area as a whole or for its core economies; Sander and Kleimeier (2006), Egert *et al.* (2004, 2006) – for evidence for Central and Eastern European countries, and Jamilov and Égert (2013) for Caucasian countries. There are also numerous papers focusing on interest rate transmission in individual economies, e.g. De Grauwe *et al.* (2007) – Belgium, Frappa *et al.* (2008) – France, Hofmann and Mizen (2004) – UK, Schluter *et al.* (2012) – Germany, Montagnoli *et al.* (2012) – Italy; Wróbel and Pawłowska (2002), Chmielewski (2003) – Poland.

Based on this considerable amount of evidence on features of the interest pass-through several conclusions might be made. First of all, transmission of interest rate is usually sluggish and sometimes not complete. The speed of adjustment and scale of pass-through in the long run is heterogeneous across bank products. Typically, lending rates to firms adjust at the greater pace, while rates on consumer credit and on short term deposits at slower pace (e.g. Mojon 2000, Sørensen and Werner 2006, de Bondt 2002). Some studies pointed on weaker transmission to products offered to consumers in comparison to products offered to firms (De Grauwe *et al.* 2007), and to slower adjustment of deposit rates than of lending rates (Hofmann and Mizen 2004). As reasons of lagged and/or not complete pass-through there are mentioned menu and switching costs (preventing banks from following every interest rate change and customers from changing a bank in search for better offer), problems related to asymmetric information (like adverse selection and moral hazard), banks' market power and not perfectly elastic demand for loans and deposits (re-

lated to limited access to alternative financing sources and to existence of close substitutes for deposits) (for discussion see: Mojon 2000 or de Bondt 2002). Secondly, the features of interest rate pass-through differ on the economy level, which is usually linked to the structure the financial system and its characteristics, especially the level of bank competition, but also scale of excess liquidity in the banking sector, financial development and credit quality. Moreover, the strength of interest rate transmission depends on macroeconomic variables, like: interest rate variability, inflation level, GDP growth.² Thirdly, some asymmetries in the interest rate transmission have been identified. It seems that larger interest rate changes are transmitted faster than smaller ones, which is in line with existence of menu costs (e.g. Hofman and Mizen 2004, De Grauwe *et al.* 2007). The evidence on asymmetry with regard to direction of interest rate changes is less conclusive (e.g. Mojon 2000, Hofman and Mizen 2004, Greenwood *et al.* 2012).

When it comes to Poland, the early literature indicated complete long-term pass-through of most of deposit rates and for short- and medium-term lending rates to firms, while less than complete pass-through for lending rates on consumer credit. The mean adjustment lag amounted to 2.5 – 4.1 months in case of deposit rates, and a little bit shorter, ranging from 1.8 to 3.8 months, in case of lending rates (Wróbel and Pawłowska 2002). More recent results (Demchuk *et al.* 2012) point on comparable scale of transmission to households' and firms' deposit rates (which is close to one), and relatively faster speed of adjustment in case of firms than households. When it comes to lending rates, the long term pass-through is complete in case of loans for housing purposes, loans to households and firms' credit in current account, contrary to very low (about 0.5) pass-through coefficient for loans to sole proprietors. It should be stressed, however, that long run relations between money market rates and banks' retail rates became distorted after the outbreak of the fi-

² For discussion of factors affecting cross country heterogeneity in the euro zone countries see: Mojon (2000), Sander and Kleimeier (2004), Sørensen and Werner (2006), while for a wider perspective: Gineishvili (2011) or Saborowski and Weber (2013).

nancial crisis. Chmielewski (2003) tested for asymmetry in the interest rate pass-through with respect to the sign of disequilibrium, but did not find it significant. Sznajderska (2012) investigated several types of asymmetries in the interest rate transmission. She found some evidence in favour of asymmetry, *inter alia*, with regard to magnitude of disequilibrium (i.e. that larger deviations from the equilibrium are adjusted faster than smaller deviations) and to liquidity level of the banking sector.

Several papers addressed a question on consequences of the financial crisis for interest rate transmission from money market rates to deposit and lending rates (e.g. Jobst and Kwapił 2008, Hristov *et al.* 2012, Harbo Hansen and Wetz 2011, Illes and Lombardi 2013, ECB 2013). The main issue concerned normalizing (or its lack) of elevated spreads between retail and money market rates. Illes and Lombardi (2013) showed that in major economies of the euro area decreases in policy rates were transmitted to lending rates only to limited extent due to higher risk premium. In Italy and Spain spreads were remaining on elevated levels, while in Germany and France they started to decrease. Aristei and Gallo (2012) based on results obtained from Markov-switching vector autoregressive model concluded that the immediate reaction of retail rates to changes in market rates became weaker in the euro area, but at the same time the reaction to disequilibrium between these two types of rates strengthened. Hristov *et al.* (2012) also analysed interest rate transmission in the euro area and found that the interest rate pass-through during the financial crisis became less complete for both deposit and lending rates.

2.2. Heterogeneity in interest rate transmission across individual banks

Generally speaking, there are three approaches to investigating heterogeneity of interest rate pass-through within the ECM framework. The first one consists in estimating ECM model for two or more groups of banks categorised according to the features of interest, and comparing its parameters (e.g. Weth 2002). This approach

is straightforward and requires only limited information about individual banks (as bank specific averages are used to classify individual institutions). The disadvantage is that each bank characteristic is treated separately, so connections between the analysed features are not taken under consideration. In the second approach, instead of creating groups of banks with similar characteristics, individual bank indicators are included in the ECM equation as an interaction term (e.g. Gambacorta 2008). This allows possibility of including several individual banks' indicators in one equation. In the most recent approach panel of banks is treated as heterogeneous, so parameters of the ECM equation crucial from the point of view pass-through are allowed to vary from bank to bank. Having obtained estimates of these parameters for individual banks, they are regressed (for various interest rates categories at once) on individual bank characteristics (e.g. De Grauwe *et al.* 2007). The use of heterogeneous panel methods is recommended in case of panels with large time and cross section dimension.

In this paper the first approach is employed due to some data constrains. First of all, interest rate statistics includes relatively small number of banks, so heterogeneous panel models are not best suited. Moreover, in this approach it is assumed that given bank feature affects all types of interest rate in the same way as data on various interest rates is pooled and this might not be true.³ Secondly, some financial indicators investigated are reported only on quarterly basis, while interest rate statistics are revealed each month. So employing model with interaction terms would restrict number of observations available.

In the literature various individual bank features were taken as a potential source of pass-through heterogeneity. Most of the studies indicate that heterogeneity refers in the first place to the speed of short run adjustment and vanishes in the long run

³ Pooling is used in order to increase number of observations in the second step of estimation.

(e.g. Weth 2002, Gambocorta 2008), but contrasting evidence is also present (e.g. De Grauwe *et al.* 2007).

The evidence on relationship between interest rate pass-through and bank size (measured by assets or loans) is ambiguous. Bernstein and Fuentes (2003) attained slower speed of adjustment of lending rates in bigger banks, Weth (2002), Horovath and Podpiera (2012) – faster adjustment, while Gambocorta (2008) found no significant size effect on interest rates transmission. Weaker reaction of banks' interest rates to changes in market rates in bigger banks is expected in connection to the credit channel view on transmission mechanism. Weth (2002) offered explanation of the opposite result referring to different types of client of large and small banks. Larger banks usually cooperate with larger companies, which have better access to other sources of credit⁴. This imposes these banks to follow market rates more closely than smaller banks. Bank's size might also serve as a proxy for efficiency.

Other two bank characteristics related to the credit channel view are liquidity and capital position. Evidence in line with this concept is found in De Grauwe *et al.* (2007) for Belgian banks and Gambocorta (2008) for Italian banks, as the former suggested lower long term pass-through to deposit and lending rates and the latter - lower immediate reaction of short term lending rate. Contrasting results for liquidity are presented by Horovath and Podpiera (2012) for the Czech Republic.

Empirical evidence indicates that interest rate pass-through to retail rates might be affected by the bank's structure of financing. Two issues might be considered here: how strong is the banks' deposit base and what is the maturity mismatch between deposits and loans. As argued by Berlin and Mester (1999), banks with high share of core deposits, which are inelastic to changes in interest rates, are able to adjust interest rates more sluggishly to market conditions than other banks. Slower interest rate adjustment in banks financing in greater scope with non-financial sector

⁴ Trade credit, corporate bonds, etc.

deposits is indicated by Weth (2002) and Gambocorta (2008). Additionally, Weth (2002) pointed out that the term structure of deposits and loans matters for the speed of adjustment: banks which in smaller degree refinance long term loans with long term deposits are more inclined to follow market rates closely than those for which this maturity mismatch is smaller.

Strong deposit base is sometimes considered as a proxy for relationship banking (e.g. De Grauwe *et al.* 2007, Horvath and Podpiera 2012), however alternative indicators, stressing long term character of relationship between banks and its clients – like ratio of long term loans to total loans (Gambocorta 2008) and sum of long term loans and deposits to total assets (Weth 2002) – are also employed. Banks pursuing relationship banking strategy are expected to make implicit risk-sharing agreements with clients and smooth interest rates (see e.g. Berlin and Mester 1999). De Grauwe *et al.* (2007), in contrast to Weth (2002) and Gambocorta (2008), have found this bank feature insignificant for interest rate transmission process.

Also quality of credit portfolio seems to affect interest rate setting by banks, especially by increasing margins (Gambocorta 2008; Horovath and Podpiera 2012). The influence on the speed of adjustment and long run pass-through is less conclusive (see: Horovath and Podpiera 2012, Bernstein and Fuentes 2003).

Among other sources of heterogeneity of interest rates efficiency and market share are included (De Grauwe *et al.* 2007, Horvath and Podpiera 2012).

Evidence on heterogeneity of interest pass-through in Poland is scarce. The only study based on individual bank data is Chmielewski (2003). His results indicate that in banks operating in more efficient way (with higher ROA indicator) the long run pass-through is greater and the speed of adjustment is higher, comparing to less efficient banks. Moreover, banks with lower capital adequacy ratio adjust their interest rates faster, which is in line with the credit view, and banks with worse

quality of credit portfolio transmit market rates to firms' lending rates in a quicker manner, while to deposit rates – more sluggishly.

3. Data description

3.1. Interest rates

The analysis covers period from January 2005 (when new methodology of interest rate statistics was introduced) to July 2013. As the global financial crisis – which took place between these two dates – caused distortions on the Polish interbank market, the whole sample is split into two sub-periods of a similar length: from January 2005 to August 2008 and from January 2009 to July 2013.⁵ This allows drawing some conclusions about changes in the interest rate transmission from market rate to retail rates since the beginning of the financial crisis.

The data about interest rates comes from statistics collected by Narodowy Bank Polski. During the analysed period 19 commercial banks reported their interest rates, however only about half of them participated in the statistics for the whole time (the panel is unbalanced). The final number of banks analysed is different however. Firstly, mergers and takeovers of banks were treated as establishing a new entity. Secondly, banks with the shortest interest rates series were excluded from the sample. As the result, the panel consisted of 13 - 17 individual banks, depending on the period analysed.

Despite relatively small number of banks which report their interest rates, their assets cover about 70-75% of the banking sector assets. In the analysis interest rates of various bank products have been taken under consideration. These are deposits of households and firms (total and classified according to maturity) as well as loans granted to households and firms (total and divided by purpose or amount). Only interest rates on new business in PLN are employed.

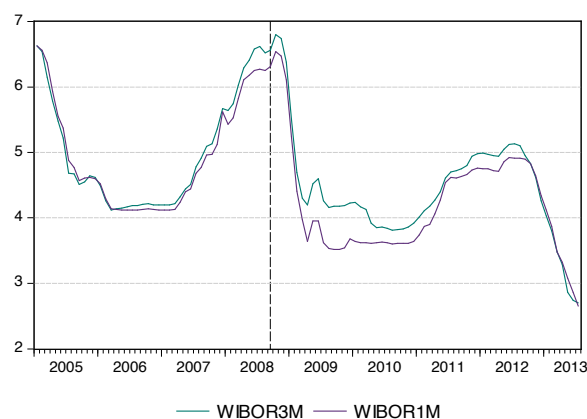
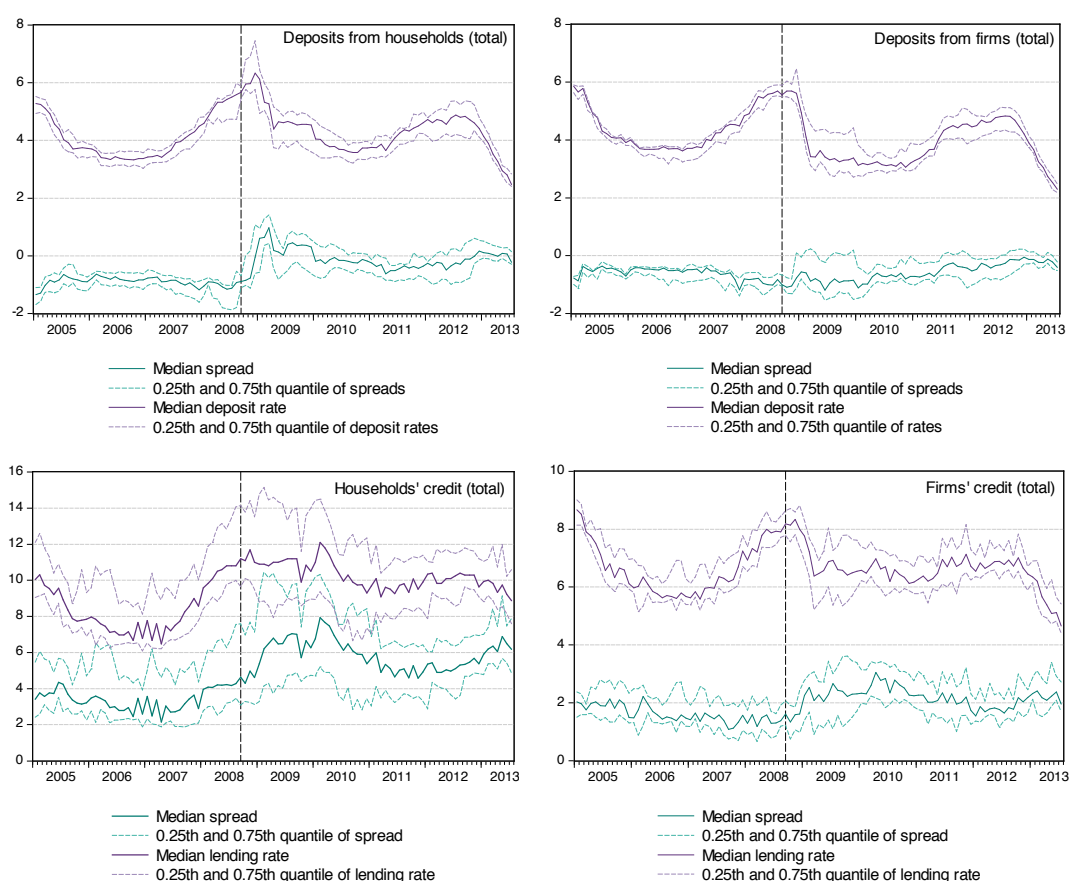
⁵ Months of the most severe distortions in the interbank market (September – December 2008) are excluded from the analysis.

As rates, in relation to which banks set their deposit and lending rates, money market rates with maturity of 1 month (WIBOR 1M) and 3 months (WIBOR 3M) were chosen. The first one is applied in case of rates on deposits with the shortest maturities, the second one for all other rates. Interbank market rates with longer maturities have not been taken under consideration, because their importance in transactions volume was quite low in first years of the sample and marginal after September 2008. Figure 2 shows development of interbank market rates and Figure 2 development of main categories of retail rates and spread to WIBOR 3M in the analysed period. Several observations might be made. Despite the fact that the analysed period is quite long and covers episodes of monetary policy tightening and easing, interest rate decreases prevailed. Assuming that there might be asymmetry in reaction of interest rates depending on direction of market rate changes, this might influence the outcomes.

It is clear from the figures that the financial crisis (vertical line marks its beginning dated on September 2008) affected retail interest rates.⁶ Since its' outbreak, the spreads between retail rates and market rates have narrowed in case of deposit rates and increased in case of lending rates. The size of change depends on retail rate category. The spread between median households' deposit rate and WIBOR 3M remains close to zero in the second sub-period, and in the months of the highest distortions in the interbank market took even positive values. When it comes to firms' deposits, median spread seems to stay unaffected, but its' 75th quantile moved to region of zero, suggesting that some banks had problems with acquire financing from the market. The spread on households' lending rate remains on much higher level than before the crisis, while spread on firms' lending rate seems to normalize.

⁶ For detailed discussion of disturbances in the interest rate transmission process see e.g. Demchuk *et al.* 2012.

Figure 1. Interbank market rates – WIBOR 1M and WIBOR 3M.

Figure 2. Retail interest rates on households' and firms' deposits and credits and spreads⁽¹⁾ to WIBOR 3M.⁽¹⁾Spread = retail rate – WIBOR 3M.

Source: own calculations based on the NBP data.

3.2. Individual bank characteristics

The second part of the paper addresses the problem of heterogeneity of pass-through process across banks. Several individual bank characteristics were taken under consideration as a potential source of this heterogeneity:

- related to the credit channel view (size, capital adequacy, liquidity),
- related to the structure of financing (share of non-financial sector deposits in liabilities),
- proxy for relationship banking (relation of long term businesses to total assets),
- quality of credit portfolio.

Each bank feature was assessed separately. Banks were assigned to one of two groups, with lower and higher value of a given characteristic, based on median value of this indicator.⁷ The data on individual banks' financial indicators comes from individual banks' statistics reported to the NBP and covers period from June 2007 to June 2013. This period is shorter than one employed in analysis of interest rate pass-through (January 2005 – June 2013). However, as these characteristics are of structural nature and only their mean values over time are needed, it is expected that this difference does not matter.

Credit channel view assigns special role to banks' size, capital and liquidity. Bank size is related also to structure of the banking sector, as bigger banks might exert their market power in setting interest rates, and to efficiency, as bigger banks usually are more effective. Bank's size is measured by total assets. Mean value of assets in banks classified to the first group is equal to about 18 000M PLN, while to the second group – about 74 000M PLN, but the range of individual values within each group is quite wide.

⁷ The indicator is corrected for cross section mean in given month/quarter. This transformation was necessary as some indicators followed a positive trend (e.g. assets) or showed cyclical behaviour (e.g. quality of credit portfolio) and the panel is unbalanced.

As a measure related to bank capital position, capital adequacy ratio was chosen as it reflects how well bank is equipped in capital in relation to risk it is taking. Average value of this indicator in the “low value” group amounts to 11.7% (which exceeds by large minimum requirement of 8%) and in the “high value” group amounts to 14.3%. Liquidity is measured as ratio of liquid assets (i.e. cash, current account and deposits at the NBP, NBP’s papers, treasury papers) to total assets. In general Polish banking sector is characterized by excess structural liquidity which might depreciate meaning of this feature for interest rate pass-through. Individual banks’ liquidity ratios are quite diversified, however.

Next indicator refers to bank’s financing strategy. The greatest role play here deposits from the non-financial sector. In the analysed period share of banks employing this strategy was quite stable and amounted to about 60-65% in terms of sector assets. The importance of financing from foreign capital increased in 2010 and 2011 (from about 6% to 17%), which might be connected to increase in credits in foreign currency, and started to lower since then (to 11% in 2013) (see NBP, 2013). The remaining banks (accounting to about 25-32% total banking sector assets) perused mixed financing strategy. When it comes to banks included in the analysis, in the group with lower value of this indicator the share of non-financial sector deposits in liabilities amounted to about 44%, while in the second group – to about 75%.

As a proxy for relationship banking a ratio of long term⁸ receivables from non-financial sector and liabilities to this sector to bank’s total assets was chosen (see Weth 2002). The greater value of this indicator suggests closer ties between bank and its clients.

The last indicator describes quality of credit portfolio. Share of non-performing loans to total loans granted to non-financial sector amounts to 5.1% in the first group of banks and 12.9% in the second group of banks.

⁸ With maturity above 1 year.

Table 1. Average values of financial indicators in banks divided into two groups.

Bank characteristic	Group 1	Group 2
Total assets (M PLN)	17 869	73 811
Capital adequacy ratio	11.7%	14.3%
Liquidity ratio	16.2%	33.3%
Share of non-financial sector deposits in liabilities	44.2%	74.8%
Ratio of long term receivables and liabilities to total assets	32.5%	57.4%
Non-performing loans to total loans	5.1%	12.9%

Source: own calculation based on NBP data.

As in estimation each bank characteristic is treated separately and distinction only into two groups is made, it's important to know how banks' categories are related to each other to avoid situation in which they are overlapping significantly. Based on Cramer's V and Spearman rank correlation coefficients it might be said that these relations are at most moderate. Bigger banks are more liquid, have larger deposit base and better quality of credit portfolio. Banks with higher capital adequacy ratio tend to have more liquid assets, and banks in which deposits play greater role in financing have usually better credit portfolios. Relationship between other indicators is rather small.

4. Interest rate transmission in the short- and long-run

4.1. Long run relationship

Analysis of the long run pass-through is conducted by estimating cointegrating relations between given retail rate and market rate, which is WIBOR 1M for deposits with maturity up to 1 month and WIBOR 3M for all other interest rate categories. Table 4 in the Annex 1 reports results of cointegration tests between these rates. Two versions of Pedroni panel cointegration test were conducted, one assuming common autoregressive process in the auxiliary regression, while the second – allowing for more heterogeneity – assuming individual autoregressive processes. Both tests indicate existence of cointegration at conventional significance level for all retail interest rates under consideration except rate of credit for consumption purposes. It seems that this interest rates type was in the long run relationship with WIBOR 3M before the financial crisis, but this relation has been disrupted since then. This result is consistent with the previous findings (see: Demchuk *et al.* 2012). Therefore consumer credit interest rate is excluded from the further analysis.

To estimate the long term pass-through dynamic OLS (DOLS) estimator was employed, as suggested by Kao and Chiang (2000). DOLS, contrary to OLS, is an unbiased estimator of the cointegrating relationship in the panel data context, and is preferred over the alternative FMOLS. As the number of cross-sections is relatively small, the pooled version of the DOLS estimator (which assumes homogeneity of the long run pass-through coefficients across sections) was chosen. This assumption is acceptable from the point of view of economic theory as in the long run banks should set their interest rates in the same way.⁹

The long term pass-through estimations are based on the following equation:

⁹ For discussion of pooled and mean group estimators see Pedroni (2001).

$$i_{n,t} = c_n + \beta mr_t + e_{n,t} \quad (1)$$

where $i_{n,t}$ denotes retail interest rate in n -th bank, mr_t – market rate, c_n – bank individual constant, β – long term pass-through coefficient. Additionally, in case of estimation on the whole sample a dummy variable (equal to 1 after September 2008 and 0 otherwise) is added in order to account for the potential impact of the financial crisis.

The results obtained for the whole sample (Table 2) indicate that market interest rates are fully transmitted to the firms deposit rates (total and for each maturity investigated) and to some rates of household deposits (those with maturity from 1 to 3 months and from 3 to 6 months). The long term pass-through (LTPT) for the remaining household deposit rates, i.e. those with the shortest and the longest maturity, amounts to 0.84 and 0.79, respectively. Turning to credit rates, the complete pass-through is obtained in the case of total household credit and credit to sole proprietors. The test statistics of the hypothesis of full LTPT for the last category of the households credit – i.e. for housing purposes – is on the verge of rejection. Interest rates of firms' loans, contrary to household loans, adjust to market rates in the long run only in about 80%. This would mean that banks smooth interest rates on firms loans.

If we divide the whole sample into two sub-periods (before and after the financial crisis), two observations might be made. First of all, the transmission to some deposit rates has become stronger. In the first sub-period interest rates of deposits, both households' and firms', did not adjust fully to the market interest rates (the LTPT estimates ranges from 0.78 to 0.93). In the second sub-period however, LTPT for total households deposits has increased (has become complete), due to higher pass-through of deposits with maturity from 1 to 3 months. The estimates of the LTPT of firms deposit rates have also increased and in most cases exceeded unity. Secondly, the scale of long term adjustment of lending rates has deteriorated. All

LTPT coefficients have decreased significantly below 1.¹⁰ These changes, at least partially, might be explained with reference to the consequences of the financial crisis for the Polish interbank market. After September 2008, due to increased banks' demand for non-financial sector deposits, interest rates on deposit jumped above WIBOR 3M rates. In 2009 normalization of the situation on the interbank market was accompanied by monetary policy easing, and deposit rates dropped below interbank rate again. This meant that in that period retail deposit rates decreased more strongly than market rates. When it comes to loan rates, the margins have increased after the financial crisis and banks have become more restrictive in granting loans. In the circumstances of falling interest rates this has resulted in smaller scale of the long term adjustment of lending rates.

The changes in the long term pass-through might be related not only to the consequences of the financial crisis but also to possibly asymmetrical reaction of interest rates in periods of falling and rising rates. As far as in the first sub-period there was a balance between positive and negative changes in market interest rates, the second sub-period (and the whole sample) is dominated by interest rates falls (see Figure 2). Weaker adjustment of lending rates than deposit rates might mean that banks take advantage of falling interest rates in order to increase spread between deposits and lending rates. However, previous studies confirm this kind of asymmetric reaction of bank interest rates only to some degree.

¹⁰ The long run multiplier for households' credit rates is very small in the post crisis sample. It is due to the fact that almost half of total credit to household is attributed to consumer credit, for which the cointegrating relation has been broken after September 2008.

Table 2. Estimates of the long run pass-through of market rates to retail rates.⁽¹⁾

Interest rate type	2005-2008		2009-2013		2005-2013 ⁽²⁾	
	LTPT	H ₀ : LTPT=1 (p-value)	LTPT	H ₀ : LTPT=1 (p-value)	LTPT	H ₀ : LTPT=1 (p-value)
Households deposits						
total	0.82	(0.000)	0.97	(0.514)	0.92	(0.048)
up to 1 month	0.85	(0.000)	0.82	(0.000)	0.84	(0.000)
from 1 to 3 months	0.85	(0.000)	1.03	(0.597)	0.99	(0.848)
from 3 to 6 months	0.91	(0.017)	0.89	(0.128)	0.95	(0.369)
from 6 to 12 months	0.78	(0.000)	0.73	(0.000)	0.79	(0.000)
Firms deposits						
total	0.88	(0.000)	1.10	(0.046)	0.96	(0.240)
up to 1 month	0.93	(0.003)	1.05	(0.149)	0.98	(0.638)
from 1 to 3 months	0.84	(0.000)	1.18	(0.000)	1.01	(0.698)
from 3 to 6 months	0.79	(0.000)	1.11	(0.003)	0.95	(0.315)
Credit to households						
total	1.39	(0.000)	0.48	(0.009)	0.99	(0.949)
for consumption	1.16	(0.175)	x	x	x	x
for housing purposes	1.00	(0.925)	0.74	(0.001)	0.87	(0.051)
to sole proprietors	1.08	(0.357)	0.76	(0.024)	1.02	(0.817)
Credit to firms						
total	0.93	(0.065)	0.67	(0.000)	0.77	(0.000)
up to 4M PLN	0.96	(0.307)	0.70	(0.000)	0.81	(0.000)
above 4M PLN	0.95	(0.281)	0.76	(0.000)	0.81	(0.000)

⁽¹⁾ Pooled DOLS estimator with two lags and one lead.

⁽²⁾ With dummy variable to account for the effect of financial crisis.

4.2. Short run adjustment

Following the literature, the short term adjustment of deposit and lending rates to the market rate is assessed based on estimation of an ECM model employing the residual terms from the cointegrating equation ($e_{n,t}$):

$$\Delta i_{n,t} = \mu_n + \sum_{l=1}^3 \gamma_l \Delta i_{n,t-l} + \sum_{k=0}^3 \alpha_k \Delta mr_{t-k} + \beta e_{n,t-1} + \varepsilon_{n,t} \quad (2).$$

The number of lags in the above equation is determined by the BIC criterion (maximum 3 of each variable are considered). Due to quite long time dimension of the panel, the potential bias from estimating the dynamic panel regression by FE estimator is expected to be insignificant, so this problem is disregarded. In order to eliminate influence of distortions related to financial crisis, outliers have been removed from the sample prior to the estimation.¹¹ The immediate reaction of the retail interest rate is described by parameter α_0 . The loading coefficient β determines the speed of adjustment toward the long run. Additionally, graphs showing reaction of banks' interest rates to increase of the market rate are presented.

Table 3 presents estimates of equation (2) in three periods under consideration. Let's first focus on the longest period (2005-2013). Short term reaction of interest rates on households' total deposits and firms' total deposits is almost the same. In the first month about 52% of market rate change is transmitted to deposit rates and in each next month about 12% of disequilibrium is cleared. If more detailed deposit categories are taken under consideration however, the results suggest that immediate reaction of rates on households' deposits is a little bit lower than those of firms and amounts to 33-41% comparing to 50-59% in case of firms. The loading coefficients are of similar magnitude for both groups. Turning to the rate on households' total credit, the adjustment process is very slow (the slowest of all analysed rates), as the parameter of immediate reaction is statistically insignificant and the loading coefficient is very low (-0.06). Also interest rate on credit to sole proprietors reacts very slowly to changes in WIBOR 3M. Within a set of rates on households' credit, the fastest adjustment is noticed in case of credit for housing purposes: about 39% of market rate change is passed in the first month and the loading coefficient amounts to -0.07. Summing up, households' lending rates adjust slower toward the equilibrium rates than households' deposit rates. Contrary to households' credit

¹¹ They have been identified based on distance from mean expressed in interquartile range. The total number of outliers amounted to about 2-4% of the sample for each interest rate.

rate, rate on firms' loans react strongly and quickly to changes in the market rate. About 66-74% of WIBOR 3M change is transmitted in the first month and the loading coefficient ranges from -0.20 to -0.29 depending on loan category. This result is not surprising as firms, especially large, have access to other sources of financing and banks' offer must be competitive.

The analysis of results for the two separate sub-periods, pre and post crisis, shows that reaction of rate on total deposits of both, households and firms, has become slightly faster (Table 3, Figure 3). This is also true for some detailed categories of firms deposits (mainly due to stronger immediate reaction), while not for detailed categories of households deposits. When it comes to lending rates, the impulse response functions show that the rate on credit to sole proprietors reacts a little bit slower than previously. The same observation is made for lending rates on firms' total credit. Differences in loading coefficients, determining speed of adjustment in further periods, are even smaller. Taking all this under consideration, the changes in sluggishness of adjustment are rather not significant.

Table 3. Short term adjustment of retail interest rates to market rates.⁽¹⁾

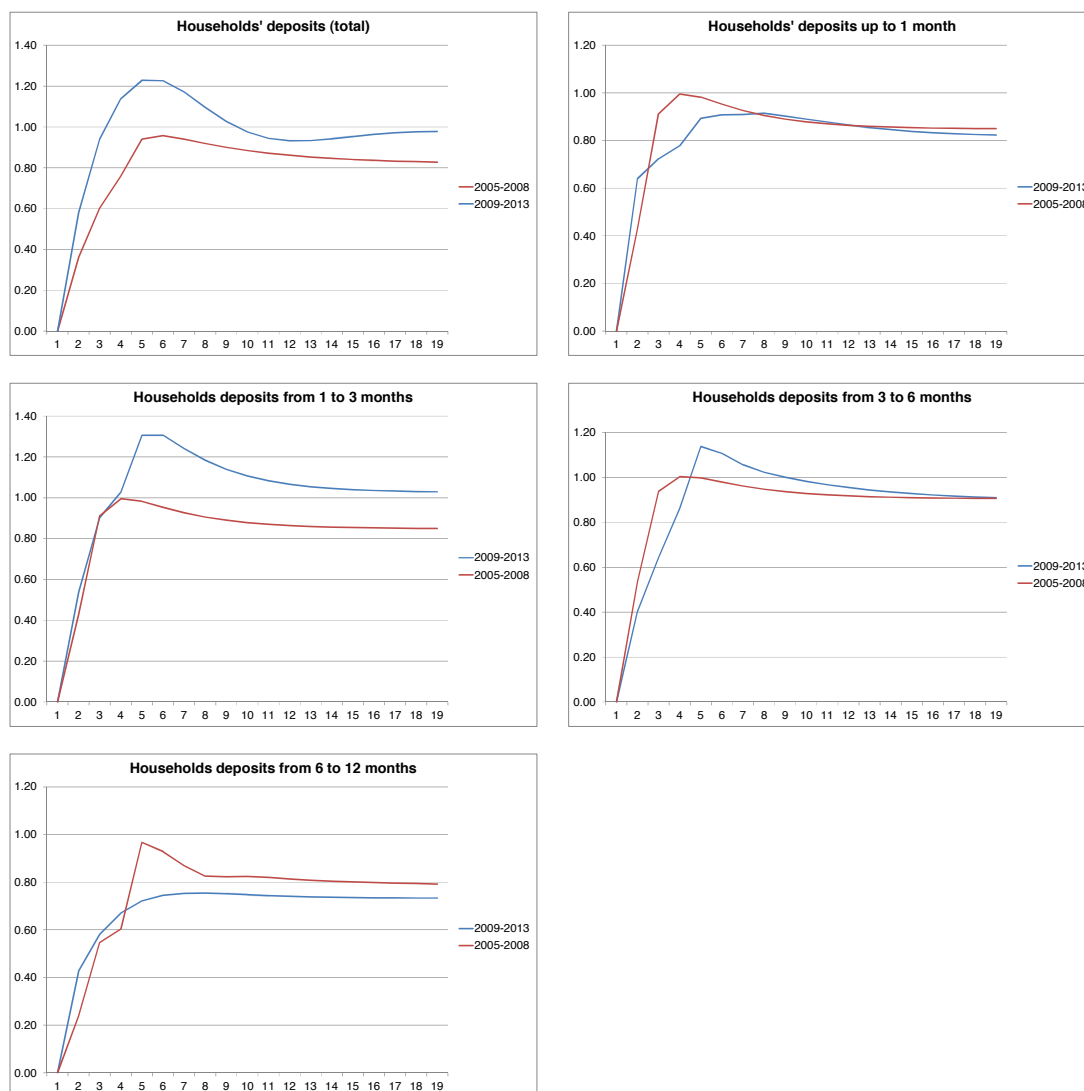
Interest rate type	2005-2008		2009-2013		2005-2013	
	immediate reaction	loading coefficient	immediate reaction	loading coefficient	immediate reaction	loading coefficient
Households deposits						
total	0.36***	-0.15**	0.58***	-0.27***	0.52***	-0.12***
up to 1 month	0.38***	-0.14**	0.64***	-0.15***	0.41***	-0.08***
from 1 to 3 months	0.43***	-0.20**	0.54***	-0.21***	0.40***	-0.11***
from 3 to 6 months	0.53***	-0.19**	0.40***	-0.17***	0.33***	-0.10***
from 6 to 12 months	0.24**	-0.17***	0.43***	-0.19***	0.33***	-0.14***
Firms deposits						
total	0.37***	-0.26***	0.81***	-0.17***	0.53***	-0.11***
up to 1 month	0.39***	-0.23***	0.83***	-0.18***	0.53***	-0.13***
from 1 to 3 months	0.65***	-0.13*	0.77***	-0.27***	0.59***	-0.09**
from 3 to 6 months	0.44***	-0.27***	0.90***	-0.33***	0.50***	-0.11**
Credit to households						
total	0.57	-0.20***	0.46***	-0.11**	0.32	-0.06***
for consumption	-0.10	-0.17***	x	x	x	x
for housing purposes	0.52***	-0.18**	0.56***	-0.11***	0.39***	-0.07***
to sole proprietors	0.64**	-0.29**	0.16	-0.24**	0.25	-0.11***
Credit to firms						
total	1.19***	-0.42***	0.57***	-0.33***	0.66***	-0.20***
up to 4M PLN	0.81***	-0.53***	0.83***	-0.42***	0.70***	-0.21***
above 4M PLN	1.24***	-0.47**	0.75***	-0.44***	0.74***	-0.29***

⁽¹⁾ FE (within) estimator with robust standard errors; number of lags is determined by BIC criterion.

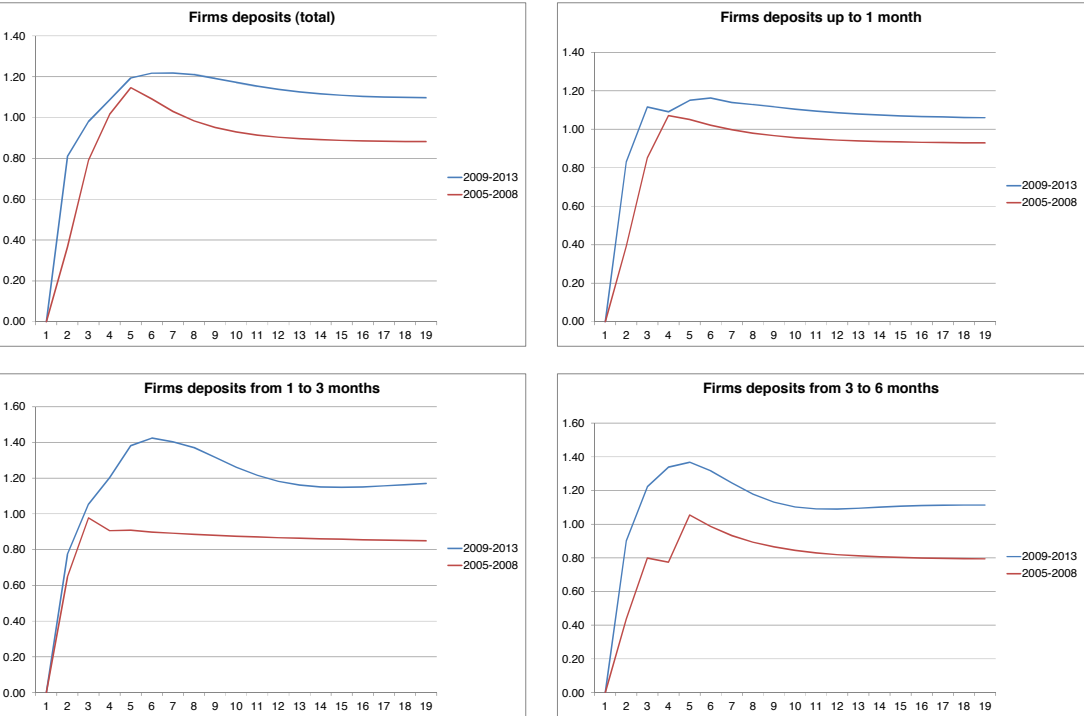
⁽²⁾ Remark: * p<.1; ** p<.05; *** p<.01

Figure 3. Impulse response functions of interest rates before and after outburst of the financial crisis.

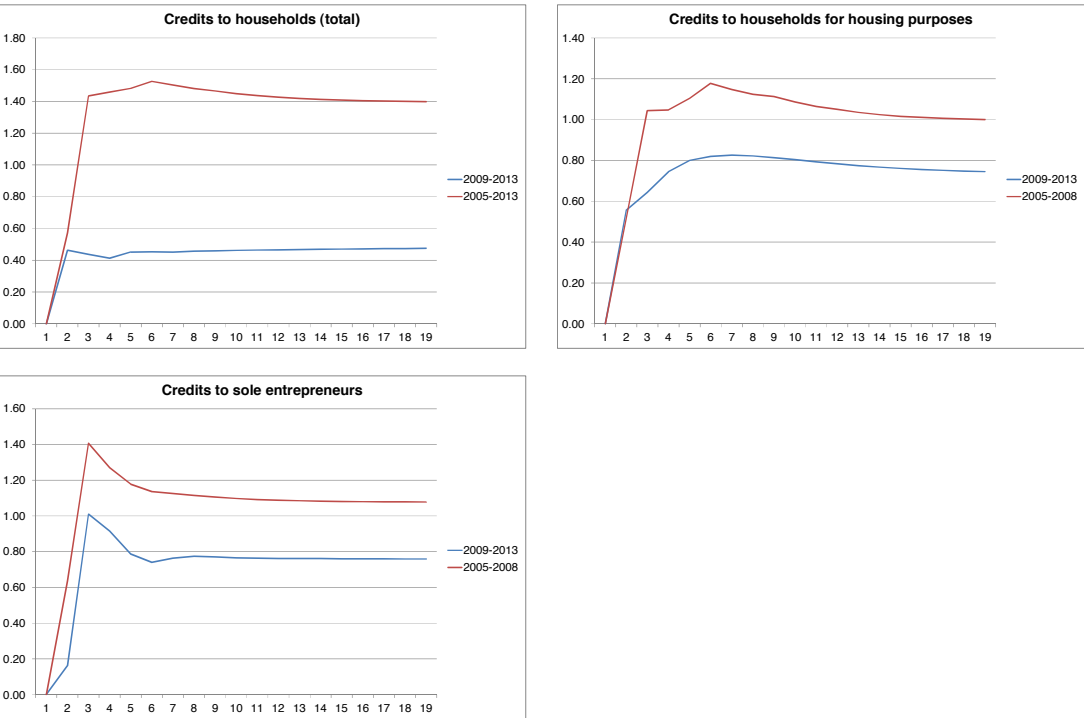
A. Interest rates on households deposits



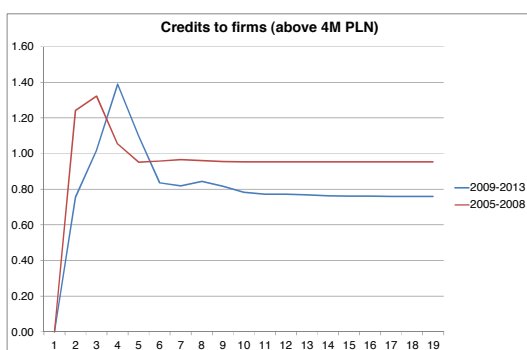
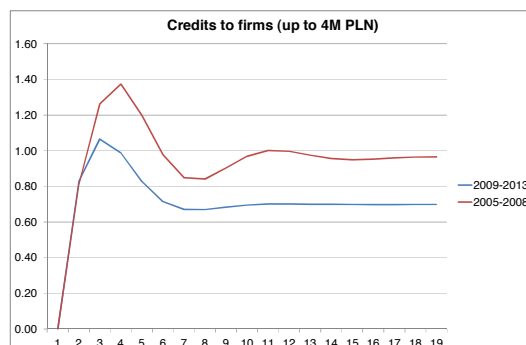
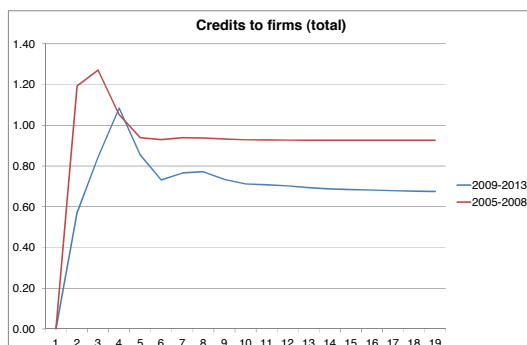
B. Interest rates on firms deposits



C. Interest rates on households credit



D. Interest rates on firms credit



5. Individual bank characteristics and interest rate pass-through

In order to assess the scope to which individual bank characteristics influence the process of adjustment of retail interest rates to the market rates, two approaches are taken. In both, all banks under consideration are divided into two groups of similar number according to a given ratio: one group brings together all banks with low value of the ratio, and the second – with high value. It is assumed that the pass-through process progresses in the same manner in all banks within a given group (except from a bank individual effect), but is different than in the other group. For each individual bank characteristics a separate equation is estimated. In the first approach it is assumed that interest rates in all banks converge to the same long run level, but possibly with different speed. This assumption seems plausible from theoretical and empirical point of view¹² and allows straightforward comparison of the speed of adjustment between both groups of banks. As a robustness check, the second more general approach is employed, in which both groups are allowed to differ in the scale of the long run pass-through and in the short run adjustment dynamics.

All estimations are conducted on the longest sample only, i.e. from January 2005 to July 2013.

5.1. Results from two-step procedure

In the first approach we make use of residuals from the cointegrating regression (1) and estimate short run dynamics with ECM equation similar to (2), but for two separate groups:

$$\Delta i_{n,t} = \mu_n + \sum_{g=1}^2 D_g (\alpha_{0,g} \Delta mr_t + \beta_g e_{n,t-1} + \gamma_g \Delta i_{n,t-1} + \alpha_{1,g} \Delta mr_{t-1}) + \varepsilon_{n,t} \quad (3).$$

¹² For example, Weth (2002) and Gambocorta (2008) present evidence on lack or on only limited heterogeneity in the long run adjustment. The opposite conclusion was reached by De Grauwe *et al.* (2007).

In this specification correction of the potential impact of the financial crisis on the transmission mechanism is done on the level of the cointegrating equation and not included in the ECM model directly. The above model includes maximally one lag of interest rate changes (comparing to 3 in specification (2)), because otherwise, due to the greater total number of parameters, robust standard errors could not be calculated.

The estimation results for each individual bank characteristic are presented in Appendix 2. In tables estimates of the immediate reaction coefficients (α_{01} and α_{02}) and of loading coefficients (β_1 and β_2) for both groups of banks are presented and tests on statistical significance of differences between them are conducted.

Size

The results suggest that size of a bank do not influence adjustment process of interest rates in short run. Differences between immediate reactions and in loading coefficients in both groups of banks are not statistically significant for all interest rate groups except total firms' deposits. Interest rate on total firms' deposits react stronger in the first month of WIBOR 3M rate in bigger banks than in smaller banks. However, the loading coefficient suggests faster adjustment in smaller than in bigger banks. Evidence from other countries is also inconclusive for size.

Liquidity ratio

It seems that more liquid banks adjust deposits interest rates faster than less liquid banks. Estimates of immediate reaction coefficients are higher for banks with larger share of liquid assets for almost all bank interest rates, but the difference is statistically significant only for some deposit rates. When it comes to loading coefficients, they also suggest in most cases faster adjustment of rates in more liquid banks, but the differences is almost never statistically significant.

The observation that more liquid banks follow market interest rate changes more closely than less liquid banks is inconsistent with theoretical prediction. A version of credit view to monetary transmission mechanism says that during monetary policy tightening bigger, more liquid and more capitalized banks might slower adjust interest rates to market conditions than smaller, less liquid and less capitalized banks, because they are able to finance their activity from the market at lower costs. However, three points should be made here. First of all, in the period under analysis monetary policy easing prevailed. So faster adjustment of deposit rates means that more liquid banks have been able to lower their financing costs faster than less liquid banks. Secondly, empirical evidence is not so unequivocal. A positive relationship between banks' liquidity and speed of adjustment was found in the Czech Republic (Horvath and Podpiera, 2012) and Italy¹³ (Gambacorta 2004). Finally, among banks in the sample, bigger ones are also more liquid, so this relation might be artificial.

Capital adequacy ratio

When it comes to the capital adequacy ratio, the results suggest faster adjustment of interest rates in banks with higher capitals than in those with lower. The difference is statistically significant, for either immediate reaction coefficient or loading coefficient, in case of rates on households' deposits with maturity from 3 to 6 months and from 6 to 12 months, for firms' deposits with maturity from 1 to 3 months and from 3 to 6 months, for rate on credit to sole proprietors and on total firms credit. Similarly as in the case of liquidity ratio, this result is opposite to expected, predicted by the credit channel view. Moreover this conclusion is opposite to the one drawn in the previous study for Poland (Chmielewski 2003).

¹³ Gambacorta's (2004) results suggested faster adjustment in bigger, more liquid and better capitalised banks if influence of each characteristic was investigated separately, as in this paper. However, if all characteristics were considered jointly, more liquid and better capitalized banks turned out to react less to market conditions and bank size became insignificant.

Share of deposits from non-financial sector in liabilities

The next individual bank characteristics under investigation refers to the dominant source of banks' financing. It is expected that banks which rely more on deposits from non-financial sector are able to adjust their interest rates to market conditions in a slower manner than banks which rely more on financing from the interbank market. This prediction is confirmed to some extent by the results of the ECM estimation. The immediate reaction of retail interest rates is greater in banks with smaller share of deposits in liabilities, but the difference is statistically significant only in case of households' deposits with longer maturities (from 3 to 6 months and from 6 to 12 months) and for firms deposits with maturity from 1 to 3 months. When it comes to the loading coefficients, they suggest slower adjustment process in banks with higher ratio in case of credit to sole proprietors.

Relationship banking

Establishing close relationship between banks and their customers seems not to influence the process of interest rate transmission to deposit rates in the short run, as differences between relevant parameters in both groups of banks are not statistically significant. The results on lending rates are a little bit puzzling. It seems that rate on credit to sole proprietors adjust slower in banks with higher proxy for relationship banking, whereas rate on credit to firms (total and above 4M PLN) adjusts faster.

Quality of credit portfolio

Quality of credit portfolio seems to not influence the speed of interest rate adjustment. The only exceptions are interest rates on firms' deposits with maturity from 1 to 3 months and on credit to sole proprietors. For them the speed of adjustment is faster in banks with more non-performing loans.

5.2. Results from one-step procedure

The second ECM specification refers to the one employed by Weth (2002) and is as follows:

$$\Delta i_{n,t} = \mu_n + \sum_{g=1}^2 D_g [\alpha_{0g} \Delta mr_t + \beta_g (i_{n,t-1} - mr_{t-1}) + \delta_g i_{n,t-1} + \alpha_{1,g} \Delta mr_{t-1} + \gamma_g \Delta i_{n,t-1}] + \kappa K + \varepsilon_{n,t} \quad (4),$$

where D_1 and D_2 denote dummy variables determining to which group given bank belongs, K is a dummy variable (taking 1 from September 2008 on and 0 otherwise) taking into account possible impact of the financial crisis. Similarly as in (3) maximally one lag of interest rate changes was included. The above specification is quite general as it does not impose full long-run pass-through. The hypothesis of completeness of the long run adjustment might be tested instead: if parameter δ is statistically significant, than the hypothesis of long term pass-through equal to one is rejected.¹⁴ Therefore this specification allows estimating both, long-run and short-run dynamics of interest rate adjustment in one step.

The results of estimation of equation (4) are presented in the Appendix 3. The tables show immediate reaction of interest rates, loading coefficients and long term pass-through in both groups. The statistical significance of differences in parameters between these groups is tested, as well as completeness of long term adjustment.

Estimated long run pass-through coefficients are larger than those estimated in the cointegrating equations. In this section we focus only on differences in the LTPT in two groups of banks. The results suggest that these differences for the most cases are statistically insignificant.

¹⁴ The long term pass-through is calculated as $\frac{\beta_g}{\beta_g - \delta_g}$.

Size

The size of a bank seems to affect long term pass-through only in case of a few interest rate types and in various directions. Bigger banks smooth interest rates on households' deposits with maturity up to 1 month and on firms' total deposits and deposits with maturity up to 1 month, but the long run reaction of interest rates on households' deposits with maturity from 3 to 6 months and on total credit to households is greater than in smaller banks.

Turning to the short run reaction, there is some evidence that bigger banks faster adjust interest rates on households' and firms' deposits¹⁵ and rates on firms' credit. The speed of adjustment of interest rate on households' credit is the same for small and big banks.

The outcome that bigger banks adjust their rates faster than smaller banks stays in conflict with prediction of the credit channel view, similarly as discussed in the previous section for liquidity and capital adequacy ratio, but again is acceptable if one takes under consideration prevalence of interest rate cuts in the analysed period. Additionally, the result on firms' credit is in line with interpretation offered by Weth (2002) who stated that there is a difference in customers between bigger and smaller banks. The former usually grant credits to bigger companies which have easier access to other sources of financing, so interest rates offered by bigger banks have to follow market conditions more closely than smaller.

Liquidity ratio

The results for liquidity ratio are similar as for size. They suggest differences in the long term pass-through only for a few rates of households' and firms' deposits (it is smaller in more liquid banks) and faster short run transmission in more liquid

¹⁵ The exception is an interest rate on firms' deposit with maturity from 1 to 3 month, but for this maturity there is a difference in long run level, so comparisons not so straightforward.

banks. Negative relationship between long term multipliers and banks' liquidity was found also by De Grauwe *et al.* (2007) for Belgian banks. The difference in parameters describing the short run adjustment is statistically significant for almost all deposit rates, for rate on credit to sole proprietors and on total credit to firms. This result confirms the one obtained from two step procedure.

Capital adequacy ratio

The difference in the long run pass-through between banks differing with capital adequacy ratio is statistically insignificant. The results for the short run adjustment confirm the previous observation that banks with higher capital react faster to changing market conditions.

Share of deposits from non-financial sector in liabilities

The evidence on differences in the scale of the long run adjustment of interest rates in banks financing in greater degree from non-financial sector deposits and from market is mixed. It seems that banks relying more on deposits, to greater degree smooth interest rates on some households' deposits and on credit for housing purposes. On the other hand, the LTPT is greater for these banks in case of firms' deposits and on credit to sole proprietors.

The results on the short run dynamics confirms those obtained for the two-step procedure.

Proxy for relationship banking

The estimated long term pass-through is the same for banks with higher and lower value of indicator approximating having a stable relationship by a bank with customers. The only exception is rate on firms' credit above 4M PLN: banks with higher value of this proxy do not fully adjust interest rates in the long run, while in banks with lower value of this proxy adjustment is complete.

Turning to the short run, the results, as expected, suggest slower adjustment of interest rates in banks having close relationships with their customers. It refers to majority of deposit rates and rate on big credits to firms. Rates on credits to households seem to stay unaffected.

Quality of credit portfolio

Similarly as for the equation (3), there is only minor evidence on differences in interest rate transmission process in banks classified according to the quality of portfolio.

6. Conclusions

The aim of the paper was to assess interest rate pass-through in Poland from market rates to banks deposit and lending rates based on individual bank data. Special interest was in exploring the influence of individual bank characteristics on this process, like the speed of adjustment and its completeness in the long run. As the sample covered also period prior to beginning of the financial crisis, some attention was devoted to changes in this process, as well.

The results suggest that the long run pass-through of market interest rates is complete for firms deposits (all maturities) and some categories of households' deposits. Also rates on consumer credit are characterized by complete long run transmission. The exceptions are lending rates in case of firms, which adjust in the long run only in about 80%. It must be noted however, that these adjustment coefficients were obtained with inclusion of a shift in spread in the post-crisis sample. So it is assumed that after September 2008 there was a change in the equilibrium rate to which retail rates converge. When it comes to the speed of adjustment, the quickest reaction characterizes firms' lending rates, and the slowest – consumer lending rates.

Estimates on two sub-samples suggest that comparing to the pre-crisis period, in recent years the scale of adjustment of deposit rates have increased in case of deposits, and decreased when it comes to the lending rates. However, it must be kept in mind that the level of spread is different in both sub periods, and that this effect might be related to potential asymmetries in the interest rate adjustments as sample characteristics are different in both periods.

As far as influence of individual bank characteristics on the pass-through process is concerned, it seem that they affect long run multipliers only in limited scope, as the differences are statistically significant only for interest rates on few bank products

categories. Having in mind that differences are observed only for interest rates on few banking product categories, the following conclusions might be drawn. Firstly, the scale of long run pass-through is positively associated with:

- in case of deposit rates – lower assets, lower liquidity ratio, weaker deposit base;
- in case of lending rates – lower proxy for relationship banking (only for large credit to firms) and better quality of credit portfolio (only for credit to sole proprietors); stronger deposit base seems to lower scale of adjustment of rate on credit for housing purposes, but increase rate on credit to sole proprietors.

Secondly, faster adjustment of interest rates in the short run, reflected in higher immediate reaction or/and stronger reaction to disequilibrium, is supported by:

- in case of deposit rates – larger assets, larger liquidity ratio, larger capital adequacy ratio, smaller deposit base, lower proxy for relationship banking and worse quality of credit portfolio;
- in case of lending rates – larger assets (firms credit), larger liquidity ratio and lower proxy for relationship banking.

Identification of sources of heterogeneity in interest rate pass-through across banks might be impaired by distortions in the interbank market due to the financial crisis. Therefore, it would be interesting to repeat this study in few years on shorter sample to see whether the same (possibly clearer) patterns emerge.

In this study, influence of each individual bank characteristic was treated separately, so it cannot be ruled out that identified relationships result in certain degree from correlations between banks indicators (like size and liquidity). Analysing joint impact of several bank features on interest rate transmission process would constitute a cross-check of the obtained results. As another possible extension, it would

be interesting to incorporate asymmetries with regard to direction of interest rate change to analysis of importance of individual bank characteristics.

References

Berlin M., Mester L. J. (1999), Deposits and Relationship Lending, Working Paper, The Wharton Financial Institutions Center.

Bernstein S., J. R. Fuentes (2003), Is there lending rate stickiness in the Chilean banking industry?, *Banking Market Structure and Monetary Policy*, Central Bank of Chile.

Borio C.E.V., Fritz W. (1995), The response of short term bank lending rates to policy rates: a cross-country perspective, Working Paper No. 27, BIS.

Chmielewski T. (2003), Interest rate pass-through in the Polish banking sector and bank-specific financial disturbances, MPRA Paper No. 5133.

Cottarelli C., Kourelis A. (1994) Financial Structure, Bank Lending Rates, and the Transmission Mechanism of Monetary Policy. IMF Working Paper 94/39, IMF.

De Bondt G. (2002), Retail bank interest rate pass-through: new evidence on the euro area level. Working Paper No. 136, ECB.

De Grauwe F., De Jonghe O., Vennet R. V. (2007), Competition, transmission and bank pricing policies: Evidence from Belgian loan and deposit markets, *Journal of Banking & Finance* 31:259–278.

Demchuk O., Łyziak T., Przystupa J., Sznajderska A., Wróbel E. (2012), Monetary policy transmission mechanism in Poland. What do we know in 2011? Working Paper No. 116, Narodowy Bank Polski.

ECB (2013), Assessing the retail bank interest rate pass-through in the euro area at times of financial fragmentation, Monthly Bulletin, ECB, August 2013.

Égert B., Crespo-Cuaresma J., Reininger T. (2004), Interest Rate Pass-Through in New EU Member States: The Case of the Czech Republic, Hungary and Poland. William Davidson Institute Working Paper No. 671, The University of Michigan.

Égert B., Crespo-Cuaresma J., Reininger T. (2006) Interest Rate Pass-Through in Central and Eastern Europe: Reborn from Ashes Merely to Pass Away? William Davidson Institute Working Paper No. 851, The University of Michigan.

Frappa S., Murez M., Montornes J., Barbier de la Serre A. (2008), Bank interest rates pass-through: new evidence from French panel data, MPRA Paper No. 26709.

Gambacorta L. (2004), How do banks set interest rates? Working Paper No. 10295, NBER.

Gambacorta L. (2008), How do banks set interest rates? *European Economic Review* 52:792–819.

Gigineishvili N. (2011), Determinants of Interest Rate Pass-Through: Do Macroeconomic Conditions and Financial Market Structure Matter? Working Paper No. 11/176, IMF.

Greenwood-Nimmo M., Shin Y., van Treeck T. (2012), The Decoupling of Monetary Policy from Long-Term Interest Rates in the U.S. and Germany. Available at SSRN: <http://ssrn.com/abstract=1894621>.

Harbo Hansen, N. and P. Welz (2011), “Interest Rate Pass-through During the Global Financial Crisis: The Case of Sweden”, OECD Economics Department Working Papers, No. 855, OECD Publishing.

Hofmann B., Mizen P. (2004), Interest Rate Pass-Through and Monetary Transmission: Evidence from Individual Financial Institutions' Retail Rates. *Economica* 71:99-123.

Horvath R., Podpiera A. (2012), Heterogeneity in bank pricing policies: The Czech evidence, *Economic Systems* 36:87–108.

Hristov N., Hülsewig O., Wollmershäuser T. (2012), The Interest Rate Pass-Through in the Euro Area During the Global Financial Crisis, CESifo Working Paper No. 3964.

Hsiao Ch. (2006), Panel Data Analysis – Advantages and Challenges, Working Paper No. 06.49, Institute of Economic Policy Research, University of Southern California.

Illes A., Lombardi M. (2013), Interest rate pass-through since the financial crisis, BIS Quarterly Review, September 2013.

Jamilov R., Égert B. (2013), Interest Rate Pass-Through and Monetary Policy Asymmetry: A Journey into the Caucasian Black Box. William Davidson Institute Working Paper No. 1041, The University of Michigan.

Jobst C., Kwapil C. (2008), The Interest Rate Pass-Through in Austria – Effects of the Financial Crisis, Monetary Policy and The Economy Q4/08, Vienna, OeNB.

Kapuściński M., Łyziak T., Przystupa J., Stanisławska E., Sznajderska A., Wróbel E. (2014), Monetary transmission mechanism in Poland. What do we know in 2013?, NBP Working Paper, Narodowy Bank Polski.

Kao, C., Chiang M.H. (2000), On the estimation and inference of a cointegrated regression in panel data, *Advances in Econometrics*, 15:179–222.

Mojon B. (2000), Financial structure and the interest rate channel of ECB monetary policy, Working Paper No. 40, ECB.

Montagnoli A., Napolitano O., Siliverstovs B. (2012), Regional interest rate pass-through in Italy. KOF Working Paper No. 308, KOF Swiss Economic Institute, ETH Zurich.

NBP (2013), Financial Stability Report, Narodowy Bank Polski, July 2013.

Pedroni P. (2001), PPP tests in cointegrated panels, *The Review of Economics and Statistics*, 83(4): 727–731.

Saborowski Ch., Weber S. (2013), Assessing the determinants of interest rate transmission through conditional impulse response functions, Working Paper No. 13/23, IMF.

Sander H., Kleimeier S. (2004), Convergence in euro-zone retail banking? What interest rate pass-through tells us about monetary policy transmission, competition and integration. *Journal of International Money and Finance* 23:461–492.

Sander, Kleimeier (2006) Convergence of interest rate pass-through in a wider euro zone? *Economic Systems* 30: 405–423.

Schlüter T., Hartmann-Wendels T., Busch R., Sievers S. (2012), Determinants of the interest rate pass-through of banks – evidence from German loan products. Discussion Paper No. 26/2012, Deutsche Bundesbank.

Sørensen Ch. K., Werner T. (2006), Bank interest rate pass-through in the euro area. A cross country comparison. Working Paper No. 580, ECB.

Sznajderska A. (2012), On the empirical evidence of asymmetry effects in the interest rate pass-through in Poland, Working Paper No. 114, Narodowy Bank Polski.

Weth M.A. (2002), The pass-through from market interest rates to bank lending rates in Germany, Discussion paper 11/02, Economic Research Centre of the Deutsche Bundesbank.

Wróbel E., Pawłowska M. (2002), Monetary transmission in Poland: some evidence on interest rate and credit channels. Materiały i Studia, Paper No. 24, Narodowy Bank Polski.

Appendix 1. Results of cointegration tests

Table 4. Results of Pedroni cointegration test (p-value for ADF statistics).

Interest rate type	Common AR coefficient ⁽¹⁾			Individual AR coefficient ⁽²⁾		
	2005-2008	2009-2013	2005-2013	2005-2008	2009-2013	2005-2013
Households deposits						
total	0.0012	0.0000	0.0003	0.0000	0.0000	0.0000
up to 1 month	0.0969	0.0000	0.0205	0.0000	0.0000	0.0002
from 1 to 3 months	0.0000	0.0000	0.0173	0.0000	0.0000	0.0023
from 3 to 6 months	0.0003	0.0000	0.0012	0.0000	0.0000	0.0010
from 6 to 12 months	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Firms deposits						
total	0.0198	0.0005	0.0064	0.0000	0.0001	0.0074
up to 1 month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
from 1 to 3 months	0.0000	0.0000	0.0014	0.0000	0.0000	0.0000
from 3 to 6 months	0.0000	0.0000	0.0012	0.0000	0.0000	0.0000
Credit to households						
total	0.0000	0.0000	0.0005	0.0000	0.0000	0.0000
for consumption	0.0000	0.2724	0.6206	0.0000	0.1009	0.7866
for housing purposes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
to sole proprietors	0.0030	0.0000	0.0000	0.0001	0.0000	0.0000
Credit to firms						
total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
up to 4M PLN	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
above 4M PLN	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

⁽¹⁾ H₀: all individuals in panel are not cointegrated; H₁: all individuals in panel are cointegrated;

⁽²⁾ H₀: all individuals in panel are not cointegrated; H₁: a significant portion of individuals are cointegrated;

Appendix 2. Result of estimation of the ECM equation (3) – two step procedure

Table 5. Estimates of the equation (3) for small (group 1) and big (group 2) banks (measured by assets).

Interest rate type	Immediate reaction (α_0)				Loading coefficient (β)			
	α_{01}	α_{02}	$(\alpha_2 - \alpha_1)$	$H_0: \alpha_2 - \alpha_1 = 0$ (p-val)	β_1	β_2	$(\beta_2 - \beta_1)$	$H_0: \beta_2 - \beta_1 = 0$ (p-val)
Households deposits								
total	0.41***	0.54***	0.13	(0.239)	-0.12***	-0.11***	0.01	(0.880)
up to 1 month	0.36***	0.48***	0.12	(0.335)	-0.06***	-0.08***	-0.02	(0.401)
from 1 to 3 months	0.28**	0.40***	0.12	(0.398)	-0.15***	-0.10***	0.05	(0.322)
from 3 to 6 months	0.36***	0.26***	-0.11	(0.416)	-0.12**	-0.11***	0.01	(0.865)
from 6 to 12 months	0.28***	0.29***	0.01	(0.905)	-0.15***	-0.11***	0.04	(0.328)
Firms deposits								
total	0.43***	0.60***	0.17*	(0.073)	-0.15***	-0.08***	0.07**	(0.034)
up to 1 month	0.54***	0.57***	0.03	(0.753)	-0.13***	-0.13***	0.00	(0.961)
from 1 to 3 months	0.63***	0.60***	-0.03	(0.741)	-0.14***	-0.05	0.09	(0.100)
from 3 to 6 months	0.57***	0.53***	-0.03	(0.830)	-0.15***	-0.08**	0.06	(0.266)
Credit to households								
total	0.57***	0.58***	0.01	(0.967)	-0.07***	-0.05	0.02	(0.520)
for housing purposes	0.41**	0.39***	-0.02	(0.913)	-0.05	-0.07***	-0.02	(0.646)
to sole proprietors	-0.09	0.28	0.37	(0.190)	-0.22***	-0.12**	0.10	(0.138)
Credit to firms								
total	0.76***	0.89***	0.13	(0.478)	-0.20**	-0.33***	-0.13	(0.236)
up to 4M PLN	0.78***	0.77***	-0.01	(0.962)	-0.22***	-0.27***	-0.05	(0.467)
above 4M PLN	1.13***	0.92***	-0.21	(0.104)	-0.34***	-0.43***	-0.08	(0.437)

Remarks: FE (within) estimator with robust standard errors; number of lags is determined by BIC criterion; sample: 2005-2013;

* p<.1; ** p<.05; *** p<.01

Table 6. Estimates of the equation (3) for banks with low (group 1) and high (group 2) liquidity ratio.

Interest rate type	Immediate reaction (α_0)				Loading coefficient (β)			
	α_{01}	α_{02}	$(\alpha_2 - \alpha_1)$	$H_0: \alpha_2 - \alpha_1 = 0$ (p-val)	β_1	β_2	$(\beta_2 - \beta_1)$	$H_0: \beta_2 - \beta_1 = 0$ (p-val)
Households deposits								
total	0.28***	0.49***	0.21*	(0.070)	-0.14***	-0.10***	0.04	(0.413)
up to 1 month	0.35***	0.51***	0.16	(0.124)	-0.06***	-0.10**	-0.04	(0.388)
from 1 to 3 months	0.23*	0.47***	0.24*	(0.077)	-0.13**	-0.12***	0.01	(0.877)
from 3 to 6 months	0.20***	0.40***	0.20*	(0.096)	-0.14***	-0.09**	0.05	(0.305)
from 6 to 12 months	0.22***	0.36***	0.14	(0.203)	-0.18***	-0.09***	0.09***	(0.004)
Firms deposits								
total	0.42***	0.59***	0.17*	(0.068)	-0.14***	-0.09***	0.05	(0.198)
up to 1 month	0.50***	0.59***	0.09	(0.365)	-0.12***	-0.16***	-0.04	(0.436)
from 1 to 3 months	0.56***	0.67***	0.11	(0.271)	-0.07	-0.14***	-0.07	(0.222)
from 3 to 6 months	0.47***	0.60***	0.13	(0.379)	-0.07**	-0.16***	-0.09	(0.156)
Credit to households								
total	0.62**	0.53***	-0.09	(0.750)	-0.06	-0.06***	-0.00	(0.865)
for housing purposes	0.33**	0.50***	0.16	(0.270)	-0.05	-0.06**	-0.01	(0.795)
to sole proprietors	0.03	0.23	0.20	(0.467)	-0.09***	-0.26***	-0.17***	(0.006)
Credit to firms								
total	0.42***	0.80***	0.38	(0.103)	-0.19***	-0.36***	-0.16	(0.150)
up to 4M PLN	0.70***	0.83***	0.13	(0.556)	-0.22***	-0.30***	-0.08	(0.338)
above 4M PLN	0.96***	10.02***	0.07	(0.564)	-0.40***	-0.39***	0.01	(0.929)

Remarks: FE (within) estimator with robust standard errors; number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1, ** <.05, *** pp<.01

Table 7. Estimates of the equation (3) for banks with lower (group 1) and higher (group 2) capital adequacy ratio.⁽¹⁾

Interest rate type	Immediate reaction (α_0)				Loading coefficient (β)			
	α_{01}	α_{02}	$(\alpha_2 - \alpha_1)$	$H_0: \alpha_2 - \alpha_1 = 0$ (p-val)	β_1	β_2	$(\beta_2 - \beta_1)$	$H_0: \beta_2 - \beta_1 = 0$ (p-val)
Households deposits								
total	0.43***	0.56***	0.13	(0.210)	-0.12***	-0.12**	-0.00	(0.999)
up to 1 month	0.45***	0.41***	-0.04	(0.693)	-0.06***	-0.11**	-0.05	(0.234)
from 1 to 3 months	0.27**	0.45***	0.18	(0.190)	-0.11***	-0.13***	-0.01	(0.757)
from 3 to 6 months	0.16***	0.51***	0.35***	(0.006)	-0.12***	-0.09**	0.03	(0.532)
from 6 to 12 months	0.26***	0.29***	0.03	(0.810)	-0.16***	-0.09***	0.07**	(0.030)
Firms deposits								
total	0.45***	0.57***	0.12	(0.172)	-0.11***	-0.12***	-0.01	(0.829)
up to 1 month	0.55***	0.52***	-0.03	(0.775)	-0.11***	-0.18***	-0.07	(0.134)
from 1 to 3 months	0.55***	0.70***	0.15	(0.158)	-0.05	-0.17***	-0.12**	(0.044)
from 3 to 6 months	0.41***	0.68***	0.27**	(0.041)	-0.07**	-0.18***	-0.11	(0.114)
Credit to households								
total	0.64***	0.49**	-0.15	(0.599)	-0.05*	-0.08***	-0.03	(0.377)
for housing purposes	0.34***	0.55***	0.20	(0.133)	-0.04	-0.10***	-0.06	(0.082)
to sole proprietors	0.14	0.20	0.06	(0.851)	-0.09***	-0.30***	-0.21***	(0.000)
Credit to firms								
total	0.60***	0.63**	0.02	(0.926)	-0.18***	-0.39***	-0.21*	(0.071)
up to 4M PLN	0.77***	0.78***	0.01	(0.955)	-0.22***	-0.31***	-0.09	(0.208)
above 4M PLN	1.00***	1.00***	0.00	(0.973)	-0.39***	-0.41***	-0.02	(0.869)

⁽¹⁾ FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1; ** p<.05; *** p<.01

Table 8. Estimates of the equation (3) for banks with lower (group 1) and higher (group 2) share of deposits from non-financial sector in liabilities.

Interest rate type	Immediate reaction (α_0)				Loading coefficient (β)			
	α_{01}	α_{02}	$(\alpha_2 - \alpha_1)$	$H_0: \alpha_2 - \alpha_1 = 0$ (p-val)	β_1	β_2	$(\beta_2 - \beta_1)$	$H_0: \beta_2 - \beta_1 = 0$ (p-val)
Households deposits								
total	0.57***	0.42***	-.14	(0.218)	-0.12***	-0.12***	-0.00	(0.962)
up to 1 month	0.52***	0.35***	-.17	(0.106)	-0.09***	-0.06***	0.03	(0.417)
from 1 to 3 months	0.39**	0.32***	-.07	(0.656)	-0.12***	-0.12***	0.00	(0.991)
from 3 to 6 months	0.50***	0.19***	-.30**	(0.026)	-0.09**	-0.13***	-0.04	(0.385)
from 6 to 12 months	0.38***	0.20***	-.18*	(0.091)	-0.09***	-0.16***	-0.07**	(0.035)
Firms deposits								
total	0.54***	0.46***	-.08	(0.411)	-0.14***	-0.09***	0.04	(0.300)
up to 1 month	0.61***	0.46***	-.16	(0.144)	-0.16***	-0.11***	0.05	(0.239)
from 1 to 3 months	0.72***	0.52***	-.19*	(0.063)	-0.14***	-0.05	0.09	(0.103)
from 3 to 6 months	0.64***	0.45***	-.19	(0.205)	-0.16***	-0.08**	0.08	(0.202)
Credit to households								
total	0.66**	0.48***	-.18	(0.513)	-0.07***	-0.05*	0.02	(0.670)
for housing purposes	0.48***	0.34***	-.14	(0.430)	-0.04	-0.07*	-0.03	(0.512)
to sole proprietors	-0.12	0.36	.47	(0.129)	-0.27	-0.10	0.17***	(0.006)
Credit to firms								
total	0.62***	0.62***	.00	(0.996)	-0.23**	-0.26***	-0.03	(0.778)
up to 4M PLN	0.85***	0.72***	-.13	(0.544)	-0.28***	-0.21***	0.07	(0.327)
above 4M PLN	1.01***	0.96***	-.06	(0.677)	-0.41***	-0.39***	0.02	(0.863)

(1) FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1, ** p<.05, *** p<.01

Table 9. Estimates of the equation (3) for banks with lower (group 1) and higher (group 2) relationship banking indicator.⁽¹⁾

Interest rate type	Immediate reaction (α_0)				Loading coefficient (β)			
	α_{01}	α_{02}	$(\alpha_2 - \alpha_1)$	$H_0: \alpha_2 - \alpha_1 = 0$ (p-val)	β_1	β_2	$(\beta_2 - \beta_1)$	$H_0: \beta_2 - \beta_1 = 0$ (p-val)
Households deposits								
total	0.51***	0.45***	-0.06	(0.602)	-0.12***	-0.13***	-0.01	(0.841)
up to 1 month	0.41***	0.44**	0.02	(0.838)	-0.06***	-0.08***	-0.02	(0.570)
from 1 to 3 months	0.36***	0.30**	-0.06	(0.684)	-0.12***	-0.12**	0.00	(0.910)
from 3 to 6 months	0.36***	0.23***	-0.13	(0.288)	-0.09**	-0.13***	-0.04	(0.466)
from 6 to 12 months	0.33***	0.22***	-0.10	(0.310)	-0.12***	-0.12***	0.00	(1.000)
Firms deposits								
total	0.45***	0.54***	0.09	(0.379)	-0.14***	-0.10***	0.04	(0.257)
up to 1 month	0.56***	0.53***	-0.02	(0.824)	-0.13***	-0.13***	0.00	(0.957)
from 1 to 3 months	0.69***	0.53***	-0.15	(0.133)	-0.14***	-0.06	0.08	(0.132)
from 3 to 6 months	0.65***	0.43***	-0.22	(0.106)	-0.13***	-0.08*	0.05	(0.313)
Credit to households								
total	0.42**	0.77***	0.35	(0.221)	-0.08***	-0.04*	0.04	(0.255)
for housing purposes	0.42***	0.39**	-0.03	(0.847)	-0.09***	-0.04	0.05	(0.162)
to sole proprietors	0.40	-0.04	-0.43	(0.159)	-0.28***	-0.11***	0.16***	(0.007)
Credit to firms								
total	0.76***	0.45**	-0.30	(0.214)	-0.16***	-0.34***	-0.17*	(0.095)
up to 4M PLN	0.81***	0.75***	-0.06	(0.799)	-0.20***	-0.29***	-0.09	(0.140)
above 4M PLN	1.06***	0.94***	-0.13	(0.304)	-0.30***	-0.48***	-0.18*	(0.084)

⁽¹⁾ FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1; ** p<.05; *** p<.01

Table 10. Estimates of the equation (3) for banks with better (group 1) and worse (group 2) quality of credit portfolio.⁽¹⁾

Interest rate type	Immediate reaction (α_0)				Loading coefficient (β)			
	α_{01}	α_{02}	$(\alpha_2 - \alpha_1)$	$H_0: \alpha_2 - \alpha_1 = 0$ (p-val)	β_1	β_2	$(\beta_2 - \beta_1)$	$H_0: \beta_2 - \beta_1 = 0$ (p-val)
Households deposits								
total	0.45***	0.51***	0.06	(0.600)	-0.13***	-0.12**	0.01	(0.903)
up to 1 month	0.40***	0.46***	0.06	(0.615)	-0.08***	-0.06**	0.02	(0.485)
from 1 to 3 months	0.34***	0.35***	0.01	(0.953)	-0.12***	-0.12***	0.00	(0.846)
from 3 to 6 months	0.23***	0.42***	0.19	(0.155)	-0.12***	-0.10**	0.02	(0.685)
from 6 to 12 months	0.26***	0.30***	0.04	(0.739)	-0.15***	-0.10***	0.04	(0.259)
Firms deposits								
total	0.56***	0.44***	-0.12	(0.248)	-0.09***	-0.14***	-0.05	(0.241)
up to 1 month	0.55***	0.55***	0.00	(0.956)	-0.14***	-0.12***	0.02	(0.712)
from 1 to 3 months	0.52***	0.76***	0.24**	(0.018)	-0.06	-0.15***	-0.09	(0.110)
from 3 to 6 months	0.44***	0.68***	0.24	(0.109)	-0.09**	-0.15***	-0.06	(0.340)
Credit to households								
total	0.62***	0.52**	-0.10	(0.712)	-0.06*	-0.07***	-0.01	(0.694)
for housing purposes	0.44***	0.33**	-0.11	(0.489)	-0.05	-0.07*	-0.02	(0.562)
to sole proprietors	0.32	-0.22	-0.53	(0.100)	-0.11**	-0.26***	-0.15**	(0.024)
Credit to firms								
total	0.67***	0.54**	-0.13	(0.619)	-0.26***	-0.23**	0.03	(0.770)
up to 4M PLN	0.83***	0.70***	-0.13	(0.546)	-0.24***	-0.24***	0.00	(0.937)
above 4M PLN	0.99***	1.01***	0.02	(0.892)	-0.36***	-0.49**	-0.12	(0.480)

⁽¹⁾ FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1; ** p<.05; *** p<.01

Appendix 3. Result of estimation of the ECM equation (4) – one step procedure

Table 11. Estimates of the equation (4) for small (group 1) and big (group 2) banks (measured by assets).⁽¹⁾

Interest rate type	Immediate reaction (α_0)			Loading coefficient (β)			Long term pass-through (LTPT)		
	α_1	α_2	$\alpha_2 - \alpha_1$	β_1	β_2	$\beta_2 - \beta_1$	LTPT ₁ [=1 ?]	LTPT ₂ [=1 ?]	(LTPT ₁ - LTPT ₂)
Households deposits									
total	0.245**	0.528***	0.283***	-0.177***	-0.131***	0.046	1.38	1.24	-0.14
			(0.009)			(0.138)	[0.003]	[0.009]	(0.424)
up to 1 month	0.303***	0.548***	0.245**	-0.084***	-0.094***	-0.010	1.73	1.06	-0.67*
			(0.022)			(0.729)	[0.013]	[0.335]	(0.073)
from 1 to 3 months	0.276*	0.563***	0.287*	-0.238***	-0.144***	0.094***	1.32	1.34	0.02
			(0.080)			(0.007)	[0.001]	[0.000]	(0.893)
from 3 to 6 months	0.375***	0.560***	0.185	-0.200***	-0.163***	0.037	1.27	1.52	0.26*
			(0.112)			(0.133)	[0.006]	[0.000]	(0.078)
from 6 to 12 months	0.381***	0.518***	0.137	-0.137***	-0.144***	-0.007	1.02	1.13	0.12
			(0.236)			(0.774)	[0.782]	[0.278]	(0.421)
Firms deposits									
total	0.378***	0.578***	0.200**	-0.155***	-0.093***	0.062	1.31	1.00	-0.32*
			(0.038)			(0.134)	[0.073]	[0.947]	(0.098)
up to 1 month	0.547***	0.605***	0.058	-0.119***	-0.135***	-0.015	1.37	0.95	-0.43*
			(0.586)			(0.725)	[0.083]	[0.003]	(0.068)
from 1 to 3 months	0.610***	0.676***	0.065	-0.180***	-0.090***	0.090**	1.15	1.45	0.30
			(0.493)			(0.034)	[0.114]	[0.000]	(0.135)
from 3 to 6 months	0.613***	0.628***	0.015	-0.171***	-0.126***	0.045	1.33	1.47	0.13
			(0.930)			(0.385)	[0.123]	[0.004]	(0.651)
Credit to households									
total	0.479*	0.588***	0.110	-0.171***	-0.158***	0.013	1.23	2.92	1.69**
			(0.718)			(0.799)	[0.448]	[0.001]	(0.022)
for housing purposes	0.460**	0.606***	0.146	-0.085***	-0.104***	-0.019	1.36	1.85	0.49
			(0.413)			(0.504)	[0.326]	[0.000]	(0.404)
to sole proprietors	0.525***	0.737***	0.212	-0.219***	-0.224***	-0.005	1.00	1.35	0.35
			(0.247)			(0.948)	[1.000]	[0.009]	(0.265)
Credit to firms									
total	0.530**	0.893***	0.363	-0.201***	-0.316***	-0.115*	0.87	0.96	0.09
			(0.124)			(0.096)	[0.444]	[0.505]	(0.601)
up to 4M PLN	0.468***	0.810***	0.343*	-0.186***	-0.228***	-0.042	0.87	0.98	0.11
			(0.090)			(0.446)	[0.325]	[0.789]	(0.446)
above 4M PLN	1.156***	0.857***	-0.300	-0.255***	-0.376***	-0.121*	0.81	0.97	0.16
			(0.137)			(0.054)	[0.315]	[0.484]	(0.413)

Table 12. Estimates of the equation (4) for banks with low (group 1) and high (group 2) liquidity ratio.⁽¹⁾

Interest rate type	Immediate reaction (α_0)			Loading coefficient (β)			Long term pass-through (LTPT)		
	α_{01}	α_{02}	$\alpha_{02}-\alpha_{01}$	β_1	β_2	$\beta_2-\beta_1$	LTPT ₁ [=1 ?]	LTPT ₂ [=1 ?]	(LTPT ₁ -LTPT ₂)
Households deposits									
total	0.307***	0.558***	0.251**	-0.135***	-0.169***	-0.034	1.44	1.18	-0.25
			(0.010)			(0.296)	[0.009]	[0.018]	(0.189)
up to 1 month	0.365***	0.540***	0.175**	-0.081***	-0.148***	-0.066*	1.51	1.04	-0.46
			(0.035)			(0.056)	[0.142]	[0.341]	(0.221)
from 1 to 3 months	0.377***	0.605***	0.228**	-0.159***	-0.195***	-0.037	1.47	1.22	-0.25*
			(0.028)			(0.337)	[0.001]	[0.002]	(0.084)
from 3 to 6 months	0.334***	0.663***	0.328***	-0.151***	-0.189***	-0.038	1.34	1.44	0.10
			(0.002)			(0.168)	[0.006]	[0.001]	(0.580)
from 6 to 12 months	0.319***	0.415***	0.096	-0.119***	-0.146***	-0.028	0.88	1.16	0.29
			(0.424)			(0.213)	[0.235]	[0.112]	(0.122)
Firms deposits									
total	0.430***	0.558***	0.128	-0.141***	-0.093***	0.048	1.35	0.94	-0.41**
			(0.165)			(0.228)	[0.038]	[0.272]	(0.024)
up to 1 month	0.516***	0.615***	0.099	-0.118***	-0.142***	-0.024	1.28	0.97	-0.31
			(0.307)			(0.554)	[0.175]	[0.155]	(0.140)
from 1 to 3 months	0.620***	0.668***	0.048	-0.103***	-0.203***	-0.099**	1.46	1.12	-0.34*
			(0.611)			(0.045)	[0.001]	[0.007]	(0.052)
from 3 to 6 months	0.536***	0.687***	0.151	-0.121***	-0.241***	0.120***	1.50	1.17	-0.33
			(0.304)			(0.009)	[0.083]	[0.036]	(0.268)
Credit to households									
total	0.508**	0.634***	0.126	-0.171***	-0.144***	0.027	2.13	2.13	0.00
			(0.647)			(0.530)	[0.027]	[0.018]	(0.998)
for housing purposes	0.438***	0.662***	0.224	-0.107***	-0.088***	0.019	1.68	1.58	-0.10
			(0.138)			(0.490)	[0.000]	[0.117]	(0.853)
to sole proprietors	0.636***	0.683***	0.047	-0.167***	-0.315***	-0.148**	1.30	1.20	-0.10
			(0.770)			(0.018)	[0.274]	[0.119]	(0.768)
Credit to firms									
total	0.720***	0.792***	0.073	-0.209***	-0.349***	-0.140**	1.01	0.89	-0.12
			(0.749)			(0.033)	[0.889]	[0.201]	(0.314)
up to 4M PLN	0.646***	0.718***	0.073	-0.183***	-0.241***	-0.058	0.89	0.97	0.08
			(0.743)			(0.234)	[0.274]	[0.715]	(0.506)
above 4M PLN	0.928***	1.001***	0.073	-0.270***	-0.367***	-0.096	0.87	0.93	0.07
			(0.739)			(0.105)	[0.090]	[0.478]	(0.533)

⁽¹⁾ FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1; ** p<.05; *** p<.01

Table 13. Estimates of the equation (4) for banks with low (group 1) and high (group 2) capital adequacy ratio.⁽¹⁾

Interest rate type	Immediate reaction (α_0)			Loading coefficient (β)			Long term pass-through (LTPT)		
	α_{01}	α_{02}	$\alpha_{02}-\alpha_{01}$	β_1	β_2	$\beta_2-\beta_1$	LTPT ₁ [=1 ?]	LTPT ₂ [=1 ?]	(LTPT ₁ -LTPT ₂)
Households deposits									
total	0.395***	0.414***	0.019	-0.123***	-0.165***	-0.041	1.21	1.31	0.10
			(0.851)			(0.127)	[0.017]	[0.009]	(0.518)
up to 1 month	0.551***	0.484***	-0.067	-0.087***	-0.097***	-0.010	1.07	1.31	0.21
			(0.626)			(0.714)	[0.193]	[0.021]	(0.275)
from 1 to 3 months	0.406***	0.527***	0.120	-0.136***	-0.215***	-0.079**	1.29	1.33	0.04
			(0.296)			(0.014)	[0.001]	[0.000]	(0.720)
from 3 to 6 months	0.359***	0.643***	0.284**	-0.156***	-0.191***	-0.035	1.42	1.44	0.02
			(0.013)			(0.226)	[0.004]	[0.000]	(0.903)
from 6 to 12 months	0.385***	0.528***	0.142	-0.128***	-0.163***	-0.034	0.91	1.19	0.28
			(0.296)			(0.232)	[0.579]	[0.011]	(0.168)
Firms deposits									
total	0.547***	0.455***	-0.092	-0.116***	-0.115***	0.001	1.05	1.19	0.14
			(0.300)			(0.976)	[0.353]	[0.247]	(0.442)
up to 1 month	0.603***	0.556***	-0.047	-0.137***	-0.099***	0.038	0.98	1.16	0.18
			(0.646)			(0.327)	[0.467]	[0.347]	(0.310)
from 1 to 3 months	0.583***	0.702***	0.118	-0.086***	-0.197***	-0.112**	1.37	1.18	-0.19
			(0.216)			(0.012)	[0.000]	[0.009]	(0.226)
from 3 to 6 months	0.603***	0.636***	0.034	-0.107***	-0.237***	-0.129***	1.18	1.35	0.17
			(0.824)			(0.006)	[0.204]	[0.007]	(0.480)
Credit to households									
total	0.694***	0.375**	-0.319	-0.140***	-0.135***	0.006	2.57	1.60	-0.97
			(0.242)			(0.888)	[0.006]	[0.154]	(0.258)
for housing purposes	0.649***	0.469***	-0.180	-0.104***	-0.115***	-0.011	1.97	1.36	-0.62
			(0.309)			(0.712)	[0.000]	[0.168]	(0.103)
to sole proprietors	0.673***	0.686***	0.012	-0.193***	-0.265***	-0.072	1.46	1.06	-0.403
			(0.936)			(0.221)	[0.025]	[0.661]	(0.119)
Credit to firms									
total	0.833***	0.710***	-0.122	-0.267***	-0.245***	0.022	0.91	0.96	0.05
			(0.577)			(0.768)	[0.134]	[0.745]	(0.669)
up to 4M PLN	0.727***	0.669***	-0.058	-0.231***	-0.184***	0.047	0.95	0.94	-0.01
			(0.793)			(0.405)	[0.487]	[0.551]	(0.904)
above 4M PLN	1.027***	0.906***	-0.121	-0.292***	-0.363***	-0.071	0.88	0.93	0.05
			(0.612)			(0.346)	[0.084]	[0.589]	(0.735)

⁽¹⁾ FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1; ** p<.05; *** p<.01

Table 14. Estimates of the equation (4) for banks with lower (group 1) and higher (group 2) share of deposits from non-financial sector in liabilities. ⁽¹⁾

Interest rate type	Immediate reaction (α_0)			Loading coefficient (β)			Long term pass-through (LTPT)		
	α_{01}	α_{02}	$\alpha_{02}-\alpha_{01}$	β_1	β_2	$\beta_2-\beta_1$	LTPT ₁ [=1 ?]	LTPT ₂ [=1 ?]	(LTPT ₁ -LTPT ₂)
Households deposits									
total	0.472***	0.408***	-0.063	-0.164***	-0.133***	0.031	1.29	1.31	0.02
			(0.622)			(0.264)	[0.037]	[0.006]	(0.913)
up to 1 month	0.514***	0.406***	-0.108	-0.098***	-0.081***	0.018	1.13	1.28	0.15
			(0.213)			(0.355)	[0.438]	[0.151]	(0.630)
from 1 to 3 months	0.538***	0.441***	-0.097	-0.203***	-0.147***	0.056	1.38	1.33	-0.05
			(0.467)			(0.135)	[0.003]	[0.000]	(0.732)
from 3 to 6 months	0.655***	0.417***	-0.238*	-0.200***	-0.155***	0.045	1.69	1.22	-0.47*
			(0.081)			(0.133)	[0.000]	[0.000]	(0.077)
from 6 to 12 months	0.566***	0.259***	-0.307***	-0.157***	-0.124***	0.034	1.23	0.88	-0.35**
			(0.000)			(0.142)	[0.000]	[0.227]	(0.016)
Firms deposits									
total	0.517***	0.474***	-0.043	-0.114***	-0.113***	0.001	1.17	1.10	-0.07
			(0.638)			(0.975)	[0.356]	[0.133]	(0.707)
up to 1 month	0.650***	0.497***	-0.152	-0.123***	-0.106***	0.017	1.10	1.06	-0.03
			(0.149)			(0.594)	[0.559]	[0.270]	(0.854)
from 1 to 3 months	0.770***	0.580***	-0.190**	-0.186***	-0.095***	0.091*	1.13	1.50	0.37*
			(0.035)			(0.052)	[0.100]	[0.000]	(0.067)
from 3 to 6 months	0.647***	0.600***	-0.047	-0.228***	-0.116***	0.112**	1.36	1.32	-0.03
			(0.776)			(0.026)	[0.031]	[0.009]	(0.890)
Credit to households									
total	0.550**	0.594***	0.044	-0.120***	-0.179***	-0.058	1.42	2.78	1.36
			(0.867)			(0.146)	[0.095]	[0.004]	(0.140)
for housing purposes	0.721***	0.437***	-0.284	-0.116***	-0.083***	0.033	2.58	1.30	-1.27**
			(0.130)			(0.302)	[0.000]	[0.104]	(0.011)
to sole proprietors	0.621***	0.704***	0.083	-0.256***	-0.211***	0.045	0.92	1.61	0.69***
			(0.528)			(0.522)	[0.612]	[0.001]	(0.005)
Credit to firms									
total	0.925***	0.637***	-0.288	-0.226***	-0.286***	-0.059	0.96	0.92	-0.04
			(0.161)			(0.428)	[0.696]	[0.293]	(0.761)
up to 4M PLN	0.824***	0.610***	-0.214	-0.209***	-0.202***	0.007	0.89	0.99	0.09
			(0.343)			(0.914)	[0.343]	[0.823]	(0.452)
above 4M PLN	1.011***	0.937***	-0.074	-0.330***	-0.319***	0.011	0.94	0.88	-0.07
			(0.758)			(0.885)	[0.594]	[0.220]	(0.605)

⁽¹⁾ FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1; ** p<.05; *** p<.01

Table 15. Estimates of the equation (4) for banks with lower (group 1) and higher (group 2) relationship banking indicator⁽¹⁾

Interest rate type	Immediate reaction (α_0)			Loading coefficient (β)			Long term pass-through (LTPT)		
	α_{01}	α_{02}	$\alpha_{02}-\alpha_{01}$	β_1	β_2	$\beta_2-\beta_1$	LTPT ₁ [=1 ?]	LTPT ₂ [=1 ?]	(LTPT ₁ - LTPT ₂)
Households deposits									
total	0.437***	0.397***	-0.040	-0.184***	-0.117***	0.067**	1.28	1.21	-0.08
			(0.693)			(0.013)	[0.007]	[0.013]	(0.625)
up to 1 month	0.458***	0.445***	-0.014	-0.082***	-0.085***	-0.003	1.32	1.06	-0.26
			(0.883)			(0.902)	[0.101]	[0.741]	(0.444)
from 1 to 3 months	0.556***	0.364***	-0.192*	-0.215***	-0.142***	0.074**	1.34	1.28	-0.06
			(0.067)			(0.032)	[0.000]	[0.001]	(0.617)
from 3 to 6 months	0.594***	0.382***	-0.212*	-0.198***	-0.154***	0.045	1.43	1.43	0.00
			(0.071)			(0.107)	[0.000]	[0.004]	(0.997)
from 6 to 12 months	0.414***	0.341***	-0.073	-0.157***	-0.125***	0.032	1.11	0.95	-0.16
			(0.471)			(0.207)	[0.126]	[0.774]	(0.454)
Firms deposits									
total	0.467***	0.533***	0.066	-0.109***	-0.121***	-0.011	1.20	1.05	-0.15
			(0.447)			(0.741)	[0.249]	[0.422]	(0.423)
up to 1 month	0.577***	0.571***	-0.006	-0.099***	-0.135***	-0.036	1.14	1.00	-0.13
			(0.952)			(0.334)	[0.401]	[0.885]	(0.439)
from 1 to 3 months	0.734***	0.542***	-0.192**	-0.197***	-0.091**	0.106**	1.21	1.28	0.07
			(0.026)			(0.024)	[0.002]	[0.000]	(0.641)
from 3 to 6 months	0.779***	0.690***	-0.089	-0.286***	-0.110***	0.177***	1.35	1.14	-0.21
			(0.535)			(0.001)	[0.001]	[0.184]	(0.338)
Credit to households									
total	0.421**	0.741***	0.320	-0.166***	-0.143***	0.023	1.94	2.22	0.27
			(0.252)			(0.552)	[0.032]	[0.013]	(0.763)
for housing purposes	0.492***	0.600***	0.107	-0.112***	-0.085***	0.028	1.56	1.75	0.19
			(0.531)			(0.356)	[0.007]	[0.032]	(0.710)
to sole proprietors	0.661***	0.667***	0.006	-0.259***	-0.209***	0.049	1.10	1.49	0.38
			(0.969)			(0.457)	[0.474]	[0.051]	(0.205)
Credit to firms									
total	0.786***	0.755***	-0.031	-0.254***	-0.252***	0.002	1.04	0.83	-0.20
			(0.891)			(0.982)	[0.655]	[0.099]	(0.110)
up to 4M PLN	0.673***	0.723***	0.050	-0.187***	-0.220***	-0.032	0.98	0.91	-0.06
			(0.825)			(0.549)	[0.823]	[0.179]	(0.598)
above 4M PLN	0.885***	1.067***	0.182	-0.412***	-0.257***	0.155**	1.03	0.76	-0.27**
			(0.432)			(0.033)	[0.669]	[0.051]	(0.040)

⁽¹⁾ FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1; ** p<.05; *** p<.01

Table 16. Estimates of the equation (4) for banks with better (group 1) and worse (group 2) quality of credit portfolio. ⁽¹⁾

Interest rate type	Immediate reaction (α_0)			Loading coefficient (β)			Long term pass-through (LTPT)		
	α_{01}	α_{02}	$\alpha_{02}-\alpha_{01}$	β_1	β_2	$\beta_2-\beta_1$	LTPT ₁ [=1 ?]	LTPT ₂ [=1 ?]	(LTPT ₁ -LTPT ₂)
Households deposits									
total	0.441***	0.404***	-0.037	-0.130***	-0.168***	-0.038	1.21	1.41	0.20
			(0.749)			(0.197)	[0.006]	[0.006]	(0.288)
up to 1 month	0.527***	0.527***	0.001	-0.099***	-0.088***	0.011	1.12	1.36	0.24
			(0.996)			(0.743)	[0.323]	[0.145]	(0.456)
from 1 to 3 months	0.447***	0.538***	0.091	-0.153***	-0.193***	-0.040	1.31	1.43	0.12
			(0.468)			(0.239)	[0.000]	[0.001]	(0.366)
from 3 to 6 months	0.456***	0.594***	0.138	-0.165***	-0.190***	-0.025	1.33	1.57	0.24
			(0.309)			(0.369)	[0.002]	[0.000]	(0.276)
from 6 to 12 months	0.344***	0.437***	0.093	-0.131***	-0.149***	-0.018	0.93	1.20	0.27*
			(0.423)			(0.440)	[0.528]	[0.006]	(0.068)
Firms deposits									
total	0.554***	0.410***	-0.144	-0.106***	-0.132***	-0.026	1.03	1.28	0.26
			(0.156)			(0.558)	[0.584]	[0.186]	(0.252)
up to 1 month	0.587***	0.569***	-0.018	-0.135***	-0.105***	0.030	0.99	1.25	0.26
			(0.875)			(0.429)	[0.578]	[0.313]	(0.306)
from 1 to 3 months	0.570***	0.799***	0.229**	-0.101**	-0.171***	-0.070	1.38	1.18	-0.19
			(0.017)			(0.114)	[0.000]	[0.048]	(0.301)
from 3 to 6 months	0.657***	0.572***	-0.084	-0.118***	-0.240***	-0.123**	1.42	1.32	-0.10
			(0.607)			(0.025)	[0.024]	[0.027]	(0.699)
Credit to households									
total	0.721***	0.344**	-0.377	-0.160***	-0.141***	0.019	2.52	1.70	-0.82
			(0.135)			(0.677)	[0.006]	[0.075]	(0.368)
for housing purposes	0.578***	0.485**	-0.092	-0.096***	-0.100***	-0.005	1.49	2.76	1.27
			(0.633)			(0.860)	[0.020]	[0.006]	(0.122)
to sole proprietors	0.712***	0.513***	-0.198	-0.194***	-0.287***	-0.093	1.49	0.98	-0.51*
			(0.155)			(0.172)	[0.012]	[0.901]	(0.051)
Credit to firms									
total	0.746***	0.813***	0.067	-0.270***	-0.241**	0.029	0.90	1.01	0.11
			(0.760)			(0.746)	[0.138]	[0.925]	(0.390)
up to 4M PLN	0.689***	0.705***	0.016	-0.218***	-0.191***	0.027	0.92	1.00	0.08
			(0.949)			(0.679)	[0.172]	[0.983]	(0.576)
above 4M PLN	0.981***	0.937**	-0.044	-0.301***	-0.393***	-0.091	0.90	0.93	0.03
			(0.906)			(0.399)	[0.215]	[0.609]	(0.860)

⁽¹⁾ FE estimator (within); number of lags is determined by BIC criterion; sample: 2005-2013; * p<.1; ** p<.05; *** p<.01

www.nbp.pl

