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Interest rate pass-through in Poland since the global financial crisis

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Abstract

We analyse why loan rates in Poland have diverged from interbank interest rates since the beginning of the global financial crisis. Following Illes et al. (2015) we calculate a weighted average cost of liabilities, which might be considered as a more accurate proxy for a marginal cost of funding for banks than an interbank interest rate. Then, we investigate the interest rate pass-through on bank-level panel data using both measures. We find that an increase in the weighted average cost of liabilities, relative to interbank interest rates, explains some of the increase in credit spreads. However, deterioration of economic outlook, an increase in uncertainty and non-performing loans, as well as tightening of capital regulation have also been at play. That the cost of funding matters for loan rates has important implications for the current discussion on the potency of negative interest rates, as they rather cannot be transmitted to deposit rates, which are the main component of bank funding.

JEL classifications: E43, E52, C23
Keywords: interest rate pass-through, monetary policy, global financial crisis, lending spreads, panel data models

1 Introduction

As the global financial crisis broke out, central banks decidedly lowered their official interest rates. However, in many cases their transmission to interbank, deposit and loan rates was far from proportional, indicating distortions in the functioning of the interest rate channel of the monetary transmission mechanism. In the euro area, tensions in the interbank market have been observed already since mid-2007, but it was a year later when the crisis came into a severe phase and the money market froze. Unusually high spreads on short term interbank borrowing raised concerns about effectiveness of the interest rate transmission from central bank rate to money market rates (see e.g. ECB, 2010; Abbassi and Linzert, 2012). Distortions appeared also in the transmission to retail rates, but have been relatively small until early 2010, when the global financial crisis evolved into the sovereign debt crisis (e.g. ECB, 2013; Paries et al., 2014). Despite the common monetary policy, persistent difference in the level of lending rates between core and peripheral euro area countries emerged (being significantly higher and further from central bank rate in the latter).

In Poland, the distortions on financial markets related to the global financial crisis were less severe than in the euro area.[1] Nevertheless, retail rates did not respond to the monetary policy easing as could be expected on the basis of the past experience. After the cumulative interest rate cuts by 250 basis points (bps) between November 2008 and June 2009, the rates on loans to households (for house purchases and to sole proprietors) decreased by about 110-120 bps, and on loans to non-financial firms by about 180 bps. Also the interest rates on deposits, especially from households, remained on elevated levels. In 2015, seven years after the outburst of the global financial crisis, the spreads between lending rates and money market rates were still on levels higher than typical for the period pre-2008.

The literature puts forward several factors explaining weak responsiveness of lending retail rates to expansionary monetary policy (Illes and Lombardi, 2013; Gambacorta et al., 2014; Paries et al., 2014; Illes et al., 2015). Firstly, access of banks to funding has been constrained and/or became more costly. Revaluation of risky assets and loss write-offs have impaired bank balance sheets, leading to a higher credit risk premium. Additionally, possibility of earning higher yields on government debt by investors contributed to a higher cost of acquiring new funding by banks. Therefore, ability and willingness of banks to extend loans have become lower. Secondly, weak economic outlook and expected rise in unemployment resulted in higher perception of risk associated with bank borrowing activity and increased credit risk premium charged on

[1] Polish banking sector did not have exposures related to sub-prime mortgages, however, the large share of banks operating in Poland is owned by foreign, mostly EU investors. Therefore, the global distortions were transmitted mainly through decisions of parent institutions in the area of risk management and through loss of confidence among interbank market participants (for detailed discussion of impact of the global financial crisis on the Polish economy see NBP, 2009).

loans. Thirdly, banks might have not been willing to reduce lending rates in order to improve their capital position, after its deterioration during the crisis.

In the paper we focus primarily on bank funding cost as a main driver of lending rates, but we also attempt to capture the influence of the remaining two factors mentioned above. The banks' funding costs play an important role in the monetary policy transmission. Theoretical mark-up model points that banks set lending rate in relation to the marginal cost of funding (De Bondt, 2002). These theoretical considerations are supported by empirical research pointing to crucial role of bank funding costs in pricing loans (e.g. Button et al., 2010). Until the beginning of the global financial crisis, the marginal cost of funding was closely approximated by market rate or risk free rate, but since then cost of acquiring additional funding increased significantly above the market rates (Beau et al., 2014; Illes et al., 2015). Banks could absorb the higher funding cost and accept reduced profitability of lending, or pass them to borrowers and increase lending rates risking lower loan demand. Empirical evidence that we describe in the next section suggests that the increase in funding costs related to the global financial crisis contributed to higher retail lending rates.

In order to assess the role of cost of funding in explaining evolution of retail lending rates in Poland, we calculate – for each of 19 commercial banks participating in the interest rate statistics – a weighted average cost of liabilities (WACL) in a similar way as Illes et al. (2015). Comparison of this proxy of marginal funding costs to the central bank rate and money market rate confirms that they decoupled around September 2008. Next, exploiting panel structure of the data, we estimate the interest rate pass-through models using market rates and our weighted average cost of liabilities measure, and assess which version helps better predict level of lending rates since late 2008. We account for other factors affecting interest rate transmission by extending the baseline equation with proxy for uncertainty and banks' capital position. We find that funding costs play the most important role in explaining lending rates of loans for house purchases and loans to sole proprietors – the two loan categories which interest rates were most distorted during the crisis. The fundamental source of divergence of the weighted average cost of liabilities from interbank interest rates, transmitted to lending rates, was a banks' fight over deposits, the most important component of banks' financing. In response to the distortions on the interbank market, banks adjusted their funding structure and increased demand for deposits of a non-financial sector, which in turn increased deposit spreads. However, an increase in perceived risk related to banking activities have also been at play.

Our paper contributes to the literature in several ways. Despite many papers attempting to explain relatively weak adjustment of retail lending rates to policy rate in economies that suffered the most from the global financial crisis (like the US, euro area, UK), there is scarce evidence on interest rate transmission during these turbulent times in the other European countries, like Poland and other CEE countries. Polish

banking sector has distinct characteristics than more financially developed countries (especially when it comes to funding structure of banks) and was affected by the crisis only indirectly. Our paper aims to fill this gap. Secondly, we stress the role of costs of retail deposits in banks' funding costs. Due to the above-mentioned difference in the funding structure, the main factor contributing to higher funding costs of banks operating in Poland was an increase in retail deposit rates rather than higher cost of issuing debt securities (related mainly to higher risk of sovereign debt securities). Finally, we calculate the weighted average cost of liabilities for individual banks rather than for countries like in Illes et al. (2015), which might result in a more accurate approximation of funding costs, and include additional factors (credit risk/macroeconomic uncertainty, capital buffers) in the model of interest rate pass-through.

Our results have two important implications. Firstly, they suggest that lending rates may stay at elevated levels for a longer time, even if the perceived risk of lending returns to the pre-crisis level. This is because the increase in the weighted average cost of liabilities is related to the move of banks towards a more sustainable model of funding. Secondly, our results matter for the current discussion on the potency of negative interest rates, as they rather cannot be transmitted to deposit rates, which are the main component of bank financing.

The structure of the paper is as follows. The second section reviews shortly the literature on measuring banks' marginal costs and their application in the interest rate pass-through analysis. Next, we describe data and make some comments on evolution of lending spreads. The fourth section explains calculation of the WACL. Our main results are presented in the fifth section. We use money market rate and the WACL to model interest rate pass-through in the error correction framework, a standard approach in the case of non-stationary interest rates, and then compare performance of alternative models in a simple forecasting exercise. The last section concludes.

2 Literature review

The global financial crisis, followed by the sovereign debt crisis, has brought a renewed interest in transmission from policy rate to retail lending rates. The traditional relations between these rates have been strongly disturbed and new factors, related mainly to risk associated with both lending to banks and by banks to the non-financial sector, needed to be included in the analysis. A detailed survey of interest rate transmission in the euro area, including its disturbances during the financial and sovereign debt crises, is provided by Andries and Billon (2016), therefore here we focus only on papers stressing the role of funding costs for the interest rate transmission.

Until recently, for the purpose of analysis of interest rate pass-through the banks' funding costs were successfully approximated by a policy rate or money market rate. As a consequence of the crisis, these two rates have decoupled leading to interest in more direct measures of banks' funding costs. Beau et al. (2014) decompose bank funding costs into risk free rate, credit risk premium, liquidity premium and other costs. The risk free rate is directly shaped by the central bank, while banks' credit risk and liquidity premium are affected by individual bank characteristics, debt instrument characteristics and macroeconomic environment. In line with this decomposition, a possible measure of marginal funding costs faced by banks is a sum of short term money market rate plus an average of five-year credit default swap premia of banks – an approximation of price of the long term wholesale funding (Button et al., 2010).[2] In this approach, non-market sources of funding are ignored, based on arguments that it is difficult to raise deposits from the non-financial sector in a short period of time and that maturity of loans significantly exceeds maturity of retail deposits. Nevertheless, the cost of retail deposits affect lending rates through a mark-up over marginal cost (higher deposit rates reduce net margin on lending). An alternative proxy of the marginal cost of funding – the weighted average cost of liabilities calculated on the basis of the liabilities structure and appropriate interest rates – was applied by Illes et al. (2015) and von Borstel et al. (2015). The WACL exploits all positions in banks' liabilities, including the retail deposits (the details on its calculation are given in section 3).

In our analysis we follow approach of Illes et al. (2015), as in the Polish banking sector retail deposits play an important role as a source of banks' financing – they account on average for about 70% of liabilities, comparing to less than 10% share of debt issued by banks. For comparison, the average share of retail deposits in the European Union banks amounts to about 40% (ECB, 2009). Secondly, during the severe phase of the financial crisis banks very actively tried to attract deposits of the non-financial sector, and their action was successful as indicated by an increased share of deposits after 2008. Moreover, the weighted average cost of liabilities accounts for heterogeneous strategies of funding of distinct banks.

[2] This maturity of CDS corresponds roughly the maturity of loans extended by UK banks.

In the aforementioned works, the WACL was employed in analyses of interest rate pass-through during the financial and sovereign crises.[3] Illes et al. (2015) show that lending spreads over WACL, contrary to spreads over policy rate, have been stable for a number of European countries between 2003 and 2014. Moreover, an analysis of pass-through coefficients points on significantly smaller distortions during the turbulent times. Contrary to other studies, von Borstel et al. (2015) conclude that the impact of policy rate on lending rates in the euro area during the sovereign debt crisis has not differed from its impact prior to the financial crisis. Nevertheless, in the crisis time the monetary policy was inefficient when it comes to altering the mark-ups over the costs of funding. Finally, Button et al. (2010) show that marginal funding costs play an important role in shaping lending rates, both secured and unsecured, but since the outburst of the global financial crisis other factors have gained importance. These factors are most likely associated with higher expected losses on loans and capital charge.

When it comes to other factors affecting the interest rate transmission (different from marginal cost of funds), the literature stresses the need to extend the interest rate pass-through analysis with some measures of credit risk of borrowers and bank capital position (e.g. Button et al., 2010; Paries et al., 2014). It is often pointed out that after the outburst of the global financial crisis banks' perception of risk has changed, leading to higher charges for credit risk. Banks could also have increased mark-ups in order to rebuild their capital position, which has deteriorated during the crisis.

[3]Other papers extend the pass-through equation with some measures of risk associated with lending to banks (e.g. Gambacorta et al., 2014; Paries et al., 2014).

3 Data

3.1 Sample

In the paper we explain developments in retail rates in Poland. The data comes from Monetary Financial Institutions Interest Rate Statistics (MIR) collected by the Narodowy Bank Polski (NBP), and harmonized across the European Union countries. We examine only new loans in PLN. The following categories of loans are analysed: loans for house purchases granted to households and non-profit institutions serving households (as one category, hereafter: loans for house purchases), loans to sole proprietors and loans to firms. Interest rate on loans for house purchases is an annual percentage rate of charge, incorporating all charges paid by the borrower (commissions, compulsory loan insurance premium against death and unemployment), as banks may reduce margins while increasing other costs to compensate for it. Other lending rates include only interest costs.

Apart from MIR, we make use of data on banks' liabilities, collected by NBP within the framework of financial reporting.

We employ data at individual bank level. The number of commercial banks reporting interest rates amounts to 19, but as not all banks offer all kinds of loans or in some periods some banks did not grant any loans of a particular type, the number of individual interest rate series might vary from one loan category to another.[4]

The time dimension of the sample is relatively long: from January 2005 to March 2015. During this period some mergers took place, but this process did not affect interest rate setting by banks and hence we have conducted analysis on the original data.[5] This way we avoid excluding some banks from the analysis due to too short series resulting from splitting data at merger date. The panel is unbalanced.

3.2 Interest rate spreads before and since the global financial crisis

3.2.1 Deposit spreads

In this subsection we describe changes in deposit rates during the global financial crisis, as deposits of the non-financial sector comprise the most important source of financing in the Polish banking sector.

Previous research showed that deposit rates are in the long run relationship with money market rates, and before the beginning of the financial crisis the pass-through from money market rate to deposit rates was almost complete (Stanisławska, 2015). After September 2008, this relation was distorted – there was a significant change in the level of deposit rates in relation to money market rates (see Kapuściński et al.,

[4] We do not include in the sample two cooperative banks because specificics of their activity differ from those of commercial banks.

[5] This is supported by analysis of rolling regressions of transmission equation for individual banks.

2014).[6]

Figure 1 plots spreads between deposits rates (on new deposits from households and firms) and money market rate (WIBOR 3M) from 2005 to 2015. Households deposit rates increased sharply in the 4th quarter of 2008, and in next two years they gradually decreased, but did not reach the pre-crisis level. In 2011 a new upward trend appeared. Rates on deposits from firms were more stable. There was a short-lived increase in deposit rate around 2008/2009, and since 2011 an upward trend, similar to one in deposit rates from households, has been observed. During the period of the most severe distortions on the money market and in the end of the sample, banks were willing to accept deposits at rates higher than the money market rate. Looking at time structure, spreads on deposits with maturity up to 1 month changed only slightly, which might be linked to the fact that liquidity for shorter maturities was delivered by the NBP as part of "Confidence Package" – a set of instruments aimed at delivering liquidity to banks.

Figure 1. Spreads on deposit rates (deposit rate minus money market rate)

Note: Dashed lines mark average levels of spread in pre- and post-crisis period.
Source: own calculations based on NBP data.

Why banks have increased deposit spreads over interbank interest rates during the global financial crisis? A plausible explanation can be provided with the following stylised example, illustrated in Table 1. Let us consider 2 firms and 2 banks. Firm 1 takes out a loan from bank 1, and corporation 2 – from bank 2 (stage 1). It means that assets of these banks increase by the amount of newly granted loans, and liabilities by the amount of newly created deposits (with mirror changes in balance sheets of firms). Now, for some reason, firm 1 decides to transfer its deposit from bank 1 to bank 2 (stage 2a). The balancing item for the change in deposits is a change in reserves. If it happens that bank 1 does not have sufficient amount of reserves to settle this transaction, it

[6] Additionally, the long run-pass through coefficients in equations for longer maturities have increased.

Table 1. Lending, deposit flow and its settlement in balance sheets of commercial banks and firms

Bank 1		Bank 2		Firm 1		Firm 2	
			Stage 1 (lending)				
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
+Loan of firm 1	+Deposit of firm 1	+Loan of firm 2	+Deposit of firm 2	+Deposit in bank 1	+Loan in bank 1	+Deposit in bank 2	+Loan in bank 2
			Stage 2a (deposit flow)				
	-Deposit of firm 1		+Deposit of firm 1	-Deposit in bank 1			
				+Deposit in bank 2			
			Stage 2b – scenario 1 (interbank lending)				
+Reserves	+Loan from bank 2	-Reserves					
		+Loan to bank 1					
			Stage 2b – scenario 2 (attracting deposits)				
+Reserves	+Deposit of firm 2	-Reserves	-Deposit of firm 2			-Deposit in bank 2	
						+Deposit in bank 1	
			Stage 2c (settlement)				
-Reserves		+Reserves					

Source: own elaboration.

has either to borrow them from bank 2 (stage 2b-scenario 1) or try to attract deposits from firm 2, which keeps them in bank 2 (stage 2b-scenario 2).[7] And it can do so by increasing deposit rates. When the financial crisis hit, the interbank market froze, and banks seemed to try to move to the second scenario.

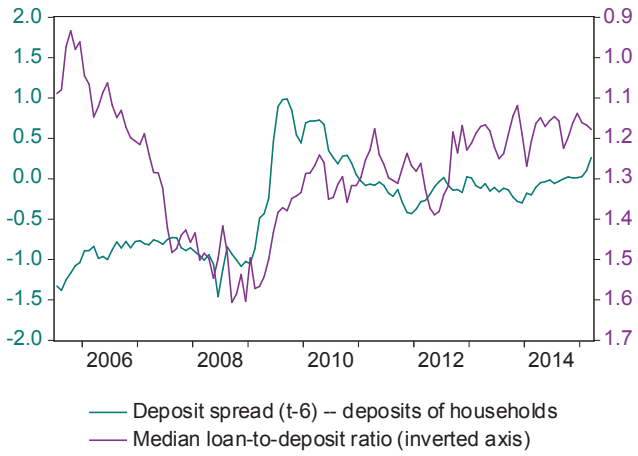
This way banks achieved largely successful rebalancing, as Figure 2 shows. Before the crisis, there was a large increase in a median loan-to-deposit ratio (LDR), reflecting mainly a net outflow of deposits for a median bank. After that "deficit banks" increased deposit spreads, attracting deposits and lowering LDRs.

Taking into account that deposits of the non-financial sector are the major source of financing of banks (with few exceptions), the narrowing of spreads over money market rates indicates a relative rise of costs of financing of banks (in relation to WIBOR rates). Distortions in transmission from money market rate to deposit rates (as well as from central bank rate to money market rate – not described here, see Kapuściński et al., 2014), suggest that money market rate might not reflect properly changes in banks' cost of financing during the financial crisis, and motivates calculating a new measure of this cost, similar as Illes et al. (2015).

The scale of adjustment of deposit rates differed across banks. One might wonder

[7] If there is no sufficient aggregate amount of reserves, a central bank steps in with repo.

Figure 2. Deposit spread and loan-to-deposit ratio



Source: own calculations based on NBP data.

whether these differences are related to banks' individual characteristics, especially financing structure. Unfortunately the number of banks available for analysis is too small to include their characteristics in regression, but it is possible to make some general observations.

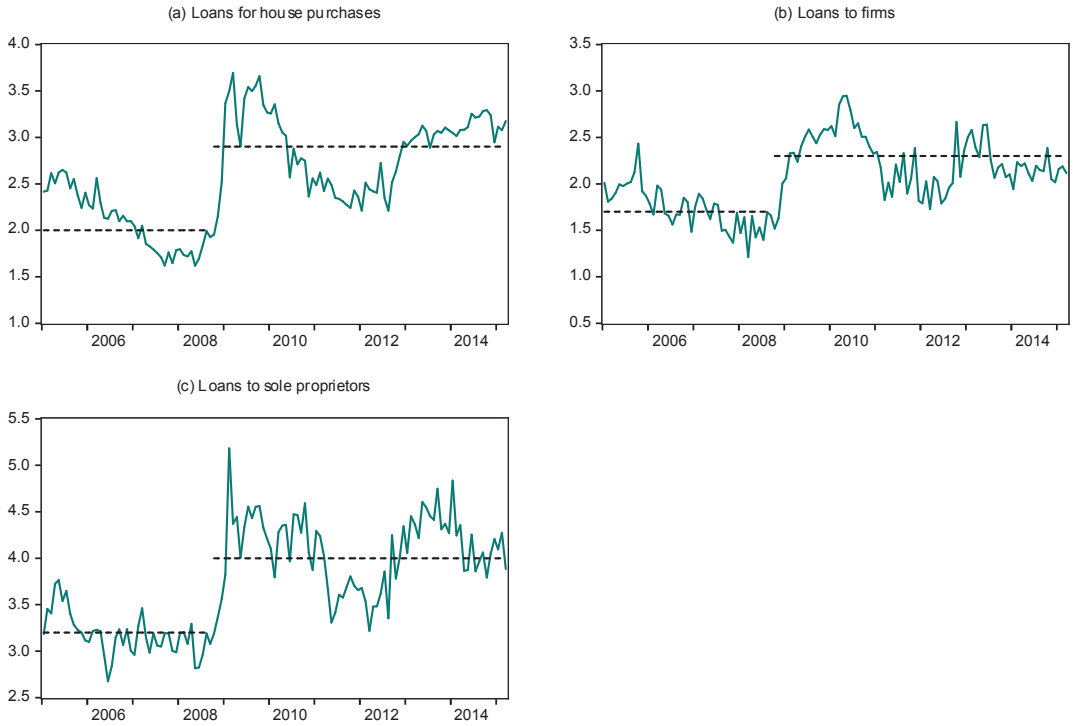
It seems that banks relying relatively more on financing from deposits of non-financial sector (and general government sector) adjusted deposit rates after Septermber 2008 less than banks financing relatively more from the financial sector. Average change in spread in a group of banks with the highest share of private non-financial and general government sectors was equal to +0.30 p.p., compared to +0.68 p.p. in the remaining banks. It might be suspected that facing problems with refinancing from the money market, the banks more dependent on deposits from the financial sector were forced to attract more resources from the non-financial sector and therefore offered more attractive deposit rates. It means that the adjustment in deposit rates was connected with the process of changing financing structure. It should be mentioned that some banks – with foreign parent banks – were able to obtain financing from their parent institutions (NBP, 2009).

3.2.2 Lending spreads

The lending spreads were affected by the crisis as well (Kapuściński et al., 2014; Stanisławska, 2015). Change in lending spreads was observed for all credit categories, but interest rates on loans to households were altered more than interest rates on loans to firms (Figure 3). In an average bank, spreads on loans granted to households for house purchases increased after September 2008 by about 1 p.p., to sole proprietors by about 0.75 p.p., while spreads to loans granted to firms (small and large loans) by

about 0.6 p.p. Lending spreads of all credit categories included in the analysis were on elevated level in 2009-2010 (compared to the pre-crisis period), but later they evolved differently. Spreads on loans to households (for house purchases and to sole proprietors) increased again after 2011 and are currently still markedly higher than prior to the crisis. Rates on loans to firms have remained relatively stable since 2011 and stay on a slightly higher level than typical for pre-crisis period.

Figure 3. Spreads on lending rates (lending rate minus money market rate)



Note: Dashed lines mark average levels of spread in pre- and post-crisis period.
Source: own calculations based on NBP data.

4 Weighted average cost of liabilities

4.1 Construction

Constructing weighted average cost of liabilities we follow Illes et al. (2015), who calculated it for 11 European Union countries (on a country level). We used their approach to approximate the funding cost for individual banks operating in Poland. First, we determined the structure of banks' liabilities. We include only liabilities in the domestic currency. This seems to be a valid simplification, as banks having foreign currency liabilities either have matching amount of loans in foreign currencies (which we do not analyse either) or have to hedge their open currency exposures, bringing the cost of funding to that of domestic currency liabilities. Additionally, in doing so we avoid the need to estimate costs of hedging (which would be non-trivial). Although financing strategies of individual banks differ, for an average bank the most important component of liabilities are deposits from the non-financial sector: they constitute more than 60% of total liabilities.[8] Deposits of financial sector institutions play much smaller role as a source of financing, as their share equals on average 15%. Both deposits of general government and debt securities issued by banks make up slightly less than 10% of total liabilities. Despite relatively small role of the latter on average, including financing by debt securities as a separate category is important as it is highly concentrated in a few banks. Loans from other monetary financial institutions and repurchase agreements account for less than 5% of total liabilities, while operations with central bank – less than 1%. Table 2 summarizes structure of banks' liabilities in PLN in the two subperiods. On the basis of this structure, we computed weights of different categories of financing (taking into account also maturity of liabilities) – for each month and bank separately.

Time dimension is very important in our analysis, as banks have adjusted their sources of financing since the outset of the crisis. Due to distortions on the interbank market (turnover decreased significantly, especially for longer maturities), banks attempted to attract deposits from households and firms. It is reflected in an increase of share of deposits of the non-financial sector since 3rd quarter of 2008, and fall a in share of deposits from the financial sector. Some banks increased also their financing through debt securities. In response to the turmoil on the interbank market, the NBP employed the Confidence Package. It played a role only during the most severe phase of the crisis, so it is not noticeable in long-term averages. It should be mentioned that some banks received financial resources from their parent foreign institutions (NBP, 2009), but these liabilities were denominated in foreign currencies and therefore are not included in our analysis.

[8] According to classification introduced in NBP (2010), banks making up about 60% of sectors' assets follow funding strategy based mainly on deposits, 14% – strategy based on financing from foreign parent institutions, and the remaining – mixed strategy.

Table 2. Composition of weighted average cost of liabilities

Category of liabilities	Interest rate	Average weight	
		2005:01-2008:09	2008:10-2015:03
Liabilities to private non-financial and general government sectors		**0.68**	**0.71**
Deposits of households, by maturity	interest rate on new deposits of households (except for overnight deposits for which we use rate on outstanding amounts)	0.37	0.45
Deposits of firms, by maturity	interest rate on new deposits of firms (except for overnight deposits for which we use rate on outstanding amounts)	0.21	0.20
Deposits of central and local government sector, by maturity	interest rate on new deposits of firms (except for overnight deposits for which we use rate on outstanding amounts)	0.10	0.07
Liabilities to financial sector		**0.24**	**0.19**
Deposits, by maturity	WIBID	0.17	0.14
Loans from other monetary financial institutions	WIBOR 1Y	0.03	0.02
Repurchase agreements, by maturity	WIBOR O/N for maturities up to 1 week, OIS rates for longer maturities	0.04	0.03
Debt securities issued		**0.07**	**0.09**
Debt securities, by maturity	WIBOR 6M for maturities up to 1 year, yield on Polish benchmark bonds for longer maturities		
Liabilities to central bank		**0.00**	**0.00**
Open market operations	reference rate		
Lombard credit	lombard rate		
Refinancing credit	refinancing rate		

Source: own calculations based on NBP data.

Having weights reflecting the structure of individual bank's liabilities, we assign appropriate interest rates to them. Rates on deposits of households and firms come from interest rate statistics collected by the NBP and are available at individual bank level. Rate on term deposits refers to new businesses, while a rate on overnight deposits refers to stock. The interest rate statistics do not cover deposits of central and local government, therefore we assume that this type of deposits is treated as firms' deposits. Interest rates assigned to other categories of liabilities are the same for all banks (quoted reference rates), as we do not have detailed information on interest paid by individual banks. For deposits of monetary financial institutions we apply interbank deposit rates (WIBID) of a respective maturity, and for repurchase agreements – OIS rates (except

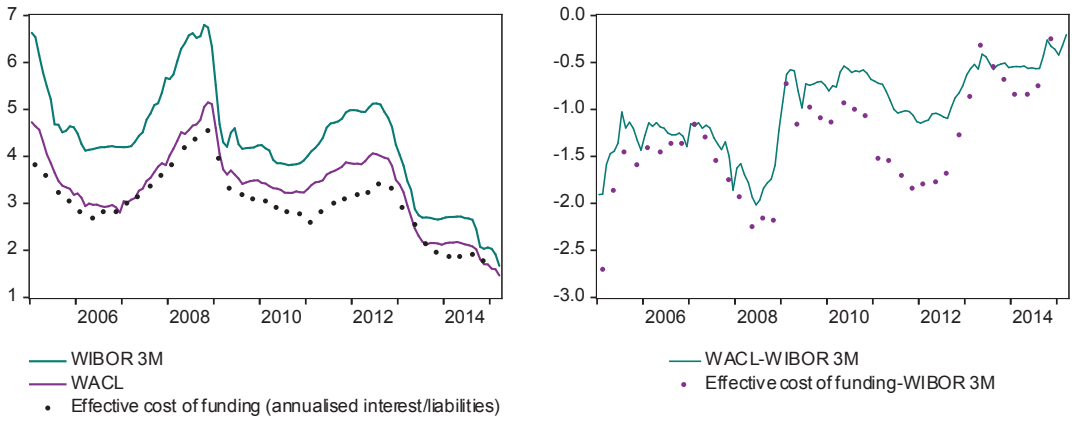
for maturities up to 1 week) as they do not include risk premium. Due to relatively long maturity of loans from other monetary financial institutions, we matched them with WIBOR 1Y rate. We approximated the cost of issuing debt securities by banks with interbank market rates (for short maturities) and with yield on Polish benchmark bonds (for longer maturities). The drawback of using the same market rates to all banks, especially in the case of loans from other financial institutions and debt securities, is that we do not capture idiosyncratic credit risk, and as a consequence our measure might underestimate the cost of liabilities. However, the role of these sources of financing is minor in most of banks included in the analysis.

The calculated weighted average cost of liabilities is not fully marginal measure, similarly as in Illes et al. (2015), because the weights reflect structure of stocks, not flows of liabilities. The data on flows is unavailable for the whole period under consideration.

4.2 Comparison with other measures of bank funding cost

Figure 4 compares WACL with a standard measure of a marginal cost of funds (for banks), WIBOR 3M, and (as a cross-check) with an effective cost of funding. The latter was calculated for each bank dividing annualized interest expenses by liabilities, using data from financial statements. This measure reflects an average, not a marginal cost of funding, but in contrast to other measures it is fully bank-specific (the WACL does not take into account that banks can face different interbank rates and bond yields) and includes liabilities in all currencies.

Figure 4. Comparison of measures of bank cost of funding



Note: WACL and effective interest rate represent averages across banks.
Source: own calculations based on NBP data.

For the average bank the weighted average cost of liabilities tracks the interbank market rate (WIBOR 3M) closely during the period prior to September 2008. However,

at the end of 2008, there was a shift in this relation: the same market rate matches higher weighted cost of liabilities. Since then, both rates move together again. On average, the WACL is very close to the level of an effective cost of funding. These measures slightly diverged directly after the global financial crisis, as some banks used more intensively foreign currency funding (at lower interest rates) from their parent companies at the time. The WACL leads an effective cost of funding, but this is because the first one is more related to flows and the second one to stocks.

5 Interest rate pass-through to lending rates

5.1 Narrative analysis

We have argued that money market rates have not reflected changes in costs of funding faced by banks during the disturbances on interbank market related to the global financial crisis. Research on the interest rate pass-through in Poland showed that transmission from money market rates to retail lending rates was distorted in this period. The long-run relationships have not been broken (except for interest rates on consumption credit), but lending spreads over WIBOR rates increased as shown in section 3 (see also Kapuściński et al., 2014). Additionally, some evidence suggests that long-run pass-through could have become smaller and not complete (Stanisławska, 2015).

Three complementary factors might explain this increase in lending spreads: (1) increase of costs of financing by banks in relation to market rates, (2) increased risk of economic activity and its perceptions by banks, (3) change in a capital buffer. We focus on the first explanation, but we try to address the remaining issues as well.

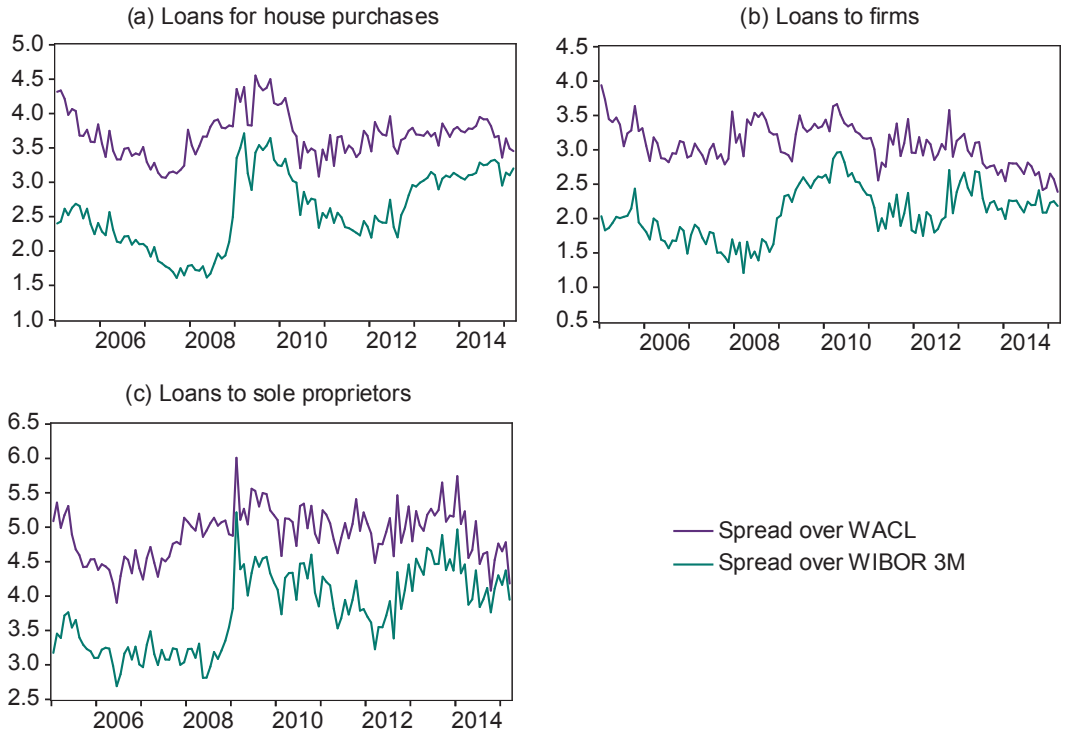
Figure 5 presents developments in lending spreads calculated in relation to WIBOR 3M rate and weighted cost of liabilities for an average bank. Difference between lending rates and our proxy of funding costs is more stable than a spread over money market rate counterpart, for all credit categories. All spreads increased at the end of 2008, but spread over the weighted average cost of liabilities to a lesser degree (Table 3).

The spread over WACL for housing loans, after downward trend in first years of our sample, started to increase in 2007 and reached a peak in 2009. Elevated level of lending rates on housing loans, in comparison to WIBOR rate and WACL, during the most severe phase of the crisis might be attributed to increased risk perception.[9] Since 2010 this spread is relatively stable. Similar pattern is found for spreads on loans to sole proprietors. Spreads over the weighted average cost of liabilities for firms' loans are more stable over time, especially the average spread before and after 2008:09 is almost the same. Interestingly, the spreads started to decrease since 2012 and at the end of the sample reached very low levels. Most likely, it was the case because the government introduced De Minimis Guarantee Scheme, under which a state bank (Bank Gospodarstwa Krajowego) started granting guarantees for loans for non-financial corporations, lowering credit risk.

The need to augment interest rate pass-through equations with risk factors is suggested inter alia in ECB (2013) and Gambacorta et al. (2014). Also Illes and Lombardi (2013) argue that increased credit risk affected interest rate transmission in major EU countries since the global financial crisis (for a detailed discussion of interest rate pass-through in Europe during the global financial crisis see Andries and Billon, 2016). The

[9] This kind of loans was perceived as especially risky because of burst of real estate bubbles in some European countries at that time (Spain, Ireland), and previously in the US.

Figure 5. Comparison of lending spreads over money market rate (WIBOR 3M) and weighted average cost of liabilities



Note: WACL and effective interest rate represent averages across banks.
Source: own calculations based on NBP data.

Table 3. Comparison of average lending spreads over money market rate (WIBOR 3M) and weighted average cost of liabilities in two sub-periods: before and after 2008:09

Loans	Spread over WIBOR 3M		Spread over WACL	
	2005:01–2008:08	2008:09–2015:03	2005:01–2008:08	2008:09–2015:03
for house purchases	2.0	2.9	3.5	3.8
to sole proprietors	3.2	4.0	4.7	4.9
to firms	1.7	2.3	3.2	3.0

Note: average spread over banks.
Source: own calculations based on NBP data.

decomposition of lending spreads in Poland (at the aggregate level) confirms that the risk of economic activity and its perception by banks played a very important role in shaping spreads in this period (Kapuściński et al., 2016).

The literature mentioned above identifies supply side and demand side risk factors that affected the interest rate transmission. The former are related to banks' unwillingness to lend due to a need to improve their balance sheets and to a constrained access to

funding. As proxies for this kind of risks factors, the following variables were suggested: banks' expected default frequencies, the capital-to-asset ratio, the liquidity-to-asset ratio or bank lending survey indicators. The latter components reflected increased credit risk related to deteriorated economic outlook and higher macroeconomic uncertainty. The credit risk might be approximated by probabilities of default of non-financial corporations, employment expectations, unemployment rates or the cost of equity for financial companies and banks.

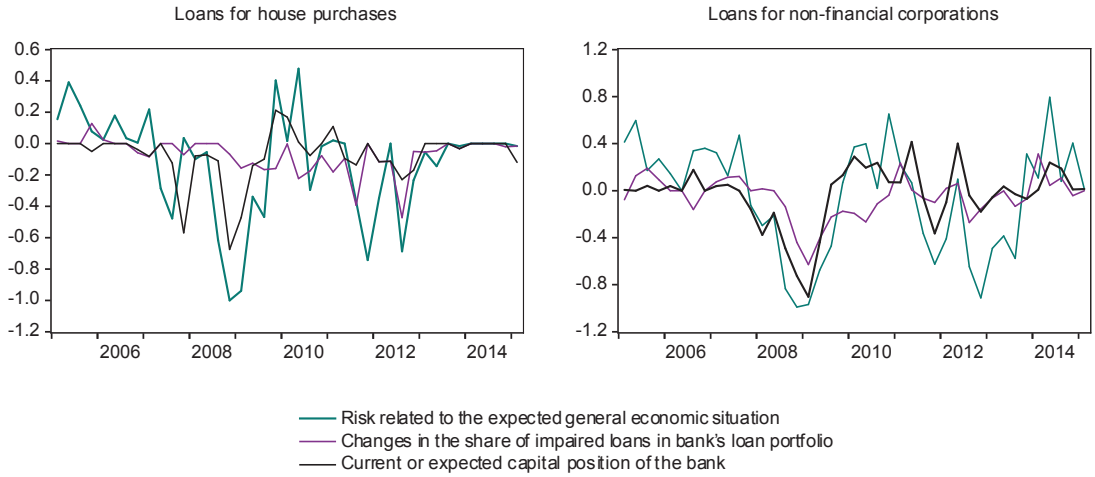
In our case, the risk factors on the banks' side are reflected, to certain degree, in their costs of financing. Therefore we augment our model only with measures of credit risk and/or uncertainty. We consider several proxies of increased credit risk or its perception: a forecast of GDP growth in next year, disagreement about future economic outlook and a share of non-performing loans.[10] The advantage of the first two variables is that they are forward looking, but are available only at aggregate level. On the contrary, the latter variable is bank- and product-specific (we calculated NPLs for each credit category separately, however, due to changes in reporting, we proxy NPLs for house purchases in the domestic currency by NPLs in all currencies), but reflects current, not expected, changes in the quality of loans. We conduct analysis for all these measures.

We also use a capital buffer, which we calculate as a difference between a capital adequacy ratio (for 2005-2013)/total capital ratio (for 2014-2015) and their reference levels, under which the Financial Supervision Authority (FSA) allows for full dividend payout. This measure also reflects risk, as capital constitutes a buffer against loan-losses. But additionally, it shows probability of breaching the level of capital expected by the FSA. In order to avoid it, banks may want to increase lending spreads to improve profitability.

Besides results from the above-mentioned papers, the decision to include measures of risk/uncertainty and a capital buffer in our models is supported by Senior Loan Officer Opinion Surveys (Figure 6). Banks were concerned about prospects of macroeconomic situation since mid-2007 to mid-2009 and in 2011-2012. In the former period their lending policy was affected by a share of non-performing loans, as well as current and expected capital position. Influence of share of non-performing loans on lending policy is less important in the case of loans for house purchases, probably due to the fact that loans of this kind are usually collateralised.

[10]The data on GDP growth forecasts comes from Reuters Thomson survey among financial analysts. Gaps in this data, prior to 2008, were replaced by NBP projections. To measure disagreement about future economic outlook, we use standard deviation of forecasts of GDP growth in next year (since June 2008) and disagreement on unemployment rate in next year (prior to this date) – both from Reuters Thomson survey, adjusted accordingly. No uniform series on future GDP or unemployment rate is available for the whole time span.

Figure 6. Factors influencing changes in lending policies (net percentage)



Note: Figures present the net percentage. A positive value of net percentage should be interpreted as the easing of lending policy, while a negative value of net percentage – as the lending policy tightening.
Source: NBP data.

5.2 Models and in-sample results

We model interest rate pass-through within the error cointegration framework – a standard approach adopted in this type of analyses. Westerlund (2007) cointegration tests confirm that there is a long run relationship between retail lending rates and money market rate (WIBOR 3M), in the traditional approach, as well as between lending rates and the weighted average cost of liablities, as suggested by Illes et al. (2015) (test results are shown in appendix). Adding credit risk/uncertainty proxies or a capital buffer does not change the test results.

In order to assess interest rate transmission, we employ Pesaran et al. (1999) pooled mean group estimator, which assumes that in the long run all banks equally adjust lending rates to money market/funding cost, but in the short run their reaction may vary. We prefer this estimator to alternative fixed effect, as an erroneous assumption of homogeneity of all model parameters might lead to a loss of consistency. The evidence for Poland and other countries supports validity of assumption of the common long-run pass-through and varying short-run reactions to interest rate changes (see Weth, 2002; Berstein and Fuentes, 2004; Horváth and Podpiera, 2012; Stanisławska, 2015). The long-run homogeneity assumption may be tested by comparing estimates of the long-run adjustment coefficients with pooled mean group and mean group estimator with a Hausman-type test.[11] Its results confirm that this assumption is fulfilled in the case of all lending rates under consideration.

[11] For details on this test see Pesaran et al. (1999).

In the baseline version we assume that banks set interest rates only in relation to the money market rate or the weighted average cost of liabilities, and we estimate the following error correction model, corresponding to ARDL(2,1):

$$\Delta lr_{i,t} = \alpha_i(lr_{i,t-1} - \beta ir_{i,t}) + \delta_i \Delta ir_{i,t} + \lambda_i \Delta lr_{i,t-1} + \mu_i + \varepsilon_{i,t}.$$

where $lr_{i,t}$ denotes lending rate and $ir_{i,t}$ – money market rate (WIBOR 3M) or WACL.[12] In additional regressions we extend the pass-through equation with measures of credit risk/uncertainty or a capital bufer and get the following model:

$$\Delta lr_{i,t} = \alpha_i(lr_{i,t-1} - \beta ir_{i,t} - \gamma add_{i,t}) + \delta_i \Delta ir_{i,t} + \pi_i \Delta add_{i,t} + \lambda_i \Delta lr_{i,t-1} + \mu_i + \varepsilon_{i,t}.$$

where add_t denotes one of our measures of credit risk/uncertainty (GDP growth forecast, GDP growth forecast dispersion, share of non-performing loans) or a capital buffer. All models were estimated on sample from January 2005 to March 2015.

Tables 4-6 show results for long-run relationships between lending rates, and measures of a marginal cost and other regressors.[13] Models with WIBOR have better in-sample fit, as reflected by lower Bayesian information criteria. This is in spite of a higher variability of lending spreads in relation to WIBOR 3M than versus WACL.

Rates on loans for house purchases move one-for-one with WIBOR, even without controlling for other factors (surprisingly, the result disappears when controlling for dispersion of GDP forecasts and a capital buffer). This is not the case in models for rates on loans for non-financial corporations and for sole proprietors. For the former, coefficient for WIBOR is statistically different from one (smaller) even when additional regressors are included. For the latter, controlling for GDP forecast, a capital buffer or all variables jointly brings estimates to unity.

In most cases point estimates of coefficients for WACL are higher than for WIBOR. They are also higher than one, even by as much as 10 bps. This may indicate that financial accelerator works, but causes of that result may also be more technical. Namely, this may be due to still remaining omitted variable bias (for example, we do not control for government programmes) or due to imperfections in calculated WACL. Nevertheless, in models with WACL we reject hypothesis of full long-run adjustment in fewer cases than in models with WIBOR. This applies to interest rates on all types of loans, but is the most evident for rates on loans for house purchases.

When additional regressors are statistically significant, in most cases (with some minor exceptions, most likely related to multicollinearity) they enter with "correct" signs. Higher expected GDP growth and lower macroeconomics risk/uncertainty (measured by dispersion of GDP forecasts) are associated with lower lending rates. Inter-

[12] Lag length was chosen using Schwarz information criterion.
[13] Short-run relationships are shown in the appendix

estingly, models with WIBOR indicate importance of the GDP growth forecasts, while models with WACL – dispersion of these forecasts. This difference might be explained by the fact that the GDP growth forecasts have been permanently lower since the beginning of the crisis, which corresponds to higher lending spreads over WIBOR in this period, while rise in forecasts dispersion was short-lived (it increased in the most severe phase of the crisis and then returned to "normal" level), so it matches temporary rise in spreads over WACL. Lending rates are also lower in periods/banks with lower non-performing loan ratios and higher capital buffers. The estimated effect of non-performing loans on interest rates on loans for house purchases is, puzzlingly, negative. This may be because NPLs for house purchases in all currencies are not a sufficiently good proxy for NPLs in the domestic currency.

Table 4. Estimation output, long run, dependent variable – interest rate on loans for house purchases

	Measure of marginal cost – WIBOR 3M						Measure of marginal cost – WACL					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Marginal cost	**0.96*****	**0.97*****	0.91***	**0.94*****	0.92***	**0.94*****	**1.09*****	**1.07*****	**1.02*****	**1.08*****	**1.03*****	**1.00*****
	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.05)	(0.05)	(0.06)	(0.05)	(0.04)	(0.05)
GDP forecast		-0.29***				-0.22***		-0.04				-0.01
		(0.03)				(0.04)		(0.05)				(0.05)
GDP forecast SD			1.12***			0.21			1.48***			1.10***
			(0.26)			(0.23)			(0.33)			(0.32)
NPL				-0.02*		-0.02***				-0.04**		-0.03**
				(0.01)		(0.00)				(0.01)		(0.01)
Capital buffer					-0.11***	-0.03					-0.1***	-0.05
					(0.02)	(0.02)					(0.02)	(0.02)
BIC	1074.16	1025.93	1021.81	1057.10	1043.7	958.0	1287.35	1270.62	1246.91	1279.84	1257.26	1203.2

Note: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05. Coefficients statistically indifferent from 1 in bold (α=0.05).
Source: own calculations.

Table 5. Estimation output, long run, dependent variable – interest rate on loans to firms

	Measure of marginal cost – WIBOR 3M						Measure of marginal cost – WACL					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Marginal cost	0.9***	0.9***	0.89***	0.91***	0.88***	0.91***	1.11***	1.1***	**1.06***	1.12***	1.1***	**1.05***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
GDP forecast		-0.2***				-0.20***		0.05				0.08*
		(0.03)				(0.03)		(0.04)				(0.04)
GDP forecast SD			0.25			0.07			0.92***			0.66*
			(0.23)			(0.22)			(0.26)			(0.26)
NPL				0.01*		0.02***				-0.01		-0.01
				(0.00)		(0)				(0.01)		(0.01)
Capital buffer					-0.05***	-0.01					-0.05**	-0.03
					(0.01)	(0.01)					(0.02)	(0.02)
BIC	2352.47	2313.44	2346.41	2325.2	2285.3	2211.5	2571.17	2560.47	2557.78	2549.00	2505.74	2457.3

Note: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05. Coefficients statistically indifferent from 1 in bold (α=0.05).
Source: own calculations.

Table 6. Estimation output, long run, dependent variable – interest rate on loans to sole proprietors

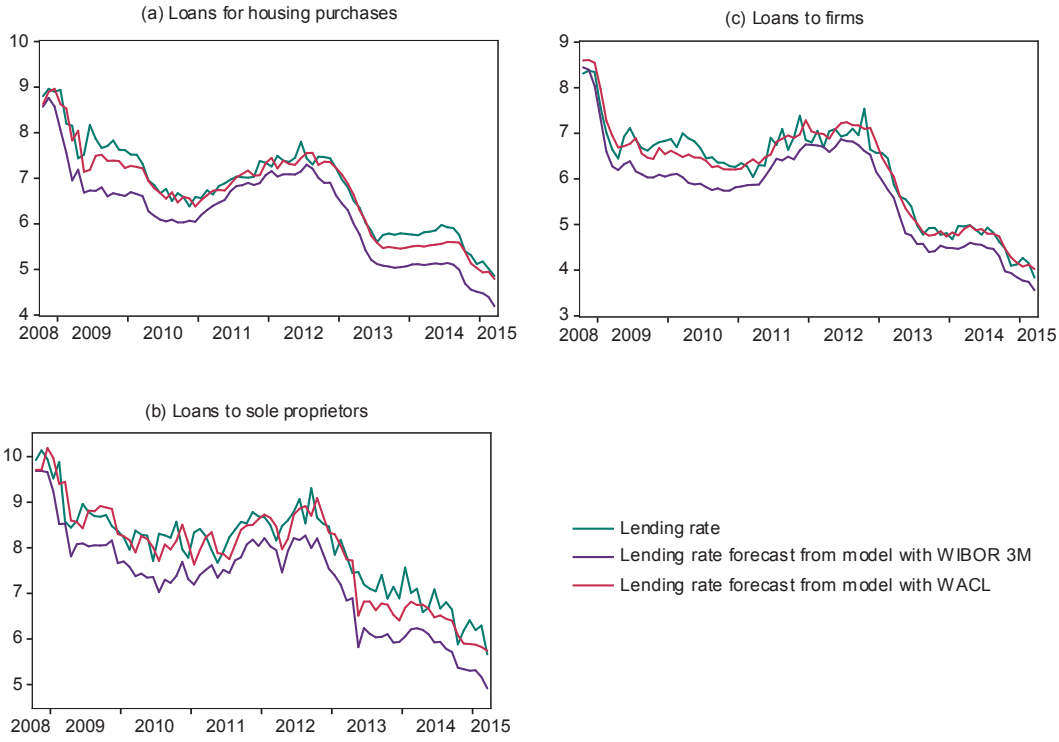
	Measure of marginal cost – WIBOR 3M						Measure of marginal cost – WACL					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Marginal cost	0.87***	**0.94***	0.85***	**0.91***	**0.89***	**0.93***	**0.96***	**1***	**0.85***	0.74***	**0.93***	0.68***
	(0.05)	(0.06)	(0.06)	(0.05)	(0.06)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)
GDP forecast		-0.23***				-0.18**		-0.07				-0.13
		(0.06)				(0.07)		(0.06)				(0.07)
GDP forecast SD			0.24			-0.14			1.25***			1.07*
			(0.4)			(0.44)			(0.43)			(0.46)
NPL				0.04***		0.01*				-0.01		-0.01*
				(0.01)		(0.01)				(0.01)		(0.00)
Capital buffer					0.06*	0.02					0.01	0.03
					(0.03)	(0.03)					(0.03)	(0.03)
BIC	3166.32	3148.61	3150.6	3130.6	3126.76	3065.5	3220.28	3213.26	3202.04	3201.8	3179.73	3133.5

Note: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05. Coefficients statistically indifferent from 1 in bold (α=0.05).
Source: own calculations.

5.3 Predictive power

Another way to compare alternative sets of models, with the money market rate and with the weighted average cost of liabilities, is to assess forecasts of lending rate produced by them. Therefore, we re-estimated interest pass-through equations from the previous sections on the sample before the global financial crisis (i.e. January 2005-September 2008) and used them to calculate forecasts of lending rates in the remaining part of the sample (October 2008-March 2015). Figure 7 plots predicted lending rates together with the actual values of lending rates for average bank (baseline specification). It clearly shows that models with WIBOR 3M rate underestimate actual lending rates in the sample covering crisis and post-crisis period, contrary to models with the weighted average cost of liabilities, which predict lending rates more accurately.

Figure 7. Forecasts of lending rates (average over banks) over 2008:09-2015:03, models without additional regressors



Note: These are one step ahead static forecasts.
Source: own calculations based on NBP data.

We compare the forecasts performance from these two sets of models over the whole crisis and post-crisis period (October 2008-March 2015). Table 7 presents RMSE of forecasts from models with the weighted average cost of liabilities in relation to RMSE of forecasts delivered from models with WIBOR 3M (all specifications). For the baseline

Table 7. RMSE relations: model with WACL/model with WIBOR 3M

Additional regressors	Loans for house purchases	Loans to firms	Loans to sole proprietors
None	0.65	0.91	0.80
GDP forecast	0.75	1.03	0.84
GDP forecast SD	0.63	0.83	0.75
NPL	0.70	1.22	0.82
Capital buffer	0.59	0.91	0.83
All	0.63	1.13	0.96

Source: own calculations.

specification, including only the interest rates, there is a clear advantage of the model with the weighted average cost of liabilities, especially in the case of interest rates on loans for house purchases. Including credit risk/uncertainty in models with WIBOR 3M helps to predict lending rates of firms: for selected specifications models with money market rates, predictions are characterized by similar (or even smaller) RMSE as models with the weighted average cost of liabilities.

6 Conclusion

The disturbances on the Polish money market related to the outburst of the global financial crisis affected interest rate transmission form money market rates to retail interest rates. One of the consequences was increase of spreads between interest rates on loans to households and firms over money market rates. We argue that this change was linked not only to increased credit risk, but was driven also by higher costs of obtaining funds by banks.

Suggestions that problems with refinancing by banks played a role in setting retail interest rates was put forward by ECB (2013) and Illes et al. (2015) in relation to strong deterioration of interest rate pass through relations in major EU economies. We used the approach of Illes et al. (2015) to calculate the weighted average cost of liabilities of banks in order to assess its impact on interest rate transmission in Poland. WACL is calculated by weighting interest rates on liabilities by corresponding shares.

It turned out that since 2008 Q4 (the beginning of the financial crisis) changes in money market rates have not fully reflected changes in funding costs. This distortion can be attributed to an increase in deposit spreads, as banks wanted to attract deposits in order to be less reliant on interbank lending.

We find lending spreads over WACL to be less variable than spreads over an interbank interest rate. Although panel error correction models with WACL turn out to perform worse in-sample than models with an interbank interest rate, the latter lose in terms of predictive power for the crisis and post-crisis sample. Estimates of coefficients for WACL are more often not different from one (indicating complete transmission of interest rates) than coefficients for an interbank interest rate. In general, WACL seems to be a better measure of a marginal cost of funding for banks than an interbank interest rate since the global financial crisis. Additionally, we find that risk/uncertainty and capital buffers also matter for lending rates. Banks tend to reduce interest rates with higher expected GDP growth and capital buffers, as well as lower uncertainty over future GDP growth and NPL ratios.

Our results imply that in crisis times policies lowering funding costs and risk, and increasing a capital buffer may improve pass-through to lending rates. What we find is also relevant for the current discussion on negative interest rates – if lending rates are set as a funding cost plus mark up, and deposits (interest on which rather cannot go below zero) constitute an important source of funding, negative interest rates may not be transmitted to lending rates after some point, to a large extent losing their rationale (Bech and Malkhozov, 2016).

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Appendix: Cointegration tests and short-run estimation results

Table A. Results of Westerlund cointegration tests between lending rates and money market rate or weighted average cost of liabilities – individual bank data (2005m1 – 2015m3, monthly)

Lending rate	Stat	WIBOR 3M	WACL
Credit for house purchases N=17	G_t	-2.56***	-2.11**
	G_a	-17.61***	-11.87**
	P_t	-8.15***	-10.11***
	P_a	-11.88***	-13.08***
Credit to sole proprietors N=18	G_t	-3.10***	-3.25***
	G_a	-19.34***	-19.01***
	P_t	-14.34***	-13.96***
	P_a	-19.22***	-17.90***
Credit to firms (total) N=19	G_t	-3.71***	-3.60***
	G_a	-27.75***	-24.75***
	P_t	-18.10***	-17.33***
	P_a	-29.40***	-26.26***
Small credit to firms N=18	G_t	-3.50***	-2.88***
	G_a	-24.54***	-18.60***
	P_t	-16.64***	-14.53***
	P_a	-26.30***	-20.52***
Big credit to firms N=15	G_t	-4.23***	-4.02***
	G_a	-30.95***	-28.33***
	P_t	-17.83***	-17.59***
	P_a	-33.92***	-31.49***

Note: The null hypothesis states that there is no cointegration. */**/*** denotes significance on 10/5/1% level. Lag set at 1.
Source: own calculations.

Table B. Estimation output, short run, dependent variable – interest rate on loans for house purchases (first difference)

	Measure of marginal cost – WIBOR 3M						Measure of marginal cost – WACL					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ECT	-0.23***	-0.26**	-0.25***	-0.25***	-0.25***	-0.30**	-0.21***	-0.19***	-0.23***	-0.22***	-0.23***	-0.23*
	(0.07)	(0.08)	(0.08)	(0.07)	(0.07)	(0.10)	(0.05)	(0.06)	(0.06)	(0.05)	(0.05)	(0.07)
ΔLending rate(-1)	-0.17	-0.18	-0.15	-0.17	-0.17	-0.15	-0.14	-0.18	-0.12	-0.14	-0.13	-0.15
	(0.09)	(0.12)	(0.09)	(0.09)	(0.09)	(0.11)	(0.1)	(0.13)	(0.09)	(0.09)	(0.1)	(0.12)
ΔMarginal cost	0.16	0.39**	0.16	0.17	0.18	0.30	0.09	0.26*	0.11	0.10	0.1	0.23
	(0.22)	(0.13)	(0.21)	(0.21)	(0.22)	(0.18)	(0.17)	(0.11)	(0.17)	(0.15)	(0.16)	(0.13)
ΔGDP forecast		-0.08				-0.01		-0.15				-0.10
		(0.11)				(0.10)		(0.12)				(0.11)
ΔGDP forecast SD			0.09			0.07			0.07			-0.03
			(0.21)			(0.15)			(0.2)			(0.17)
Δ NPL				0.54		0.40				0.44		0.35
				(0.33)		(0.31)				(0.4)		(0.28)
ΔCapital buffer					0.00	0					0.02	0.02
					(0.02)	(0.02)					(0.02)	(0.02)
Constant	0.58***	0.91***	0.55***	0.68***	0.76***	1.07***	0.63***	0.64***	0.59***	0.74***	0.81***	0.79***
	(0.12)	(0.23)	(0.11)	(0.15)	(0.16)	(0.29)	(0.12)	(0.15)	(0.12)	(0.14)	(0.14)	(0.17)

Note: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05.
Source: own calculations.

Table C. Estimation output, short run, dependent variable – interest rate on loans to firms (first difference)

	Measure of marginal cost – WIBOR 3M					Measure of marginal cost – WACL						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ECT	-0.38***	-0.43***	-0.38***	-0.39***	-0.38***	-0.43***	-0.33***	-0.34***	-0.34***	-0.34***	-0.34***	-0.35***
	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)
ΔLending rate(-1)	-0.15***	-0.12***	-0.15***	-0.14***	-0.15***	-0.11***	-0.13***	-0.12***	-0.13***	-0.13***	-0.13***	-0.12**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
ΔMarginal cost	0.31**	0.4***	0.33**	0.29*	0.31**	0.42**	0.38***	0.34***	0.43***	0.37***	0.4***	0.4***
	(0.14)	(0.15)	(0.14)	(0.15)	(0.14)	(0.17)	(0.17)	(0.1)	(0.12)	(0.12)	(0.11)	(0.11)
ΔGDP forecast		0.07				0.01		0.03				-0.02
		(0.05)				(0.04)		(0.04)				(0.04)
ΔGDP forecast SD			-0.07			0.03			-0.2			-0.19
			(0.14)			(0.16)			(0.16)			(0.16)
ΔNPL				0.05		0.04				0.03		0.04
				(0.03)		(0.03)				(0.03)		(0.03)
ΔCapital buffer					0.04*	0.02					0.04	0.04
					(0.03)	(0.02)					(0.02)	(0.02)
Constant	0.96***	1.44***	0.94***	0.93***	1.08***	1.49***	0.81***	0.78***	0.76***	0.86***	0.89***	0.81***
	(0.12)	(0.19)	(0.12)	(0.12)	(0.14)	(0.2)	(0.13)	(0.12)	(0.13)	(0.13)	(0.13)	(0.12)

Note: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05.
Source: own calculations.

Table D. Estimation output, short run, dependent variable – interest rate on loans to sole proprietors (first difference)

	Measure of marginal cost – WIBOR 3M						Measure of marginal cost – WACL					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ECT	-0.31***	-0.32***	-0.31***	-0.33***	-0.30***	-0.33***	-0.30***	-0.31***	-0.30***	-0.3***	-0.30***	-0.31***
	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
ΔLending rate(-1)	-0.21***	-0.21***	-0.22***	-0.20***	-0.21***	-0.21***	-0.2***	-0.21***	-0.21***	-0.20***	-0.20***	-0.20***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
ΔMarginal cost	0.05	0.18	0.1	0.02	0.05	0.18	0.16	0.19	0.27	0.19	0.17	0.34**
	(0.22)	(0.2)	(0.22)	(0.20)	(0.23)	(0.2)	(0.17)	(0.17)	(0.18)	(0.17)	(0.18)	(0.17)
ΔGDP forecast		-0.01				-0.04		-0.05				-0.09
		(0.07)				(0.07)		(0.07)				(0.06)
ΔGDP forecast SD			-0.32			-0.29			-0.42			-0.41
			(0.28)			(0.25)			(0.29)			(0.27)
ΔNPL				0.02		0.01				0.03		0.01
				(0.05)		(0.05)				(0.05)		(0.05)
ΔCapital buffer					-0.04	-0.04					-0.03	-0.03
					(0.03)	(0.03)					(0.03)	(0.03)
Constant	1.33***	1.54***	1.32***	1.17***	1.20***	1.44***	1.41***	1.49***	1.38***	1.76***	1.43***	1.85***
	(0.27)	(0.29)	(0.27)	(0.21)	(0.25)	(0.27)	(0.28)	(0.29)	(0.3)	(0.39)	(0.29)	(0.44)

Note: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05.
Source: own calculations.

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