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Contents

Abstract

This study investigates whether the effects of monetary policy are amplified through its impact on bank balance sheet strength. Or, in other words, it tests whether the bank lending channel of the monetary transmission mechanism (as reformulated by Disyatat, 2011) works. To this end, panel vector autoregressions with high frequency identification and univariate panel regressions are applied to data for Poland. Counterfactual exercises show that the analysed channel accounts for about 23% of a decrease in lending following a monetary policy impulse. This is another piece of evidence showing that the financial accelerator works in both non-financial and financial sector. In some cases it can make the interplay between monetary and macroprudential policy non-trivial.

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Keywords: monetary transmission mechanism, bank capital, panel vector autoregressions, high frequency identification

1 Introduction

Financial factors played the primary role in the Great Recession (2007-2009). The turbulence started in August 2007 when BNP Paribas halted redemptions of three investment funds. It intensified in September 2008 when Lehman Brothers filed for bankruptcy. It is not surprising that since then financial markets in general, and banks in particular, have been the subject of a larger share of economic studies. For example, many of them attempt to analyse the macroeconomic role of banks within the dominant dynamic stochastic general equilibrium framework in an increasingly useful for policy analysis manner (for recent advances see, for example, Brzoza-Brzezina, 2014; Jakab and Kumhof, 2015).

Besides observing more interest in banks, one can also find a changing approach to them. Recently, a few papers pointed out that banks neither 'multiply up' central bank money to create deposits nor do they intermediate loanable funds, as usually assumed (McLeay et al., 2014; Werner, 2015; Jakab and Kumhof, 2015). Banks create money making loans, with a central bank simply accommodating demand for reserves (Goodhart, 2009). And in creating money banks are limited mainly by expected profitability and capacity of their capital to absorb potential loan losses (fulfilling capital requirements at the same time).[1] It can make a difference for our understanding of some economic phenomena and designing economic policy.

It also matters for understanding the role of banks and their balance sheets in monetary policy transmission. There is a large body of literature on the bank lending channel, which started with a seminal paper of Bernanke and Blinder (1988) and continues until today. In its traditional formulation, it argues that monetary tightening reduces deposits and the ability of banks to make loans. As will be explained later, taking into account the above-mentioned changes in the approach to banks, that the traditional bank lending channel is operative seems unlikely. It has been already pointed out by Disyatat (2011), who proposed an alternative formulation: a monetary impulse can reduce loan supply through its impact on bank balance sheet strength. It resembles bank balance sheet, bank capital and risk-pricing channels found earlier (Chami and Cosimano, 2010; Van den Heuvel, 2006; Kishan and Opiela, 2012), with some of them focusing on quantities and some on prices.

This study investigates whether such a mechanism works. It proposes an empirical strategy to identify it, which is its main contribution to the literature. First, panel vector autoregressions with high-frequency identification are applied to data for Poland to check whether monetary policy matters for bank balance sheet strength (measured by non-performing loans, profitability and a capital buffer). Second, the impact of bank balance sheet strength on bank lending is analysed using univariate panel regressions.

[1] This is by no means a new finding. Werner (2014) argues that the 'credit creation theory of banking' was dominant in the first two decades of the 20th century.

Finally, impulse response functions from the first step are compared with counterfactual ones, which assume that the analysed channel does not work.

The results show that a monetary policy impulse increases non-performing loans, and reduces bank profitability and a capital buffer. Weaker balance sheets, in turn, are associated with lower lending growth. Overall, the bank lending channel (as reformulated by Disyatat, 2011) accounts for about 23% of a decrease in lending following a monetary policy impulse. This is another piece of evidence showing that the financial accelerator works in both non-financial and financial sector. In some cases it can make the interplay between monetary and macroprudential policy non-trivial.

For comparison, results from the traditional, less direct strategy for identifying the bank lending channel are shown as well. It relies on comparing responses of different groups of banks to monetary policy, assuming that some groups can better insulate themselves from shocks. In this case it should be those with less non-performing loans, more profitable and with a larger capital buffer. However, using this strategy would not lead to the same conclusions. This is probably because it reveals nonlinearity in responses due to many factors, including differences in portfolios of customers.

The paper is organised as follows. The second section provides a critical review of the literature. The third one describes econometric models and data. The fourth section shows results. The last one concludes.

2 The bank lending channel of the monetary transmission mechanism – old and new

There is a large body of literature on the bank lending channel, which started with a seminal paper of Bernanke and Blinder (1988). They modified the IS-LM model by adding loans. Within such a framework monetary tightening works as follows. A central bank conducts open market operations (reverse repo in this case) which drain reserves. It is assumed that a reserve requirement is binding, so banks have to reduce deposits. A lower amount of deposits, in turn, drives up interest rates. This is a so-called money view on the transmission of monetary policy. Another one, an ('old') lending view, argues that *a decrease in deposits reduces loans*, enhancing the first mechanism. It does so because deposits are assumed to be funds that banks use to make loans.

Early discussions on this framework (see Kashyap and Stein, 1993 for a review) pointed out that banks can replace deposits with other sources of funds, attenuating the bank lending channel (Romer and Romer, 1990). However, as argued for example by Stein (1998), for this channel to work it suffices that these other sources are more costly. Another objection could be that nowadays reserve requirements are relatively low, and that central banks signal their policy stance using a target for an interest rate rather than open market operations. Furthermore, they simply accommodate demand for reserves (Goodhart, 2009). Otherwise they would not achieve the interest rate target (see Disyatat, 2008). But a decline in deposits could also take place due to portfolio substitution following an interest rate increase, assuming that interest rate on deposits does not change (or changes less than a bond yield). Therefore, some more recent studies (for example, Ehrmann et al., 2001) abstract from reserves.

To test the bank lending channel most papers apply some form of an empirical strategy proposed by Kashyap and Stein (1995). It relies on comparing responses of different groups of banks to monetary policy, assuming that certain groups can better insulate themselves from a decrease in deposits. In the above-mentioned study they showed that in the United States loan portfolios of smaller banks decline more after monetary tightening, as (according to their interpretation) they cannot easily raise non-deposit sources of funds. Kashyap and Stein (2000) found that this stronger decline holds especially for banks small and with less liquid assets. According to Kishan and Opiela (2000) – for small and undercapitalised banks.[2] For liquidity the exact interpretation is usually different. It is argued that more liquid banks can compensate for a decrease in deposits by selling securities. There is also an alternative explanation for capitalisation. Peek and Rosengren (1995), and Kishan and Opiela (2006) showed that banks respond to monetary policy differently depending on whether they are capital-

[2]On the other hand, more recently Carpenter and Demiralp (2012) showed that in the United States responses of bank balance sheet variables, with banks divided by size, liquidity and capitalisation, are inconsistent with the bank lending channel being operative.

constrained or not. If they are, their ability to expand lending following easing of monetary policy is limited, irrespective of whether other constraints are binding. But overall, significant differences in responses with the 'correct' sign are interpreted as an indication that the bank lending channel works.

The literature expanded in two directions. First, size, liquidity and capitalisation were supplemented with other characteristics. Gambacorta (2005), and Cetorelli and Goldberg (2008) found that access to funding within holdings and global banks can insulate from monetary impulses. According to Altunbas et al. (2009) the same holds for using securitisation, which makes assets effectively more liquid. Altunbas et al. (2010) showed that bank risk can be considered as another proxy for access to non-deposit sources of funds.

Second, similar exercises were conducted for other countries/regions. For example, for Europe Ehrmann et al. (2001) showed that in some countries banks respond to monetary policy differently, depending on liquidity of their assets. Altunbas et al. (2002) found nonlinear responses with respect to capitalisation. Specifically, according to these studies loan portfolios of less liquid/undercapitalised banks decrease more following monetary tightening. There are also a few papers for Poland, with mixed results. Pawłowska and Wróbel (2002) showed that size, liquidity and capitalisation matter when it comes to responses of bank loans to monetary policy, but surprisingly more liquid banks respond more strongly. The latter result can also be found in Chmielewski (2005), who additionally established that there is a role for bank risk and ownership (with more risky and foreign banks reducing lending more). Havrylchyk and Jurzyk (2005) confirmed his finding on ownership, but also showed that the role of size, if any, can go in the opposite direction than in Pawłowska and Wróbel (2002). Matousek and Sarantis (2009) arrived at the same conclusion on size. On the other hand, they confirmed the result of Pawłowska and Wróbel (2002) on capital. According to Opiela (2008) banks with a full deposit guarantee used to contract lending more than those with a partial guarantee after monetary tightening. However, this is no longer relevant, as currently deposits in all banks are guaranteed in the same way. For a more extensive survey on this literature see Peek and Rosengren (2013).

But Disyatat (2011) raised more fundamental objections to the traditional approach to the bank lending channel. To begin with, it was already mentioned that monetary tightening/easing can be implemented without any additional open market operation. For example, currently Narodowy Bank Polski (NBP) makes an interest rate decision 11 times a year on first or second Wednesday of a given month. Regular open market operations are conducted each Friday. Say, a 25 basis point increase in a reference rate (which is a yield on 1-week operations absorbing liquidity) on Wednesday influences interbank interest rates immediately (if expected even in advance), not on next Friday.[3] In addition, a volume of open market operations is unlikely to be affected by the interest

[3] Of course, it also holds for central banks in developed economies (see Borio, 1997).

rate decision, as demand for reserves is largely interest-inelastic. Surplus liquidity has to be absorbed/missing liquidity has to be provided simply to achieve the interest rate target. And a given level of reserves can coexist with many different levels of interest rates (this is a so-called decoupling principle, see Borio and Disyatat, 2010). Therefore, a link: reserves-money multiplier-deposits rather cannot be a starting point for the bank lending channel.

Another one could be a decrease in deposits due to portfolio substitution. But do aggregate deposits decline following an interest rate increase? And if they do, for what reason? The key assumption is that interest rate on deposits does not change (or changes less than a bond yield) after monetary tightening. Indeed, in the United States there used to be Requlation Q, which imposed ceilings on saving deposit rates. But it was phased out in 1986. Currently there is practically no opportunity cost in holding saving deposits, or at least a bond yield does not constitute such a cost (Stiglitz and Greenwald, 2003). On the other hand, demand deposits usually offer lower or no return. But these are kept rather for other (transactional) purposes and should not be interest-elastic in the first place. Furthermore, although deposits are being transferred between banks on a large scale every day, an aggregate decline in them can happen only in specific circumstances. There are three most important cases. First, when deposits are exchanged for cash. Second, when non-banks buy financial assets from banks. It should be noted that when a household buys a bond from a non-bank corporation it exchanges a deposit for a bond. Now it is the corporation who has the deposit in a bank, not the household. However, an aggregate amount of deposits does not change. But when the household buys this bond from the bank deposit of the household is 'destroyed'. The same happens when non-banks repay loans to banks, which is the third case of interest (see McLeay et al., 2014). In other words, when loans decrease so do deposits, not the other way around.

The last point leads to another one, probably the most important in this discussion. Namely, banks do not intermediate deposits, they create deposits making loans (see Jakab and Kumhof, 2015). Put differently, new loans are not funded by recycling of deposits that were made earlier, but by creation of new deposits. This is what differentiates banks from other corporations, including non-bank corporations specialised in making payday loans. And in creating money banks are limited mainly by expected profitability and capacity of their capital to absorb potential loan losses (fulfilling capital requirements at the same time). Of course, a given bank has to roughly balance deposit outflows with inflows, as the balancing item for a change in deposits is a change in reserves. If the bank does not have sufficient reserves to settle the net outflow, it has to borrow them. This can turn out to be unsustainable in the long run (see the case of Northern Rock during the last crisis, Shin, 2009). But this is a different point than saying that banks are limited in their lending activity by deposits. Taking all this into account, that the traditional bank lending channel is operative seems unlikely.

Therefore, Disyatat (2011) proposed an alternative ('new') formulation for the bank lending channel. He argued that *the effects of monetary policy can be amplified through its impact on bank balance sheet strength, which influences loan supply.* The exact mechanism is supposed to work as follows. Monetary tightening, implemented by an interest rate increase, affects bank cash flows, net interest margins, asset valuation and asset quality. This is reflected in lower profits and capital.[4] Weaker bank balance sheets, in turn, lead to higher costs of funds for both banks and their customers, which reduces lending.

This description resembles a few mechanisms found earlier: bank balance sheet, bank capital and risk-pricing channels (Chami and Cosimano, 2010; Van den Heuvel, 2006; Kishan and Opiela, 2012).[5] The first two are focused on quantities and the third one on prices. All of them are similar to the balance sheet channel/financial accelerator (Bernanke et al., 1999) but on a bank level instead of a level of non-financial corporations. Indeed, for parsimony it would be probably best to refer to a single balance sheet channel, operating for non-bank corporations, banks, as well as households.[6] This is what, for example, Igan et al. (2013) implicitly do in their empirical study on the relationship between monetary policy and balance sheets in general. That monetary policy works through its impact on the health of banks is also basis for a so-called I theory of money (Brunnermeier and Sannikov, 2016).

Importantly, the results from the literature on the traditional bank lending channel can be to a large extent reconciled with its revised version (Disyatat, 2011). For example, smaller, less liquid and undercapitalised banks can be perceived as more risky and therefore face a stronger increase in their cost of funding following monetary tightening. It should be noted that what matters is existing, not necessarily new funding. And that larger reliance on market-based funding amplifies, not attenuates the mechanism. This is an important difference in implications between the two approaches to the bank lending channel.

Even if the traditional empirical strategy can give some indication whether the effects of monetary policy are amplified through its impact on bank balance sheet strength, Disyatat (2011) suggests to use strategies based on interest rates or spreads, rather than quantities. Besides the above-mentioned studies on the risk-pricing channel, this is what, for example, Gambacorta (2008) and de Haan et al. (2015) do. But since usually micro data on interest rates is scarce, and because quantity rationing seems to be both theoretically (see Jakab and Kumhof, 2015) and empirically (see Bassett et al., 2014; Altavilla et al., 2015) important, one can also directly investigate whether monetary policy indeed affects bank balance sheet strength and, if it does, whether it matters for bank lending. This study proposes to use such an empirical strategy.

[4] On the role of bank capital see Holmstrom and Tirole (1997), and Borio and Zhu (2012).

[5] On the bank balance sheet channel see also Hosono and Miyakawa (2014), on the bank capital channel Meh (2011), on the risk-pricing channel Breitenlechner and Scharler (2015).

[6] The point that the balance sheet channel can work for both non-bank corporations and banks can be found already in Bernanke and Gertler (1995), as well as in Bernanke (2007).

3 Empirical strategy

3.1 Models

The empirical investigation is conducted in three steps. The first one checks whether monetary policy matters for bank balance sheet strength. To this end, there are estimated panel vector autoregressions in the following form:[7]

$$y_{it} = A_{0i} + A_1 y_{it-1} + A_2 y_{it-2} + \cdots + A_p y_{it-p} + B x_{it} + e_{it}, \quad (1)$$

where i and t are unit and time subscripts, p is a number of lags, y_{it} is a vector of endogenous variables, x_{it} is a vector of exogenous variables (possibly in lags), e_{it} is a vector of error terms, A_{0i} is a vector of fixed effects (intercept terms), and $A_1, A_2, \ldots, A_p$ and B are matrices of other parameters. These models allow to capture dynamic interrelations between variables, which are especially important in this case. Error terms are assumed to be identically and independently distributed, with a covariance matrix Σ.

In line with the empirical literature on the bank lending channel units are assumed to be heterogeneous only in intercept terms. This is reflected in a i subscript for a vector A_0. In static panel data models fixed effects are usually eliminated by a within transformation – subtraction of a unit-specific average of a given variable from each observation. Then, estimation is conducted on transformed variables using simple ordinary least squares (OLS). However, such a transformation causes bias in estimates when a lagged dependent variable is used as a regressor (in panel vector autoregressions it is, in each equation). This is because a within transformed lagged dependent variable is correlated with a within transformed error.

The most common way to avoid this problem is to remove fixed effects by a first difference transformation. In such a case, parameters are estimated using instrumental variables (IV) or generalised method of moments (GMM), with first differenced variables instrumented by their lagged levels or first differences. These are so-called Anderson-Hsiao and Arellano-Bond/Blundell-Bond estimators. The problem is that the first one is inefficient and that the Sargan test for overidentifying restrictions for the second one is uninformative for models with the number of units smaller that the number of instruments (that would be the case in this study, even using the most parsimonious specification). Moreover, first differences for some variables seem unnatural. Taking this considerations into account, another transformation is used. Namely, fixed effects are removed calculating forward orthogonal deviations, which are differences between each observation and a unit-specific average of *future* observations of a given variable. Parameters are estimated using GMM, instrumenting transformed variables with untransformed ones.

[7] Estimation is conducted using a *pvar* package in Stata (Abrigo and Love, 2015).

In order to quantify the effects of monetary policy in panel vector autoregressions (and in non-structural models in general), endogenous and exogenous policy actions have to be separated from each other. Or, in other words, monetary policy shocks have to be identified. Here, this is achieved using (relatively) high-frequency data from financial markets. Specifically, a 'current interest rate change' factor from Kapuściński (2015), reflecting exogenous policy actions, is employed as one of variables. It was obtained following a method of Gurkaynak et al. (2005). First, there were calculated changes in variables representing the expected path of interest rates one year ahead, within two-day windows around policy meetings. Second, they were 'compressed' using principal components. Third, the first two factors were rotated and normalised, so that one of them could be interpreted as an unexpected component of changes in the current interest rate and the other one as a proxy for central bank communication. The first one is used here. For details see Kapuściński (2015).

Monetary policy shocks identified with high-frequency data have been used in vector autoregressions since Bagliano and Favero (1999). They employed them as an exogenous variable and calculated dynamic multipliers (instead of impulse response functions, as usually in vector autoregressions) in order to analyse the effects of monetary policy, using an interest rate as one of endogenous variables at the same time. More recently, Barakchian and Crowe (2013) used them as an endogenous variable instead of an interest rate. Gertler and Karadi (2015), and Passari and Rey (2015) instrumented an interest rate with these shocks.

High-frequency identification was chosen because it has the potential to correct for some drawbacks of more traditional identification strategies, such as short-run restrictions. These include a time-invariant structure (parameters in a monetary policy rule can change over time), a restricted information set (policymakers can track literally hundreds of variables), the use of final, revised data (estimates of GDP frequently change) and long distributed lags (there is little reason to believe that policymakers respond to, for example, inflation or GDP from a year earlier, Rudebusch, 1998).

The baseline model includes the economic sentiment indicator (ESI), a monetary policy shock, non-performing loan (NPL) ratio, a return on assets (ROA)[8], a capital buffer and loans as endogenous variables (with such an ordering in Cholesky decomposition), as well as seasonal dummies as exogenous variables. The choice of the ESI instead of GDP is motivated by an inherent simultaneity between GDP and loans, which makes the choice of Cholesky ordering non-trivial. On the one hand, for example, when a corporation wants to make an investment and finance it with a loan, it is investment demand what drives loans. But on the other hand, it is acceptance of the loan what makes the investment possible. Moreover, the *change* in loans funds the *level* of loan-financed expenditures (Biggs et al., 2009), while it seems more natural to

[8]The use of a return on equity does not change the results.

have both loans and a measure of expenditures (usually GDP) either in levels or in first (log-)differences in a model. Between the ESI and loans there is still a strong interrelation, but it seems that feedback from loans to the ESI, which is survey-based (and forward-looking), should be delayed (hence the ESI is put before loans when calculating impulse response functions). Monetary policy is assumed to affect economic conditions only with a lag, but it is allowed to affect measures of bank balance sheet strength (NPL ratio, ROA, a capital buffer) and loans within a given period. The ordering of bank-specific variables (the last four ones) is dictated by the causal interpretation: a change in asset quality affects profitability and capital, which in turn influences the ability and willingness of banks to make loans.[9] Generally, the above-mentioned set of variables is just sufficient to answer the question of interest.

As models are estimated on quarterly data, the number of lags is set to four. However, both lag length and specification are subject to numerous robustness checks. As far as specification is concerned, first, the set of variables is supplemented by a domestic interest rate, with the following Cholesky ordering: a monetary policy shock, the ESI, a domestic interest rate, NPL ratio, ROA, a capital buffer, loans. This approach is closer to the one of Bagliano and Favero (1999), instead of that of Barakchian and Crowe (2013), as in the baseline model.[10] Second, because there can be a trade-off between the number of variables and the quality of estimates, there are estimated models with measures of bank balance sheet strength taken separately. Third, additional controls are used (separately) as exogenous variables (in lags from 1 to p): a GDP deflator, house prices, a foreign interest rate, an exchange rate and the VIX (Chicago Board Options Exchange (CBOE) Volatility Index). For lag length, it is checked whether results change when it is reduced to two periods.

The second step of the empirical investigation is to analyse the impact of bank balance sheet strength on bank lending. Here, reduced-form, univariate panel regressions are estimated. They can be represented by Equation 1, with now y_{it} being univariate and x_{it} including both endogenous variables (in lags from 1 to p) and exogenous variables (possibly in lags). Again, units are assumed to be heterogeneous only in intercept terms, fixed effects are removed using forward orthogonal deviations and parameters are estimated employing GMM (with untransformed variables used as instruments for transformed ones). The dependent variable are, of course, loans. The core of baseline models includes lagged loans, the ESI, a monetary policy shock and seasonal dummies as independent variables. Additionally, variables measuring bank balance sheet strength are added separately and jointly. All independent variables are in lags from 1 to p, which in this case is again set to 4. Effectively, it means that now the focus is on equation for loans from the first step. Robustness analysis in this case involves re-

[9] Generalised impulse responses (not reported), which are insensitive to the ordering of variables, look similar to orthogonalised ones.

[10] Compared to Bagliano and Favero (1999), here monetary policy shock is not used as exogenous, but as 'the most exogenous out of endogenous' variables.

placing a monetary policy shock with a domestic interest rate, controlling (separately) additionally for a GDP deflator, house prices, a foreign interest rate, an exchange rate and the VIX (in lags from 1 to p), and reducing lag length to two periods.

In the third step, knowing the effects of monetary policy on bank balance sheet strength, and of bank balance sheet strength on bank lending, there are conducted counterfactual exercises. Impulse responses from the first step are compared with counterfactual ones, which assume that the (new) bank lending channel of the monetary transmission mechanism does not work. The latter are calculated with parameters measuring the impact of bank balance strength on lending set to zero.[11] As a summary measure of the role of the analysed channel, there is used a cumulative (percentage) difference in responses of loans to monetary policy after 20 periods. In order to obtain a plausible range of estimates, these differences are calculated not only for the baseline model, but also for the alternative specification (with the set of variables supplemented by a domestic interest rate), for models with additional controls and for the different lag length (two, instead of four).

For comparison, the traditional, less direct strategy for identifying the bank lending channel is used as well. As in the second step, it employs reduced-form, univariate panel regressions (estimation is conducted in the same way). Loans are explained by their lags, the ESI, a monetary policy shock, measures of bank balance sheet strength (added separately and jointly) and seasonal dummies, but also by interaction terms between the monetary policy shock and measures of bank balance sheet strength (also added separately and jointly). All independent variables are in lags from 1 to p, with p set to four. The interaction terms are used to compare responses of different groups of banks to monetary policy. The underlying idea is that some of them should be able to better insulate themselves from shocks. In this case it would be those with less non-performing loans, more profitable and with a larger capital buffer. Significant interaction terms (reflecting significant differences in responses) with the 'correct' sign would be interpreted as an indication that the bank lending channel works (but, as will be explained later, they can be compatible also with other hypotheses).

Although that the traditional bank lending channel is operative seems unlikely already from the institutional point of view, some empirical evidence (with the same caveat as above) can be provided checking whether access to market-based funding attenuates (as implied by the traditional approach) or amplifies (as in the new approach) the effects of monetary policy. This is made by estimating equation as in the previous exercise, but with a share of market-based funding and its interaction with the monetary policy shock as additional independent variables. Other details, including the core set of variables, are kept unchanged. As a robustness check, the monetary policy shock is replaced by a domestic interest rate.

[11] Carpenter and Demiralp (2012), and Bluwstein and Canova (2015), although for different purposes, adopt a similar approach.

3.2 Data

Each model is estimated on an unbalanced panel for Poland, covering the period between the first quarter of 2001 and the first quarter of 2015, and 20-42 banks (36 on average). The latter cover between 29% and 81% of aggregate loans (65% on average). Banks without granted loans, suspended, in liquidation, in bankruptcy and not conducting operating activity are removed from the sample. The same holds for cooperative banks and branches of credit institutions, as specifics of their activity differ from those of commercial banks. In order to correct for breaks, following mergers and acquisitions new units are created in the data.[12] Moreover, there are removed banks with less than half observations in the time dimension.

Two groups of variables are used: macro, which are the same for each bank, and micro, which are bank-specific. These with frequency higher than quarterly are averaged over quarters (the monetary policy shock is cumulated first). Each variable is employed in levels if stationary, or in first differences or growth rates if integrated of order one (none of them is found to be integrated of order 2 or higher). For macro variables, there are used three tests: augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS). In a case of conflicting results, the decision on the correct transformation (or lack thereof) is made on the basis of economic intuition. The situation is slightly different with micro variables, which are employed in estimation only after detection and treatment of outliers. As the latter can influence the results of tests for stationarity, it is first tested on aggregate data (with ADF, PP and KPPS tests). Then, after the transformation suggested by the first step and outlier detection and treatment, Levin, Lin and Chu, and Peseran and Shin tests for stationarity for panel data are used for confirmation.

Starting with macro variables, the ESI (seasonally adjusted) and the VIX are taken in levels from the European Commission and the CBOE, accordingly. The monetary policy shock from Kapuściński (2015) is used in first differences, similarly as the domestic interest rate, represented by WIBOR 3M (Warsaw interbank offer rate, a three-month interbank interest rate), the foreign interest rate, the exchange rate, the GDP deflator and house prices. While the domestic interest rate is taken in a raw form, the other two financial market variables are calculated using data for three-month interbank interest rates for CHF, EUR and USD (as quoted in London), and CHF/PLN, EUR/PLN and USD/PLN exchange rates (all series from Datastream). The foreign interest rate is a weighted average, and the exchange rate is a nominal effective one (an increase reflects a depreciation), with weights proportional to a share of each currency in foreign currency loans in Poland (NBP data, available from March 2004, the same structure as in March 2004 assumed earlier). The GDP deflator (seasonally adjusted)

[12] Mergers and acquisitions are identified using NBP database on banks removed from the list of monetary financial institutions, a study of Kozak (2013) and press releases.

is from Eurostat, and house prices are from NBP since the fourth quarter of 2006 and from the Central Statistical Office before.

All micro variables are taken from publicly unavailable NBP databases. Loans are in quarterly growth rates. They include both these in domestic and those in foreign currency, with the latter exchange rate adjusted. The adjustment is made by dividing foreign currency loans by the nominal effective exchange rate similar to the one above, but based on end-of-month data[13] and normalised to 1 at the beginning of the sample. The NPL ratio is calculated as a share of non-performing loans in total loans and used in first differences. Because there was a methodological change for non-performing loans, and because for some period (January 2008-February 2010) two methodologies overlap, there is made a smooth transition between the NPL ratio calculated in both ways. ROA, which is a relation between annualised quarterly profits and average quarterly assets, is taken in levels. The capital buffer (used in levels) is calculated as a difference between a capital adequacy ratio/total capital ratio and a level of the capital adequacy ratio/total capital ratio under which the Financial Supervision Authority (FSA) allows for a full dividend payout).[14] In this case there was a methodological change as well, and there is made a smooth transition for the period of overlap (the first quarter of 2014) to correct for that. The share of market-based funding is a relation between debt from financial institutions and total debt. It is taken in levels without testing for stationarity to allow for easy interpretation of the interaction term between the share of market-based funding and the monetary policy shock.[15] Outliers are removed with winsorizing, replacing observations below 10th and above 90th percentile with these percentiles.[16] Time series (medians and percentiles in the case of micro variables), as well as the results of unit root tests and sample coverage after individual corrections in the data are shown in Appendix.

[13] Balance sheets are reported as stocks at the end of a given month.

[14] This reference levels amounted to: 12.5% in the first quarter of 2015, 12% in 2012-2014, 10% in 2009-2011 and 8% before. In presented models these levels are used in a raw form, but the use of smoothed ones does not change the results. The outcomes do not change when both the capital adequacy ratio/total capital ratio and the reference levels are used as variables either.

[15] Because this variable varies between 0 and 1, outliers are not removed either.

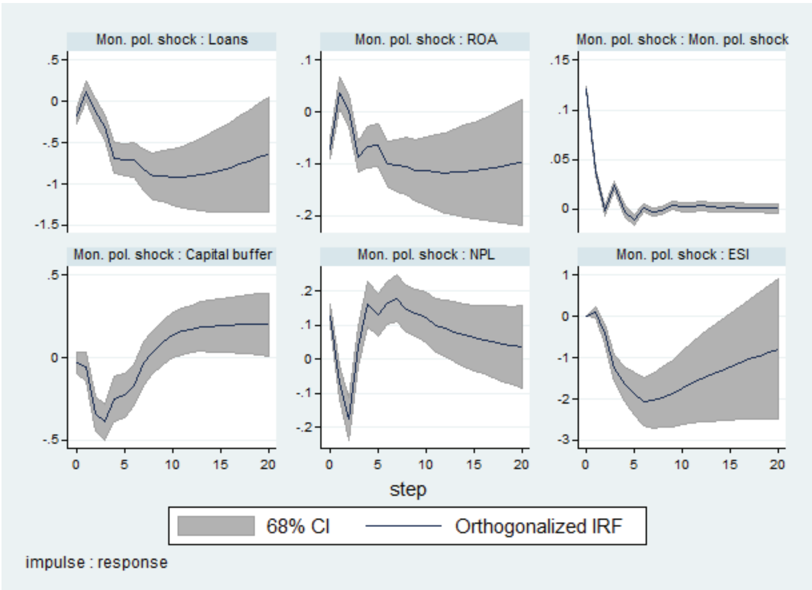
[16] It may seem to be extreme, but it should be noted that for periods when there are 20 banks it simply means that 2 smallest and 2 largest observations are treated as outliers. The results do not change significantly when 5th and 95th percentiles are used. For the capital buffer, cutting off only the upper tail does not change the results either.

4 Results

4.1 Panel vector autoregressions

Figure 1 shows responses to a monetary policy impulse from the baseline PVAR model. It includes 68% confidence intervals calculated using Monte Carlo simulation with 1000 repetitions. The impulse itself dies out very quickly, which suggests that the monetary policy shock is indeed effectively an exogenous variable. Economic conditions start to deteriorate 2 quarters following monetary tightening, as reflected by a decrease in the ESI. Because higher interest rates and lower incomes make it more difficult to service debt, after another quarter there is a persistent increase in non-performing loans. A statistically significant decrease in them at the beginning should be rather treated as an artefact, related to the fact that it takes time for asset quality to become worse. With a larger share of non-performing loans banks have to make new loan loss provisions, which reduce their profitability. The decrease in profits is probably amplified by a fall in asset prices. At first lower profitability is accompanied by a lower capital buffer, since banks build it mainly by retaining profits. But then banks seem to balance the decrease in the buffer, probably additionally compensating for an increase in risk, because a cumulative response of the buffer after 20 quarters (not shown) may be positive (the point estimate suggests a positive cumulative response, but the confidence interval is wide). Finally, the deterioration in economic sentiment and bank balance sheets lowers both loan demand and supply. This is reflected by a decrease in actual lending.

Figure 1. Responses to monetary policy impulse – baseline



Source: Own calculations

Results from alternative specifications for this subsection, but also for Subsection

4.2 and Subsection 4.4, are provided in Appendix. Figure D shows responses to a monetary policy impulse from the model with the set of variables supplemented by a domestic interest rate. It gives slightly more delayed decreases in the ESI, loans and ROA, and a more delayed increase in NPL ratio. The point estimate for a cumulative reaction of the capital buffer is still negative after 20 quarters this time, but again the confidence interval is wide. In Figures E-G there are responses from models with measures of bank balance sheet strength taken separately. In this case reactions of NPL ratio and ROA are somewhat more pronounced, which may indicate an omitted variable bias. A cumulative reaction of the capital buffer is again rather still negative after 20 quarters. Responses from models with additional controls are shown in Figures H-L. Only inclusion of GDP deflator gives markedly different dynamics, but even in this case conclusions remain largely unchanged. As far as point estimates are concerned, little changes also when lag length is reduced to two periods, as shown in Figure L. However, in this case confidence intervals are larger. Nevertheless, in general, results from panel vector autoregressions seem to be robust – a monetary impulse makes bank balance sheets weaker.

That economic conditions deteriorate and loans decrease in Poland following monetary tightening is an almost universal finding (see, for example, Kapuściński et al., 2016). A quite similar pattern of responses of bank capital (in this case measured simply by a capital adequacy ratio) and profitability can be found in Serwa and Wdowiński (2015). Wdowiński (2014) also found that higher interest rates are associated with more non-performing loans. However, all these studies use aggregate data.

4.2 Univariate panel regressions

Table 1 shows long-run multipliers from the baseline set of reduced form, univariate panel regressions with loans as the dependent variable. Since loan growth is persistent, its lags are statistically significant in each specification, with a positive sign. An improvement in the ESI supports lending, as could be expected. The effects of monetary policy on loans turn out to be less clear than when using PVAR models. In specifications with NPL ratio and ROA monetary tightening is associated with a decrease in lending. Point estimates are relatively large, but it should be noted that the monetary policy shock has much lower variance than the domestic interest rate (in first differences, as used in estimation, 0.04 versus 0.49 percentage points). However, whenever a capital buffer is added, the monetary policy shock is not statistically significant at any reasonable significance level.[17] A larger share of non-performing loans is associ-

[17]It may be related to the imperfections of the GMM estimator. When models are re-estimated using the fixed effects estimator (not reported), which in this case is biased, the monetary policy shock is statistically significant with the expected sign in each specification, while the other results remain largely unchanged. It should be noted that the bias of the fixed effects estimator should not be large, since the time dimension of the panel is reasonably long. However, the GMM estimator was used for consistency with models from the previous subsection.

ated with lower lending growth, probably because banks need to compensate for credit risk by higher margins (which reduces demand) and because they perceive less borrowers as creditworthy (accepting a smaller share of loan applications). Also, holders of bank liabilities may demand higher interest rates, which can raise loan rates further. This result does not survive inclusion of other variables measuring bank balance sheet strength, which may indicate a problem with multicollinearity.[18] Irrespective of whether they are included separately of jointly, higher ROA and capital buffer seem to support lending. In the first case this is most likely because for a given dividend payout ratio, the higher the profitability, the higher the loan growth a bank can afford without reducing a capital ratio. But when this limitation is farther from being biding (that is, when the capital buffer is larger), banks can take more risk by lending more. Furthermore, banks closer to the level of the capital ratio required by the FSA may require higher margins in order to improve their capital positions, reducing loan demand.

Table 1. Estimation output, univariate panel regressions – baseline (dependent variable – loans)

	(1)	(2)	(3)	(4)
Loans	0.73***	0.74***	0.62***	0.61***
	(0.03)	(0.03)	(0.06)	(0.06)
ESI	0.33***	0.34***	0.26***	0.16***
	(0.05)	(0.06)	(0.05)	(0.06)
Monetary policy	-10.20***	-9.25**	2.88	3.50
shock	(3.90)	(4.05)	(4.45)	(4.63)
NPL	-0.96**			0.14
	(0.47)			(0.46)
ROA		1.35*		3.89***
		(0.73)		(1.02)
Capital buffer			1.28***	1.14***
			(0.36)	(0.33)
Observations	1,797	1,797	1,781	1,781
R-squared	0.46	0.46	0.36	0.38

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Own calculations

Going to results from robustness analysis (again in Appendix), Table C shows an estimation output from models with the monetary policy shock replaced by the domestic interest rate. In this case the only notable difference is a smaller long-run multiplier for the effects of monetary policy (probably related to the difference in variances of both

[18] Again, when using the fixed effects estimator, non-performing loans are statistically significant with the expected sign in both specifications.

measures of it, as mentioned above). In Table D there are results from models with additional control variables. Only house prices and the exchange rate turn out to be (statistically) significant for loans. When control variables are included, estimates for the effects of the ESI are smaller, in a model with house prices even insignificant. The same happens when lag length is reduced to two periods (Table E). The long-run effects of ROA and the capital buffer are also estimated to be smaller, with the first variable insignificant when taken separately. Additionally, as little as two lags seem not to be enough to capture the effects of monetary policy and non-performing loans (both are insignificant). In short, here also robustness analysis does not seem to invalidate the findings from the baseline set of models – weaker balance sheets are associated with lower lending growth.

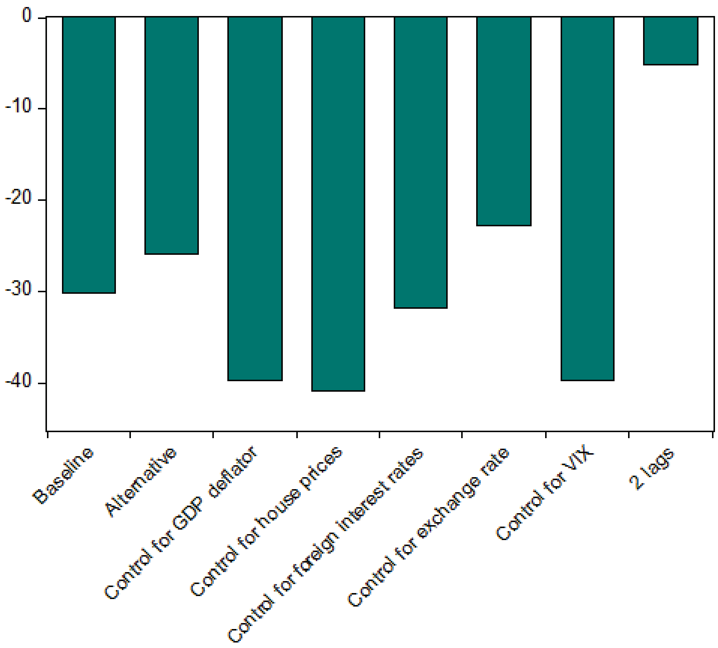
The positive relationship between measures of economic activity and loans can be also found in studies on the monetary policy transmission in Poland (Kapuściński et al., 2016 can again be used as an example). IMF (2013) shows that higher NPL ratios and lower net interest margins (which can be used as a proxy for profitability) are associated with lower lending. On the other hand, it finds that an increase in bank capital causes a fall in loan growth. The same can be found (at least for initial periods) in Serwa and Wdowiński (2015), who also confirm that higher ROA increases lending. The conflicting results on the effects of bank capital may (at least to some extent) derive from an omitted variable bias in studies that do not control for the capital ratio required by the FSA. When the FSA was increasing the requirement, banks responded by increasing the actual capital ratio, reducing their lending growth at the same time. Here the relationship is negative for the requirement, but not necessarily for capital as a buffer against loan losses.

4.3 Counterfactual exercises

The previous two subsections showed that monetary tightening makes bank balance sheets weaker, and weaker balance sheets cause lower lending growth. It means that conditions for the (new) bank lending channel of the monetary transmission mechanism to work do hold. But how important is this channel? Figure 2 compares reactions of lending to monetary tightening from Subsection 4.1 with counterfactual ones. Specifically, it shows percentage differences in cumulative impulse responses after 20 quarters. The counterfactuals assume the analysed channel does not work. They are calculated switching off the end (the impact of bank balance sheet strength on bank lending) of the mechanism. Here, ‘alternative’ specification refers to the one with the domestic interest rate as one of endogenous variables.

A few observations emerge. First, differences in responses are similar across specifications (30% for the baseline, 26% for the alternative). Second, on average, the differences are larger for models with additional controls. They are smaller for a model

Figure 2. Differences in cumulative responses of loans to monetary policy impulse after 20 quarters



Source: Own calculations

with the VIX. Third, differences in responses are markedly increasing in number of lags. It can mean that the effects significantly increase in time. In general, a decrease in lending following a monetary policy impulse to the (new) bank lending channel ranges between 5 and 41%, with 23% in the middle. It seems to be a plausible estimate.

4.4 The traditional empirical strategy

Table 2 shows results from two additional exercises. Models 1-4 follow the traditional empirical strategy for identifying the bank lending channel, checking whether some groups of banks can better insulate themselves from monetary policy. These nonlinearities would be visible in statistically significant long-run multipliers for interaction terms and their 'correct' signs (negative for interactions of the monetary policy shock with non-performing loans, positive for interactions with other measures of bank balance sheet strength). But both when interactions terms are included separately and jointly they are not statistically significant at any of usually used significance levels. For ROA, and in one case for NPL ratio, point estimates even go in the 'wrong' direction. It means that, on the one hand, the effects of monetary policy can be amplified through its impact on bank balance sheet strength (as shown in previous sections). On the other hand, banks with stronger balance sheets do not necessarily decrease their lending less following monetary tightening. It may be because nonlinearities in responses can emerge due to many factors, including the fact that banks have different portfolios of customers. As the approach to the bank lending channel has changed, not only different interpretations of earlier results, but also different empirical strategies may be warranted.

Table 2. Estimation output, the traditional empirical strategy – baseline (dependent variable – loans)

	(1)	(2)	(3)	(4)	(5)
Loans	0.73***	0.74***	0.59***	0.58***	0.73***
	(0.03)	(0.03)	(0.09)	(0.11)	(0.03)
ESI	0.33***	0.36***	0.23***	0.12	0.36***
	(0.05)	(0.06)	(0.07)	(0.1)	(0.05)
Monetary policy shock	-10.70***	-6.46	-3.67	-2.66	3.14
	(4.00)	(4.64)	(4.09)	(4.26)	(5.86)
NPL	-0.99**			0.73	
	(0.46)			(0.81)	
ROA		1.24*		5.60**	
		(0.72)		(2.33)	
Capital buffer			1.84**	1.77**	
			(0.77)	(0.83)	
Monetary policy shock*NPL	0.07			-3.23	
	(3.47)			(3.02)	
Monetary policy shock*ROA		-4.55		-2.18	
		(2.84)		(2.45)	
Monetary policy shock*Capital buffer			1.13	1.54	
			(0.94)	(1.11)	
Market-based funding					3.29
					(9.54)
Monetary policy shock*Market-based funding					-28.50**
					(11.51)
Observations	1,797	1,797	1,781	1,781	1,797
R-squared	0.47	0.46	0.18	0.17	0.46

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Own calculations

Model 5 tests whether larger share of market-based funding insulates banks from monetary policy or amplifies their responses. The first outcome is implied by the traditional approach to the bank lending channel and the second one by the new approach. It turns out that loan portfolios of banks with more reliance on marked-based funding respond more, as suggested by significant interaction term (between the monetary policy shock and share of market-based funding) and a negative sign. For example, for a bank with a 25% share the long-run multiplier would be -6.34, while for a bank with a 75% share – -18.02 (again, this is a large estimate, but a given level of the monetary policy shock can correspond to a change in the domestic interest rate many times larger). Although it may also be a result of banks having different portfolios (with different demand elasticities), it can also be interpreted as a sign that the development of interbank markets rather supported, than attenuated the bank lending channel.

Finally, Table F provides a robustness check on the results above. The monetary policy shock is replaced by the domestic interest rate. In this case, the interaction term between a measure of monetary policy and ROA is statistically significant, but with unexpected, negative sign. Other results remain qualitatively unchanged. A point estimate for the interaction term between the domestic interest rate and the share of market-based funding is now more reasonable, implying a 2.09% decrease in lending following a 1 percentage point increase in the interest rate for a bank with a 25% share, and a 6.28% decrease for a bank with a 75% share.

5 Conclusion

The study proposed an empirical strategy to identify whether the effects of monetary policy are amplified through its impact on bank balance sheet strength. Such a mechanism is known as the bank lending channel of monetary policy transmission (as reformulated by Disyatat, 2011) and does not require loans to be limited by central bank money or deposits. Panel vector autoregressions with high frequency identification, univariate panel regressions and counterfactual exercises were applied to data for Poland. They showed that a monetary policy impulse increases non-performing loans, and reduces bank profitability and a capital buffer. Weaker balance sheets, in turn, are associated with lower lending growth. Overall, the mechanism accounts for about 23% of a decrease in lending following a monetary policy impulse.

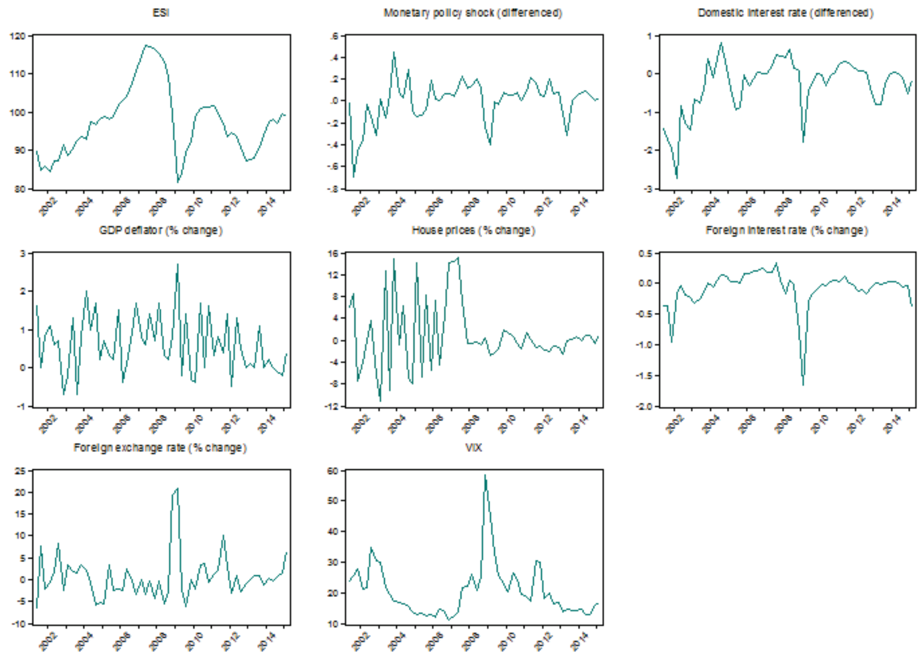
For comparison, results from the traditional, less direct strategy for identifying the bank lending channel were shown as well. However, using this strategy would not lead to the same conclusions. This is probably because it reveals nonlinearity in responses of different groups of banks to monetary policy due to many factors, including differences in portfolios of customers. As the approach to the bank lending channel has changed, not only different interpretations of earlier results, but also different empirical strategies may be warranted.

This is another piece of evidence showing that the financial accelerator works in both non-financial and financial sector. In some cases it can make the interplay between monetary and macroprudential policy non-trivial. On the one hand, for example, during a boom associated with a positive credit gap systematic monetary and macroprudential policy complement each other. On the other hand, following a monetary policy surprise its effects are partially offset by systematic macroprudential policy. Coordination may be needed for optimal outcomes.

For future research, it would be useful to extend the analysis to quantify the role banks not only as an amplifier, but also as a source of shocks, using data from the Senior loan officer opinion survey. Studies of Bassett et al. (2014) and Altavilla et al. (2015) are examples of steps in this direction.

Appendix

Figure A. Macro data



Source: CBOE, Central Statistical Office, Datastream, European Commission, Kapuściński (2015), NBP, own calculations

Figure B. Micro data

Source: NBP, own calculations

Table A. Unit root tests – aggregate

	Augmented Dickey & Fuller		Phillips & Perron		Kwiatkowski, Phillips, Schmidt & Shin	
	Level	Differenced	Level	Differenced	Level	Differenced
ESI	-2.66*	-4.89***	-2.09	-4.89***	0.17	
Monetary policy shock	-2.01	-4.36***	-1.75	-4.37***	0.69**	0.30
Domestic interest rate	-4.24***		-5.43***		0.69**	0.36*
GDP deflator	-1.39	-2.84***	-1.50	-6.23***	0.91***	0.29
House prices	-1.12	-4.14***	-1.33	-8.03***	0.66**	0.16
Foreign interest rate	-1.77	-3.84***	-1.97	-3.71***	0.71**	0.10
Exchange rate	-1.69	-5.57***	-1.17	-5.60***	0.46*	
VIX	-3.05**		-3.04**		0.11	
Loans	-1.16	-1.16	-0.65	-1.55	0.88***	0.19
NPL	-2.29	-2.46**	-1.09	-2.31**	0.57**	0.14
ROA	-2.01	-9.34***	-4.51***		0.17	
Capital buffer	-1.4	-8.94***	-1.35	-8.82***	0.72**	0.10

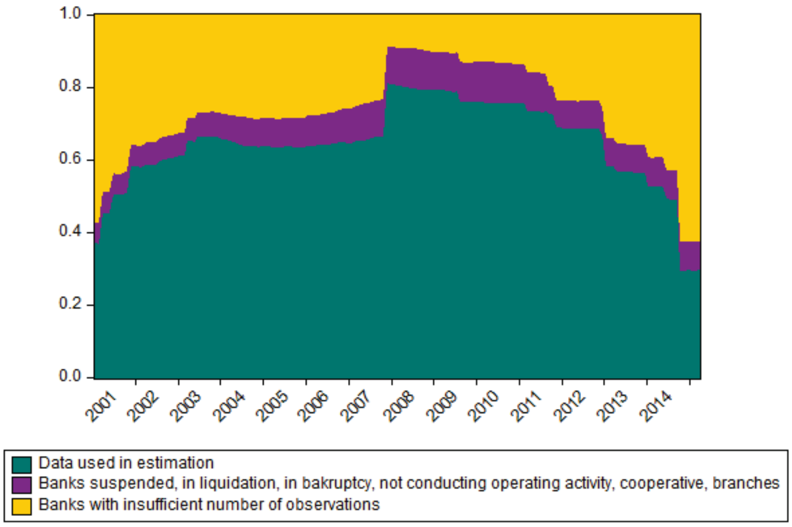
Note: *** p<0.01, ** p<0.05, * p<0.1
Source: Own calculations

Table B. Unit root tests – micro

	Levin, Lin & Chu		Im, Pesaran & Shin	
	Level	Differenced	Level	Differenced
Loans		-10.18***		-11.2***
NPL		-15.44***		-16.59***
ROA	-18.06***		-18.42***	
Capital buffer	-6.39***		-4.48***	

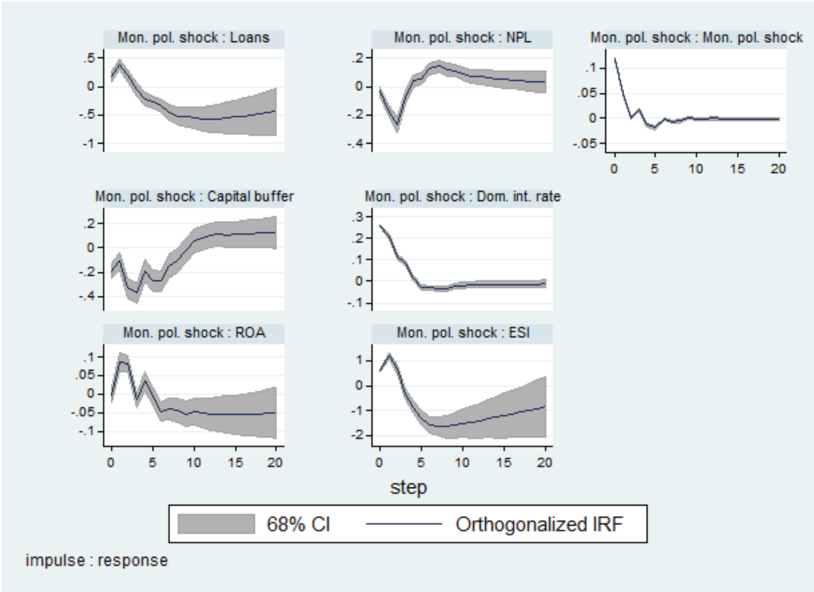
Note: *** p<0.01, ** p<0.05, * p<0.1
Source: Own calculations

Figure C. Sample coverage



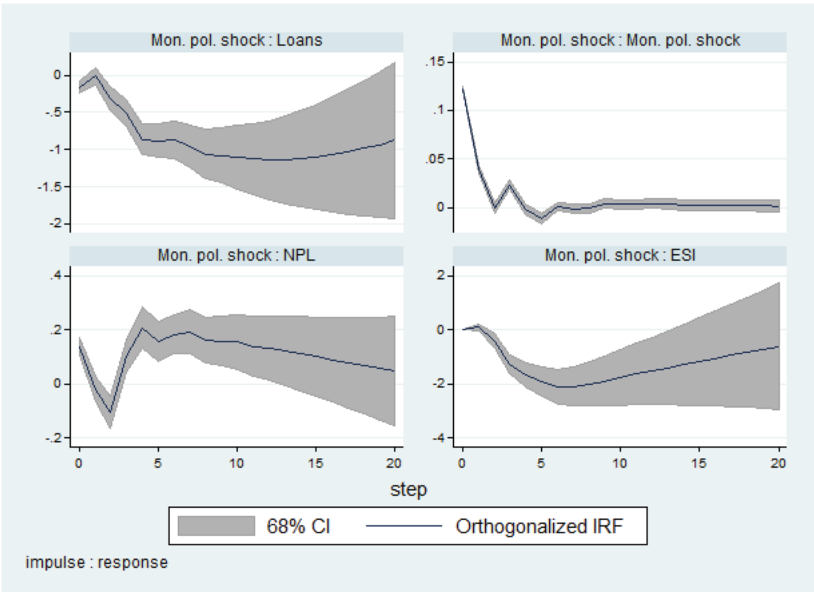
Source: NBP, own calculations

Figure D. Responses to monetary policy impulse – alternative: domestic interest rates as an additional endogenous variable



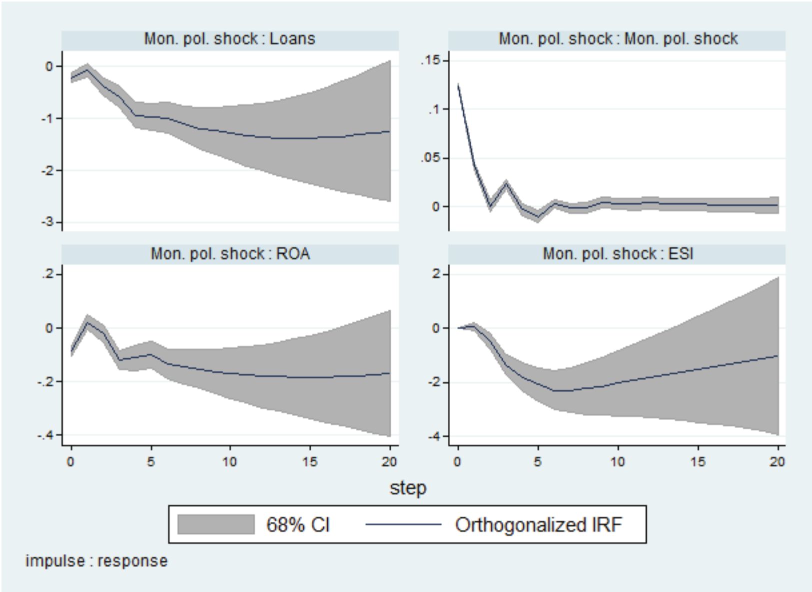
Source: Own calculations

Figure E. Responses to monetary policy impulse – alternative: NPL only



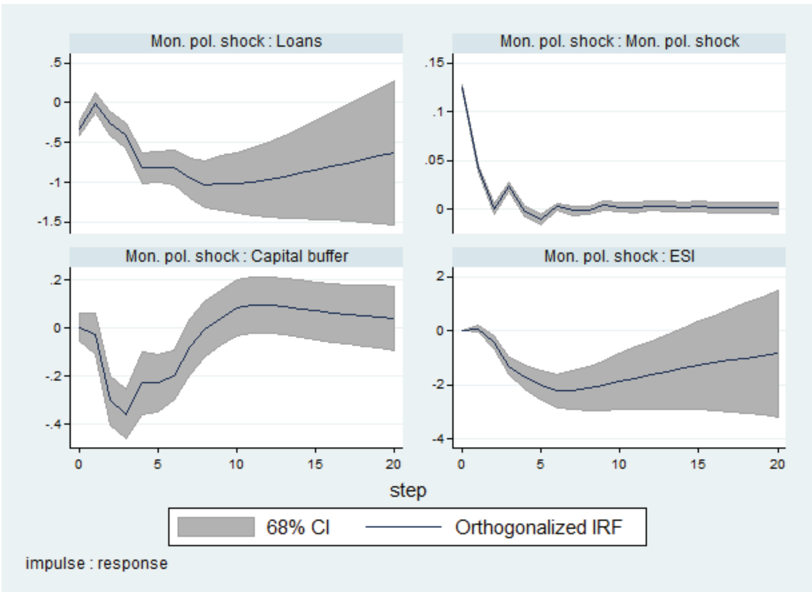
Source: Own calculations

Figure F. Responses to monetary policy impulse – alternative: ROA only



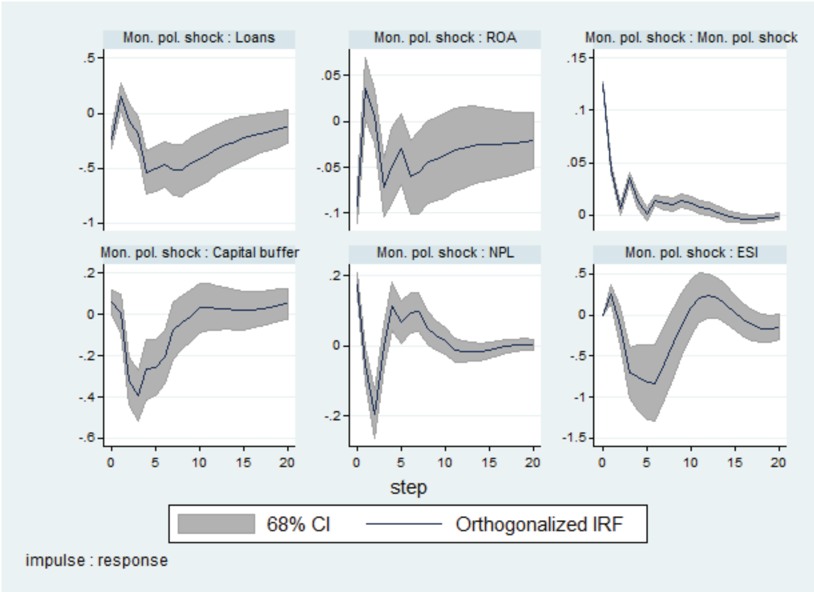
Source: Own calculations

Figure G. Responses to monetary policy impulse – alternative: capital buffer only



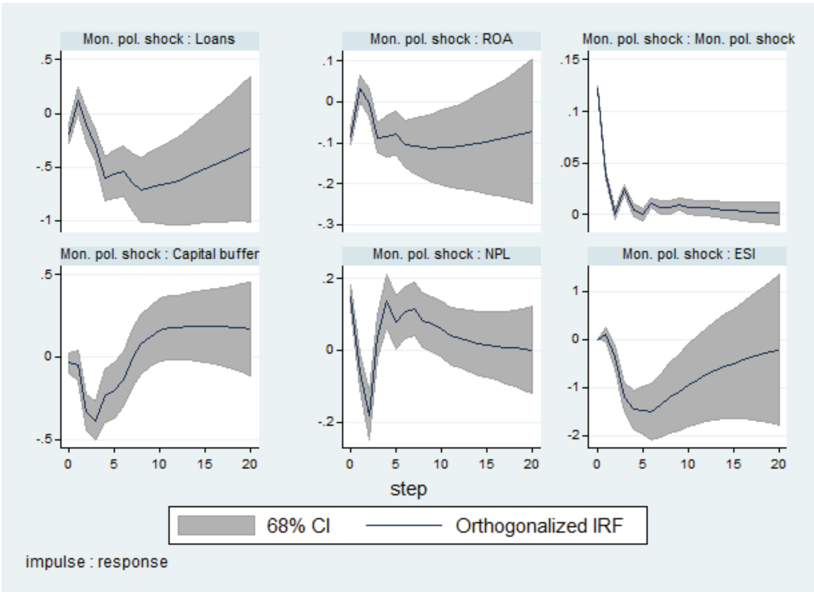
Source: Own calculations

Figure H. Responses to monetary policy impulse – alternative: GDP deflator as an additional exogenous variable



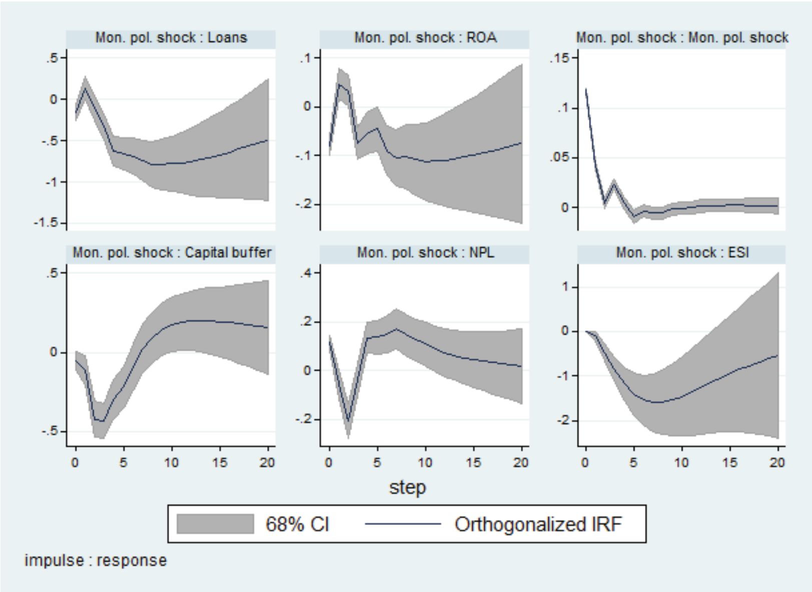
Source: Own calculations

Figure I. Responses to monetary policy impulse – alternative: house prices as an additional exogenous variable



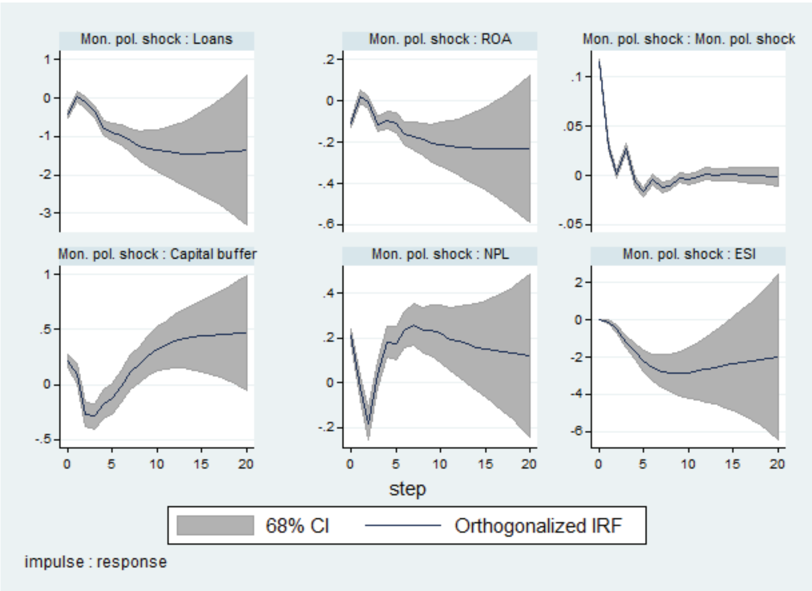
Source: Own calculations

Figure J. Responses to monetary policy impulse – alternative: foreign interest rate as an additional exogenous variable



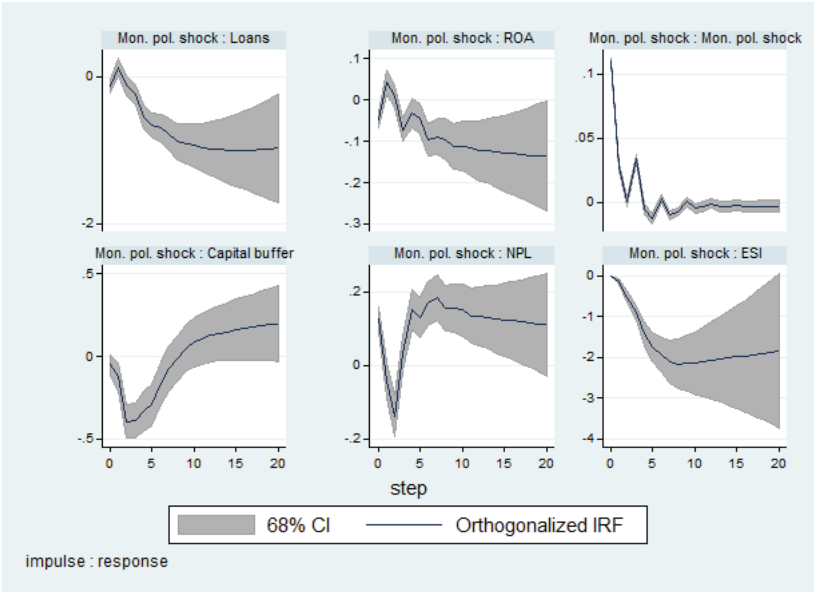
Source: Own calculations

Figure K. Responses to monetary policy impulse – alternative: exchange rate as an additional exogenous variable



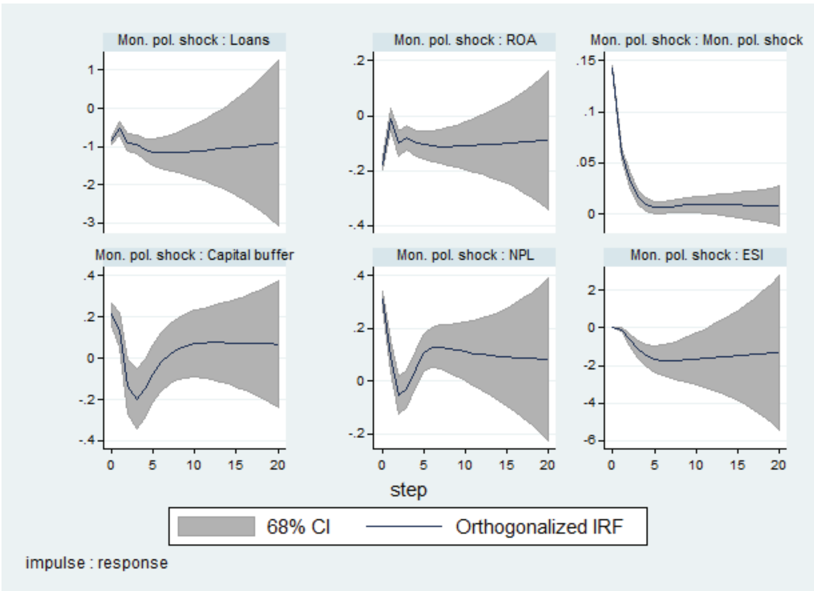
Source: Own calculations

Figure L. Responses to monetary policy impulse – alternative: VIX as an additional exogenous variable



Source: Own calculations

Figure M. Responses to monetary policy impulse – alternative: 2 lags



Source: Own calculations

Table C. Estimation output, univariate panel regressions – alternative: interest rate instead of monetary policy shock (dependent variable – loans)

	(1)	(2)	(3)	(4)
Loans	0.72***	0.73***	0.63***	0.61***
	(0.03)	(0.03)	(0.06)	(0.06)
ESI	0.38***	0.39***	0.26***	0.18**
	(0.06)	(0.06)	(0.07)	(0.07)
Domestic interest	-3.88***	-3.49***	0.16	-0.01
rate	(0.94)	(0.98)	(1.36)	(1.46)
NPL	-1.09**			0.04
	(0.44)			(0.51)
ROA		1.42**		3.72***
		(0.70)		(1.09)
Capital buffer			1.22***	1.06***
			(0.39)	(0.37)
Observations	1,797	1,797	1,781	1,781
R-squared	0.47	0.46	0.38	0.39

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Own calculations

Table D. Estimation output, univariate panel regressions – alternative: control variables (dependent variable – loans)

	(1)	(2)	(3)	(4)	(5)
Loans	0.62***	0.61***	0.62***	0.61***	0.62***
	(0.06)	(0.06)	(0.07)	(0.06)	(0.07)
ESI	0.17***	0.05	0.12**	0.23***	0.13**
	(0.06)	(0.07)	(0.05)	(0.06)	(0.05)
Monetary policy	3.38	5.24	2.99	3.81	6.05
shock	(4.79)	(4.58)	(6.05)	(4.54)	(4.15)
NPL	0.12	0.24	0.16	-0.12	0.10
	(0.47)	(0.45)	(0.44)	(0.48)	(0.44)
ROA	3.81***	3.90***	3.76***	3.97***	3.77***
	(1.04)	(1.01)	(1.13)	(1.05)	(1.13)
Capital buffer	1.10***	1.15***	1.10***	1.16***	1.10***
	(0.35)	(0.33)	(0.38)	(0.35)	(0.38)
GDP deflator	-0.65				
	(1.21)				
House prices		0.39***			
		(0.12)			
Foreign interest			2.52		
rate			(3.94)		
Exchange rate				0.58***	
				(0.14)	
VIX					0.00
					(0.08)
Observations	1,781	1,781	1,781	1,781	1,781
R-squared	0.40	0.39	0.39	0.39	0.39

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Own calculations

Table E. Estimation output, univariate panel regressions – alternative: 2 lags (dependent variable – loans)

	(1)	(2)	(3)	(4)
Loans	0.62***	0.61***	0.55***	0.55***
	(0.03)	(0.03)	(0.04)	(0.04)
ESI	0.20***	0.18***	0.16***	0.14***
	(0.03)	(0.03)	(0.03)	(0.04)
Monetary policy	1.08	0.49	3.15	4.09*
shock	(2.50)	(2.38)	(2.16)	(2.20)
NPL	0.34			0.50*
	(0.32)			(0.27)
ROA		0.56		1.70***
		(0.41)		(0.56)
Capital buffer			0.56***	0.55***
			(0.21)	(0.21)
Observations	1,881	1,881	1,865	1,865
R-squared	0.40	0.40	0.39	0.39

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Own calculations

Table F. Estimation output, the traditional empirical strategy – alternative: interest rate instead of monetary policy shock (dependent variable – loans)

	(1)	(2)	(3)	(4)	(5)
Loans	0.72***	0.73***	0.53***	0.50*	0.71***
	(0.03)	(0.03)	(0.20)	(0.28)	(0.03)
ESI	0.37***	0.41***	0.15	-0.01	0.4***
	(0.05)	(0.06)	(0.16)	(0.28)	(0.05)
Domestic interest	-4.29***	-1.79	-2.86*	-0.87	0.40
rate	(0.96)	(1.19)	(1.50)	(1.28)	(1.37)
NPL	-1.10**			1.71	
	(0.44)			(2.14)	
ROA		0.79		8.25	
		(0.72)		(6.21)	
Capital buffer			2.85	3.20	
			(1.83)	(2.56)	
Domestic interest	1.01			-1.15	
rate*NPL	(0.74)			(1.52)	
Domestic interest		-1.96***		-2.29**	
rate*ROA		(0.73)		(1.16)	
Domestic interest			0.68	0.93	
rate*Capital buffer			(0.57)	(0.89)	
Market-based					-0.20
funding					(9.76)
Domestic interest					-8.77***
rate*Market-based funding					(2.76)
Observations	1,797	1,797	1,781	1,781	1,797
R-squared	0.47	0.47	.	.	0.47

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Own calculations

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