What is the impact of central bank on banks' lending policy? The evidence from SLOOS for Poland

Abstract

The paper shows how central bank impacts credit policy of the banking sector. Using aggregate data from Senior Loan Officer Survey and SVAR models with non-recursive decomposition, it analyses effects of short-term interest rate innovations on loan standards, terms and conditions for short-and long-term loans for various types of enterprises. It finds that shocks to the monetary policy are amplified by operation of credit channel and that the reactions of standards on long-term loans for small and medium sized enterprises are somewhat bigger than those on loans for large entities. Loans for investment are rather affected by credit standards, other types of loans: in current account and for financing working capital and for real property acquisition tend to respond to the interest rate. Recursive factorizations may over-estimate the role of credit channel.

JEL: E5, G21

Key words: monetary policy transmission, credit standards and credit terms, bank survey, recursive and non-recursive decompositions

1. Introduction

Understanding how central bank affects credit policy of the banking sector is important for understanding business cycles and constitutes a basic information for the monetary authorities. Monetary policy may impact real sector through a group of credit channels, including bank lending channel and balance sheet channel. This paper concentrates on the former. In the bank lending channel, monetary policy tightening affects negatively banks' balance sheet strength, capital position, and perception of risk inducing banks to reduce loan supply Disyatat (2009). Moreover, a higher interest rate leads to a problem of adverse selection and moral hazard. Higher interest rate affects the pool of borrowers, increasing the share of these which are "dishonest", who repay the loan only if it is in their interest to do so, Jaffee and Russel (1976), Stiglitz and Weiss (1981). It also may lead borrowers to invest in riskier projects, lowering the expected return to the lender. To counteract adverse selection, moral hazard and limit their exposure, commercial banks would tend to tighten their credit policies after a monetary tightening.

Besides, there can occur credit policy tightening unrelated to the monetary policy and behaviour of the interest rate. Lehman Brothers bankruptcy, which dampened confidence in the global financial markets, resulted in lending drop in many EU countries, and led to the worst recession since the Great Depression, may serve as an example. In Poland, the reaction of banks was more attenuated, nonetheless it was visible in credit standards and conditions declared in the Senior loan officer opinion survey and in the actual data on loans extended to the private sector. In spite of tightened credit standards, terms and conditions, GDP growth rate remained positive, though lower than in the past. The economy did not fall into a recession, but credit policy of banks was a possible driver of the slowdown.

This study sheds light on the influence of central bank's monetary policy decisions on credit policies of commercial banks, i.e. credit standards, terms and conditions and on the impact of banks' credit policy on lending to the corporate sector. Credit standards are understood as the minimum standards of creditworthiness, set by banks, that the borrower is required to meet to obtain a loan. Terms and conditions (T&C) are price and non-price features of the loan agreement between the bank and the borrower. They include: spread over a relevant market reference rate for average borrowers and spread for riskier than average borrowers, non-interest loan costs, maximum loan size, collateral requirements and maximum loan maturity, (NBP, 2016). Using data from Senior loan officer opinion survey (SLOOS) conducted by Narodowy Bank Polski (NBP) since the late 2003, we examine: (i) how loan standards and conditions are affected by the central bank monetary policy, (ii) whether standards applied on loans for small and medium-sized enterprises react to the monetary policy shocks in the same way as these applied on loans extended to the large units, (iii) whether, and if so, how loan standards and conditions affect the amount of outstanding credit and private investment as compared to the interest rate. In a companion paper, and using the same data set, we examine factors other than the interest rate, which might have an impact on credit standards. We show that in "normal times", i.e. before and after the financial crisis, macroeconomic and industry-specific risks played a predominant role, whereas in the course of the financial crisis, changes in banks' lending policy were mainly due to factors related to banks' balance sheets and risks related to the biggest borrowers.

SLOOS in the U.S. or Bank Lending Surveys (BLS) in the euro area have been used as an important source of information on credit channel operation since a seminal work by Lown and Morgan (2002) and (2006). Conclusions concerning reactions of credit standards and conditions to the monetary policy innovations, which emerge from these papers, are mixed, especially for the U.S. Lown and Morgan show that credit standards are more important than

the interest rate in explaining credit and GDP variation. After a monetary policy shock credit standards practically remain unchanged, what means that lending channel is not operative. Importantly, federal funds rate drops after tightening of credit standards. In contrast to Lown and Morgan, Basset et al. (2014) find that an effective tightening of monetary policy (an increase in the real federal funds rate) does not leave credit standards unchanged, but is rather associated with their softening due to the forward-looking nature of SLOOS respondents. In turn, Maddaloni and Peydró (2010) provide evidence that the interest rate and credit standards move in the same direction, namely, that low short-term interest rates soften standards, for both household and corporate loans[1]. This softening – especially for mortgages – is amplified by securitization activity, weak supervision for bank capital and too low for too long monetary policy rates. Finally, Ziadeh-Mikati (2011) finds that low levels of both short and long term rates are associated with lower percentage of banks reporting a tightening in lending standards and higher percentage of banks reporting an easing in standards, for all types of commercial loans. All terms of loans are found to be eased when lower rates are applied.

The results for Europe are more conclusive[2]. In general, the answer on the question whether monetary policy has an impact on credit standards and conditions is positive. Ciccarelli, Maddaloni, Peydró (2013), Maddaloni, Peydró and Scopel (2008), De Bondt, Maddaloni, Peydró and Scopel (2010), Maddaloni and Peydró (2010) and Couaillier (2015) show that monetary policy has an influence on credit terms and conditions and that the credit channel amplifies the impact of a monetary policy shock on GDP, inflation and loans. For example, Couaillier (2015) assesses how a range of monetary policy tools affects the

[1] Maddaloni and Peydro (2010) suggest that the difference between their results for the US and those by Loan and Morgan (2002, 2006) are due to the omitted variable bias, i.e. a lack of the long-term interest rate in Lown and Morgan.

[2] In Europe business cycles are driven by investment whereas in the US by private consumption. This can be a plausible reason for discrepancies between results for the US and Europe.

standards and conditions of loans faced by non-financial corporates and, ultimately, credit growth. To that purpose, he uses Bayesian VARs to overcome the short-sample problems. The results show that there exists an effective bank lending channel in Europe: banks react to monetary policy tightening not only by raising loan interest rates, but also by tightening other terms of loan contracts, such as maturity and collateral requirements, restricting credit supply and hampering credit growth.

So far, there has not been a similar analysis for Poland. We fill this gap and provide evidence on credit channel operation in Poland basing on the aggregated survey data. The survey conducted by NBP, contains questions about current and expected credit standards for various types of loans and enterprises, i.e. short and long-term, large (LEs thereafter) as well as small and medium-sized corporates (SMEs thereafter). This makes it possible to verify whether monetary policy is channelled through banks' lending policy, and secondly, if after a monetary policy shock, SMEs suffer from worse credit availability than LEs, as predicted by the economic theory, but not necessarily by the empirical works, Couallier (2015). The question whether monetary policy shocks result in tighter credit terms and conditions for SMEs than for LEs is important for the Polish economy as the former account for 93% of the total number of firms, for 43% of employment in the non-financial sector, for about 30% of investment, and for about 57% of total claims of the banking sector on enterprises, Sawicka, Postek (2017) and Polish Financial Supervision Authority.

There are three main findings of the paper. First, we obtain a fairly robust evidence that monetary policy has an impact on lending policies applied to all types of loans to the corporate sector: restrictive monetary policy induces tightening of credit standards and conditions. It means that operation of the interest rate channel is amplified by the credit channel. Second, credit standards and T&C affect investment loans, but have a weaker, if any, impact on other credits, i.e. loans for real property acquisition and for financing working

capital and in current account. We provide evidence that these types of loans respond rather to the interest rate. The same applies to the reactions of the real sector, approximated in this paper by private investment. Therefore, we argue that in Poland, the traditional interest rate channel dominates credit channels. Finally, we demonstrate that after a monetary policy shock, standards applied on long-term loans to SMEs react somewhat stronger than these applied on loans to LEs.

A novel of this paper is that to extract structural shocks, it uses a non-recursive factorization which allows simultaneous reactions of short-term money market rate and credit standards (or credit terms and conditions). In particular, we impose restrictions on the contemporaneous matrix which is estimated by maximum likelihood. The over-identifying restrictions are tested at the standard level. The simultaneous reactions of the interest rate and lending standards/terms may reduce the estimated impact of banks' lending policy on investment and on the amount of outstanding credit, since changes in the interest rate can offset tightening/softening of credit standards. Since other works tackling the issue of the central bank's impact on credit policy of the banking sector exploited a recursive factorization, we compare our results to those from Cholesky. We show that using Cholesky factorization may lead (but not necessarily leads) to some overestimation of the role of credit channel in the monetary transmission.

The remainder of the paper is organized as follows: Section 2 briefly presents Senior loan officer opinion survey conducted by NBP and overviews behaviour of credit standards and conditions over the period 2003Q4-2016Q3. Section 3 describes stylized facts, Section 4 shows the estimation method and data used in the paper. Section 5 contains the results. Finally, the next one summarizes and concludes.

2. Senior loan officer opinion survey. Standards, terms and conditions over 2003-2016

The objective of the Senior loan officer opinion survey is to define the direction of changes in the lending policy, i.e. the standards and T&C on loans as well as changes in demand for loans in the Polish banking system.

The survey has been conducted since 2003Q4 on a quarterly basis. The number of banks participating in the survey varied over time. In 2009 it increased from 24 to 30 to enhance representativeness of the sample. Then the number of participant decreased to 27 owing to mergers and acquisitions. In the period under consideration, the survey covered from 72% to 87% of total loans to enterprises and households in the banking sector's portfolio.

Loan officers are posed 7 questions concerning current and expected for the next quarter lending policies to the corporate sector. A template of questions on credit standards and credit terms is as follows: "Over the last three months, how have your bank's credit standard/credit terms changed?" The question on credit standards is posed separately for short-term loans to LE, long-term loans to LE, short-term loans to SME and long-term loans to SME. A possible span of answers embraces five options: tightened considerably, tightened somewhat, remained basically unchanged, eased somewhat, eased considerably. Banks are also asked about factors driving changes in lending policies: current and expected capital position, central bank monetary policy decisions, risk related to the expected general economic situation, industry-specific risk, risk related to the financial standing of a bank's largest borrowers, changes in the share of adversely classified loans in a bank's loan portfolio, changes in competition (from other banks, from non-banks financial institutions and from market financing. Furthermore, banks report on changes in demand for loans and their underlying reasons. Besides, there are questions on banks' expectations with respect to credit standards and terms with the same pattern as in the case of current lending policies.

The aggregation of the data behind the survey results consists in the calculation of weighted percentages of responses and the net percentage, i.e. the difference between the structures presenting opposite trends. In line with the adopted methodology, quantities refer to weighted percentages and not to the number of banks. Thus, the phrase "10% of banks" should be understood as "the asset-weighted 10% of banks" (NBP, 2016).

Up to the third quarter of 2007 banks generally softened credit standards and conditions for enterprises (throughout the paper, an increase in credit standards and conditions is understood as their tightening). This was a period when Poland entered the European Union and shortly afterwards, when both Polish and European economies were booming. Banks signalled lower macroeconomic risk and growing pressure from competitors. Credit standards and conditions rocketed with first disturbances observed in the world financial markets. They reached the highest levels in 2008Q4-2009Q2 and then began to recover gradually with receding global uncertainty. They got temporarily tightened once again in the second phase of the financial crisis, i.e. when a crisis of the sovereign debt burst out. In 2014-2015Q2, after some appeasement in the euro area, banks softened both credit standards and terms. However, in the late 2015, due to domestic uncertainties and risks concerning expected introduction of a tax on new bank loans and a possible compulsory conversion of foreign exchange denominated mortgage credits for households, the easing phase came to an end.

Before the financial crisis, banks tended to ease standards to SMEs more than for LEs, especially on short-term loans (Figure 1, LH panel). This reflects raising interest of banks in this segment of the credit market. On one hand, it is due to a fact that LEs have gradually gained access to capital markets and could diversify sources of external financing, and became less dependent on banking credits. On the other hand, SMEs have developed over time and banks turned out to be more willing to extend loans to this group. Over 1995-2011, the share of SMEs relying on banking loans in the total number of SMEs increased more than

twice. Financial crisis temporarily halted the process of credit use intensification. During the crisis banks tightened credit standards for SMEs more than for LEs[3]. Since 2010 banks began to soften standards for short-term loans for LEs and to a somewhat lesser extent also for SMEs. Standards applied on long-term loans entered into an easing phase much later, in 2014Q3. Since 2013, to facilitate access to bank lending, SMEs have been eligible for state aid within *de minimis* Portfolio Guarantee Facility. Under the programme, a state-owned bank grants entities from the SMEs sector, on their request, guarantees to secure the repayment of loans granted by commercial or cooperative banks. The programme can be considered as a supplementary collateral and this way it can make credit supply more rigid if there is a monetary policy tightening.

A brief analysis of distributions of credit standards reveals that means of all standards but these for SMEs on the short-term loans are positive, what suggests that in the period under consideration, on average, banks tended to tighten their credit policy. This is due to a considerable share of observations from the financial and sovereign debt crises. A test of equality of means shows that we cannot reject the null that they are all equal (we have tested the relevant pairs, i.e. standards applied on short-term loans for LEs and SMEs and then on long-term loans for LEs and SMEs). However, we reject at 5% that variances of standards on short-term loans for LEs and SMEs are equal, but not at the 1% significance level. This means that standards for SMEs have been slightly more volatile than those for LEs.

Collateral and spread on loans for riskier borrowers are these T&C which are the most strongly correlated with credit standards. To tighten T&C, banks used most frequently spread on loans to the riskier borrowers, i.e. price element, whereas to soften – such non-price elements of loan covenants as maximum size and maximum maturity. Spread on average

[3] The cumulative effects for the period 2008.3-2009.3 for standards applied on short-term and long term credits for SME were respectively -2.3 and -2.6, while those for LE amounted to -1.9 and -2.2.

loans Granger causes[4] all other terms with the exception of a maximum loan size; spread on the riskiest loans Granger causes all terms except spread.

Since 1998 Poland has been conducting monetary policy within inflation targeting regime with inflation target of 2.5% and a tolerance band of ±1 pp. As a policy instrument, it has been using a short-term interest rate. Over 2003Q4-2016Q3 monetary policy stance did not exhibit the same periods of easing and tightening as credit standards (Figure 1). Owing to an episode of a higher inflation on the eve of the EU entry, central bank increased the policy rate, thus there co-existed monetary tightening with banks' credit policy softening. Once inflation burnt down, NBP reduced the interest rate. The next period of monetary tightening occurred in 2007. Interest rate increases were to counteract price pressures resulting from economic overheating and – to some extent – from a supply-side shock (soaring prices of raw materials and foodstuffs in the world markets). Financial crisis induced sharp cuts in the central bank policy rate and additional liquidity provisions to the banking system, once interbank transactions in the money market halted owing to the confidence crisis. Another aim of the central bank was to offset tightening of credit standards and T&C by banks. In 2011 aggregate demand pressures on prices revived once again, leading to the monetary tightening, this time accompanied by a more restrictive credit policy by banks, especially with respect to standards on long-term loans for SMEs. Since 2013Q2 Polish economy has operated in the environment of low inflation, i.e. below the lower level of NBP's tolerance, or even of deflation. The stance of monetary policy was softened twice: in the second half of 2014 and at the beginning of 2015. This time the stance of banks' lending policy matched that of the monetary policy.

[4] Granger causality tests have been performed with 1 lag.

3. A handful of stylized facts on loans to the corporate sector

In Poland, banking sector is by far the most important provider of external financing to the corporate sector: loans to the non-financial enterprises related to GDP amount to 16%, while bonds of the corporates to 5%. Firms have loans both in domestic and foreign currencies. Over 2003-2016, loans in foreign currencies accounted on average for about 25% of the total amount of loans to the enterprise sector. Loans in foreign currencies are dominated by these long-term, i.e. for investment and real property purchase. The latter were growing rapidly before the financial crisis. Loans in PLN are dominated by these for financing working capital and in current account (WC&CA henceforth), see Figure A1 in the Statistical Annex. Bank loans finance about 12-13% of investment expenditures, with a lowermost level equal to 9%-10% in 2012 and then in 2016 (Chmielewski et al. 2018, and Główny Urząd Statystyczny 2017). Transfers of the EU funds to the corporate sector constituted an important source of financing private investment in the years 2010-2011, when the yearly rates of growth of bank loans for investment, both in domestic and in foreign currencies, oscillated around zero.

In 2004-2008 banks' loans to the corporate sector in the domestic currency exhibited a significant rise. This was particularly true for loans for real property acquisition and WC& CA loans, which displayed two digit rates of growth. Financial crisis resulted in a sharp fall of credit growth, but starting from 2011, WC&CA and loans for investment began to recover; solely loans for real property acquisition have remained subdued. The share of WC&CA loans has been steadily falling since mid-2005 (from about 60% to 48%), whereas the share of investment credits has been increasing.

A breakdown of banking sector claims on the corporate sector according to the borrower size, i.e. to LEs and SMEs exist only since 2010. They show that SMEs account for about 54-

59% of the total amount of banks claims. Importantly, SMEs dominate in all types of claims but "Other" (see Figure A2 and A3).

4. Estimation strategy and data

We conduct our analysis on a generally accessible data set of standards and T&C on the aggregate level[5]. To some extent, this paper follows Lown and Morgan (2002), (2006), De Bondt et al. (2010), and Ciccarelli et al.(2010), who used structural vector autoregressive models to investigate the impact of credit standards, terms and conditions on the real sector and the influence of the monetary authorities on banks' credit policy. In those works, shocks have been identified through a recursive decomposition (Cholesky). Ordering credit standards last (Lown and Morgan (2002) and (2006) or just before the interest rate, Ciccarelli et al.(2010) implies either that the interest rate reacts to innovations in the banking sector with a lag of 1 quarter or that loan policy of commercial banks reacts to monetary policy innovations with a lag. However, both assumptions are dubious.

The NBP survey is released with a one quarter lag, i.e. in quarter *t*, the monetary policy committee knows loan standards and conditions which were applied in *t-1*, thus at a first glance, it seems reasonable to assume that monetary policy instrument affects contemporaneously standards and conditions, but it is not affected by standards and T&C which are simply unknown to the interest rate setting body. This would justify employing Cholesky decomposition with standards/terms ordered last. However, there are two reasons which may invalidate these arguments.

Firstly, short-term money market rate is not solely under the influence of the central bank. In fact, it may contemporaneously reflect the outcomes of lending policy by the banking

[5] See http://www.nbp.pl/homen.aspx?f=/en/systemfinansowy/kredytowy

sector. If banks' policy with respect to credit standards and T&C affects demand for loans or a perception of risk related to the future developments in the economy, then the short-term money market rate may adjust instantaneously. Thus, using a recursive decomposition may lead to significant errors. The recursive decomposition may be exploited in models with credit standards expected in *t-1* for period *t*. In such models, expected standards should be ordered before the interest rate, since they may affect the interest rate contemporaneously. Also, they are not contemporaneously affected by the interest rate. It is hardly probable that they contemporaneously affect investment, but it is conceivable that they have a contemporaneous impact on demand for loans and the interest rate.

Secondly, monetary policy committee members may have contemporaneous information at least on some elements of banks' credit policies. They are provided on banks' web sites which show such lending terms and conditions as collateral requirements, maximum size, maturity or non-interest rate cost. It is even more plausible that such information is contemporaneously scrutinized by central banks since the financial crisis, when banks sharply tightened terms and conditions what led to a plunge in lending.

Thus, in contrast to the existing literature, we use a non-recursive factorization, what allows for simultaneous reactions of standards/conditions and the short-term interest rate (Warsaw Interbank Offer Rate, WIBOR3M). As a robustness check, we compare results from the non-recursive and recursive decompositions and demonstrate that some reactions of the real sector and credits are overestimated if loan standards/loan terms and conditions and the interest rate are assumed to react sequentially.

The value added of this paper is therefore a use of non-recursive decompositions with respect to credit standards T&C, what eliminates or at least reduces the problem of a dubious ordering in Cholesky decomposition. Moreover, in models with the non-recursive

decomposition it is possible to impose and test a set of over-identifying restrictions which bring us closer to a true monetary policy shock and credit supply shock of the banking sector.

Credit standards can be considered as a variable bringing information on "credit availability" which is not necessarily the same as "credit supply". For example, Ciccarelli et al. (2010) treat credit standards as "credit availability", and only together with banks' answers on strength of their balance sheets they are presumed to depict operation of bank lending channel (credit supply). Basset et al. (2012) suggest using a measure of credit supply derived from a regression of credit standards on bank-specific and macroeconomic factors which also affect demand. They use residuals of such regression as a more rigorous measure of credit supply, since this way, a simultaneous impact of supply and demand factors can be disentangled. When included in a VAR framework, shocks to the credit supply measure led to substantial falls in output and capacity of the non-financial sector to borrow from banks, and to a significant easing of monetary policy. In this paper, the problem of demand factors affecting credit standards is alleviated due to our use of the non-recursive decomposition. The impact of the interest rate captures changes in demand and makes the obtained shocks closer to the true credit supply shocks.

In the paper, estimations are based on a suite of vector autoregressive models. If the underlying structural model is as in (1):

(1) $AY_t = C(L)Y_{t-1} + B\nu_t$,

where Y_t is a vector of endogenous variables, A is a vector of contemporaneous relations among the variables, $C(L)$ is a matrix of a finite order lag polynomial, and ν_t is a vector of structural disturbances, we can estimate a VAR model as the reduced form of the underlying model:

(2) $Y_t = A^{-1}C(L)Y_{t-1} + u_t$,

Where Y_t is a vector of endogenous variables, u_t is a vector of VAR residuals, normally independently distributed with full variance-covariance matrix Σ. The relation between the residuals and structural innovations is

(3) $Au_t = B\nu_t$ and

(4) $u_t = A^{-1}B\nu_t$.

In the baseline setting we have the following endogenous variables: private investment, the volume of credits in the domestic currency for investment, for real property acquisition and for financing current account and working capital. They are referred to as l_t^{inv}, l_t^{re} and l_t^{CAWC} respectively[6]. WC&CA loans are treated as short-term and therefore used in models where standards on short-term credits are employed. In turn, the two other types of credits correspond to standards on long-term loans[7]. This estimation strategy is due to the lack of data on loans of maturity of up to 1 year and above 1 year – the relevant statistics is only available for banks' claims, which contain also other debt instruments besides loans. In the models loans are in real terms. They are calculated using investment price deflator (chain linked, 2010). Next, the models contain credit standards applied to large and small and medium sized enterprises (*i=1*or *i=2*) on short-term loans or long-term loans (*j=1* or *j=2*), referred to as $std_t^{i,j}$. Finally, we employ a short-term money market interest rate, WIBOR 3M ($i_t^{WIBOR3M}$) as a proxy for the central bank's policy rate.

[6] Although banks' credit policy concerns both loans in the domestic and in the foreign currencies, we leave aside the latter category. It blurs reactions of loans to the domestic interest rate since it depends rather on a spread between domestic and foreign interest rate and because to make the model well-specified, we would have had to introduce the exchange rate. Bearing on mind data shortness, we cannot expand our model by two variables more.

[7] We do not analyse credits dubbed as "other" since it would be impossible to ascribe them the proper maturity.

In the models which are to verify the role of particular credit terms and conditions we use: spread on average loans ($spread_t$) spread on riskier loans ($spread\ risk_t$), non-interest loan cost ($ni\ cst_t$), maximum size of the loan ($size_t$), security and/or collateral ($collateral_t$), maximum loan maturity ($maturity_t$).

Since Poland is a small open economy, we plug in two exogenous euro area variables, namely 3-month Euribor and investment in the euro area (12 countries) to pin down its close relationships with the euro area. Additionally, we use a dummy variable to capture an abrupt rise in investment prices by 6.2% in 2006Q1 and its drop by 6.2% in 2006Q2. In the robustness checks we have used a dummy reflecting introduction of *de minimis* programme.

What is unusual in our models is clearly a selection of endogenous macroeconomic variables. Usually, they comprise GDP and inflation to capture the usual targets of monetary policy: stabilization of the business cycle and inflation. However, in our models they are not included. We have replaced GDP by investment which is more closely related to loans to the corporates than total GDP. Due to a relatively low ratio of loans to the enterprise sector to GDP, it seems easier to gauge a possible impact of credit standards and conditions using investment. Shortness of the data set and an obvious need for parsimony led us to omit prices. In our setting, prices are included only implicitly, as a deflator for loans. Nonetheless, we believe that the lack of prices does not invalidate our conclusions on the role of the interest rate and credit channels for the real sector. Importantly, a suggested list of endogenous variables makes it possible to impose a set of reasonable over-identifying restrictions.

To identify structural innovations, it is necessary to impose restrictions on matrices A and B in (4). Owing to real and nominal rigidities we keep a block recursive structure between slowly moving real sector variables and fast moving variables. The first group contains private investment and real credit, while the second one credit standards or T&C, depending

upon a model, and the monetary policy variable. In the non-recursive decomposition we assume that interest rate policy and credit standards/conditions can react simultaneously.

Thus, we consider a following baseline model. We assume that private investment and real credit react to developments in banks' credit standards and monetary policy with a lag. Demand for credit is contemporaneously affected by developments in private investment. This may be considered as disputable in the case of short-term credit, however we argue that some investment can also be financed with short-term loans. Credit standards are contemporaneously affected by the outstanding credit and affect the interest rate. Finally, the interest rate is contemporaneously impacted by private investment and credit standards . Thus, restrictions in matrices A and B are as in (5):

$$(5)\quad \begin{bmatrix} 1 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 \\ \alpha_{31} & 0 & 1 & \alpha_{34} \\ 0 & \alpha_{42} & \alpha_{43} & 1 \end{bmatrix} \begin{bmatrix} u_t^{inv} \\ u_t^{l^{inv,re,WCCA}} \\ u_t^{WIBOR3M} \\ u_t^{std^{i,j}} \end{bmatrix} = \begin{bmatrix} v_t^{inv} \\ v_t^{l^{inv,re,WCCA}} \\ v_t^{WIBOR3M} \\ v_t^{std^{i,j}} \end{bmatrix}$$

To check the impact of monetary policy on credit terms and conditions, as well as their role in the monetary transmission, we simply replace credit standards with T&C, i.e. spread on average loans, spread on riskier loans, non-interest loan cost, maximum size of the loan, security and/or collateral, maximum loan maturity. Thus, we build 18 models, i.e. 6 for each type of corporate loans. We expect that in response to monetary policy tightening, banks tighten credit standards, terms and conditions accordingly.

Data on private investment (seasonally adjusted, corrected for working days) and deflator of private investment, both for Poland and the euro area, come from the Eurostat, these on loan volumes, credit standards and conditions from the Narodowy Bank Polski, while money market interest rate from Reuters.

All estimations have been performed using two lags, on a sample 2003Q4-2016Q3. The information criteria (Schwarz, Akaike) usually showed one or two lags; choosing the number of lags, we have also considered serial correlation of residuals and their distribution. Throughout the paper, an increase in credit standards or credit terms means tightening of lending policy (we have multiplied the original data by (-1)).

5. Estimation results

The main results are reproduced in Figures 2-12. Due to the space limits, in Fig. 12 we show only the impulse response functions of credit terms to monetary policy shocks obtained from models with investment loans, but these from models employing loans for WC&CA and for real property acquisition are similar.[8] A dummy for *de minimis* programme has been found statistically significant for short-term loans for SMEs, however, the obtained impulse response functions to shocks to the interest rate as well as to variables reflecting credit policy of banks, remain broadly the same. Results from Cholesky decomposition are shown in Figures 13-20. In all figures the horizontal axis is for time horizon in quarters.

5.1. Responses to the interest rate innovations

Impulse response functions from all models show that after a negative monetary policy shock (tightening) credit standards and T&C are tightened too. This is in line with results for the euro area e.g. Maddaloni, Peydró and Scopel (2008), Couallier (2015). In general, the responses are statistically significant, however, not instantaneously, but usually from 3rd to 6th quarter after the shock. That means that, although with some delay, monetary policy shocks are amplified by the respective adjustments in banks' lending policy.

[8] The respective figures can be obtained on request. Here, we abstract from a possible non-linear reaction if a shock of 1 pp. occurs. Normally, the interest rate shock is close to 0.25 pp.

All standards react to the monetary policy shocks according to the same pattern. A statistically significant tightening of standards comes about in the third quarter after the initial (negative) interest rate shock, the maximum reaction is in the 4^{th}-5^{th} quarter and since then standards are gradually softened. A similar lagged reaction pattern display some lending terms and conditions, i.e. a spread on loans for riskier borrowers and a required collateral, whereas other: average spread, non-interest rate cost and maximum maturity are tightened at once. The initial reaction of maximum loan size is on the border of statistical significance. Either instantaneous or lagged impact of the monetary policy shocks on credit standards and T&C, and in particular on the required collateral, maximum maturity and size of a loan, means that the central bank has some impact on the banks' propensity to take risk and on the risk-taking channel of the monetary transmission.

To make a comparison between reactions of standards for LEs and SMEs to the monetary policy shocks easier, we have generated impulse response functions to a standardized shock equal to 1 pp. of WIBOR3M (Figure 8)[9]. Standards applied on long-term loans for SMEs react somewhat stronger than those for LEs. Monetary tightening by 1 pp. makes 20-24% asset weighted banks (in net terms) tighten lending standards on long-term loans to SMEs, whereas the respective figures for standards on long-term loans for LEs range from 12% to 15%. As shown in Figure 10, confidence intervals of ±1 standard error for impulse response functions of standards for LEs do not embrace impulse response functions for SMEs and *vice versa*. This is however not true for the intervals of ±2 standard errors. Thus, there is some evidence, although not very strong, of a larger responsiveness of standards for long-term loans for SMEs. Point estimate of the maximum reaction of short-term standards for LEs and SMEs displays a discrepancy of some 5 percentage points - after a 1 pp. monetary policy shock 11% (in net terms) of banks tighten lending policy with respect to LEs and 16% (in net

[9] These are standardized impulse response functions from Fig. 6-11. As before, in the simulation we abstract from the possible nonlinearities.

terms) to SMEs. However, the respective impulse response function for SMEs practically rests on the upper line of the ±1SE confidence interval for the impulse response function for LEs. Thus, in the case of standards on the short-term loans we reject a hypothesis that they react stronger for SMEs than for LEs. Thus, monetary tightening/softening affects more SMEs than LEs in the segment of long-term loans only. The underlying reason is most probably a higher risk which is related to the long-term than to the short-term lending. It is therefore rather investment activity than current operation of SMEs which may be affected after monetary policy tightening.

Monetary policy shocks have an influence on private investment, loans for real property acquisition and WC&CA, whereas the reaction of investment loans to the interest rate innovations is not significant. Private investment reacts at once to the interest rate innovations, whereas the response of loans shows up with a lag, as if the corporate sector needed some time to adjust to a higher cost of capital. In the case of WC&CA loans there is a short-lived increase after a monetary policy shock, what probably means that firms continue financing working capital in spite of a higher cost. If reflected in consumer prices, this may lead to the operation of the cost channel.

5.2 Responses to innovations to credit standards, credit terms and conditions

Innovations to credit standards affect investment loans for LEs and slightly less palpably those for SMEs (this reaction is at the border of the statistical significance for the first 4-5 quarters after the shock). In contrast to responses of loans to the interest rate shocks, the responses to innovations to standards are instantaneous. The standards, either on loans for LEs or on those for SMEs do not exert any statistically significant reactions of private investment. Thus, it seems that demand factors, gauged by the interest rate, affect investment more than the supply of credit. Credit standards seem not to affect loans for real property

acquisition and for financing WC&CA. These types of loans are rather under the influence of the interest rate.

Shocks to the specific credit terms and conditions do not affect private investment; only some of them have an impact on loans for investment and WC&CA loans. In particular, negative (tightening) shocks to collateral and spread on loans for riskier borrowers tend to reduce loans for investment; negative shocks to collateral and maximum maturity transitorily reduce WC&CA loans. Although SMEs have usually poorer collateral than LEs, we cannot attribute shocks to collateral and the resulting drop in investment loans to SMEs, since they may use *de minimis* package as a supplementary "collateral". To save the space, in the graphs we present solely the results which are statistically significant or at the border of the statistical significance.

A typical shock to spread on loans for riskier borrowers reduces investment loans stronger and somewhat longer than this to collateral (Figure 9). Credits for real property acquisitions seem to remain intact by shocks to credit terms.

In general, in the non-recursive decompositions, shocks to four kinds of T&C, i.e. spread, non-interest rate cost, maximum size and maturity, tend to be offset by the interest rate falls. A similar effect, but with respect to credit standards, is reported in Lown and Morgan (2002) and (2006) for the U.S and Couallier (2015) for the euro area. There is no evidence in the Polish data that shocks to credit standards lead to a lower interest rate. The phenomenon is limited to reactions of the interest rate to shocks to credit terms. The initial fall of the interest rate can stem from a drop in demand of banks for refinancing, both current and expected, but since the fall in the interest rate does not quickly disappear, we suspect that it is sustained by an expansionary monetary policy of the central bank, counteracting credit tightening of the banking sector.

Interestingly, while models with investment loans and for WC&CA generally give intuitive impulse responses to shocks to credit terms, this is not the case of loans for real property acquisition. They may display a "credit puzzle" after innovations to spread on loans for the riskier borrowers and to maximum size (they are not shown in the paper). Only shocks to maturity bring about a small, short-lived drop in loans for the real property acquisition. This is not due to the interest rate developments, since Cholesky decomposition shows a very similar behaviour of these loans. While we do not have enough evidence to draw hard conclusions, we suspect that the puzzle can result from a possible substitution between loans for real property and investment.

5.3 Cholesky decomposition

The impact of the interest rate shocks on lending standards in Cholesky decompositions are similar to these from non-recursive factorizations, i.e. (i) monetary policy shocks impact credit standards and amplify effects of monetary policy, and (ii) standards on loans for SMEs react somewhat stronger than those on loans for LEs. A considerable difference is however observed in reactions of credit terms and conditions. This concerns those which in the non-recursive decompositions react to the monetary policy shocks at once (average spread, non-interest rate cost and maximum maturity). Responses of private investment and loans to the interest rate shocks are similar in both decompositions, Figures 13-20. To save the space, for T&C we show only these, which are statistically significant.

Another set of dissimilarities shows up in reactions to shocks to lending standards, T&C. Some responses of private investment and loans to lending standards which have been insignificant in the non-recursive decompositions, are significant in the Cholesky factorization. This is the case of responses of private investment to innovations to standards applied on long-term and short-term credits for SMEs, and on the short-term loans for LEs.

Differences are even greater in the case of responses to innovations to credit terms and conditions. They are mostly due to the behaviour of the interest rate. In contrast to the non-recursive decomposition, the interest rate does not fall after a shock to the credit terms. In many cases it rather increases, e.g. after shocks to spread, spread on loans for the riskier borrowers, required collateral and maturity in the models with short-term credits. This leads to dissimilar reactions of private investment and loans. Moreover, private investment seems to fall after a negative shock (tightening) to such terms as spread on average loans and maximum maturity, while in the non-recursive decompositions investment remained intact. As mentioned before, models with loans for real property acquisition display the same puzzle as models with the non-recursive factorization.

5.4. Robustness checks

To some extent, recursive decompositions may be considered as robustness checks. Besides, we have performed estimations employing consumer price index (CPI) and bilateral EUR/PLN exchange rate as the exogenous variables to verify whether there is a significant problem with the omitted variables. The former variable was supposed to alleviate the problem of a possible misspecification of the monetary policy shocks, the latter to take into account that the corporate sector had loans in foreign currencies. In particular, we plugged the exchange rate into models with investment credits and credits for real property acquisition. Finally, we applied a dummy for the *de minimis* programme. The results remained broadly the same, in some cases the inclusion of consumer prices slightly speeded up the return of loans to the baseline after innovations to credit standards, T&C. However, neither prices nor the exchange rate did not solve the problem of credit puzzles obtained in models with loans for the real property acquisition.

6. Conclusions

Using a suite of structural vector autoregressive models with non-recursive factorization which allows simultaneous reactions of the short-term interest rate (WIBOR3M) and credit standards/credit terms and conditions, this paper demonstrates that in Poland monetary policy shocks have an impact on banks' lending policy. The results from the same models but obtained from a simple Cholesky decomposition show that the latter may overestimate the role of credit channel in the monetary transmission.

Our estimates suggest that credit channel, although operative, plays a less pronounced role than the traditional interest rate channel. Impulse responses from all our models show that monetary policy shocks have an impact on private investment. However, investment is neither affected by standards, nor by T&C. Interest rate shocks exert an impact on loans for WC&CA and these for real property acquisition. Solely investment loans, and in particular loans to large enterprises, seem to be responsive rather to shocks to banks' lending policy than to the monetary policy. All lending standards, terms and conditions respond to the monetary policy shocks. After monetary policy shocks, responses of credit standards for SMEs for long-term credits are more pronounced than those for LEs. However, reactions of standards on short-term loans for LEs and SMEs are similar. This is due to less risk related to short-term than to the long-term lending.

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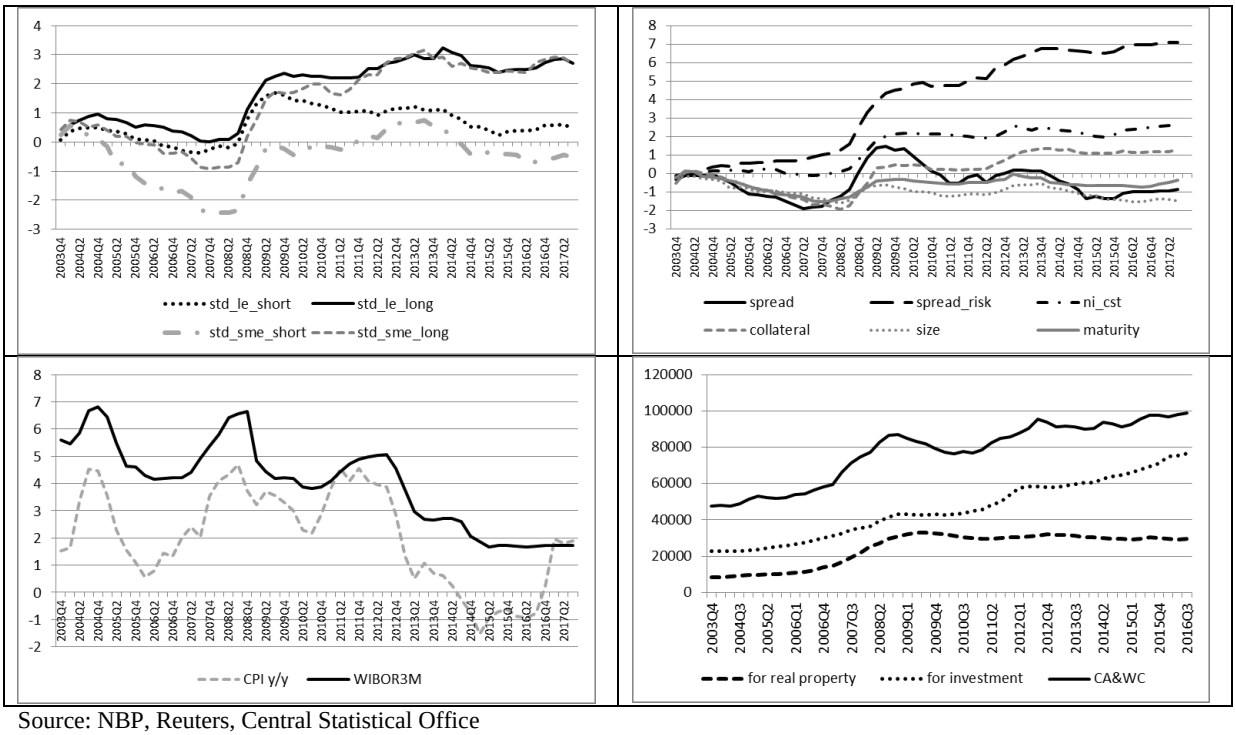
Figure 1. Cumulated credit standards on short and long-term loans for LEs and SMEs, 2003Q4-2017Q3 (↓=softening), upper LH panel. Credit standards on long-term loans to LEs, and cumulated credit T&C (↓=softening), upper RH panel; short-term interest rate WIBOR3M and CPI inflation y/y lower LH panel, loans in million PLN, lower RH panel



Source: NBP, Reuters, Central Statistical Office

Figure 2. Impulse response functions – a shock WIBOR3M and long-term standards for LEs, investment loans

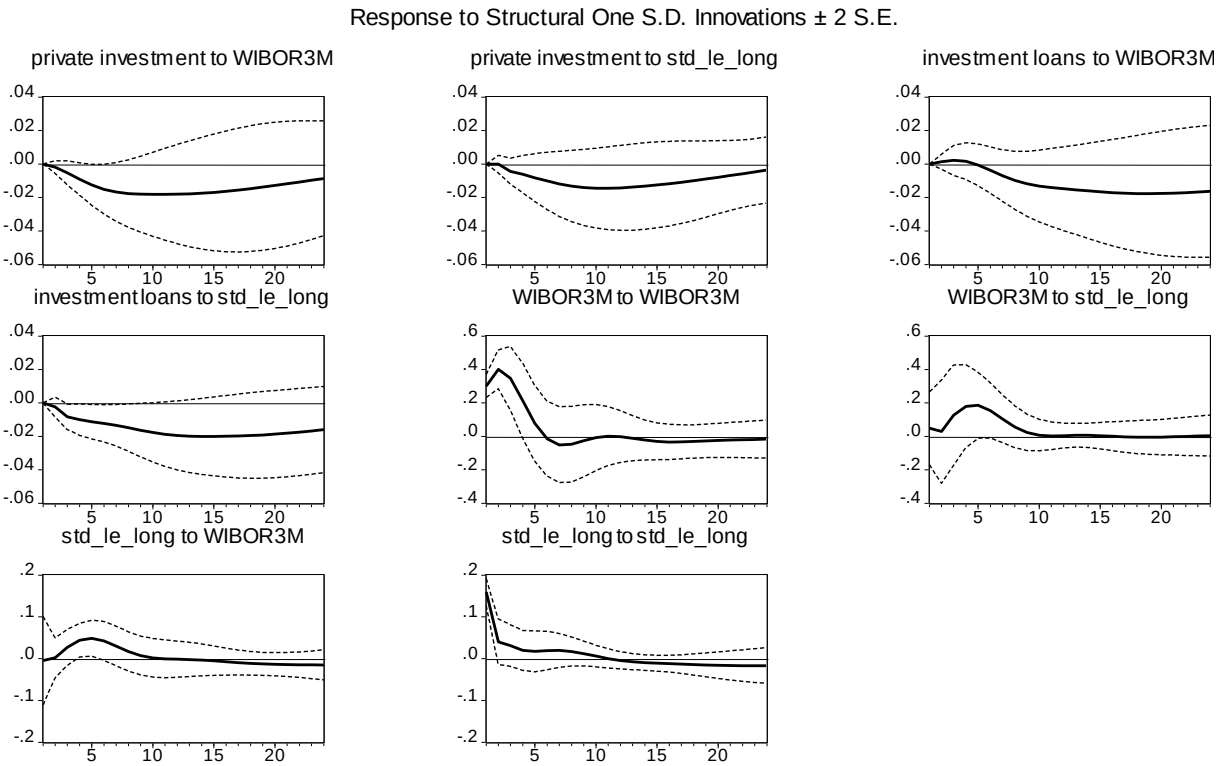


Figure 3. Impulse response functions – a shock WIBOR3M and long-term standards for SMEs, investment loans

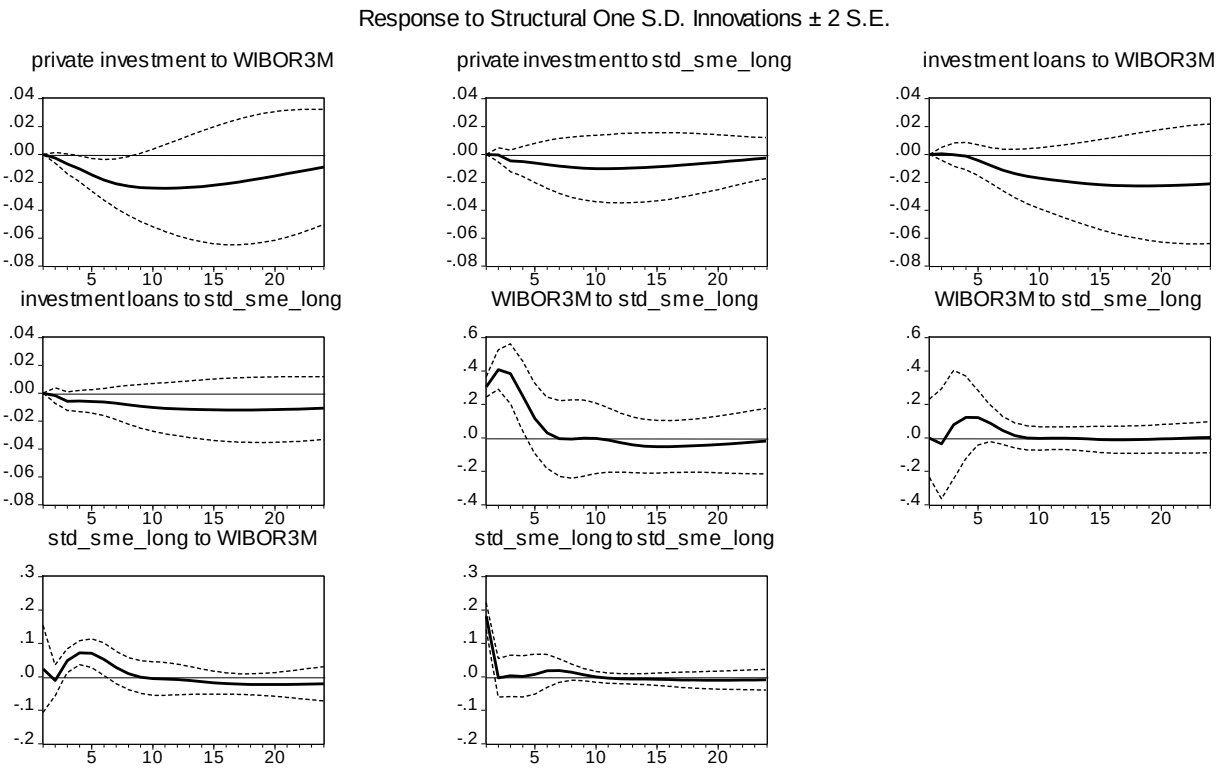


Figure 4. Impulse response functions – a shock WIBOR3M and short-term standards for LEs, WC&CA loans

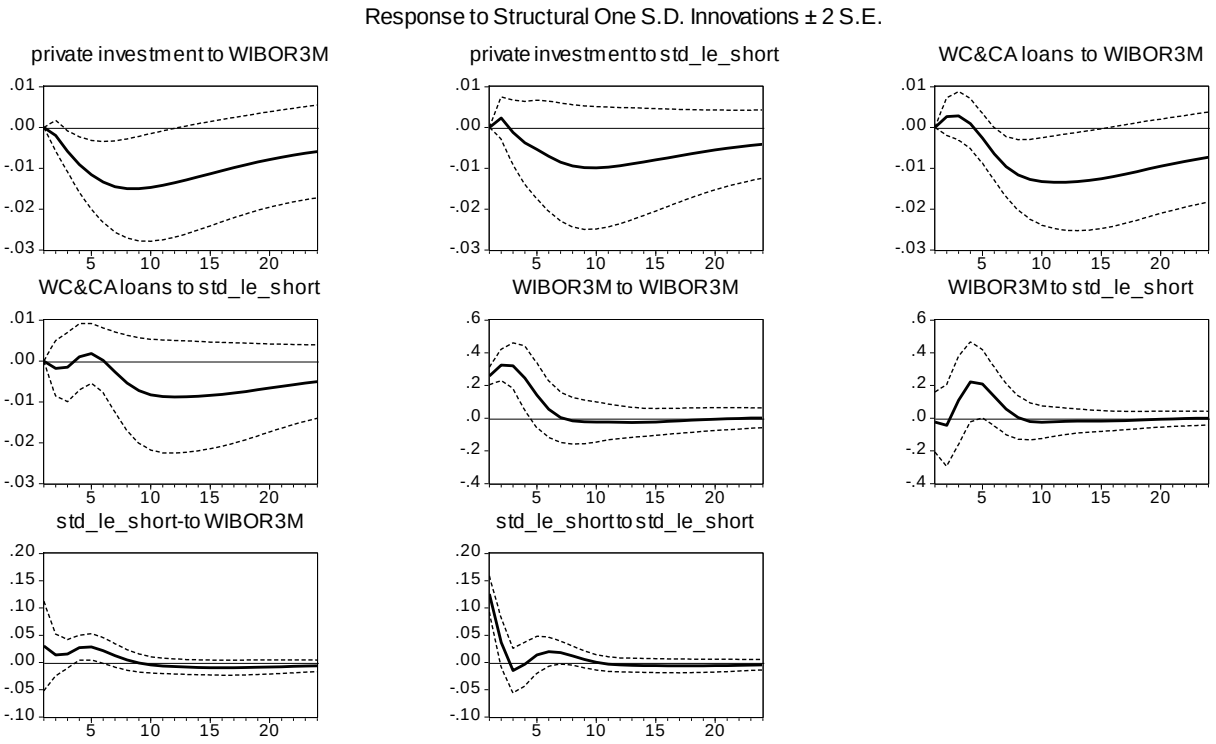


Figure 5. Impulse response functions – a shock WIBOR3M and short-term standards on SMEs, WC&CA loans

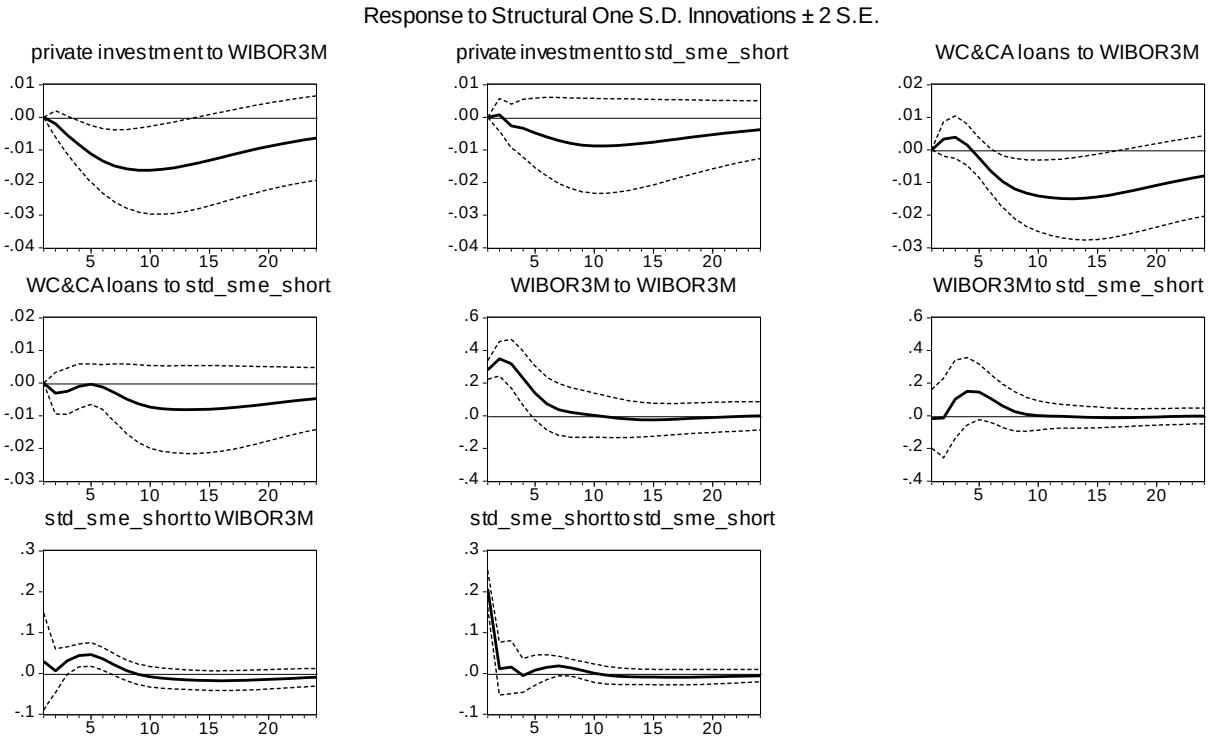


Figure 6. Impulse response functions – a shock WIBOR3M and short-term standards for LEs, loans for real property acquisition

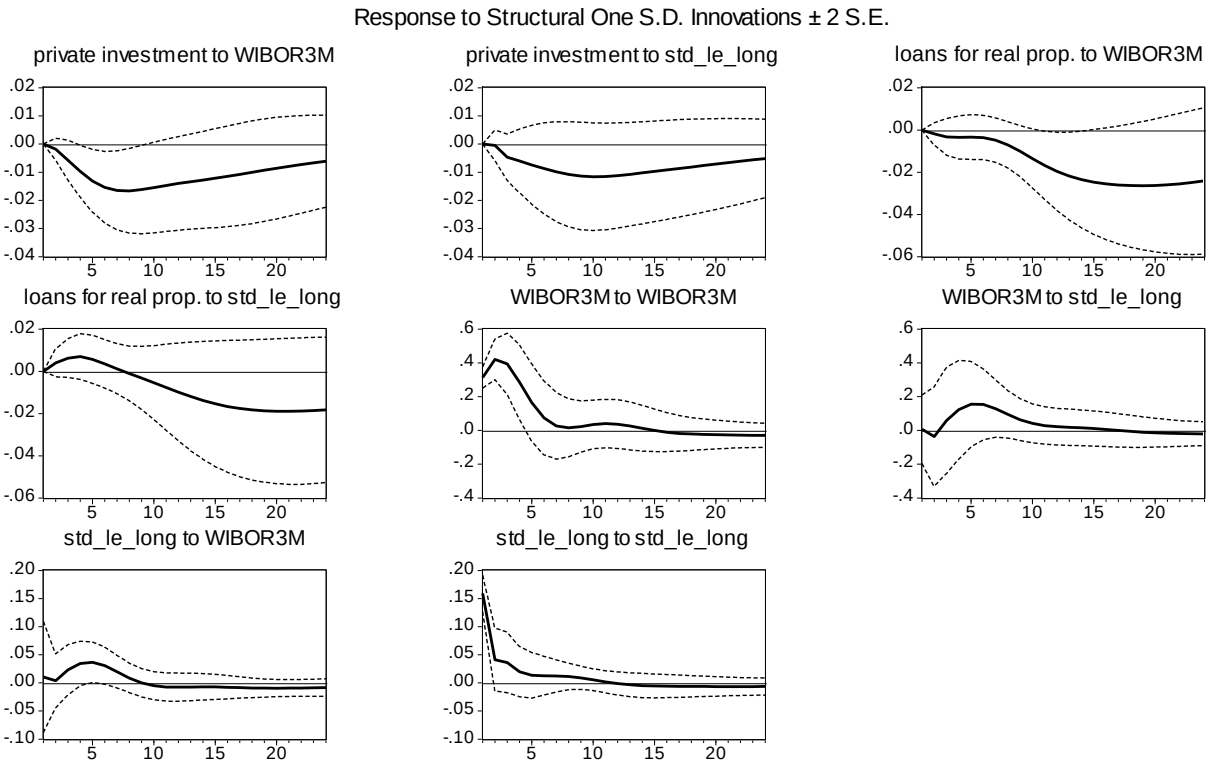


Figure 7. Impulse response functions – a shock WIBOR3M and short-term standards for SMEs, loans for real property acquisition

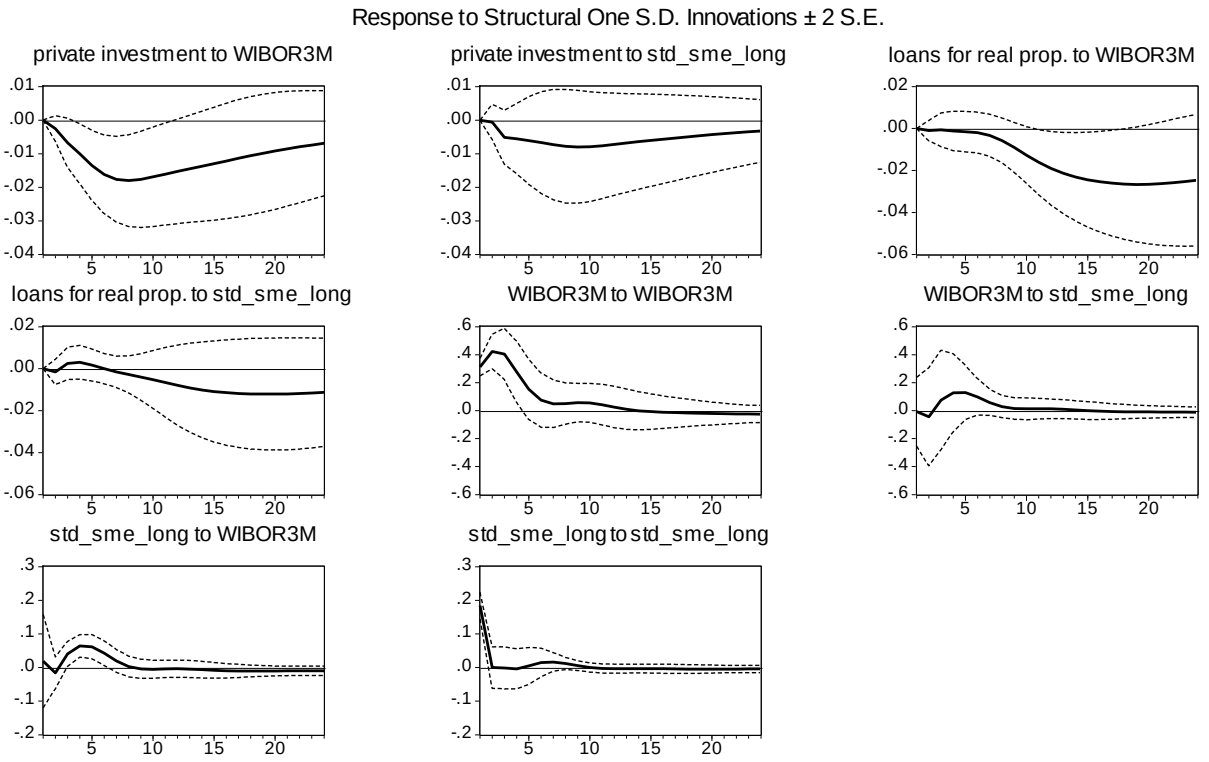


Figure 8. A zoom on impulse responses of loan standards to LEs and SMEs to a 1 pp. structural shock to WIBOR3M rate

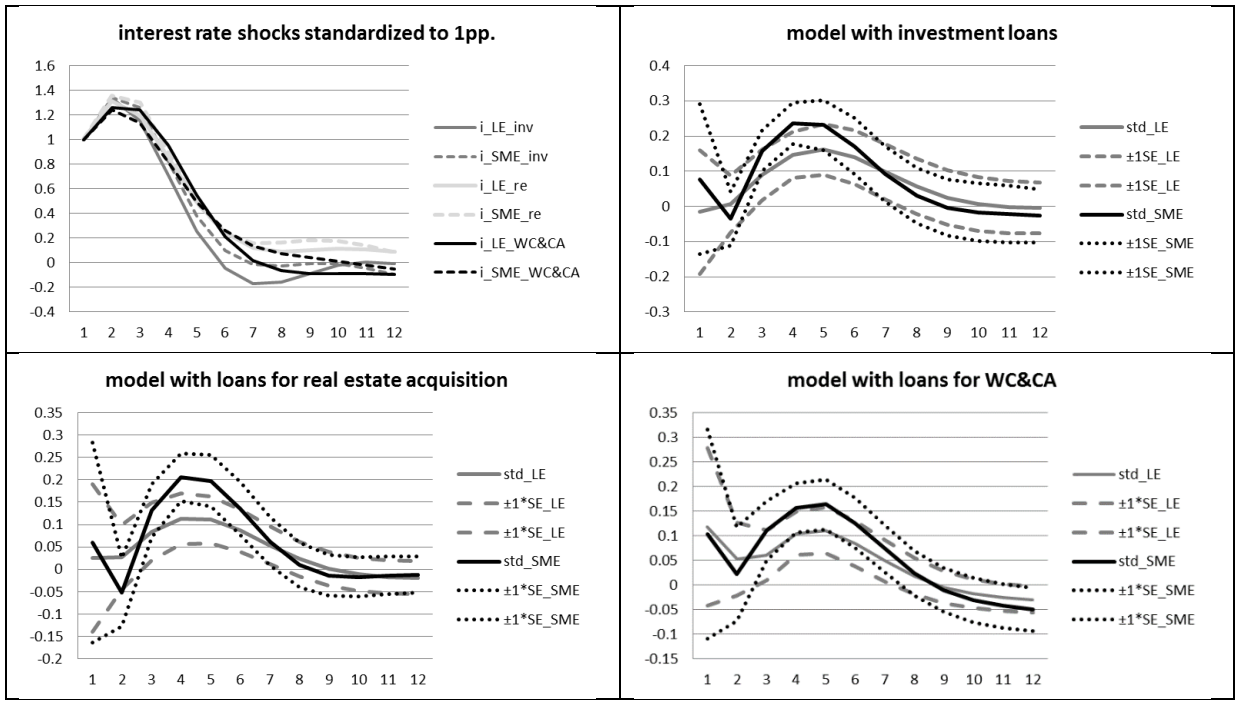


Figure 9. A selection of impulse responses to shocks to credit terms, VAR models with investment loans (upper panels)

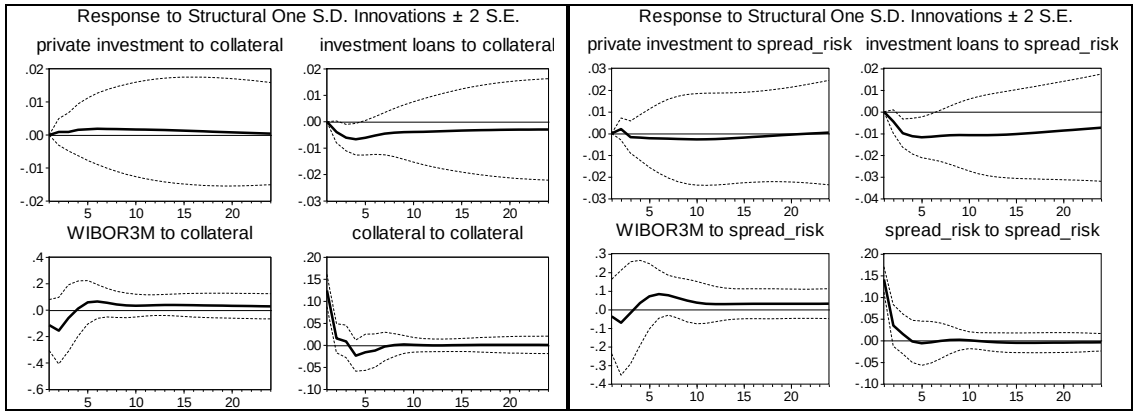


Figure 10. Impulse responses to shocks to credit terms, VAR models with WC&CA loans

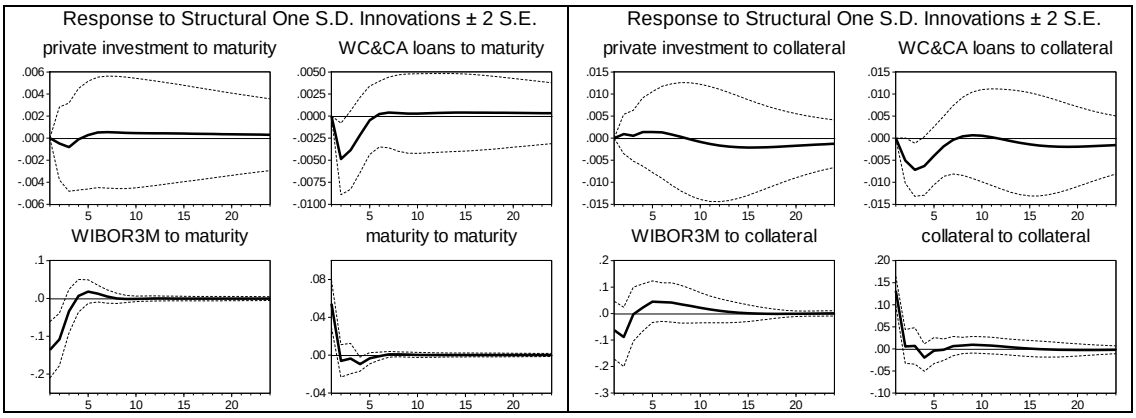


Figure 11. Impulse response functions to shocks to credit terms, VAR models with loans for real property acquisition

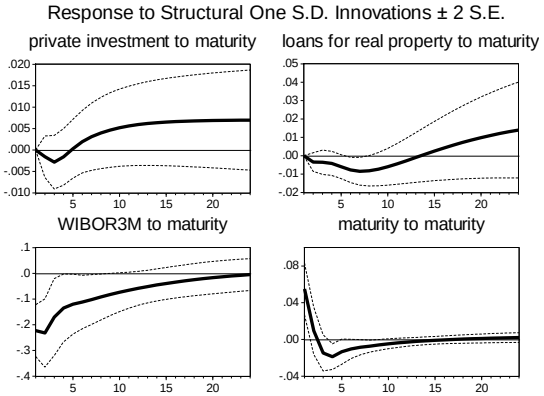


Figure 12. A zoom on impulse responses of credit terms and conditions to a 1 pp. structural shock to WIBOR3M, up to 12 quarters after the shock, obtained from a model using investment loans

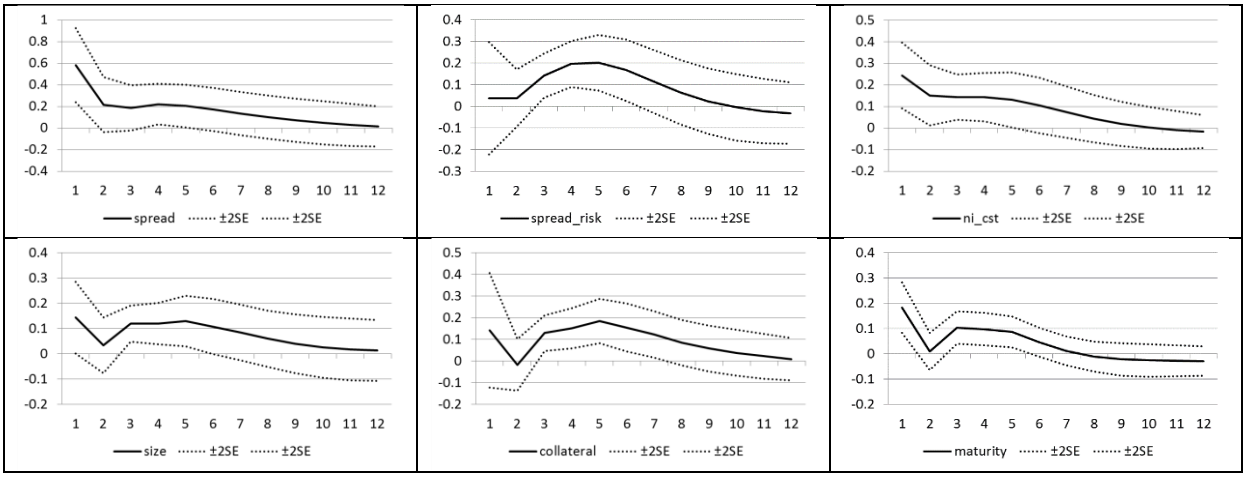


Figure 13. Impulse responses to monetary policy and standards for LEs on long-term loans (VAR with investment credit, Cholesky)

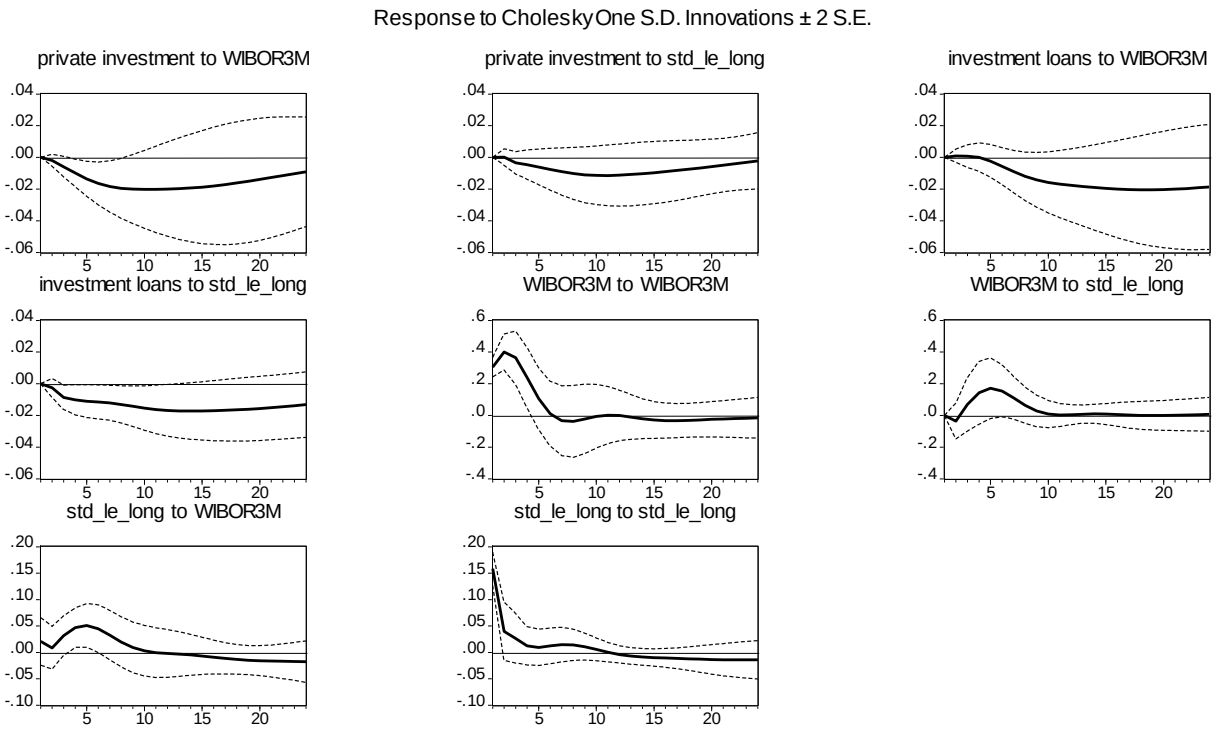


Figure 14. Impulse responses to monetary policy and standards for SMEs on long-term loans (VAR with investment credit, Cholesky)

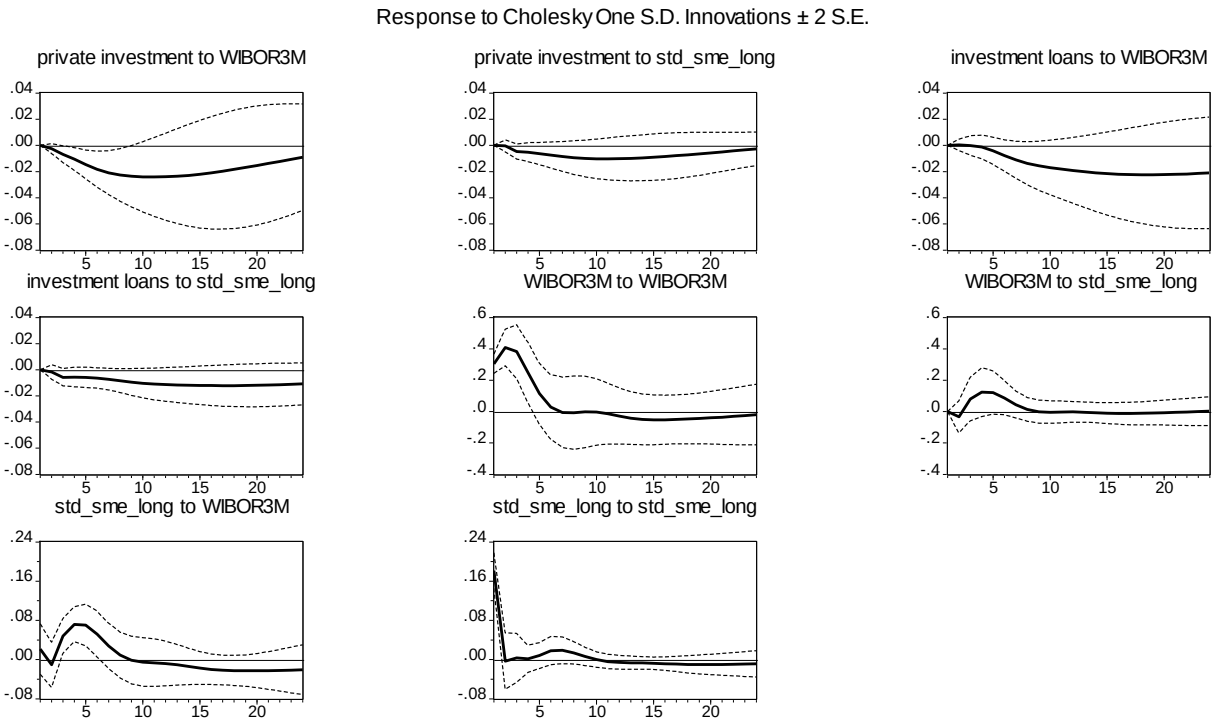


Figure 15. Impulse response functions to monetary policy and standards for LEs on long-term loans (VAR with credit for real property acquisition, Cholesky)

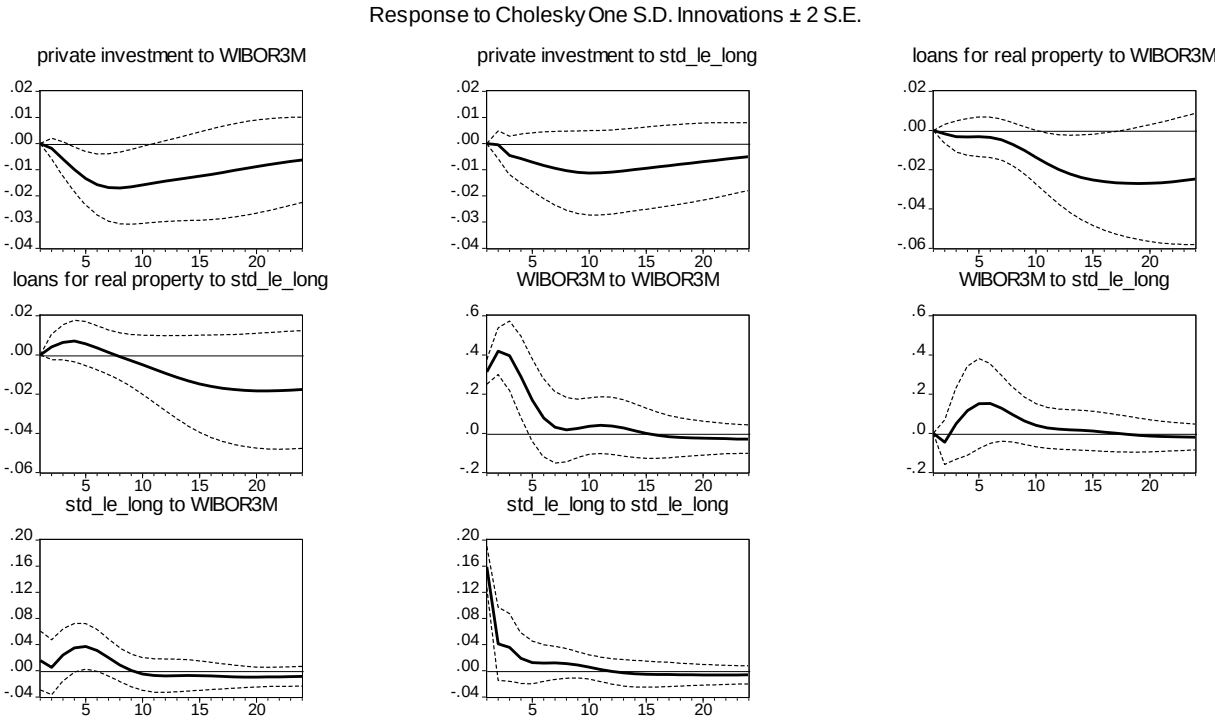


Figure 16. Impulse response functions to monetary policy and standards for SMEs on long-term loans (VAR with credit for real property acquisition, Cholesky)

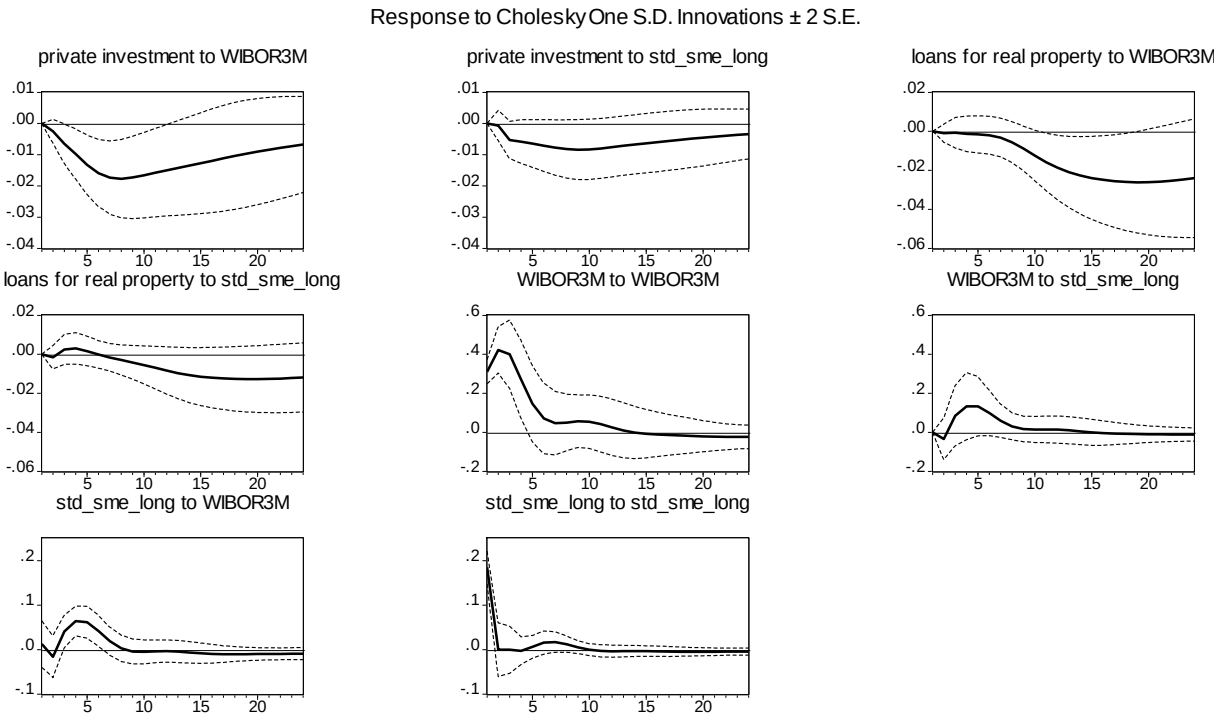


Figure 17. Impulse response functions to monetary policy and standards for LEs on short-term loans (VAR with credit for WC&CA, Cholesky)

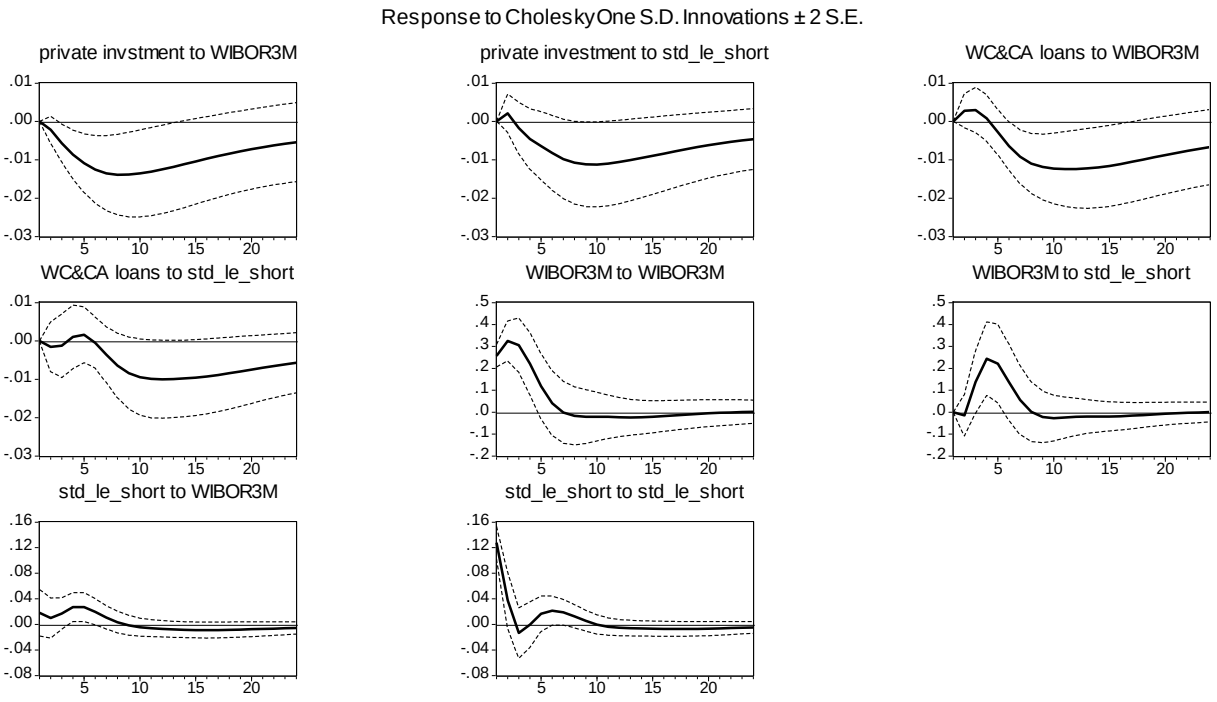


Figure 18. Impulse response functions to monetary policy and standards for SMEs on short-term loans (VAR with credit for WC&CA, Cholesky)

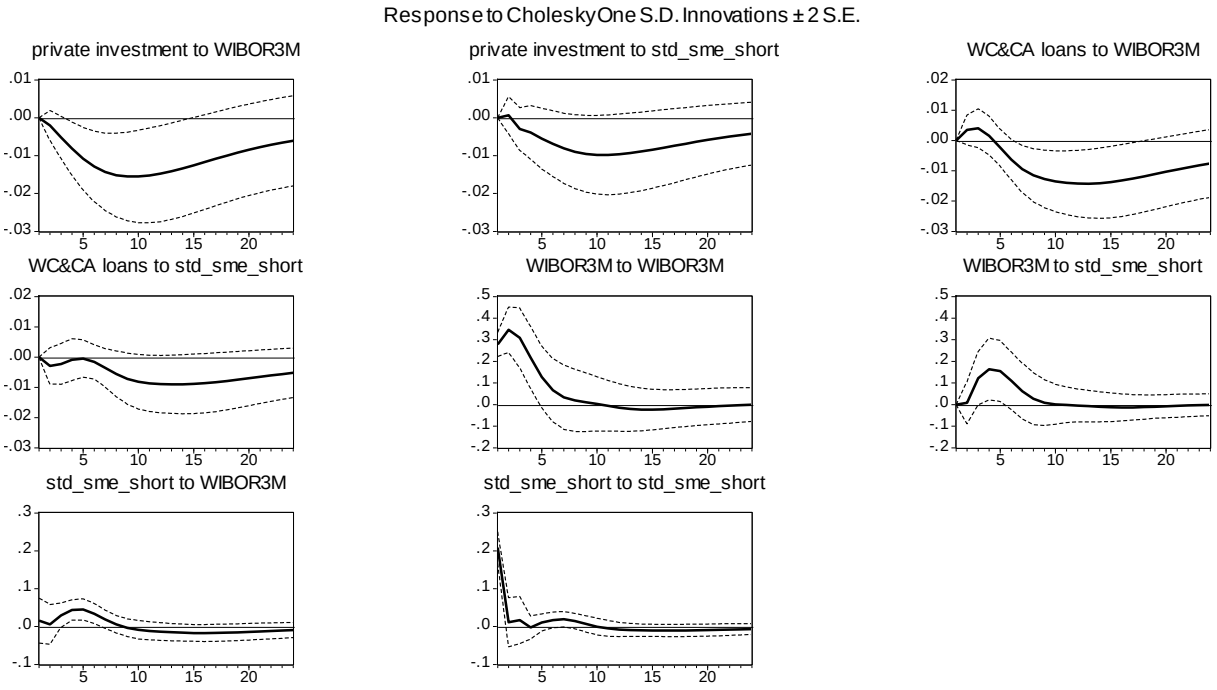


Figure 19. Impulse response functions to selected T&C: investment loans (Cholesky)

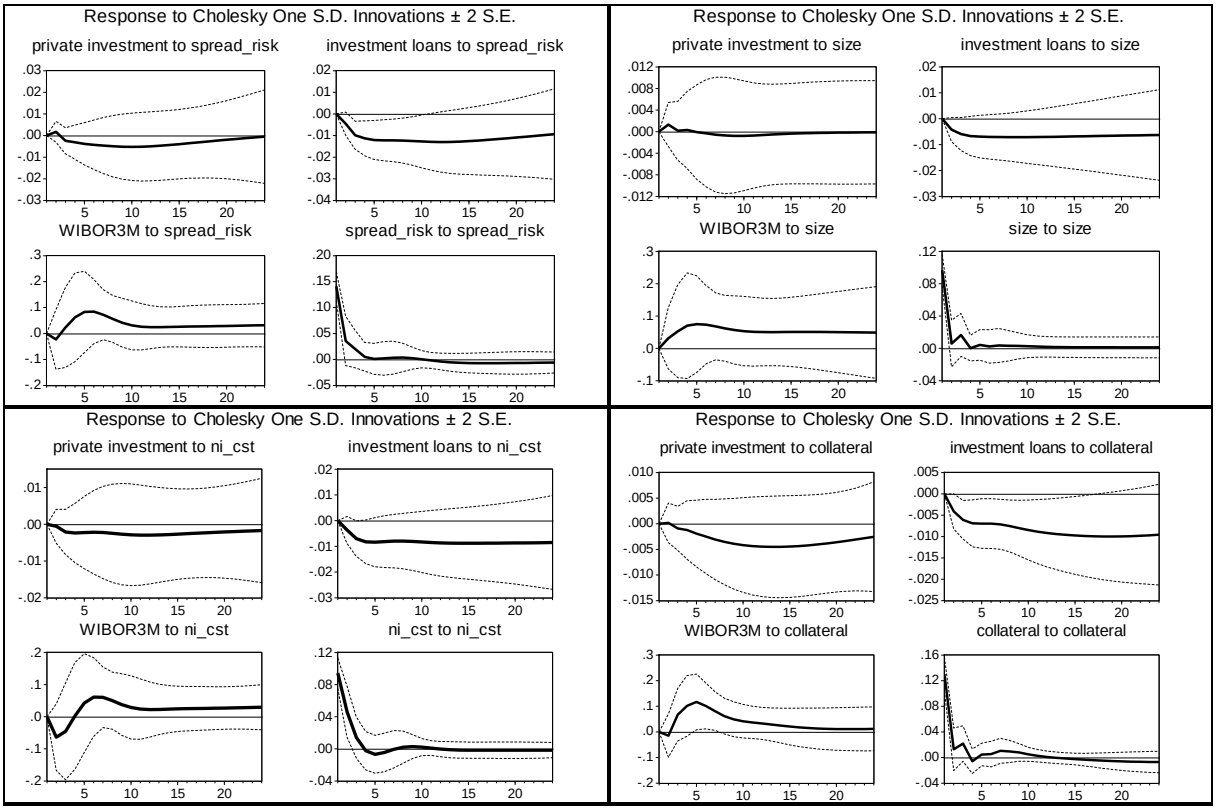
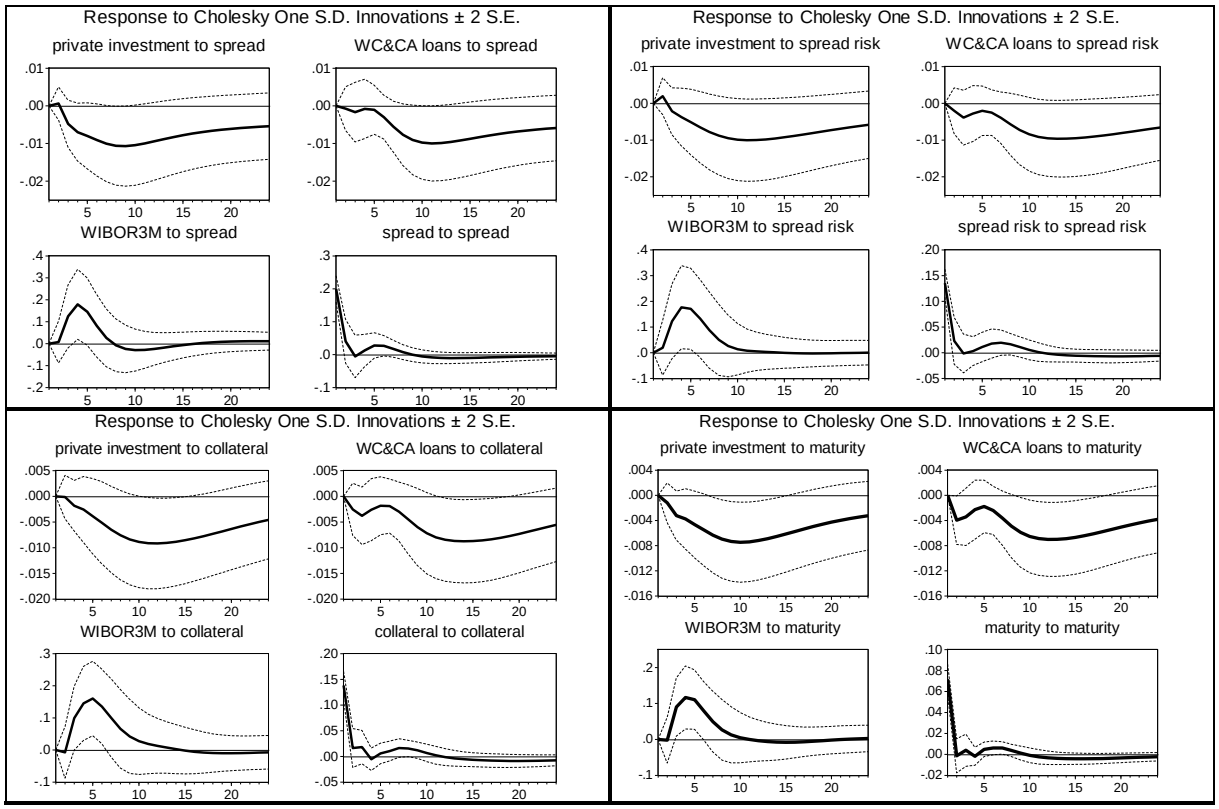
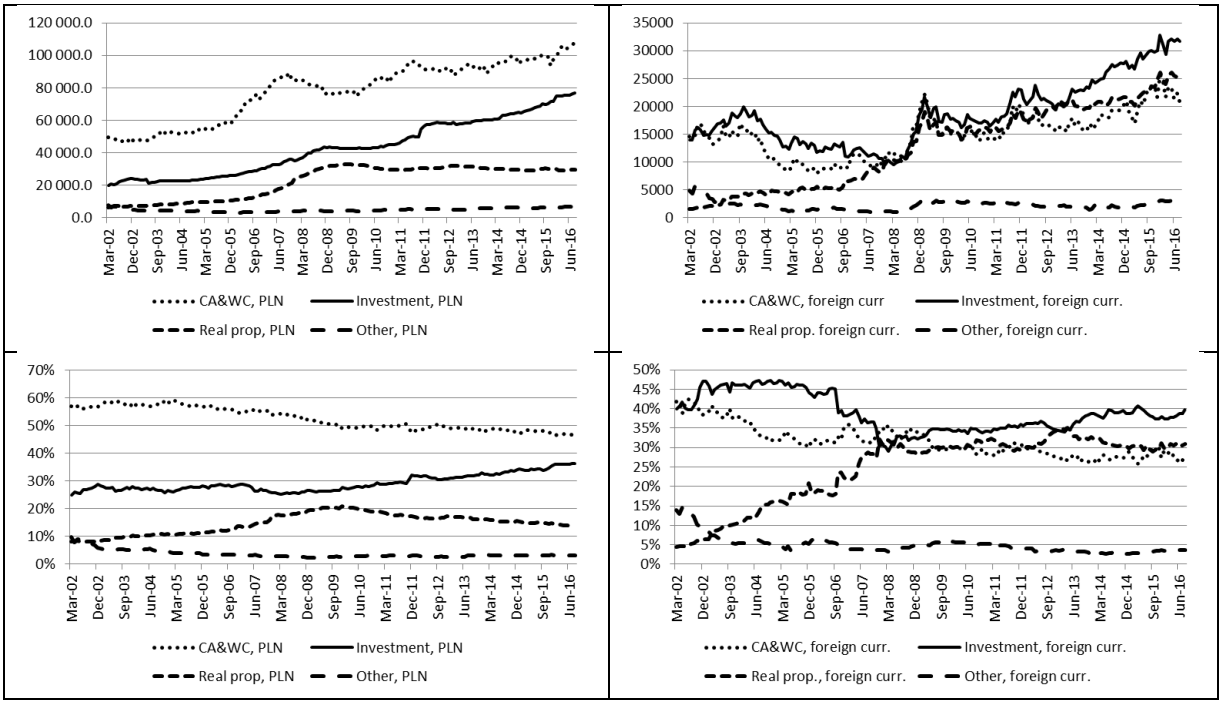


Figure 20. Impulse responses functions to credit terms: WC&CA loans (Cholesky)



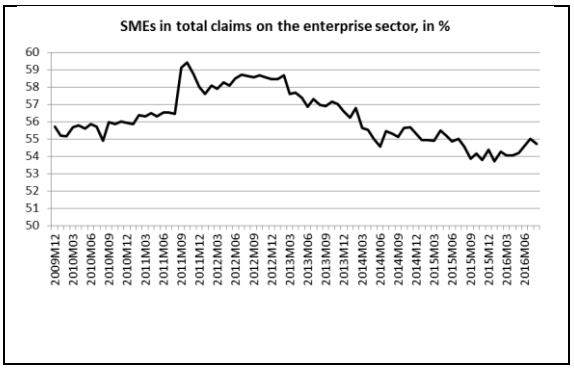
Statistical Annex

Figure A1. Loans in PLN (LH panels) and in foreign currencies (RH panels) to the corporate sector: levels (upper panels), and shares (lower panels)



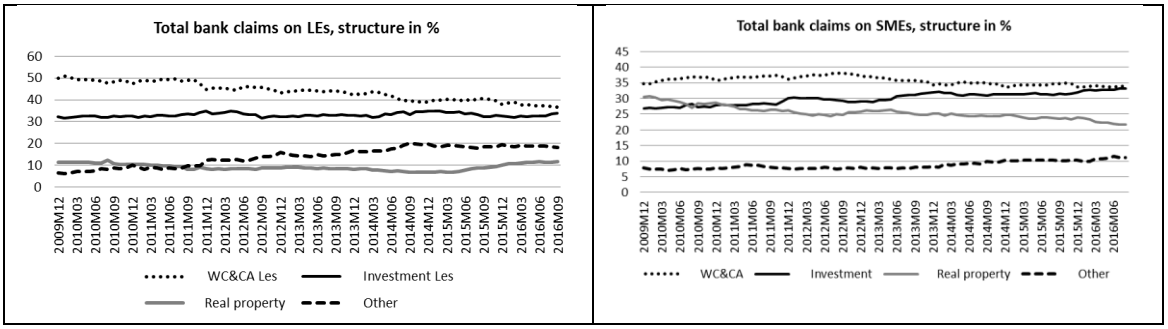
Source: NBP data

Figure A2. Share of SMEs in the total amount of banking sector claims on the corporates



Source: Polish Financial Supervision Authority data

Figure A3. Structure of bank claims on LEs and SMEs



Source: Polish Financial Supervision Authority data