What is the impact of central bank on banks' lending policy with respect to the corporate sector? Evidence from SLOOS for Poland

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Abstract

The paper shows how central bank impacts credit policy of the banking sector. Using aggregate data from the "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 the operation of the lending channel and that the reactions of standards on long-term loans for small and medium sized enterprises are somewhat more pronounced than those on loans for large entities. Loans for investment are affected by credit standards to a certain degree, other types of loans, such as loans on current account and loans for financing working capital as well as for real property acquisition tend to respond to the interest rate. Recursive factorizations may over-estimate the role of the credit channel.

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1 Introduction

Understanding how the central bank affects the 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 the real sector through various credit channels, including the bank lending channel and the balance sheet channel. This paper concentrates on the former. In the bank lending channel, monetary policy tightening affects negatively the strength of banks' balance sheet, their capital position and the 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", i.e. who repay the loan only if it is in their interest to do so (Jaffee, Russel 1976; Stiglitz, 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 the 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 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, the GDP growth rate remained positive, though lower than in the past. The economy did not fall into a recession, but the credit policy pursued by 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 the spread over a relevant market reference rate for average borrowers and the spread for riskier than average borrowers, non-interest loan costs, the maximum loan size, collateral requirements and the maximum loan maturity (NBP 2016). Using data from the "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 monetary policy shocks in the same way as these applied on loans extended to 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.

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; 2006). Conclusions concerning the reactions of credit standards and conditions to monetary policy innovations 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, the federal funds rate drops after the 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 monetary policy rates that are too low for too long. Finally, Ziadeh-Mikati (2011) finds that low levels of both short and long term rates are associated with a 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 and Peydró (2010; 2013), Maddaloni, Peydró and Scopel (2008), De Bondt et al. (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 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.

So far, no similar analysis has existed for Poland. We fill this gap and provide evidence on credit channel operation in Poland on the basis of aggregated survey data. The survey conducted by NBP contains questions about the 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 empirical studies (Couaillier 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; Polish Financial Supervision Authority, banking sector – monthly data).

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 the tightening of credit standards and conditions. It means that the operation of the interest rate channel is amplified by the lending 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 loans on current account and working capital loans. These types of loans respond

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[1] Maddaloni and Peydró (2010) suggest that the difference between their results for the US and those by Loan and Morgan (2002; 2006) is due to the omitted variable bias, i.e. the absence 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.

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 such loans to LEs.

A novel approach of this paper resides in its effort to extract structural shocks by using a non--recursive factorization, which allows simultaneous reactions of the 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 the tightening/softening of credit standards.[3] 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 sthat Cholesky factorization may lead (but does not necessarily lead) to some overestimation of the role of the credit channel in 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. Section 5 discusses the results. Finally, the last section 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 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 the 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 asked 7 questions concerning the current lending policies to the corporate sector and those expected for the next quarter. 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 LEs, long-term loans to LEs, short-term loans to SMEs and long-term loans to SMEs. A possible span of answers embraces five

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[3] Another possibility would be to use sign-restricted SVARs. However, they are vulnerable to misidentification through masquerading shocks. Namely, if a shock of interest is the only shock to plausibly uniquely satisfy a given set of sign restrictions, combinations of other structural disturbances may do so as well, thus distorting inference (Wolf 2017). Also, identification would require the introduction of additional data series, in particular interest rate on new loans to identify a credit supply shock, a shock to demand for credit and a monetary policy shock. However, data on lending rates (new businesses) has been available only since the beginning of 2005. Thus, we would lose 5 pre-crisis observations, what might move the sample towards a significant preponderance of observations from the period of the financial crisis.

options: tightened considerably, tightened somewhat, remained basically unchanged, eased somewhat, eased considerably. Banks are also asked about factors driving changes in lending policies: the 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-bank 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, T&C with the same pattern as in the case of current lending policies.

The aggregation of data behind survey results consists in the calculation of weighted percentages of responses and the net percentage, i.e. the difference between the groups 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, thus we multiply the raw data by (–100)). 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 a growing pressure from competitors. Credit standards, T&C 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 the crisis of the sovereign debt burst out. In 2014-2015Q2, after some appeasement in the euro area, banks softened both their credit standards and terms. However, in the late 2015, due to domestic uncertainties and risks concerning the expected introduction of a tax on new bank loans and a possible compulsory conversion of foreign-currency-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 the growing interest of banks in this segment of the credit market. On the one hand, it is due to the fact that LEs have gradually gained access to capital markets and could diversify sources of external financing, becoming 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 more than doubled. Financial crisis temporarily halted the process of credit use intensification. During the crisis banks tightened credit standards for SMEs more than for LEs.[4] Since 2010 banks began to soften standards for short-term loans to LEs and to a somewhat lesser extent also to 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 the *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 in this way it can make credit supply more rigid if there is a monetary policy tightening.

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[4] The cumulative effects for 2008.3-2009.3 in the case of standards applied on short-term and long-term credits to SMEs were respectively -2.3 and -2.6, while those for LEs amounted to -1.9 and -2.2.

A brief analysis of the distributions of credit standards reveals that the means of all standards except these for SMEs on short-term loans are positive, which 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 period of 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% the hypothesis 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.

The collateral and the spread on loans to riskier borrowers are these T&C which are the most strongly correlated with credit standards. To tighten T&C, banks most frequently used spread on loans to riskier borrowers, i.e. the price element, whereas to soften – such non-price elements of loan covenants as maximum size and maximum maturity. The spread on average loans Granger causes[5] all other terms with the exception of the maximum loan size; the spread on riskiest loans Granger causes all terms except spread.

Since 1998 Poland has been conducting monetary policy within the inflation targeting regime with the 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 and Figure 2). Owing to an episode of higher inflation on the eve of the EU entry, the central bank increased the policy rate, thus monetary tightening co-existed 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 policy was to offset the tightening of credit standards and T&C by banks. In 2011 aggregate demand pressures on prices revived once again, leading to 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.

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

In Poland, the banking sector is by far the most important provider of external financing to the corporate sector: loans to non-financial enterprises amount to 16% in relation to GDP, while corporate bonds stand at 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 long-term ones, i.e. loans extended

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

for investment and real property purchase. The latter were growing rapidly before the financial crisis. Loans in PLN are dominated by loans for financing working capital and loans on current account (WC&CA henceforth), see Figure 3. 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; GUS 2017). Transfers of EU funds to the corporate sector constituted an important source of financing private investment in 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. The financial crisis resulted in a sharp fall of credit growth, but starting from 2011, WC&CA loans and loans for investment began to recover; only the loans for real property acquisition remained subdued. The share of WC&CA loans has fallen steadily since mid-2005 (from about 60% to 48%), whereas the share of investment credits has increased.

A breakdown of the banking sector claims on the corporate sector according to the size of the borrower, i.e. to LEs and SMEs has been available only since 2010. It shows that SMEs account for about 54–59% of the total amount of bank claims. Importantly, SMEs dominate in all types of claims except the "Other" category.

4 Estimation strategy and data

We conduct our analysis on a generally accessible data set of standards and T&C on the aggregate level.[6] To some extent, this paper follows Lown and Morgan (2002; 2006), De Bondt et al. (2010), and Ciccarelli, Maddaloni and Peydró (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 monetary authorities on banks' credit policy. In those works, shocks have been identified through a recursive decomposition (Cholesky). Ordering credit standards last (Lown, Morgan 2002; 2006) or just before the interest rate, Ciccarelli, Maddaloni and Peydró 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 these assumptions are dubious.

The NBP survey is released with a one quarter lag, i.e. in quarter t, the monetary policy committee knows the loan standards and conditions which were applied in $t-1$, thus at a first glance, it seems reasonable to assume that the 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/T&C placed last. However, there are two reasons which may invalidate these arguments.

Firstly, the short-term money market rate may contemporaneously reflect the outcomes of the lending policy conducted by the banking sector. If banks' policy with respect to credit standards and T&C affects the demand for loans or the perception of risk related to future developments in the economy, then the short-term money market rate may adjust instantaneously. Thus, employing a recursive decomposition may lead to significant errors. The recursive decomposition may be used in models with credit standards expected in quarter $t-1$ for quarter t. In such models, expected standards

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

should be placed 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 on 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 bringing a plunge in lending.

Thus, in contrast to the existing literature, we use a non-recursive factorization, which allows simultaneous reactions of standards/conditions and the short-term interest rate (Warsaw Interbank Offer Rate, WIBOR3M). However, because other studies use Cholesky, 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 the use of non-recursive decompositions with respect to credit standards and T&C, which eliminates or at least reduces the problem of a dubious ordering in the Cholesky decomposition. Moreover, in models with the non-recursive decomposition it is possible to impose and test a set of over-identifying restrictions. This brings us closer to identification of true monetary policy and credit supply shocks.

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, Maddaloni and Peydró 2010) treat credit standards as "credit availability", and only together with banks' answers on the strength of their balance sheets they are presumed to depict the operation of the 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 the monetary policy. However, in this paper the problem of demand factors affecting credit standards is alleviated due to our use of 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):

$$AY_t = C(L)Y_{t-1} + Bv_t \qquad (1)$$

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 v_t is a vector of structural disturbances, we can estimate a VAR model as the reduced form of the underlying model:

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

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:

$$Au_t = Bv_t \tag{3}$$

and

$$u_t = A^{-1}Bv_t \tag{4}$$

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 working capital and advances on current account. They are referred to as l_t^{inv}, l_t^{re}, and l_t^{wcca} respectively. 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 the spread between the domestic and a foreign interest rate and because to make the model well-specified, we would have had to introduce the exchange rate. Bearing on mind the shortness of data, we cannot expand our model by two more variables.

WC&CA loans are treated as short-term and therefore are 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 are only available for banks' claims, which contains also other debt instruments besides loans. In our models loans are expressed in real terms. They are calculated using the investment price deflator (2010 = 100). 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, denoted as $i_t^{WIBOR3M}$, as a proxy for the central bank's policy rate.

In the models which are to verify the role of particular credit terms and conditions we use the spread on average loans (*spread$_t$*), the spread on riskier loans (*spread risk$_t$*), non-interest loan cost (*ni cst$_t$*), the 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 the 3-month Euribor and investment in the euro area (12 countries) to pin down close trade and financial interrelationships. 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 use a dummy reflecting the introduction of *de minimis* programme.

What is unusual in our models is clearly the selection of endogenous macroeconomic variables. Usually, they comprise GDP and inflation to capture the 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. The shortness of the data set and an obvious need

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

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 the model as well as 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):

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

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, such as the spread on average loans, the spread on riskier loans, non-interest loan cost, the maximum size of the loan, security and/or collateral, maximum loan maturity. Thus, we build 18 models, 6 for each type of corporate loan. We expect that in response to monetary policy tightening, banks tighten credit standards, terms and conditions accordingly.

To check whether our SVARs are not misspecified as they might lack some variables, in the robustness checks we enlarge our models, adding four variables to the original set of endogenous variables. They come from the SLOOS and are pointed at by banks as factors which drive credit standards. In particular, we employ two variables which approximate risks related to the macroeconomic and industry-specific developments in the real sector, and two variables which approximate risk related to the banking sector: the share of non-performing loans (*npl*) in the credit portfolio and the current and expected capital position of a bank. As before, we use a non-recursive decomposition allowing interest rate and standards react simultaneously. A greater number of variables makes it possible to have equation for loan demand depending not only on the scale variable, i.e. investment, but also on the interest rate. Moreover, in this case we allow lending standards react contemporaneously to investment and risk factors, as in (6).

$$
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 \\
\alpha_{21} & 1 & 0 & \alpha_{24} & 0 \\
\alpha_{31} & \alpha_{32} & 1 & 0 & 0 \\
\alpha_{41} & 0 & 0 & 1 & \alpha_{45} \\
\alpha_{51} & 0 & \alpha_{53} & \alpha_{54} & 1
\end{bmatrix}
\begin{bmatrix}
u_t^{inv} \\
u_t^{inv,\,re,\,wcca} \\
u_t^{risk} \\
u_t^{WIBOR3M} \\
u_t^{std^{i,j}}
\end{bmatrix}
=
\begin{bmatrix}
v_t^{inv} \\
v_t^{inv,\,re,\,wcca} \\
v_t^{risk} \\
v_t^{WIBOR3M} \\
v_t^{std^{i,j}}
\end{bmatrix}
\tag{6}
$$

where "risk" stands either for risk related to macroeconomic developments, industry-specific developments, the *npl* share or the capital position.

Thus, for the robustness check we build 24 new models, allowing lending standards be contemporaneously affected not only by the interest rate, as before, but also by potential risk factors. Naturally, we do it at the cost of losing the degrees of freedom.

Estimations have been performed using two lags, on the 2003Q4-2016Q3 sample.[8] The information criteria (Schwarz, Akaike) usually showed one or two lags; choosing the number of lags, we have also considered the serial correlation of residuals and their distribution. In graphs throughout the paper, an increase in credit standards or credit terms and conditions means the tightening of lending policy. Details on sources and the construction of variables can be found in Table 1.

5 Estimation results

Figures from 5 through 15 plot the main results – impulse response functions (solid lines) and standard error bands (dashed lines). Due to space limits, Figure 15 plots only the impulse response functions (IRFs) of credit terms to monetary policy shocks obtained from models with investment loans. However, the ones coming from models employing WC&CA loans and loans for real property acquisition are similar.[9] A dummy for the *de minimis* programme has been found statistically significant in the case of short-term loans to SMEs, however, the obtained IRFs to shocks to the interest rate as well as to the variables reflecting the credit policy of banks, remain broadly the same. Results from Cholesky decomposition are shown in Figures from 16 through 23, results from the structural decomposition obtained from the enlarged models are depicted in Figures 24–27. In all figures the horizontal axis is for time horizon in quarters.

5.1 Responses to interest rate innovations

The impulse response functions show that after monetary policy 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 the 3rd to the 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.

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 interest rate shock, the maximum reaction is in the 4th–5th quarter and since then standards are gradually softened. Some lending terms and conditions, i.e. the spread on loans for riskier borrowers and the required collateral, display a similar lagged reaction pattern, whereas the average spread, non-interest rate cost, maximum maturity and maximum size are tightened at once. Either instantaneous or lagged impact of monetary policy shocks on credit standards and T&C (and in particular on the required collateral, maximum

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[8] Some estimations in the robustness checks were performed with 1 lag.

[9] 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.

maturity and the size of 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 it easier to compare reactions of standards for LEs and SMEs to monetary policy shocks, we generated IRFs to a standardized shock equal to 1 pp. of WIBOR3M (Figure 11).[10] Standards applied on long-term loans for SMEs react somewhat stronger than those for LEs. Monetary tightening by 1 pp. increases by 20–24 pp. the net fraction of banks tightening lending standards on long-term loans to SMEs, whereas the respective figures for standards on long-term loans to LEs range from 12 pp. to 15 pp. As shown in Figure 11, confidence intervals of ±1 standard error for IRFs of standards for LEs do not embrace IRFs 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 larger responsiveness of standards for long-term loans for SMEs. The 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 the net fraction tightening increases by 11 pp. with respect to LEs and 16 pp. in the case of SMEs. However, the respective IRF for SMEs practically rests on the upper line of the ±1SE confidence interval for the IRF for LEs. This leads us to the rejection of the hypothesis that standards on short-term loans to SMEs react stronger than those on loans to LEs. Thus, monetary tightening/softening affects SMEs more than LEs in the segment of long-term loans alone. The underlying reason is most probably the higher risk which is attributed to the long-term in comparison to short-term lending.

Monetary policy shocks have an influence on private investment, loans for real property acquisition and WC&CA, whereas the reaction of investment loans to interest rate innovations is not significant. Private investment reacts to 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, which probably means that firms continue financing working capital in spite of higher cost. It is worth noting that if real wages are rigid, which would prevent demand from affecting marginal costs in the short-run, such behaviour of short-term loans may trigger the cost channel.

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

The typical shock to long-term standards for LEs and SMEs amounts to an 16 and 18 pp. increase in the net fraction tightening, while to short-term standards to an 12 and 21 pp. increase, respectively. Innovations to credit standards affect investment loans to LEs and less palpably those to SMEs (this reaction is only close to the statistical significance, especially in the 3rd quarter after the shock). In contrast to responses of loans to 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 elicit 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 WC&CA financing. These types of loans are rather under the influence of the interest rate.

Shocks to 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, the tightening of collateral

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[10] These are standardized IRFs from Figures 5–10. As before, in the simulation we abstract from the possible nonlinearities.

and the spread on loans for riskier borrowers tends to reduce loans for investment; shocks to collateral and maximum maturity temporarily 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 the *de minimis* package as a supplementary "collateral". To save space, in the graphs we present solely the results which are statistically significant.

The typical shock to spread on loans for riskier borrowers reduces investment loans more and for longer than a shock to collateral (Figure 12). Credits for real property acquisitions seem to remain unaffected by shocks to credit terms.

In general, in 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; 2006) for the US and Couallier (2015) for the euro area. There is no evidence in 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 banks' demand 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 the credit tightening of the banking sector.

Interestingly, while models with investment and WC&CA loans generally give intuitive impulse responses to shocks to credit terms, this is not the case with loans for real property acquisition. They display a "credit puzzle" after innovations to the spread on loans for the riskier borrowers and to the maximum size (they are not shown in the paper). Only shocks to maturity bring about a small, short-lived drop in loans for real property acquisition. This is not due to 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 interest rate shocks on lending standards in Cholesky decompositions is similar to the impact of shocks from non-recursive factorizations, i.e. (i) monetary policy shocks impact credit standards and amplify the effects of monetary policy, and (ii) standards on loans to SMEs react somewhat stronger than those on loans to LEs. A considerable difference is, however, observed in reactions of credit terms and conditions. This difference applies to those T&C which in the non--recursive decompositions react to monetary policy shocks immediately (average spread, non-interest rate cost and maximum maturity). Responses of private investment and loans to interest rate shocks are similar in both decompositions (Figures 16–23). To save 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 and T&C. Some responses of private investment and loans to lending standards which were insignificant in the non--recursive decompositions, are significant in the Cholesky factorization. This is the case of responses of private investment to shocks to standards on long-term and short-term credits to SMEs, and on the short-term loans to 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 credit terms. In fact in many cases the interest rate increases. This happens in the models with short-term credits following shocks to spread, the spread on loans for the riskier borrowers, the required collateral and maximum maturity. This leads to dissimilar reactions of private investment and loans. Moreover, private investment seems to fall after the tightening of such T&C as the spread on average loans and maximum maturity, while in the non-recursive decompositions investment remained unaffected. As mentioned before, models with loans for real property acquisition display the same puzzle as models with non-recursive factorization.

5.4 Robustness checks

To some extent, recursive decompositions may be treated as a robustness check. As discussed above, they bring similar results with regard to the impact of interest rate shocks on lending standards and terms and conditions, but in some cases differ with respect to reactions of the interest rate to shocks to T&C and reactions of loans to such shocks.

The results of robustness checks obtained from models as in (6) generally support the conclusion that monetary policy tightening shocks lead to tightening of banks' lending policy. Only 3 out of 24 obtained IRFs of standards to monetary policy shocks are not statistically significant; the rest is significant (at impact or with a lag); they are displayed in Figures from 24 through 27. Impulse responses which are not significant are observed for some models with short-term loans (WC&CA). Thus, we conclude that the evidence that monetary policy shocks have an impact on banks' lending policies is fairly robust. This impact is more visible in the reactions of standards for long-term loans than for short-term loans. Moreover, as in models with 4 endogenous variables, after monetary policy tightening standards for SMEs react somewhat more than for LEs.

Besides, we have performed estimations employing the consumer price index (CPI) and a bilateral EUR/PLN exchange rate as 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 monetary policy shocks, the latter to take into account the fact 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. These two changes had only a minor impact on the obtained results. Namely, in some cases the inclusion of consumer prices slightly speeded up the return of loans to the baseline. However, neither prices nor the exchange rate solved the problem of credit puzzles obtained in models with loans for real property acquisition.

Another set of robustness checks was aimed at checking whether shocks to WIBOR3M are indeed monetary policy shocks and do not contain changes of the interbank rate due to turbulent financial markets or any other reasons that might explain changes in WIBOR residuals. With this aim in mind we replaced the WIBOR3M rate with POLONIA,[11] i.e. the index of overnight interbank loans. The results are robust: shocks to the POLONIA reference rate move lending standards in a statistically significant way. The same applies to the reactions of credit T&C.

Finally, we applied a dummy for the *de minimis* programme. The results remained broadly the same.

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[11] POLONIA index has been in use only since February 2005. To save observations from 2003–2005, we have complemented the missing POLONIA observations with WIBOR O/N, the interbank rate which is the closest to POLONIA.

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 monetary transmission.

Our estimates suggest that the lending 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 on loans for real property acquisition. Only the 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 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, the reactions of standards on short-term loans for LEs and SMEs are similar, presumably due to lower risk related to short-term than to the long-term lending.

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Acknowledgements

Appendix

Figure 1

Credit standards, T&C, and loans extended to the corporate sector (CS)
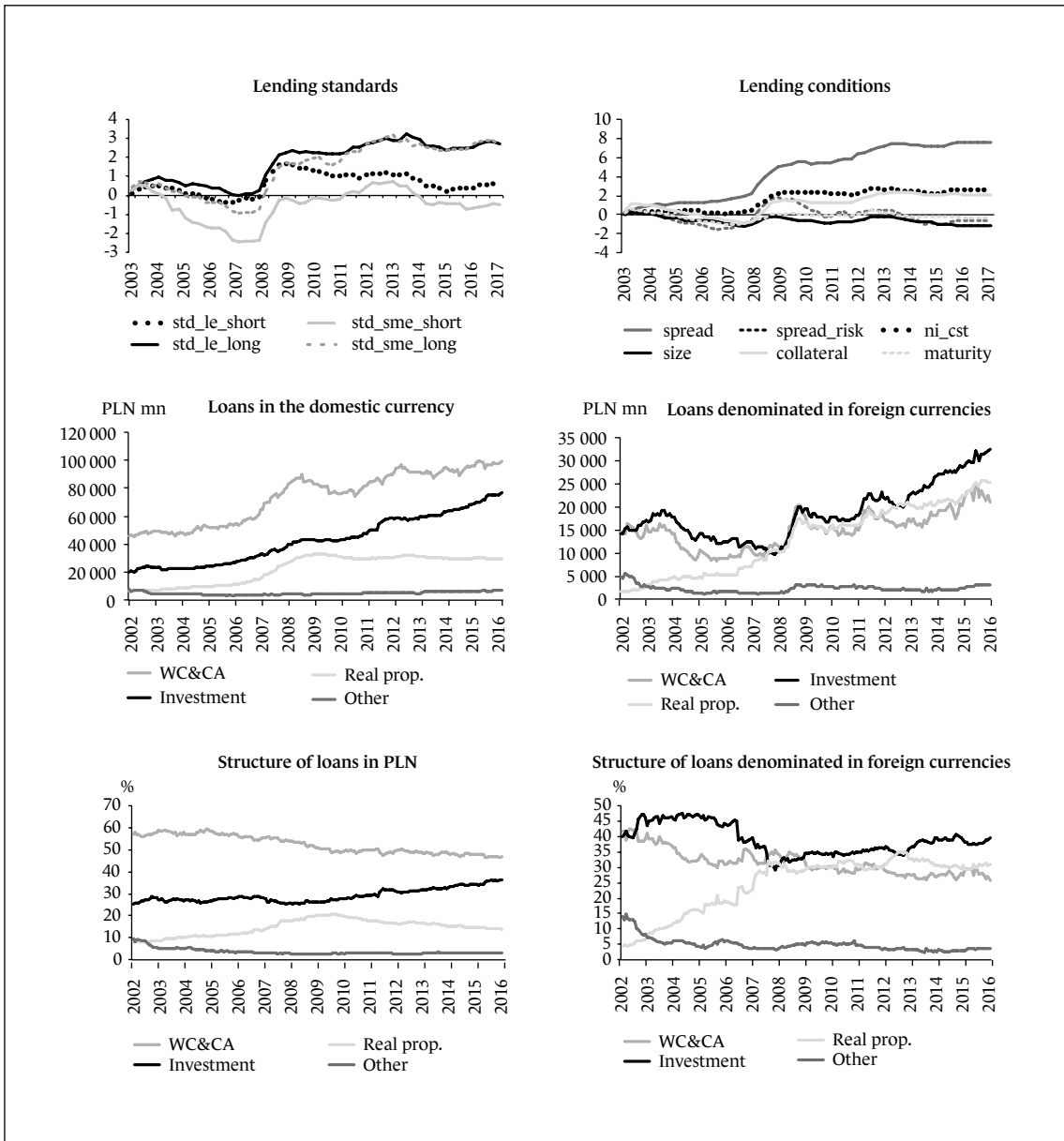
Notes:

Cumulated standards (↓ = softening), upper LH panel cumulated T&C (↓ = softening), upper RH panel; loans in PLN (middle LH panel) and in foreign currencies (middle RH panel); shares of various loans in total loans to the CS in PLN in % (LH lower panel) and in foreign currencies (RH lower panel).

Source: NBP.

Figure 2

WIBOR 3M short-term interest rate and CPI inflation y/y
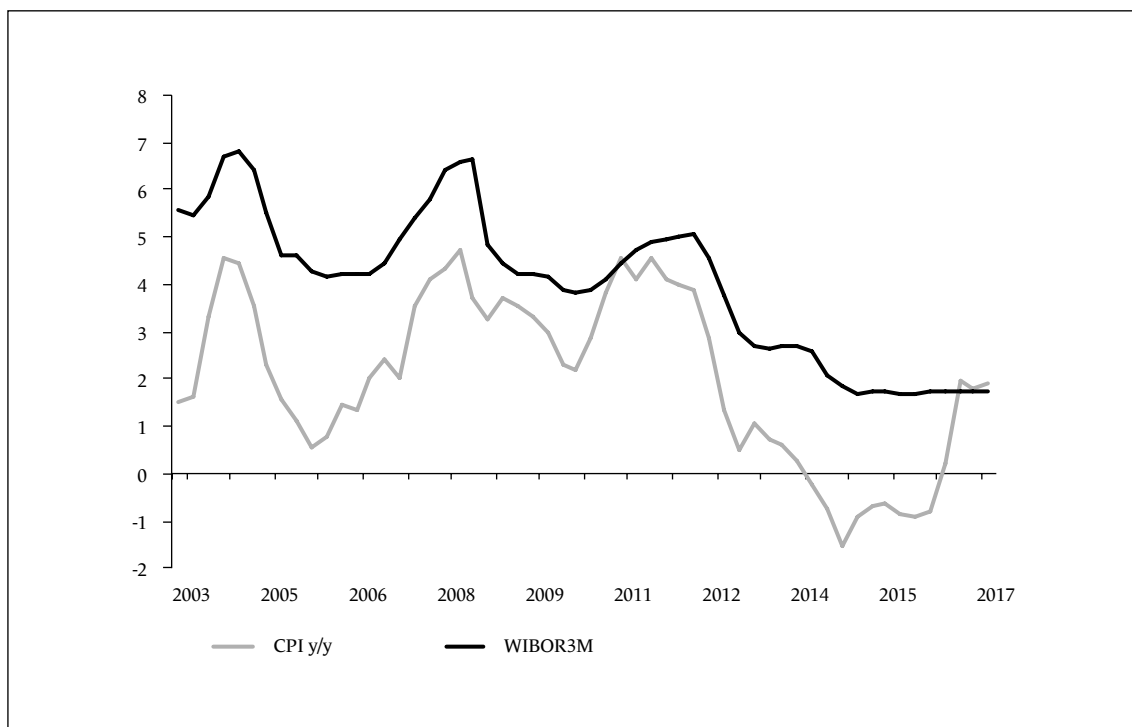
Source: GUS, Reuters.

Figure 3

Structure of bank claims on LEs and SMEs
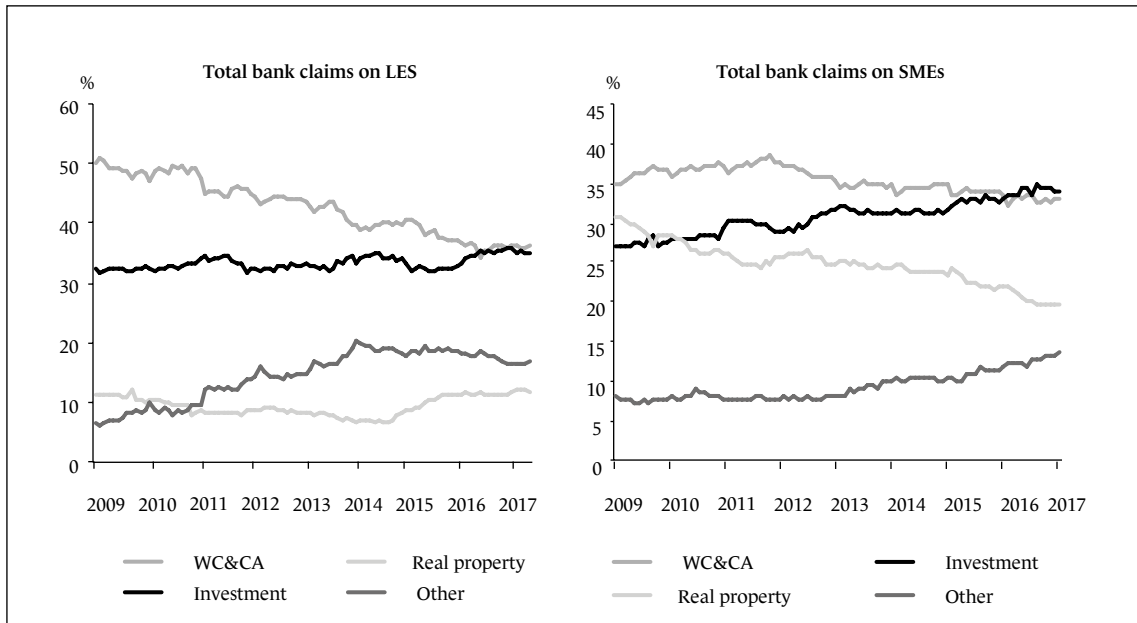
Source: Polish Financial Supervision Authority.

Figure 4

Share of SMEs in the total amount of banking sector claims on the corporate sector
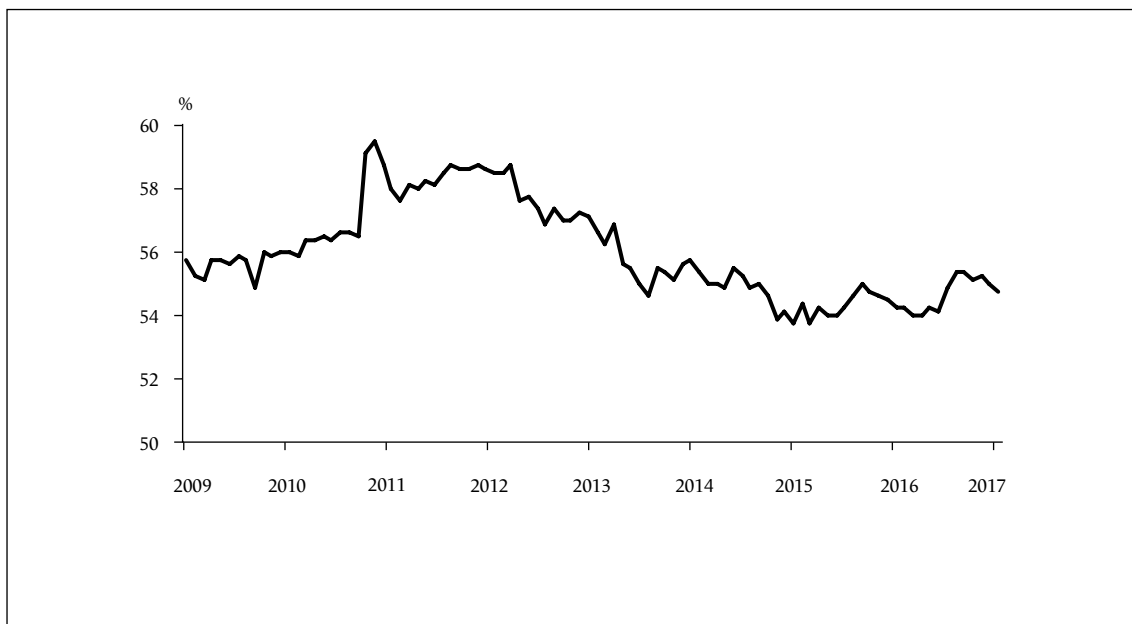
Source: Polish Financial Supervision Authority.

Figure 5

IRFs to a one S.D. structural shock to WIBOR 3M and long-term standards for LEs, model with investment loans
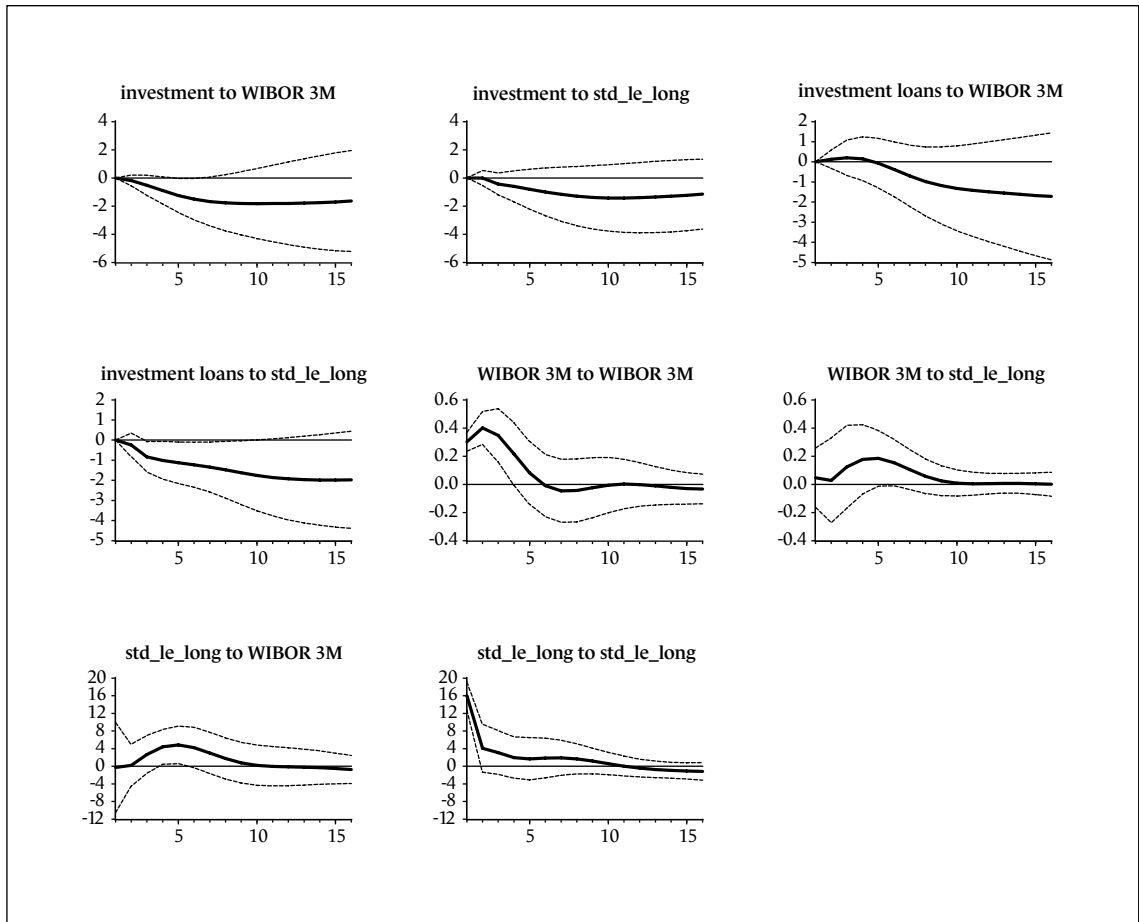
Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.
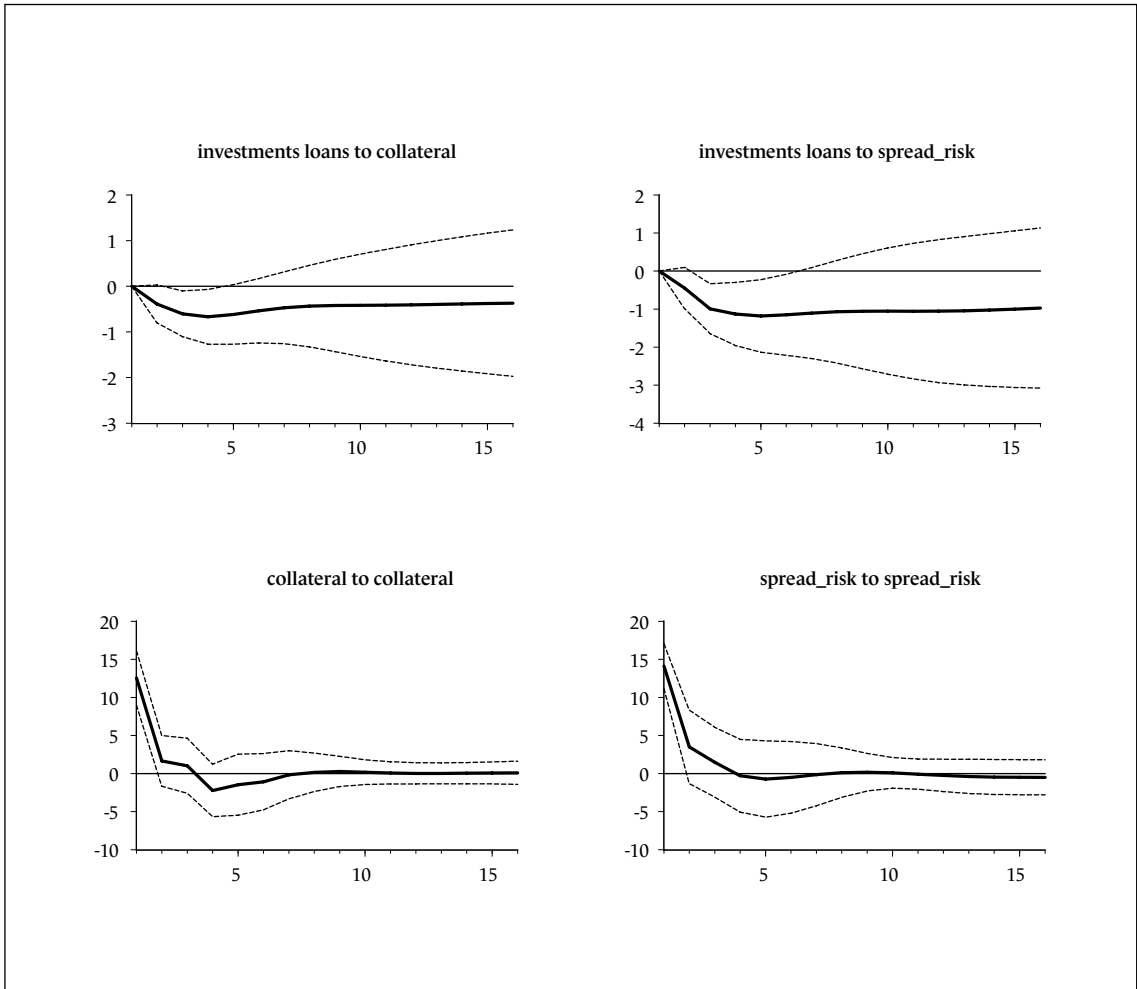
Figure 6

IRFs to a one S.D. structural shock to WIBOR 3M and long-term standards for SMEs, model with investment loans
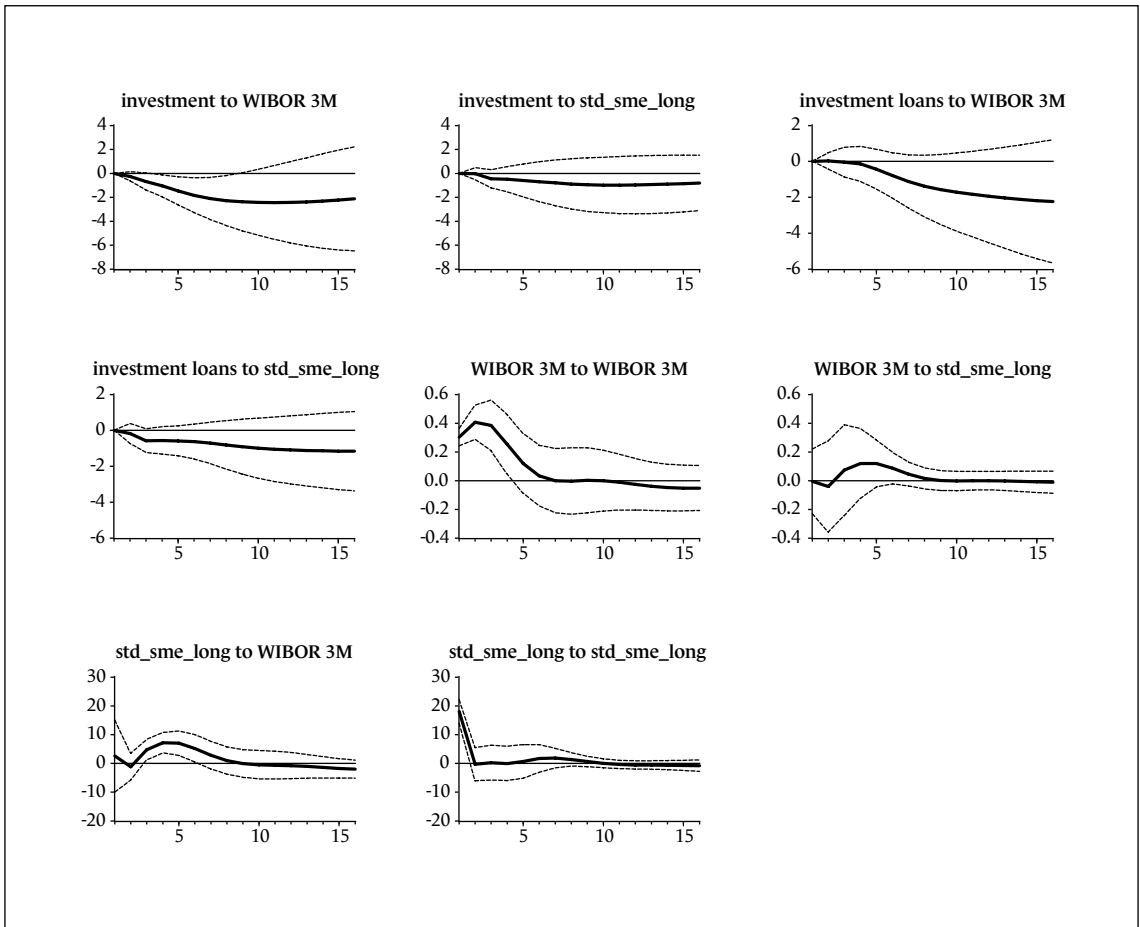
Note: reactions of investment and loans are in per cent, those of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.

Figure 7

IRFs to a one S.D. structural shock to WIBOR 3M and short-term standards for LEs, model with WC&CA loans
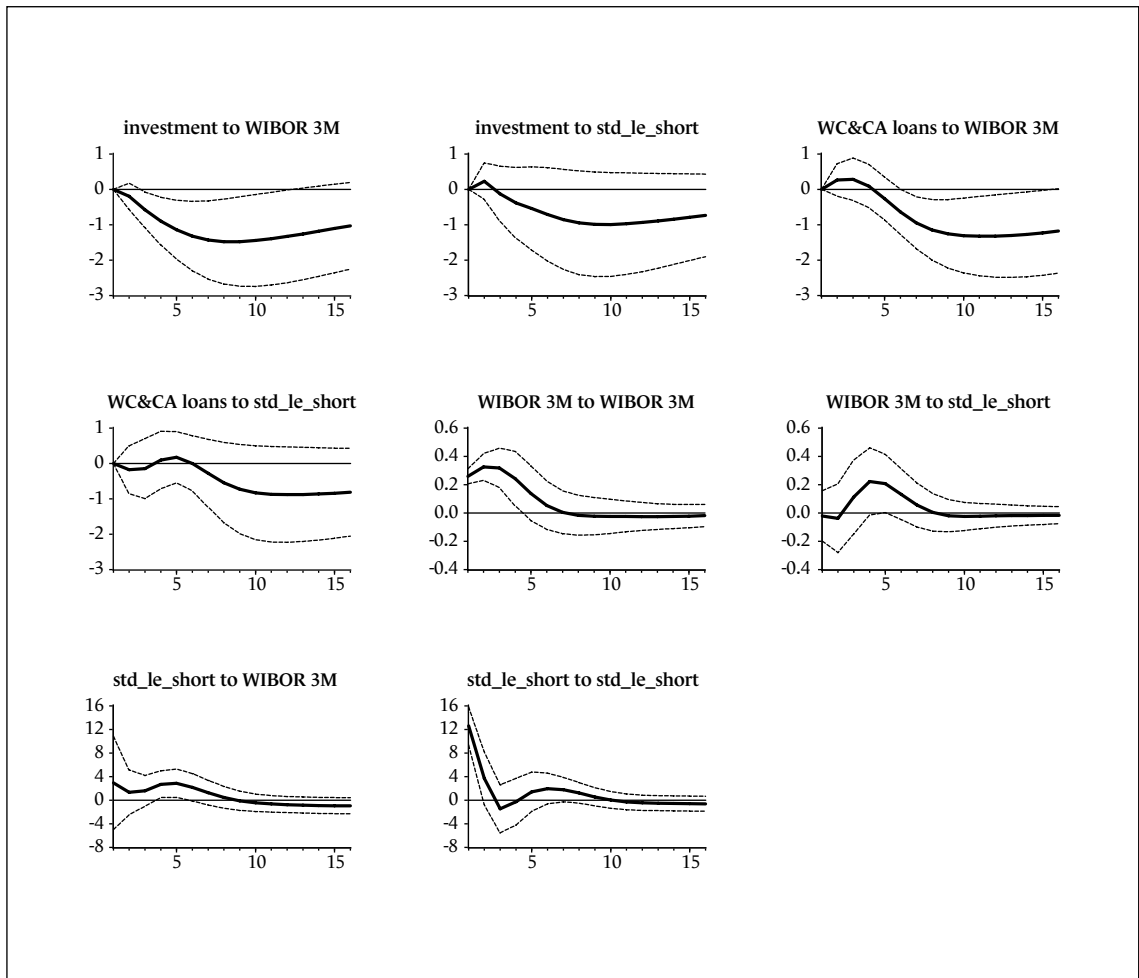
Note: reactions of investment and loans are in per cent, those of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.

Figure 8

IRFs to a one S.D. structural shock to WIBOR3M and short-term standards on SMEs, model with WC&CA loans
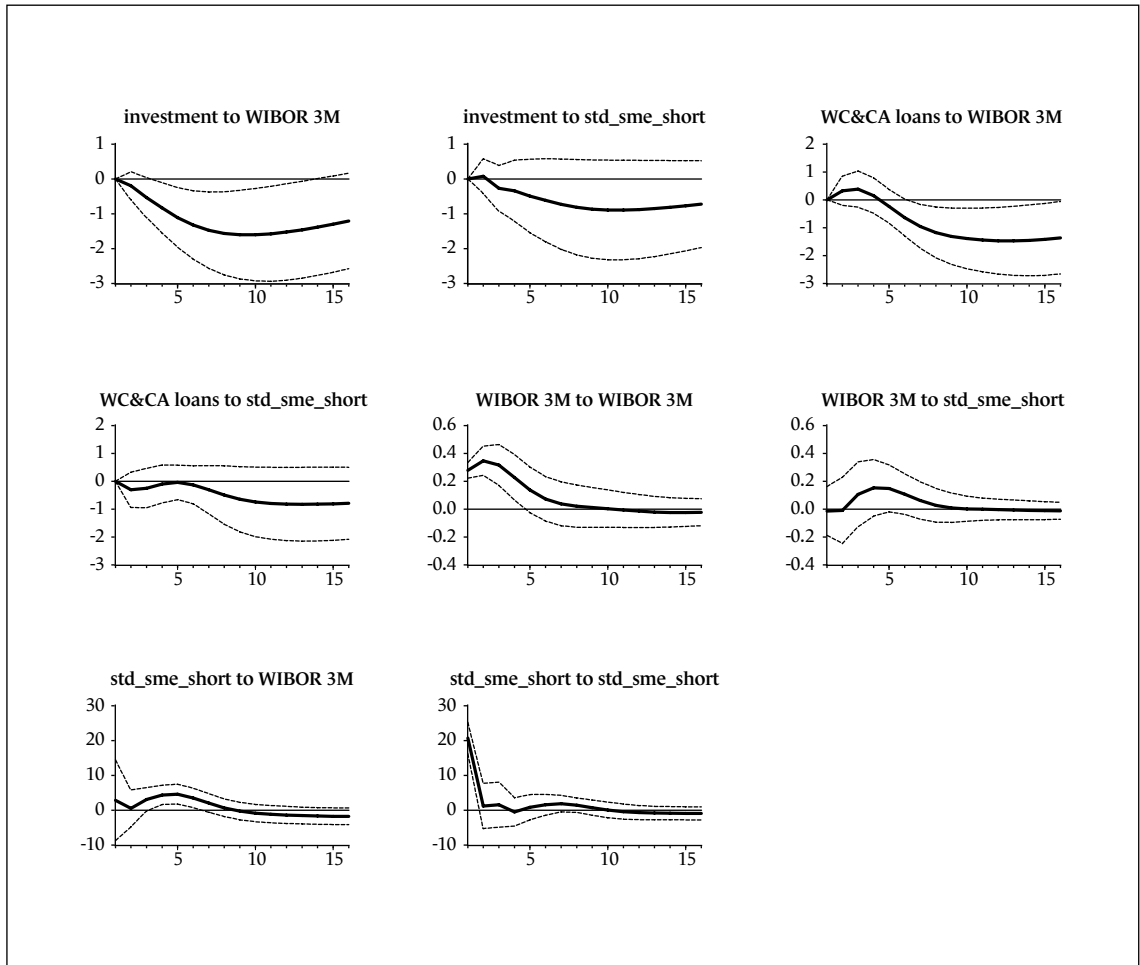
Note: reactions of investment and loans are in per cent, those of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.

Figure 9

IRFs to a one S.D. structural shock to WIBOR 3M and long-term standards for LEs, model with loans for real property acquisition
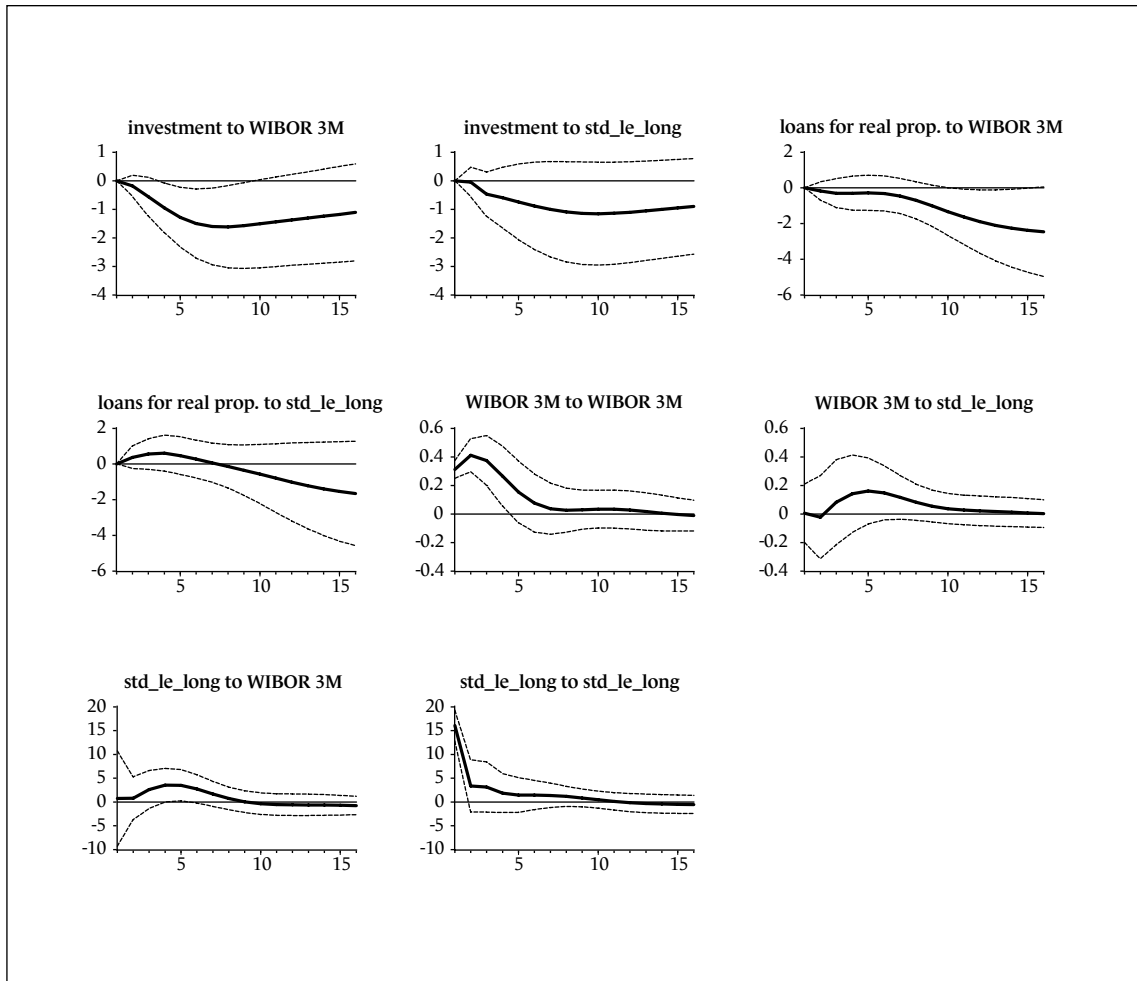
Note: reactions of investment and loans are in per cent, those of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.

E. Wróbel

Figure 10

IRFs to the structural one S.D. shock to WIBOR 3M and long-term standards for SMEs, model with loans for real property acquisition
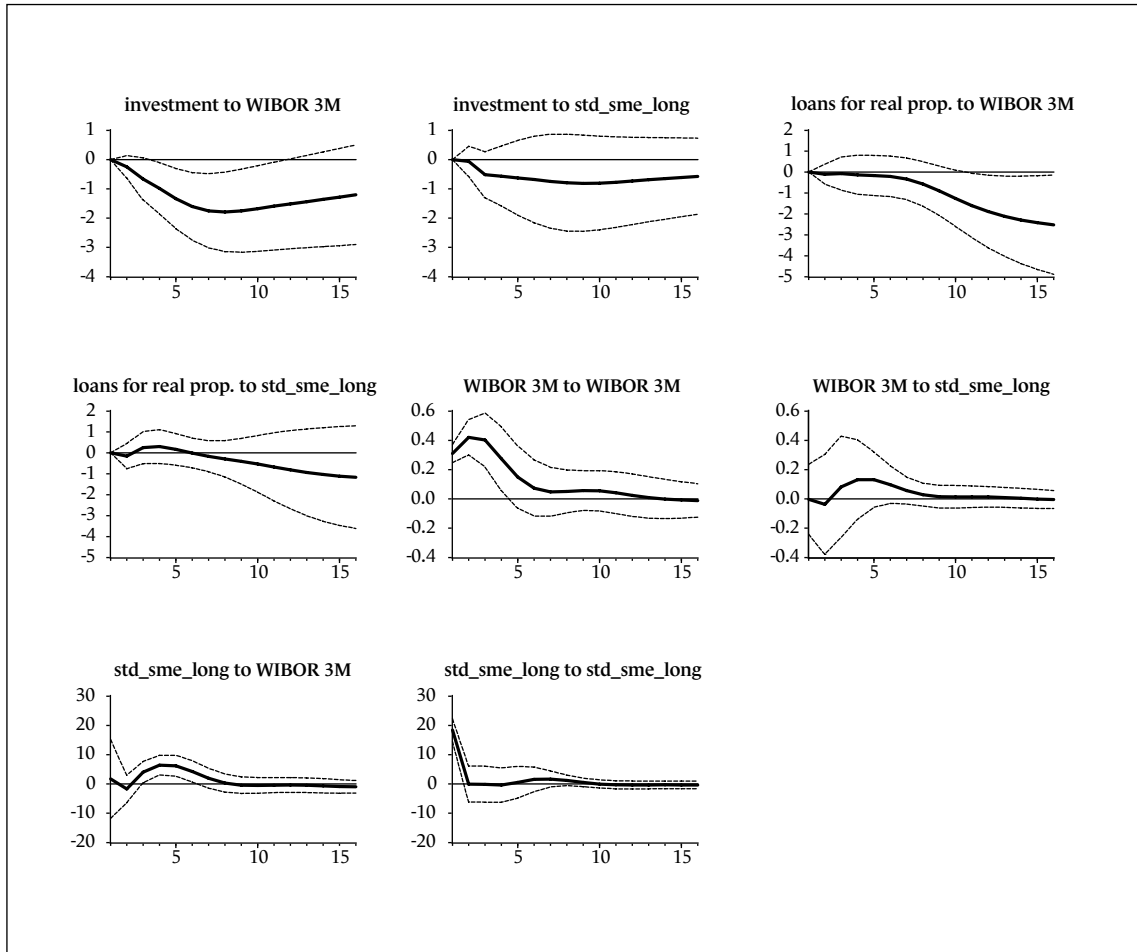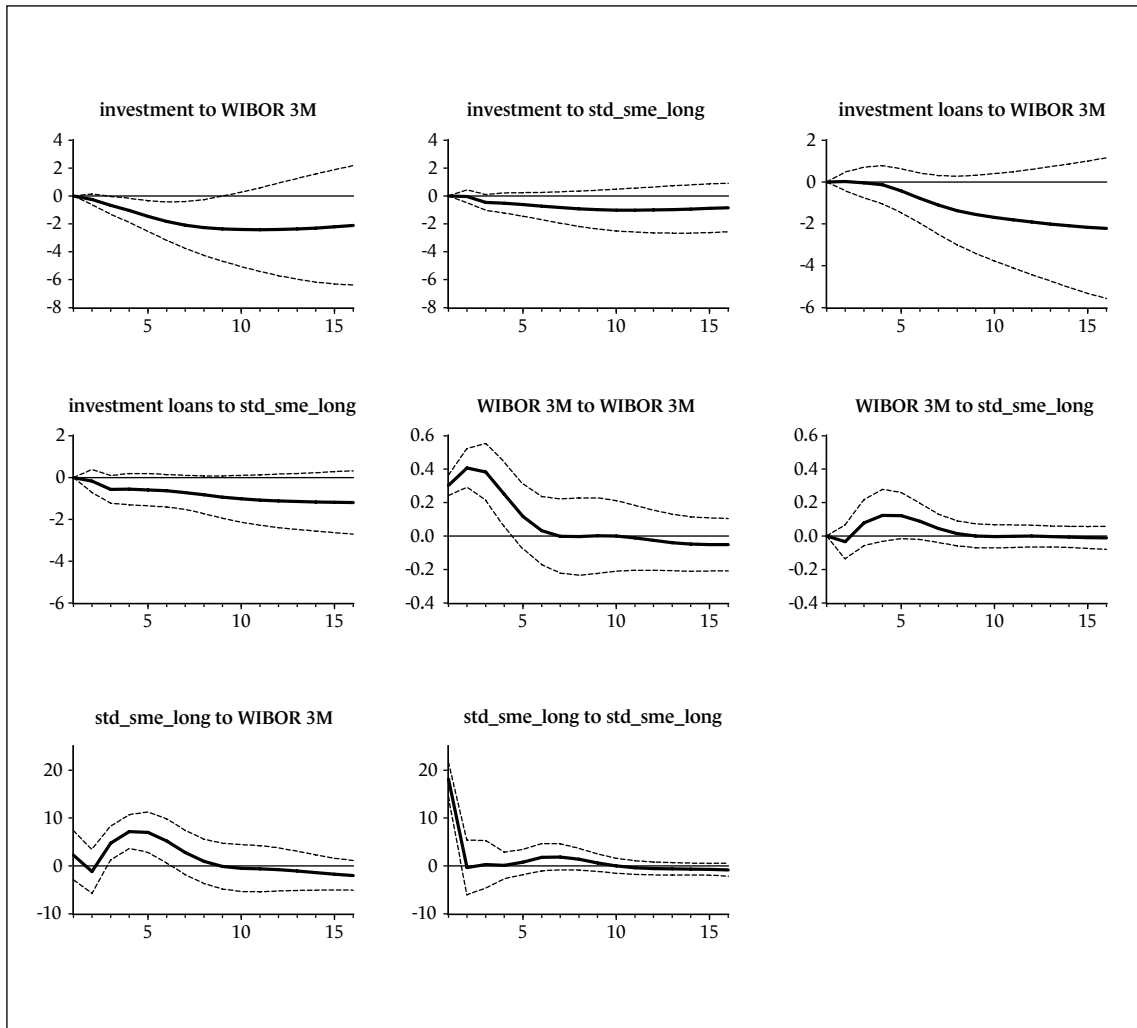

Note: reactions of investment and loans are in per cent, those of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.
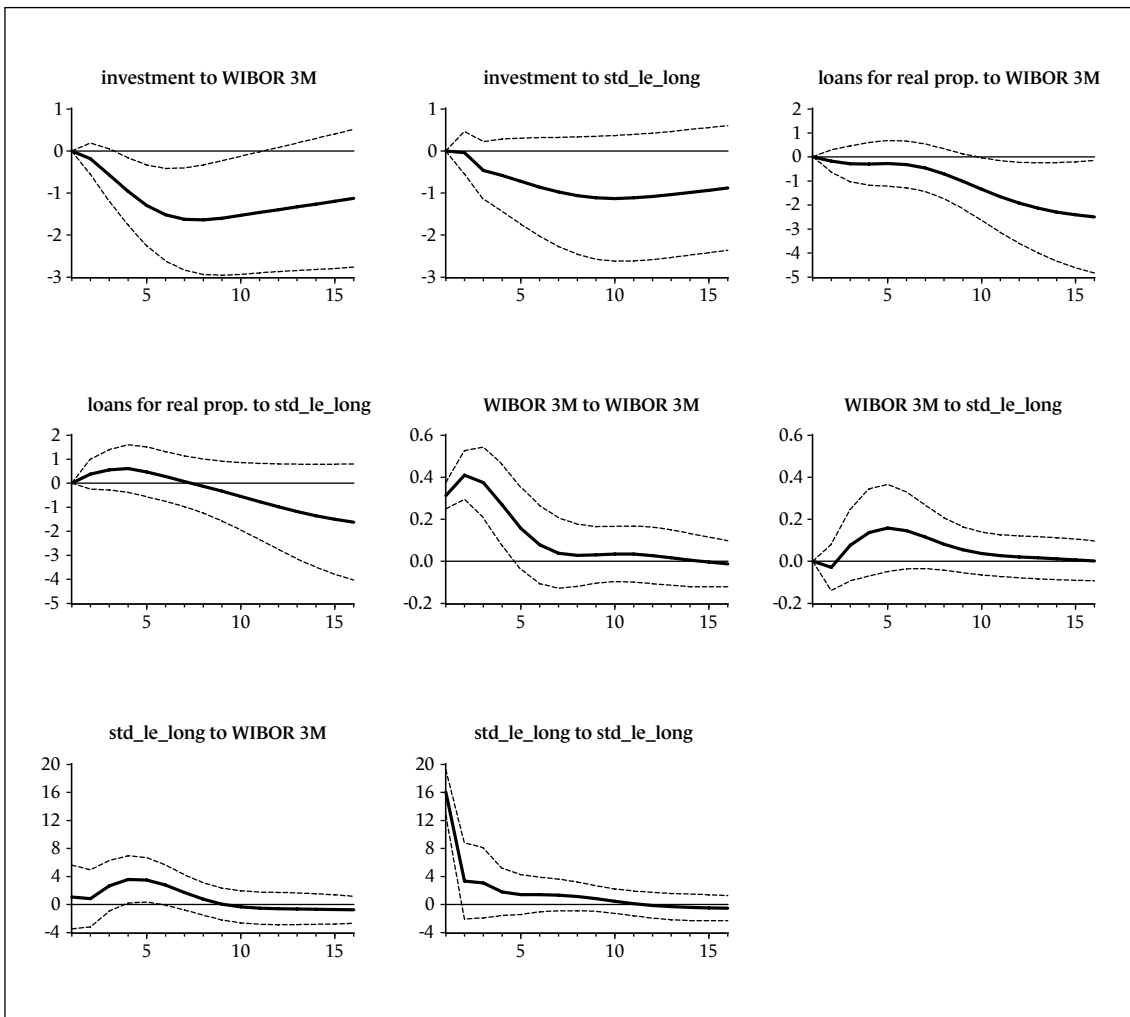
Figure 11

A zoom on IRFs of loan standards for LEs and SMEs to a 1 pp. structural shock to WIBOR 3M rate
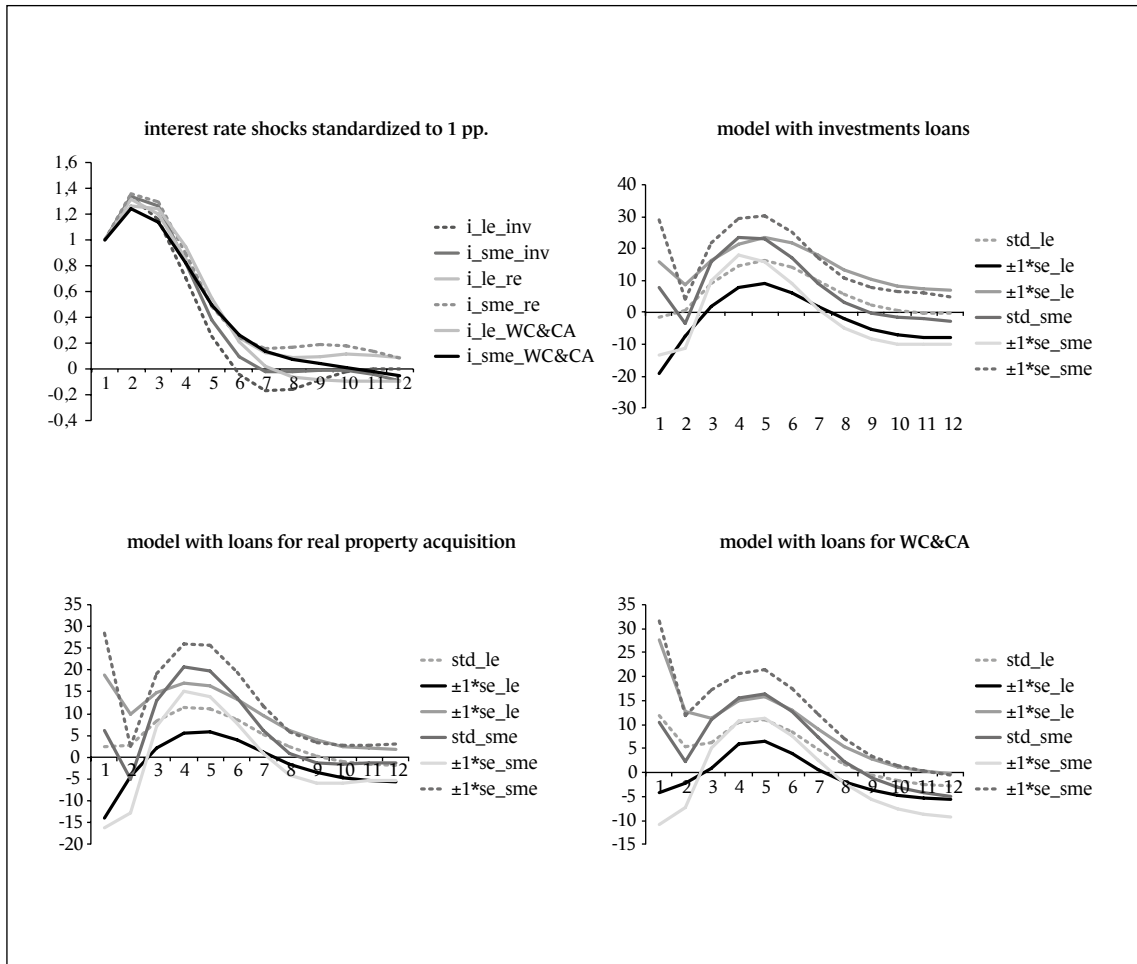
Note: all reactions are in percentage points.

Figure 12

IRFs of investment loans to a one S.D. structural shock to the required collateral (left-hand panel), and to spread for riskier borrowers (right-hand panel)

Note: reactions of loans are in per cent, those of lending T&C are in percentage points. Dotted lines show 95% confidence intervals.

Figure 13

IRFs of WC&CA loans to a one S.D. structural shock to maximum maturity (left-hand panel) and to the required collateral (right-hand panel)
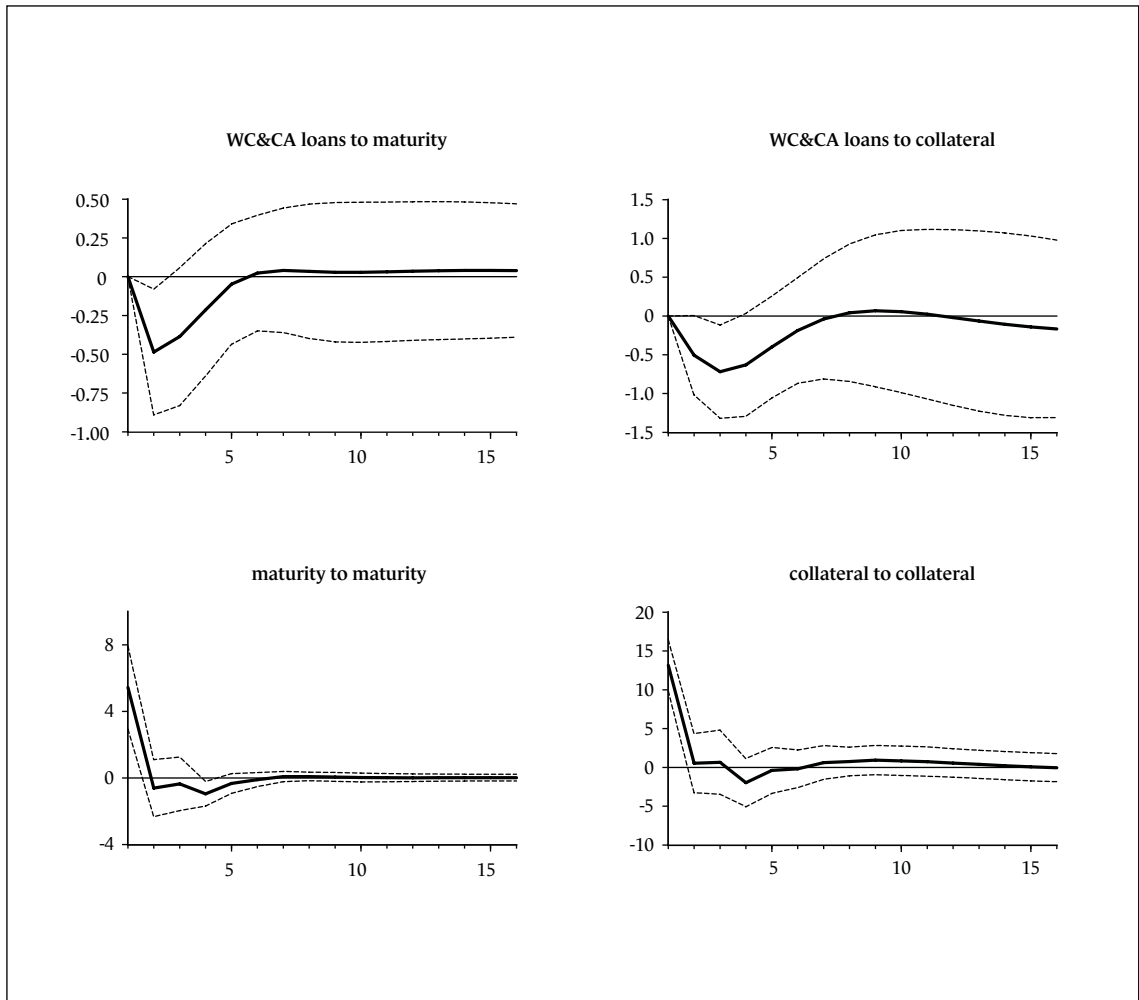
Note: reactions of loans are in per cent, those of lending T&C are in percentage points. Dotted lines show 95% confidence intervals.

Figure 14

IRF of loans for real property acquisition to a one S.D. structural shock to maximum maturity
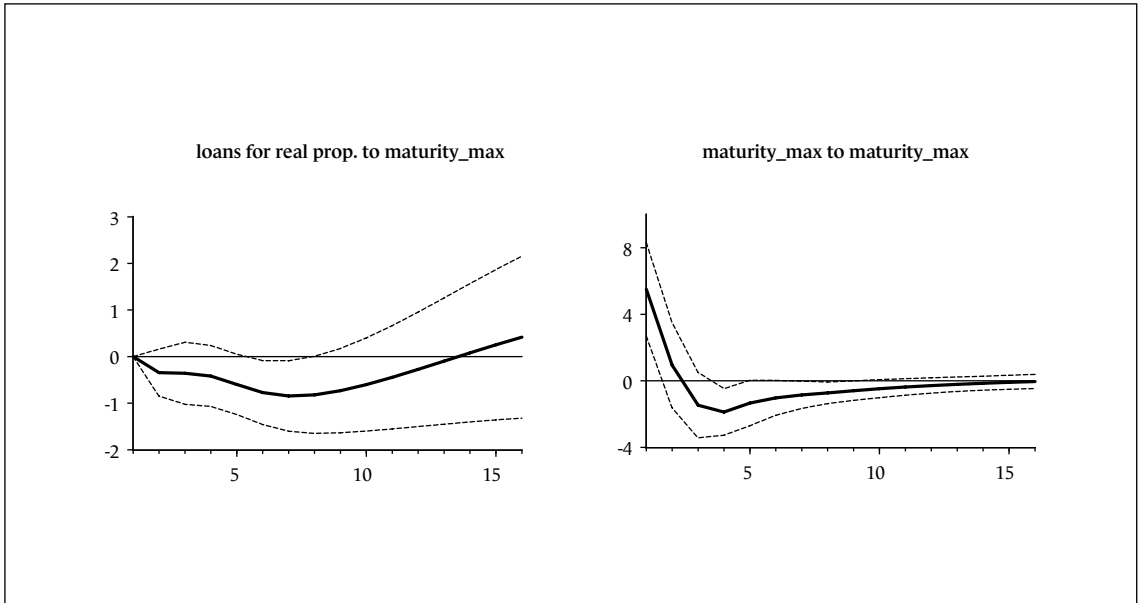
Note: reactions of loans are in per cent, those of lending T&C are in percentage points. Dotted lines show 95% confidence intervals.

Figure 15

A zoom on IRFs of credit terms and conditions to a 1 pp. structural shock to WIBOR3M, obtained from models with investment loans
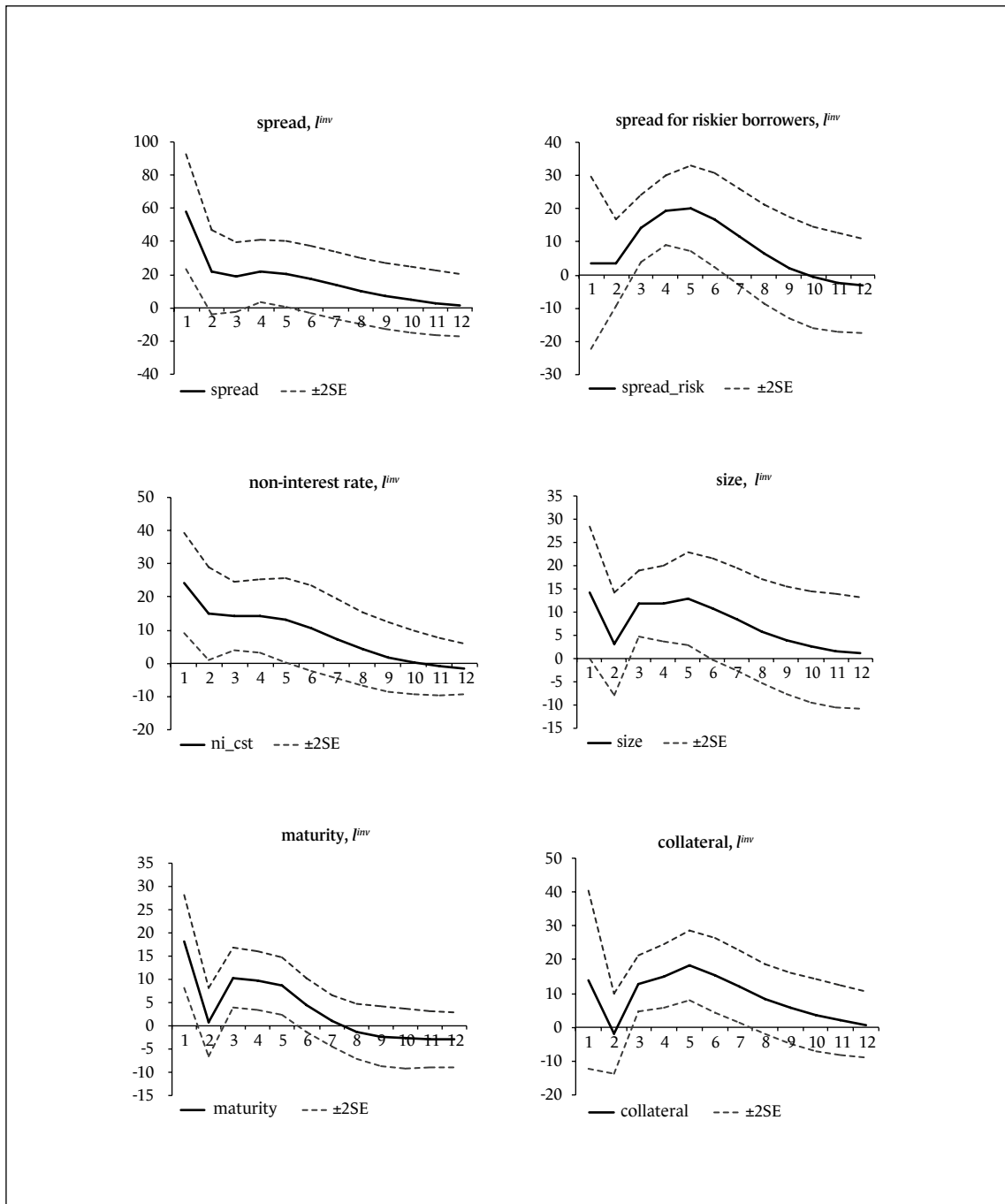
Note: reactions of T&C are in percentage points.

Figure 16

IRFs to one S.D. shocks to WIBOR 3M and to standards for LEs on long-term loans (model with investment loans, Cholesky decomposition)
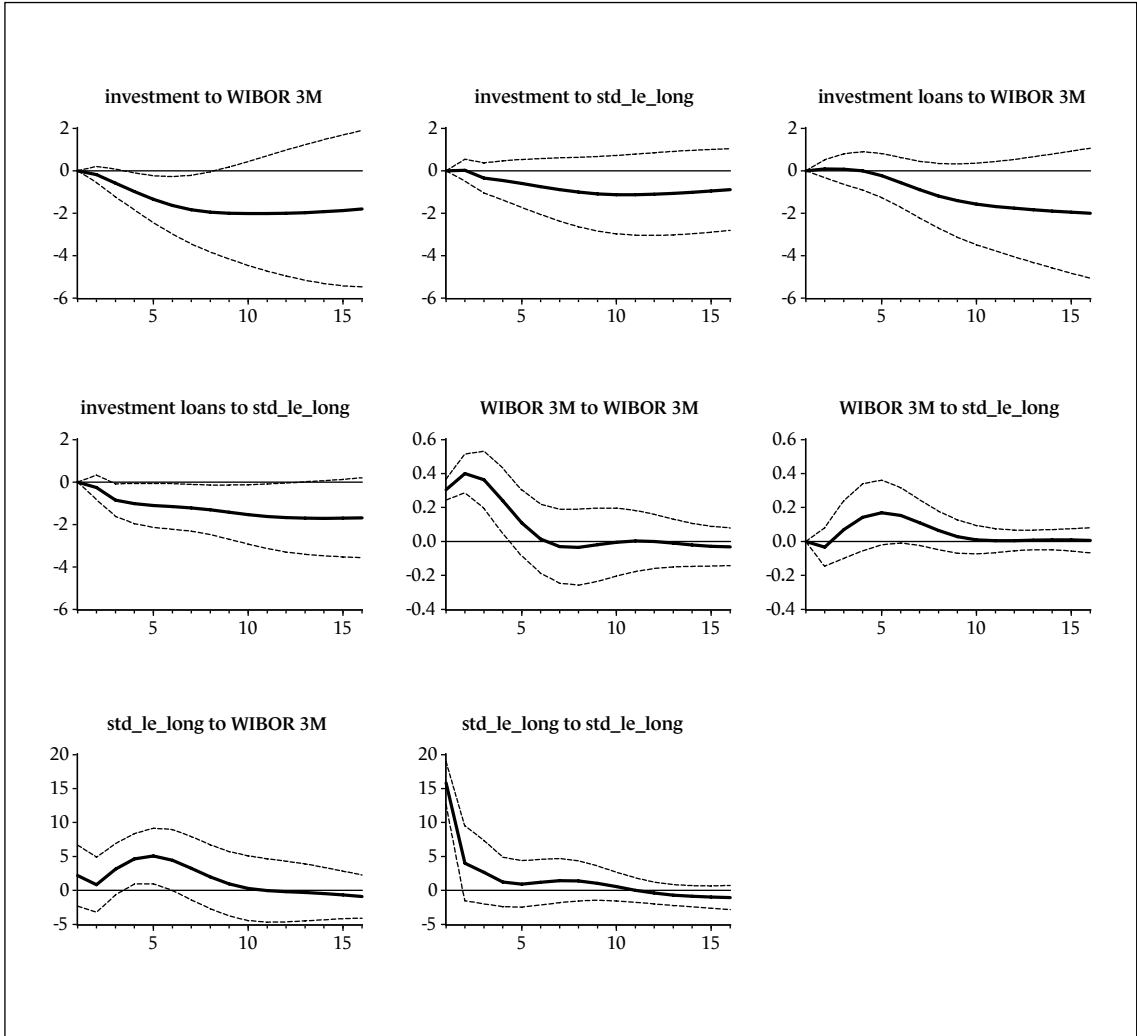
Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.
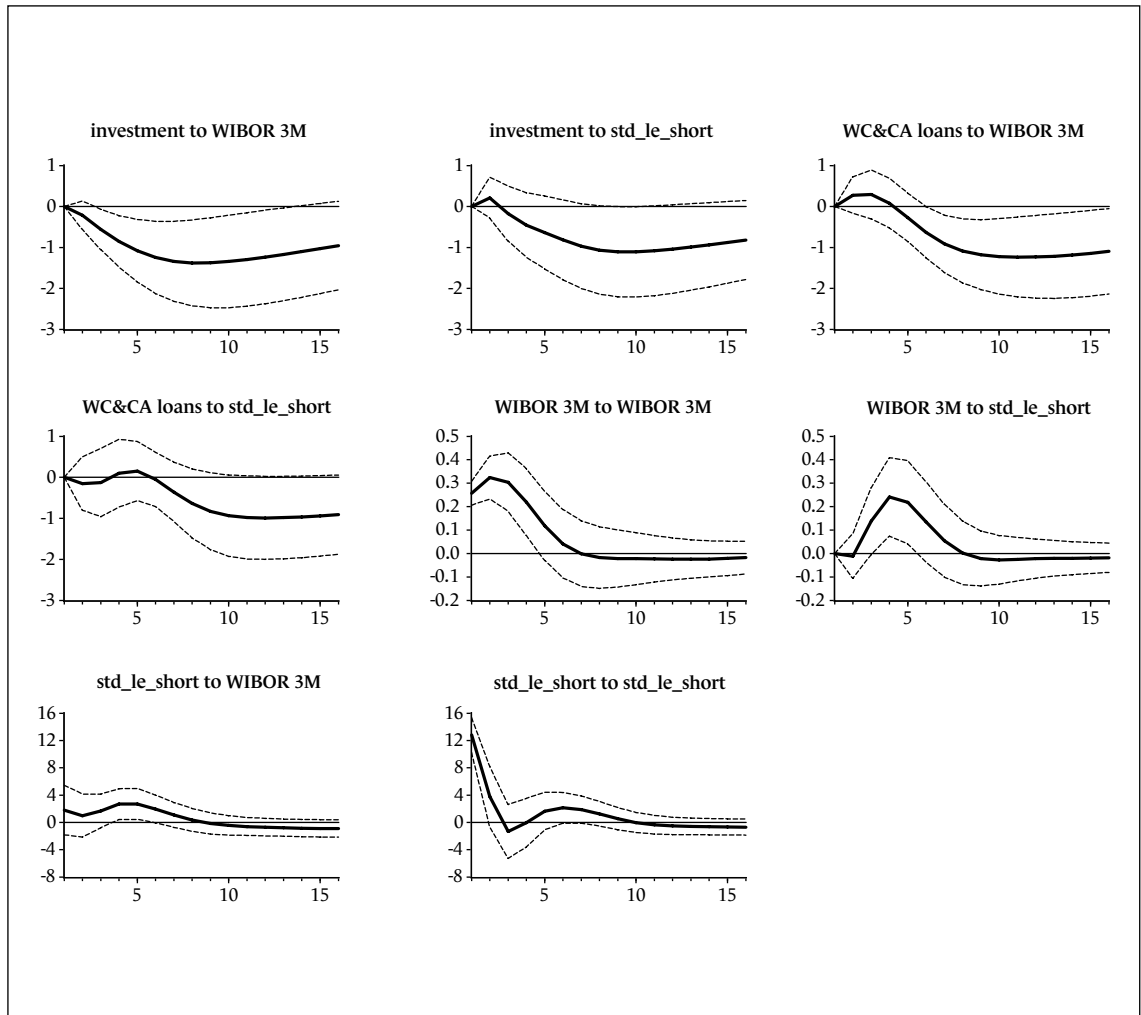
Figure 17

IRFs to one S.D. shocks to WIBOR 3M and to standards for SMEs on long-term loans (model with investment loans, Cholesky decomposition)

Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.
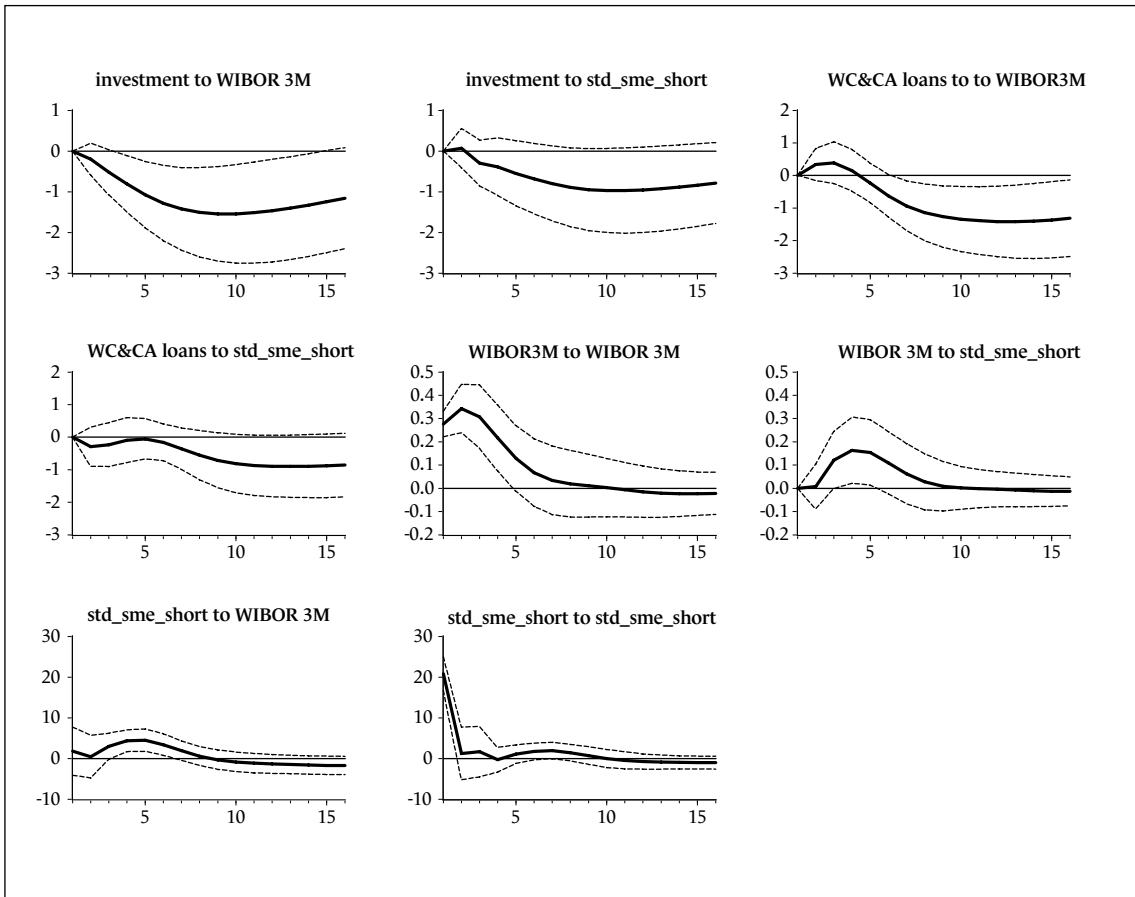
Figure 18

IRFs to one S.D. shocks to WIBOR 3M and to standards for LEs on long-term loans (model with loans for real property acquisition, Cholesky decomposition)

Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.

Figure 19

IRFs to one S.D. shocks to WIBOR 3M and to standards for SMEs on long-term loans (model with loans for real property acquisition, Cholesky decomposition)
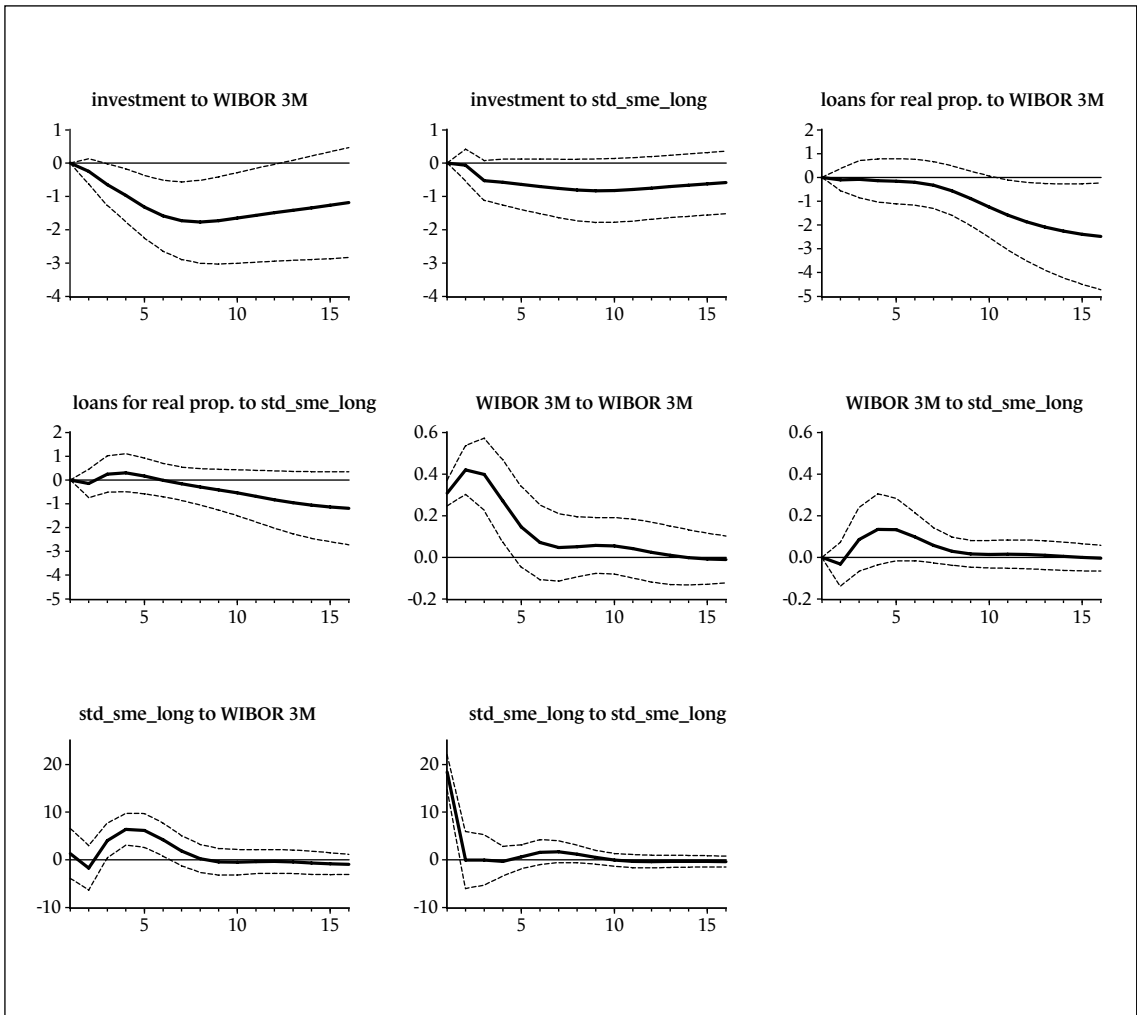
Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.
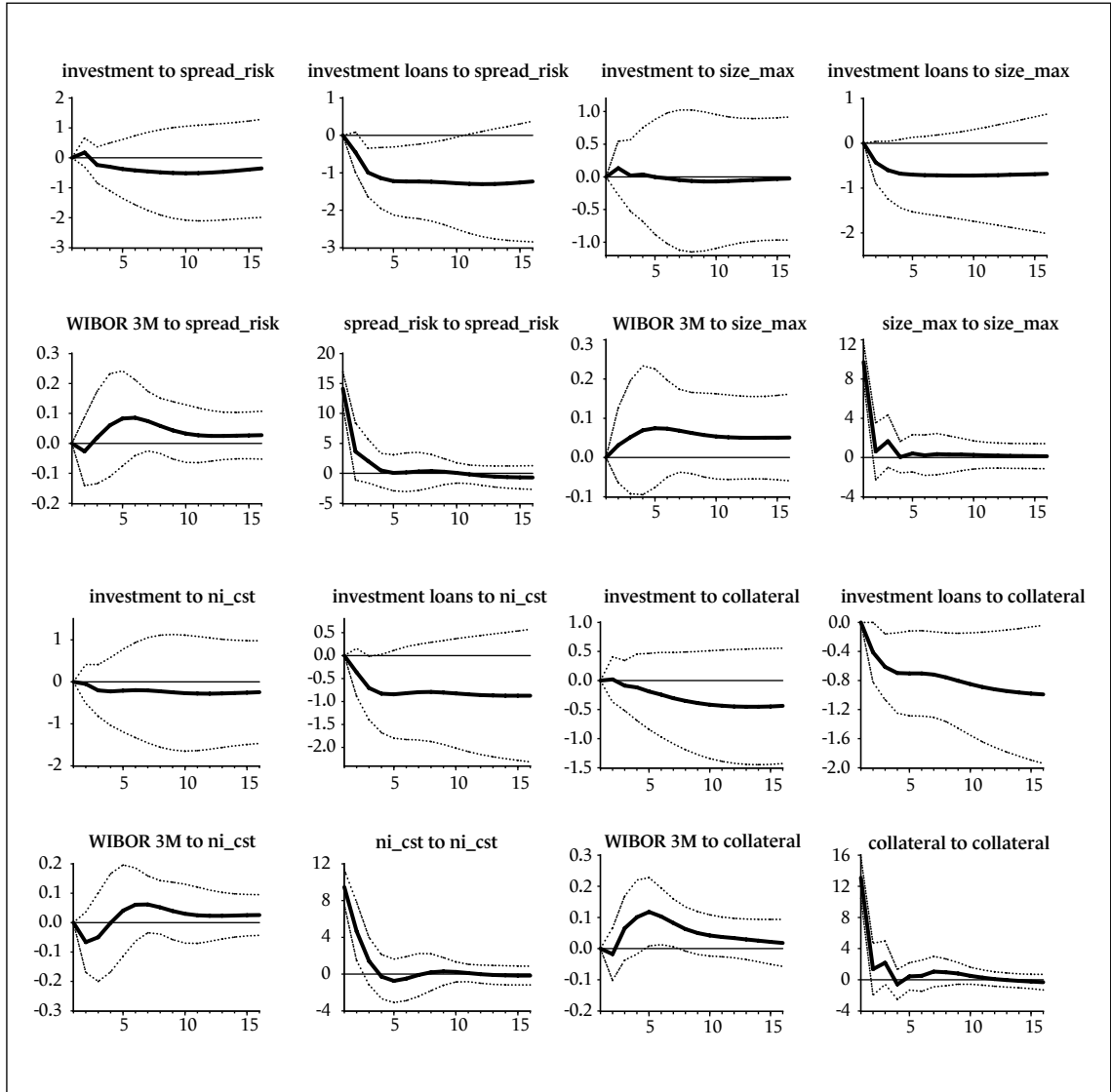
Figure 20

IRFs to one S.D. shocks to WIBOR 3M and to standards for LEs on short-term loans (model with WC&CA loans, Cholesky decomposition)

Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.

Figure 21

IRFs to one S.D. shocks to WIBOR 3M and to standards for SMEs on short-term loans (model with WC&CA loans, Cholesky decomposition)

Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending standards are in percentage points. Dotted lines show 95% confidence intervals.
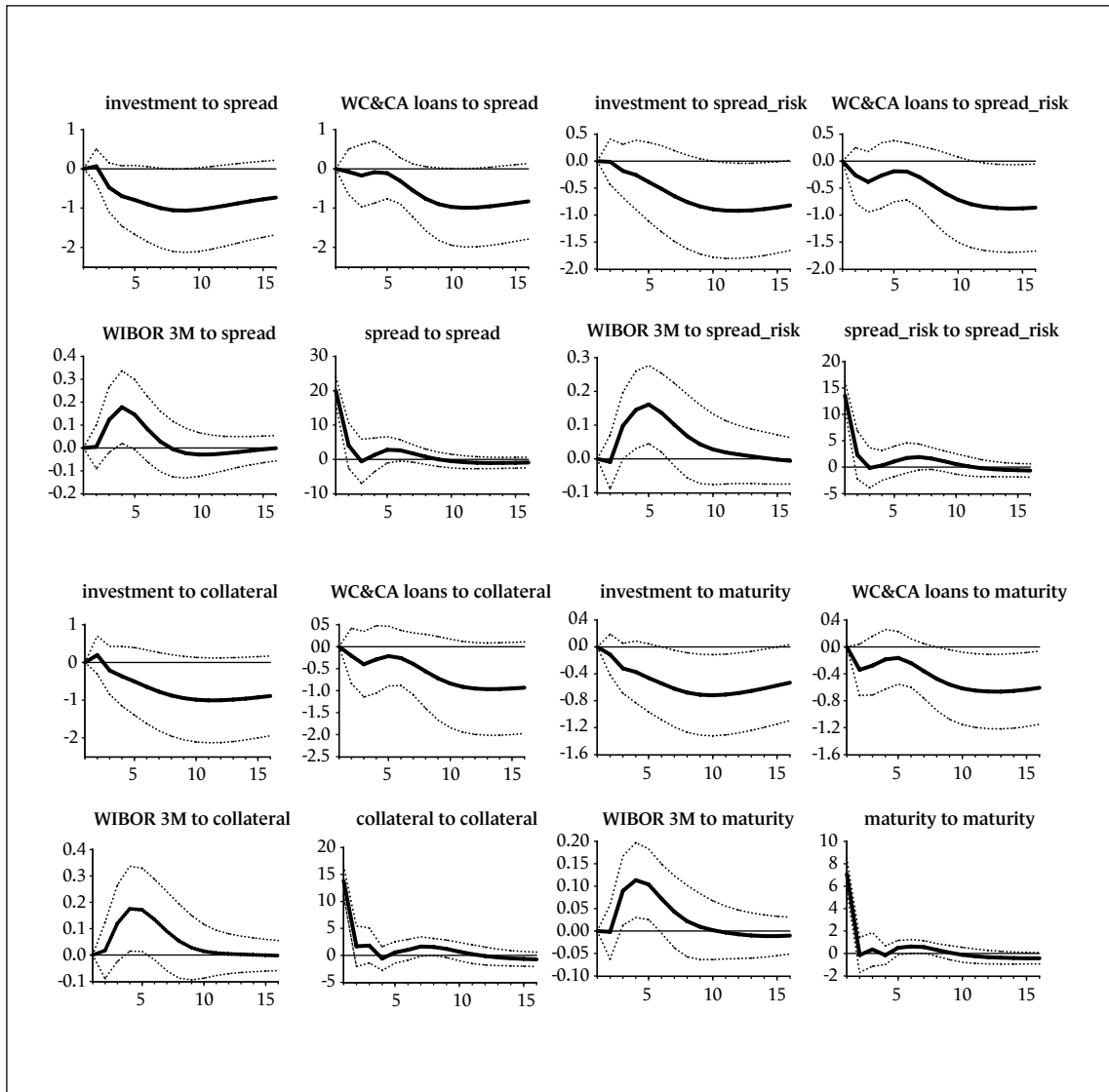
Figure 22

IRFs to one S.D. shocks to selected lending terms and conditions (models with investment loans, Cholesky decomposition)

Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending T&C are in percentage points. Dotted lines show 95% confidence intervals.
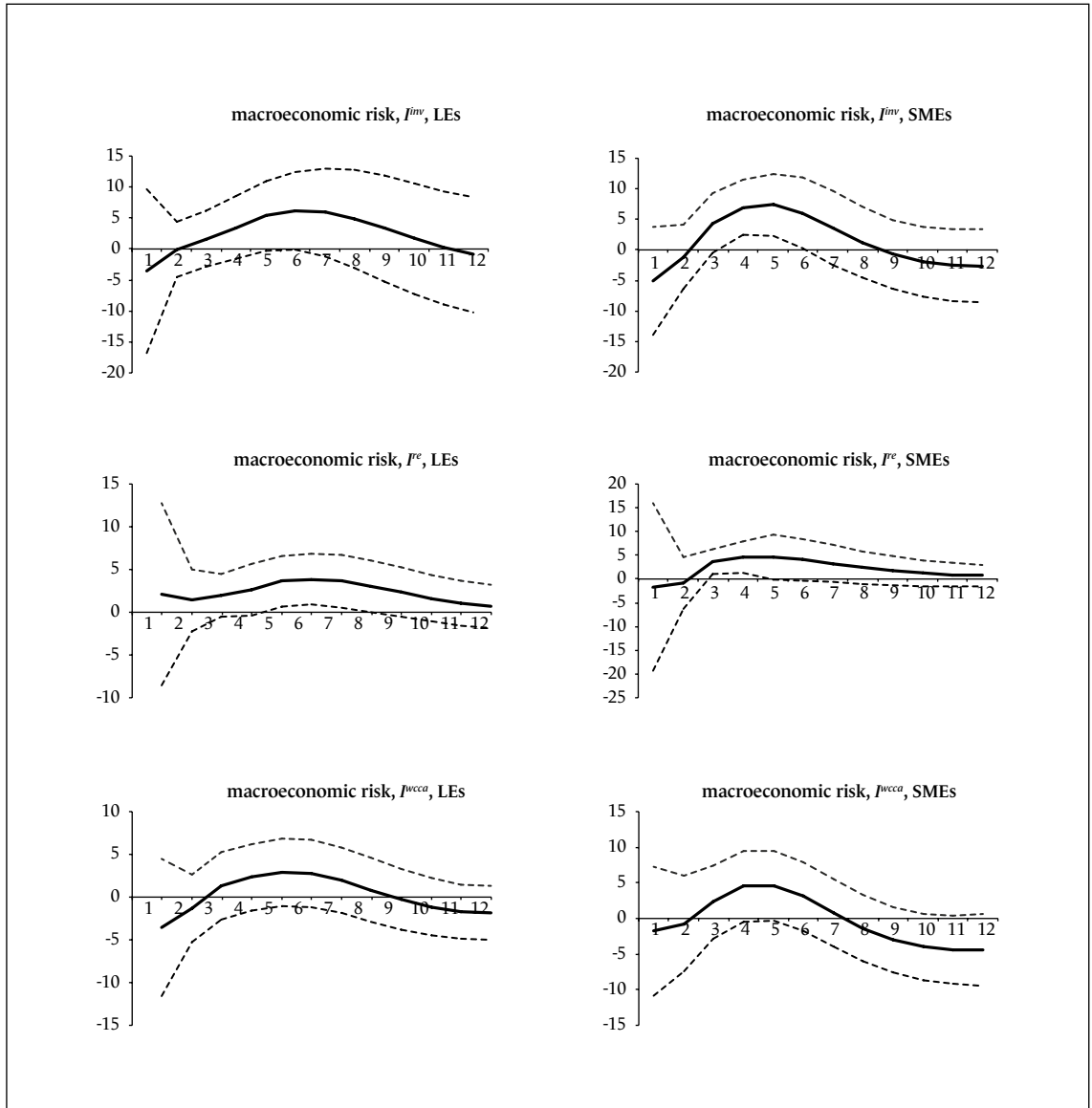
Figure 23

IRFs to one S.D. shocks to selected lending terms and conditions (models with WC&CA loans, Cholesky decomposition)

Note: reactions of investment and loans are in per cent, these of WIBOR 3M and lending T&C are in percentage points. Dotted lines show 95% confidence intervals.

Figure 24

IRFs of lending standards for LEs and SMEs to a one S.D. structural WIBOR 3M shock; 5 variable models with risks related to macroeconomic developments as a factor driving lending standards
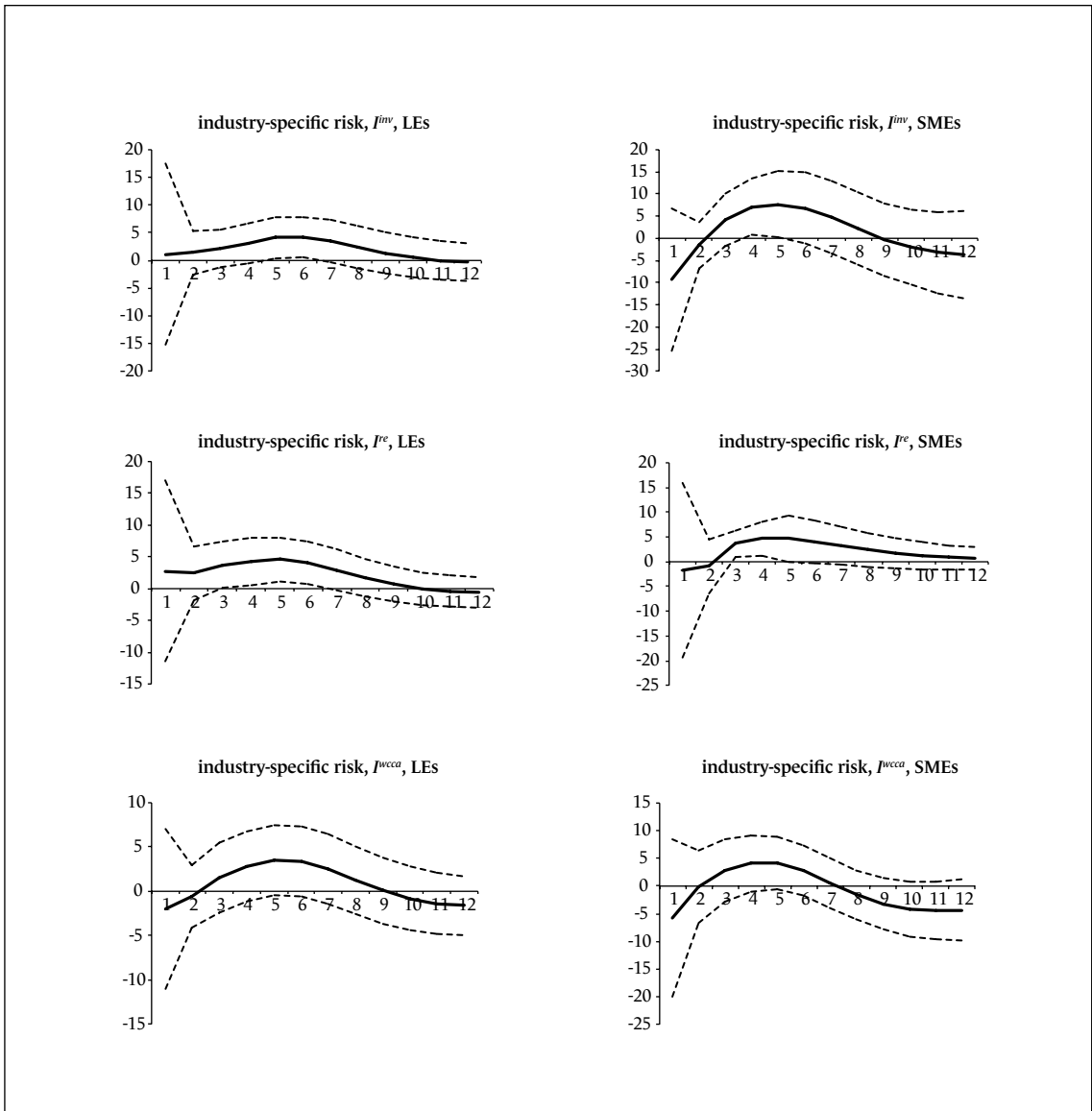

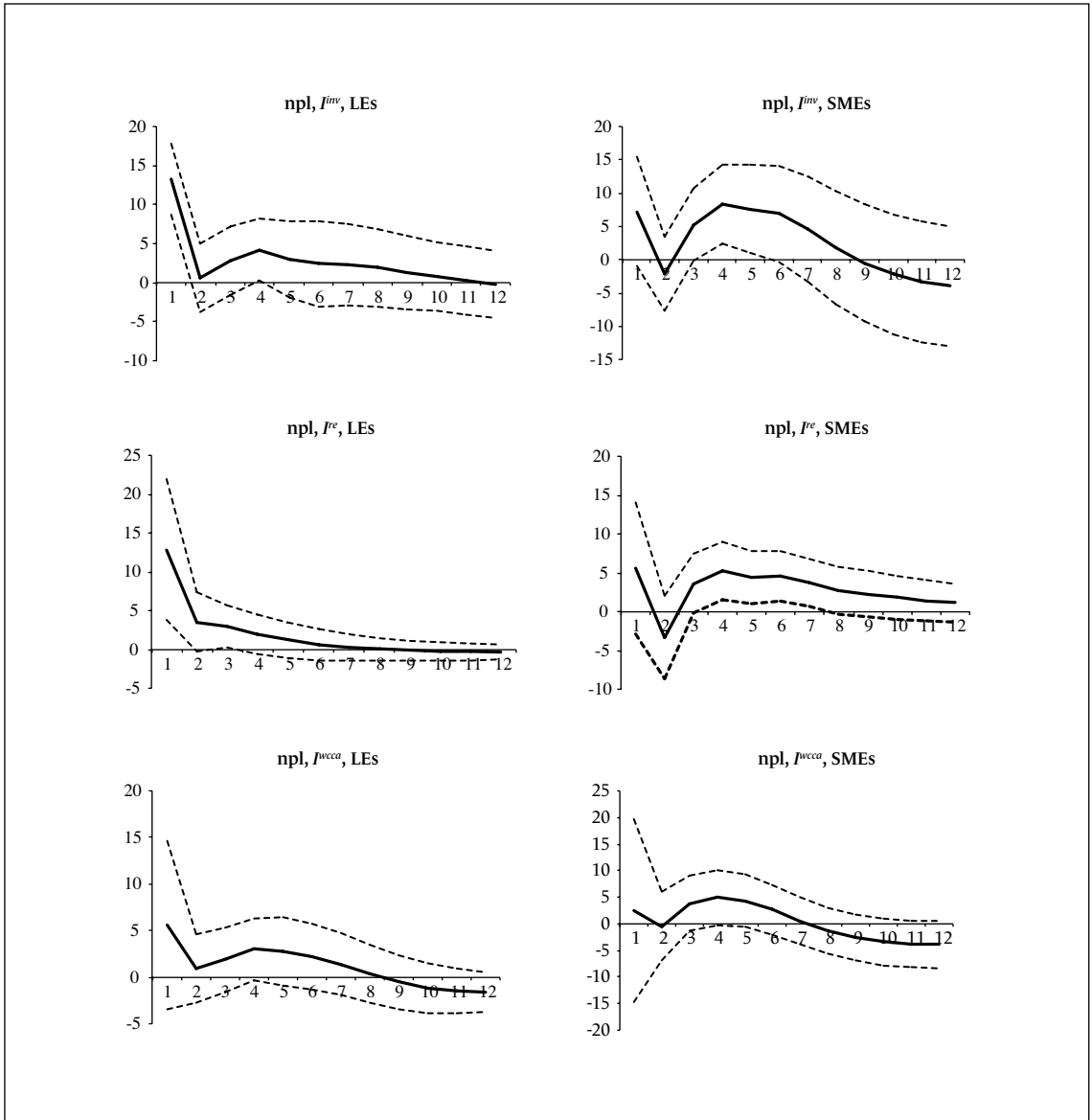Note: impulse responses are in percentage points.

Figure 25

IRFs of lending standards for LEs and SMEs to a one S.D. structural WIBOR 3M shock; 5 variable models with risks related to industry-specific developments as a factor driving lending standards

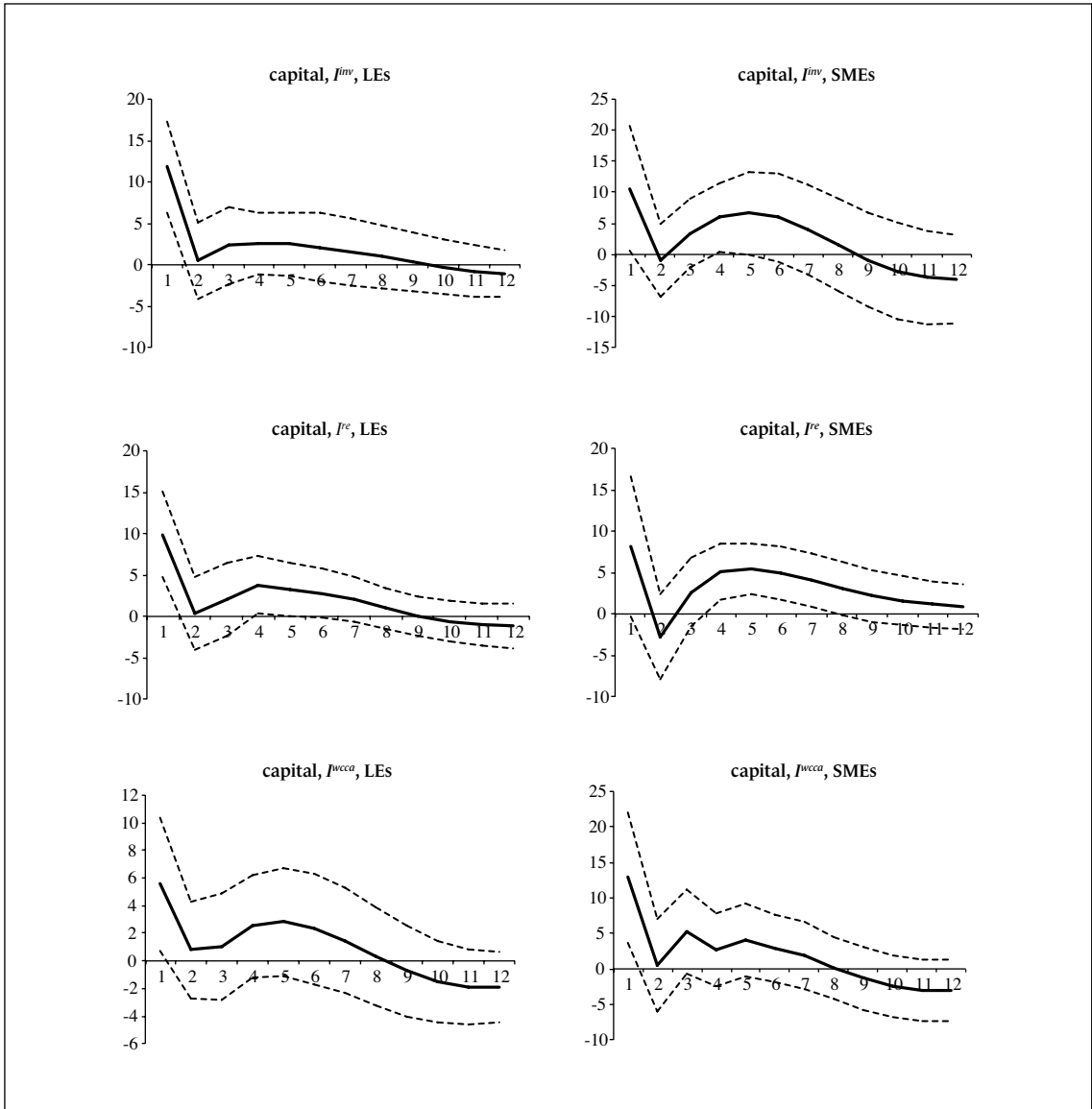Note: impulse responses are in percentage points.

Figure 26

IRFs of lending standards for LEs and SMEs to a one S.D. structural WIBOR 3M shock; 5 variable models
with risks related to non-performing loans in a bank's portfolio as a factor driving lending standards

Note: impulse responses are in percentage points.

Figure 27

IRFs of lending standards for LEs and SMEs to a one S.D. structural WIBOR 3M shock; 5 variable models with risks related to the capital position of a bank as a factor driving lending standards

Note: impulse responses are in percentage points.

Table 1

Data used in the estimations

Variable	Transformation	Source
Loans to the corporate sector in the domestic currency (for investment, for real property acquisition, for WC&CA)	The log of, multiplied by 100, s.a	NBP
Investment, Poland, chain linked, 2010	The log of, multiplied by 100, s.a., corrected for working days	Eurostat
Investment, euro area, chain linked, 2010	The log of, multiplied by 100, s.a., corrected for working days	Eurostat
WIBOR 3M, percent per annum	Quarterly average of the 3-month daily rate	Reuters
EURIBOR 3M, percent per annum	Quarterly average of the 3-month daily rate	ECB (SDW)
Investment deflator, 2010 = 100	The log of, multiplied by 100, s.a.	Eurostat
Lending standards (on long-term and short-term credits to: (i) LEs, and (ii) SMEs	Multiplied by -100	NBP (SLOOS)
Lending terms and conditions: spread, spread for riskier borrowers, non interest rate cost, maximum size, maximum maturity, required collateral	Multiplied by -100	NBP (SLOOS)
Loans to the corporate sector in real terms	Loans to the corporate sector- -investment deflator	Own calculations
Additional variables, used in the robustness checks		
Consumer Price Index	The log of, s.a., multiplied by 100	GUS
POLONIA	Quarterly average of the daily overnight rate; missing observations for 2003.4-2004.4 supplemented with quarterly average of the daily WIBOR overnight rate	NBP, Reuters
Exchange rate, EUR/PLN	The log of, multiplied by 100	NBP
Lending standards' driving factors: industry-specific risk, risk related to the financial standing of the largest borrowers, non-performing loans in banks' loan portfolio, the capital position of a bank	Multiplied by -100	NBP (SLOOS)