Monetary transmission mechanism in Poland

What do we know in 2017?

Tomasz Chmielewski, Mariusz Kapuściński, Andrzej Kocięcki, Tomasz Łyziak, Jan Przystupa, Ewa Stanisławska, Ewa Wróbel

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Summary

Periodic reports on the monetary policy transmission mechanism in Poland[1] aim to present the results of ongoing research on monetary policy impact on macroeconomic processes. In particular, the reports look at the changes in the operation of the transmission mechanism, particularly regarding its strength. The analysis covers both a review of the features of the Polish economy that have a potential impact on the monetary policy transmission mechanism, and empirical results obtained using a wide range of econometric tools. In this report, as part of the latter approach we refer to individual data and survey data to a greater extent than in the past, thus increasing the amount of information used.

In the previous report (Kapuściński *et al.*, 2016) we showed that in terms of its basic features, the monetary policy transmission mechanism in Poland can be considered similar to those of more mature market economies. The declining strength of the exchange rate channel, particularly in terms of its impact on economic activity, is compensated for by the greater importance of the bank credit channel and the growing role of expectations. We also showed that central bank communication plays an important role in managing macroeconomic expectations.

The newest results, presented in this report, are consistent with the conclusions of the previous analyses regarding the strength, lag and role of individual channels in the monetary policy transmission mechanism in Poland. The new elements of the report include the analysis of the changes of the transmission mechanism of monetary policy impulses over time, research into the properties of the transmission mechanism in various phases of the business cycle and an assessment of the impact of monetary policy on lending policy of commercial banks, particularly on credit standards and loan terms as well as the scale of risk taken on by banks.

In the period in which NBP has applied the inflation targeting strategy, the response of GDP and inflation to changes in short-term interest rates has gradually become stronger. The factors behind this were the development of the financial sector, credit deepening and the growing openness of the economy, as well as the increasing credibility of monetary policy, reflected in the anchoring of inflation expectations. The long-term trends shaping the monetary policy transmission mechanism overlap with its changes within the business cycle. According to the results presented in the report, the response of economic activity to a change in the short-term interest rate is the strongest and fastest in the recovery phase of the cycle, while it is the slowest and weakest in the recession phase. In turn, the response of inflation to monetary policy decisions is the strongest and fastest in the expansion phase, while it is the weakest and slowest in the depression phase.

In recent years we have observed a greater importance of bank credit for the transmission of monetary policy shocks. Our detailed analyses show that the impact of the short-term interest-rate on the volume of loans for sole proprietors and households, whose share in the loan portfolio of commercial banks is rising, is much bigger than the impact on corporate loans. The volume of corporate loans, particularly investment loans,

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[1] Demchuk *et al.* (2012), Kapuściński *et al.* (2014), Kapuściński *et al.* (2016).

significantly depends on credit standards and loan terms, which – according to the results of our research – are affected by monetary policy decisions. Therefore lending policy of commercial banks adjusts to changes in monetary policy not only quantitatively – through a change in the interest rate on loans – but also in terms of qualitative aspects related to the evaluation and approval of loan applications.

The impact of currently low interest rates on the propensity of banks to take on risk poses an important question. The results of research in this area show that in Poland this impact has been statistically insignificant or small. In particular, in the period since the outbreak of the financial crisis, when nominal NBP interest rates were lowered, reaching all-time lows, monetary policy inclined banks to reduce risk rather than encouraging them to take on more of it. Taking into account economic developments in Poland so far, we therefore find no confirmation of the functioning of the risk-taking channel in Poland.

To summarise, the picture of the monetary policy transmission mechanism in Poland emerging from the latest report is consistent with the findings of the previous research. We confirm a greater role of bank credit in the monetary policy transmission mechanism than in the past as well as the currently small importance of the exchange rate for economic activity and markedly smaller impact of exchange rate fluctuations on inflation than in previous decades. From the point of view of the tasks of the central bank, the most important finding from the empirical research that was carried out is that we do not find evidence to believe that the period of historically low interest rates caused a decline in the effectiveness of the transmission of monetary policy impulses or led to banks taking on excessive risk, with negative consequences for financial stability that this would entail.

Theory and structural conditions of the monetary policy transmission mechanism

This part of the report describes the theoretical relations on which the monetary policy transmission mechanism is based (section 1.1), together with an overview of the features of the Polish economy, which – in light of the theoretical premises and empirical studies covering a large group of countries – may have an impact on the functioning of the transmission mechanism and its individual channels (section 1.2).

1.1. Channels of monetary policy transmission mechanism

The literature groups the channels of the monetary transmission mechanism in a number of ways. The broadest division comprises the interest rate channel, the exchange rate channel and the credit channel. This classification is often extended to include the asset price channel. A slightly more detailed classification has been put forward by Boivin et al. (2010), who first divide the transmission channels into neoclassical ones, based on the mainstream theoretical models of investment, consumption and international trade, and non-neoclassical ones, based on the assumption of imperfect financial markets. At the next level, this first group is broken down into channels associated with the individual components of aggregate demand (investment, consumption, trade) while the other one is broken down into bank-related channels and the balance sheet channel. Altogether, the authors identify eight channels.

The two approaches can to some extent be combined by matching the particular channels described in Boivin *et al.* (2010) to the interest rate, exchange rate, credit or asset price channels. This approach is adopted in this paper, with the classification extended by other, less frequently mentioned channels, including those through which monetary policy influences the supply side of the economy. The operation of most of the channels relies heavily on the presumption that a change in the nominal interest rate is followed by a change in the real interest rate, which is in line with the New Keynesian assumption of price rigidity.

Two effects combine to make up **the interest rate channel**: the direct impact of the interest rate on investment, and the intertemporal substitution channel. With reference to the former, a monetary policy tightening raises the cost of capital, which causes investment to decline. As to the latter, changes in interest rates alter the slope of the consumption profile so that higher interest rates result in lower current consumption and higher future consumption.

The exchange rate channel operates in the following manner: In line with the uncovered interest rate parity, a monetary tightening causes the exchange rate to appreciate. In the next step, if the domestic interest rate is higher than the interest rate abroad, depreciation occurs, enabling the returns from domestic and foreign assets to equalise. Moreover, a higher interest rate disparity boosts the profitability of carry trade, a strategy involving incurring loans in low-interest rate currencies in order to deposit funds in high-interest ones, which creates upward pressure on the exchange rate (in the second group). Consequently, price competitiveness of

exports, as well as foreign demand, decline. At the same time, there is a fall in import prices, which reduces inflation and boosts imports.[2]

The asset price channel comprises the effects related to Tobin's q channel and the wealth channel. Tobin's q ratio is the ratio of the market value of companies to the replacement cost of their capital. A rise in interest rates translates into lower equity prices and lower levels of Tobin's q due to weaker business conditions and a decrease in corporate profits and dividends.[3] Thus, in order to purchase a given amount of investment goods, firms would have to issue more shares (in comparison with the scenario of investment being financed through a share offering amid a higher market valuation of the company), which could lead to a greater dilution of existing shareholders. As a consequence, the existing owners are less willing to approve new share issues, and the limited inflow of new funds to firms results in less investment. In contrast, under the wealth channel, the same decline in share prices reduces the wealth of households, which – feeling less affluent – cut down on consumption.

As mentioned above, the **credit channel** operates owing to frictions in market mechanisms, such as information asymmetry or segmentation. In this case, asymmetry occurs between banks and borrowers, as borrowers may know more about their capacity to pay off the debt than banks do. Segmentation involves limited access to sources of financing other than a bank loan, which is particularly significant in the case of small and medium-sized enterprises and households. If a rise in interest rates results in borrowers' diminished creditworthiness or banks' smaller lending capacity, expenditure will be lower and the impact of monetary policy on the real economy will be enhanced. The first kind of credit channel is the balance sheet channel. A rise in the interest rate causes a decrease in economic agents' net worth, undermining their creditworthiness and increasing the external finance premium (the difference between the cost of external financing and the cost of self-financing). The second credit channel is the bank lending channel. In this framework, monetary policy tightening translates into a deterioration in banks' balance sheets (a decrease in their capital through the negative effect of higher interest rates on the quality and valuation of assets), a rise in their external finance premium, and the interest charged on loans to the non-financial sector. In other words, it is a balance sheet channel in the case of banks. A similar mechanism is also termed the bank capital channel (Boivin *et al.*, 2010 consider it as the third credit channel) and the risk-pricing channel.[4]

Other channels mentioned in the literature include the redistribution channel, the cost channel and the risk-taking channel. The redistribution channel comprises two effects. The first one is the Fisher channel, a framework under which a rise in interest rates, to the extent it translates into lower inflation, causes a change in the real value of balance sheets, so that lenders gain, whereas borrowers lose. The second effect arises from

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[2] The adverse effect of exchange rate appreciation on price competitiveness of exports may be partially offset by the balance sheet effect of exchange rate movements. This occurs if domestic economic agents hold net liabilities denominated in a foreign currency, since the appreciation of the exchange rate means a decline in their value in terms of national currency. The improvement in balance sheets subsequently triggers more spending (Krugman 1999)

[3] Alternative arguments are based on the effect on the demand for shares or changes in the discount rate.

[4] The traditional argument about the operation of the bank lending channel has been that a tightening of monetary policy reduces bank reserves and deposits, subsequently decreasing credit supply. Yet Disyatat (2010) and Kapuściński (2017a) show that such a description is inconsistent with contemporary institutional conditions.

the fact that monetary policy tightening entails a re-distribution of cashflows from households paying net interest indexed to the level of market rates (usually short-term money market interest rates) to households receiving net interest – this is the interest rate exposure channel. In both cases, if the group of households that are net creditors (i.e. ones receiving net interest payments) has a lower marginal propensity to consume, a rise in interest rates will result in a decline in aggregate expenditure (Sufi, 2015). A related channel – the debt service channel – has been proposed by Hofmann and Peersman (2017), who focus on the impact of the changes in the central bank interest rate on the ratio of interest and principal payments to the income of the private sector (the so-called debt-service ratio). Auclert (2015) shows that the necessary condition for the operation of the redistribution channel, i.e. a negative correlation between the marginal propensity to consume and the uncovered exposure to interest rate risk, is met in Italy and the United States. Studies by Keys *et al.* (2014) and Di Maggio *et al.* (2015) provide supporting evidence for the United States, and Cloyne *et al.* (2015) for the United Kingdom. These studies have found that a decline in interest payments following a monetary easing causes a larger increase in spending in households with higher debt levels. Moreover, research by Calzy *et al.* (2013) shows that a higher proportion of flexible-rate mortgage loans co-occurs with a stronger influence of monetary policy impulses on spending.

The cost channel is in operation if a rise in the cost of working capital financing resulting from an interest rate rise is partially passed on to prices. This can partially explain the "price puzzle" – the initial rise in inflation following a monetary policy impulse, which is referred to in many studies into the monetary transmission mechanism based on SVAR models (alternatively this could be due to erroneous specification of the models). Barth and Ramey (2000) in their industry-level studies, as well as Tillmann (2009), working on aggregate data, find evidence for the operation of the cost channel in the United States, while Gaiotti and Secchi (2006) find evidence in Italy, using enterprise-level data. The implications of the operation of this channel are investigated in theoretical models by Demirel (2013), Westermeier (2010), Hülsewig *et al.* (2009) and Kaufmann and Scharler (2009).

Within the risk-taking channel, changes in interest rates affect risk perception and tolerance (and consequently, the level of portfolio risk), the pricing of assets as well as conditions and criteria for provision of financing by financial intermediaries. This may result, for example, from the fact that some institutions have fixed targets for rates of return. When lower interest rates prevail, it may be necessary to take on more risk in order to attain a given rate of return. Borio and Zhu (2008) find that in similarity to the balance sheet channel, probably most of the time the risk-taking channel only enhances the effect of monetary policy. This means that any interest rate cuts may lead to an additional decline in credit spreads and/or a rise in credit level, and hence also an increase in output and/or inflation. Sometimes the build-up of excessive credit caused by insufficient degree of monetary policy tightening may, however, be conducive to financial crises. A theoretical model providing for the operation of this channel has been proposed by Dubecq *et al.* (2015). Based on bank-level data, Delis *et al.* (2011) and Niu (2012) show that lower interest rates coincide with higher propensity to take risks in the United States, while Ramayandi *et al.* (2014) find the same to be true of Asia. The evidence for this has been found as a result of a study based on aggregate data, conducted by Angeloni *et al.* (2013). Bruno and Shin (2012) show that a monetary easing in the United States causes, through the risk-taking channel, an inflow of capital to emerging economies.

What we describe above is the impact of monetary impulses on aggregate demand and, directly or indirectly, on inflation. Yet the literature quotes reasons for which **monetary policy may also affect the supply side, e.g. the natural rate of unemployment or the potential output**. Thus, it can be expected to influence not only cyclical fluctuations, but, to some extent, also long-term economic growth. This is related to the phenomenon of hysteresis, which arises in the economy when its long-term equilibrium depends on what has happened in the short term. In a seminal study Blanchard and Summers (1986) argue that if a shock (and thus also a monetary impulse) raises the actual unemployment rate for a sufficiently long period, this also leads to a higher natural rate of unemployment. Ball (1999), as well as Stockhammer and Sturn (2008) show that the different degree to which monetary policy is relaxed in times of recession in OECD countries partially explains the persistence of the elevated unemployment. According to an analysis by Galí (2016), under the conditions of hysteresis optimal monetary policy encompasses responding to the unemployment rate. In the Laureys (2014) model, prolonged unemployment causes depreciation of human capital, with a downward effect on potential output. Yet this has a merely limited influence on the optimal way to set interest rates. Theoretical works in which hysteresis relates directly to potential product include, among others, studies by Kapadia (2005), Kienzler and Schmid (2013), and van Aarle (2016).

Monetary policy may also affect potential output if it contributes to credit booms. Based on a panel of developed countries, Borio *et al.* (2015) show that credit booms co-occur with declining productivity growth due to reallocation of employment towards sectors with slower productivity growth, such as construction. This effect is all the greater if, in addition, a credit boom is followed by a crisis. On the other hand, according to the study by Frankin *et al.* (2015) concerning Britain, shortage of credit (in this study related to a decrease in credit supply after a financial crisis) may also dampen the productivity of labour, as well as wages and capital intensity in production. Moreover, for companies faced with a drop in credit supply, the probability of default is higher. This is reflective of a general problem in determining whether a credit boom in the given period is related to dynamic growth of the potential of the economy, or whether it runs counter to the fundamentals, thus potentially boosting prices and jeopardizing financial stability (see Benes *et al.*, 2014a, 2014b). By nature, unstable credit booms often are not caused exclusively by overly expansionary monetary policy, but also by excessive deregulation of the banking supervision or procyclical tax breaks, as exemplified by the experience of, among others, Ireland and Spain (see Sławiński, 2013).

1.2. Monetary policy transmission mechanism – structural conditions

1.2.1. Structural conditions affecting strength and lags of monetary transmission

Studies by Mateju (2014), Georgiadis (2014) as well as Havranek and Rusnak (2013) suggest that the following structural conditions significantly affect the strength and lags of the impact of monetary policy impulses: the development of the financial system, the degree of competition in the banking sector, rigidities in the labour market and the structure of production, and the openness of the economy. Figure 1 shows selected measures of these characteristics for Poland and the euro area (EA), which in this chapter serves as a benchmark.

The ratio of the financial sector assets and private debt to GDP in Poland is below the EA average. This should render a weaker response of prices and output, because the credit channel is weaker, and lags in the monetary transmission mechanism shorter due to the lower capacity of financial institutions to hedge against monetary shocks. As in the euro area, the banking sector is the cornerstone of financial intermediation in the Polish economy. In 2016, the share of banks in the financial assets of the financial sector stood at 65.4% in Poland, i.e. slightly more than in the euro area (62.4%).

Data on the intensity of competition in the banking sector suggest its higher level in Poland than in the euro area, which should entail a smoother transmission of interest rates, and hence a stronger impact of monetary policy. The share of the five largest banks in the assets of the Polish banking sector is lower than the EA average; the Herfindahl index stood at 0.07 in 2016 in Poland, compared with 0.11 in the euro area (ECB data). This potentially results in a higher ratio of costs to income in Poland than in the euro area (in 2016: 57.6% compared with 54.9% – ECB data). On the other hand, net interest income, approximating net interest margin, is higher in Poland than in the euro area. This may mean that concentration only to a limited degree translates into competition and margins. Nevertheless it should be noted that margins may also be affected by the level of interest rates, which are higher in Poland than in the euro area.

Rigidities in the Polish labour market are smaller than in euro area on average, which – in line with the standard new Keynesian model – should, through lower wage rigidity, translate into a stronger response of prices (since it involves a greater response of a firm's marginal cost to a monetary shock) and a weaker response of output (as higher inflation entails a lower real interest rate) to monetary impulses (lower sacrifice ratio). The share of trade union members in the total workforce is low and falling in Poland. Moreover, substantially fewer Polish employees are covered by collective bargaining arrangements than in the euro area – the latest data from the ICTWSS database[5] put this proportion at 14.7% of the total workforce in Poland, as opposed to 62.8% in the euro area. An additional factor mitigating wage rigidity in Poland is the fact that wage negotiations take place predominantly at the company level, while in the euro area this tends to happen at the sectoral level. Also, the degree of employment protection in Poland is lower than in the euro area, and has been stable since 2004. The above refers exclusively to work contracts for an indefinite period, yet the

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[5] Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts.

degree of protection under fixed term contracts is similar. In Poland, the share of workers employed under the latter, more flexible type of contract (27.5% in 2016) is the highest in the European Union.[6]

Besides wage rigidity, the response of prices and output in the standard New Keynesian model is also affected by price rigidities. According to the study by Macias and Makarski (2013), prices in Poland are adjusted more often than in the euro area (once every 10.9 months, compared to once every 13 months), enhancing the response of prices and weakening the response of output to monetary impulses.

Goods-producing sectors (i.e. agriculture, forestry, hunting and fishing, mining and extraction, manufacturing, construction) account for a higher share in the value added than is the case, on average, in the euro area; this share is also stable. This should mean a greater response of output to changes in the monetary stance due to higher (according to empirical research – see e.g. Peersman and Smets, 2005) sensitivity of these sectors to monetary shocks. On the other hand, the share of investment, i.e. the GDP component with a stronger response to interest rate changes than consumption, is slightly lower in Poland than in the euro area (in 2016, 19.6% in Poland, as against 20.1%) and has been falling since 2008.

The ratio of Poland's foreign trade to GDP is lower than the average for the euro area countries, which – all other things being equal – should render a weaker response of prices to a monetary policy impulse, due to a stronger exchange rate channel. Yet Poland's international trade is proportionately greater than euro area trade with the economies outside the zone (in 2016, 100.7% of GDP compared to 68.2% of GDP – Eurostat data).

In light of the cited studies, the above factors may affect the strength and lags of the monetary transmission mechanism. Yet the operation of the individual channels of this mechanism is also potentially influenced by other factors, which we analyse more closely in the next chapter of the report (1.2.2).

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[6] It should be noted that in 2016-2017 employment rose mainly owing to indefinite-period contracts, which resulted in a slight decline in the percentage of fixed term contracts – see also NBP (2017), *Raport o rynku pracy i sytuacji gospodarstw domowych* [Report on labour market and households' situation], nr 03/17, p. 8.

Figure 1. Structural determinants of monetary policy transmission mechanism
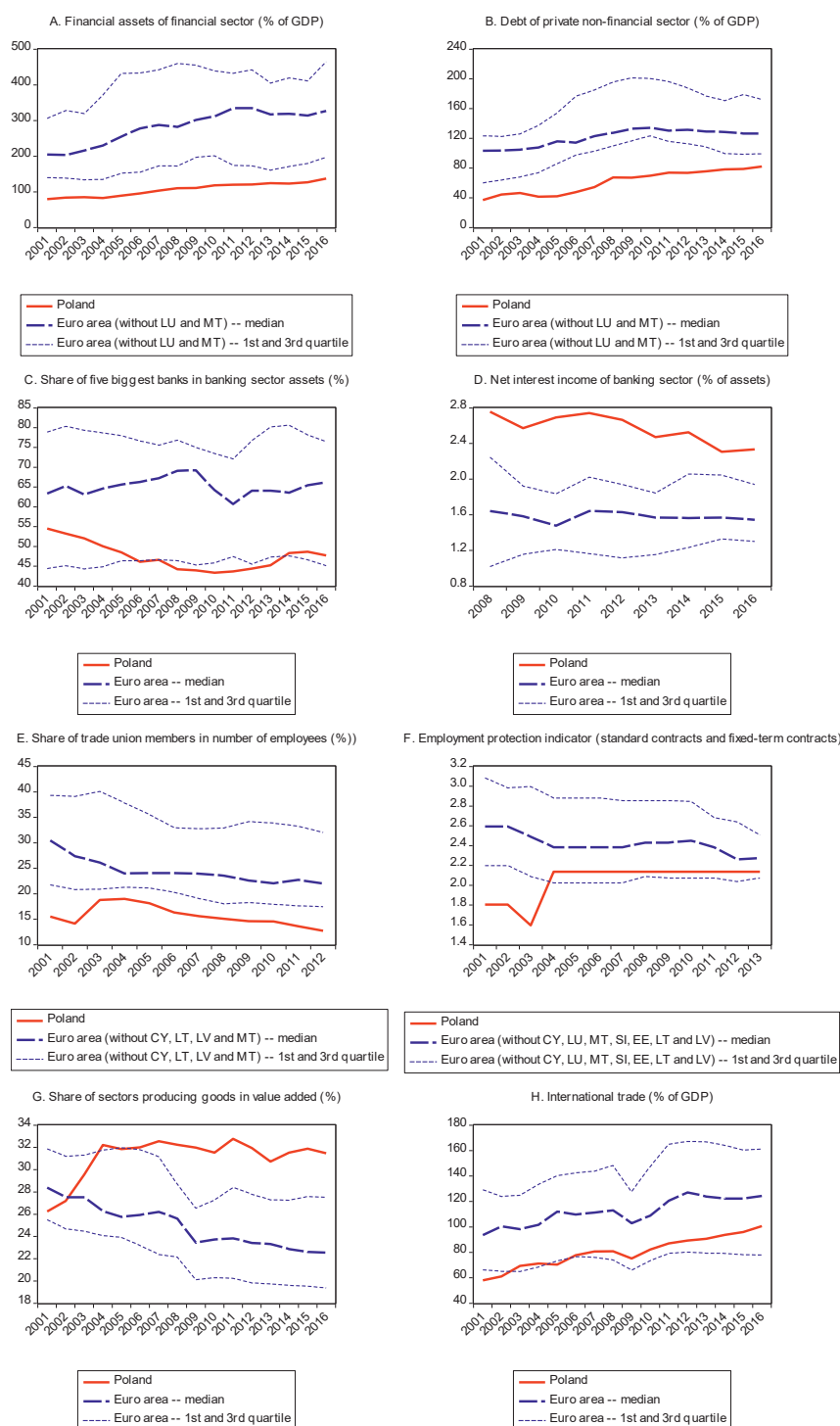
Sources: panels A, B, G, H – Eurostat; C, D – ECB; E, F – OECD.

1.2.2. Additional conditions affecting the operation of the monetary policy transmission channels

While analysing the structural features potentially affecting the functioning of the individual channels of monetary policy transmission mechanism in Poland, which were presented in more detail in our previous report (Kapuściński *et al.*, 2016), we employ a set of variables presented in Tables 1-4.[7]

An important element of the monetary policy transmission mechanism, subjected to detailed empirical research in this report (see chapters 3.1.2 and 3.3), is the credit market. Its characteristics influence the operation of the monetary policy transmission channels. For instance, the fact the bulk of loans in Poland are granted at flexible interest rates, indexed to interbank rates, is a factor enhancing the effects of the interest rate channel and the debt service channel with respect to the borrowers who incurred their loans earlier. Yet the pass-through of the central bank interest rates to the interest rate of new loans in Poland may be hampered by imperfect substitution between various sources of non-financial sector financing, along with a relatively high level of liquidity and solvency indices of the commercial bank sector.[8]

A factor of significance for the operation of the interest rate channel and the credit channel is the role of credit among the sources of financing of the non-financial sector. Although the credit-to-GDP ratio in the Polish economy is gradually rising, the corporate sector as a whole does not rely on finance obtained from the banking sector. On the one hand, the high proportion of small and medium-sized non-financial corporations, which have limited access to external sources of financing other than bank credit (particularly with regard to the financing of working capital), enhances the pass-through of monetary policy decisions to economic activity. On the other hand, large companies may try to obtain financing not only form domestic banking institutions, but also from foreign banks. They also have access to financing through corporate bond issues. Moreover, a large group of companies operating as part of international capital groups are financed directly by their owners. Some of the firms use trade credit as an important source of financing. A comparison of these sources of financing leads to the conclusion that loans extended by the domestic banking sector do not account for the majority of the financing of the domestic non-financial corporate sector.

In contrast, domestic banks are the primary financing source for households. The housing loan boom of 2004-2008 resulted in a higher number of households whose current cash flows are encumbered with repayments of housing loans, yet the extent of these burdens is not always directly dependent on changes in the NBP monetary policy. In the case of foreign currency housing loans, the amount of the instalments depends on the decisions of respective foreign central banks and the movements in the nominal exchange rate. This part of the credit portfolio can only be influenced indirectly – as an element of the exchange rate channel. An appreciation of the domestic currency improves the balance sheets of agents holding uncovered net liabilities in foreign currencies and reduces the size of financial flows related to the service of debt as expressed in the domestic currency. This can boost domestic demand, partially offsetting the adverse impact of net exports.

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[7] These are in line with the monetary policy transmission mechanism described in the paper by Egert and MacDonald (2009).
[8] However, the empirical research presented in chapter 3 suggests that the bank characteristics impact on the interest rate pass-through in Poland only to a limited degree.

The exchange rate channel – as mentioned in chapter 1.2.1 – is strengthened by the fact that the Polish economy is increasingly open. Nevertheless, the operation of this channel is weakened by two key factors. The first one is low and stable inflation, consistent with the NBP monetary policy target. It affects the strength of the pass-through of exchange rate changes to prices, which depends positively on the rate of inflation and its volatility. It can thus be concluded that the impact of the exchange rate on prices has diminished over the period during which NBP implemented the inflation targeting strategy under the influence of the rising credibility of monetary policy.

Another important factor constraining the influence of the exchange rate on economic activity and consumer prices is the structure of foreign trade. The sensitivity of import volumes and prices to changes in the exchange rate is dampened by firms' participation in global value chains (Ahmed *et al.*, 2015). The intensity of those relations can be approximated by the share of foreign value added in domestic exports and the share of domestic value added in the exports of other countries. Between the mid-1990s and 2011 these rose in Poland from 17% to 34%[9] and from 22% to 24%[10], respectively (Ambroziak and Marczewski, 2014). This means that approx. 60% of exports is only loosely related to exchange rate levels.[11] Besides, the pass-through of exchange rate changes should be larger for non-processed imported goods (Forbes *et al.*, 2017), whose share in imports is limited.

The operation of the asset price channel may be supported by the increasing financial wealth of households. Yet in Poland approximately half of household financial assets consists of cash and bank deposits, which have expanded far more robustly in recent years than the stock of other financial assets. This phenomenon has contributed primarily to enhancing the impact of monetary policy through traditional transmission channels, amid a fairly low influence on the asset price channel.

With regard to the above factors, a number of noteworthy changes have occurred in Poland in recent years. Firstly, the share of unprocessed goods imports has fallen, which should reduce the sensitivity of inflation to the exchange rate. Secondly, the banks' total capital ratio increased, which may have a weakening effect on the interest rate channel and the credit channel. Thirdly, in 2013-2015 the share of credit in financing investment rose, which in turn should support the operation of the interest rate channel and the credit channel.

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[9] The increase in foreign value added in Polish exports, related to the inflow of foreign direct investment, is one of the fastest in Europe and exceeds the EU average by approx. 10 percentage points. See: *IMF World Economic Outlook*, October 2015, chapter 3.

[10] The share of domestic value added in the exports of other countries was at its highest in 2007 (27%).

[11] The literature cites a reduction in operating costs as one of the benefits of participation in GVCs, while one of the elements neutralising the changes in the exchange rate is the optimisation of currency invoicing (see also OECD, WTO and World Bank Group reports on Global Value Chains drawn up for the G20 Trade Ministers Meeting, Sydney, Australia, 19 July 2014).

Table 1. Factors affecting functioning of the interest rate channel

	2004	2006	2008	2010	2012	2014	2016
NFS deposits at banks (% GDP)[1, 2]	32.39	34.97	38.36	42.27	43.61	48.69	54.34
Household and NPISH deposits at banks (% GDP)[1, 2]	23.18	23.18	26.63	29.62	31.96	35.51	39.77
NFC deposits at banks (% GDP)[1, 2]	9.21	11.79	11.73	12.65	11.65	13.18	14.57
NFS loans at banks (% GDP)[1, 2]	24.26	29.91	45.51	46.71	47.47	49.06	51.33
Household and NPISH loans at banks (% GDP)[1, 2]	11.83	17.19	28.71	32.60	32.49	33.95	35.36
NFC loans at banks (% GDP)[1, 2]	12.43	12.72	16.80	14.12	14.98	15.12	15.97
Bonds in NFS assets (% PKB)[2]	2.5	2.3	1.9	1.5	1.1	0.9	0.9
- Bonds in household and NPISH assets (% GDP)[2]	1.20	0.80	0.70	0.50	0.60	0.30	0.40
- Bonds in NFC assets (% PKB)[2]	1.30	1.50	1.20	1.00	0.50	0.60	0.50
Household and NPISH deposits in credit unions (% GDP)[2, 3]	0.42	0.52	0.67	0.90	0.95	0.73	0.59
Household and NPISH loans in credit unions (% GDP)[2, 3]	0.31	0.38	0.54	0.68	0.68	0.54	0.40
NFC bonds (% GDP)[2]	3.00	2.00	1.90	2.30	3.40	5.00	5.70
NFC shares (% PKB)[2]	10.00	19.30	9.80	19.40	17.10	16.20	16.10
Short-term NFS deposits (%)[1]	95.05	97.26	95.75	96.77	96.62	92.32	93.52
- Short-term household and NPISH deposits (%)[1]	93.33	96.26	94.15	95.81	95.87	89.68	91.42
- Short-term NFC deposits (%)[1]	99.49	99.27	99.50	99.09	98.75	99.62	99.41
Short-term NFS loans (%)[1]	31.93	24.45	19.81	17.13	16.21	15.06	14.03
- Short-term household and NPISH loans (%)[1]	24.62	16.78	11.86	10.80	9.03	8.52	7.89
- Short-term NFC loans (%)[1]	38.80	34.86	33.24	31.39	31.37	29.27	27.13
Central bank and Treasury securities in bank assets (%)[1]	18.52	17.53	15.32	18.15	16.13	17.44	19.97
Share of banks with majority Treasury stake (%)[1]	20.30	19.69	17.34	21.24	22.70	23.97	28.88
Share of banks with majority foreign capital (%)[1]	62.81	65.91	68.20	62.38	60.48	61.31	56.08
Non-performing/impaired loans (%)[1]	15.02	7.41	4.58	8.78	8.84	8.12	7.11
Commercial bank ROA (%)[1]	1.28	1.57	1.43	0.96	1.09	1.00	0.79
Capital adequacy ratio/total capital ratio (%) [1 4]	15.40	13.20	11.20	13.84	14.74	14.69	17.72
Share of households with a housing loan (%)[1]		7.04	9.66	10.7	12.67	13.67	14.61
Share of foreign financing of NFC (debt, estimate, %)[1]	26.83	32.30	36.90	41.07	42.16	41.35	40.79

Notes: NPISH – non-profit institutions serving households, NFC – non-financial corporations, NFS – non-financial sector.

Source: 1 – NBP, 2 – Eurostat, 3 – KSKOK, 4 – KNF, 5 – OECD, 6 – GPW, New Connect.

Table 2. Factors affecting functioning of the exchange rate channel

	2004	2006	2008	2010	2012	2014	2016
Inflation level (5-year average, %)[3]	4.37	1.90	2.71	2.88	3.77	2.41	0.71
Inflation volatility (st. dev. over 5 years, p.p.)[3]	3.45	1.37	1.43	1.24	0.72	1.61	1.77
Unprocessed goods imports (%)[2]	10.67	10.96	12.00	12.28	15.34	12.99	8.93
Participation in global value chains, GVC[5]	49.87	53.17	52.79	53.14	55.74*	x	x
- Foreign value added in exports (%)[5]	28.42	30.90	30.98	31.20	32.99	32.98	x
- Domestic value added in foreign exports (%)[5]	21.45	22.27	21.81	21.94	23.5*	x	x
NFS foreign currency deposits (%)[1]	15.25	15.75	10.65	9.27	9.99	9.14	10.82
- Household and NPISH foreign currency deposits (%)[1]	14.34	13.16	8.68	7.24	7.42	7.30	8.13
- NFC foreign currency deposits (%)[1]	17.55	20.95	15.22	14.17	17.25	14.20	18.26
NFS foreign currency loans (%)[1]	24.70	27.15	33.83	33.27	30.95	28.43	26.42
- Household and NPISH foreign currency loans (%)[1]	24.91	30.85	39.44	37.43	34.62	29.07	25.78
- NFC foreign currency loans (%)[1]	24.50	22.14	24.34	23.92	23.18	27.03	27.81

Notes: NPISH – non-profit institutions serving households, NFC – non-financial corporations, NFS – non-financial sector.

Source: 1 – NBP, 2 – Eurostat, 3 – GUS, 4 – KNF, 5 – OECD (* - 2011 r.), 6 – GPW, New Connect.

Table 3. Factors affecting functioning of the credit channel

	2004	2006	2008	2010	2012	2014	2016
Share of SMEs in total number of companies (%)[3]	99.80	99.90	99.80	99.80	99.90	99.82	99.82*
Share of SMEs in production (%)[3]	61.70	59.30	58.70	56.90	55.80	56.65	57.33*
Share of banks in financing investment (%)[3]	12.20	12.90	13.80	12.40	9.30	11.55	12.61*
NFC trade credit (% GDP)[1]	22.22	21.20	22.28	22.03	20.01	19.75	20.76

Notes: SME – small and medium-sized enterprises, NFC – non-financial corporations.

Source: 1 – NBP, 2 – Eurostat, 3 – GUS (* - 2015), 4 – KNF, 5 – OECD, 6 – GPW, New Connect.

Table 4. Factors affecting functioning of the asset price channel

	2004	2006	2008	2010	2012	2014	2016
Financial assets of households (% GDP)[2]	71.90	82.20	73.50	82.80	87.00	95.40	101.80
- Households' financial assets excluding cash and deposits (% GDP)[2]	42.90	52.20	39.30	45.90	47.60	51.50	52.60
Housing assets of households' (% GDP)[2]	183.88	187.30	207.01	196.81	182.28	176.99	171.26
Stock market capitalization (% GDP)[2, 6]	31.26	59.44	36.28	55.46	45.73	73.39	60.80

Source: 1 – NBP, estimates (*-2005), 2 – Eurostat, 3 – GUS, 4 – KNF, 5 – OECD, 6 – GPW, New Connect.

Strength and lags in the monetary policy transmission mechanism

This part of the report presents an analysis of the general features of the monetary transmission mechanism and the so-called stylized facts[12]. We use various types of vector autoregression models (section 2.1) as well as structural models, based on the New-Keynesian economic paradigm (section 2.2), dominant in central banks.

2.1. General features of the transmission mechanism

We determine the general features of the transmission mechanism on the basis of the (structural) vector autoregression models, (S)VAR. We use a relatively limited number of assumptions in order to let the data speak. Apart from standard (S)VAR models used regularly to analyse the transmission mechanism, we also use factor-augmented vector autoregression (FAVAR) models, which take into account wide data sets, and also SVAR models with time-varying parameters (TVP-SVAR).

2.1.1. How far-reaching are the effects of monetary policy?

The results of the estimation of (S)VAR models, described in detail in Appendix 1[13], confirm the general conclusions about the shape of monetary policy transmission in Poland presented in the previous reports (Kapuściński *et al.*, 2016). An unexpected increase in the short-term interest rate leads to appreciation of the domestic currency, a decrease in economic activity, and a decline in the consumer confidence index (BWUK)[14], as well as a decline in prices (Figure 2). The response of investment to changes in interest rates is significantly stronger than the response of consumption. The results of additional simulations of (S)VAR models show that the degree of exchange rate pass-through to economic activity and inflation is relatively small (see Appendix 1[15]).

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[12] According to Kaldor (1961), stylized facts are a simplified (generalised) description of empirical regularities. In the report we concentrate on those that are significant from the point of view of the functioning of the monetary transmission mechanism.

[13] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

[14] BWUK is the arithmetic mean of the evaluations of the changes in household's financial condition, changes in the general economic situation of the country, and major purchases currently made (source of data: GUS).

[15] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

Figure 2. Impulse response functions of selected variables to monetary policy shock, quarterly (S)VAR models
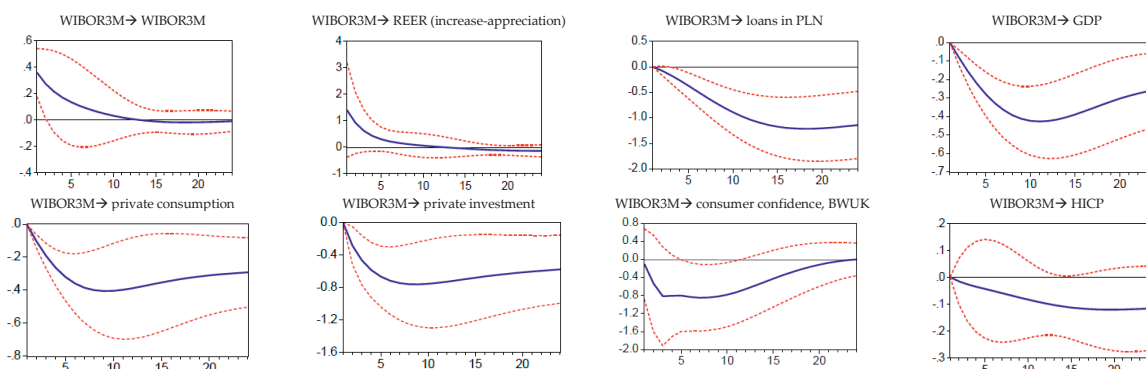
Note: The above responses to monetary policy shock, along with 95 % confidence intervals, are derived from the (S)VAR models characterised in Appendix 1 (http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf).

Source: own calculations

The estimation requirements and the number of available observations make traditional (S)VAR models contain a limited number of variables. We use the FAVAR model (Kapuściński, 2017c), in order to take into account a wider set of variables and examine how far-reaching the effects of monetary policy are. From the 132 variables related to real economic activity, inflation, credit, money, interest rates, the financial market and expectations, we extract the so-called factors, and then we estimate the parameters of the FAVAR models. Figure 3 shows the response of 31 selected variables to an increase of 1 p.p. in the short-term interest rate and 68% confidence intervals. The response of the remaining variables, similar to the details of the research, are described in Appendix 1[16] and in Kapuściński (2017c).

A tightening of monetary policy causes a fall in industrial output, employment, job offers, lending, share prices, the ratio of share prices to corporate profits, the PMI index and the consumer confidence indicator, as well as a depreciation of the zloty. On the other hand, the following increase: registered unemployment, the share of non-performing loans in the loan portfolio, longer money market rates, yields on government bonds and interest rates on loans. Spreads between the interest on loans and the WIBOR ON rate initially decline, indicating a slight lag in the transmission of the rates, and then they increase, suggesting the functioning of the credit channel, strengthening the effects of monetary policy. Spreads between longer money market rates and yields on government bonds and the WIBOR ON rate fall; however, this seems to be the result of observations at the beginning of the sample, when interest rates were relatively high, but significant reductions were expected. The non-intuitive response of the exchange rate can be explained by the version of the uncovered interest rate parity (UIP) extended by the risk premium, in which the tightening of monetary policy, through the deterioration of economic activity, causes an increase in the premium (see chapter 3.2.1). Although the confidence intervals for the responses of the remaining variables are rather wide, the point impulse response functions have signs in accordance with economic theory. In particular, an increase in the WIBOR ON rate causes a decrease in CPI inflation.

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[16] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

Figure 3. Impulse response functions to monetary policy impulse – FAVAR models
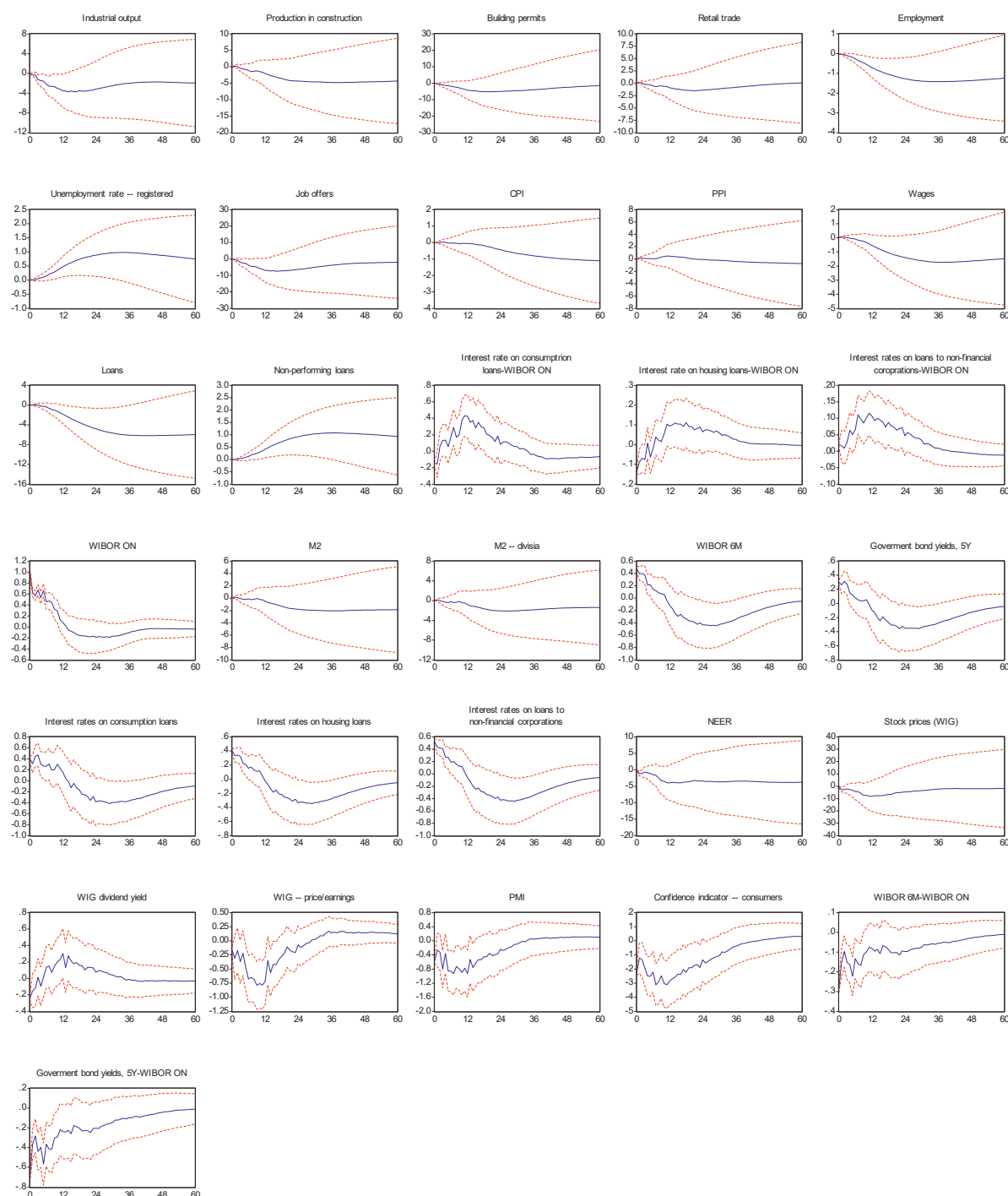
Note: In the case of variables expressed as percentages, the responses should be interpreted as deviations from the scenario without the shock in percentage points, in the case of the remaining variables – as deviations in percent.

Source: own calculations

2.1.2. Is the monetary policy transmission mechanism in Poland subject to changes over time?

A natural generalisation of traditional structural vector autoregression models (VAR) is to allow all model coefficients to change over time. SVAR models with coefficients that vary over time (TVP-SVAR) have become a popular tool used to examine changes in the monetary policy transmission mechanism, mainly thanks to the widely quoted work of Primiceri (2005). In order to apply this research method we used a set of five variables that are part of the basic specification of standard SVAR models, i.e. GDP, inflation, loans, WIBOR 3M interest rate and the exchange rate. We used quarterly data from 1999-2017 for the estimation. Details of the research method and the results are contained in Appendix 1[17] and in Kocięcki (2017).

The response of inflation to unexpected changes in the short-term interest rate was gradually strengthened in the period under analysis (Figure 4). Only the period up to 2003 was characterised by the so-called price puzzle, i.e. the non-intuitive rise in inflation after a tightening of monetary policy. Significant changes can be noticed in the response of economic activity to changes in monetary policy (Figure 5). The response of annual GDP growth to the interest rate shock is stronger and faster after 2005, while in the earlier period it was slower and weaker. The response of loan growth was not consistent with common belief in the early 2000s , i.e. monetary policy tightening caused a rise in lending; however, since roughly 2005 the response is in accordance with intuition (Figure 6). In the recent period the response seems to have gained in strength.

Figure 4. Response of inflation to the interest rate shock over the years and a detailed cross-section for four selected quarters after the shock
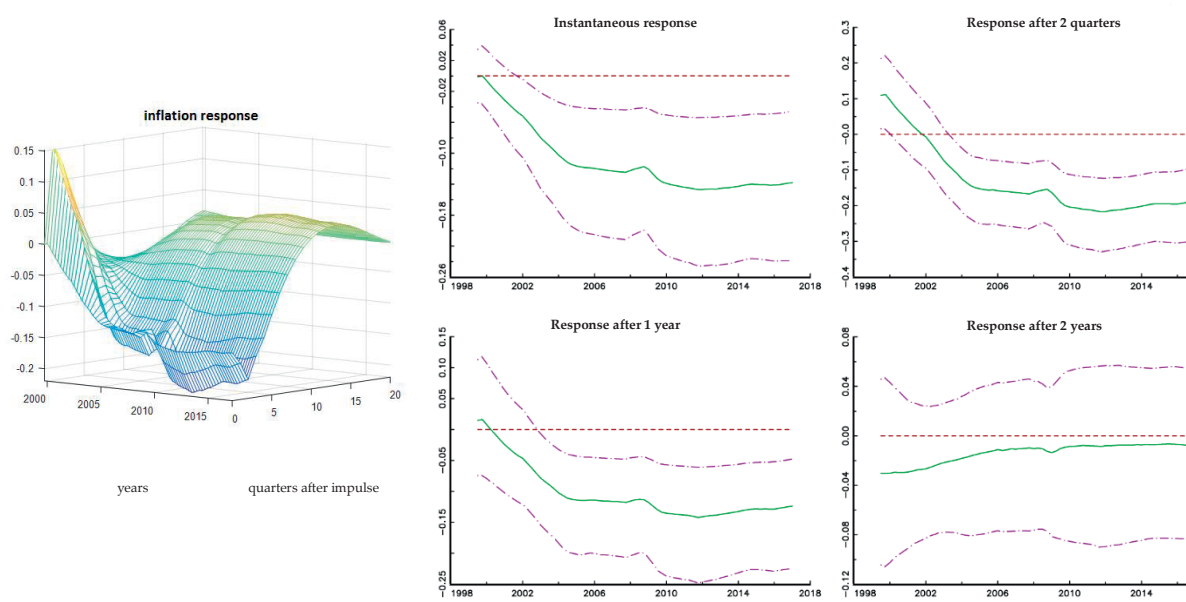
Note: Broken lines refer to the 68% error band.

Source: own calculations (Kocięcki, 2017).

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[17] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

Figure 5. Response of annual GDP growth (in p.p.) to the interest rate shock over the years and a detailed cross-section for four selected quarters after the shock
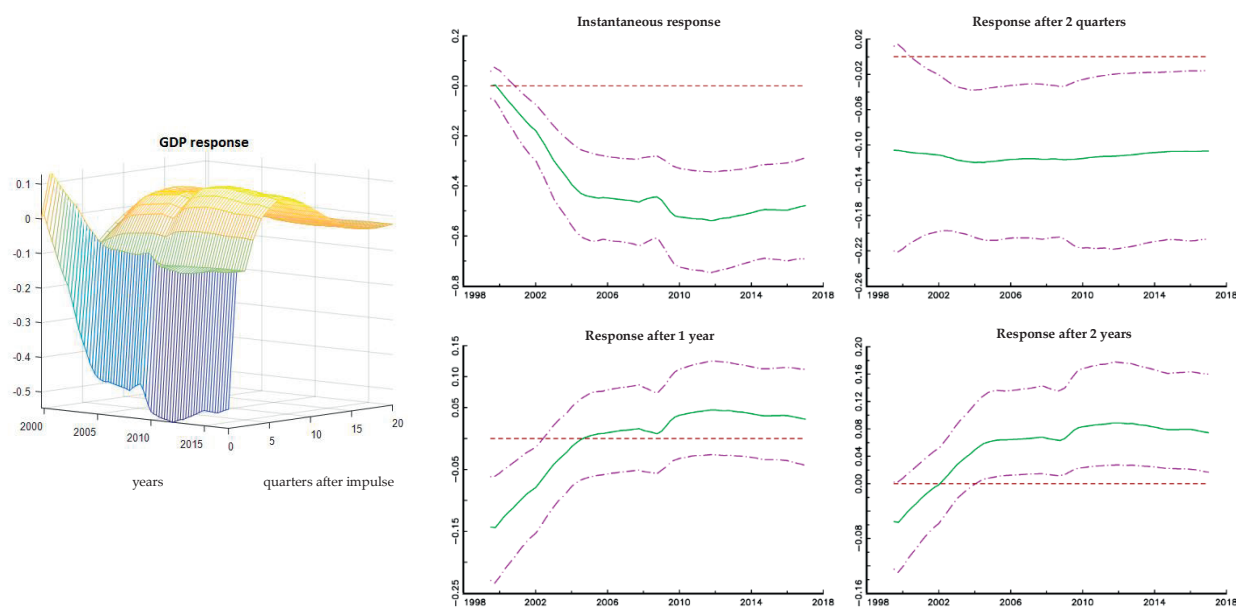
Note: Broken lines refer to the 68% error band.

Source: own calculations (Kocięcki, 2017).

Figure 6. Response of annual loan growth (in p.p.) to the interest rate shock over the years and a detailed cross-section for four selected quarters after the shock
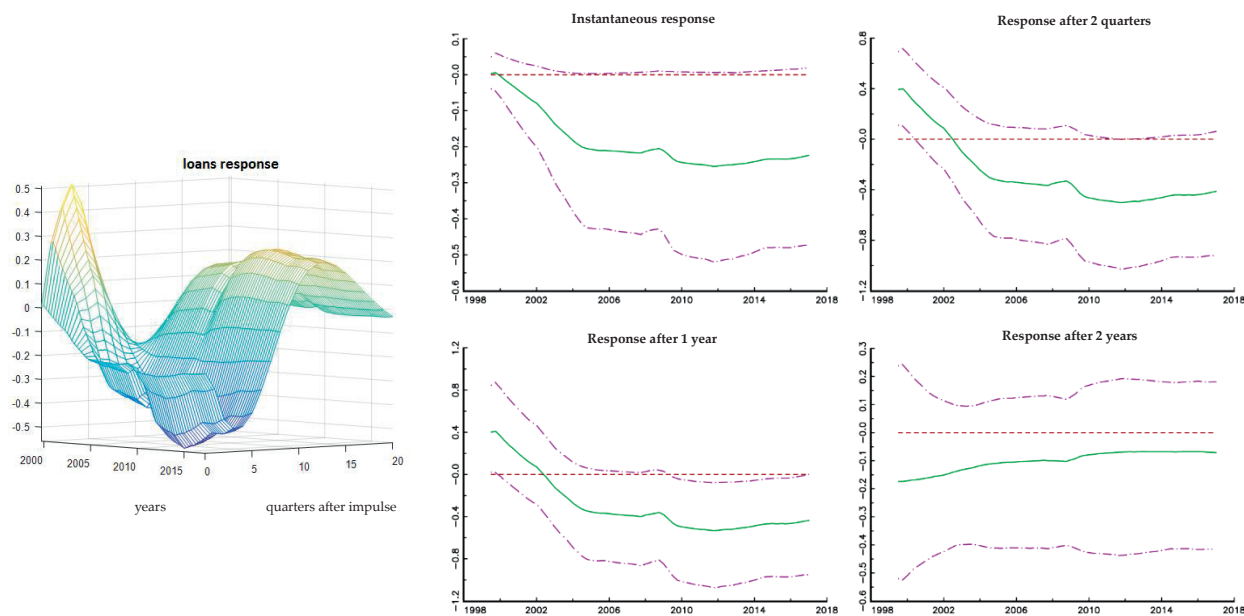
Note: Broken lines refer to the 68% error band.

Source: own calculations (Kocięcki, 2017).

The above figures present the responses of the variables under consideration to a typical monetary policy shock, the size of which – in accordance with the logic of the model – changed over the years (Figure 7A). When the response functions of these variables are scaled, so that they present the effects of an interest rate shock of a permanent size equal to 0.25 p.p., the effects of strengthening the monetary policy transmission mechanism in Poland become even more visible (Figure 7B-D).

Figure 7. Scaled impulse responses of selected variables to monetary policy shock equal to 0.25 p.p.

A. Standard deviation of monetary policy shock
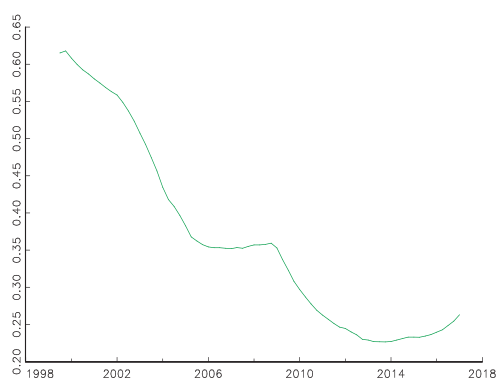
B. Response of inflation to monetary policy shock
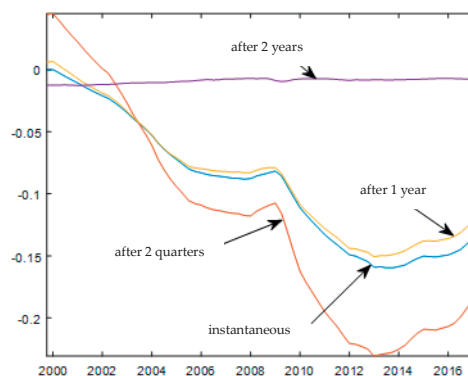
C. Response of annual loan growth to monetary policy shock
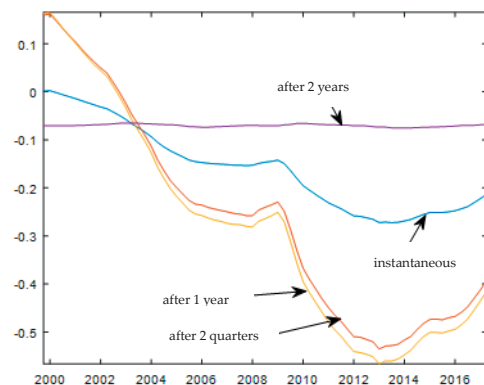
D. Response of GDP growth to monetary policy shock
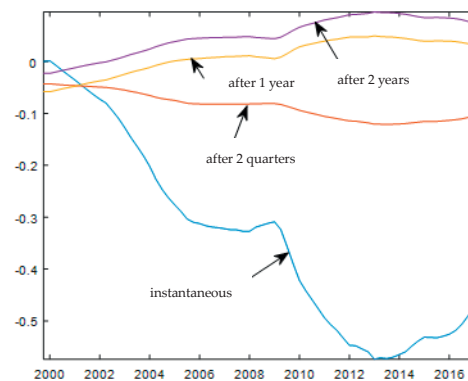
Source: Kocięcki (2017).

2.2. Simulations of the monetary policy transmission mechanism

In this part of the report we refer to structural models rooted deeper in economic theory than (S)VAR models, in order to analyse the strength and lags of the transmission mechanism, and to determine the relative role of individual transmission channels on inflation.

2.2.1. Structural models used to analyse the monetary policy transmission mechanism

In the simulations we use three structural models of the monetary policy transmission mechanism, i.e. the QMOTR (Quarterly Model of (Monetary) Transmission) with stochastic shocks, the Small Model of (Monetary) Transmission (MMT), and the Small Monetary Policy Model (MMPP). They all use the paradigm of New Keynesian economics and are built around four fundamental macroeconomic relationships: the aggregate demand curve, the Phillips curve, the exchange rate equation referring to the concept of the uncovered interest rate parity and the monetary policy rule. However, these models differ from each other in many respects. In particular, they put emphasis on different stages of the process of monetary policy transmission, using a different set of macroeconomic variables, and are also characterised by different degrees of forward-lookingness of individual macroeconomic relations and mechanisms shaping macroeconomic expectations.

The QMOTR model (Quarterly Model of (Monetary) Transmission) bases on the semi-structural Global Projections Models (GPM), developed by the International Monetary Fund (see e.g. Carabenciov *et al.*, 2013). In the QMOTR model a special attention is paid to the economic activity, in particular to foreign trade. The residuals (shocks) in the main equations were disaggregated, which enabled the identification of economic shocks that affected the economy . The model was estimated using Bayesian methods. The high degree of forward-lookingness of the model and the adoption of model-consistent macroeconomic expectations make the response functions obtained from the model indicate a rather rapid adjustment of the economy to various shocks, including the monetary policy shock. A detailed description of the QMOTR model is included in Appendix 2[18].

The Small Model of (Monetary) Transmission (MMT) is similar to the model used by the Bank of Israel (Argov *et al.*, 2007) and broadly consistent in terms of specification with its version used in the previous report (Kapuściński *et al.*, 2016). The model's block describing the transmission of monetary policy impulse to the financial sector is enlarged owing to the inclusion of two interest rates, i.e. the money market rate and the loan rate , as well as the volume of loans and standards for granting loans. The aggregate demand curve in the MMT model is characterised by a low degree of forward-lookingness. A detailed description of the MMT model is included in Appendix 3[19].

The core HICP inflation excluding food and energy prices is the main measure of inflation used in both models. The underlying reason was the need to ensure comparability between domestic and foreign

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[18] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.
[19] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

variables (in this way, the real exchange rate and the real interest rate are deflated with the same type of price index).[20]

The Small Monetary Policy Model (MMPP) is similar to the MMT model in terms of construction; however, it has a more developed nominal block (prices and inflation expectations).[21] There are four consumer price indicators, i.e. CPI inflation, core inflation excluding food and energy prices, and also food price and energy price indices. In the current version of the model inflation expectations of enterprises, financial sector analysts and consumers are taken into account, measured on the basis of survey data. They are characterised by limited, but various degrees of forward-lookingness. Expectations about the remaining macroeconomic variables are of a hybrid character in the model. In particular, the exchange rate is characterised by substantially larger inertia than in the other models. Appendix 4[22] describes details of the MMPP model.

2.2.2. Main characteristics of monetary policy transmission mechanism

To assess the strength and lags of the transmission of monetary policy impulses, we inspect the results of the simulation in which the short-term interest rate (WIBOR 3M) is increased by 1 p.p. for a period of one quarter and then allowed to develop according to the estimated monetary policy rule. We assume that in the period under analysis no other disturbances hit the economy, which means that the impulse responses of selected macroeconomic variables (Figure 8, Table 5) show a net effect related only to the change in interest rates.

The simulation results obtained from individual models, although qualitatively similar to each other, display some differences in terms of strength of response of certain macroeconomic variables to the monetary policy impulse, as well as the lag with which the responses occur. A tightening of monetary policy causes an immediate appreciation of the currency and an increase in interest rates on loans at commercial banks. The maximum response of annual GDP growth occurs no later than one year after the change in interest rate. At that time, the fall in the GDP growth rate, depending on the model, stands at between 0.1 and 0.3 p.p. Differences in the impulse responses of core inflation, excluding food and energy prices are smaller than in the case of economic activity. The maximum fall in core inflation amounts to approx. 0.2-0.3 p.p. and occurs with a lag no longer than 7 quarters. The impulse response of overall CPI inflation, obtained from the MMPP model, is slightly weaker than the reaction of core inflation. Its maximum amounts to approx. -0.2 p.p. and occurs in the second year after the interest rate change.

Due to the fact that after the first quarter of the simulation horizon the interest rate rule, relating the short-term interest rate to deviations of inflation from the NBP inflation target and the output gap, begins to operate in all the models, falls in inflation and economic activity resulting from the initial tightening of monetary policy result in a corresponding monetary policy easing.

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[20] The correlation between core measures of CPI and HICP inflation calculated in relation to the analogical quarter of the previous year amounted to 0.9 for the period in which the models were estimated.

[21] The MMPP model was recently used in the context of analyses of the importance of inflation expectations of various groups of entities in the transmission mechanism of monetary policy impulses (Łyziak, 2016c).

[22] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

Figure 8. Monetary transmission mechanism – results from structural models
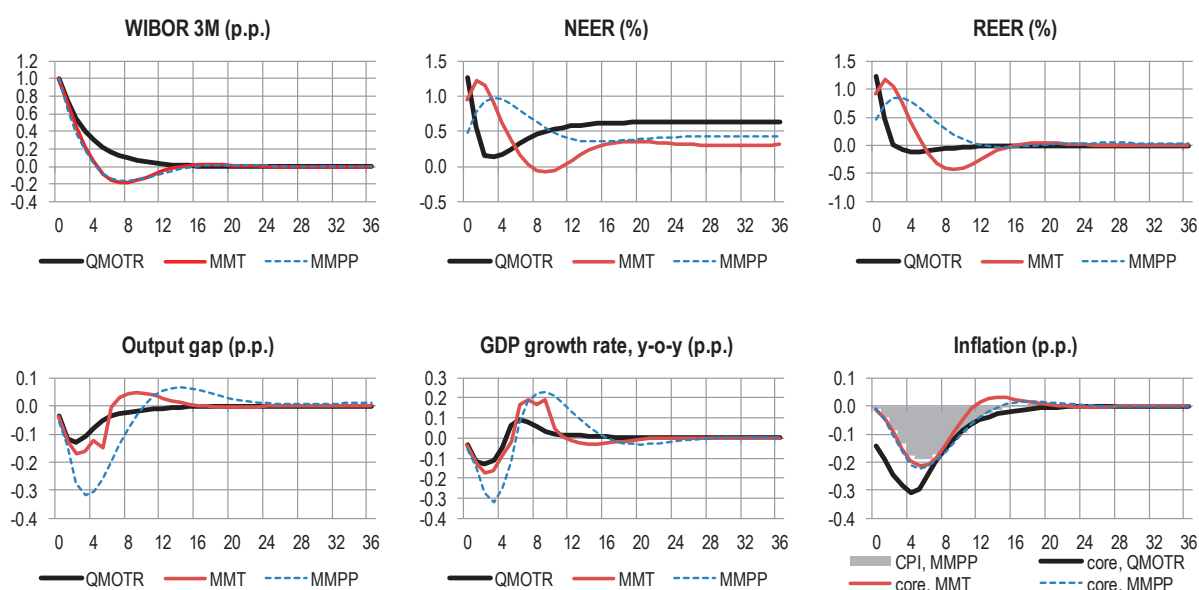
Source: own calculations.

Table 5. Monetary transmission mechanism – synthesis of results from QMOTR, MMT and MMPP structural models

	QMOTR	MMT	MMPP
Lending interest rate			
strength of maximum response (in p.p.)	x	0.7	0.8
lag of maximum response (quarter)	x	2	2
Nominal effective exchange rate (increase – appreciation)			
strength of maximum response (per cent)	1.3	1.2	0.9
lag of maximum response (quarter)	1	1-2	2-3
GDP growth y/y			
strength of maximum response (in p.p.)	-0.1	-0.2	-0.3
lag of maximum response (quarter)	1-3	2-3	2-4
Core inflation y/y			
strength of maximum response (in p.p.)	-0.3[1]	-0.2[1]	-0.3[2]
lag of maximum response (quarter)	3-5	3-7	5-6
CPI inflation y/y			
strength of maximum response (in p.p.)	x	x	-0.2
lag of maximum response (quarter)	x	x	4-8

Notes: [1] – HICP core inflation; [2] – CPI core inflation. The lag of maximum response is defined as the quarter or quarters in which the response of the given variable is equal to the maximum, accurate to one decimal place.

Source: own calculations.

2.2.3.   Assessment of the relative strength of respective channels of the transmission mechanism

The response of inflation to the monetary policy impulse presented in the previous part of the report contains the effects of various transmission channels. In this chapter we evaluate their relative strength. For this purpose we use the MMT structural model, in which the interest rate channel, the exchange rate channel and the credit channel are represented.

The simulation exercise was run in three steps. In the first step, we obtained the response of inflation to an increase of 1 p.p. in the short-term interest rate for a period of four quarters. This period is longer than in the simulations of the transmission mechanism described in section 2.2.2, which makes the effects of individual transmission channels more visible, and the results of the simulation are comparable with the results described in previous reports. Next, in an analogical simulation, we fixed the nominal effective exchange rate, thus rendering an approximation of the effect of interest rates on inflation through channels other than the exchange rate channel. In the last step, we fixed the variable representing the credit channel, i.e. the standards for granting loans, thus obtaining the approximated estimation of the effects of this channel.

The results obtained from the simulation with all the model's feedbacks (Figure 9) show that the maximum response of inflation to a 1 p.p. rise in the short-term interest rate for a period of four quarters occurs with a 6-quarter lag after the interest rate change and amounts to approx. -0.5 p.p. The interest rate channel and the credit channel considered together are significantly stronger than the exchange rate channel, although the latter dominates in the first 5-6 quarters following the change in the interest rate. 52% of the maximum response of core inflation results from the effects of the interest rate channel and credit channel, while approx. 48% results from the exchange rate channel. In the strongest transmission horizon the strength of the interest rate channel is almost five times bigger than in the case of the credit channel.[23]

Figure 9. Strength of respective channels of the transmission mechanism
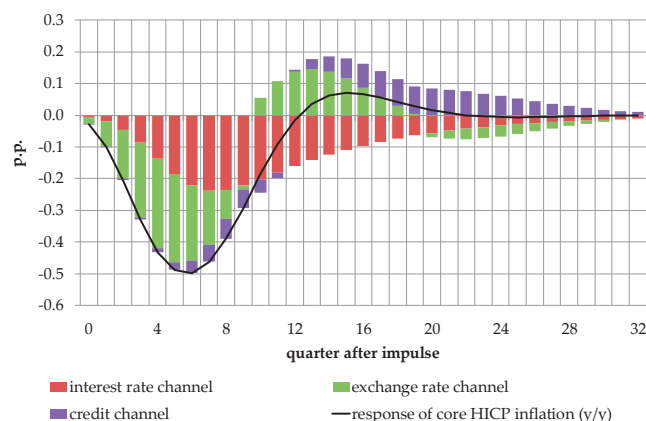
Source: own calculations.

[23] The results of an analogical decomposition of the response of inflation to a monetary policy impulse lasting one quarter indicate a stronger significance of the interest rate channel and smaller significance of the exchange rate and credit channels.

2.3. Cyclical characteristics of the monetary policy transmission mechanism

As we showed in the previous report, monetary policy may cause different effects in various phases of the business cycle (Kapuściński *et al.*, 2016). The latest research (Przystupa, 2017) describes the cyclical characteristics of the transmission mechanism in Poland in greater detail. The simulation of the short-term interest rate impulse was run using the QMOTR models calibrated for various values of the output gap. The impulse response functions obtained are dependent on the starting level of the output gap. When describing the obtained results, we average them in various phases of the business cycle, i.e. during recession, depression, recovery, and expansion.[24]

When assessing the cyclical diversification of estimates of parameters of the fundamental macroeconomic relationships of the model (Figure 10), it can be noticed that the largest difference in estimates is observed in the case of the aggregate demand curve and the Phillips curve. In periods of a positive output gap, particularly in the expansion phase, the impact of the output gap on consumer prices becomes stronger. This can be explained by capacity constraints in the economy. As the economic situation improves, the increasing use of productive capacity hampers the ability of firms to increase production, thus transforms demand growth into inflation rather than an increase in production. At the same time, prices in such periods respond strongly to changes in inflation expectations (the percentage of firms optimising prices increases) and the exchange rate, while inflation inertia declines. Interestingly, also in the case of economic activity and the exchange rate, the significance of expectations increases in periods of prosperity. In addition, in periods of recovery, in which the output gap is increasing, the impact of real interest rates on economic activity is greater than in periods of a slump.

The cyclical diversification of the estimated parameters of the QMOTR model was taken into account when conducting the simulation of the short-term interest rate impulse, analogous to that of chapter 2.2.2 of the report. The results of the simulation (Figure 11) show that the response of GDP growth is the strongest and fastest in the recovery phase, while it is the slowest and weakest in the recession phase. In turn, the response of HICP core inflation seems to be the strongest and fastest in the expansion phase, while it is the slowest and weakest in the depression phase.

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[24] In the recovery phase the output gap is negative, but is increasing. In the expansion phase the output gap is increasing and positive. In the recession phase the output gap is positive, but is decreasing. In the depression phase the output gap is negative and is decreasing.

Figure 10. Estimates of the main parameters of the QMOTR model in various phases of the business cycle
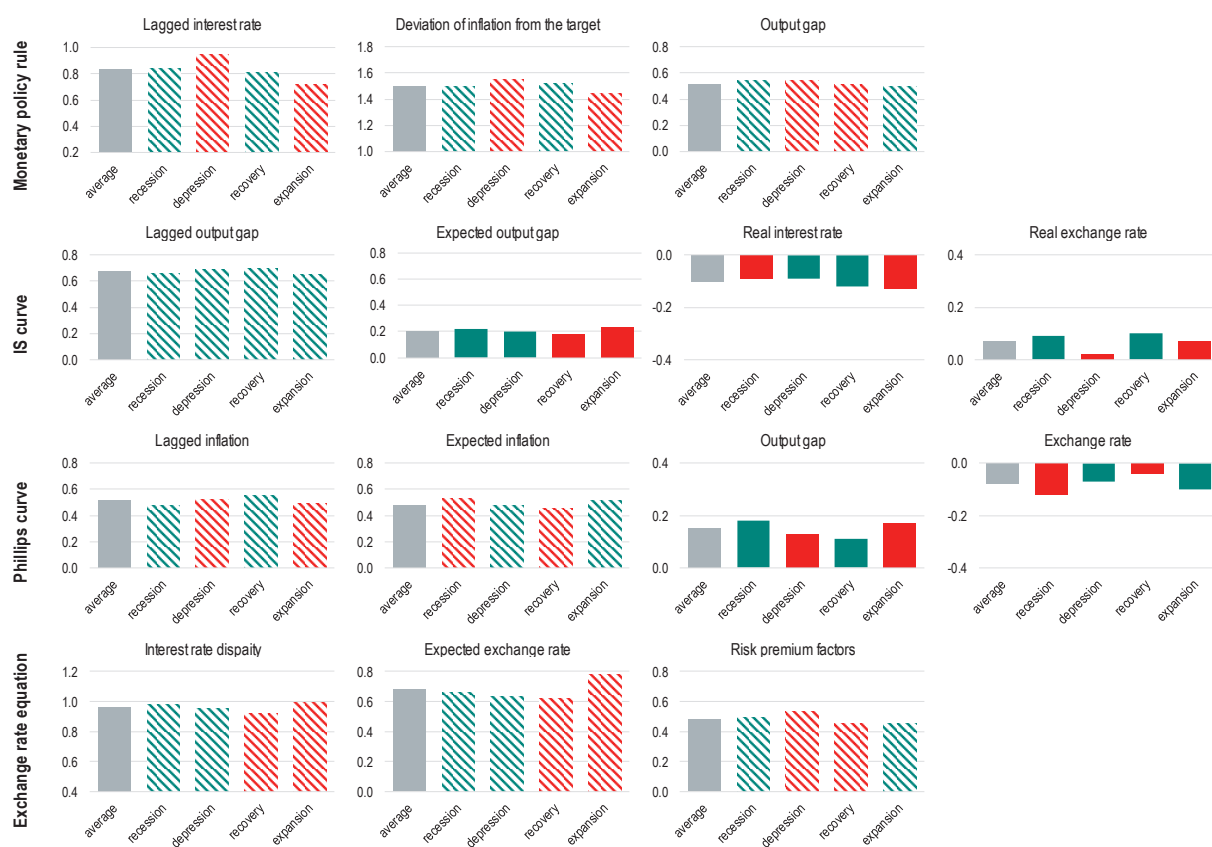
Notes: In the case in which the maximum and minimum estimates of the parameters in the various phases of the business cycle are not statistically different from the average estimates (using a full sample) we mark them with a striped pattern. We mark in red the estimates of the parameters which are statistically different from each other. E.g. taking into account parameters of expectations in the IS curve, we can conclude that its extreme estimates in the phases of the cycle differ from the average estimates and that the parameter in the recovery and expansion phase are different from each other. In turn, in the case of the parameter of interest rate disparity in the exchange rate equation, its estimates in the individual phases of the business cycle do not statistically differ from the average, but the differences in the estimates in the recovery and expansion phase are different from each other.

Source: own calculations (Przystupa, 2017).

Figure 11. Interest rate impulse and responses of selected variables in various phases of the business cycle

A. WIBOR 3M interest rate (p.p.)

B. Nominal effective exchange rate (increase – appreciation) (%)

C. GDP growth y/y (p.p.)

D. HICP core inflation (p.p.)
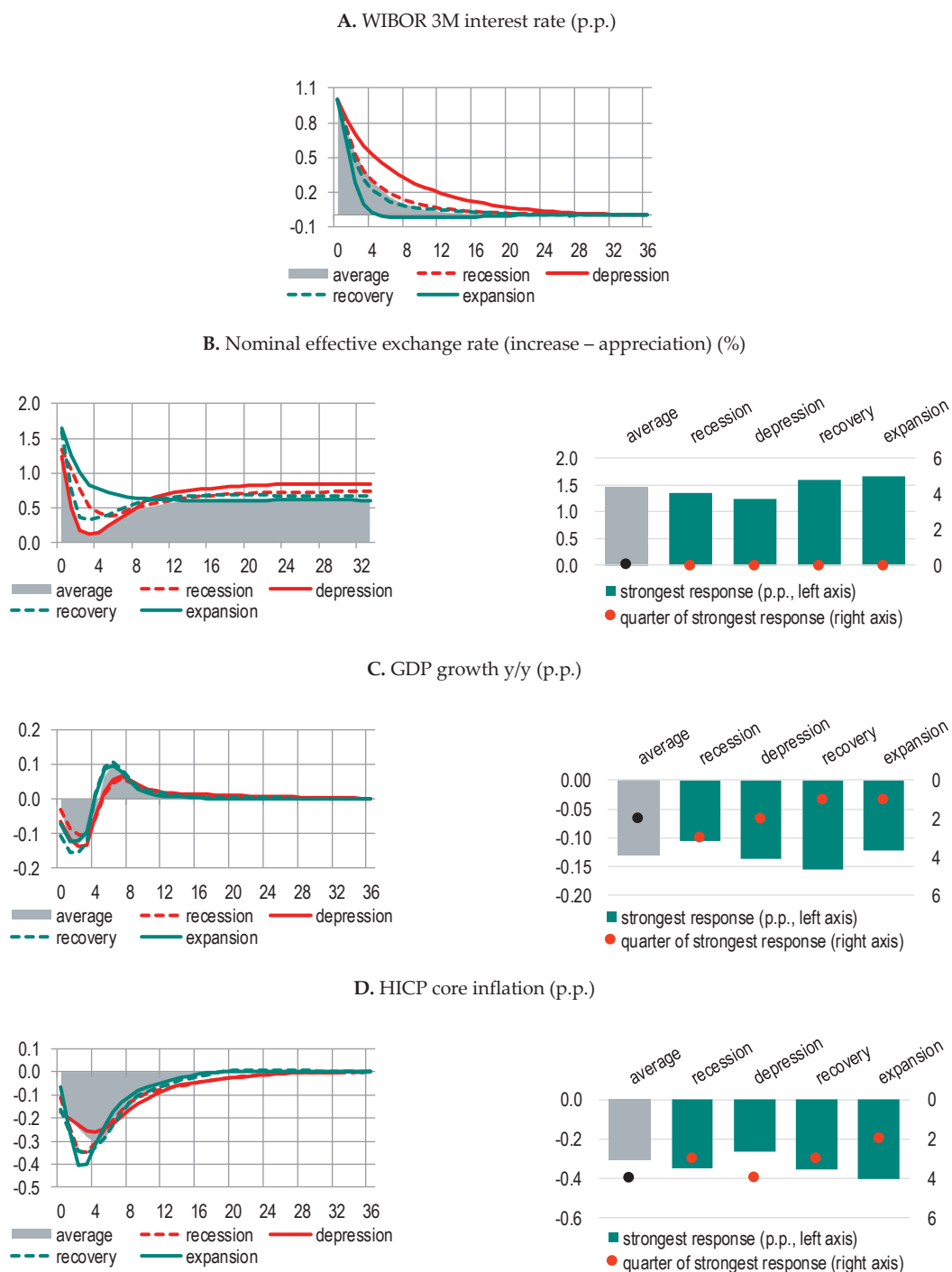
Source: own calculations (Przystupa, 2017).

The functioning of selected channels and stages of the monetary policy transmission mechanism

In the next part of the report we present the results of empirical research regarding selected channels and the stages of the monetary transmission mechanism in Poland, in particular the interest rate channel (section 3.1), the exchange rate channel (section 3.2), the credit channel, and the risk-taking channel (section 3.3). We also analyse the process of forming inflation expectations and the relationships between inflation expectations and inflation (section 3.4).

3.1. Interest rate channel

When presenting the results regarding the broadly understood interest rate channel we focus on the impact of the NBP reference rate on the money market rate, interest rate pass-through to the deposit and lending rates in commercial banks, and also to bond yields and share prices.

3.1.1. Transmission in the money market

When studying the impact of the NBP reference rate on money market rates we differentiate between expected (i.e. expected by money market participants) and unexpected changes in the reference rate and we show other factors which impact on the money market rates. We present the econometric models used for this analysis in Appendix 5[25].

Long-term relationship occurs between the reference rate and the money market rates, from which there are deviations in the short term (Figure 12). Increase of the NBP reference rate by 1 p.p. causes an increase in all the money market rates also by approx. 1 p.p. on average.[26] The adjustment of the money market rates is not only strong, but also immediate.

Expected changes in the reference rate are immediately and fully transmitted to the POLONIA rate; however, the impact of unexpected changes is smaller (Figure 13A). In the case of longer money market rates, we observe the opposite : unexpected changes in the NBP reference rate immediately and fully transmit to these rates, while the impact of expected changes is smaller. The main reason for these differences is that expectations about events which occur beyond the period relating to the given rate do not have an impact on it. When a change in the NBP reference rate is expected, anticipatory adjustments of longer rates take place, while the short-term POLONIA rate is still shaped by the current level of NBP rates. In the situation in which

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[25] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

[26] In the case of WIBOR 1M and 3M, formal tests do not allow one to assume that their adjustment is full, despite the estimate being close to unity.

these expectations prove to be wrong and the NBP reference rate remains unchanged, the POLONIA rate will not change; however, the longer rates, factoring in the effect of the mistaken expectations, will be corrected.

Interbank market rates also respond to changes in excess bank reserves, changes in the probability of default of banks, and surprises in macroeconomic data (Figure 13B-D). The increase in excess reserves causes a fall in the POLONIA rate, both in the long term and short term.[27] A higher probability of default of banks is associated with higher money market rates on average, although this impact is not statistically significant in every case. Positive surprises in GDP data cause an increase in longer money market rates, through an increase in the expected reference rate path. Surprises in inflation and industrial output impact on the WIBOR 6M and 1Y rates.

Figure 12. Transmission in the money market

A. NBP reference rate and money market rates
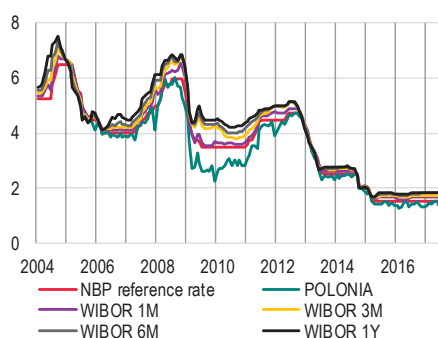
B. Spreads over the NBP reference rate
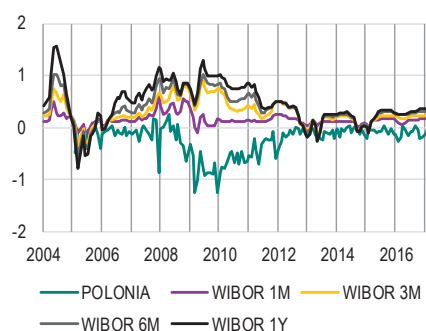
Source: own calculations based on NBP data.

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[27] Kapuściński and Pietryka (2017) show that the width of the corridor between interest on NBP deposit and lending operations also impacts on deviations of the POLONIA rate from the NBP reference rate. Although NBP could mitigate the impact of changes in surplus reserves on the spread of the POLONIA rate through narrowing the interest rate corridor, this would limit turnover on the one-day interbank deposit/loan market (see Appendix 5, http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf).

Figure 13. Factors impacting on money market interest rates
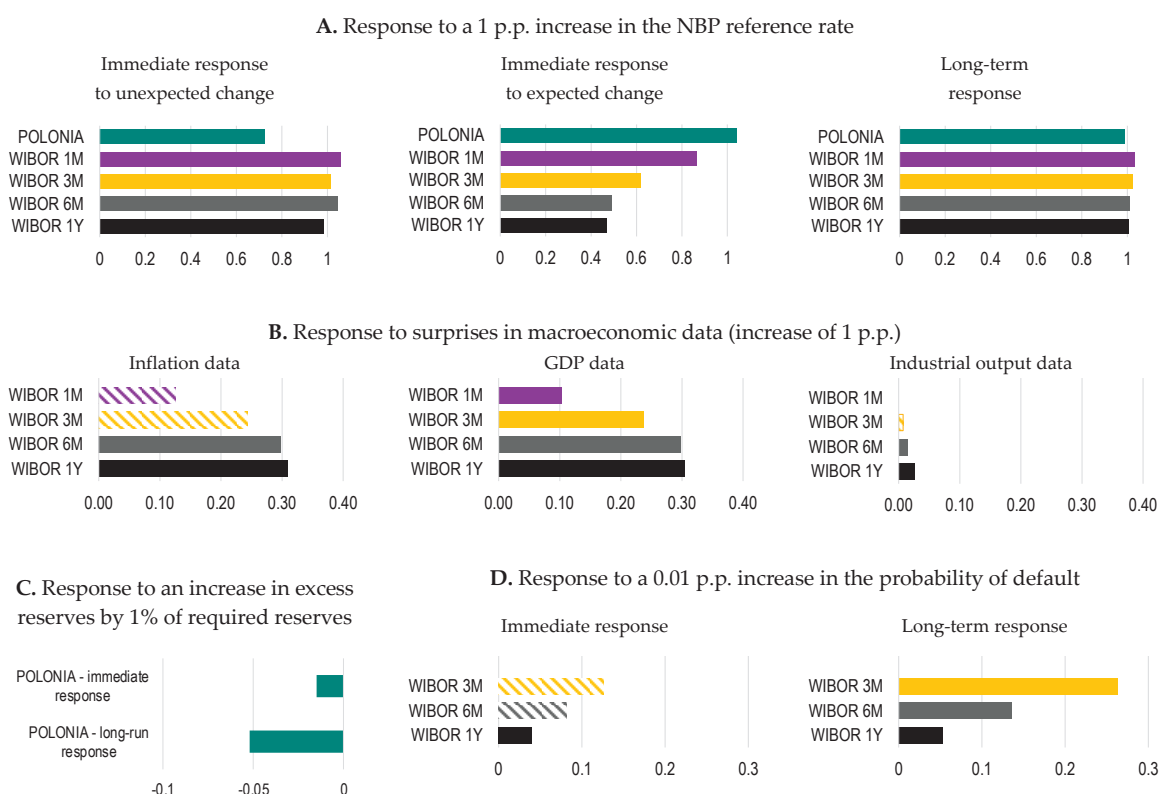
A. Response to a 1 p.p. increase in the NBP reference rate

B. Response to surprises in macroeconomic data (increase of 1 p.p.)

C. Response to an increase in excess reserves by 1% of required reserves

D. Response to a 0.01 p.p. increase in the probability of default

Notes: The striped pattern means the response does not differ statistically from zero.

Source: own calculations.

3.1.2. Transmission to deposit and lending rates

We analyse the impact of money market rates on deposit and lending rates from two perspectives. Firstly, in order to assess the strength of transmission of changes in money market rates (WIBOR 3M or WIBOR 1M) on them, we use aggregated data, i.e. the average weighted interest rates on loans and deposits in banks. Secondly, using the data of individual banks, we check what additional factors influence the level of interest rates or the transmission process. Models and results based on individual data are described in Appendix 6[28].

The pass-through from money market interest rates to the deposit and lending rates in commercial banks is strong and relatively fast. The increase in uncertainty following the collapse of Lehman Brothers disrupted the adjustment of retail interest rates in Poland only temporarily; however, spreads between deposit rates and the WIBOR rate, despite a sharp fall in recent years, still remain at an elevated level compared to the pre-crisis period (Figure 14).

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[28] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

Figure 14. Interbank market rate and retail deposit and lending rates

A. Level of deposit rates
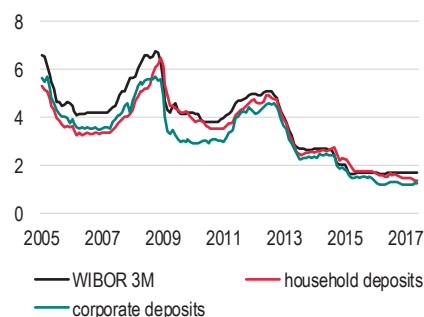
B. Deposit spreads over WIBOR 3M or 1M
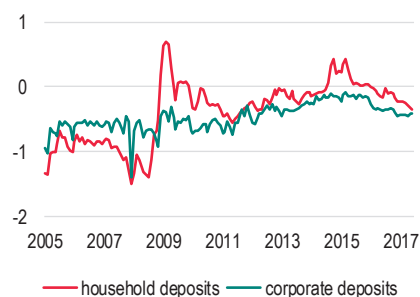
C. Level of lending rates
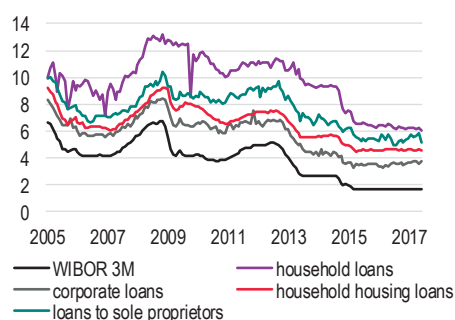
D. Lending spreads over WIBOR 3M or 1M
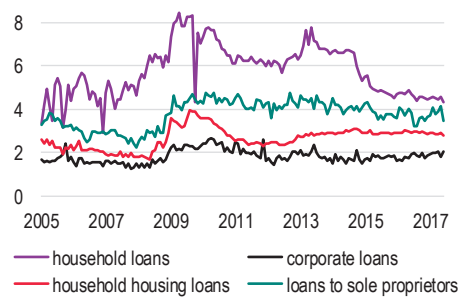
Source: NBP.

Changes in market rates are fully transmitted to the average interest rate on household deposits (Table 6). This is due to deposits with maturity of over 1 month and up to 12 months. The interest rate on the shortest deposits, up to 1 month, shows a weaker adjustment. The interest rate on corporate deposits shows an adjustment of approx. 85% to changes in the money market rate.

Interest rates on total loans, and loans to households and to firms, fully adjust to changes in market rates. The point estimates of the long-run adjustment multipliers of individual types of loans are usually close to one; nevertheless, in the case of certain types of loans, formal tests show that the hypothesis that in the long-term the adjustment of interest rates on loans is complete should be rejected. In particular, the long-run adjustment

of housing loans for households is lower than one[29], while the adjustment of the interest rate on loans for sole proprietors seems to be stronger than the change in the money market rate[30]. Among the types of household loans, poorly secured consumer loans stand out – in this case there is no long-term relationship with the money market rate.

Table 6. Estimates of long-run pass-through of money market rates to deposit and lending rates, 2005:01-2017:06, aggregated data

	Long-run multiplier	Is long-run multiplier=1?	Parameter of error correction mechanism
Interest rate on deposits			
Total household deposits	0.93	yes	-0.21
Household deposits up to 1 month	0.7	no	-0.2
Household deposits from 1 to 3 months	1.02	yes	-0.19
Household deposits from 3 to 6 months	1.04	yes	-0.31
Household deposits from 6 to 12 months	1.02	yes	-0.27
Total corporate deposits	0.9	no	-0.49
Corporate deposits up to 1 month	0.85	no	-0.38
Corporate deposits from 1 to 3 months	1.14	no	-0.25
Interest rate on loans			
Total household loans	1.08	yes	-0.11
Housing loans for households	0.65 / 0.76*	no / no*	-0.14 / -0.26*
Loans for sole proprietors	1.11	no	-0.47
Total corporate loans	0.95	yes	-0.42
Corporate loans, up to PLN 4 m	1.03	yes	-0.31
Corporate loans, above PLN 4 m	0.92	yes	-0.48

Notes: The parameter of error correction mechanism informs about the speed of adjustment to the equilibrium. The higher it is in absolute value, the faster interest rates converge to the long-term equilibrium. The "*" symbol signifies results of estimates for the annual percentage rate of charge of housing loans for households (containing the total cost of the loan to the consumer, expressed as a percentage of the amount of the loan in annual terms).
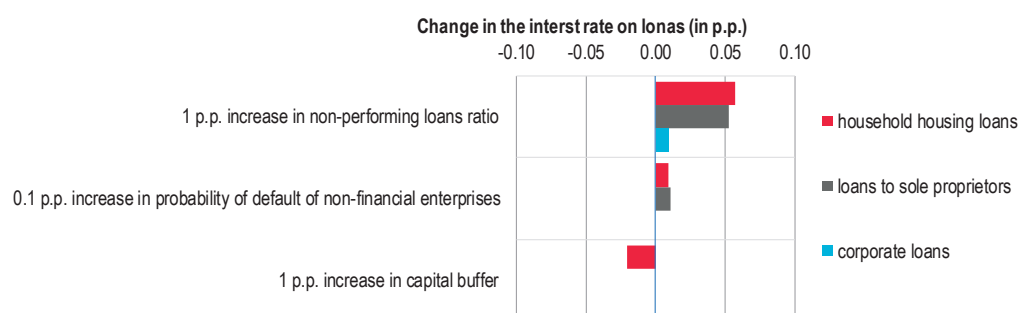
Source: own calculations.

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[29] The so-called annual percentage rate of charge (APRC) of housing loans, containing the total cost of the loan to the consumer, adjusts to the WIBOR rate to a slightly greater extent than to the "price-list" rate. Although the relationship of the ARPC with the money market rates is more stable than for the price-list rates, we observe certain disturbances and changes in this case too. The financial crisis of 2008, associated with the real estate bubble in the USA, was a serious disturbance. The crash in this market spread to the interest rates on housing loans in other countries, which was fostered by the speculative bubbles in certain euro area countries. Until 2012, the adjustment of the long-term effective interest rate on housing loans to the money market rate was full. Since 2013, the long-run multiplier has been below 0.80. At the same time, the estimation of the constant increased, reflecting the level of the mark-up. Therefore, it seems that when determining the interest rate on housing loans, banks are currently reacting to a slightly smaller extent to changes in the money market rate, and make stronger adjustments of mark-ups. The reason for this may be the increased demand for zloty-denominated housing loans due to the restrictions on the possibility to take out foreign currency loans and the launch of the government-subsidised "Housing for the Young" scheme, as well as the recommendation of the Polish Financial Supervision Authority to apply strict requirements regarding the granting of housing loans.

[30] The analysis of the adjustment of the long-term interest rate on deposits and loans based on data from individual banks confirms the results obtained on the basis of aggregated data, with the exception of the category of loans for sole proprietors. The coefficient of long-term adjustment estimated on the basis of individual data is lower than 1 (approx. 0.91), while the test of the hypothesis of a full adjustment gives a result close to rejection. The discrepancy between estimates on aggregated and individual data could arise due to the fact that banks differ greatly in terms of interest rate policy for this category of loans.

Besides the interbank market rate, the quality of the loan portfolio also has an impact on the level of the interest rate on housing loans for households, loans for sole proprietors and corporate loans. The increase in non-performing loans leads *ceteris paribus* to an increase in the interest rates on loans (Figure 15). The interest rate on housing loans and loans for sole proprietors also increase in periods of increased credit risk, measured by the probability of default of non-financial enterprises. Moreover, the interest rate on housing loans responds to the level of the capital buffer, i.e. surplus capital above the regulatory requirement in relation to assets. A higher capital buffer lowers the loan margin.

Figure 15. Impact of additional factors on the interest of retail loans

Notes: A description of models and results is included in Appendix 6 (http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf).
Source: own calculations based on NBP data.

Individual characteristics of banks, such as the size of assets, capital buffer (surplus capital above regulatory requirements), or the share of deposits in liabilities, do not have a significant impact on the scale and speed of adjustment of the retail interest rate to the interbank market rate. Out of the analysed variables, only liquidity proves to differentiate the long-term reaction of interest rate on household and corporate deposits and the interest rate on corporate loans (see Appendix 6[31]). Banks with higher liquidity, measured by the ratio of liquid assets to total assets, to a smaller extent pass on changes in the WIBOR rate to the interest rate of their products than banks with lower liquidity (Figure 16). Moreover, banks with a higher capital buffer adjust the interest rate on corporate deposits and loans slightly faster, while more liquid banks do so slightly faster in the case of household deposits.

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[31] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

Figure 16. Liquidity of banks and adjustment of retail interest rates to change in the WIBOR rate by 1 p.p.
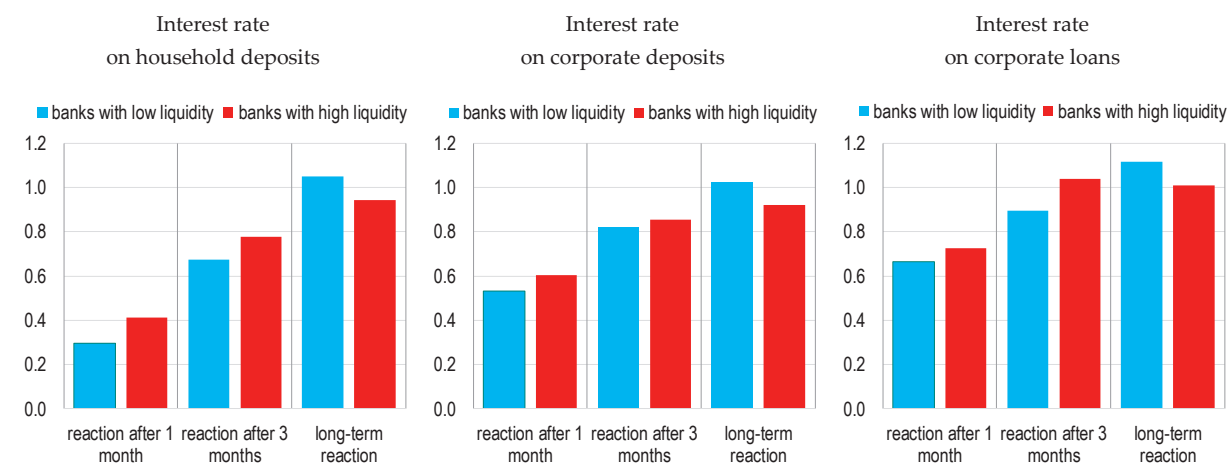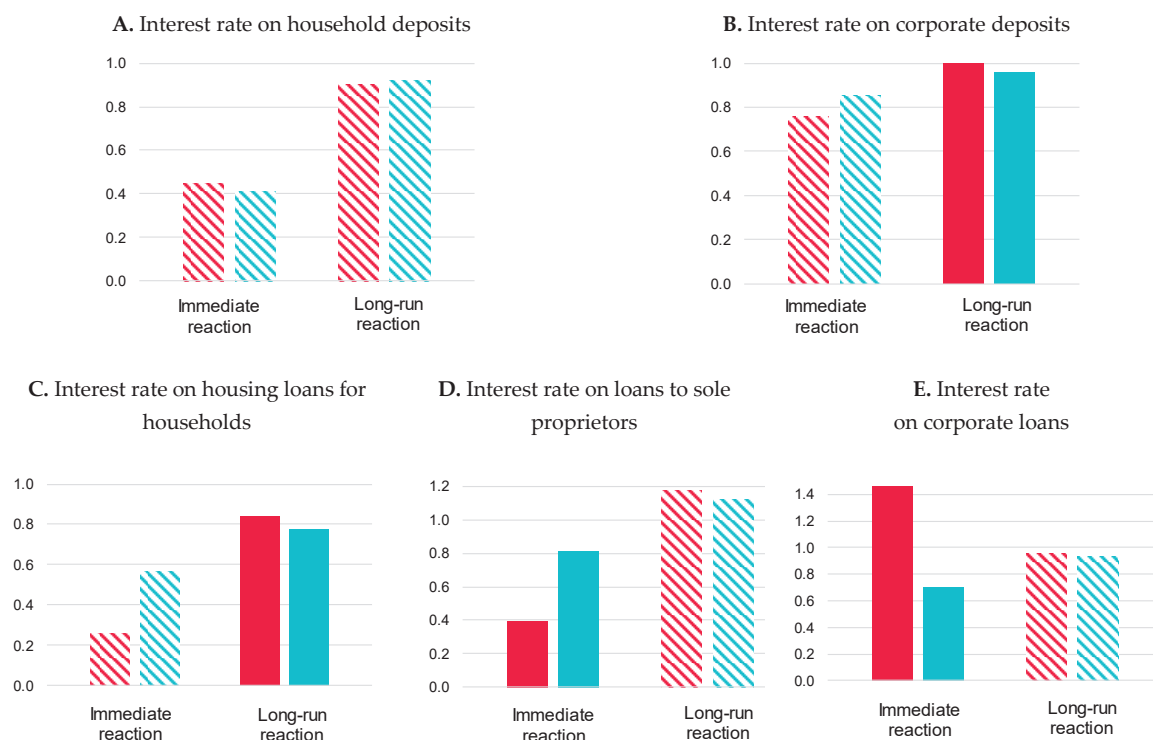

Notes: The bars on the charts show the adjustment of the retail interest rate in the short term and long term to changes in the WIBOR rate by 1 p.p. in banks characterised by various levels of liquidity (measured as the ratio of liquid assets to total assets). A bank with low liquidity is a bank whose liquidity ratio is equal to the 25th percentile, and a bank with high liquidity if equal to the 75th percentile in the group of analysed banks.

Source: own calculations based on NBP data.

When assessing the possible differences in adjustment of interest rates on deposits and loans to movements in the interbank market rates, both in the short term and long term, it seems that the bulk of the adjustments are of a symmetrical character (Figure 17, see also Appendix 6[32]). The interest rate on corporate deposits responds stronger to increases in market rates than to falls in the rates, which can be explained by the unwillingness of banks to reduce interest rates of these deposits in the period of disturbances on the interbank market, which took place in the period of falling market rates. Similarly, the interest rate on housing loans for households responds to increases in the interbank market rates in a more pronounced manner than to corresponding falls, although in this case the result is on the border of statistical significance. As far as the speed of adjustment is concerned, the interest rate on loans for sole proprietors responds faster to falls in interest rates than to corresponding increases, while the opposite effect is observed in the case of the interest rate on corporate loans. However, the identified asymmetries are not strong, and in addition may result from the fact that in the period under analysis, particularly since the beginning of the financial crisis, falls in the market rates prevailed.

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[32] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

Figure 17. Adjustment of interest rates on retail deposits and loans to increase (in red) and fall (in blue) in the WIBOR rate (by 1 p.p)

A. Interest rate on household deposits

B. Interest rate on corporate deposits

C. Interest rate on housing loans for households

D. Interest rate on loans to sole proprietors

E. Interest rate on corporate loans

Notes: The striped pattern signifies that the difference between the response to an increase and decrease in the WIBOR rate is statistically insignificant. The plain bars signify that the difference is statistically significant. Immediate response is a response in the same month as the change in the WIBOR rate.
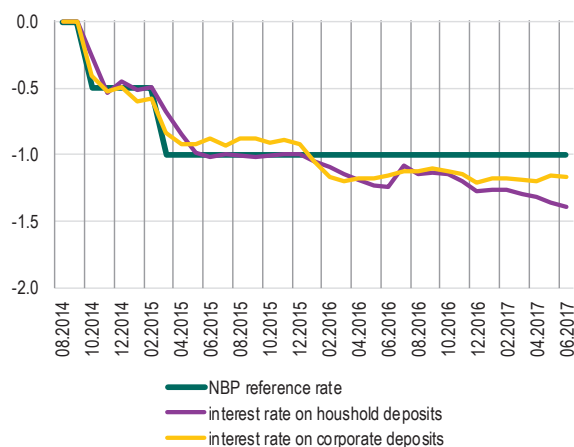
Source: own calculations based on NBP data.

Despite historically low interest rates, retail interest rates adjusted to the last two reductions in the NBP reference rate – made in October 2014 and March 2015 – in accordance with the relationships described above (Figure 18). The interest rate on housing loans and corporate loans also decreased in accordance with the identified relationships, while the interest rate of the latter began to display an anticipatory response as early as a month before the reduction in the NBP reference rate in October 2014. The interest rate on loans for sole proprietors initially displayed a sharper rather than proportional decrease, but next it increased slightly (the interest rate of this category of loans is the most volatile). However, banks already having low lending rates reduced them to a smaller extent than banks with high lending rates, which may suggest a less effective pass-through of any possible further decreases in market rates to the lending rates (Figure 19). In 2016 the interest rates of deposits and loans were affected by the introduction of the tax on bank assets, which – with an unchanged NBP reference rate – translated into a reduction in the interest rate on corporate and household deposits (particularly deposits with maturity up to 1 month) and an increase in the interest rate on corporate loans (particularly large loans, above PLN 4m). The tax on bank assets reduced the interest rate on household deposits with maturity up to 1 month by approx. 6 basis points, while for other maturities, the variable

approximating the impact of the tax proved to be statistically insignificant. The interest rate on corporate deposits also decreased due to the bank tax, by approx. 9-10 basis points.

Figure 18. Adjustment of retail deposit and lending rates to the last two reductions in the NBP reference rate (in October 2014 by 0.5 p.p. and in March 2015 by 0.5 p.p.)

A. Cumulative changes in the NBP reference rate and in deposit rates

B. Cumulative changes in the NBP reference rate and in lending rates
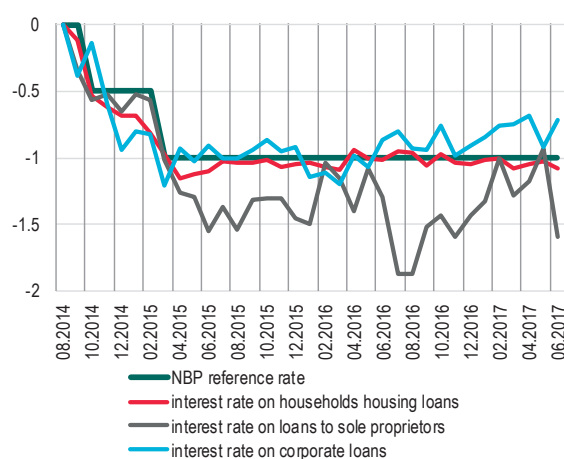
Notes: In the case of the interest rates on deposits, the starting point is September 2014. The interest rates on loans began to adjust in advance, which is why the starting point is August 2014.

Source: own calculations based on NBP data.

Figure 19. Relationship between the change in deposit and lending rates after the last two reductions in the NBP reference rate and their starting point

A. Interest rate on deposits

B. Interest rate on loans

Notes: The last two reductions in the NBP reference rate took place in October 2014 (by 0.5 p.p.) and in March 2015 (by 0.5 p.p.). The horizontal axis marks the level of retail interest rates before the reduction in the NBP reference rate (in the case of 1-month deposits, in the case of loans which began to adjust in advance – 2 months before the NBP decision), and the vertical axis marks the change in the retail interest rate 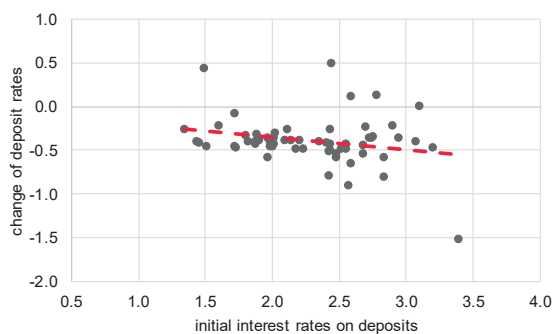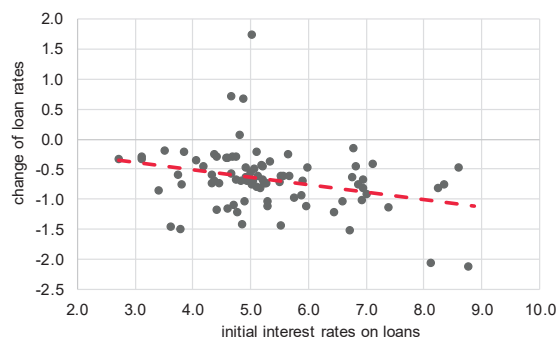in the 3-month period following the change in the reference rate. Each point illustrates the interest rate in an individual bank (on panel A this is the interest rate on household or corporate deposits, on panel B it is the interest rate on housing loans for households, the interest rate on loans for sole proprietors, or corporate loans).

Source: own calculations based on NBP data.

3.1.3. Transmission to bond yields and share prices

We analyse the impact of monetary policy on government bond yields using analogous models to those used in the analysis of transmission in the money market (Appendix 5[33]). Moreover, in 2-day windows around the decisions of the MPC, we check how bond yields and share prices (WIG20) respond to an expected or unexpected change in the NBP reference rate or signalled changes in the reference rate in the future. For share prices we also study the response to a change in the NBP reference rate in 60-minute windows.

In accordance with the results from the model based on a lower frequency (monthly), the average impact of an increase in the NBP reference rate by 1 p.p. on government bond yields is in the long term less than proportional, although in the case of 2-year bonds we do not reject the hypothesis of a full pass-through. The adjustment of yields to a change in the reference rate is gradual (Figure 20).

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[33] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

Figure 20. NBP reference rate and government bond yields

A. Level of interest rates
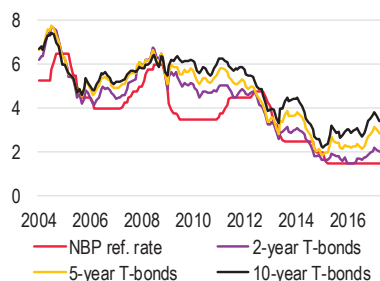
B. Spreads over the NBP reference rate
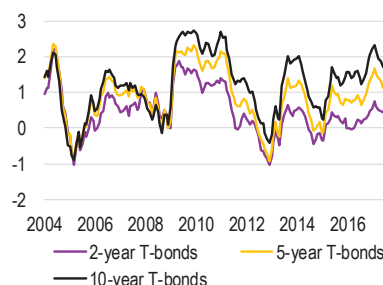
C. Response to a 1 p.p. increase in the NBP reference rate
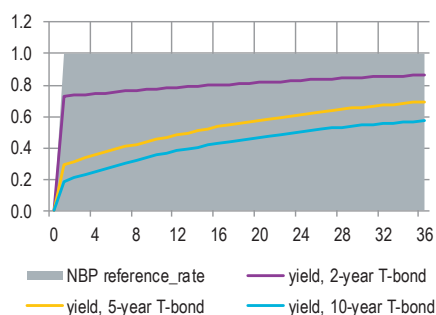
Source: own calculations.

The immediate response of government bond yields to both expected and unexpected changes in the NBP reference rate is smaller than the long-term response. For 2-year and 5-year bonds, the average impact of unexpected monetary policy decisions is larger than the effect of expected changes. The 10-year horizon is so long in the context of changes in the current NBP reference rate that bonds with such a long maturity respond on average in the same way to expected and unexpected changes (Figure 21A)[34].

As far as the impact of other variables is concerned, a higher default probability of the government is associated with higher average government bond yields, although this impact is not statistically significant in every case. Government bond yields are also affected by surprises in inflation and industrial output (Figure 21B, Figure 21C).

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[34] Formally, in the models for the short-term relationship for government bond yields, only the impact of unexpected changes in the NBP reference rate on 2-year bonds is significant; however, this may be related to the imperfectness of the measurement of the expected and unexpected component. If we replace them with a change in the reference rate without dividing into categories, it is statistically significant, and the point estimates of the parameters are between the estimates of the parameters for the expected and unexpected changes.

Figure 21. Factors influencing government bond yields
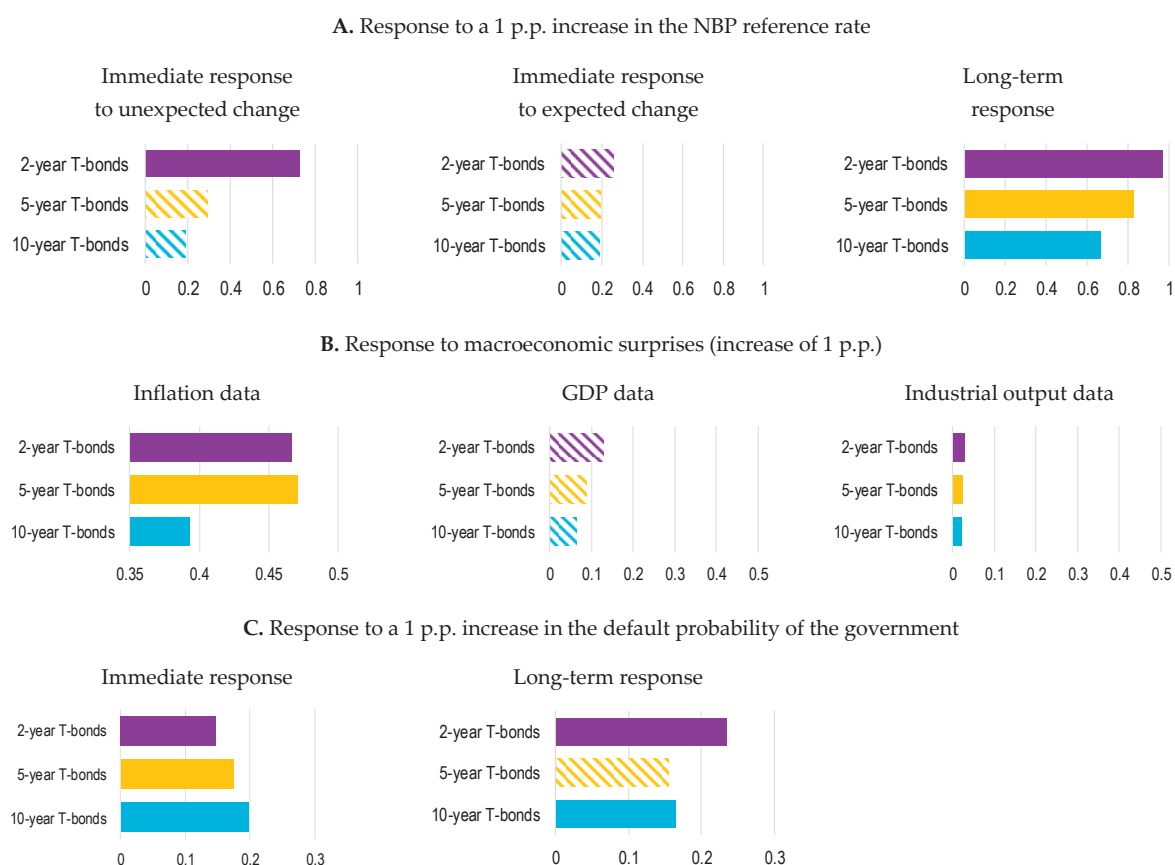
A. Response to a 1 p.p. increase in the NBP reference rate

Immediate response to unexpected change — Immediate response to expected change — Long-term response

B. Response to macroeconomic surprises (increase of 1 p.p.)

Inflation data — GDP data — Industrial output data

C. Response to a 1 p.p. increase in the default probability of the government

Immediate response — Long-term response

Notes: The striped pattern means the response does not differ statistically from zero.

Source: own calculations.

Moving on to the results from the model based on high frequency data, in the 2-day windows around the decision of the MPC, government bond yields increase following both an unexpected increase in the NBP reference rate as well as a tightening of monetary policy in the future, signalled by the MPC through forward guidance. The role of central bank communication is greater for longer interest rates and is dominant in the case of share prices, which the current decisions of the MPC do not have a significant statistical impact on (Figure 22A). In turn, in the 60-minute windows around the MPC decisions, an unexpected increase in the NBP reference rate by 1 p.p. is associated with a fall in share prices by approx. 0.53% (Figure 22B).

Figure 22. Impact of the MPC's decisions and communication on the prices of financial assets around the time of the decision meetings
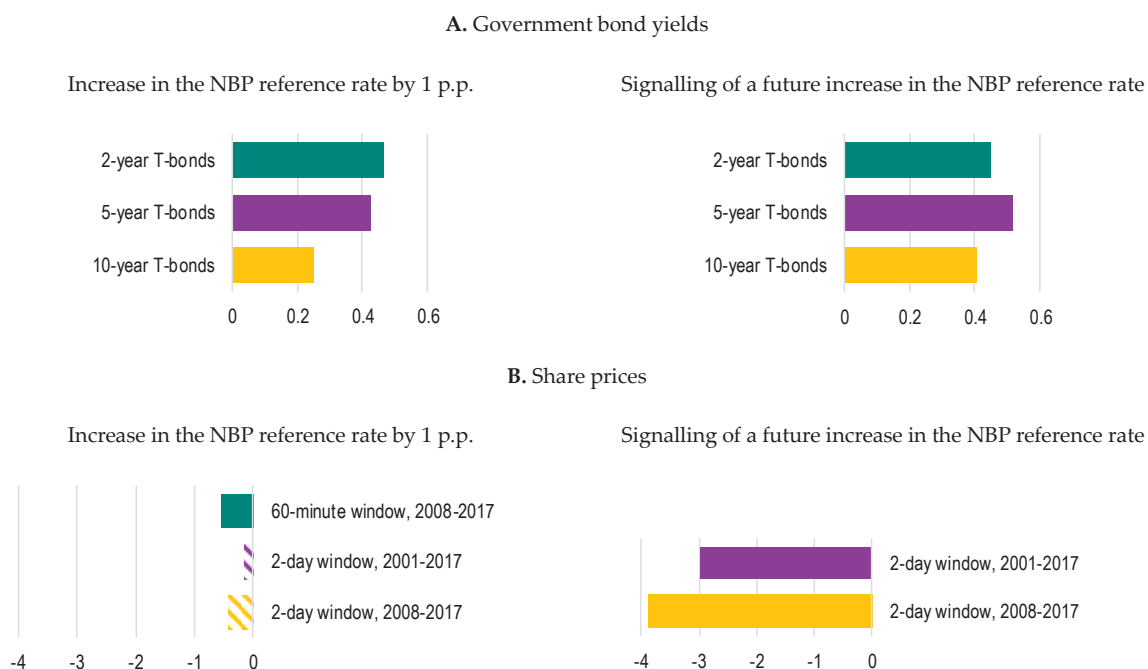
A. Government bond yields

Increase in the NBP reference rate by 1 p.p.

Signalling of a future increase in the NBP reference rate

B. Share prices

Increase in the NBP reference rate by 1 p.p.

Signalling of a future increase in the NBP reference rate

Notes: The striped pattern means the response does not differ statistically from zero.

Source: own calculations.

3.2. Exchange rate channel

3.2.1. Impact of interest rate disparity on exchange rate

In chapter 2.1.1 we showed that the counterintuitive response of the exchange rate to a monetary policy shock can be interpreted within the concept of the uncovered interest rate parity with a risk premium component. The decomposition of variance of the nominal and real effective exchange rate (NEER, REER), based on the estimate of such an equation indicates that the interest rate disparity has relatively little significance in explaining changes in the exchange rate in Poland. The fundamental role is played by risk factors for the domestic economy, proxied in particular by the output gap (Figure 23A). However, the interest rate disparity does affect the level of the exchange rate in accordance with the theory of the uncovered interest rate parity, as a result of which there is an appreciation of the zloty following an unexpected increase in the interest rate (see part 2.2.2 of the report).

An alternative method of testing the impact of monetary policy on the exchange rate is the use of high-frequency data and a focus on the behaviour of the exchange rate around the time of the Monetary Policy

Council decision meetings. Although this does not allow one to establish the persistence of the impact of monetary policy on the exchange rate, it does make possible an exact separation of the impact of the decision and monetary policy communication on the exchange rate.

Figure 23 shows the impact of an unexpected increase in the NBP reference rate by 1 p.p. and the signalling of a higher reference rate in the future by the MPC (in press releases or at the press conferences after the meetings) on the exchange rate of the zloty against the euro. The analysis is conducted in 60-minute windows around the decision of the MPC in the years 2008-2017 and in 2-day windows in the years 2001-2017 and 2008-2017. Details of the research are described in Kapuściński (2017b).

According to the results of the research conducted on data from 2008-2017 in the 60-minute windows around the MPC decisions, an increase in the NBP reference rate by 1 p.p. is associated with an appreciation of the zloty of approx. 1% (Figure 23B). In the analysis based on a longer sample and wider windows, the impact of current monetary policy on the exchange rate is not statistically significant. However, the point estimate has a correct sign, and after limiting the sample to the years 2008-2017, the impact of monetary policy on the exchange rate becomes statistically significant.

Taking into account the data from 2001-2017, the signalling by the MPC of the possibility of an increase in the NBP reference rate in the future is associated with a depreciation of the zloty. This can be explained by an increase in the risk premium or a response of the prices of other financial assets whose return has an impact on the exchange rate. However, regardless of its source, in the sample from 2008 the impact of the communication measure on the exchange rate ceases to be statistically significant.

Figure 23. Impact of interest rates on exchange rate

A. Decomposition of variance of the nominal effective exchange rate of the zloty (NEER) and the real effective exchange rate (REER), in %
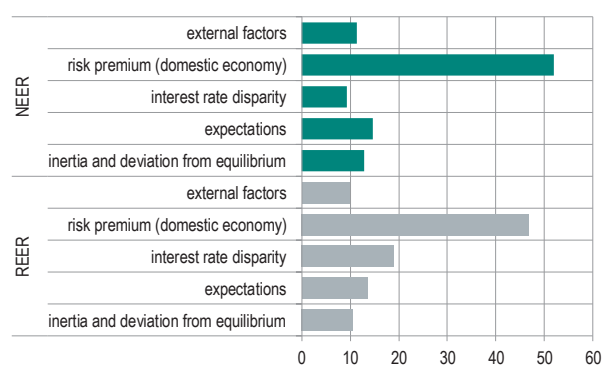
B. Impact of interest rate decisions and MPC communication on the exchange rate around the time of the decision meetings (increase – appreciation)
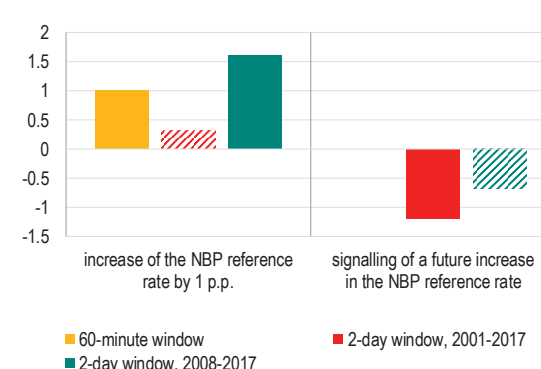
Notes: The striped pattern means the response does not differ statistically from zero.

Source: own calculations.

3.2.2. Impact of exchange rate on aggregate demand

Movements in the exchange rate affect the real economy mainly through the impact on exports and imports. An increase in the interest rate causes an immediate appreciation of the nominal exchange rate of the zloty (see part 2.2.2 of the report), and only in the subsequent periods does it cause a change in relative prices (costs), leading to change in competitiveness, affecting the volume of trade turnover. In the first two quarters after the appreciation of the exchange rate, the prices of goods not subject to processing in the country, above all, finished consumer goods, decrease, thus increasing the volume of imports (Figure 24A). Exports respond with a larger lag than imports, since for a short time the prices in foreign currency that were fixed in earlier contracts still apply. As a result of the above effects, there is a deterioration in the balance of trade (net exports). Under the impact of the gradual depreciation of the exchange rate following its initial appreciation, and the adjustment processes, the above effects are reversed. Taking into account the changes in volume of exports and imports, the effect of changes in the exchange rate for aggregate demand and GDP is small and short-term. The maximum fall in annual GDP growth resulting from appreciation of the zloty by 1% does not exceed 0.1 p.p.[35]

The role of the exchange rate in shaping the volume of exports and imports and GDP is – against the background of its other determinants – very small; however, the decisive role is played here by internal and external factors related to the real economy (Figure 24B). This result is in accordance with the conclusions from the foreign trade models (e.g. Helpman i Krugman, 1985; Melitz, 2003), showing the dependence of imports and exports on the scale of monopolistic competition, diversity of the export offer, quality of products, diversity of productivity of firms, and the degree of fragmentation of production within the global value chains (GVC). In the global value chains, trade growth is driven by supply factors (growth of diversity and quality of goods), technological factors (related to foreign investment inflows), and feedback between exports and imports, while the impact of the exchange rate is small. This is also confirmed by recent research on a large group of economies (Swarnali *et al.*, 2015), as well as research based on data from the Polish economy (Kelm, 2016). The latter shows that in Poland, foreign trade within global value chains does not respond at all to changes in the exchange rate.[36] Although – as we found in chapter 1.2.2 of the report – the significance of the exchange rate for approx. 60% of exports seems to be neglected, the exchange rate impacts on the remaining part of exports, related to sectors of goods such as agriculture, fishing, foodstuffs, furniture and lamps, copper and mineral fuels. The weight of the exchange rate in explaining the volatility of exports in these categories of products oscillates around 20% (Table 7).

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[35] This result is in line with the estimates of the International Monetary Fund (see *IMF World Economic Outlook*, October 2015, Chapter 3).

[36] Marczewski *et al.* (2014) also draw attention to the decline in significance of price competitiveness for foreign trade in Poland, associating it with the internationalisation of production processes and trade, when settlements between enterprises are made within the same capital groups.

Figure 24. Exchange rate and economic activity

A. Impact of a 1-percent appreciation of the exchange rate on annual GDP growth, imports and exports
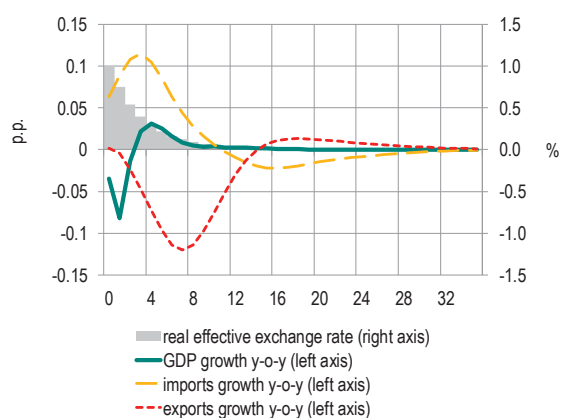
B. Decomposition of variance of GDP, volume of exports and volume of imports (in %)
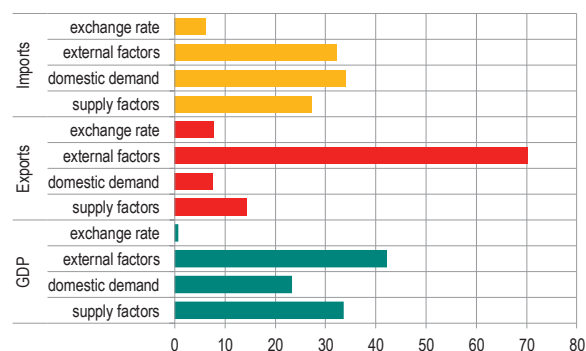
Source: own calculations.

Table 7. Estimated share of the exchange rate in explaining changes in exports in selected CN sections

CN section	Share in total exports (%)	Share in national value added in exports of a given section (%)	Estimated share of the exchange rate in explaining increases in exports in a given CN section (%)
I-III (agriculture, fishing)	6.82	80	25-30
IV (foodstuffs, alcohol)	6.35	75	20-25
V 27 (mineral fuels)	2.5	85	10-15
XV 74 (copper)	3.25	75	15-20
XX 94 (furniture, lamps)	5.87	80	20-25
XVI (machinery and electrical equipment, parts)	23.7	60	0-5
XVII (vehicles, parts)	14.4	50	0-5

Source: own calculations; GUS data.

3.2.3. Pass-through effect

Forbes *et al.* (2017) show that the exchange rate pass-through effect to consumer prices depends on the type of the shocks causing the movement in the exchange rate. In particular, this effect is greater when the change is a result of monetary policy shocks rather than other ones. Despite the fact that Poland was classified by Forbes *et al.* (2017) in the group of countries in which monetary policy shocks significantly affect the exchange rate, the exchange rate pass-through effect to consumer prices for the years 2010-2015 was estimated at only

0.07. The decline in the pass-through effect of approx. 0.2 in the years 2004-2009 is explained by Forbes *et al.* (2017) by the structural changes in the economy and credible monetary policy.

The above results are analogous to those that we presented in the previous reports on monetary transmission (Kapuściński *et al.*, 2014; Kapuściński *et al.*, 2016), as well as with the current estimates. Showing the declining impact of the exchange rate on consumer prices (Figure 25A), we indicated that it is associated with changes in the production process caused by the internationalisation of production, reflected in the growing share of international enterprises in industrial production and services. Research conducted with the application of the SVAR model (McCarthy, 1999) on quarterly and monthly data confirms that in recent years (since 2013/2014 depending on the type of price index) we have been dealing with a stabilisation of the pass-through effect – at the level of 0.06-0.08 for consumer prices, 0.30-0.34 for producer prices and 0.83-0.88 for import prices. The speed of response of prices to changes in the exchange rate is similar as in the previous studies (Table 8). In the case of consumer prices, 39% of the price change takes place during the first quarter after the exchange rate shock, for producer prices – 74%, and for import prices – 77%. Practically the whole of the pass-through effect is realised during four quarters after the change in the exchange rate.

The results of estimates of the exchange rate pass-through effect on core inflation obtained from the QMOTR model show that the pass-through effect – amounting to an average of approx. 0.08 – changes from 0.02 in the lowest point of depression to approx. 0.14 at the peak of economic activity (Figure 25B). A slightly larger impact of the exchange rate on consumer prices during a deterioration of the business cycle is associated with the attempts of firms to maintain their market share – enterprises exporting to countries with a depreciating currency are more prone to reduce prices than raise them during an appreciation of the currency (Przystupa and Wróbel, 2011). This effect stops working in extreme periods of the business cycle. The difference in response of prices to inflation between the trough and the peak of the business cycle was 0.17 in the study, and currently 0.13, remaining at statistically unchanged level despite the decline in the pass-through effect from approx. 0.21 to approx. 0.08.

Figure 25. Impact of exchange rate on prices

A. Changes in the pass-through effect over time
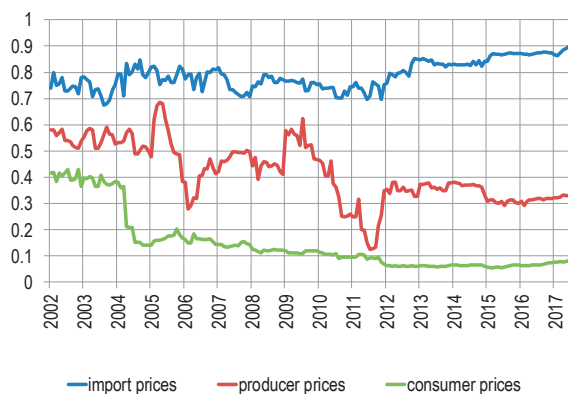
B. Pass-through effect in phases of the business cycle
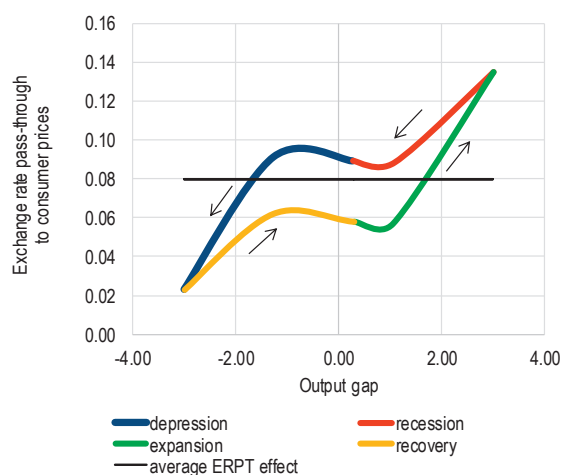
Source: own calculations.

Table 8. Time decomposition of the impact of exchange rate on prices (%)

	Quarter(s) after the exchange rate shock				
	1	2	3	4	5-8
Import prices	77	14	7	2	0
Producer prices (PPI)	74	16	6	3	1
Consumer prices (CPI)	39	36	21	3	1

Source: own calculations

3.3. Credit in the monetary policy transmission mechanism

3.3.1. Lending policy of commercial banks

Lending policy impacts not only on the interest rates on loans, but also on the propensity and ability of commercial banks to grant loans, and therefore on loan supply. In particular, through the impact on standards and terms on loans[37] applied by commercial banks, the central bank indirectly influences loan supply (see section 3.3.2). The supply policy of commercial banks also has an impact on loans, independent of the policy of the central bank. Banks establish the credit standards and loan terms depending on the

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[37] Credit standards (criteria) are the internal guidelines of banks on the acceptance of loan applications, e.g. minimum expected return on a business project . The loan terms are the loan margin, loan margin for riskier borrowers, non-interest costs of the loan, the value of collateral requirements, the maximum size and the maximum lending period of the investment. See https://www.nbp.pl/en/systemfinansowy/ankieta_en.pdf.

perceived micro- and macro-economic conditions, the state of their balance sheets, and structural factors, such as competition in the financial sector. Unexpected changes in credit standards of long-term loans for large and to a slightly lesser extent, also for small and medium-sized enterprises, and the shocks of certain terms of loans have an impact on developments in lending. Bearing in mind the significance of banks' lending policy, Figure 26 shows when, in the perspective of our models, banks' credit policy was restrictive, loose, or in accordance with the micro- and macroeconomic risk conditions and risk related to the balance sheets of the banks (see section 3.3.3)[38].

From the beginning of 2007 to the third quarter of 2008, banks conducted a loose lending policy, both towards large and small and medium-sized enterprises. This was caused by an optimistic assessment of the macroeconomic conditions and sectoral risk as well as the low assessment of the risk of a growth in non-performing loans (Figure 27). During the severe phase of the global financial crisis, banks tightened lending policy, but in the second half of 2009 the level of restrictiveness lay within the limits which could be considered adequate given the business cycle conditions and the level of micro- and macroeconomic risk. Among the causes of a tightening of lending policy during the financial crisis, one can notice risk related to the largest borrowers and factors related to the banks' balance sheets (quality of the loan portfolio and equity). In the second phase of the financial crisis, and more precisely, in the period of the European sovereign debt crisis, the banks tightened their credit standards occasionally rather than systematically. They feared the risk connected with the macroeconomic situation and industry-specific risk. The tightening of lending policy was not systematic at that time, but rather of a "stop-go" nature, expressing a high level of uncertainty and prudence. Similar uncertainty, but regarding the possibility of a loosening of lending policy, can be observed from 2014. The growing competition in the financial market perceived by banks also had impact on lending policy in this period.

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[38] The criterion for determining the ranges in which the credit standards are consistent with the economic conditions is based on the assumption that banks grant loans if the investment projects have a positive net present value, NPV. We use the observation contained in the work of Berlin (2009): if there is a slowdown in the business cycle, some of the projects that had a positive NPV have a negative value in the changed conditions. Enterprises do not receive loans, but this does not mean that banks have tightened the credit standards. In the strict meaning of the term, a tightening of credit standards occurs if the banks decide to change lending policy for reasons other than a change in NPV. In order to determine the periods in which the banks tightened lending policy, we obtained a forecast of standards in a sample from the SVAR type model (see Appendix 10, http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf). We treat its value in the range of ±0.5 standard error as credit standards justified by economic conditions, the level of risk resulting from the banks' balance sheets, and the balance sheets of the enterprises. We assume that if the actual standards are higher or lower than the theoretical value (forecast), the banks' lending policies were restrictive or loose. In a similar way we also obtained the forecast of factors which the banks may indicate as having an impact on their decisions.

Figure 26. Credit standards on long-term loans: observed and theoretical (band)
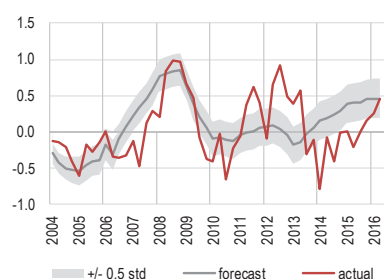
A. Large enterprises
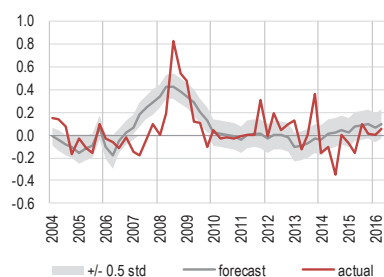
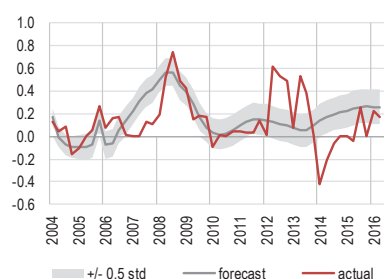**B.** Small and medium-sized enterprises
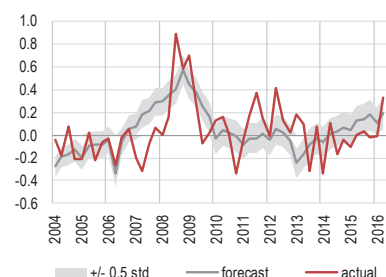
Source: own calculations.

Figure 27. Reasons for changes in lending policy of banks: observed and theoretical (band)
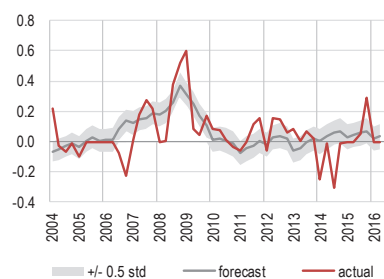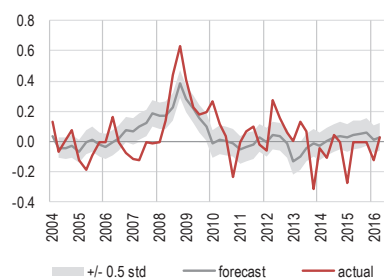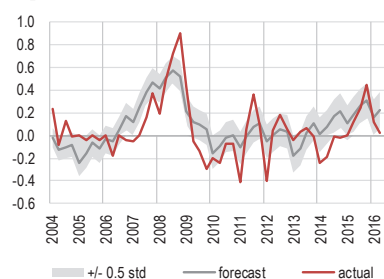
A. Macroeconomic risk

B. Branch risk

C. Risk of largest borrowers
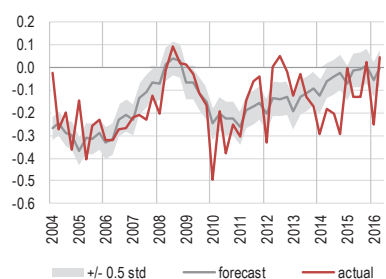

D. Share of non-performing loans

**E.** Banks' capital

F. Competition

Source: own calculations.

3.3.2. Credit channel

The response of loans to an interest rate shock, presented in section 2.1 of the report, contains the effects of various transmission channels, above all the effects of the interest rate channel (changes in demand for loans), as well as the credit channel (changes in supply of loans). Although different response of volumes of various types of loans to an interest rate shock (Figure 28) is indicated as evidence of the functioning of the credit channel, nonetheless the answer to the question on the relative weight of this channel in the monetary policy transmission mechanism remains important.

Figure 28. Response of volumes of loans in PLN (in nominal terms) to the interest rate shock
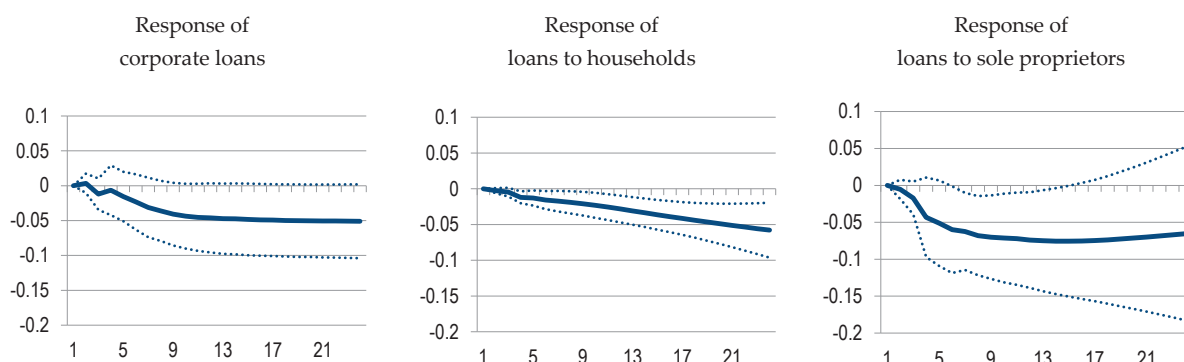
Notes: On the horizontal axis time in months since the unexpected increase in short-term interest rates with standard deviation of 1. The broken line denotes the confidence interval (+/-2 standard deviation).

Source: own calculations based on NBP data.

In the previous studies various methods have been applied to draw conclusions on the functioning of the bank credit channel. Kapuściński (2017a), whose initial results we presented in the previous transmission report (Kapuściński *et al.*, 2016), indicates that approx. 23% of the fall in the volume of loans after an increase in short-term interest rate is due to supply effects related to the bank credit channel. In accordance with the description in section 1.1, the bank credit channel operates in such a way that a tightening of monetary policy is associated with an increase in non-performing loans as well as a fall in profits and a worsening of the capital position of the banks, limiting their capacity and willingness to grant loans. In this report we refer to the widely understood credit channel, containing both the effects of the bank credit channel, the balance sheet channel, and the risk-taking channel. In the next section we analyse functioning of the risk-taking channel, whose empirical verification for Poland was missing in the literature until now.

In the latest study (Wróbel, 2017) the impact of the credit channel on the functioning of the economy is analysed by using data from the survey conducted by Narodowy Bank Polski among senior loan officers[39]. We refer to survey data, since research on the credit channel with the use of only so-called hard data causes

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[39] See http://www.nbp.pl/home.aspx?f=/systemfinansowy/kredytowy.html.

problems of distinguishing between demand for credit, which is an element of the functioning of the interest rate channel, and credit supply, which in turn is an element of the functioning of the credit channel. Among the survey questions there are those that can be directly related to the policy of shaping loan supply by banks as well as the reasons for their changes. Commercial banks answer the question whether and to what extent, they made changes in the credit standards (criteria)[40] in the last 3 months. Credit standards mean the internal guidelines of the bank regarding the acceptance of loan applications, e.g. minimum income per family member after deducting debt servicing costs, minimum expected rate of return on investment etc. Credit standards for short-term loans are differentiated (up to 1 year – loans in current account and loans for financing working capital) from long-term loans as well as credit standards applied to large and small and medium-sized enterprises. The banks are also asked whether they changed the loan terms, i.e. the average margin, margin for riskier borrowers, non-interest costs of loan, the maximum amount of loan and the maximum lending period and the required collateral. The answers of the banks[41] are weighted by the given bank's market share of individual assets, and then aggregated and presented in the form of net percentage. i.e. the difference between opposing tendencies. In the period covered by the analysis (from 2003 Q4 to 20016 Q3) the number of banks taking part in the survey varied, and the volume of loans of the banks participating in it stood at between 72-87% of total household and corporate loans.

The results of Wróbel (2017), using vector autoregression models[42], show that NBP monetary policy has a statistically significant impact on both credit standards and loan terms. The maximum response of credit standards occurs with a lag, while the adjustment of the loan terms by banks is usually immediate. The tightening of credit standards (Figure 31) applies to both short-term and long-term loans. Credit standards for small and medium-sized enterprises react slightly more strongly than credit standards for large firms. This is particularly noticeable in the case of long-term loans, which is a result of the asymmetry of information and larger uncertainty regarding the solvency of borrowers in the long- rather than short-term horizon. This means that in the event of a tightening of monetary policy small and medium-sized enterprises are more exposed to a tighter lending policy in the long-term loans segment (for investments and purchase of real estate) than large enterprises.

In the responses of loan terms to an unexpected change in interest rates (Figure 32), attention should be paid to those that occur immediately and are, at that time, statistically significant. This type of response is characterised by average loan margins, non-interest costs of loan, maximum lending period and maximum amount of loan. The remaining terms were tightened in a statistically significant way with a somewhat larger lag. Banks respond most strongly to monetary policy decisions with an increase in the average margin – after an unexpected increase in the short-term interest rate by 1 p.p. the difference between the percentage of banks (assets weighted) raising their margin and the remainder increases by approximately 60 p.p. The fact

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[40] We use interchangeably the words: "criteria" and "standards".
[41] One of five answers is possible: tightened significantly, tightened slightly, not changed, loosened slightly, and loosened significantly.
[42] The following 4 variables occur in the models: private investment, zloty-denominated corporate loans (various types), WIBOR 3M interest rate, and credit standards or loan terms.

that the central bank has an impact on credit standards and loan terms, including the required collateral, means that it can, at least to a certain extent, impact on the propensity of commercial banks to take on risk.

Figure 29. Comparison of the response of credit standards for loans to large as well as small and medium-sized enterprises to an interest rate shock (1 p.p.)

A. Large enterprises   B. Small and medium-sized enterprises
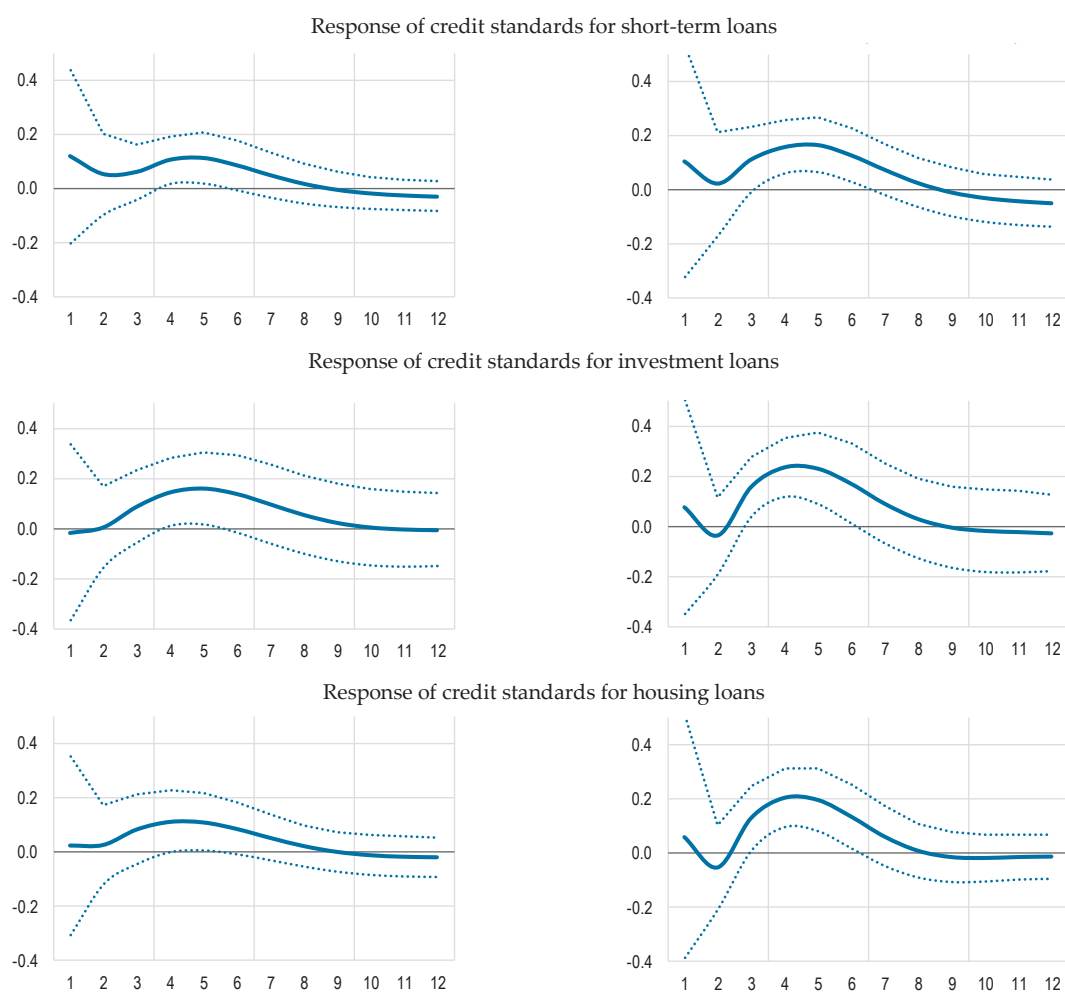
Response of credit standards for short-term loans

Response of credit standards for investment loans

Response of credit standards for housing loans

Notes: A value of the function response equal to 0.1 means that the difference between the percentage of banks (asset weighted), which tighten the standards and the remaining increases by 10 p.p. On the horizontal axis time in quarters from the moment of occurrence of the monetary policy. The broken line denotes the confidence interval (2 standard errors).

Source: own calculations.

Figure 30. Response of loan terms for corporate investment loans to an interest rate shock (1 p.p.)

A. Average margin

B. Margin for risky loans

C. Non-interest costs of loan

D. Maximum amount of loan

E. Maximum lending period

F. Required collateral

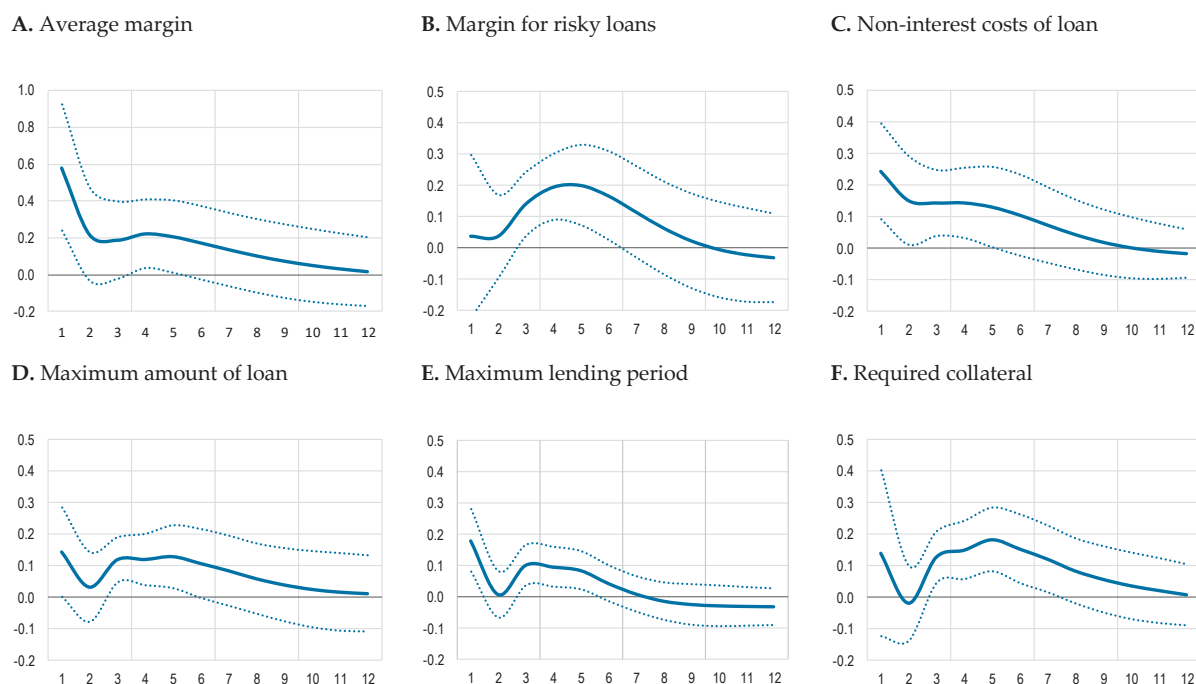Notes: A value of the function response equal to 0.1 means that the difference between the percentage of banks (asset weighted), which tighten the standards and the remaining increases by 10 p.p. On the horizontal axis time in quarters from the moment of occurrence of the monetary policy. The broken line denotes the confidence interval (2 standard errors).

Source: own calculations.

The next stage of the study of Wróbel (2017) is an assessment of the impact of banks' lending policy on zloty-denominated corporate loans and on private investment. The exogenous shock of credit standards for large enterprises causes a statistically significant fall in long-term loans; in the case of small enterprises the response of investment loans is on the edge of statistical significance. In the sample studied, credit standards had no impact on the level of the remaining loans for the corporate sector – those for real property acquisition and on short-term loans. Loans, however, were affected by shocks of certain loan terms: investment loans fell under the impact of an unexpected increase in banks' collateral requirements and margins for riskier borrowers. Loans for the purchase of real property and short-term (for working capital and in current account) loans to a small extent and temporarily fell after the unexpected negative shock of the maximum lending period. Therefore it can be argued that investment loans are the most sensitive to banks' lending policy. However, the interest rate had a statistically significant impact on loans for the purchase of real property, in current account and on financing working capital. Private investment did not respond to shocks of credit standards and loan terms, but fell under the impact of a tightening of the central bank's monetary policy.

3.3.3. Risk-taking channel

In environment of low nominal interest rates the so-called risk-taking channel can be activated. As the experience of certain economies shows, a low level of nominal interest rates may limit the ability of commercial banks to reach levels of profitability observed in regular market and macroeconomic conditions. Increasing the level of risk taken on by the banking sector in response to a reduction in the achieved rate of return is not a favourable phenomenon, since it means a worsening of the risk-return relationship in comparison with the situation at the starting point (higher profitability and less risk).

In the study of the risk-taking channel conducted on individual data from commercial banks and described in more detail in Appendix 8[43], we assumed various measures approximating the risk taken on by the banks (Figure 31B-D). They are all calculated as the sum of the growth of exposure of the bank in a given area of activity, weighted by the risk of this activity, in reference to the bank's total assets. In the first variant, the exposure of the bank covers loans[44] categorized according to sections of NACE (implemented in Poland as the Polish Classification of Activities – PKD). The risk weight of loans in a given section is equal to the ratio of created provisions in loans. In the two remaining variants we divide the bank's exposure into 5 business lines (loans for large enterprises, loans for small and medium-size enterprises, housing loans for households, consumer loans for households, other loans for households). We measured the business line risk similarly to the first variant, with the share of the provisions in loans (variant 2) or the expected loss in a given business line[45] (variant 3). Taking on greater risk by the bank is therefore manifested through a greater exposure in the riskier areas of activity.[46]

Analysing the functioning of the risk-taking channel we also took into account the different ways of determining the periods in which the level of short-term interest rates could be considered low. All of them are based on deviations of the level of nominal interest rates from their level determined by fundamental factors taken into account in various specifications of monetary policy rules estimated for Poland. In particular, the standard rule of monetary policy was taken into account, which takes into consideration the smoothing of interest rates in accordance with the relationship estimated in the Small Monetary Policy Model (see Appendix 4[47]). Figure 31A shows the empirical values of the WIBOR 3M short-term interest rate and theoretical values obtained from the estimated rules.

The results of our analysis indicate that the deviations of the short-term interest rate from their fundamental level impact on the risk taken on by banks only to a small extent. In particular, in the period since the onset of the global financial crisis, when NBP interest rates were dropped to the lowest levels on record, monetary

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[43] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

[44] These are only the so-called large exposures, i.e. above PLN 500,000, which are subject to the obligatory reporting for supervisory purposes.

[45] We approximated the expected loss by the difference between the net interest margin of the business line and the return on assets (ROA).

[46] The data are quarterly and cover the period from 2004 Q2 (variant 1) or 2008 Q1 (variants 2 and 3) to 2017 Q1 (differences are a result of availability of data). We analysed the 21 biggest banks.

[47] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

policy inclined banks to take on less rather than more risk (Figure 31B-D).[48] Taking into account the course of economic processes so far, we therefore find no confirmation of the importance of the risk-taking channel in Poland. This conclusion is favourable from the point of view of conducting monetary policy and the realisation of the remaining tasks of the central bank.

Figure 31. Impact of monetary policy on risk taken by banks

A. WIBOR 3M and the theoretical value
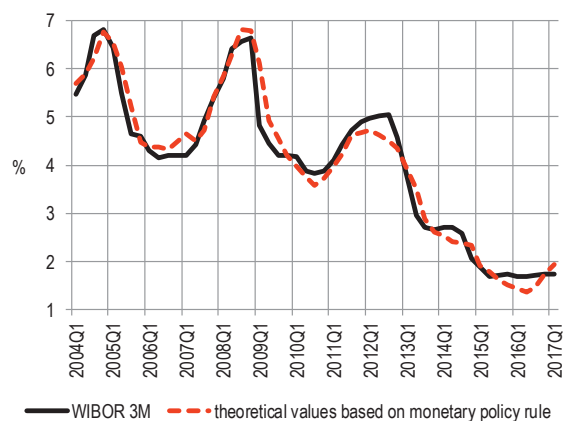
B. 1st measure of risk
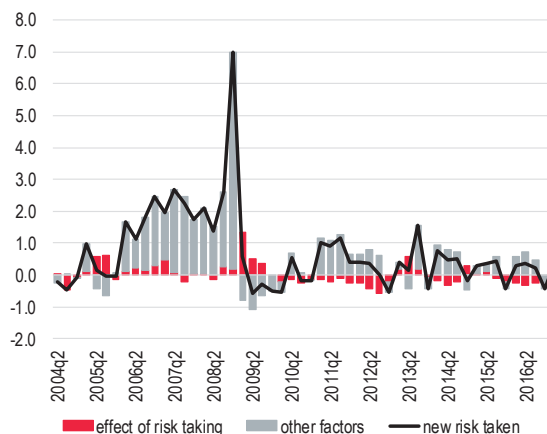
B. 2nd measure of risk
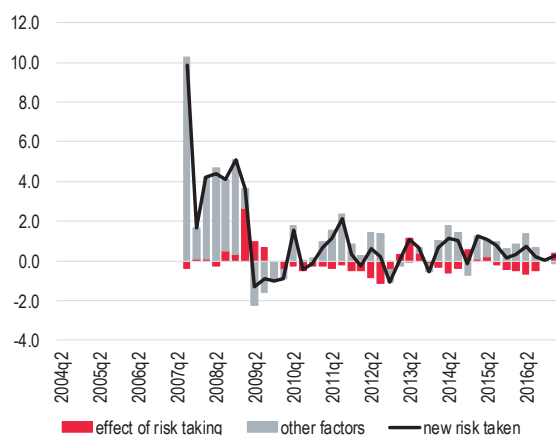
B. 3rd measure of risk
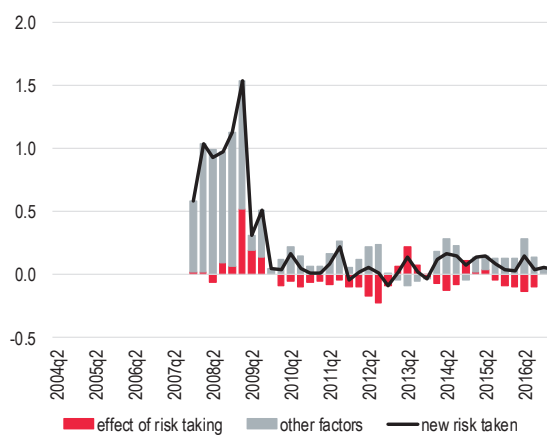
Notes: The charts present the risk in a typical bank (median in the group of analysed banks) and the effects of the risk-taking channel.

Source: own calculations based on NBP data.

[48] As part of robustness testing, we also estimated the models in which the measure of monetary policy is the nominal interest rate (POLONIA or WIBOR 3M) or the real interest rate (deflated by various measures of inflation or inflation expectations). The results indicated no occurrence of a link between the level of these rates and the risk taken by banks. Therefore the impact of monetary policy on the risk taken by banks resulting from the estimates presented below should be treated as maximum approximation.

Trying to explain why no symptoms of the operation of the risk-taking channel have so far been observed in Poland, unlike in certain other economies, we formulate the following hypotheses, which at the same time show that under certain conditions the channel could gain significance in the future.

Firstly, it could be supposed that the currently observed level of policy interest rates is not so low as to significantly limit the interest margin of banks, and as a result, their profitability.[49] This means that the bank management bodies do not feel under pressure to achieve a significant and rapid improvement in financial results, e.g. by increasing the risk incurred. However, it should be remembered that the introduction of regulatory changes and one-off events in the future could lead, regardless of the impact of monetary policy, to a fall in banks' profitability and their potential response in terms of striving to increase revenues, which could increase their propensity to take on risk.

Secondly, in the case of the risk-taking channel, a threshold effect may occur, i.e. this channel may be activated when interest rates fall to a sufficiently low level. If this really were the case, the lack of observations of the risk-taking channel in the data for the Polish banking sector would mean that the measurements of monetary policy restrictiveness employed in the study had not reached the activation threshold. However, it cannot be ruled out that in the future, regardless of the decisions regarding the conduct of monetary policy, structural changes in the economy and the financial system could cause a shift in such an activation threshold. For this reason, it is worth monitoring the possible appearance of the risk-taking channel as new data arrives.

Thirdly, the absence of a functioning risk-taking channel may be related to the preferences of banks. The banking sector in Poland is well supplied with capital. A negative relationship between changes in risk measures and the size of banks' capital surpluses could indicate that in the case of the majority of banks, high capital buffers are an expression of prudence rather than a symptom of taking on higher risk not included in the standard capital requirements. The fact that in periods of a deteriorating situation for enterprises, expressed in the increased probability of their default, banks reduced the scale of risk that they took on (this relationship is visible in all specifications of the model) may also be evidence of banks' prudence. However, it should be noted that the behaviour of some smaller banks more poorly-equipped in capital, could be different. However, the size of these institutions does not significantly impact at the level of the whole sector, and the development of the variables at this level is most important from the point of view of conducting monetary policy.

3.4. Inflation expectations and inflation

The level and process of forming inflation expectations by the private sector is of major importance for inflation and the monetary policy transmission mechanism. This statement is confirmed in empirical studies, including in studies for the Polish economy.

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[49] See, e.g. NBP (2017), *Financial Stability Report*, June 2017, chapter 2.5.

This section of the report consists of three parts. The first of these is of a general character and presents the conclusions of empirical studies regarding inflation processes in Poland seen in the framework of the Hybrid New Keynesian Phillips Curve (HNKPC). Next, we analyse the process of the formation of short-term inflation expectations by consumers, enterprises and financial sector analysts in Poland in the light of the latest empirical studies, and we also assess the significance of inflation expectations in the monetary policy transmission mechanism. Finally, we analyse the degree of anchoring of the medium-term inflation forecasts of professional forecasters, obtained in the NBP Survey of Professional Forecasters.

3.4.1. Inflation processes in Poland from the point of view of the Hybrid New Keynesian Phillips Curve

Discussions on the usefulness of the Phillips Curve, in particular, its new-Keynesian version (HNKPC), have revived in recent years due to inflation surprises in the global economy. This concerns in particular two inflation surprises in developed economies after 2008, i.e. the so-called twin puzzle (Constâncio, 2015) – missing disinflation in the US economy in the years 2009-2011, in the period of sharp falls in real GDP and a rise in unemployment, as well as excessive disinflation after 2012, particularly in the euro area. The recent work using the Phillips Curve delivers interesting conclusions on the potential causes of inflation surprises, both in the large advanced economies (see, e.g. Coibion and Gorodnichenko, 2015; Ciccarelli and Osbat, *eds.* , 2017), and in Poland (Łyziak, 2016b; Szafranek, 2017).

The conclusions regarding the Phillips Curve in the Polish economy in both of the above works are similar to each other. They show that the Hybrid New Keynesian Phillips Curve (HNKPC), applied in structural transmission models used in this report, is a useful concept for explaining inflation processes in Poland, including in the recent episode of low and negative inflation. According to the results of both the studies, the relatively best fit to the data in the sample and the best forecast beyond the sample is provided by the models in which the expected inflation is approximated by the survey measures of the expectations of enterprises or consumers, which constitutes yet another confirmation of their usefulness in explaining inflation processes.

In the period of recent disinflation, both in the case of HNKPC models explaining CPI inflation and core inflation, the value of inflation to which these models converged in the long term declined, and in the case of core inflation, there was also a decrease in the slope of the curve, i.e. the impact of the output gap on price growth has weakened. At the same time, the role of external prices in shaping domestic inflation processes increased.

3.4.2. Inflation expectations in the monetary policy transmission mechanism

While assessing the degree of anchoring of long-term inflation expectations to the central bank's target is of key significance in evaluating the credibility of monetary policy, it is the process of forming short- and medium-term inflation expectations which matters the most in the monetary policy transmission mechanism, as these have a greater impact on prices and wages than long-term expectations (see, e.g. Ciccarelli and Osbat, *eds.*, 2017, p. 26). Although short-term inflation expectations by nature display larger volatility than long-term expectations, they may be affected by the central bank's inflation target or inflation forecasts

published by the monetary authorities. Moreover, to the extent to which the agents forming those expectations show a certain degree of forward-lookingness, these may discount the path of inflation processes in the future, responding to macroeconomic variables affecting future inflation, including to changes in the interest rates of the central bank.

The measures of short-term inflation expectations in Poland used in this report are presented in Figure 32A. We use two approaches to analyse the process of forming these expectations. The first of these is the estimation of single-equation models of inflation expectations with a specification inspired by the work of Cerisol and Gelos (2009) and Łyziak (2016a) (for details about these models see Appendix 9[50]). The second of these are simulations carried out on the new version of the Small Model of Monetary Policy (MMPP), in which short-term inflation expectations of consumers, financial sector analysts and enterprises have been taken into account (for details about the MMPP model see Appendix 4[51]). In the case of single-equation models we analyse the immediate response of inflation expectations of the above groups of agents to changes of certain macroeconomic variables (Figure 32B). In the case of the simulation on the MMPP model, we study the response of inflation expectations and other macroeconomic variables to changes in the short-term interest rate (Figure 33) and we verify the weight of the inflation expectations in explaining the response of inflation to a monetary policy impulse (Figure 34).

The results are generally consistent with the findings of earlier studies presented in the previous editions of this report. They show a relatively high degree of anchoring of the inflation expectations of financial sector analysts, which respond only slightly to a change in current inflation. Being anchored to the inflation target, they also respond slightly to monetary policy impulses. Consumers form inflation expectations in a completely different manner – their expectations are heavily influenced by current inflation, responding mainly to changes in the prices of goods that are purchased often, such as foodstuffs. The inflation expectations of enterprises are the most important in explaining price changes in the Polish economy – their degree of anchoring is moderate, but they are characterised by a relatively high degree of forward-lookingness. As such, they respond to changes in the interest rates of the central bank to a larger degree than the inflation expectations of consumers and financial sector analysts. Therefore they play an important role in the monetary policy transmission mechanism.

When assessing the changes in the process of forming inflation expectations since the outbreak of the global financial crisis (see the results presented in Appendix 9[52]), one can notice a decline in the anchoring of inflation expectations of enterprises, accompanied by an increase in the response of these expectations to changes in food and energy prices. Consumers began to react more strongly to changes in energy prices, but ceased to adjust their expectations to changes in the exchange rate and nominal wages. In the case of inflation expectations of financial sector analysts, in recent years the weight of the inflation target has risen, but analysts have stopped responding to changes in short-term interest rate and the exchange rate.

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[50] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.
[51] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.
[52] All appendices are available at: http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf.

The importance of inflation expectations in the monetary policy transmission mechanism in Poland can be considered to be relatively large. If we were to assume a counterfactual lack of response of inflation expectations of all groups of agents to a change in the short-term interest rate, the maximum response of CPI inflation and core inflation to a change in interest rate would be significantly – by approx. 27% and 35% respectively – lower than in the full version of the model, taking into account direct and indirect feedback between the interest rate and the inflation expectations of economic agents.

Figure 32. Short-term inflation expectations in Poland and their response to specific impulses

A. Short-term inflation expectations
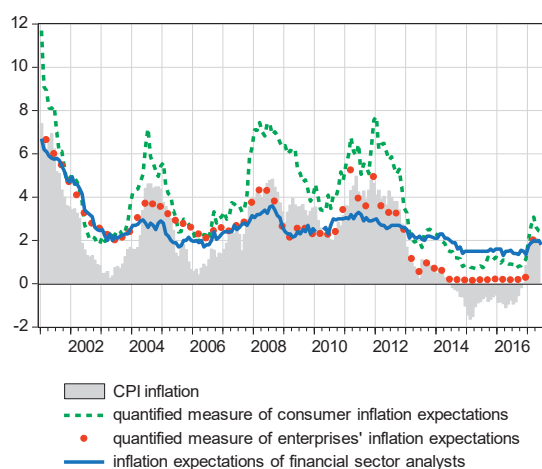
B. Immediate response of expectations to various impulses
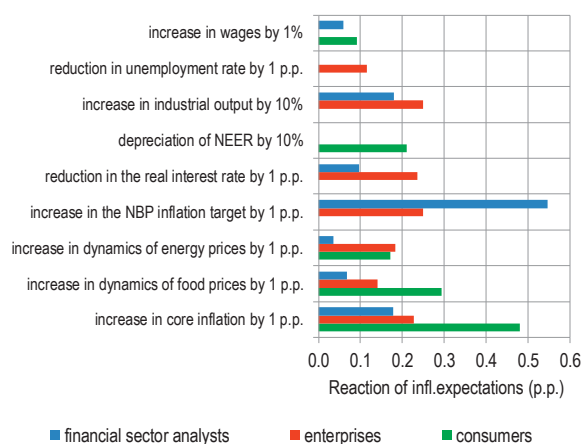
Notes: Inflation expectations of consumers and enterprises were quantified using the probabilistic method on the basis of qualitative survey data of GUS and NBP (Quick Monitoring), respectively. Inflation expectations of the financial sector analysts are obtained from Thomson-Reuters surveys. Details on quantification and suitable reference are contained in section 3.2.1 of the previous edition of the report (Kapuściński *et al.*, 2016). The above estimates were obtained from single-equation models inspired by the work of Cerisola and Gelos (2009) and Łyziak (2016a). Specifications of these models and the results of estimates are discussed in Appendix 9 (http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf).

Source: own calculations.

Figure 33. Response of inflation expectations and other variables to an increase of 1 p.p. in the short-term interest rate for a period of 4 quarter
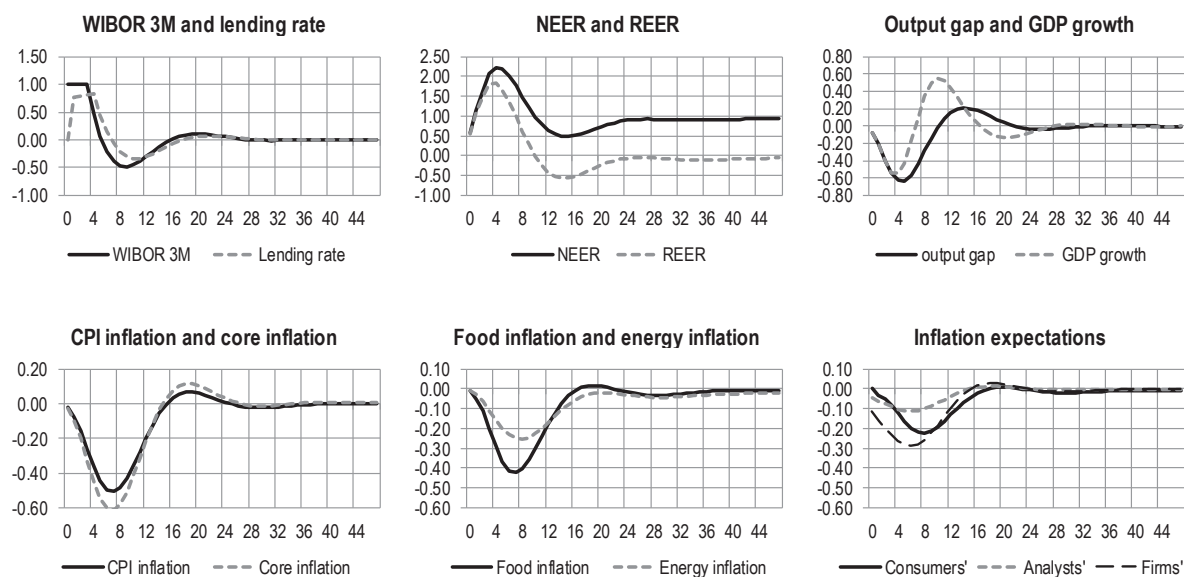
Notes: The above functions were obtained from the simulation on the Small Monetary Policy Model (MMPP) – a description of the model and results of other simulations can be found in Appendix 4 (http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf).

Source: own calculations.

Figure 34. Response of CPI inflation and core inflation to an increase of 1 p.p. in the short-term interest rate for a period of 4 quarters with the assumption of no adjustment of inflation expectations
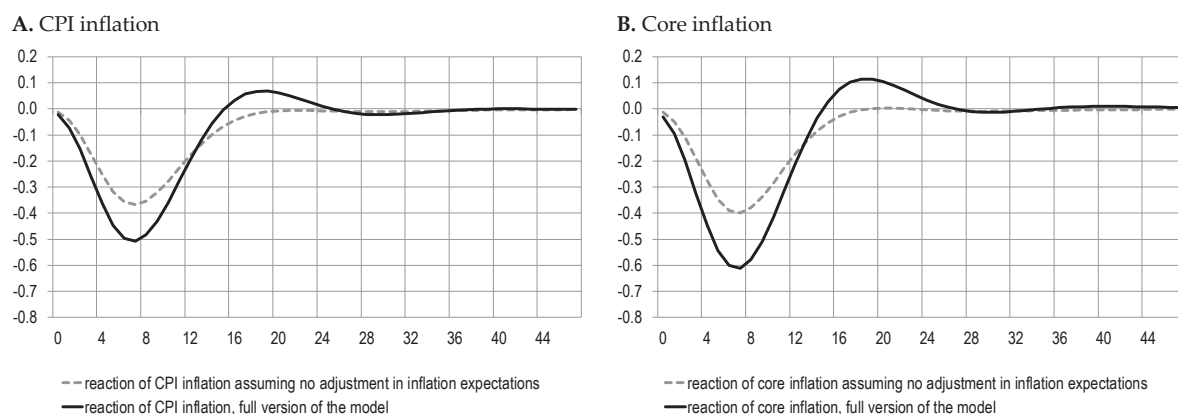
Notes: The above functions were obtained from the simulation on the Small Monetary Policy Model (MMPP) – a description of the model and results of other simulations can be found in Appendix 4 (http://www.nbp.pl/publikacje/materialy_i_studia/286_en_appendices.pdf).

Source: own calculations.

3.4.3. Degree of anchoring of inflation expectations

Anchored long-term inflation expectations are evidence of central bank credibility, which in turn, is one of the factors determining the effectiveness of the transmission channel as well as the costs of disinflation (sacrifice ratio). For this reason, it is desirable that the expectations are stable and in line with the inflation target of the central bank.

For the analysis of anchoring of expectation inflations, we use the results of the NBP Survey of Professional Forecasters (NBP SPF), whose probabilistic character is particularly useful in this case. We focus on medium-term expectations (8 quarters in advance) and show them against the background of short-term expectations (for the current years and 4 quarters in advance). To a limited extent we use the forecasts in the longer horizon (implied inflation in year 4th and 5th of the forecasting horizon).

In the previous report (Kapuściński *et al.*, 2016), published in the period of deflation, we signalled symptoms of de-anchoring of medium-term inflation expectations. This phenomenon proved to be short-lived, as confirmed by the return of these expectations to levels around the NBP inflation target (2.5%) (Figure 35A) and an increase – with the end of the period of deflation – in the likelihood of inflation in the tolerance band of deviations from the NBP inflation target (Figure 35B).[53] It should be noted that the medium-term inflation forecasts remained in the tolerance band of deviations from the NBP inflation target throughout the analysed period.

The anchoring of inflation expectations in Poland is also confirmed by the persistently low sensitivity of long-term expectations to changes in current inflation. While the short-term forecasts of professional forecasters responded strongly to changes in current inflation, the responses of medium-term forecasts were much smaller, and the implied long-term forecasts developed independently of current inflation (Figure 36).

When analysing the deviations of aggregated probabilistic forecasts of professional forecasters from the NBP inflation target, inflation projections published by the central bank (central path) and current inflation (Figure 37), we confirm the conclusions from the previous report, that in the periods of large deviations from the NBP inflation target, the expectations of private sector experts remain close to the NBP inflation target and the NBP inflation projections themselves may stabilise expectations. In the case of medium-term forecasts, when inflation is far from the target, this does not also cause an increase in the distance of forecasts from the inflation target. In such a situation, the short-term forecasts deviate somewhat from the target, but despite this they remain close to the NBP projections. Therefore it can be concluded that the experts participating in the NBP Survey of Professional Forecasters perceive inflation processes and prospects similarly to NBP.

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[53] In 2017 Q3 this likelihood exceeded 0.7, which corresponds to the level before the emergence of deflation.

Figure 35. Short- and medium-term inflation forecasts of professional forecasters and the likelihood of inflation in the tolerance band of deviations from the NBP inflation target

A. Short- and medium-term inflation forecasts of professional forecasters
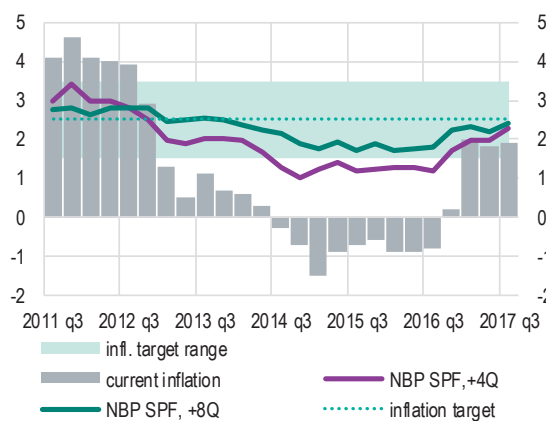
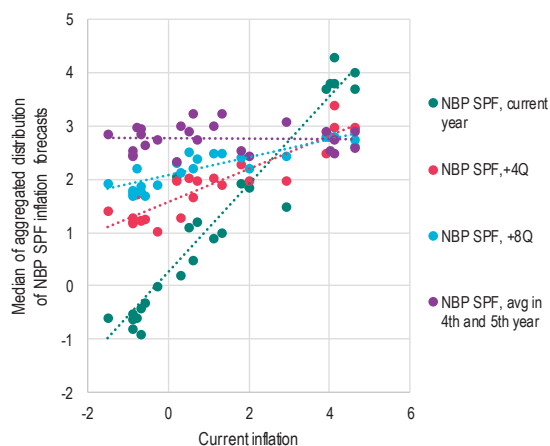**B.** The likelihood of inflation in the tolerance band of deviations from the inflation target against current inflation
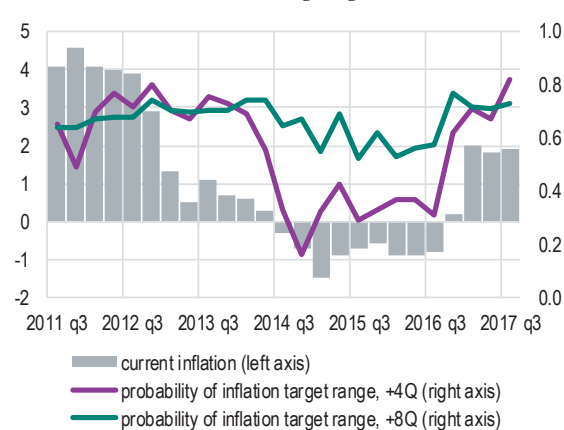
Source: own calculations.

Figure 36. Dependence of inflation forecasts in various horizons on current inflation

Notes: Current inflation is CPI inflation from the quarter preceding the given round of the NBP Survey of Professional Forecasters.

Source: own calculations.

Figure 37. Distance of aggregated distributions of forecasts of professional forecasters from the NBP inflation target, current inflation and the NBP central projections

A. Short-term inflation forecasts
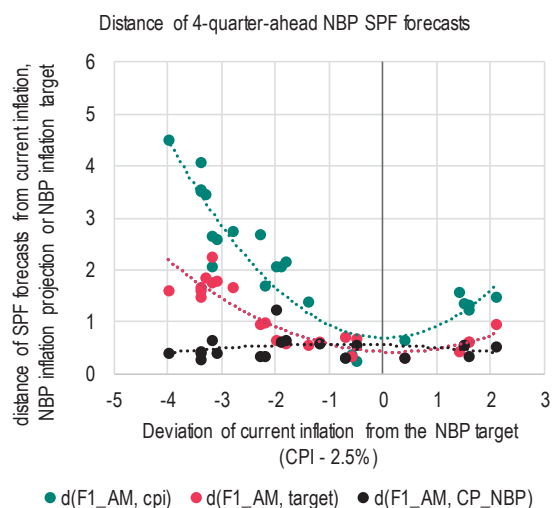
B. Medium-term inflation forecasts
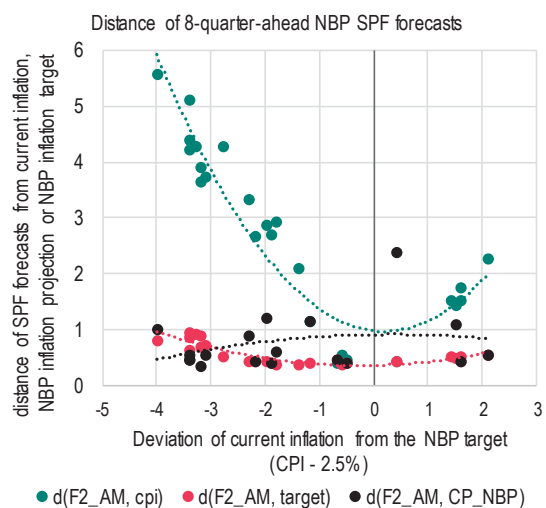
Notes: d(F1_AM, *y*) and d(F2_AM, *y*) are the distance of probabilistic aggregated forecasts from NBP SPF, in the horizon of +4 and +8 quarters respectively, from the value *y*, where *y* is current inflation (*cpi*), the NBP inflation target (*target*) or the NBP central projection (*CP_NBP*). We have described the way of measuring the distance from these values in the previous report (Kapuściński *et al.*, 2016, section 3.4.4.).

Source: own calculations based on NBP SPF and GUS.

Conclusions

The results of the latest research into the monetary policy transmission mechanism in Poland presented in this report are consistent with the previous findings. From the point of view of the effectiveness of monetary policy, the most important conclusion of the report is that both the review of the structural characteristics of the Polish economy and the model analysis confirm the significant impact of changes in short-term interest rates on macroeconomic processes in Poland – also amid of low inflation and low nominal interest rates.

Using new research methods we confirm that in the period during which NBP has pursued the inflation targeting strategy the impact of short-term interest rates on economic activity and inflation has gradually strengthened. We associate this observation with the development of the financial sector, the increase in the links between the Polish and foreign economies, and the growing credibility of monetary policy. The findings of our studies indicate that the strength of the individual channels of the transmission mechanism has also changed. As a result of the internationalisation of production processes, the impact of the exchange rate on economic activity has weakened, which has reduced the exchange rate pass-through to consumer prices. At the same time, the role of macroeconomic expectations and credit in the monetary policy transmission mechanism increased.

The long-term trends shaping the monetary policy transmission mechanism in Poland overlap with its changes due to the business cycle. In particular, the response of inflation to the monetary policy decisions is the strongest and most immediate in the expansion phase of the business cycle, while it is at its weakest and slowest in the depression phase.

Taking into account the shape of the monetary policy transmission mechanism in Poland in recent years we argue that the global financial crisis disturbed the effectiveness of this mechanism only for a relatively short time. Currently, amid low nominal interest rates, we also do not observe a weakening of the main relationships of the transmission mechanism. The interest rates on deposits and loans in commercial banks adjusted to the last two reductions in the NBP reference rate – made in October 2014 and March 2015 – in accordance with earlier patterns. We also find no confirmation of the hypothesis that amid low interest rates commercial banks in Poland were inclined to take excessive risks.

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