

Monetary policy transmission mechanism in Poland. What do we know in 2011?

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### Summary

In order to conduct monetary policy in an effective manner, the central bank must possess a thorough understanding of the monetary policy transmission mechanism. If, in turn, the central bank's decisions are to be understood by market participants, they need to understand the same mechanism. This Report – in common with the subsequent Reports of this series, which will be released every two years – aims to present summary findings of research currently conducted at the Bureau of Economic Research of the NBP Economic Institute, on selected aspects of the Polish monetary policy transmission mechanism along with an attempt at an assessment of the mechanism as a whole.

This Report was prepared in times of serious disruptions to the monetary policy transmission mechanism caused by the financial crisis. These were in part of structural, in part of cyclical nature, i.e. resulting from typical differences in the transmission mechanism observable at different stages of the business cycle. As regards some of the relationships – e.g. one between money market interest rates and the interest on deposits and loans at commercial banks – the scale and persistence of the observed disturbances may signal more permanent changes in the transmission. In this Report we strive – as much as it is possible at the moment – to determine the impact of the financial crisis on the monetary policy transmission mechanism, separating the identification of the key features of the analysed relationships from their crisis-induced distortions. In addition, we highlight the significance of non-linearity and asymmetry in the monetary policy transmission mechanism. These two features help explain the behaviour of some transmission mechanism variables at times of turmoil.

The conclusions concerning the monetary policy transmission mechanism in Poland presented in this Report have been drawn using various empirical models, which are rooted – albeit to a different degree – in the economic theory. Before presenting model findings, we assess structural features of the Polish economy which may be relevant for the functioning of the monetary policy transmission mechanism and its respective channels.

\*

In Chapter I of the Report we present a short overview of theories on the channels and stages of the monetary policy transmission mechanism. While literature provides various classification systems in this area, we adopt here the most standard one, which encompasses the interest rate channel, the exchange rate channel and the credit channels (the bank lending channel and the balance sheet channel). In this section of the Report, we also discuss the role of inflation expectations in the monetary policy transmission and we do some references to additional monetary policy transmission channels, i.e. the cost channel and the risk-taking channel.

Chapter II of the Report contains an overview of the structural features of the Polish economy which may be significant to the operation of the transmission mechanism. These features are related to the real domestic economy, its openness, and the structure of the financial system. The conclusions of this section indicate that changes in the structural features of the Polish economy, in particular the development of financial intermediation and the growing credibility of monetary policy, should lead to a steady strengthening of the monetary policy transmission mechanism. However, inferences on the strength of the respective transmission channels and its changes produce ambiguous results and need to be further resolved on the grounds of empirical models.

In Chapter III of the Report, we assess the key features of the monetary policy transmission mechanism in Poland, using vector autoregressive models and structural models. In an attempt to generalise our findings, we would like to highlight the following traits of the monetary policy transmission mechanism in Poland:

- Interest rate shocks have a statistically significant impact on the CPI and the real economy (industrial output, GDP). A rise in a short-term interest rate is followed by a zloty appreciation and a subsequent (between the 10<sup>th</sup> and 16<sup>th</sup> quarter after the interest rate shock) statistically significant depreciation as a result of deteriorating economic fundamentals.
- Prices respond to exchange rate shocks in a statistically significant way, while the real economy does not. This may be the effect of declining interest rates in response to the zloty appreciation and a considerable role of intra-corporate trade, unaffected by exchange rate fluctuations, in Poland's foreign trade.
- Interest rate shocks lead to a statistically significant decline in investment and consumption levels, with investment showing a substantially stronger response than consumption.
- Maximum response of annual GDP growth following a rise in short-term interest rate by 1 percentage point maintained for 4 quarters is observed after 4 quarters of the rate change and amounts to approx. -0.3 percentage point, while maximum response of inflation occurs after 6 quarters and amounts to approx. -0.3 percentage point. Breaking the simulation findings down into the impact of the respective transmission channels shows that during the first year following the shock, the key channel through which the central bank can affect inflation is the exchange rate channel; in terms of the aggregated effects of the interest rate and the exchange rate channels, the response of inflation is affected more by the former. The credit channel proves relatively weak, which, however, may partly result from problems in its identification.
- When non-linear response of inflation to economic activity i.e. relatively stronger in times of boom - is taken into account, the mechanism takes on a new aspect. In downturn, the peak response of inflation to a monetary impulse occurs sooner, while in boom the real economy responds more slowly and more strongly, with peak inflation response at higher levels.
- Since forward-lookingness of inflation expectations in Poland is rather low, the sacrifice ratio, i.e. GDP decrease required to reduce inflation permanently by 1 percentage point, amounts to approx. 0.65%, and the process of reducing inflation by 1 percentage point takes approx. 3 years.

In Chapter IV, we present an overview of results on the operation of the respective monetary policy transmission channels (or their parts). This section of the Report can be summarised in the following points:

- Money market rates adjust to the NBP's reference rate. The operation of this
  mechanism was seriously impaired during the financial crisis and resulted in the
  diminished information value of the WIBOR rates for commercial banks. This, in
  turn, was reflected in disruptions to relations between retail rates and money
  market rates.
- Following a rise in interest rates, the volume of credit declines. The decline is
  relatively sharper and deeper in zloty denominated loans to households than in
  loans to corporates. The strongest response is observed in loans to individual
  entrepreneurs (sole proprietors). This may suggest that this type of borrowers is
  considered as the riskiest, and so the response of lending results not only from
  weaker credit demand (the interest rate channel), but also from constraints on
  credit supply imposed by banks (the credit channel).
- Further evidence of the existence of credit channel effects may be found in the results of long-term credit supply function estimates and in the identification of the economy's response to credit supply and credit demand shocks. These results, however, are not completely unequivocal due to problems in estimating the credit demand function. An indirect argument in support of the existence of the credit channel in Poland is the analysis of the so-called buffer stock behaviour, which shows that banks are now more inclined to put constraints on lending than in the past. However, the operation of the credit channel is disturbed by exogenous credit supply shocks occurring in the economy among others, during the financial crisis, when perception of risk made banks restrict credit supply in spite of a monetary policy easing.
- Availability of currency denominated loans reduces the effectiveness of monetary policy transmission – foreign currency loans to corporates expand in response to a rise in the domestic interest rate, while foreign currency denominated loans to households remain unaffected by NBP monetary policy shocks.
- Although the significance of the exchange rate channel in Poland seems considerable, and the pass-through effect on prices is quite large (the pass-through coefficient amounts to 0.2), the impact of this channel depends heavily on the stage of the business cycle. The response of the zloty exchange rate to changes in interest rate disparity seems stronger in slowdown than in boom. At the same time, in slowdown the pass-through effect of the exchange rate changes on consumer prices is considerably weaker. The exchange rate pass-through effect is also influenced by the direction of changes in the exchange rate (stronger in depreciation than in appreciation) and the volatility of the exchange rate (stronger under low volatility, weaker under high volatility).
- The impact of exchange rate changes on exports is declining over time in 2010, exchange rate accounted for 23.5% of export growth, while in 1998 the respective figure was almost 40%. We ascribe this trend to the effect of rising significance of international corporations which settle accounts within the capital group. The response of the volume of exports and imports to a change in the real zloty exchange rate is relatively stable over time and symmetric in terms of direction of change a 10% depreciation causes a 2.6% acceleration in exports

and a 1.4% deceleration in imports. The strongest effects can be observed in the  $3^{rd}$  quarter following the shock.

• The manner in which inflation expectations are formed by consumers, enterprises and analysts of the financial sector is differentiated. In each of these groups, however, expectations are formed in a more sophisticated manner than static expectations, based solely on current inflation. Inflation expectations of enterprises and financial sector analysts are characterised by a relatively strong forward-looking character, as well as the strongest anchoring in the NBP's inflation target and the most effective processing of macroeconomic data (including interest rate data). As regards consumers, the weight of current inflation in inflation expectations is 85% and has been declining slightly over time.

In Chapter V, we assess the disruptions to the monetary policy transmission mechanism in times of the financial turmoil and we present synthetic measures of transmission efficiency.

The financial crisis disrupted the monetary policy transmission mechanism in Poland. The disturbances observed partly reflect rising perception of risk and the cyclical features of the transmission mechanism (e.g. the impact of the exchange rate on prices); partly, however, they are indicative of more permanent changes in the economy (e.g. changes to the manner in which market interest rates translate into retail rates in commercial banks).

- The financial crisis has led to substantial disturbances to the interest rate channel. This concerns in particular the impact of interbank market rates set under serious constraints on the volume of transactions upon deposit and loan rates in commercial banks. Many long-term relationships between these rates have been broken off, meaning that their levels deviate from the levels compatible with the long-term pre-crisis relationships. On the other hand, short-term relationships have not been disrupted, thanks to which deposit and loan rates follow the changes in the central bank's policy rates.
- Strength of loans response to changes in monetary policy has not been much altered except for loans to individual entrepreneurs. Lending response is, however, characterised by a longer lag than before, possibly due to disruptions to the interest rate transmission.
- The response of inflation to changes in interest rate is only slightly slower than before the crisis, while the response of the real economy is slightly weaker. At the same time, the strength of NBP's response to disturbances in the real economy has increased, as has – albeit to a lesser degree – its strength of response to price disturbances. This shows that the central bank was aware of the weakening transmission mechanism and took it into consideration in its monetary policy decisions. Fine-tuning instruments used by the NBP to provide liquidity to the banking sector helped maintain its ability to affect the economy.

Estimates of efficiency of the monetary policy transmission channels– which is a product of both identified elasticities of relationships between the variables which make up these channels and the degree of their statistical significance – suggest considerable changes in this respect during the first years of inflation targeting. As the financial system developed and monetary policy gained credibility, the efficiency of the interest rate channel increased. The rising significance of bank credit in the economy also helped enhance the efficiency of the credit channel. On the other hand, the change in the foreign exchange rate regime, i.e. the full floating of the zloty, combined with declining inflation levels and its reduced volatility gradually undermined the efficiency of the exchange rate channel. Between approximately 2004, the time of Poland's accession to the European Union and 2008, the efficiency of the respective transmission mechanism channels stabilised. However, crisis disturbances curtailed it significantly. The changes seem to be more permanent with respect to the interest rate and the credit channels than with respect to the exchange rate channel. Changes relating to the latter have resulted, to a great extent, from its cyclical nature.

## I. Theoretical background

## I.1. A standard view of the monetary policy transmission mechanism

Monetary policy transmission mechanism describes how economic agents respond to decisions of monetary authorities, along with their further mutual interactions. The process can be characterised as a set of ways (channels) of monetary policy impulse propagation, through which the central bank affects aggregate demand and prices in the economy. The key (traditional) channels of monetary policy transmission are: the interest rate channel, the exchange rate channel and the credit channel. Due to their mutual relationships, it is often difficult to differentiate between the channels precisely.

### Interest rate channel

A monetary policy tightening triggers a rise in short-term interbank market interest rates, followed by a rise in lending and deposit rates in commercial banks. Owing to price rigidity, it results in rising real interest rates, which affect consumption, savings and investment decisions. These decisions are determined by short-term interest rates, but also medium-term and long-term rates. The central bank may affect them indirectly; however, the impact depends on expectations about short-term interest rates in the future. Also, inflation expectations are important in this context. Changes in the market interest rates have a bearing on the volume of aggregate demand in the economy, e.g. rising lending rates lead to reduced credit demand, while rising deposit rates encourage future consumption. A reduction in investment and consumption demand achieved in this manner helps contain inflationary pressure.

As the capital market develops, asset price channels rise in significance, where the impact of monetary policy on yields on financial instruments is analysed, and via the yields, on investment and consumption decisions in the economy.

#### Exchange rate channel

An extension of the interest rate channel concept which adapts it to the situation of an open economy is the exchange rate channel. A monetary tightening leads to an appreciation of the domestic currency – through a rise in the disparity of interest rates. This is in compliance with the so-called uncovered interest rate parity theory and its empirical evidence allowing for an incomplete adjustment of the exchange rate to the interest rate disparity and changes in risk premium over time.

Domestic currency appreciation influences aggregate demand through two effects. The first is the so-called relative price effect, i.e. a decline in imported goods prices expressed in terms of the domestic currency (having a direct and relatively quick impact on inflation) and a rise in domestic goods prices expressed in terms of foreign currency. This leads to an increase in imports of goods and services, with a simultaneous adverse effect on the situation of home exporters, resulting in lower aggregate demand.

Domestic currency appreciation additionally leads to the balance sheet effect. The effect is related to the fact that some households and enterprises have liabilities denominated in foreign currency. Unless these are balanced with foreign currency assets, changes in the exchange rate may significantly impact the net asset position, leading to adjustments in consumption, investment and the external funds. The balance sheet effect works in the direction opposite to the change in relative prices. If domestic residents are net debtors to the rest of the world, appreciation of the domestic currency contributes to strengthening the balance sheets of domestic agents, thus giving an impulse to expansion in the aggregate demand in the economy. In summary, the balance sheet effect mitigates the relative price effect and may occasionally override it.

### Credit channels

The credit channel theory is complementary to the traditional interest rate channel concept. It places emphasis on the significance of incomplete information to the monetary policy transmission. It shows that monetary policy influence through the interest rate channel can be enhanced with changes in external finance premiums (i.e. the difference between the cost of external and internal financing). According to the credit channel theory, monetary policy tightening leading to a rise in short-term interest rates increases the external finance premium. Two key concepts explain the influence of monetary policy on the external finance premium: the bank lending channel and the balance sheet channel .

Within the bank lending channel concept it is underlined that monetary policy affects not only interest rates, but also the balance sheets of commercial banks. A monetary contraction leads to a reduction in the amount of free reserves. If banks are not able to offset the fall in reserves with an increase in equity, they are forced to adjust their assets by selling-off of most liquid ones. This is the so-called buffer stock behaviour; however, if such an adjustment is not sufficient, banks are faced with the need to constrain lending. Lower credit supply results in increased external finance premiums. Borrowers constrained on lending are forced to either cut down on spending or find an alternative source of financing. This, however, entails an extra cost of establishing a relationship with new lenders and compensating them for risk – which is higher than in the case of a bank possessing comprehensive information on the customer. Consequently, there are two prerequisites for the bank credit channel to operate: firstly, there must exist borrowers fully relying on bank credit for external financing; secondly banks may not be able to shield their credit portfolios against changes in monetary policy.

The balance sheet channel view focuses on the lender's inability to monitor the potential credit standing without incurring extra cost. For this reason, loan requests are primarily assessed in terms of categories such as: the value of cash flows, net worth. External finance premium is inversely correlated with borrowers' creditworthiness, which in turn depends on the macroeconomic conditions, hence also on monetary policy. For example, a monetary tightening leads to falling asset prices and cash flow. The volume of loans may depend on the value of collateral. If it falls down, some firms may have to curb investment spending as their capacity to borrow diminishes.

#### Expectations in the monetary policy transmission mechanism

Literature on the mechanism of monetary policy impulse transmission often emphasises the significance of expectations, particularly of inflation expectations. These influence not only interest rate transmission along the yield curve, but also have a direct impact on economic behaviour of agents, constituting one of the determinants in the consumption, savings and investment decision-making. A rise in expected inflation may lead to forward-looking price increases by entrepreneurs expecting production costs and wage demands to rise. It may also boost consumption as consumers fear that their income and financial wealth may decrease in value, while producers withhold the sale of some of their output in anticipation of price increases in the future. With these market behaviour patterns emerging, i.e. surging demand amid constrained supply, higher inflation expectations may turn into a self-fulfilling phenomenon. In the interest rate channel, a sudden jump in inflation expectations leads to reduced real interest rates, causing a boost in aggregate demand and increased inflationary pressure.

Monetary policy channels are presented in the diagrams below (Diagram 1, Diagram 2, Diagram 3).

Diagram 1. Relationships within the monetary policy transmission mechanism – the synthetic view of the Bank of England  $^{\rm 1}$ 



<sup>&</sup>lt;sup>1</sup> Source: <u>http://www.bankofengland.co.uk/monetarypolicy/how.htm</u>

Diagram 2. Relationships within the monetary policy transmission mechanism according to Mishkin  $(2007)^2$ 

	Monetary policy								
	<b>↓</b>	•	•	•	•	•	•	•	•
sion sms		Oth	er asset price eff	ects			Credit View		
Transmis: mechanis	Traditional interest rate effects	Exchange rate effects on net exports	Tobin's q theory	Wealth effects	Bank lending channel	Balance sheet channel	Cash flow channel	Unanticipated price level channel	Household liquidity effects
	Monetary policy	Monetary policy	Monetary policy	Monetary policy	Monetary policy	Monetary policy	Monetary policy	Monetary policy	Monetary policy
	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
	Real interest rates	Real interest rates	Stock prices	Stock prices	Bank deposits	Stock prices	Nominal interest rates	Unanticipated price level change	Stock prices
	Ļ	$\downarrow$	Ļ	$\downarrow$	$\downarrow$	Ļ	$\downarrow$	Ļ	$\downarrow$
		Exchange rate	Tobin's q	Financial wealth	Bank loans		Cash flow		Financial wealth
		Ļ	Ļ	Ļ	Ļ		Ļ		↓
						Moral hazard, adverse selection	Moral hazard, adverse selection	Moral hazard, adverse selection	
						Ļ	Ļ	Ļ	
						Lending activity	Lending activity	Lending activity	
						Ļ	Ļ	Ļ	Probability of financial distress
	Ļ	Ļ	Ļ	Ļ	Ļ	Ļ	Ļ	Ļ	$\downarrow$
Components of spending (GDP)	Investment Residential housing Consumer durable expenditure	Net exports	Investment	Consumption	Investment Residential housing	Investment	Investment	Investment	Residential housing Consumer durable expenditure

<sup>2</sup> Mishkin F. (2007), *The Economics of Money, Banking and Financial Markets*, 8th edition, Pearson, Boston.



Diagram 3. Relationships within the monetary policy transmission mechanism according to Łyziak (2011)<sup>3</sup>

## I.2. Non-standard channels of monetary policy transmission

#### The cost channel

Within the framework of the cost channel concept it is emphasised that monetary policy can affect not only the demand side of the economy but the supply side as well. Rising short-term interest rates means higher cost of capital for the companies which use external financing to fund their operations. The increased cost of capital is then transferred to consumers through a rise in prices (margins) on the goods and services.

#### The risk-taking channel

Technology changes observed in the 1970s, the deregulation of the financial markets and the institutional changes resulted in wider access to risk and offered the possibility to transfer risk through e.g. securitisation. Moreover, in the face of a global crisis, there aroused questions about the influence of excessively low interest rates on the level of risk taken by financial institutions. Low interest rates may have led to the extension of too risky loans.

Hence, there is a growing literature on the so-called risk-taking channel, understood as the relationship between monetary policy and perception and valuation of risk by economic agents. Central bank interest rate changes seem to affect – both directly and indirectly – the level of risk taken by banks. Even though it does not seem to be an important monetary transmission channel in Poland, explaining it allows a fuller un-

<sup>&</sup>lt;sup>3</sup> Łyziak T (2011), Oczekiwania inflacyjne, in: Sławiński A. [ed.] (2011) Polityka Pieniężna, CH Beck.

derstanding of the influence of monetary policy on the economy. This is why, mindful of the interest in this channel in the literature – related to the global crisis – we devote slightly more attention to it here.

The literature typically distinguishes three ways in which the risk-taking channel operates. Firstly, interest rate level affects the valuation of risk by banks. A decreasing policy rate boosts the value of assets and collateral, resulting in lower assessment of default likelihood with respect to potential borrowers. It also reduces the perceived volatility of asset prices. The rising value of assets, incomes and profits reduces the perceived risk and risk aversion. This mechanism encourages banks to accept higher risk. Secondly, some companies require their managers to attain pre-set nominal rates of return, which tend to be relatively stable over time. Declining policy interest rates trigger a decrease in the rates of return on assets considered risk free. To attain the intended profits, agents seek riskier assets, ones that would generate higher yields. Thirdly, monetary policy may affect risk perception through its communications and through its degree of transparency. A higher predictability of the central bank' actions reduces uncertainty in the markets and leads to higher propensity to incur risk. Hence, some economists recommend that in boom periods policy interest rates should be maintained at levels higher than required, in order to reduce incentives increasing liquidity risk at banks.

Most studies devoted to this channel emphasise the relationship between low interest rates and high level of risk being taken in the financial markets.<sup>4</sup> Considering the recent global financial crisis, which occurred after a prolonged period with low interest rates prevailing, this is hardly surprising. Recent research agrees that long periods with policy rates remaining at low levels may cause banks to incur more risk. There also exist studies indicating that a restrictive monetary policy leads to a decline in the risk taken by banks.<sup>5</sup>

## I.3. Stages of monetary policy transmission mechanism

Distinguishing the channels of monetary policy transmission mechanism does not allow us to fully capture the essence of this process, which involves mutual relationships between variables. The monetary policy transmission can be described not only in terms of its channels, but also in terms of subsequent stages of transmission.<sup>6</sup>

Monetary policy transmission starts from an impulse provided by a change in the official interest rate of the central bank. The problem of interest rate setting (the central bank response function) is in this framework situated within the problems of monetary policy transmission mechanism. The first stage of the monetary policy impulse transmission describes the response of interest rates, yields on financial instruments and prices of financial and real assets to a change in the official interest rate of the central bank. The second stage of the monetary policy impulse transmission deals with the influence of changes in interest rates, yields on financial instruments and prices of fi-

<sup>&</sup>lt;sup>4</sup> See e.g.: Altunbas Y., Gambacorta L., Marqués Ibañez D. (2010), *Does monetary policy affect bank risk taking?*, ECB Working Paper Series, No. 1166, European Central Bank; Bekaert G., Hoerova M., Lo Duca M. (2010), *Risk, uncertainty and monetary policy*, NBER Working Papers, No.16397.

<sup>&</sup>lt;sup>5</sup> See e.g. De Graeve F., Kick T., Koetter M. (2008), *Monetary policy and financial (in)stability: an integrated micro-macro approach*, Journal of Financial Stability, No. 4 (3), pp. 205–231.

<sup>&</sup>lt;sup>6</sup> See: Mahadeva L., Sinclair P. [eds.] (2005), How Monetary Policy Works, Routledge, Chapter 2.3.

nancial and real assets on aggregate demand. The third stage of the monetary policy impulse transmission captures the influence of changes in interest rates, asset prices and aggregate demand on unemployment, wage and price level.

Below we present a diagram depicting stages of monetary policy transmission mechanism (**Diagram 4**).

Diagram 4. Stages of monetary policy transmission mechanism according to Mahadeva and Sterne [eds.] (2005), *op. cit.* 





Stage 3

# II. Stylized facts relevant for the operation of the monetary transmission mechanism

Before going on to present the empirical findings obtained on the basis of macroeconomic models of various kinds, we wish to look at the monetary policy transmission from a more general perspective, analysing the structural features of the Polish economy which may be relevant to the functioning of the transmission mechanism and its channels. The analysis suggests a gradual consolidation of many features, leading to an enhanced monetary policy transmission mechanism.

#### Features of the system of financial intermediation

Indices of financial intermediation sector development level – such as the ratio of financial system assets to the GDP or monetisation indices – confirm the rising role of this sector in the Polish economy, which – *ceteris paribus* – should enhance the monetary policy transmission mechanism.<sup>7</sup> These indices remain at levels comparable with those observed in other countries of the region, if still significantly below those observed in the euro area (**Table 1, Table 2**).

In Poland, as in other countries of the region and the euro area, it is the banks, with assets accounting for 70% of total financial system assets, that prevail in the system of financial intermediation. While this share is gradually declining as other financial institutions – such as investment, insurance and pension funds – gain in significance, the value of bank loans and deposits versus the GDP is steadily rising (**Table 2**). The impact of monetary policy is however diluted by a relatively low level of household and corporate debt.

Stock market capitalisation as percentage of GDP is lower in Poland than in the euro area. However, the Polish stock exchange is gaining in significance – its capitalisation as percentage of GDP is considerably higher than in the other countries of the region. This will probably work towards diminishing the relevance of the credit channel, and the enhanced impact of asset price changes in the interest rate channel.

An important determinant of the relative impact of various ways in which monetary policy affects consumption and investment decisions of agents is the structure of their asset portfolios. In recent years, the rising ratio of the value of households' financial assets to the GDP has been accompanied by changes in their structure: the percentage of savings held as cash or deposits is declining, while the proportion of shares and participation units in investment, insurance and pension funds is rising. This provides more evidence in support of the rising significance of the changes in asset prices in the interest rate channel.

#### Features of the banking system

Given the dominating role of the banking sector in the monetary transmission process, the structural features of this sector are of key importance.

Poland is characterised by a mismatch in the term structures of deposits and loans, so typical of the sector – short-term deposits and long-term loans prevail (Table 3). The

<sup>&</sup>lt;sup>7</sup> It is a generally accepted view that the monetary transmission mechanism is boosted in tandem with the rising level of the financial intermediation system and the monetisation of the economy. At the same time, however, the current financial crisis has exposed the fact that a highly advanced financial intermediation system (structured instruments) may weaken central bank influence on economic processes.

mismatch is deepening – the percentage of both short-term deposits and long-term loans is rising. This should enhance the monetary policy transmission mechanism: basically, the lower the coverage of long-term loans with long-term deposits, the higher the banks' willingness to align their interest rates to the interbank market rates.

The strength of the monetary policy transmission mechanism in Poland is constrained by a large share of foreign-currency denominated loans to households and corporates in total loans (respectively, 37% and 25%) (**Table 4**). This excludes some bank assets from the direct influence of monetary policy and may cause a potential risk of insolvency of agents in the case of a significant and lasting zloty depreciation.

The Polish banking sector, in similarity to the banking sector of other transition economies is characterised by excess liquidity. This makes it more resilient to negative liquidity shocks, such as the one which occurred e.g. after the bankruptcy of Lehman Brothers, while at the same time it may impair the effectiveness of monetary policy transmission mechanism. Although banking sector liquidity ratios decreased during the crisis, they still remained high (**Table 5**). Moreover, the share of highly liquid assets in total bank assets is rising, which may render them more resilient to changes in the central bank's policy, thus weakening the strength of both the interest rate channel and the credit channel. Another factor which may make banks independent of the NBP's monetary policy is the fact that most of the banking sector's assets are held by foreign investors (**Table 6**). Those banks have a relatively easier access to sources of financing which are beyond influence of the NBP's monetary policy.

A factor potentially strengthening monetary policy transmission is the growing competitiveness of the Polish banking sector, as measured by its concentration. The share of the five largest banks in total assets of the banking sector has come down from 53% in 2002 to 44% in 2010 (Table 7). In Poland, the ratio is lower than in other countries of the region and close to the level observed in the euro area.

#### Openness of the economy and features of the real sector

Regarding the openness of the economy in terms of combined trade and finance, Poland proves to be less open than the euro area and the countries of Central and Eastern Europe. This makes it relatively less sensitive to disturbances in the foreign markets. In spite of the Polish economy becoming increasingly open, the share of intracorporate trade in total exports is rising as well, which may dampen the impact of the exchange rate on the real economy (**Table 1**, **Table 2**).

An overwhelming majority of firms in Poland are small or very small (with a workforce of up to 49 people). Their percentage in the total number of enterprises has been stable at 99%; they account for 52% of the total workforce and their revenue accounts for 36% of the total revenue of the enterprise sector (**Table 8**). It may be assumed that a relatively important role of small enterprises strengthens the monetary policy transmission mechanism, as this type of firms – which are predominantly financed by bank credit – are highly dependent on the central bank policy. On the other hand, it should be noted that large firms prevail in terms of revenue: while accounting for merely 0.2% of the workforce they generate as much as 42% of the revenue of the entire sector; it may be assumed that they are less dependent on the central bank policy. This may be due to the special (in particular, long-term) relations between these companies and banks as well as their equity links with foreign entities.

The main source of financing in the Polish enterprise sector is own funds, which account for 70% of financing (Table 9). Amongst the sources of external financing, it is the

credit that plays a major role, which should enhance the transmission of monetary policy decisions (the interest rate channel and the credit channels).

#### *Rigidities in the economy*

The general shape of monetary policy transmission is affected by the degree of wage and price flexibility. If prices adjust to monetary policy impulses relatively fast, the response of the economic activity indicators should be weaker.

Wage and price rigidities in the Polish economy and in other CEE countries – assessed using the OECD employment protection indicator<sup>8</sup> and the trade union density index – seem to be at a level close to each other and lower than in the euro area (**Table 1**, **Table 2**).

When attempting to assess the changes in wage and price rigidity indicators for the Polish economy, we arrive at ambiguous findings. On the one hand, the employment protection index rose in the analysed period implying an increase in labour market rigidity. On the other hand, the trade union density index fell, which suggests the opposite as the existence of strong trade unions results in less frequent wage cuts, lower average wage volatility as well as curbing personnel turnover.<sup>9</sup> In Poland this index is significantly below the EU level – yet, it follows the same downward trend observed in the EU.<sup>10</sup>

#### Monetary policy credibility

In Poland, the credibility of the central bank's monetary policy measured as average deviation of inflation from the inflation target is increasing (Table 2), which should support the effectiveness of the monetary transmission mechanism.

### Conclusions

Analysis of the structural features of the Polish economy may be summed up as follows: the development of the financial intermediation sector widens the scope of NBP monetary policy influence, which – as the credibility of this policy increases – should strengthen the monetary policy transmission mechanism. Yet, an overview of the structural features of the Polish economy does not warrant an unequivocal evaluation of the strength of the respective transmission mechanism channels and its anticipated changes. Although the dominant role of banks in the financial intermediation system and the growing competition between banks may point to potentially strong interest rate and credit channel effects, this is countered by a relatively low total loans-to-GDP ratio, prevalence of self-financing in Polish enterprises as well as a large proportion of highly liquid assets in the assets of the banking sector. By the same token, the growing openness of the Polish economy may not necessarily contribute to strengthening the exchange rate channel of the monetary policy transmission mechanism on account of increasing share of intra-corporate trade, which is to a large extent independent of the

<sup>&</sup>lt;sup>8</sup> The OECD employment protection indicator is computed on the basis of many factors relating to, first of all, dismissal regulations and the percentage of temporary contracts. Trade union density index, on the other hand, approximates the percentage of employees who are members of trade unions.

<sup>&</sup>lt;sup>9</sup> Source: NBP (2011), Labour market survey, NBP.

<sup>&</sup>lt;sup>10</sup> The proposition that price rigidity in Poland is lower than in the euro area is confirmed by survey findings. It can be accounted for in part by a higher inflation level in the countries of our region and its greater volatility. At the same time it should be noted that the findings of these surveys also point to gradual increase of these rigidities. See: Jankiewicz Z., Kołodziejczyk D. (2008), *Mechanizmy kształtowania cen w przedsiębiorstwach polskich na tle zachowań firm ze strefy euro*, Bank i Kredyt, No. 2, pp. 19-42, NBP.

zloty exchange rate changes (and which is why we would expect a relatively small influence of exchange rate changes on the real economy). The increasing monetary policy credibility should, however, boost the role of inflation expectations in the monetary policy transmission by shortening transmission lags and curbing costs to the real economy.

Table 1. Key structural features of the Polish economy significant to the transmission mechanism as compared with other countries, 2010

	Poland	Czech Republic	Hungary	euro area
OECD employment protection legislation index* (1)	2.19	1.99	1.85	2.44
Trade union density* <sup>(2)</sup>	15.6	17.4	16.8	27.2
Average inflation 2004-2010 <sup>(3)</sup>	2.9	2.5	5.3	2.0
Share of investment in the GDP <sup>(4)</sup>	20.8	22.6	18.4	19.2
Trade openness <sup>(5)</sup>	86	136	166	80
Financial openness <sup>(6)</sup>	142	187	467	377
Banking sector concentration (share of assets held by 5 largest banks) <sup>(7)</sup>	44.2	62.0	54.5	44.7
Financial system assets/GDP <sup>(8)</sup>	118	136	162	494
Banking system/financial system assets <sup>(8)</sup>	70	84	64	69
Bank loans/GDP <sup>(8)</sup>	49.2	54.7	52.0	120.5
Bank deposits/GDP <sup>(8)</sup>	43.6	65.8	34.8	85.4
M2/GDP <sup>(9)</sup>	54.7	73.8	53.7	91.6
M3/GDP <sup>(9)</sup>	55.3	75.3	61.5	103.9
Stock market capitalisation/GDP <sup>(8)</sup>	38.7	22	21	54.5
Financial assets of households/GDP** (10)	62	77	93	201

\*2008, \*\* 2006

(1) OECD Employment protection legislation index is an approximate measure of the restrictiveness of the procedures concerning employee dismissals and hiring on temporary and permanent contracts. The indicator ranges between 0 and 6. A lower value of the indicator denotes smaller labour market rigidities and higher price elasticity.

(2) The OECD trade union density index is computed as a percentage of employees who are trade union members in the overall number of people in employment. The euro area index is calculated as the average for 15 euro area countries: Austria, Belgium, Estonia, Finland, France, Germany, Greece, Holland, Ireland, Italy, Luxembourg, Portugal, Slovakia, and Slovenia (3) Annual ECB data.

(4) IMF, WEO.

(5) Trade openness is calculated as the ratio of the sum of exports and imports of goods and services to the GDP; own calculations based on data provided by major statistical offices and central banks of the respective countries

(6) Financial openness is calculated as the ratio of the sum of assets and liabilities of the international net position to the GDP; own calculations based on IMF data.

(7) ECB, Structural indicators for the EU banking sector, 2010.

(8) NBP, Rozwój systemu finansowego w Polsce w 2010.

<sup>(9)</sup> Own calculations based on data provided by major statistical offices and central banks of the respective countries. (10) Eurostat.

0			
	2002	2006	2010
OECD employment protection legislation index	1.65	2.07	2.19*
Trade union density	24.08	16.77	15.01
Share of investment in the GDP	18.6	21.1	20.8
Trade openness	61	83	86
Financial openness	89	118	142
Intra-corporate trade to total exports <sup>(1)</sup>	42.2	45.3	46.5
Banking sector concentration (share of assets held by 5 largest banks)	53.4	46.5	43.9
Financial system assets/GDP	75	97	118
Banking system/financial system assets	76	67	70
Bank loans/GDP	24.4	30.4	49.2
Bank deposits/GDP	34.4	35.4	43.6
M2/GDP	40.1	45.4	54.7
M3/GDP	40.3	46.7	55.3
Stock market capitalisation/GDP	13.7	41.3	38.7
Financial assets of households/GDP	45.2	60.0	63.9**
Average deviation of inflation from target (%)	2.06	1.47	0.35

## Table 2. Key structural features of the Polish economy significant to the transmission mechanism, changes over time

\*2008, \*\* 2009

(1) This indicator jumped markedly in 1999 from 37.5% to over 42% in 2002; calculations based on Eurostat data in accordance with the BEC classification; goods group aggregation as presented in Chapter 1.2 of the report *Gospodarka i handel zagraniczny Polski. Raport roczny*, IBRKK, Warszawa 2011.

The remaining sources were cited in the notes to Table 1.

#### Table 3. Term structure of loans and deposits of the non-financial sector, %

	2002	2006	2010
Share of short-term (up to 1 year) loans in total loans	46.0	34.0	25.2
Share of short-term (up to 1 year) loans to corporates in total loans to corporates	43.5	35.8	31.8
Share of short-term (up to 1 year) loans to households in total loans to households	32.2	18.3	11.4
Share of short-term (up to 1 year) deposits in total deposits	91.3	93.5	93.4
Share of short-term (up to 1 year) corporate deposits in total corporate deposits	94.5	96.2	95.9
Share of short-term (up to 1 year) deposits of households in total deposits of households	90.3	94.3	95.0

Source: own calculations based on NBP data, see: Należności i zobowiązania monetarnych instytucji finansowych wobec sektorów krajowych (bez SKOK i FRP), annual average.

#### Table 4. Currency structure of loans and deposits of the non-financial sector, %

	2002	2006	2010
Share of foreign currency-denominated loans to corporates	30.2	22.4	24.5
Share of foreign currency-denominated loans to households	21.7	30.6	36.9
Share of foreign currency-denominated deposits of corporates	21.6	21.6	14.7
Share of foreign currency-denominated deposits of households	17.5	14.0	7.5

Source: own calculations based on annual average balances as quoted by the NBP.

#### Table 5. Banking sector liquidity

	2002	2006	2010
Balance of open market operation transactions , bn PLN	-10.2	-20.2	-71.5
Share of highly liquid assets, %	19.5	18.8	20.2
NBP bills to banks' assets, %	2.04	2.97	6.38

Source: own calculations based NBP data.

#### Table 6. Banking sector ownership structure, %

	2002	2006	2010
Share of assets held by domestic investors	32.2	30.3	33.8
Share of assets held by foreign investors	67.9	69.7	66.2

Source: Report on the situation of banks, KNF, data as at the end of the year.

#### Table 7. Concentration in the banking sector, %

	2002	2006	2010 (*2009)
Share of assets held by 5 largest banks	53	46	44
Share of loans extended by 5 largest banks	49	44	43*
Share of deposits in 5 largest banks	60	55	54*

Source: Raport o sytuacji banków, KNF, data as at the end of the year.

#### Table 8. Structure of the enterprise sector, %

	Share in the number of enterprises		Share of	nues s		
	2004	04 2006 2009			2006	2009
Small (from 9 to 49 employees)	99.0	99.0	98.9	39.5	38.2	36.3
including: micro (up to 9 employees)	96.4	96.3	95.9	24.7	24.9	22.7
Medium-sized (from 50 to 249 employees)	0.8	0.8	0.9	22.2	21.9	21.3
Large (above 250 employees)	0.2	0.2	0.2	38.2	39.9	42.4
Source: Działalność przedsiębiorstw niefinansowych w 2004,	2006 i 2009 i	oku, GUS.		•		

#### Table 9. Structure of sources of investment financing %

	2003	2006	2009
Own funds	75.5	75	70.0
Bank loan from domestic banks	10.2	11.4	12.0
Foreign funds	4.7	4.3	7.6
Other sources	4.1	5	5.7

Source: Środki trwałe w gospodarce narodowej w 2009 roku, GUS, data as at the end of the year.

## III. General features of monetary policy transmission mechanism in Poland

## III.1. Analysis based on (S)VAR -type models

The estimation was made on quarterly and monthly data. In the quarterly model, the following variables were used: CPI, investment, consumption, GDP, WIBOR 1M rate and nominal effective exchange rate (NEER). The sample starts in the first quarter of 1998 going through the second quarter of 2011. In models using monthly data the real economy was represented by industrial output, the remaining variables were as in the quarterly model; the estimation was carried out on data from January 1998 to August 2011. To identify shocks, the Cholesky decomposition was used (in the convention employed the shock is equal to one standard deviation).<sup>11</sup>

#### Interest rate shock

The results obtained on the basis of quarterly data show (Figure 1, Figure 3) that a negative monetary policy shock (monetary tightening) of about 0.3 percentage point triggers a statistically significant decline in the level of investment (from the 4<sup>th</sup> to 11<sup>th</sup> quarter after the shock) by approximately 0.7% (the peak effect coincides with the 9<sup>th</sup>-11<sup>th</sup> quarter after the shock), consumption – by 0.3% (the peak effect in 9<sup>th</sup>-10<sup>th</sup> quarter after the shock), and GDP – by 0.2% (the peak effect in 9<sup>th</sup>-13<sup>th</sup> quarter after the shock). The response of prices displays a counter-intuitive increase, as is frequent in this type of estimation. The so-called price puzzle is usually explained with rising inflation expectations. It should decrease, if not be eliminated, after variables serving as proxy for expectations (e.g. oil price) have been included. In our estimations inflation expectations approximated in this way did not improve the result. The absence of other variables that should be included in the specification or the operation of the cost channel (these two effects are not mutually exclusive) may be another potential reason here. When the results obtained on the basis of monthly data from January 1998 to August 2011, in which the puzzle is absent, are accounted for (Figure 2), we tend to think it is primarily the result of specification problems. A statistically significant price decline following interest rate shock takes place in the 11<sup>th</sup>-15<sup>th</sup> month. The peak effect

<sup>&</sup>lt;sup>11</sup> Using Cholesky decomposition ensures comparability of our results with the results of transmission mechanism analysis in the euro area that can be found in: Angeloni I., Kashyap A., Mojon B. [ed.] (2003), *Monetary Policy Transmission in the Euro Area*, Cambridge University Press, which is a seminal work on this subject. To compare the results of the Cholesky decomposition with the Kim and Roubini-type decomposition for Poland see, e.g.: Łyziak T., Przystupa J., Wróbel E. (2008), *Monetary policy transmission in Poland: a study of the importance of interest rates and credit channels*, SUERF Studies, No 1.

In the case of quarterly models the following order was used: CPI, investment, consumption, GDP, nominal effective exchange rate, WIBOR 1M. The order results from the assumption that when setting the interest rate the central bank takes into account current information about price and real economy behaviour as well as the developments in the exchange rate. To test the robustness of the results the order of variables was changed, first of all that of the exchange rate and interest rate. In addition to a larger price puzzle when the exchange rate was put on the last place, response functions did not undergo major changes. In the case of models estimated on monthly data the following order was used: CPI, industrial output, interest rate, nominal effective exchange rate. This time the exchange rate is on the last place which means that it responds to simultaneous interest rate movements, while the interest rate does not respond to concurrent exchange rate movements. We think this assumption fits the monthly frequency of data better than the previously used assumption that is more justified for quarterly data.

is approximately 0.13%.<sup>12</sup> A statistically significant depreciation occurring between the 10<sup>th</sup> and 16<sup>th</sup> month after an unexpected monetary policy tightening that results from worsening fundamentals of the economy (a decrease in GDP) is also worth noting.

A picture similar, except for the above-mentioned price puzzle, emerges from the estimation on monthly data (**Figure 2**). After a negative monetary policy shock of approximately 0.5 percentage point, CPI falls in a statistically significant way after 26 months (maximum effect is 0.3%), and industrial output by approximately 0.5% from the 5<sup>th</sup> to 22<sup>nd</sup> month following the shock. Zloty exchange rate movements, first a short-lived appreciation, then a depreciation are not statistically significant although they are consistent with intuition.

#### Exchange rate shock

The response of the real economy to exchange rate shocks (appreciation) is statistically insignificant (Figure 4), which may, on the one hand, result from the induced interest rate decline, and, on the other hand, from a significant share of intra-corporate trade (cf. chapter IV.2.2 of the Report).

A statistically significant impact of the exchange rate shock on price level amounting to approximately 0.14% in the second quarter after the shock and 0.2% in 3<sup>rd</sup>-4<sup>th</sup> quarter is consistent with other studies on this effect (cf. chapter IV.2.3). In the model estimated on monthly data (Figure 5), price response to the exchange rate shock is very slight and almost statistically insignificant in the first 4 months, which is incompatible with other estimations of the effect of exchange rate transmission to prices. The response of industrial output is also insignificant, which confirms the results obtained on monthly data.

#### Domestic demand shock

A positive real economy shock, i.e. an exogenous increase in domestic demand, triggers a statistically significant rise in prices, interest rate (the central bank tightens monetary policy) and zloty appreciation – positive fundamentals lead to an increase in demand for the zloty (Figure 6).

#### Price shock

An unexpected price growth evokes, in turn, a statistically significant interest rate increase (monetary policy tightening) and the resulting transitory decline in output. Yet, the response of the exchange rate is not statistically significant (**Figure 7**).

<sup>&</sup>lt;sup>12</sup> Compared to the results of similar estimations for the euro area the response of prices to interest rate shock in Poland is weaker and that of the real sphere is higher. It should be emphasised, however that the model specification we used was not identical to the one used for the euro area.



#### Figure 1. Response functions of key macroeconomic variables to interest rate shock, quarterly frequency

Figure 2. Response functions of key macroeconomic variables to interest rate shock, monthly frequency



Figure 3. Comparison of response functions of GDP, individual consumption and investment to interest rate shock, quarterly frequency





#### Figure 4. Response functions of key macroeconomic variables to exchange rate shock, quarterly frequency

Figure 5. Response functions of key macroeconomic variables to exchange rate shock, monthly frequency



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#### Figure 6. Response functions of key macroeconomic variables to domestic demand shock, monthly frequency

Figure 7. Response functions of key macroeconomic variables to price shock, monthly frequency



# III.2. Simulations of the monetary policy transmission mechanism on a small structural model

#### Key characteristics of the monetary policy transmission mechanism in Poland

The analysis of the interest rate impact on economic activity was carried out on the basis of a small structural model of the transmission mechanism (MMT).<sup>13</sup> Two versions of the model were used. In the first – the impact of economic activity (output gap) on inflation is linear, in the second – non-linear (relatively stronger in periods of boom).

In simulations WIBOR 3M rate is increased or decreased by 1 percentage point for a period of 4 quarters and returns to its initial level subsequently. The results of the simulation obtained from the basic version of MMT model, i.e. the linear version, show that the peak response of GDP growth to interest rate impulse occurs in the 4<sup>th</sup> quarter after the impulse and amounts to approximately 0.3 percentage point. The peak response of inflation occurs with a larger, 6-quarter lag and amounts to 0.3 percentage point.

When a non-linear inflation response to output gap (empirically confirmed) is assumed the picture of the transmission mechanism slightly changes. If the output gap is negative or zero at the starting point, inflation response occurs 2 quarters earlier, i.e. in the 4<sup>th</sup> quarter after the interest rate impulse. Yet, the scale of maximum response remains unchanged. On the other hand, when the output gap is strongly positive we observe three effects: first, the response of GDP growth to interest rate impulse becomes lagged and slightly increased; second, maximum response of inflation is significantly stronger although with the same lag as in the linear model; third, a slight difference is observed between the maximum response of inflation in the case of interest rate hike (decline in inflation by approximately 0.7) and in the case of interest rate fall (increase in inflation by 0.8 percentage point).

The response of interest rate on zloty denominated loans (total), real effective exchange rate (REER), output gap and GDP, net inflation (excluding food and fuels) and CPI inflation to monetary policy impulse is presented below (**Table 10**, **Figure 8**).

<sup>&</sup>lt;sup>13</sup> The model is described in: Łyziak T., Przystupa J., Stanisławska E., Wróbel E. (2011), *Monetary policy transmission disturbances during the financial crisis. A case of an emerging market economy*, Eastern European Economics, No. 49(5), pp. 30-51.

	Linear MMT	Non-lin	ear MMT				
		gap ≤ 0	gap = 0.04				
Lendi	ng rate respons	e					
peak response strength (perc. points.)	0.98	0.98 <sup>(i)</sup>	0.99 <sup>(i)</sup>				
		-0.98 <sup>(d)</sup>	-0.99 <sup>(d)</sup>				
peak response lag (quarter)	3	3 <sup>(d)</sup>	3 <sup>(d)</sup>				
Real effective exchange ra	ite response (inc	rease – appre	ciation)				
neak response strength (%)	176	1.74 <sup>(i)</sup>	1.62 <sup>(i)</sup>				
	1.70	-1.74 <sup>(d)</sup>	-1.61 <sup>(d)</sup>				
peak response lag (quarter)	2	2 <sup>(i)</sup> 2 <sup>(d)</sup>	2 <sup>(i)</sup> 2 <sup>(d)</sup>				
Outr	Output gap response						
	0.10	-0.42 <sup>(i)</sup>	-0.49 <sup>(i)</sup>				
peak response strength (perc. points.)	-0.42	0.42 <sup>(d)</sup>	0.51 <sup>(d)</sup>				
peak response lag (quarter)	6	6 <sup>(i)</sup>	6 <sup>(i)</sup>				
		6 <sup>(a)</sup>	6 <sup>(d)</sup>				
GDP y/y res	ponse (approxi	mation)					
peak response strength (perc. points.)	-0.33	-0.34 <sup>(i)</sup>	$-0.40^{(i)}$				
		0.34 <sup>(i)</sup>	<u>0.41(ii)</u>				
peak response lag (quarter)	4	4(d)	6 <sup>(d)</sup>				
Ne	et inflation y/y						
nock reasons strongth (none nointe)	0.24	-0.34 <sup>(i)</sup>	-0.82 <sup>(i)</sup>				
peak response strength (perc. points.)	-0.34	0.32 <sup>(d)</sup>	1.11 <sup>(d)</sup>				
peak response lag (quarter)	5	4(i) 4(d)	$6^{(i)}$ 7(d)				
Response of (	CPI inflation y/y	response	70				
	0.24	-0.34 <sup>(i)</sup>	-0.68 <sup>(i)</sup>				
peaк response strength (perc. points.)	-0.34	0.34 <sup>(d)</sup>	0.80 <sup>(d)</sup>				
peak response lag (quarter)	6	4(i)	6(i)				
		4 <sup>(a)</sup>	6 <sup>(d)</sup>				

#### Table 10. Monetary policy transmission mechanism - synthetic results

Note: Separate data are given for the increase (i) and decrease (d) of interest rate for the non-linear MMT version.

## **Figure 8. Monetary policy transmission mechanism – detailed results** (*in the non-linear version – determined by the initial level of output gap – GAP*)





## *Tentative evaluation of the relative strength of individual monetary policy transmission mechanism channels*

Using the linear version of the small structural model of the monetary transmission mechanism in Poland (MMT), an exercise was run to approximately evaluate the relative strength of monetary transmission channels. It should be emphasised that the interest rate and exchange rate channels are well represented in the model whereas the credit channel is represented in a simplified form<sup>14</sup>, which may render the evaluation of its relative strength underestimated. The exercise was run in three steps. In the first step, the response of inflation to a rise in short-term interest rate by 1 percentage point for the period of 8 quarters was evaluated. Next, in an analogical simulation, the nominal effective exchange rate was fixed, thus giving an approximation of the effect of interest rates on inflation through the interest rate and lending channels. In the last step, we additionally fixed cyclical risk premium variable (difference between lending rate and WIBOR 3M), which was supposed to proxy credit channel operation.

The interest rate and exchange rate channels seem to be the strongest transmission channels in Poland (Figure 9). The interest rate channel seems stronger than the exchange rate channel, moreover its relative strength increases. The exchange rate channel is, in turn, the quickest transmission mechanism channel. If the exchange rate channel should not work, the maximum response of inflation would be lagged by 3 quarters compared to the situation where all channels had been operative, however the response strength would be similar.



Figure 9. Relative strength of individual transmission mechanism channels

<sup>&</sup>lt;sup>14</sup> Spread between the lending rate and the interbank short-term interest rate (WIBOR 3M) depending on the phase of the business cycle serves as a proxy for credit channel proxy (banks' inclination to reduce credit supply). Cf. Łyziak T., Przystupa J., Stanisławska E., Wróbel E. (2011), *Monetary policy transmission disturbances during the financial crisis. A case of an emerging market economy*, Eastern European Economics, No. 49(5), pp. 30-51.

#### III.3. Sacrifice ratio<sup>15</sup>

To estimate sacrifice ratio, i.e. costs related to monetary policy decisions, we use a small theoretical model, calibrated in the way reflecting the characteristics of the monetary policy transmission mechanism in Poland.<sup>16</sup>

The simulation assumes that the central bank intends to permanently decrease inflation by 1 percentage point. Monetary authorities make a decision on reducing the inflation target and adjust the short-term interest rate to the new target. In the model framework the increase in the interest rate influences inflation through two main channels that have an impact on the real economy, i.e. the interest rate channel (impact on consumer and investment demand) and through the exchange rate channel (impact on net exports and prices of imported goods). Another effect of the change in central bank inflation target is the adjustment of inflation expectations to the monetary authorities' new target whose scale depends on the degree to which expectations are forward looking ( $\varphi$ ). The degree of expectations' forward-lookingness – equal to 0.15 – has been calibrated on the basis of estimates using direct measures of consumer inflation expectations in Poland <sup>17</sup> (cf. chapter IV.4.2 of the Report). Alternative exercises were run for fully static expectations ( $\varphi$ =0), half static and half forward looking ( $\varphi$ =0.5) and fully forward looking ( $\varphi$ =1) expectations.

The results of the simulations show that with the increase of the degree to which inflation expectations are forward looking, the price dynamics in the economy approaches the new monetary policy target quicker (**Figure 10**), and the disinflation process is characterised by lower costs, i.e. a smaller fall in the output gap (**Figure 11**) and a smaller cumulative GDP loss, i.e. the sacrifice ratio (**Figure 12**). In the case of the expectations-formulating mechanism that is coincident with the one characterising inflation expectations of Polish consumers, bringing down inflation to the new inflation target takes approximately 3 years, and the cumulative GDP loss that needs to be incurred (sacrifice ratio) amounts to approximately 0.65%.<sup>18</sup>

<sup>&</sup>lt;sup>15</sup> This chapter of the Report is based on: Łyziak T. (2011), *Oczekiwania inflacyjne*: in: A. Sławiński [ed.] (2011), *Polityka Pieniężna*, CH Beck, pp. 105-118.

<sup>&</sup>lt;sup>16</sup> Models of the New Keynesian economy have served as the reference point for the construction of the MMPP model. Its structure is strongly aggregate and accounts for four basic macroeconomic relationships, i.e. the aggregate demand curve, exchange rate formula, Phillips curve and the monetary policy rule. MMPP model characteristics are presented in: Łyziak T. (2011), *Oczekiwania inflacyjne*: in: A. Sławiński [ed.] (2011), *Polityka Pieniężna*, CH Beck, pp. 105-118.

<sup>&</sup>lt;sup>17</sup> The reasons for taking consumer inflation expectations into account were as follows: first, a relatively long and internally homogeneous expectation series of this group of agents, and, second, relatively best statistical features of Phillips curve estimations, in which these expectation measures were used (cf. Łyziak T. (2012), *Inflation expectations in Poland*, NBP Papers, No. 115), and not enterprises' and financial sector analysts' expectation measures. Estimation of the sacrifice ratio obtained in this way may, however be slightly overestimated as consumer inflation expectations are characterised by a lower degree of forward-lookingness than the expectations of the remaining groups of agents (chapter IV.4.2 of the Report).

<sup>&</sup>lt;sup>18</sup> The measurement of the sacrifice ratio strongly depends on the methodology applied. The analysis of actual disinflation processes constitutes an alternative for the model approach presented here. The sacrifice ratio measured in this way is significantly lower for Poland than the average for the OECD countries while being higher than identical estimates for the German economy and for countries conducting the inflation targeting strategy. Cf. Gonçalves C.E.S., Carvalho A. (2007), *Inflation targeting matters: evidence from OECD economies' sacrifice ratios*, Journal of Money, Credit and Banking, No. 41(1), pp. 233-243.

Figure 10. Response of CPI inflation y/y (perc. points, INFA ) to the change in inflation target for different degrees of forward-lookingness of inflation expectations







Figure 12. Cost of disinflation measured with the sacrifice ratio (SR) for different degrees of forward-lookingness of inflation expectations



## IV. Operation of respective transmission channels

## IV.1. Interest rate channel

#### IV.1.1. Transmission in the money market

WIBOR rates adjust to reference rate movements reasonably well (Figure 13, Table 11, Table 12). Interest rates with shorter maturities adjust in the quickest and fullest way. The coefficient of the instantaneous adjustment ranges from 0.92 for a 9-month rate to 1.08 for 1-week and 1-month rate. This implies that in the interbank market, interest rates adjust almost fully to reference rate movement within a month. The coefficient of long-term adjustment for money market rates with maturities of up to 3 months ranges from 0.83 to 1.06, therefore the rates seem to fully adjust to reference rate movements. Interest rates with maturities of 6 and 9 months also adjust strongly to reference rate movements in the long term but the adjustment is not full and amounts to 0.68 and 0.60, respectively.

The financial crisis disturbed the process of transmission in the money market (more information on this subject can be found in chapter V.1 of the Report). At the end of 2008, the confidence crisis and uncertainty in the interbank market led to a significant increase in spreads between the POLONIA and WIBOR 3M rates and the NBP reference rate (Figure 13). The crisis period was characterised by an apparently good adjustment of interbank market rates to central bank rate movements – the analysed rates moved together and the error correction model parameters did not worsen (Table 11, Table 12). However, the fact that transactions stopped in the interbank market was likely to reduce the informational content of WIBOR rates which was reflected in setting retail deposit and lending rates by commercial banks.



Figure 13. Interest rates (upper panel) and spreads (lower panel)

Table 11. Cumulative changes in selected interest rates in periods of monetary policy tightening and easing (calculations for monthly data)

Period	Reference rate	WIBOR 1W	WIBOR 1M	WIBOR 3M	WIBOR 6M	WIBOR 9M
2004:07-2004:09	1.25	1.34	1.25	1.21	1.04	0.84
2005:03-2006:03	-2.50	-2.39	-2.43	-2.42	-2.34	-2.20
2007:04-2008:07	2.00	2.06	2.14	2.40	2.37	2.35
2008:11-2009:07*	-2.50	-2.98	-2.92	-2.54	-2.38	-2.31
2011:01-2011:07	1.00	1.10	0.97	0.78	0.62	0.50

\* It should be noted that the relatively strong decline in WIBOR rates in this period resulted from their increase at the beginning of the financial crisis with a constant NBP reference rate.

## Table 12. Results of the estimation of error correction models for monthly data for the period fromJanuary 2003 to July 2011

	Long-term	Instantaneous	Speed of adjustment
	adjustment coefficient	adjustment coefficient	(months)
WIBOR 1W	1.06	1.08	0.26
WIBOR 1M	1.01	1.08	0.29
WIBOR 3M	0.83	0.99	0.11
WIBOR 6M	0.68	0.94	0.61
WIBOR 9M	0.60	0.92	0.85

## IV.1.2. Transmission to deposit and lending rates in commercial banks

The study on the transmission of movements in central bank interest rates to deposit and lending rates was carried out on monthly data on a sample starting in January 1998 and ending in September 2011 for the stock of total deposits and loans; for specific products, including the new deposit and loan contracts it was carried out on a subsample from January 2005 to September 2011.<sup>19</sup> In the sub-sample covering the years 2005-2011, in particular since the first symptoms of the financial crisis in 2007, major disturbances in the transmission had taken place (**Figure 14**, **Figure 15**, **Figure 16**). Their significant intensification occurred after the collapse of Lehman Brothers; distinct disturbances were also observed in 2011 in connection with the second phase of the financial crisis. Therefore, this period does not provide much information about the regularities of interest rate transmission in the banking sector as periods of larger or lesser exogenous disturbances prevail, and points instead to the way interest rate transmission behaves under increased uncertainty. The impact of the financial crisis on the transmission mechanism is discussed in chapter V.1 of the Report. Here, we are going to present the results flawless of the disturbances.<sup>20</sup>

When evaluating the extent of interest rate adjustment in the banking sector we assume that banks set retail rates in relation to the marginal cost of raising funds in the inter-bank market (in the case of deposits: WIBOR 1M or WIBOR 3M – depending on the deposit maturity; in the case of loans – WIBOR 3M). In principle, the long-run passthrough is expected to be close to 1, although in certain periods, e.g. of strong competition for market share, this assumption may not be satisfied (notably in the short sample we use, covering the years 2005-2011). Yet, we expect that the long-run relationship of money market interest rates and retail rates does exist, and, therefore, banks do not set retail rates in isolation from money market interest rates which, in turn are affected by central bank policy.

<sup>&</sup>lt;sup>19</sup> The sample that served for estimations is short as the methodology and the scope of the NBP interest rate statistics have been modified over time. This is practically the only sample entailing present-day observations that allows comparing particular bank products (uniform samples cover the following periods: to February 2002, from March 2002 to December 2004, from January 2005 to date). The "long" sample, for which we only estimate the relationships between the WIBOR rate and average weighted interest on loans and deposits is thus not uniform and we were therefore forced to introduce dummy variables for the moments of methodology modifications. Estimation of long-term relationships (of equilibrium) for such statistics is difficult and the results are subject to particularly large uncertainty. The uncertainty of estimations in a short sample results not only from its size but also from disruptions in the transmission mechanism in times of the financial crisis. A significant part of the sample is affected – the second half of 2007, the period from September 2008 to the end of the first half of 2009 and the period from the end of the first quarter of 2011 until the end of the sample.

<sup>&</sup>lt;sup>20</sup> Not all series needed to be cleared of disturbances, e.g. interest on new 1-month household deposits. In another study (Sznajderska A. (2012), *On the empirical evidence of asymmetry effects in the interest rate pass-through in Poland*, NBP Papers, No. 114) we show, among others, the impact of increases and decreases in money market rate, level of liquidity and business cycle on the asymmetry in the interest rate pass-through in commercial banks. When comparing the results with those presented in the Report it should be taken into account that they are based on slightly different samples.





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2011





Figure 16. Spread between interest on selected loans to corporates and households and money market rates (WIBOR 3M)



Where:  $I_LOANS_NEW_..._TOTAL$  - total new loans,  $I_LOANS_NEW<3M$  - new loans with maturity up to 3 months,  $I_OVERDRAFT_CS$  - bank overdraft  $I_LOANS_1-5Y$  - loan balance with maturity from 1 to 5 years,  $I_HOUSING$  - housing loans,  $I_SOLE_PROP$  - loans to individual entrepreneurs,  $I_..._CS$  - consumer loans

#### Transmission to deposit and lending rates in 1998-2011

There are no long-term relationships between interest on total deposits and loans and WIBOR 3M rate for the sample as a whole. However, if the sample is divided into two sub-samples – the first one until Poland's entry into the EU and the other from June 2004 to September 2011, such relationships may be identified (Table 13).

The relationship of deposits and money market rate in the sub-sample to May 2004 is not stable, though, which concerns both long- and short-run relationship. The relevant relationship for interest on loans is far more stable – it displays only temporary disturbances in 2000. In the second sub-period there are different, in terms of quality, long-run relationships – a trend emerges (**Figure 17**). This is probably caused by crisisrelated disturbances to a great extent but it may not be ruled out that until the end of 2006 it resulted from rising demand for loans, and from the development of the financial market, which led to increased possibilities of depositing funds outside the banking system. In the long-run relationship of interest on deposits temporary disturbances take place in 2007 and then in 2009. The short-run relationship is far more unstable – disturbances appear in 2007 and, with a short interruption, are observed almost until the end of 2009. In the case of interest on loans the long-run relationship is relatively stable, while the short-run relationship displays disturbances in 2006-2007.

Retail rate, period		Long adjustment	g-run coefficient	Coefficient determining the speed	
		Estimated	Is adjustment full?	t-stat. in parenthesis	
Deposite total stacks	1998:01-2004:05	0.864	No	-0.209 (-3.500)	
Deposits, total, stocks	2004:06-2011:09	1.104	Yes	-0.113 (-5.136)	
Leave total stades	1998:01-2004:05	0.874	No	-0.280 (-5.052)	
LOANS, JOLAI, SLOCKS	2004:06-2011:09	0.862	Yes	-0.207 (-4.907)	





#### Transmission to deposit rates in 2005-2011

Among corporate deposits (new deposits) the most stable long-run relationship with money market rate is displayed by deposits with up to 1-month maturity although this relationship was also subject to clear disruptions in 2007 (Table 14). The relationship of deposits with longer maturity with WIBOR 3M rate is very unstable – it refers to both the coefficients determining the speed of adjustment to equilibrium and the equilibrium relationship itself (3- and 6-month deposits). The relationship of the average weighted interest on corporate deposits with the money market rate displays slightly fewer disturbances than the relationships of particular deposit types. The coefficient of long-term adjustment is close to 1 but in the period from May 2008 to the end of 2010 it was unstable.

Interest on household deposits adjusts in a similar way – the most stable long-run relationship is that between the 12M and 1M deposit and the money market rate (WIBOR 3M and WIBOR 1M, respectively) but they also show certain disturbances (lesser in the case of 12M than 1M deposits). In the case of the former, disturbances took place only in the third quarter of 2009 while in the case of the latter – a destabilisation of the long-term adjustment coefficient occurred in 2008-2009 and the whole relationship was unstable in 2008. The coefficient determining the speed of return to equilibrium displayed temporary disturbances in 2008-2009. The existence of a long-run relationship between interest on 3M and 6M deposits and WIBOR 3M rate is debatable: the coefficient determining the speed of return to equilibrium is very low in both cases and statistically insignificant (**Table 14**); both long-run relationships are unstable. Average weighted interest rate on new household deposits remains in a long-term equilibrium relationship with the money market rate, the value of the pass-through ratio is 1; the coefficient determining the speed of return to equilibrium – 0.24. This relationship was also subject to disturbances in 2007-2009.

To sum up, it can be observed that both in the case of new corporate and household deposits the degree to which market rates are transmitted is full or close to full (in the case of deposits with up to 1M maturity). The same is true for average weighted interest on these deposits. Interest on corporate deposits returns to long-term equilibrium faster than interest on household deposits.

Deposit		Lon adjustmen	g-run It coefficient	Coefficient determining the speed	
		Estimated	Is adjustment full?	t-stat. in parenthesis	
	up to 1M		no	-0,615 (-3.996)	
componetos	1M - 3M	1.089	>1	-0.290 (-3.375)	
corporates	3M - 6 M	1.051	yes	-0.285 (-2.727)	
	average*	0.948	no	-0.635 (-4.507)	
	up to 1M	0.997	yes	-0.164 (-2.984)	
	1M - 3M	1.680	no	-0.044 (-1.731)	
	3M - 6 M.	1.402	no	-0.075 (-1.749)	
households	6M – 12M	0.764	Yes, but restrict- ed relationship is unstable	-0.647 (-5.628)	
	average	0 996	ves	-0.242 (-3.963)	

Table 14. Adjustment parameters of retail rates on deposits (new deposits) for which cointegration test (Johansen test with Barletta correction factor for a small sample) showed the existence of one cointegration vector

\* Due to the structure of corporate deposits (primarily deposits with maturity of up to 1M) the equilibrium relationship was estimated with respect to WIBOR 1M rate, adjustment to WIBOR 3M is far slower – circa 38% of disequilibrium is eliminated within 1 month, with the same as in the case of WIBOR 1M long-term coefficient.

#### Transmission to lending rates in 2005-2011

The transmission of money market rates to lending rates in the analysed period may be divided into three sub-periods: in the first one, lasting approximately till the end of 2007 or the middle of 2008 (depending on loan type) a negative, close to deterministic, trend is observed in the spread (i.e. the difference between lending rate and WIBOR 3M rate); in the second, lasting approximately until the middle of 2009 – there was a strong positive trend, also close to deterministic, and in the third sub-period, lasting from the middle of 2009 to the end of the analysed sample – again there was a negative trend in the spread or, alternatively, the spread remained at a high level (**Figure 16**).

In the first of the above mentioned sub-periods, which was a period of boom<sup>21</sup> – banks tended to search for an increase in the loan market share, evaluating borrowers' situation and their own refinancing possibilities positively. Exogenous loan supply shocks (as defined in chapter IV.3.1 of the Report) could occur at that time. In the second of the periods, the financial crisis developed in global markets, the economic situation worsened dramatically, and, as a result, banks started to raise interest on loans above the money market rate. In the third period, depending on the type of loan and client, banks either eased their policies or, which was related to risk level assigned to individual loan types, did not reduce it proportionally to the decline of market rates. Therefore, in the case of some loans, e.g. consumer loans, the long-term equilibrium relationship could not be identified. This does not mean that, in general, interest on loans is set without any relationship to central bank policy but that in such a short and varied sample, in terms of the economic situation and uncertainty (in spite of the sample having been cleaned), these relationships could not be identified.

Long-run relationships (at the border of statistical significance) with WIBOR 3M rate exist for interest on overdraft, new loans to sole proprietors, total new loans to house-holds and housing loans. Yet, we did not succeed in identifying a long-run relationship for interest on total new loans to corporates and new loans with maturities of up to 3 months to corporates (**Table 15**). It should be emphasised that all long-run relationships display significant instability from 2007 to 2009.

Loon	Long adjustment	g-run coefficient	Coefficient determining the speed	
LUAII	Estimated	Is adjust- ment full?	t-stat. in parenthesis	
To corporates, overdraft	0.818	yes	-0.086 (-3.645)	
To households, new loan	1.422	yes	-0.334 (-3.847)	
To sole proprietors, new loans	0.521	no	-3.00 (-5.042)	
Housing loans	1.312	yes	-0.104 (-2.658)	

Table 15. Adjustment parameters of selected retail lending rates (new loans) for which cointegration test (Johansen test with Barlett correction for a small sample) showed the existence of one cointegration vector

<sup>&</sup>lt;sup>21</sup> The analysis of the transmission effect in different phases of the business cycle can be found in: Sznajderska A. (2012), *On the empirical evidence of asymmetry effects in the interest rate pass-through in Poland,* mimeo, NBP Papers, No. 114. The cyclicality of spreads and the credit channel of monetary transmission mechanism is discussed in theoretical and empirical works, e.g.. Bernanke B., Gertler M., Gilchrist S. (1998), *The financial accelerator in a quantitative business cycle framework*, NBER Working Paper, No. 6455; Agénor P.-R., Bratsiotis G., Pfajfar D. (2011), *Monetary shocks and the cyclical behavior of loan spreads*, CGBCR Discussion Papers, No. 156.

## IV.1.3. Credit response to monetary policy impulse

The response of zloty denominated loans to corporates and households was analysed with the VAR model (the Cholesky decomposition), estimated on a monthly sample starting in January 1998 going through August 2011. The following variables (levels) have been used: consumer price index (CPI), industrial output, WIBOR1M, nominal effective exchange rate (NEER), different loan types.

Following an interest rate shock, zloty denominated loans to corporates decline (**Figure 18**). A statistically significant effect occurs quicker for bank overdraft (after 10 months) than for long-term loans (17 months after the shock). An unexpected WI-BOR1M interest rate hike leads to a long-lasting decline in credits – their reduced level is still observed after 36 months; the maximum response to shock in the order of 0.5 percentage points amounts to circa 1.8%. The response of loans to sole proprietors (i.e. small enterprises formally classified as households) is far stronger than that of loans to corporates. Sole proprietors' response is twice as strong and exceeds 3%. In addition, a statistically significant effect in this case follows the interest rate impulse immediate-ly. There are reasons to believe that banks are more radical and quicker to cut back on their lending to entities about which they have less information and which they deem to be riskier than corporates. This effect is in line with the credit channel theory.

The response of zloty denominated loans to households to interest rate shock is generally quicker than that of loans to corporates (**Figure 19**) – a statistically significant effect occurs already after 5 months. The response is also stronger than in the case of corporates (the maximum effect of a shock of approx. 0.5 percentage point is around 3%). The response of housing loans is slower than that of total loans; the scale of the decline is, however, larger, amounting to a maximum of approx. 4%.

The possibility of incurring a foreign currency loan reduces the effectiveness of monetary policy transmission: an unexpected WIBOR1M rate hike results in an increase in foreign currency loans to corporates<sup>22</sup> (**Figure 20**). An exchange rate shock initially leads to accounting effect (debt reduction due to zloty appreciation) but subsequently, after around 12 months, leads to an increase in foreign currency loans. The impact of the domestic demand shock is similar – initially there is a reduction in corporates' debt, which is the result of both a better financial situation and the zloty appreciation that takes place after such a shock. After around 2 years, foreign currency debt goes up (all results presented here are at the limit of statistical significance). There is no response of foreign currency loans to households to the domestic monetary policy shock but they rise after a positive real economy shock.

<sup>&</sup>lt;sup>22</sup> These loans have been adjusted for foreign exchange rate changes. The share of foreign currency loans in total loans to corporates is fairly high – in 2002 it amounted to 30.2%, in 2010 – to 24.5% (cf. **Table 4**).



#### Figure 18. Response function of loans in zloty to corporates to interest rate shock

Figure 19. Response function of loans in zloty to households to interest rate shock



## Figure 20. Foreign currency loan response function to domestic demand, interest rate and exchange rate shock



## IV.2. Exchange rate channel

### IV.2.1. The role of interest rate disparity in exchange rate determination

In standard exchange rate models based on the concept of uncovered interest rate parity, risk premium is understood as the deviation of an economic category (share of current account balance in the GDP, net foreign assets in the GDP, public finance debt or unemployment rate) from its long-term average. In the UIP models derived from the Taylor rule the natural risk premium for the real exchange rate is the output gap.

The model of uncovered interest rate parity with a time-varying risk premium is estimated for the nominal and real effective exchange rate of the Polish zloty (NEER/REER). Data from the period 1998Q1-2011Q1 are used. In this period categories representing risk premium were changing. The expected output gap, which is an approximation of the risk premium and, at the same time, an evaluation of the economy's fundamentals, is statistically significant from 2005. Previously, investors paid more attention to less aggregated macroeconomic data that significantly deviated from their long-term averages. In 2000-2003, risk premium was well reflected by the contribution of trade balance to the GDP or the contribution of current account balance to the GDP – the impact of these variables on the exchange rate was characterised by a high quarter to quarter volatility. For the years 2001-2004, the term-structure of interest rates which reflected the expected movements in the reference rate<sup>23</sup> was used as a risk premium – its impact on the exchange rate was, however, not very stable over time. In 2002-2004, risk premium was well represented by the share of external or domestic financing of the state budget in the total budget funding – the estimated impact of these variables on the exchange rate was fairly stable in the analysed period.

The estimation of parameters describing the response of the exchange rate to the interest rate disparity and risk premium changes are presented in **Figure 21** and **Figure 22**. In the estimated equations up to 2005, risk premium was described by deviations of the components of the current account balance and state budget in relation to the GDP from their long-term averages; from 2005 – by expected changes in the output gap.



Figure 21. NEER/REER response to the change in nominal/real disparity (recursive estimation)

 $<sup>^{23}</sup>$  Interest rate term-structure was represented by the difference between WIBOR 3M and WIBOR 1M rates.



Figure 22. NEER/REER response to the change in risk premium (recursive estimation)

\* Up to 2005 risk premium was represented by deviations of the components of the current account balance and state budget in relation to the GDP from their long-term averages; from 2005 – by the expected changes in the output gap.

The strength of exchange rate response to changes in the interest rate disparity seems to depend on the phase of the business cycle (**Figure 21**): during a period of boom (nonnegative output gap) the response is weaker than in times of a decline in economic situation (negative output gap). What should be taken into account when interpreting this observation from the point of view of monetary policy transmission is that this pattern is particularly visible in the initial period of the financial crisis when the disparity of 3-month interest rates was influenced by risk assessment to a greater extent than by monetary policy decisions<sup>24</sup>, and the major zloty depreciation was mainly caused by external factors (confidence crisis).

The impact of risk premium (expressed by the output gap) on the exchange rate seems to be weaker during a period of prosperity and increases as the economic situation gets worse. In the case of the nominal exchange rate, this is connected with short-term evaluation of the risk of investing in the zloty. In the case of the real exchange rate, risk assessment relates to long-term investment in the real economy inducing higher but more stable risk premium. The difference in risk assessment translates into the dependence of the exchange rate on interest rate movements – the response of the real exchange rate is twice as strong. In the example described here, one can observe the effect of separating expected exchange rate movements from changes in the disparity of interest rate in the situation of varying risk premium. In extreme cases, even in the absence of interest rate movements, and only as a consequence of a change in risk assessment, there is an inflow of capital to the country causing exchange rate movements - the significance of the interest rate decreases. In times of a slump, the expected rate of return on short- (nominal exchange rate) and long-term (real exchange rate) investment gains in importance, increasing the weight of disparity. The increase in risk premium occurring at the same time leads to a situation where interest rate movements, partially compensated with the rise in the significance of the disparity, are necessary to constrain the outflow of capital.

<sup>&</sup>lt;sup>24</sup> Attention should again be drawn to the fact that WIBOR 3M rates at that time were the effect of nontransaction quotation which limited their informational merits.

## IV.2.2. The impact of exchange rate on aggregate demand

Changes in the exchange rate affecting relative prices modify the competitiveness of Polish goods in international markets and imported goods in Polish market. To build empirical models of export and import value, we used an identity, according to which the value of exports expressed in domestic currency is equal to the product of export volume and export transaction prices. Imports were treated in an analogical way. According to the theory of imperfect substitutes, the real demand for export is an increasing function of external demand and a decreasing function of the real exchange rate (REER) that measures price (cost) competitiveness of export goods or the decreasing function of nominal exchange rate (NEER) and the increasing function of world prices. At the same time, the weight of external demand and price (cost) competitiveness are modified by foreign direct investment and integration-related effects (trade liberalisation). The evaluated weight of particular components explaining the export and import volume in Poland is presented in **Figure 23** and **Figure 24**.









In 2010 external demand accounted for 74.8% of the rise in Polish export volume (the rise in the significance of this factor by 16.3 percentage points against 1998), in which the weight of demand generated by manufacturing links with the international economy, approximated by foreign direct investment (FDI), amounted to 27.2% in 2010, which represents a rise by 21.5 percentage points since 1998 and by 8.6 percentage points since 2004. Such a change in the significance of FDI may be explained by an increase in the long-term foreign capital involvement in mainly export-oriented projects.

This interpretation is supported by the decline in the impact of the zloty exchange rate in 1998-2000 on exports by 16.4 percentage points, to 23.5% in 2010 due to the fact that international corporations make settlements within a capital group treating output in a subsidiary as part of the group output. In these circumstances, exchange rate changes are compensated by the movements in import prices or changes in the size of import input. It is also worth noting that while intra-corporate ties account for 27% of the rise in total exports, in the case of exports of investment goods, transport equipment and household and RTV equipment the figure goes up to almost 40%.<sup>25</sup>

The hypothesis of the reason for the increasing role of FDI as a demand factor determining Polish exports is confirmed by the change in the role of foreign investment in explaining imports. Their large weight in mid-1990s resulted from this capital being invested in food and automotive industry, whose output was earmarked almost exclusively for the domestic market. Foreign direct investment accounted for the majority of imports, i.e. 23%, in 1998. Its role decreased subsequently to 13.7% in 2004 and, along with another wave of FDI, this time export-oriented, increased only slightly by 2010 – to 15.1%. At the same time, the role of the real zloty exchange rate decreased by 1.8 percentage points (to 17.6%). Domestic demand continues to determine imports growth.

Export volume response to changes in external demand does not depend on the phase of business cycle and is relatively quick – in the 2<sup>nd</sup> and 3<sup>rd</sup> quarter after the change, export response is the strongest and the decline in demand by 1 percentage point triggers a decline in export volume growth by around 4 percentage points. In turn, as the import content of export goods is high, reaching 0.7 in investment goods and household and RTV equipment, changes in export volume inevitably entail corresponding changes in import volume. The response is quick due to great importance of intracorporate import – one quarter after the decline in export growth by 1 percentage point, the growth rate of imports goes down by almost 0.7 percentage point and the maximum decline in import growth connected with export change affected by a change in external demand amounts to 2.8 percentage points (Figure 23). The response of both export and import volume to exchange rate movements is stable over time, symmetric (similar in periods of depreciation and appreciation) and almost as quick as the response to a change in external demand (Figure 24). Taking account of the fact that the zloty exchange rate explains less than 25% of export volume growth and less than 20% of import volume growth, a 10% depreciation (appreciation) in the zloty exchange rate results in an increase (decrease) in export volume growth by 2.6 percentage points and a decrease (increase) in import volume growth by 1.4 percentage points. The strongest response materialises in the 3<sup>rd</sup> guarter after the impulse.

<sup>&</sup>lt;sup>25</sup> IBRKK (2010), *Gospodarka i handel zagraniczny Polski w 2009 r. Raport roczny*, IBRKK, Warsaw and the 2008, 2009 and 2011 editions of the report.

Figure 23. Export response to a decline in external demand by 1 perc. point and the related import response



Figure 24. Export and import growth response to a 10% depreciation of zloty real exchange rate \*



\* Exchange rate is deflated by unit labour costs in the analysis of export response and by CPI in the analysis of import response.

## IV.2.3. Pass-through effect

Exchange rate pass-through effect<sup>26</sup> to consumer prices is estimated in Poland to be around 0.18<sup>27</sup> on average. Its magnitude depends on the phase of the business cycle, the direction of exchange rate changes and its volatility (**Table 16**). During the economic boom the exchange rate pass-through to CPI is 0.18 and declines in the early phase of recession to almost zero; in the late phase of recession, the trough and early phase of recovery it increases, respectively, from zero do 0.18, and then to 0.28, declining to 0.18 in the phase of economic peak (**Figure 25**). During appreciation the pass-through effect declines to 0.02-0.07; during depreciation – it increases to 0.24. A low the ex-

<sup>&</sup>lt;sup>26</sup> Textbooks define exchange rate pass-through effect into domestic prices as the response of import prices expressed in domestic currency to the changes in exchange rate between the exporting and the importing country. Under perfect competition this ratio should equal unity. Gagnon and Ihrig (2004) demonstrated that if producers have confidence in a monetary policy actively stabilising inflation, they are less inclined to change consumer prices in response to a change in the currency exchange rate. They analysed the pass-through effect in developed countries in 1971-2004 and estimated that the stabilisation of inflation in the middle of the 1980s led to a decline in the pass-through effect from 0.16 in 1971-1983 to 0.05 in 1984-2004. In countries where the direct inflation targeting regime was implemented in the 1990s the decline was even larger: from 0.18 to 0.03. The magnitude of the effect for developed countries in 1971-1983 is similar to the present pass-through level in Poland and other Central and Eastern European Countries. Cf. Gagnon J. E., Ihrig J. (2004), *Monetary policy and exchange rate pass-through*, International Journal of Finance and Economics, No. 9(4), pp. 315-338.

<sup>&</sup>lt;sup>27</sup> This part of the Report is based on: Przystupa J., Wróbel E. (2011), *Asymmetry of the exchange rate pass-through: an exercise on the Polish data*, Eastern European Economics, No. 49(1), pp. 30-51.

change rate volatility implies a high pass-through effect (0.55); a high volatility reduces the effect significantly (to 0.25). The lowest pass-through effect (0.14) is observed during the shift from one stage to the other.

Consumer prices respond to exchange rate movements with a lag. If there is a change in the exchange rate in a given quarter, consumer prices in the same quarter absorb 12% of the change, in the next quarter – 44%, in a further quarter – 35% and 9% in the next five quarters.

<i>y y</i>	0	1 0			
Asymmetry of the ex-	Threshold ol	models (τ = thresh- d)	Nonreversible linear models		
to CPI related to:	variable > $\tau$ variable < $\tau$		$t_1 > t_0$	$t_1 \leq t_0$	
0.1.1	$\tau = 0.$	24%	0.054	0.091	
Output gap	0.192	0.179	0.274		
Growth rate of NEER	τ = 2.	08%	0.010	0.238	
	0.065	0.239	0.018		
NEED latility	$\tau = 4.32\%$		0.120	0.141	
NEER VOIAtility	0.247 0.549		0.139		
CPI inflation	τ = inflati	on target	0.1(0	0.183	
	0,195	0,201	0.160		

#### Table 16. Asymmetry of the exchange rate pass-through to CPI

Source: Przystupa J., Wróbel E. (2011), Asymmetry of the exchange rate pass-through: an exercise on the Polish data, Eastern European Economics, No. 49(1), p. 41.

#### Figure 25. Dependence of pass-through effect on business cycle phases



Note: The figure presents the dependence of the pass-through effect on business cycle. The arrows show the minimum and maximum values of the pass-through effect which are respectively assigned to turning points between early and late recession phase and shift from early to late recovery phase. The approximation of the business cycle has been estimated with Christiano-Fitzgerald asymmetric filter.

## Example: what part of CPI inflation was caused by movements in zloty exchange rate?

Differences between the linear and the asymmetric impact of exchange rate movements on consumer price are evident primarily in periods of unstable economic situation with the pass-through effect in the contraction phases lower than in the recovery phase. This is connected to the fact that in periods of worsening economic activity, in their attempt to maintain market share, corporations are more inclined to keep prices unchanged or reduce them rather than raise them.

To illustrate differences in the evaluation of exchange rate weight in influencing inflationary processes that result from allowing for asymmetry of the pass-through effect, an analysis was carried out covering the period 2004-2011. The largest movements in prices triggered by exchange rate changes occurred in periods of economic recovery caused by external factors, e.g. Poland's accession to the EU, when a quick growth of the economy combined with decreased risk generated a strong appreciation of the zloty. The rising pass-through effect reduced inflation at the beginning of 2005 by 1.3 percentage points (**Figure 26**). The period of the recent financial crisis may serve as another example: the outflow of capital from Poland connected with the estimated rise in risk in the countries of Central and Eastern Europe resulted in a strong depreciation of the zloty at the turn of 2008 and 2009. The decline in GDP growth was accompanied by a cyclical decline in the exchange rate pass-through effect to consumer prices. As a result of the above its impact on inflation in the second quarter of 2009 amounted to 1 percentage point, and not 2.7 perc. points as would be justified by the linear effect (**Table 17**).

#### 3.0 0.30 2.5 CPI changes trigerred by exchange rate change (linear PT) 0.25 2.0 0.20 15 1.0 p.p. 0.15 CPI changes trigerred by exchange rate changes 0.5 (non-linear PT) 0.0 0.10 -0.5 0.05 -1.0 non-linear PT (right exis) -1.5 0.00 2011Q3 2004Q3 201003 2011Q1 200503 2010Q1 009Q3 2004Q1 00501

#### Figure 26. CPI movements triggered by zloty exchange rate movements



A. 2008-2009								
	2008	2008	2008	2008	2009	2009	2009	2009
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
linear PT	-0.572	-0.706	-0.782	-0.155	1.709	2.654	1.199	-0.409
asymmetric PT	-0.668	-0.734	-0.689	-0.257	0.631	0.938	0.442	0.018
B. 2010-2011								
	2010	2010	2010	2010	2011	2011	2011	2011
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
linear PT	-0.644	-0.338	0.049	0.062	-0.190	-0.245	-0.067	0.415
asymmetric PT	-0.057	-0.019	0.056	-0.013	-0.215	-0.263	-0.058	0.617

The interpretation of figures in the table is as follows: by how many percentage points would inflation in a given quarter be higher (- sign) or lower (+ sign) than actually observed if there had been no exchange rate movements (i.e. if the exchange rate had been constant in the analysed period).

## IV.3. Credit channel

## IV.3.1. Identification of credit supply function

The response of loans to monetary policy shocks presented in chapter IV.1.3 does not allow to state whether the credit channel is working in the economy – in other words, whether the monetary policy has an impact on the supply side of credit.<sup>28</sup> To isolate the long-term supply function from data on loans, a model was used in which, based on the theory of credit channel, certain variables were assigned a role in shaping the supply of, and others the demand for credit. In the model, in addition to loans to households and corporates in real terms <sup>29</sup>, the following variables are used: GDP, interest rate, being a proxy of a cost of the banks self-financing (WIBOR 1M), average (weighted) interest rate on loans to households and corporates and the capital adequacy ratio. It is assumed that supply depends positively on spread between loan rate and the rate which shows the refinancing cost by banks either on money market or from the central bank. It also depends negatively on the capital adequacy ratio. On the other hand, supply should not be affected by GDP. To identify demand function we assume that is positively affected by GDP (scale variable) and negatively on loan rate, but does not depend either on refinancing rate or capital adequacy ratio. In the model we use credit in real terms, which implies an ex ante assumption that when prices rise, supply/demand for credit increases in the same proportion. This assumption has been tested and rejected – the resulting coefficient was far greater than unity. This implies that, first, when articulating demand for credit, entities probably overestimate the rise in prices, and, second, that this may have an impact on the possibility and/or quality of supply and demand function identification. It should be emphasised that in the case of credit-related decisions, price expectations are formulated for a relatively long term, so as to cover the whole or at least a major part of the period of funding an investment project with a loan. It is certainly particularly difficult in the case of construction and assembly investment projects, purchase of imported goods (in a situation of high volatility of the exchange rate), etc.

The equation of the credit supply we received has the characteristics of a long-run relationship, gradually returning to equilibrium: the parameters have the expected signs and the ratio determining the speed of return to equilibrium in the short-run equation is statistically significant. It is, however, a slow process (during one quarter, 6.5% of disequilibrium is eliminated). The estimated parameters show that the capital adequacy ratio rise by 1 percentage point leads to a decline in credit supply (in real terms) by 0.24%, and the rise in the lending rate by 1 percentage point above the rate approximating the cost of banks' refinancing leads to a rise in credit supply by 0.23%. A stability test of the estimated equations points to a temporary instability linked to the financial crisis. These results let us believe that the central bank has influence on credit supply through the WIBOR rate and that the credit channel does operate. Another premise supporting our conclusion in this respect is the response of loans to individual entrepreneurs discussed in chapter IV.1.3, which, following a monetary policy

<sup>&</sup>lt;sup>28</sup> Credit supply and demand functions are unobservable. The observed amount of lending is the outcome of supply and demand. Therefore, we do not know whether the interest rate channel or the credit channel were mainly in operation after the interest rate shock or if they functioned jointly. Until the outbreak of the crisis, empirical research for certain countries had confirmed and for others rejected the functioning of the credit channel, or recognised it as insignificant in the transmission mechanism. The main problem is a proper identification of supply and demand functions.

<sup>&</sup>lt;sup>29</sup> To obtain real values we used GDP deflator.

shock, decreases to a greater extent than loans to other borrowers. Banks' behaviour which consists in reducing supply primarily to those entities about which they have little information and are therefore deemed to be more risky is in line with the theoretical picture of credit channel functioning.<sup>30</sup>

The functions of long-term credit demand we obtained point to counter-intuitive sign by the interest rate and to absence of adjustment to equilibrium, which could be recognised as a factor undermining the credibility of the result relating to the supply function. To obtain additional information about credit supply and demand and to verify whether credit supply exogenous shocks<sup>31</sup> occurred in Poland in similarity to in the euro area, another analysis was made. We applied an approach which is not based on strict theoretical foundations to such an extent as the previous approach but is in line with the theory of the credit channel and the IS-LM curve operating pattern.

To identify credit supply and demand shocks, we used the VAR model with restrictions on sign and the lags in the response of prices and the real sector to shocks. Monthly data were used and the sample covers the period from January 1998 to August 2011. The following variables were used: CPI, industrial output, zloty denominated loans to households and corporates in nominal terms, average weighted lending rate for households and corporates, reserve money (M0), WIBOR 1M interest rate.

To identify the credit demand shock (independent from the condition of the real economy and monetary policy) it was assumed that upon a rise in credit, lending rates rise, whereas prices and output respond with a lag. To identify the credit supply shock (or more precisely: credit multiplier shock) it was assumed that a rise in credit should be accompanied by a decline in the interest charged on it (what means that for reasons external to the model, banks are more inclined to extend a loan) and a rise in WIBOR 1M rate while prices and output should respond with a lag. The results were compared with a negative shock of WIBOR 1M interest rate (monetary policy easing). The assumption that identifies monetary easing includes: a decline in central bank rate, a decline in lending rate, a rise in credit volume, a lagged response of prices and output. The figures presented below (**Figure 27, Figure 28, Figure 29**) show impulse response functions. <sup>32</sup>

Disturbances to credit demand which are accompanied by an interest rate hike lead to a decline in the stock of reserve money and output and a rise in prices. A decline in output despite a rising credit volume may result from the interest rate increase and the substitution of domestic output with imports. The fact that also matters is that a rise in prices reduces credit in real terms which may also partially explain the decline in output.

<sup>&</sup>lt;sup>30</sup> The existence of the credit channel in Poland is also suggested by: Marzec J., Pawłowska M. (2010), *Racjonowanie kredytów a substytucja między kredytem kupieckim a bankowym – badania na przykładzie polskich przedsiębiorstw*, Materiały i Studia NBP, No. 261. Using panel data from 2001-2009, the authors show that banks carried out a restrictive policy towards small enterprises more often than towards large ones.

<sup>&</sup>lt;sup>31</sup> The exogenous lending supply shocks may result from the functioning of e.g. risk-taking: banks using complex financial instruments increasing the possibility of lending creation or other factors, such as increasing the possibility of refinancing by banks (e.g. abroad), etc. Thus, it is an approach which, after the financial crisis experience, expands the understanding of the credit channel while traditionally only the impact of the monetary policy on the possibility of banks' refinancing and lending creation were considered.

<sup>&</sup>lt;sup>32</sup> External lines show a 68-percent area of confidence of the response function to disturbance while the disturbance is equal to one standard deviation.

A credit supply shock leads to a relatively small output rise in spite of a rise in credit volume. The period of interest decline is very short (the data allow only 4 months). After this time there is a rise in interest rates in the banking sector. As a result, industrial output goes down; only prices go up. Similarly as in the case of demand disturbances, this rise is only temporary. The picture of the response function suggests that the rise in demand financed with credit probably increases mainly inflation expectations, hence an almost instantaneous price hike (it was assumed that it occurred with a lag after the shock). The decline in output suggests that expanding credit may increase imports. Similarly as in the case of disturbances to credit demand, output may be weakened by a rise in prices that reduces the real credit volume. Macroeconomic effects of disturbance to credit demand and supply are therefore mutually similar in Poland.<sup>33</sup>

An interest rate shock – an unexpected monetary policy easing – leads to a permanent decline in the stock of reserve money and a long-lasting rise in credit. Lending rates go down, although not to such an extent as WIBOR 1M rate, prices increase in a permanent way but their initial response is clearly slower than in the case of credit supply shock. The rise in output is temporary, in line with the theory, (attention should be drawn to the fact that CPI response is close to the response received with the use of Cholesky decomposition – cf. chapter III.1 of the Report, and the absence of the so-called price puzzle), while the response of output is larger now.

The results we obtained show that exogenous credit supply shocks may have occurred in the economy – the data do not reject the restrictions imposed and response functions to the impulse are consistent with intuition. It is worth noting that the assumption enabling the identification of the credit supply shock, i.e. the decline in interest which should occur when commercial banks want to raise credit supply irrespective of central bank policy may hold good only for 4 months. This implies that in subsequent months banks adjust their pricing policy to the central bank policy and the process of supply shock elimination begins. A credit demand shock leads to a rise in prices and the related increase in central bank interest rates leads to a decline in output despite the temporary rise in credit; these are, therefore, shocks that do not contribute, even temporarily, to the rise in output.

<sup>&</sup>lt;sup>33</sup> The results for the euro area are different: it is more probable than in Poland that loans supply disturbances will lead to a rise in production; in the case of loans demand disturbances in the euro area the probability that prices will rise is far smaller than in Poland (cf. Peeersman G. (2011), *Macroeconomic consequences of unconventional monetary policy in the euro area*, ECB Working Paper, No. 1397). One of the possible reasons for differences in the behaviour of industrial output in Poland and in the euro area seems to be a greater response of the monetary policy rate in Poland both to lending demand and supply shocks.



## Figure 27. Response functions to credit demand shock





Figure 29. Response functions to monetary policy shocks

#### IV.3.2. The response of loans to different types of corporates to monetary policy impulse

According to the theory of credit channel, banks should cut back on their lending more radically and faster to entities about which they have less information and which they deem to be more risky. This implies that a different response of credit to different types of corporates to monetary policy disturbances may be an indirect premise for the functioning of the credit channel. The results presented in chapter IV.1.3 show that such a regularity appears in Poland – loans to individual entrepreneurs respond to interest rate disturbances in a much stronger way than loans to other types of corporates (Figure 18).

#### IV.3.3. **Buffer-stock behaviour**

The response of different assets held in banks' portfolios to monetary policy disturbances is another form of drawing indirect conclusions about the functioning of the bank lending channel. The occurrence of the buffer-stock behaviour has been confirmed in responses to interest rate impulse in VAR model estimated on 1997:01-2008:09 sample (Figure 30A). The responses show that after a tightening of monetary policy a quick adjustment of the most liquid asset portfolios (government securities and NBP money bills) follows - the response of credit is weaker than the response of securities and acts with a lag. When studying a sample expanded by the period of the financial crisis, it turns out that the response of liquid assets to monetary policy impulse becomes statistically insignificant and the response of zloty denominated loans gains in strength (Figure 30B). This enables us to posit a hypothesis that banks are currently more inclined to adjust credit supply than in the past, which means that the bank lending channel may become more important. This phenomenon may, however, be short lived and characteristic of periods of increased demand for liquidity rather than for more stable periods.



Figure 30. Buffer stock behaviour - response functions to interest rate impulse

## IV.4. Inflation expectations of consumers, enterprises and financial sector analysts<sup>34</sup>

The process of formulating inflation expectations in the economy is of great significance for the transmission mechanism of monetary policy impulses. To analyse the main characteristics of inflation expectations in the Polish economy we refer to direct consumer, corporates' and financial sector analysts' inflation expectation measures. The expectations relate to one-year time horizon. The sample includes observations from the years 2001-2010<sup>35</sup>.

<sup>&</sup>lt;sup>34</sup> This part of the Report has been prepared on the basis of: Łyziak T. (2012), *Inflation expectations in Poland*, NBP Papers, No. 115. The study presents the methods of measuring inflation expectations and analyses a number of their characteristics. When analysing the characteristics of consumer and corporate inflation expectations in this part of the Report we use average values generated for different expectations measures (in the quoted study, 3 measures of consumer inflation expectations and 2 measures of corporate inflation expectations are used).

<sup>&</sup>lt;sup>35</sup> The series of consumers' and financial sector analysts' inflation expectations have a monthly frequency, the series of enterprises' inflation expectations – a quarterly frequency.

## IV.4.1. Are inflation expectations in Poland rational?

Inflation expectations in Poland do not satisfy the hypothesis of rational expectations.

Errors of consumers', corporates' and financial sector analysts' inflation expectations (**Table 18**) are not of a random nature, which means that expectations do not meet the condition of unbiasedness. The accuracy of expectations formulated by financial sector analysts and corporates remains at a similar level; relatively bigger errors (in terms of mean absolute error) characterise consumers' inflation expectations.<sup>36</sup> However, errors in expectations of all analysed groups of agents are smaller than errors of naive forecasts.

The analysed groups of economic agents are characterised by a different degree of effectiveness in processing the available information (**Table 19**). In Poland, consumers effectively use only a small part of available information – this concerns variables easily observable and widely commented on, such as the zloty exchange rate or the price of oil. Financial sector analysts, and corporates in particular, are able to effectively process a wider scope of information, including short-term interest rates. This means that in their forecasts they take into account, to an adequate degree, the impact of current monetary policy decisions on future inflation.

#### Table 18. Inflation expectations errors

	Mean absolute error (MAE)	Mean absolute percentage error (MAPE)
Consumers <sup>(1)</sup>	1.82	101.9
Corporates <sup>(2)</sup>	1.42	135.0
Financial sector analysts <sup>(3)</sup>	1.39	129.7
Naive forecasts	1.89	145.1

<sup>(1)</sup> Monthly data, sample: 2001:05-2011:04.

<sup>(2)</sup> Quarterly data, sample: 2001:03-2011:04.

<sup>(3)</sup> Monthly data, sample: 2001:02-2011:04.

#### Table 19. Macroeconomic effectiveness of inflation expectations

	Informational variables							
	WIBOR1M	WIBOR3M	PLN/EUR	USU/NJ9	Industrial output	Unemploy- ment rate	Oil price	IdD
Consumers	-	-	+	++	+		++	-
Corporates	++	++	+	++	++	+	++	-
Financial sector analysts	+	++	+	++	+	+	++	

Meaning of the symbols: "+" - information variable used in an effective way when formulating inflation expectations, "+" - information variable used fairly effectively when formulating inflation expectations, "-" - information variable not used effectively when formulating inflation expectations, "-" - information variable rather not used effectively when formulating inflation expectations.

<sup>&</sup>lt;sup>36</sup> It is worth noting that consumers' inflation expectations in Poland are becoming closer to the forecasts of financial sector analysts in periods when inflation receives wider coverage in the media, i.e. in periods of relatively high inflation. Cf. Łyziak T. (2012), *Inflation expectations in Poland*, NBP Papers, No. 115.

## *IV.4.2.* The degree of forward-lookingness of inflation expectations in Poland

Inflation expectations of the analysed agents are characterised by a different degree to which they are forward-looking (**Table 20**). Consumer inflation expectations are determined by the past inflation to the greatest extent but even they are not formulated on the basis of past observations only. Financial sector analysts' inflation expectations are characterised by a larger weight of the forward-looking factor, and corporates' inflation expectations – by the largest weight. As many as 33% of corporates seem to formulate their inflation expectations in a rational way.

	Weight of the forward-looking component of expectations	Weight of the backward-looking component of expectations
Consumers <sup>(1)</sup>	0.16	0.84
Corporates <sup>(2)</sup>	0.33	0.68
Financial sector analysts <sup>(3)</sup>	0.24	0.76

(1) Monthly data, sample: 2001:05-2011:04.

(2) Quarterly data, sample: 2001:Q2-2011:Q1.

<sup>(3)</sup> Monthly data, sample: 2001:05-2011:04.

## IV.4.3. The degree to which inflation expectations are anchored in Poland

When formulating inflation expectations, consumers, corporates and financial sector analysts assign a different weight to the NBP inflation target (**Table 21**). It has a strong influence on inflation expectations of financial sector analysts and corporates, and only a slight impact on consumer inflation expectations.

Table 21. The degree to which inflat	ion expectations are anchored in Poland
--------------------------------------	---

	Weight of inflation target in formulating expectations	Weight of current inflation in formulating expectations
Consumers <sup>(1)</sup>	0.16	0.84
Corporates <sup>(2)</sup>	0.59	0.41
Financial sector analysts <sup>(3)</sup>	0.72	0.28

<sup>(1)</sup> Monthly data, sample: 2001:05-2011:04.

<sup>(2)</sup> Quarterly data, sample: 2001:02-2011:01.

<sup>(3)</sup> Monthly data, sample: 2001:05-2011:04.

# V. Disturbances in monetary transmission mechanism in Poland during the financial crisis and assessment of transmission effectiveness

## V.1. Disturbances in monetary transmission mechanism in Poland during the financial crisis

During the financial crisis the monetary policy transmission mechanism in Poland was subject to disturbances. This relates mainly to the interest rate transmission.

#### Transmission disturbances in the money market

Major disturbances were mainly observed in the money market: spreads increased (Figure 31A), the volume of transactions in the interbank market dropped significantly (Figure 31B), only short-term transactions were concluded, primarily for a period of up to 1 week, longer-term quotes in the interbank market were of a non-transaction nature. The functioning of the money market was assisted by the Confidence Package introduced by the NBP, i.e. a set of measures aimed at providing banks with liquidity in zloty (repo transactions with a maturity of up to 6 months) and foreign currency liquidity (swap operations), broadening the range of assets that might serve as collateral in operations with the NBP, early redemption of 10Y NBP bonds and reducing the reserve requirement ratio. The long-run relationship between the NBP reference rate and the most important, from the point of view of further stages of monetary transmission, market rates, i. e. WIBOR 1M and WIBOR 3M, were not broken off although the fact that quotes were of a non-transaction nature was likely to reduce informational value of WIBOR rates for banks and led to disturbances at a further stage of transmission mechanism, i.e. the relationship between money market rates and deposit and lending rates in commercial banks.



Figure 31. Impact of financial crisis on money market in Poland



B. O/N turnover in the interbank market (in PLN million)

#### Disturbances in the impact of money market interest rates on retail rates

In connection with a sudden rise in macroeconomic risk, many (if not all) of the existing long-run relationships between market rates and interest on deposits and lending rates in commercial banks were disrupted. Breaking off a long-run relationship while preserving the short-run one means that interest in banks may, for longer periods, reflect only WIBOR rate movements and the level of the money market rate does not play the role of benchmark for the level of retail rates. An example of a long-run relationship that continued in spite of market disturbances is the relationship between the interest on 1-month household deposits and the WIBOR 1M rate. In the case of interest on 6-month household deposits its long-run relationship with money market rates was broken down. To show what it means in practice, a forecast of interest on these deposits was made using the relationship that had existed before the collapse of Lehman Brothers and was compared with the actual rates (**Figure 32**). The forecast shows the level of interest that would have existed *ceteris paribus* if the long-run relationship had been maintained. Movements in the market rate translate into changes in interest on 6-month deposit but its level develops independently of the WIBOR rate.

Figure 32. Actual and forecasted interest on 1-month household deposits for which the long-run relationship with WIBOR rate has continued (left panel) and on 6-month household deposits for which such a relationship does not exist (right panel)



Marking: thick line - actual interest, dotted line - forecasted interest from the model estimated until September 2008.

Unlike in the long-run relationships, the short-run (dynamic) relationships between the money market rate and retail rates were not broken down but a clear instability of parameters at the end of 2007 and 2008 and/or in 2009 may be observed in the case of most deposits. In the case of interest on deposits, the estimated short-run relationships show that changes in interest on 3- and 12-month household deposits and 6month corporate deposits fully adjust to WIBOR 3M rate movements.<sup>37</sup>

The short-run (dynamic) relationships remain stable for most of the lending rates we analysed, with the exception of the housing loans interest relationship which displayed clear parameter changes in 2007-2009. The estimated short-run relationships show that in the case of lending rates, adjustment to WIBOR 3M rate movements is full except for consumer loans where changes in their interest are not linked to movements in money market rates.

### Disturbances in the response of key macroeconomic variables to interest rate and domestic demand shocks

To check whether the response of basic macroeconomic variables has changed as a result of the financial crisis, response to shocks was compared (VAR model, monthly frequency) from January 1998 to September 2008 and from January 1998 to September 2011. The first sample includes observations following the collapse of Lehman Brothers, i.e. shows how the economy responded to shocks prior to the financial crisis.<sup>38</sup>

#### Inflation and the real economy

The response of inflation to monetary policy tightening has slightly slowed down in comparison to the period before the financial crisis. On the other hand, the response of

 $<sup>^{37}</sup>$  For monthly data, the estimated statistically significant coefficients from *t* to *t*-2 were added up and the hypothesis whether the sum is equal to unity was verified. A similar procedure was applied to short-run lending rate relationships.

<sup>&</sup>lt;sup>38</sup> The details of the method and the results can be found in: Łyziak T., Przystupa J., Stanisławska E., Wróbel E. (2011), *Monetary policy transmission disturbances during the financial crisis. A case of an emerging market economy*, Eastern European Economics, No. 49(5), pp. 30-51.

the real economy is slightly less pronounced than the response observed in the past.<sup>39</sup> It may result from the behaviour of WIBOR 3M rate, which has responded to central bank policy to a lesser extent. This is demonstrated by the rising and volatile spread between the reference or overnight rate and WIBOR 3M rate (cf. chapter IV.1.1 of the Report) and may also result from disturbances in the transmission of the NBP interest rate to retail rates.

#### Exchange rate

The response of the exchange rate (NEER) to an interest rate shock is similar (statistically insignificant short-lived appreciation followed by depreciation). After a (positive) shock of domestic demand the period of statistically significant appreciation is shorter in the sample including observations from the period of the crisis than in the sample for the period to September 2008.

#### Loans

The strength of response of loans to corporates and individuals to interest rate shocks has not changed much. However, it has changed significantly in the case of loans to individual entrepreneurs. The response of all the above-mentioned loans is slower than in the past, which may result from the disturbances in interest rate transmission.

As the financial crisis caused a sudden rise in macroeconomic risk and a decline in output, it was checked whether the response of loans to such shocks has changed compared to the period before Lehman Brothers collapse. The results show that the strength of response of loans to corporates has increased while it has declined for individuals<sup>40</sup> and remained practically unchanged for individual entrepreneurs. This may suggest that the financial crisis led to an increase in banks' caution vis-à-vis corporates and that in this segment of the market, sensitivity of the credit channel in its broad meaning, i.e. the response of credit supply not only to interest rate shocks but also to perceived macroeconomic risk, is on the rise.

#### NBP response function

We assume that inflation and the condition of the real economy (represented by industrial output in our VAR model) are elements of the NBP response function. The strength of NBP response to disturbances in the real economy and, to a slightly lesser extent, to inflation shocks have increased in comparison with the period to September 2008. It is worth noting that prior to the crisis, interest rate did not respond in a statistically significant way to real economy shock while in the analysed sample as a whole this is a statistically significant effect. This implies that the central bank was aware of the possibility of a transitory weakening of the transmission mechanism and took it into account in the monetary policy decisions.

<sup>&</sup>lt;sup>39</sup> There were also changes in labour market response to a monetary policy impulse. The response of unemployment rate to an interest rate impulse is stronger and characterised by a higher volatility than before the crisis. We may believe that the reasons for these changes should be sought in Poland's accession to the EU – adding observations from the period of the financial crisis only revealed these changes.

<sup>&</sup>lt;sup>40</sup> As the result is surprising (we expected the response to be larger on the sample covering the crisis) its robustness was tested. The model was supplemented with unemployment rate and an analysis was carried out of the response of loans to individual persons to its shock. It turned out the response of loans to individual persons is also smaller to the shock in the full sample than in the sub-sample to September 2008.

#### Conclusions

The disturbances in the monetary transmission mechanism in Poland during the financial crisis seem to partly reflect the rising risk perception and the cyclical features of the transmission process (e.g. the impact of the exchange rate on prices), and partly the structural changes in the economy (market interest rate transmission to retail prices).

The way the NBP monetary policy responded to the observed and forecasted macroeconomic effects of the financial crisis, i.e. interest rate adjustments accounting for the scale of monetary transmission mechanism and the use of additional instruments providing liquidity to the banking sector, led to the fact that the central bank's capability to influence macroeconomic processes was not significantly disrupted.

## V.2. Effectiveness of the monetary transmission mechanism in Poland

The analysis of the effectiveness of monetary transmission mechanism in Poland<sup>41</sup> shows that the exchange rate channel is the most efficient one (**Figure 33**). The effectiveness of this channel decreases permanently after structural shocks and changes cyclically in line with the business cycle. The change in the exchange rate regime (implementation of a floating exchange rate) was a structural shock. The effectiveness of the exchange rate channel within two years following the change in the regime decreased by half. On the other hand, Poland's accession to the EU (with unchanged exchange rate regime) was a shock disrupting the economic situation, which led to only transitory disturbances in this channel's effectiveness. In turn, the financial crisis clearly – by approximately 30% – changes the level of this channel's effectiveness, which would suggest not only a business cycle-related but also a structural nature of this change.

It seems, however, that the cyclical component of the observed disruption is the dominant one: the effectiveness of the exchange rate channel had been rising systematically since the 3<sup>rd</sup> quarter of 2009 – in the 3<sup>rd</sup> quarter of 2011 it was only 20% lower than before the crisis. Such behaviour is characteristic for effectiveness changes in the business cycle: effectiveness falls in the first and middle phase of recession, returns to the level from before the recession in the late phase of the recession and the stabilisation of the business cycle at a low level and remains unchanged in all phases of the recovery. The changes in the effectiveness of the exchange rate channel are consistent with the cyclical effect of exchange rate changes pass-through to domestic prices described in chapter IV.2.3 – in the first and middle phase of recession the effect of exchange rate pass-through is low and the cost of fighting inflation goes up.

The effectiveness of the interest rate channel increased suddenly after the implementation of inflation targeting and may be interpreted as a symptom of an increase in the economy's maturity, i.e. its monetisation and the level of financial intermediation, as well as the increase in central bank's credibility. From the implementation of the inflation targeting strategy to the collapse of Lehman Brothers the effectiveness of the in-

<sup>&</sup>lt;sup>41</sup> The methodology of analysing the effectiveness of the monetary transmission used in this chapter of the Report is described in: Łyziak T., Przystupa J., Stanisławska E., Wróbel E. (2011), *Monetary policy transmission disturbances during the financial crisis. A case of an emerging market economy*, Eastern European Economics, No. 49(5), pp. 30-51. The effectiveness is calculated on the basis of VAR-type models and depends on the estimates of parameters with variables accompanying particular monetary transmission channels and their statistical significance.

terest rate channel practically did not change, except for a transitory rise following Poland's entry into the EU. Between the 3<sup>rd</sup> quarter of 2008 and the 3<sup>rd</sup> quarter of 2010 the effectiveness of this channel fell by 20% and has remained at a practically unchanged level since then. This shows that disruptions in the transmission of money market interest rates to interest rates in the banking sector have continued.<sup>42</sup>

The indicator of the credit channel effectiveness (understood in the narrow sense: inflation is influenced by aggregate demand that depends on credit supply) behaves in a very similar way to the effectiveness of interest rate channel but is two times smaller than the interest rate channel.

The response of the credit channel effectiveness to the financial crisis is however far more significant. In the first stage of the crisis banks responded by contracting lending significantly, against the conducted monetary policy.



#### Figure 33. Effectiveness of monetary transmission channels in Poland

http://www.nbp.pl/home.aspx?f=/badania/konferencje/2011/mtm/index pl.html.

<sup>&</sup>lt;sup>42</sup> The persistence or even a slight fall of the interest rate channel effectiveness may also be related to a placing the monetary policy focus differently in the period of the financial crisis, i.e. attaching more importance by the central bank to shaping liquidity measures in the banking sector than to changes in PO-LONIA rate. Cf. Łyziak T., Przystupa J., Sznajderska A., Wróbel E. (2011), *Pieniądz w polityce pieniężnej. Zmienna informacyjna? Kanał mechanizmu transmisji? Jaka rola w Polsce?*, mimeo, NBP,

## Conclusions

The assessment of the monetary policy transmission mechanism in Poland presented in this Report assembles the knowledge on the impact of interest rates on the economy that has been presented in studies prepared by the Bureau of Economic Research of the Economic Institute published recently or studies in progress. The new elements of the evaluation of the Polish monetary transmission mechanism that have been taken into account in the Report are, in particular:

- accounting for asymmetric and non-linear phenomena in the analysis of the monetary policy transmission mechanism, facilitating, among others, to understand the disturbances to this mechanism that appear during a crisis<sup>43</sup>;
- evaluating the cost of monetary policy;
- identifying credit supply and demand shocks and attempting to distinguish between the response of credit demand and supply to monetary policy impulse;
- defining the relative role of the disparity between the interest rate and risk factors varying in time in determining the zloty exchange rate in different phases of the business cycle;
- evaluating the features of inflation expectations of various groups of entities (consumers, entrepreneurs, financial sector analysts), including, in particular, diagnosing the features of inflation expectations of enterprises that leads to the conclusion that their informational content and anchoring the NBP inflation target are surprisingly high;
- evaluating the effectiveness of the transmission mechanism in Poland and its changes over time.

The Report is, however, selective by its very nature and does not address certain issues that are potentially significant for the analysis of the monetary policy transmission mechanism in Poland or that may turn out to be such in the nearest future. Among such issues – indicating, at the same time, research areas that are worth studying – are:

- the risk-taking channel, the significance of which has drawn special attention since the outbreak of the financial crisis;
- the asset price channel of the transmission mechanism that is likely to gain in importance along with the development of the capital market<sup>44</sup>;
- the functioning of the cost channel of the monetary policy transmission mechanism, which although rather insignificant now – may gain significance as external sources of firm funding become more important.

<sup>&</sup>lt;sup>43</sup> We are planning to continue this type of work and to take into account asymmetric and non-linear phenomena of the transmission mechanism in a macroeconomic model of an average scale.

<sup>&</sup>lt;sup>44</sup> Preliminary work on this subject is in progress and partial results are presented in: Łyziak T., Przystupa J., Sznajderska A., Wróbel E. (2011), *Pieniądz w polityce pieniężnej. Zmienna informacyjna? Kanał mechanizmu transmisji? Jaka rola w Polsce?*, mimeo, NBP,

http://www.nbp.pl/home.aspx?f=/badania/konferencje/2011/mtm/index pl.html.

In the light of the results of empirical studies presented in the Report and the literature available<sup>45</sup> it may be concluded that the form of the monetary policy transmission mechanism in Poland is consistent with structural features of the Polish economy and coincides with those characteristic of more developed European economies, e.g. the euro area. Although the financial intermediation system is less developed than in the euro area, Poland, like the new EU Member States is characterised by a lower degree of rigidity and more frequent price adjustments (as a result of a relatively higher and more volatile inflation), due to which there exist no grounds for stating that the transmission mechanism is weaker in these countries than in the euro area countries (Jarociński 2010<sup>46</sup>).

The characteristics of the monetary policy transmission mechanism in Poland, which changed considerably in the transition period along with the development of the financial system and changes in the monetary policy, displayed symptoms of stabilisation in 2004/2005-2007. Poland's accession to the European Union, resulting in a major reduction of macroeconomic uncertainty, was one of the factors that contributed to this process. The monetary policy transmission mechanism was, however, disturbed by the financial crisis. Its impact on the transmission mechanism remains strong, which is demonstrated notably by the analysis of the effectiveness of transmission mechanism channels.

<sup>&</sup>lt;sup>45</sup> Cf. e.g. Grabek G., Kłos B., Kokoszczyński R., Łyziak T., Przystupa J., Wróbel E. (2009), Porównanie podstawowych cech mechanizmu transmisji monetarnej w Polsce i w strefie euro, in: NBP (2009), Raport na temat pełnego uczestnictwa Rzeczypospolitej Polskiej w trzecim etapie Unii Gospodarczej i Walutowej.

<sup>&</sup>lt;sup>46</sup> Jarociński M. (2010), *Responses to monetary policy shocks in the East and West of Europe: a comparison*, Journal of Applied Econometrics, No. 25, pp. 833-868 (a comparative analysis was conducted, in the study for the Czech Republic, Poland, Slovenia and Hungary on the one hand, and Finland, France, Italy, Portugal, and Spain on the other).

It should be remembered that, in the light of survey data, a gradual reduction in the frequency of price adjustment is taking place in Poland (rigidity increase) – cf. Jankiewicz Z., Kołodziejczyk D. (2008), *Mechanizmy kształtowania cen w przedsiębiorstwach polskich na tle zachowań firm ze strefy euro*, Bank i Kredyt, No. 2, pp. 19-42, NBP.