MATERIAŁY I STUDIA

Paper No. 24

Monetary transmission in Poland: some evidence on interest rate and credit channels

Ewa Wróbel, Małgorzata Pawłowska

Warsaw, October 2002

Design:

Oliwka s.c.

Layout and print:

NBP Printshop

Published by:

National Bank of Poland
Department of Information and Public Relations
00-919 Warszawa, 11/21 Świętokrzyska Street
phone: (22) 653 23 35, fax (22) 653 13 21

http://www.nbp.pl

Contents

List of graphs

List of tables

Monetary transmission in Poland: some evidence on interest rate and credit channels

Ewa Wróbel*, Małgorzata Pawłowska**

Abstract

In the paper we show the macroeconomic effects of a monetary policy shock using both recursive and non-recursive SVAR decomposition. We find that the responsiveness of the CPI index and output in Poland is smaller and slower than in the euro zone. Using panel data we check how bank-specific characteristics affect operation of the lending channel. In contrast to the results for the euro area the degree of liquidity of an average bank seems not to work in a way predicted by the literature. Credit channel seems to operate rather through the degree of capitalisation and bank's size. A plausible reason is the structural overliquidity of the banking sector. On the other hand, the pass-through from the market interest rates to the loan and deposit rates is in general not slower than in the euro zone.

* National Bank of Poland (NBP), Bureau of Macroeconomic Research (Ewa.Wrobel@mail.nbp.pl).
** National Bank of Poland (NBP), Financial System Department (Malgorzata.Pawlowska@mail.nbp.pl). The views expressed in this paper are the authors' and do not necessarily reflect those of the National Bank of Poland. The authors wish to thank W. Charemza, D. Mayes and W. Orłowski and colleagues from the NBP for helpful comments to the earlier version of the text. Any remaining errors are the responsibility of the authors.

1
Introduction

Monetary transmission in Poland tends to be slower and the response of output and inflation to changes in central bank interest rates is smaller than in many developed economies (see Łyziak, 2001, 2002; Kłos, Wróbel 2001). In this paper we show the reaction of main macroeconomic variables on interest rate and exchange rate shock with a simple VAR using first Christiano, Eichenbaum, Evans - CEE thereafter (1994) and then Kim and Roubini (1997) structural decompositions. This is consistent with the approach adopted in the recent papers on monetary transmission in the euro zone. Our aim is to: (i) compare the results with these recently obtained for the euro countries, and (ii) check the stability of the monetary transmission mechanism in Poland.

Early results of the CEE structural decomposition for Poland on a sample of monthly data 1995.01-2000.12 provide (Kłos, Wróbel 2001). They show that the interest rate shocks affect inflation and other selected nominal variables in a way similar to that in the developed market economies. However, some real variables react in a counter-intuitive or even nonsensical way. A good example is a phenomenon that we called "output puzzle", i.e. an initial rise in output after monetary policy tightening. Here we extend the sample and include the data covering the period 2001.01-2002.03. Due to the evolution of the monetary policy we also change the assumptions about the set of variables the central bank looks at when deciding about the level of the interest rate.

Financial sector structure can exert a significant impact on the monetary transmission. Therefore in the recent years analyses of the role of lending channel and interest rates pass-through in the monetary transmission gained a particular attention resulting in papers by Cecchetti (1999), De Bondt (2002), Sellon (2002), Weth (2002), Kashyap and Stein (1995, 2000), Peek and Rosengren (1995), Ehrmann et al. (2001) to name only a few. The lending channel literature points that bank-specific characteristics can influence the cost of funding and induce either price-quantity or pure quantity adjustment of bank behaviour. The European evidence shows indeed that the degree of liquidity and capitalisation affect loan supply. Following this literature we show the reaction of different categories of loans to the interest rate shocks and using panel data we determine the bank-specific characteristics that affect the operation of lending channel. Our conclusion is that in Poland lending channel operates, but in contrast to the Euro zone, size of a bank is the second characteristic besides the degree of capitalisation, which matters.

Empirical literature on the traditional interest rate channel provides a vast evidence showing that in the U.S. and in the euro zone deposit and lending rates are sticky. They do not react to changes in money market rates immediately, but with lags amounting even to several months slowing down the monetary transmission. Nor do they adjust one for one. Also, there are asymmetries in banks' reactions: lending rates respond more to increases in money market rates than to decreases, while the opposite is true for the deposit rates. This paper provides some evidence on interest rate pass-through in Poland.

The paper is constructed in a following way: we start with discussing our methodological framework: the specification of the VAR, methods of the structural decomposition, the approach to the lending channel analysis and the method of estimation of the interest rate pass-through. Next, we present the data and the results of our VAR estimates. In particular, we show the results of two recursive decompositions, based on two sets of assumptions concerning monetary policy. We also use a non recursive decomposition in the spirit of Kim and Roubini that imposes more structure on a VAR and is potentially more suitable for a small open economy. Then, we briefly discuss the IRF of different categories of credits to the non-financial sector to shed some light on how various types of expenditures respond to the monetary policy shocks. Next we present the bank-specific characteristics affecting the lending channel and finally the results of the estimation of the interest rate pass-through. The final part concludes.

2
Methodological framework

Vector Autoregression (VAR) approach provides evidence on stylized facts, which are then used to discriminate between general equilibrium monetary models. If in the aftermath of the contractionary monetary policy shock aggregate price level reacts very little, output falls temporarily and interest rates rise, then the result is inconsistent with models assuming price flexibility (see for example Favero, 2001).

By using a VAR it is possible to determine a monetary policy shock and then to examine the response of the endogenous variables to a monetary impulse. Analysis of the impact of the monetary policy shocks (or unexpected changes) provides useful information on the transmission mechanism. But a necessary condition for a VAR model to produce consistent monetary shocks is that the monetary policy regime does not change within the period under consideration, the condition that is difficult to fulfil by the economies in transition. In Poland changes in monetary policy regimes and operating procedures were quite frequent. In particular, exchange rate regime evolved from a fixed to a pure float. This makes VAR analyses difficult and leads us to shorten the sample, skipping the period up to the end of 1994, to ensure a reasonable mix of sample homogeneity and length.

First we follow CEE (1994, 1998) identification method. Monetary policy shock is then identified with a disturbance term in a regression equation of the form:

$$S_t = \psi(\Omega_t) + \sigma v_{st} \tag{1}$$

where S_t is the monetary policy instrument, ψ is a linear function, Ω_t is the information set available to the central bank when the monetary policy instrument is set, σ is a positive number, and v_{st} is a serially uncorrelated shock that is orthogonal to the elements of Ω_t and has variance unity. The assumption of orthogonality means that variables of the information set react to a monetary policy shock only with a lag. This is a quite simple identification method, and therefore it is commonly used to compare the responsiveness of the main macroeconomic variables to the monetary policy shocks in different countries.

If the true structure of the economy is in the VAR format:

$$A_0 Y_t = \sum_{i=1}^{k} A_i Y_{t-i} + B v_t \tag{2}$$

where Y_t matrix consists of three blocks: variables whose contemporaneous values appear in Ω_t, monetary policy variable block and a block of variables which only appear with a lag in Ω_t.

Thus, the CEE identification procedure requires assumptions about variables central bank looks at when setting an operating instrument and supposition about the interaction of the policy shock with the variables in the feedback rule. Variables that NBP used to consider changed substantially over the period 1995-2002. Inflation rate (measured in terms of the CPI) was the only stable item. The other variables that the NBP looked at were following:

1) monetary aggregates, either broad money (m2) or credit to the non-financial sector or deposits of private individuals;

2) exchange rate, measured as a deviation from the central parity;

3) current account deficit (with respect to the GDP);

4) output gap.

Up to 1997 monetary aggregate (m2) was used as an intermediate target of the monetary policy. It was however gradually losing its role with inflation going down in spite of the fact that monetary targets were systematically overshooted, reflecting instability of the demand for money. In 1998 Monetary Policy Council (MPC), a newly set up decision-making body, decided to adopt inflation targeting. It has however carefully observed developments in the credit to the non-financial sector as a variable reflecting inflationary pressures of the domestic demand. Uncertainty of the output gap measures (a deviation of the current output from its long-term equilibrium, the latter proxied with a trend), resulted from short time series not encompassing even one business cycle and substantial structural and institutional changes of the economy. Credit ceased to be a variable of a primary role in the interest rate setting process in 2000 and was gradually replaced by the output gap. Another variable signalling demand pressure was current account deficit. It started to play a significant role in the monetary policy setting in 1996, when it began to grow noticeably. It was still considered as a crucial variable in the first years of inflation targeting regime.

Exchange rate as an implicit target was gradually losing its role with the exchange rate regime getting more and more flexible. Up to 1997 exchange rate interventions were aimed at reducing the scale of the złoty appreciation. Since the setting of MPC more stress was put on disinflation than on output stimulation. Therefore, the złoty appreciation was considered rather as an advantage than a drawback and the NBP resigned from interventions in the foreign exchange market.

In the previous work (see Kłos, Wróbel, 2001) we used real credit as a variable that central bank looks at when setting the level of the instrumental variable. Thus, in our VAR estimate NBP responds contemporaneously to inflation and has lagged credit in its policy rule. Bearing in mind changes in monetary policy and to overcome the problem of limited information about the variables in Ω, we do a second estimation using a different set of variables. We keep inflation rate and add industrial output and the nominal effective exchange rate. In this specification, central bank responds contemporaneously to inflation and output and to the lagged values of the exchange rate; exchange rate is allowed to react contemporaneously to the interest rate shocks. The same variable set for CEE decomposition for the euro zone was used by Peersman and Smets (2001)[3] and for the U.K. by Bean, Larsen, Nikolov (2001). We shall discriminate between the two specifications simply analysing the impulse response functions.

Then, in the case when we assume that the central bank considers contemporaneous developments in prices and takes into account lagged information on credit, we have:

$$y_t = \begin{bmatrix} p_t \\ i_t \\ l_t \end{bmatrix} \quad A_0 = \begin{bmatrix} 1 & 0 & 0 \\ \alpha_{21} & 1 & 0 \\ \alpha_{31} & \alpha_{32} & 1 \end{bmatrix} \quad v_t \sim n.i.d.(0, I) \tag{3}$$

Or alternatively, if it considers contemporaneous developments in output and prices and lagged exchange rate we have:

$$y_t = \begin{bmatrix} y_t \\ p_t \\ i_t \\ e_t \end{bmatrix} \quad A_0 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 \\ \alpha_{31} & \alpha_{32} & 1 & 0 \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & 1 \end{bmatrix} \quad v_t \sim n.i.d.(0, I) \tag{4}$$

where y_t stands for the industrial output, p_t represents price level (CPI index), i_t is the short-term interest rate, l_t stands for loans to the non-financial sector (private persons and the corporate sector), e_t is the nominal effective exchange rate. Once the monetary policy shock is extracted, we examine the response of some real and nominal variables. Real variables include retail sales and unemployment rate, while nominal variables – money supply (m1) and 12-month Treasury Bill rate. To do this, we added to the list of our variables the variable we were interested in, placing it last in the ordering.

[3] Peersman and Smets use real effective rather than nominal effective exchange rate.

Then, to check for the robustness of the results we use a structural decomposition in the spirit of Kim and Roubini that is more suitable for the open economies than CEE. This decomposition imposes more structure on the VAR. The specification of the model is:

$$y_t = \begin{bmatrix} y_t \\ p_t \\ m_t \\ i_t \\ e_t \end{bmatrix} \quad A_0 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 & 0 \\ \alpha_{31} & \alpha_{32} & 1 & \alpha_{34} & 0 \\ 0 & 0 & \alpha_{43} & 1 & \alpha_{45} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & 1 \end{bmatrix} \quad v_t \sim n.i.d.(0, I) \tag{5}$$

As before, both output and price level are restricted to respond to the monetary policy with a lag. But now, the identification scheme makes it possible to introduce simultaneous feedbacks between exchange rate and interest rate. In particular, we allow the interest rate to react to the news in the exchange rate, (e_t), and the exchange rate to react contemporaneously to news in all other variables. Peersman and Smets (2001) use Kim and Roubini decomposition for the euro area.

While this approach provides some information on the stylised facts and monetary policy propagation, it does not give enough information to discriminate between competing theories of the monetary transmission. In particular, the results of these decompositions cannot distinguish the lending channel and the interest rate channel or provide information on their relative importance. Nor do they provide information whether the interest rate channel operates rather through consumption or the investment expenditures. To shed some light into the latter question we show the responsiveness of short, medium and long-term loans to the private individuals and to the corporate sector to the interest rate shocks. This is done using a previously specified VAR and applying CEE decomposition method. There is no data on consumption of durables, but assuming that medium-term and, in part, short-term credits of households are used for durables' consumption, while long-term credits are mostly used for financing housing, these results may provide a good judgement about different types of expenditures.

To check what bank-specific characteristics affect the lending channel we estimate an equation as in Ehrmann et al. (2001):

$$\Delta \log(L_{it}) = a_i + \sum_{j=0}^{l} b_j \Delta \log(L_{it-j}) + \sum_{j=0}^{l} c_j \Delta r_{t-j} + \sum_{j=0}^{l} d_j \Delta \log(GDP_{t-j}) + \sum_{j=0}^{l} e_j \inf_{t-j} + fx_{it-1} + \sum_{j=0}^{l} g_{1j} x_{it-1} \Delta r_{t-j} + \sum_{j=0}^{l} g_{2j} x_{it-1} \Delta \log(PKB_{t-j}) + \sum_{j=0}^{l} g_{3j} x_{it-1} \inf_{t-j} + \varepsilon_{it} \tag{6}$$

with $i = 1,...,N$ and $t = 1,...,t_i$ and where N denotes the number of banks and l the number of lags;

L_{it} - the loans of bank in quarter t to private non-banks;

Δr_t -represents the indicator of monetary policy – NBP reference rate, i.e. the yield on 28-days NBP-bills

$\Delta log(GDP_t)$ - growth rate of real GDP;

inf_{t-j} - inflation rate;

x_i - bank-specific characteristics.

The model allows for fixed effects across banks, as indicated by the bank-specific intercept a_i.

A usual assumption in the credit channel literature is that bank responsiveness to the monetary policy is explained by its size, the degree of liquidity and capitalisation. Namely, small, less liquid and less capitalised banks are expected to cut lending more than their bigger, more liquid and better-capitalised units.

Finally, we assess the responsiveness of the banking sector to the money market rates. In this aim we use an ECM approach. We estimate equation of a form:

$$\Delta r_t = \alpha_0 + \alpha_1 \Delta mr_t - \beta_1 (r_{t-1} - \beta_2 mr_{t-1}) + \varepsilon_t \quad (7)$$

where r stands for a respective retail rate, mr is money market rate, and Δ represents first difference operator; and α_1, β_1, $\beta_2 > 0$.

The coefficient α_1 measures an instantaneous reaction of banks, i.e. the reaction that occurs within a month. The ECM specification allows for a cointegration of banks' retail rates and market rates. For the interest rates to be cointegrated, the coefficient β_1 should be significant. We do not impose that coefficient β_2 is equal to 1 (i.e. the homogeneity between banks' rates and the money market rates), but rather estimate it. Following de Bondt (2002) we calculate for Poland the mean adjustment lag of the full pass through as $(1 - \alpha_1)/\beta_1$, (see Hendry, 1995, p. 287).

3
Data

Most of our estimations cover the period 1995.01-2002.02. The most important exception are panel data- these are quarterly and the sample covers period 1997.4-2001.4. All variables except for interest rates and exchange rate are seasonally adjusted using the procedure X-12, and all except interest rates are in log levels[4]. To eliminate the remaining traces of seasonality in the VAR models we used seasonal dummies. Macroeconomic data come from the Central Statistical Office; monetary data and retail interest rates are collected by the NBP. Money market rates come from Reuters. Loan rates are prime rates as declared by banks. NBP does not posses information on the relative share of fixed and variable rates. If a bank declares both fixed and variable interest rates on a product, say 3-month deposit, NBP would take into account only the variable rate when calculating a weighted average interest rate. This very fact probably leads to some overestimation of the adjustment speed. With the mentioned above exception of the panel data, we use monthly data in our estimates. To choose the lag length we used Akaike criterion, but in cases of a serial correlation of a disturbance term in a VAR model we used more lags.

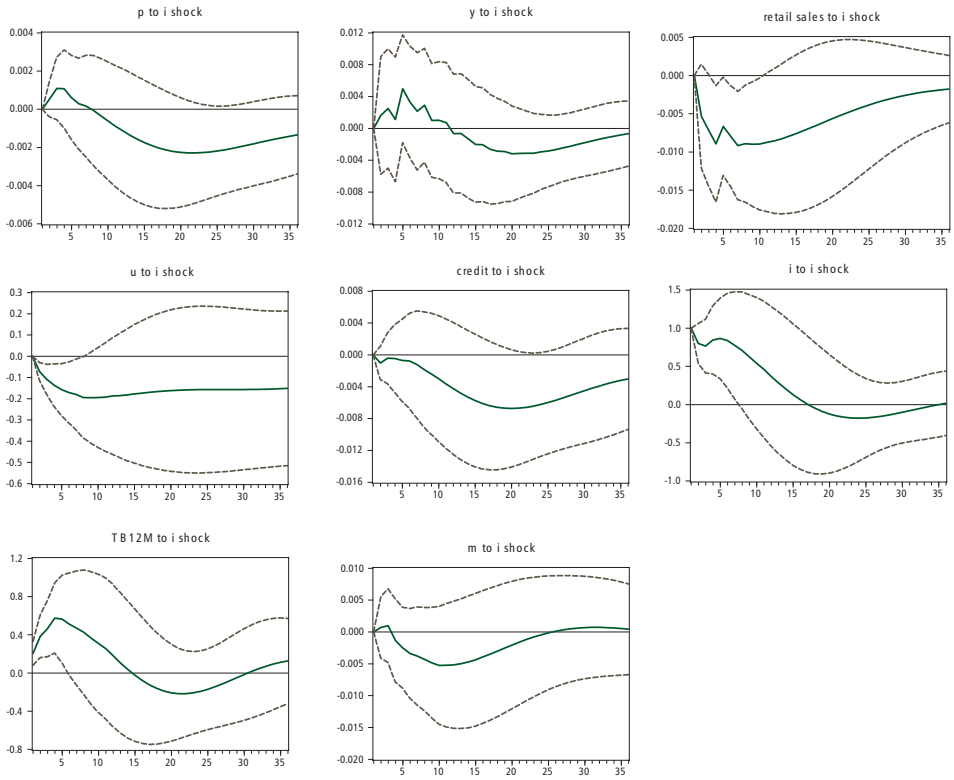
[4] We do not detrend the time series.

4
Estimation results

4.1. A broad overview of monetary transmission: SVAR estimates

The results of the CEE decomposition with credit and inflation in Ω for Poland are ambiguous (Fig. 1). While some variables – retail sales, monetary aggregates and interest rates respond to the monetary policy shock in the expected way, other react either partially, like industrial output and CPI, or totally – like the unemployment rate – in a counter-intuitive way. Angeloni et al (2001) report that a number of VAR estimates show similar properties – the examples include an increase in GDP after monetary tightening in Ireland and the Netherlands, and a positive response of investment in Austria, Greece, in the Netherlands and in the US. It should be stressed that after a nominal shock, real variables fall – as expected – only temporarily. CPI reaction exhibits two features which are not predicted by the theory. The first one is a common in the VAR literature "price puzzle", the other is a gradual return of the index to the baseline[5]. When we have extended the reaction period to 48 months (we do not show it in the paper) we got the picture of the reaction function that stabilises below the baseline.

Fig. 1
IRF from CEE decomposition (specification of the VAR as in Kłos, Wróbel, (2001), i.e. real credit in Ω)



[5] Peersman and Smets (2001) show a similar result for one country of the euro zone.

The second specification of the VAR, i.e. the one with output, CPI, and exchange rate in Ω, produces a much smaller "output puzzle", but nonetheless it still exists. As Zięba (2002) shows using Blanchard-Quah decomposition of a GDP-unemployment rate bivariate VAR, over the period 1992-2001 in Poland, GDP growth was dominated by supply shocks. Sterne and Bayoumi (1993) obtained a similar result, i.e. a dominance of supply shocks over demand shocks in output growth for economies changing structure away from agriculture (Ireland, Portugal, Greece and Spain over the period 1960-1988). Dominance of supply shocks, resulting in permanent changes in output may at least in part explain the "output puzzle" in Poland. As expected, the reaction of output and retail sales to the monetary policy shock is only temporary. Narrow money and the yield on 12-month T-Bills react in a way similar to the one obtained in the previous specification. As before, unemployment rate responds to the contractionary monetary policy shock in a counter-intuitive way (Fig. 2 and Fig. 3).

The perverse reaction of the unemployment rate has at least a few reasons. As in the case of the "output puzzle" it is probably due to the supply shocks and institutional shocks. These include privatisation, as well as changes in the social security and health care systems. In the short-run privatisation can result in unemployment increase, which is independent from the monetary policy shocks. On the other hand, there were frequent privatisation clauses pressing new owners to keep employment at the pre-privatisation level over a certain period, leading to the postponed lay-offs. Institutional shocks comprise also changes in the social security and health care systems. In 2000 this led those employed in the hidden economy to register as unemployed to be eligible for social benefits.

Fig. 2
IRF from the "second" CEE decomposition (*output, price level, exchange rate in Ω*)

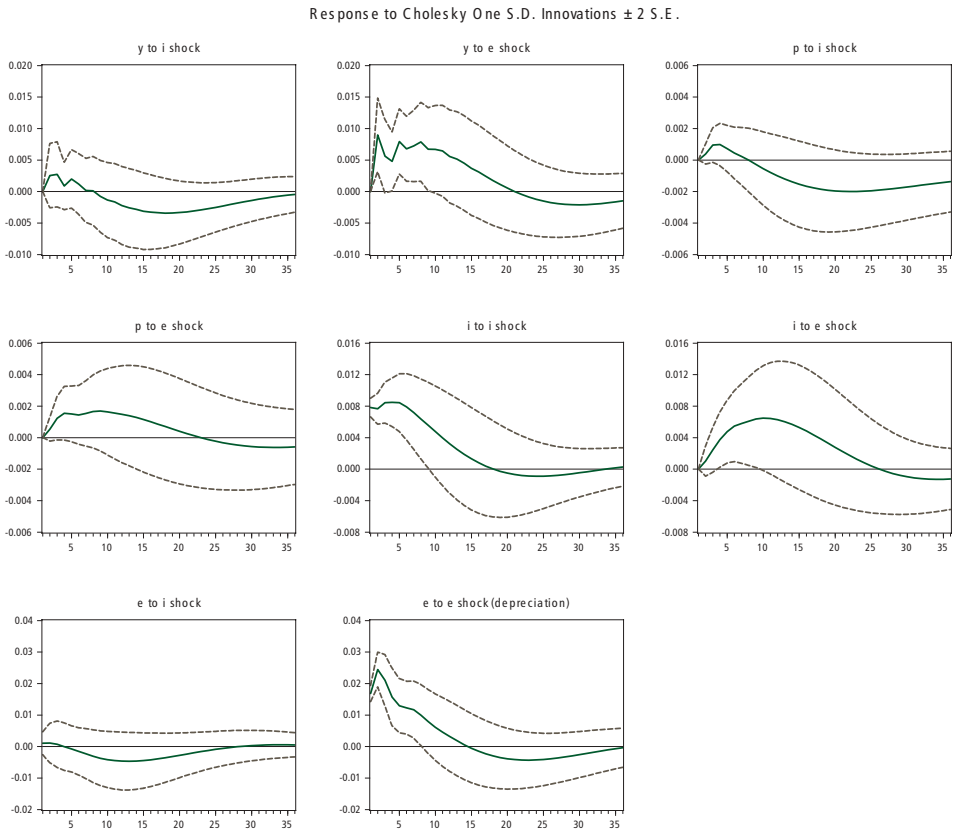
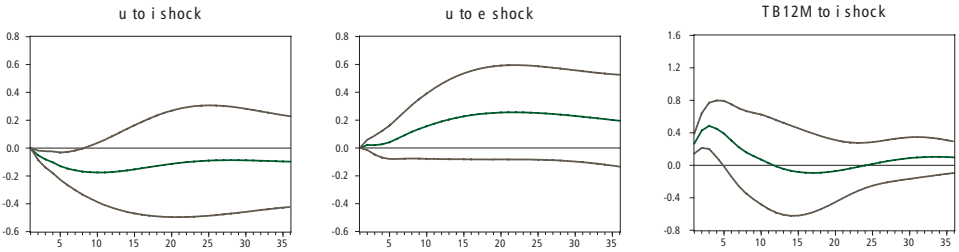
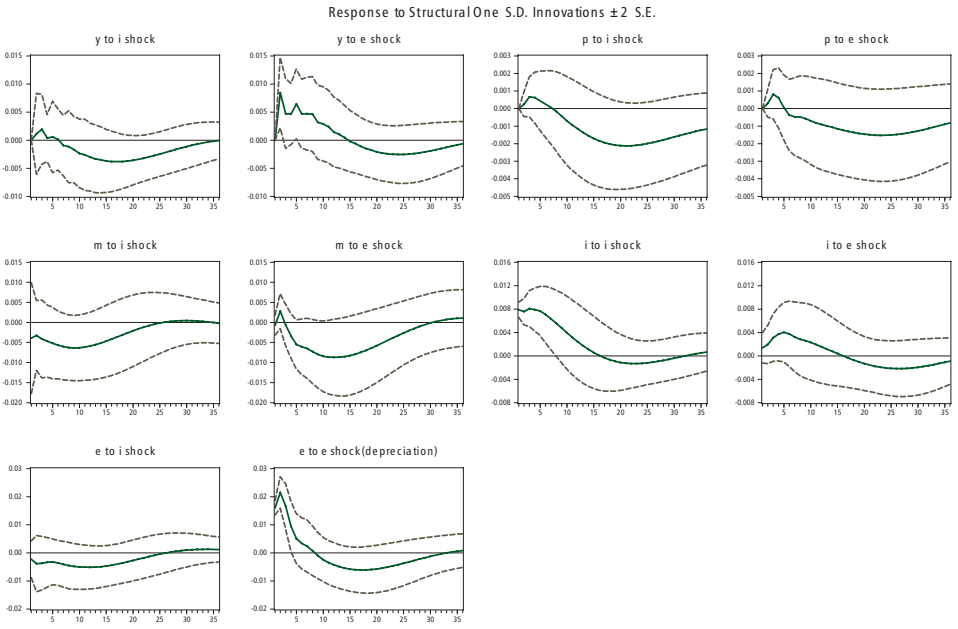


Fig. 3
IRF from the "second" CEE decomposition (continued)



The results of Kim and Roubini decomposition (Fig. 4) are very similar to the second specification of the CEE, with an exception of the response of the CPI to the exchange rate shock. The size of the "output puzzle" and the subsequent output fall is comparable in both specifications. The maximal impact of the interest rate shock on output occurs 16-19 months after the shock, like in the U.K., but markedly later than in the euro area. There is a noticeable but temporary (as expected) output increase after the exchange rate shock (depreciation). Like in all previous specifications and in many VAR results for other countries (e.g. Bean et al. results for the U.K. and Peersman and Smets for the U.S) there is a small and short-lived price puzzle. The maximal reaction of the CPI to the interest rate shock comes about with a delay of 21-23 months. This is much earlier than in euro area, the U.S. or the U.K. The CPI response to the interest rate shock is much smaller and short-lived in Poland than in these countries. The timing of output response and inflation response seems to be reasonable, with the maximal adjustment of output noticeably exceeding prices. As we have mentioned before, Kim and Roubini decomposition changes the pattern of price adjustment after the exchange rate shock. While CEE decomposition produced a prolonged increase in prices after a deprecionary shock, Kim and Roubini decomposition provides a very short one. The latter is broadly consistent with estimates of pass-through on monthly data in Przystupa (2002). Narrow money (money demand) reacts to the interest rate shock in the expected way; short-term interest rate increases after the exchange rate depreciation. None of these decompositions produces an exchange rate puzzle, i.e. exchange rate depreciation after a contractionary interest rate shock, another phenomenon quite common in the VAR literature.

Fig. 4
IRF from Kim and Roubini decomposition, 1995.01-2002.03

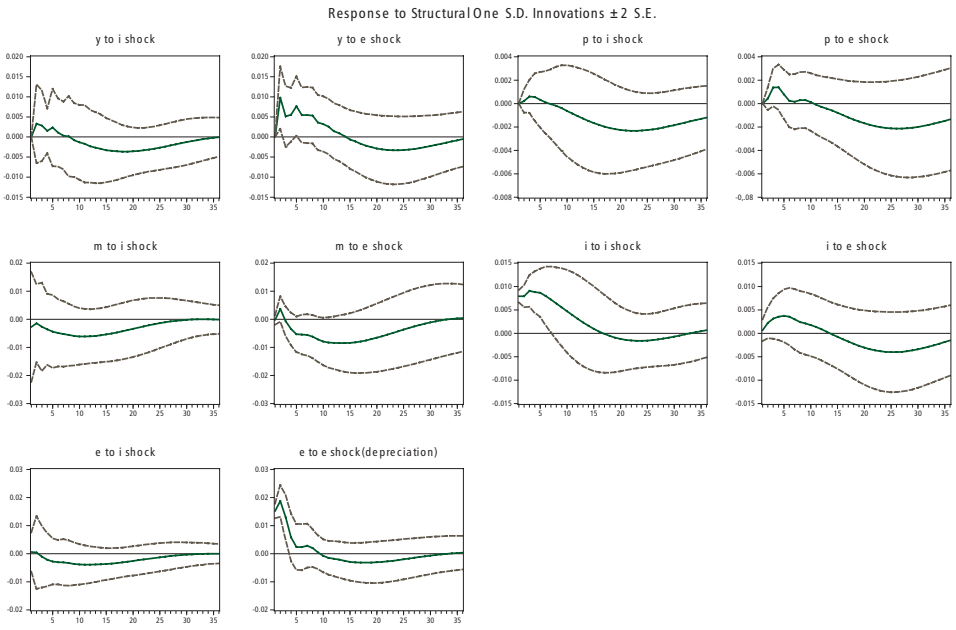


The results from our VAR's show that the impulse response functions obtained from the CEE specification with industrial output, CPI and the exchange rate as variables in the central bank reaction function are very similar to those obtained from the non-recursive decomposition of the Kim and Roubini type. The impulse response functions behave in a way that is closer to the intuition than the impulse response from the CEE-type decomposition with CPI and credit to the non-financial sector in the reaction function, suggesting a better identification of the monetary policy shock.

To see whether monetary transmission mechanism was stable we have estimated a VAR model (Kim and Roubini decomposition) on a shorter sample, ending in 2000. While there was no institutional change in 2001 that could justify such a sample break, first months of 2001 started a relatively prolonged process of the headline interest rates fall and a period of the lowest inflation rate Poland has experienced since the start of the transition process.

A comparison of Fig. 4 and Fig. 5 reveals that the impulse response functions are rather stable. The changes are minor; they concern industrial output and prices. IRF of industrial output exhibits a deeper fall when it is estimated on a sample ending in 2002.03 than on the shorter one. On the other hand, it reacts less over the sample 1995-2002 to the exchange rate shock. We do not have any sound explanation why over the longer sample price puzzle became bigger, presumably interest rate policy of the central bank was more backward looking than before. Prices also seem to be slightly less responsive to the exchange rate shock. This in turn can be due to the fact that exchange rate pass-through gets lower with lower inflation rate.

Fig. 5
IRF from Kim and Roubini decomposition, 1995.01-2000.12

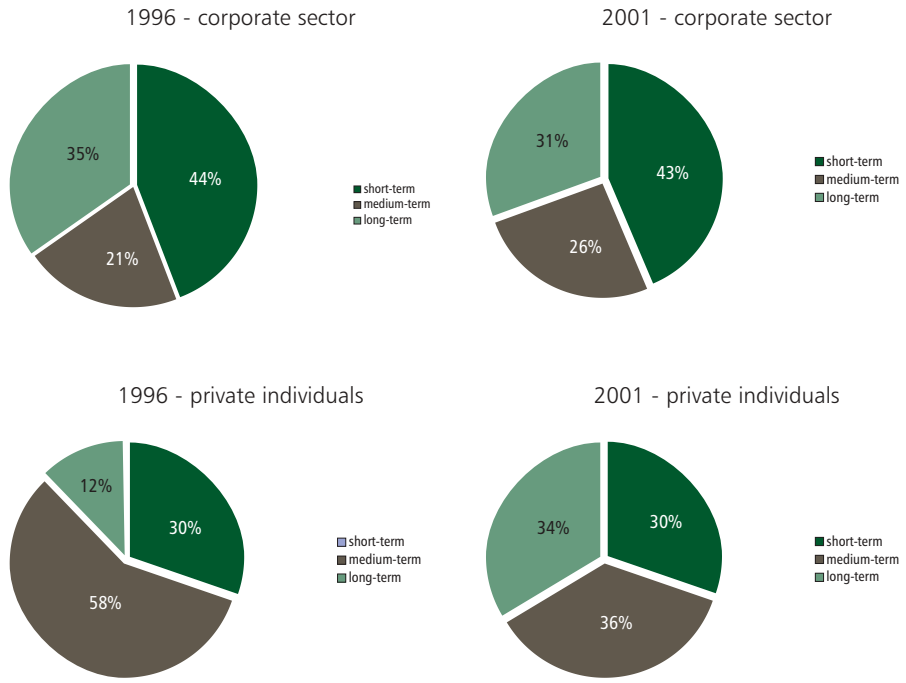


4.2 Transmission in the banking sector

4.2.1. Loan response to the monetary policy shocks

To check the responsiveness of various categories of credit to private individuals and to the corporate sector we use the CEE decomposition method. The specification was just as in our previous "better" VAR, i.e. industrial output, CPI, interest rate and exchange rate. Now we add credit and order it last. Credit to private individuals and to the corporate sector is divided into three groups: short-term (with maturity of up to 1 year), medium-term (maturity of above 1 to 5 years) and long-term (maturity of above 5 years). Term structure of loans to the corporate sector is rather stable, whereas this of the private individuals has changed significantly, see Fig. 6.

Fig. 6
1996 and 2001 credit term structure

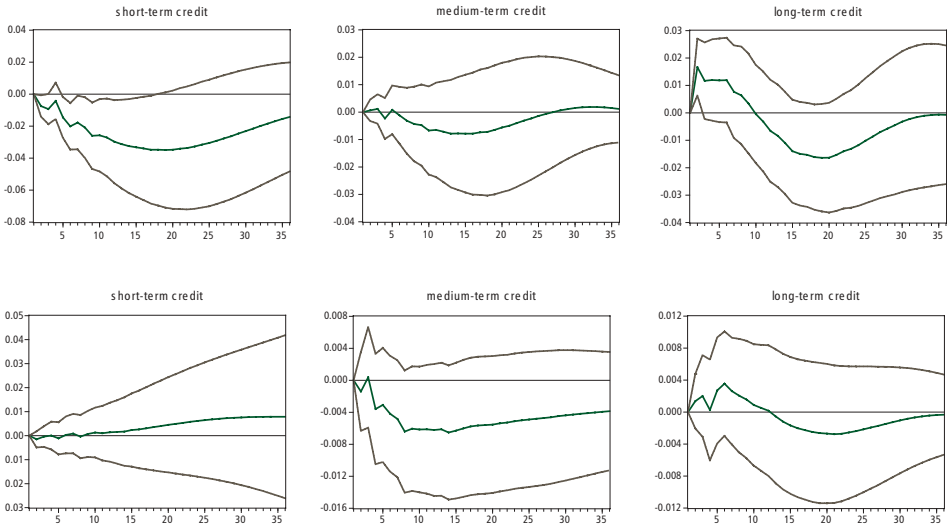


Foreign currency loans (FCL) stand for an increasing part of the total lending to the non-financial sector (at the end of 2001 the share of FCL in the total credit amounted to 24%) because of a high interest rate differential and a low perception of the exchange rate risk. Thus, to some extent, an increase in the domestic interest rates leads to a substitution of lending in the domestic currency (złoty) with lending in foreign currencies. FCL to the corporate sector are almost evenly distributed between the maturities selected above, whereas in case of the household sector, they concentrate in the third group, i.e. the group of long-term credits, and they are typically for housing.

Our previous VAR showed that after a contractionary interest rate shock, the złoty temporarily slightly appreciates. This should lead to a reduction in the złoty value of the FCL. If the interest rate differential gets bigger, then households and firms are more willing to draw new FCL or denominate the existing złoty loans. The latter effect is probably not very big because of the transaction cost. Assuming that the initial exchange rate effect on FCL is only minor and/or short-lived, we would expect that after monetary policy tightening, lending to the households and the corporate sector responds more sluggish than it could be if there were not FCL. In principal, the

shorter the maturity of loans, the more responsive to the monetary policy they should be. But there is more than that. As Gertler and Gilchrist (1993) point, monetary policy tightening can initially induce an increase in some types of credit. The best borrowers, e.g. big firms, may demand more credit at prevailing interest rates to buffer any decline in cash flow. Other borrowers face a decline in credit supply. Therefore, it may happen that total bank credit will not decline instantaneously (see also Garretsen and Swank, 1998). The response of various categories of credit is shown in Fig. 7.

Fig. 7
IRF of credit to private persons (*top panel*) and to the corporate sector (*bottom panel*) to a 1 pp interest rate shock



Just as expected, short-term credit to private persons seems to be the most responsive to the monetary policy shocks among all analysed categories of loans. It reacts almost at once and the reaction reaches the maximum 20 months after the shock. Medium-term and especially long-term credits are better secured, so there is less risk for the creditor and less incentives to reduce the supply. Thus, not surprisingly, these credits react with more delay and the reaction is smaller. Long-term credits increase initially – we cannot rule out that there is also some substitution effect, but a sound discussion of this effect needs a further research.

On the other hand, short-term credits to the corporate sector seem not to react at all to the monetary policy shocks. They are probably better secured than short-term credit to private persons, so banks have less incentives to reduce the supply. The behaviour of this type of credits seems to correspond with a lagged reaction of industrial output after monetary policy shock, but further research of this effect is needed, including analysis of credit use at the industry branch level[6]. Medium-term credit responds in a way predicted by a standard textbook, i.e. it declines after a short lag. Long-term credit seems to exhibit the effect described by Gertler and Gilchrist - it increases initially to fall with a considerable delay.

As we have mentioned before, applying such a VAR specification we cannot conclude whether these response functions reflect rather supply-side (lending channel) or demand-side (interest rate channel) adjustment. A following part of he paper is aimed to provide some insights into the operation of the lending channel in Poland.

4.2.2. Bank-specific characteristics and monetary transmission (by Małgorzata Pawłowska)

The necessary condition for the lending channel to operate is a dominant role of banks as a source of capital for the corporate sector. If some borrowers, e.g. small firms, do not have an easy

[6] We hope to get some information form a business survey conducted by NBP on a quarterly basis.

access to the capital market, their investment expenditures will depend on bank credit. Therefore, monetary tightening reducing bank reserves results in a reduction of loan supply, this in turn affects investment of the private sector and output growth.

A simple conclusion from this very brief description of the lending channel is that for some banks it may be easier to protect their loan portfolio and offset monetary policy tightening than for others. These bank-specific characteristics are:

- Size. Due to asymmetric information problem small banks can have more difficulties to raise non-deposit funds to offset monetary policy tightening and keep the supply of loans at a desired level. Put it another way, after monetary policy tightening, small banks reduce lending more than large banks (Kashyap, Stein 1995).
- The degree of liquidity. More liquid banks can easier shield their loan portfolio than less liquid banks and offset monetary policy tightening. Specifically, after an increase in the central bank interest rate they can reduce their portfolio of liquid assets (e.g. bonds) to avoid cutting loans. The rationale for such a buffer-stock behaviour of banks is the existence of credit lines, protecting the credit relationship with the client and the lack of a secondary market for the intermediated loans (Bernanke and Blinder, 1992; Garretsen and Swank, 1998; Kashyap and Stein, 2000). Lending channel operates if a reduction of loans to the private sector is bigger than the reduction of bank liquid assets.
- The degree of capitalisation. Poorly capitalised banks have a more limited access to non-deposit financing and therefore reduce lending more than the better capitalised ones (Peek, Rosengren, 1995).

In Poland bank credit is the most important source of financing the private sector. Equities and corporate bonds play only a minor role. The ratio of short- and long-term corporate securities to the bank credit in 2001 was about 10-12% and was not very different from the respective figure for Spain (see Ehrmann et al., Table 1). The stock exchange capitalisation to the GDP is growing but nonetheless it is low – in 1995 it was as low as 3,7%, at the end of 2001 it attained the level of about 14%.

On the other hand, a factor that can potentially disable the operation of the credit channel in Poland is the existence of a (persistent) surplus liquidity, defined as a net indebtedness of a central bank with respect to commercial banks. One can suspect that in such conditions banks (at least these overliquid) are less responsive to the monetary policy tightening since to avoid cutting loans they can reduce the portfolio of the NBP-bills. Surplus liquidity was concentrated in a relatively small number of the biggest commercial banks.

To compare the results on the credit channel in Poland to these in the euro area, we follow the method used by Ehrmann et al. (2001). Namely, we estimate equation (6) and assume that bank loan reaction to monetary policy depends linearly on the bank characterising variable (size, liquidity or capitalisation) and is therefore allowed to vary across banks and time. This is captured by interaction terms ($x_{it-1}*\Delta r_t$). In the model the distributional effects of monetary policy should be reflected in a significant interaction term of bank specific characteristic with the monetary policy indicator. We expect a positive coefficient on the interaction terms since as we have pointed, small, less liquid and less capitalised banks are more sensitive to the monetary policy actions than the bigger, more liquid and better-capitalised counterparts.

In our estimate we use the definitions of measures for bank-specific characteristics suggested by Ehrmann et al. Namely, the log of total assets (A_{it}) measures the size of a bank; liquidity is the ratio of liquid assets (L_{it} sum of cash, interbank lending and securities to total assets A_{it}), and capitalisation is defined as the ratio of capital and reserves C_{it}, to total assets A_{it}). All bank- specific characteristics are normalised with respect to their average across all banks to get indicators that sum to zero over all observations. For the regression model the average of the interaction term ($x_{it-1}*\Delta r_t$) is therefore zero, too.

$$Siz_{it} = \log A_{it} - \frac{1}{N_t}\sum_i \log A_{it}$$

$$Liq_{it} = \frac{L_{it}}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{L_{it}}{A_{it}}\right)$$

$$Cap_{it} = \frac{C_{it}}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{C_{it}}{A_{it}}\right)$$

In the estimation we use NBP balance sheet statistics comprising 48 commercial banks. We use quarterly data (1997.4-2001.4), therefore there are 672 observations in the panel. To estimate the equation (6) we apply the GLS method and estimate a fixed effect model.

First, in the regression 1 for the variable x_i we substitute (*Siz*), then in regression (2) and (3) - (*Liq*), and (*Cap*) respectively. The main results of the estimation are summarised in Tab. 1.

Tab. 1
Bank – specific characteristics affecting lending channel – estimation results (1997.4-2001.4)

variable [expected sign]	regression 1(Siz)	regression 2(Liq)	regression 3(Cap)
$x_{it-1} * \Delta r_t$ [?]	4.6942 [+]	-0.12460 [+]	6.282 [+]
p-value	(0.0000)	(0.0000)	(0.0000)

The long-run coefficient[7] on the size interaction term is positive and significant (regression 1). This indicates that the long-run effect of an increase in the interest rate on bank lending is smaller for a bigger bank. In the case of liquidity (regression 2) the long-run coefficient is significant but – contrary to our expectations – negative. We suspect that this result is due to the mentioned above surplus liquidity, but a further analysis, including re-estimation of the equation (1) on the data excluding the overliquid banks is needed.

In the case of capitalisation (regression 3) the long-run coefficient is – as expected – significant and positive. This indicates that the long-run effect of an increase in the interest rate on bank lending is the smaller, the more capitalised a bank is. This finding implies that, in periods of a restrictive monetary policy small, poorly capitalised banks reduce lending more than big, well-capitalised banks.

The results obtained on the national quarterly data set show that in contrast to the euro countries, where the degree of liquidity seems to be the characteristic that affects the shape of the lending channel the most, in Poland it is the size and capitalisation. The estimated coefficient on capitalisation is somewhat higher than these obtained for the selected countries of the euro zone (Ehrmann et al., 2001) we would like to stress however, that the persistent overliquidity of the banking system could affect the result of our estimation.

4.2.3. Interest rate pass-through

Theory suggests that under perfect competition, prices equal marginal cost, implying that retail bank rates should fully adjust to the respective money market rates. Relaxing the assumption of perfect competition leads to a sluggish and less than full adjustment to the marginal cost. This is however not the sole cause of the sluggishness and less than full adjustment. The interest rate pass-through is delayed and less than one to one because of:

- fixed adjustment costs of changing prices;
- uncertainty about the future evolution of central bank and money markets rates; due to adjustment costs and possible loss of the market share resulting from adjustment to the

[7] Long-run coefficient is a sum of the coefficients on the various lags of a variable, divided by 1 minus the sum of the coefficients on the lagged endogenous variable.

transitory changes in the money markets rates, banks tend to react less frequently, and make larger adjustments;

- possibility of substitution of loans and deposits by economic agents, i.e. access to the capital market. When close substitutes to bank deposits and loans do not exist banks can then exert some market power and adjust less than fully (de Bondt, 2002).

The degree of concentration of the Polish bank sector[8] measured with the Herfindahl-Hirschman index and the share of the five largest banks in deposit and credit market is medium to low (see Tab. 2). There was no a clear-cut tendency in the degree of market concentration: after an initial fall due to establishment of new units, in 1999 started the process of bank consolidation resulting in higher indices of bank sector concentration.

Empirical evidence from the U.S. and the euro zone shows that the delay in banks' response amounts even to several months. There is a considerable asymmetry in the retail rates reaction: loan

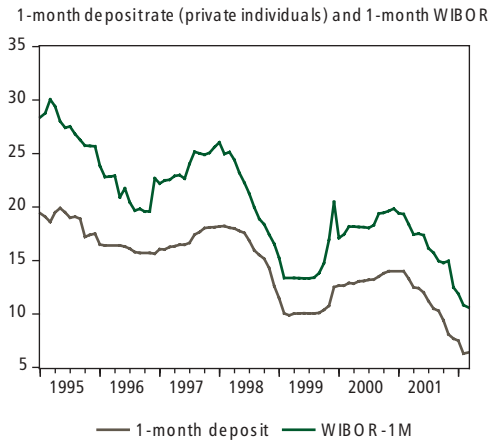
Tab. 2
Bank sector concentration level (for H-H indices 1= full concentration)

Concentration measure (end of year)	1996	1997	1998	1999	2000	2001	2002*
Assets: H-H index	0.076	0.074	0.067	0.079	0.076	0.086	0.089
Assets: 5 major banks (in %)	51.2	48.4	44.8	49.8	48.5	54.2	56.4
Deposits: H-H index	0.122	0.120	0.108	0.118	0.115	0.119	0.122
Deposits: 5 major banks (in %)	55.4	54.9	45.6	58.3	57.7	62.2	63.5
Credits: H-H index	0.061	0.057	0.052	0.070	0.070	0.079	0.079
Credits: 5 major banks (in %)	46.6	43.7	37.5	48.5	48.7	50.3 5	4.3

*end of first quarter 2002
Source: author's and General Supervision Office's calculations.

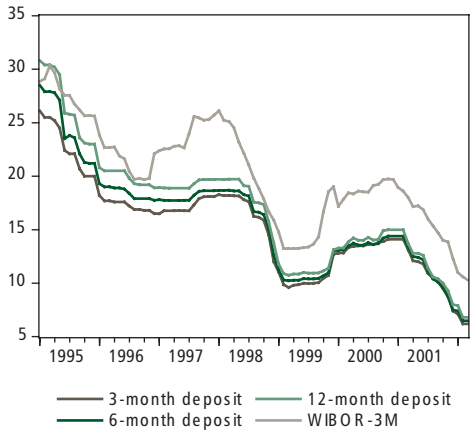
rates seem to increase more than deposit rates when monetary policy is tightened and to fall less than deposit rates when market rates fall. Evidence that can be obtained on the Polish data is very limited, because periods of upward and downward movements in the market interest rates alternated and each of them was relatively short (see Fig. 8).

Fig. 8
Deposit and loan rates

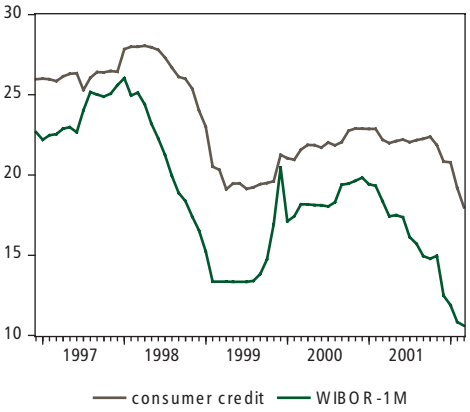


[8] Excluding co-operative banks representing ca 5% of the total banking sector. Over the analysed period banking sector consisted of ca 100 commercial banks.

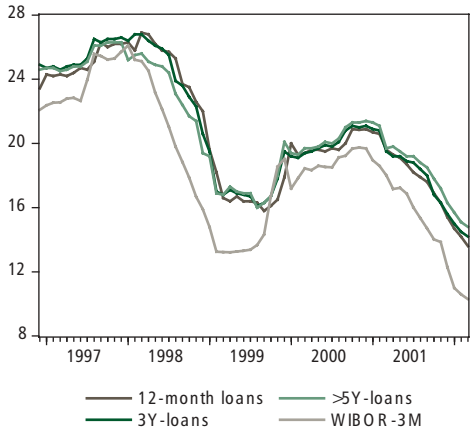
Selected deposit rates (private individuals) and 3-month WIBOR



Interest rate on consumer credit and 1-month WIBOR



Lending rates to the corporate sector and 3-month WIBOR



The results of the estimation of the ECM model as in (7) are shown in Tab. 3 - Tab. 6. We used WIBOR rates (Warsaw Interbank Offer Rate) of maturity 1 and 3 months as money market rates. 1-month WIBOR is a valid rate for 1-month personal deposit, personal loan and 12-month loan to the corporate sector. For all other deposit and loan rates we used 3-month WIBOR. In principle, we should have used money market rates of maturity comparable with a respective deposit or loan, but due to uncertainty, over the sample span transactions in the money market for periods exceeding three months were quite rare. As a result banks' quotations for longer periods do not bring sound economic information. To shed some light on a possible asymmetry of banks' reactions and to overcome the problem of too short sub-samples, we have estimated (7) for the period 1995-2000 and 1995-2002. In 2001-2002 there were frequent reductions in the NBP rates and we want to check whether the size and speed of adjustment is stable in both periods.

The inspection of Tab. 3 and Tab. 4 reveals that the parameter reflecting the instantaneous adjustment of the deposit rates is higher for the period 1995-2002 than for the period 1995-2000, the difference is however not statistically significant. On the other hand, parameters reflecting the speed of an error correction fell, and the resulting mean lag of adjustment stayed the same. The only exception is 1-month deposit. Mean average lag of adjustment ranged from 2.5 to 4.1 months over the period 1995-2000. Due to lengthening of the mean adjustment lag of 1-month deposits to more than four months, the respective figures for the period 1995-2002.02 became higher and amounted to 3.2-4.3 months.

Wald test shows that all deposits but these of 1-month maturity fully respond to the changes in the respective money market rate. 3-month deposit did not react fully over the period 1995-2000, but for the longer sample, up to 2002 we cannot reject that it totally responded to the money market rate.

There is an increase in the long-run adjustment parameter, β_2 that could reflect asymmetry in banks' reactions – i.e. a bigger reaction of deposit rates when money market rates fall than when they go up, but – once again – with the exception of 1-month deposit this increase was not statistically significant.

For the loan rates data series are generally much shorter than for the deposits. With the exception of 12-month loan rate to the corporate sector, they start in December 1996. The adjustment pattern of these rates seems to be more stable than of the deposit rates, but this can result from the difference of the sample span. Parameters reflecting the size of the instantaneous adjustment are in general similar to that estimated for the deposits. Wald test shows that both rates on loans of maturity longer than 5 years and on consumer loans do not adjust fully to the market rates. While the result for the consumer credit is just as we have expected, the latter can be due to the fact that in our estimates we have used 3-month market rate and this can be too short for a 5-year credit. The mean adjustment lag of loan rates over the sample period ranges from 1.8 months to 3.8 months. This result presumably reflects the problem of asymmetric information cost – for unsecured loans they are higher than for the secured loans (see Tab. 5 and Tab. 6).

The size of retail rates adjustment in Poland seems to be somewhat bigger than in the euro zone (see De Bondt, 2002), but a straightforward comparison is not easy. First, deposit rates that in the euro zone seem to be the most rigid concern products which are either not offered by the Polish banking sector or the central bank so far has not been collecting these data (deposits of maturities shorter than 1 month). As in the euro zone, Polish shortest deposit rate does not adjust fully. Only after adopting the euro, i.e. since January 1999 the transmission of the changes in market rates to the deposit rates in the euro zone gets much faster than before and it is clearly faster than in Poland.

Comparing adjustment of lending rates is easier, because there is no data problem. In general, in Poland lending rates seem to adjust faster – the lags in the euro zone range from 2.8 months to about 10 months, while in Poland the adjustment takes no more than four months. As in the case of the deposit rates, after adopting the euro, the speed of the interest rate adjustment in the euro zone has accelerated, but nonetheless it is still not faster than in Poland. Such a relatively

fast pass-through from the market rates to the retail rates in Poland as compared to the euro countries could result from the much higher inflation rate that persisted in Poland for the whole analysed period.

To check whether the concentration degree affects retail rates we have done a simple exercise adding monthly Herfindahl-Hirschman indices to the previously estimated pass-through equations. This approach is far from being satisfying, but seems to be the only solution in a situation of a relatively scarce data set on deposit and credit rates and impossibility of dividing the sample into long enough sub-samples of monetary easing and tightening[9]. From this simple exercise we can draw two main conclusions. First is that the degree of concentration mattered for both deposit and lending rate adjustment (the estimated coefficients were significant). For deposits the estimated coefficients were positive, while for credits – negative. With the overall downward trend of interest rates over the sample period (see Fig. 8) it means that an increase in concentration reduced the adjustment of lending rates and increased the adjustment of deposit rates.

Tab. 3
Deposit rates pass-through, 1995-2000

Deposit rate	α_0	α_1	β_1	β_2	R^2 (adj)	SE	Mean adjustment lag (months)
1 month	0.37	0.22	0.30	0.65	0.47	0.38	2.5
	(0.25)	(0.045	(0.054)	(0.035)			
3 months	-0.42	0.30	0.22	0.83	0.46	0.46	3.2
	(0.28)	(0.066)	(0.039)	(0.056)			
6 months	-0.50	0.32	0.18	0.90	0.37	0.6	3.7
	(0.35)	(0.081)	(0.039)	(0.083)			
12 months	-0.60	0.34	0.16	0.99	0.36	0.6	4.1
	(0.38)	(0.084)	(0.034)	(0.102)			

Standard errors in parantheses

Tab. 4
Deposit rates pass-through, 1995-2002.03

Deposit rate	α_0	α_1	β_1	β_2	R^2 (adj)	SE	Mean adjustment lag (months)
1 month	-0.40	0.28	0.17	0.80	0.34	0.44	4.3
	(0.21)	(0.047)	(0.049)	(0.067)			
3 months	-0.77	0.36	0.20	0.91	0.43	0.46	3.2
	(0.24)	(0.061)	(0.038)	(0.051)			
6 months	-0.81	0.38	0.17	0.98	0.36	0.55	3.6
	(0.30)	(0.07)	(0.037)	(0.07)			
12 months	-0.88	0.39	0.15	1.07	0.35	0.58	4.1
	(0.32)	(0.077)	(0.033)	(0.088)			

Standard errors in parantheses

[9] Mojon (2000) uses estimated three-month elasticities of deposit and loan rates with respect to market interest rates obtained from a standard error-correction model of retail rates pass-through in panel estimates to check for the role of the of market competition.

Tab. 5
Lending rates pass-through, 1997-2000

Deposit rate	α_0	α_1	β_1	β_2	R^2 (adj)	SE	Mean adjustment lag (months)
Consumer credit	1.54	0.23	0.22	0.85	0.59	0.43	3.5
	(0.63)	(0.068)	(0.048)	(0.084)			
Up to 1 year- to firms*	0.6	0.16	0.28	0.99	0.49	0.46	3.0
	(0.35)	(0.068)	(0.038)	(0.055)			
Over 1 year to 3 years – to firms	0.72	0.33	0.27	0.97	0.67	0.4	2.5
	(0.40)	(0.08)	(0.051)	(0.058)			
Over 5 years – to firms	1.75	0.33	0.36	0.85	0.57	0.47	1.9
	(0.58)	(0.09)	(0.074)	(0.048)			

*Sample 1995-2000.12.
Standard errors in parantheses

Tab. 6
Lending rates pass-through, 1997-2002.03

Deposit rate	α_0	α_1	β_1	β_2	R^2 (adj)	SE	Mean adjustment lag (months)
Consumer credit	1.44	0.24	0.20	0.85	0.53	0.43	3.8
	(0.59	(0.061)	(0.044)	(0.085)			
Up to 1 year- to firms*	0.24	0.20	0.27	1.03	0.44	0.56	3.0
	(0.27)	(0.06)	(0.035)	(0.048)			
Over 1 year to 3 years – to firms	0.6	0.36	0.26	0.98	0.65	0.38	2.5
	(0.32)	(0.067)	(0.045)	(0.05)			
Over 5 years – to firms	1.85	0.32	0.37	0.84	0.58	0.43	1.8
	(0.32)	(0.075)	(0.066)	(0.037)			

*Sample 1995-2002.03.
Standard errors in parantheses

5
Conclusions

In this paper we present the results of estimates of interest rate channel and credit channel in Poland for the period 1995-2002.03 using SVAR approach (Christiano, Eichenbaum, Evans and Kim and Roubini decompositions) as well as simple structural, one equation models.

Here we summarise the main results:

- Monetary policy tightening (increase in short-term interest rate) results in lower inflation and temporarily lower industrial output and retail sales. Exchange rate appreciates, money demand (M1) falls, TB-yields increase. The response of both output and CPI to the interest rate shock (one s.d. innovations) in Poland is smaller than in countries of the euro zone.
- Unemployment reacts to the monetary policy tightening in a nonsensical way, probably due to the dominance of supply shocks over demand shocks and many institutional shocks affecting labour market.
- Credits to private individuals respond to the monetary policy shocks in the expected way: short-term credits fall instantaneously, whereas medium- and long-term with a delay. The initial increase of long-term credits can result from the substitution effect (a switch from credits in the domestic currency to credits in foreign currencies).
- Short-term credit to firms does not react to monetary tightening. We do not have a sound explanation of this effect. Other types of credit to firms behave in an expected way. Long-term credit plausibly exhibits a phenomenon described by Gertler and Gilchrist, i.e. an initial increase after monetary tightening due to an increased demand for credit of the best borrowers to buffer a fall in the cash flow.
- Credit channel operates mainly through small, poorly capitalised banks.
- Immediate pass-through of interest rates is incomplete. On the other hand, in the long run the adjustment is close to 100%. The exception is 1-month deposit rate and lending rate over 5 years to firms. The speed of interest rate pass-through in Poland over the analysed period was relatively high. It needs to be stressed however, that we do not have the data on the shortest deposit rate (O/N) which supposedly reacts as the lowest pace.
- The degree of concentration, measured with Hirfendahl-Hirschman index, affects interest rate transmission. Over the sample period with the overall downward trend of interest rates, an increase in concentration reduced the magnitude of loan rate cuts and increased deposit rate cuts.

6
References

Angeloni I., A. Kashyap, B. Mojon, D. Terlizzese: (2001): *Monetary transmission in the euro area: where do we stand?* ECB Working Paper No. 114.

Bean Ch., J. Larsen, K. Nikolov (2001): *Financial frictions and the monetary transmission mechanism: Theory, evidence and policy implications*. ECB Working Paper No. 113.

Bernanke B. S., A. S. Blinder (1988): *Credit, money and aggregate demand.* American Economic Review, No. 78.

Cecchetti S. G. (1999): *Legal Structure, Financial Structure, and the Monetary Policy Transmission Mechanism, In Deutsche Bundesbank,* (ed). The Monetary Transmission process: Recent Developments and Lessons for Europe, Houndmills, Basingstoke, U.K.: Macmillan Publishing.

Christiano L. J., M. Eichenbaum, and Ch. L. Evans (1994): *The effects of monetary policy shocks: some evidence from the flow of funds.* NBER Working Paper, No. 4699.

---------- (1998): *Monetary policy shocks: what we have learned and to what end?* NBER Working Paper, No. 6400

De Bondt G. (2002): *Retail Bank Interest Rate Pass-Through: new Evidence at the Euro Area Level.* ECB Working Paper No. 136.

Ehrmann M., L. Gambacorta, J. Martinez-Pages, P. Sevesrte, A.Worms (2001): *Financial system and the role of banks in monetary policy transmission in the euro area.* ECB Working Paper No. 105.

Favero C. A. (2001): *Applied Macroeconometrics.* Oxford University Press.

Gertler M., S. G. Gilchrist (1993): *The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence.* Scandinavian Journal of Economics, vol. 95.

Hendry D. F. (1995): *Dynamic Econometrics.* Oxford University Press.

Kashyap A., J.Stein (1995): *The Impact of Monetary Policy on Bank Balance Sheets.* Carnegie Rochester Conference Series on Public Policy, Vol. 42, pp. 151-195.

Kashyap A., J.Stein (2000): *What do a million observations of banks say about the transimision of monetary policy.* American Economic Review vol. 90.

Kim S., N. Roubini (1995): *Liquidity and exchange rates in the G-7 countries: evidence from identified VAR's.* Working Paper, Yale University.

Kishan R.P., T. P. Opiela (2000): *Bank Size.* Bank Capital and the Bank Lending Chanel, Journal of Money, Credit and Banking vol. 32, No 1.

Kłos B., E. Wróbel (2001): *The monetary transmission mechanism and the structural modelling of inflation in the National Bank of Poland.* In: Modelling aspects of the inflation process and the monetary transmission mechanism in emerging market countries, BIS Papers, No 8, p.232-251.

Kuczyński G., K. Strzała (2002): *An Alternative Measure of Unemployment in Transition Economies-Idea of Free-Market Unemployment.* Statistics in Transition, No 4.

Mojon B. (2000): *Financial Structure and the Interest Rate Channel of ECB Monetary Policy.* ECB Working Paper Series, No 40.

Opiela T. P. (1998): *Kredytowy kanał transmisji polityki pieniężnej w Polsce rola struktury finansowej oraz bilansów banków.* „Bank i Kredyt", No. 6.

Peek J., E. S. Rosengren (1995): *Bank lending and the transmission of monetary policy in: J. Peek and E.S. Rosengren (eds), Is bank lending important for the transmission of monetary policy?* Federal Reserve Bank of Boston Conference Series 39.

Peersman G., F. Smets (2001): *The monetary transmission mechanism in the euro area: More evidence from VAR analysis.* ECB Working Paper No 91.

Przystupa J. (2002): *The exchange rate in the monetary transmission mechanism*, paper for the ECB conference on Monetary Transmission in EU Accession Countries.

Sellon G. H., Jr. (2002): *The Changing U.S. Financial System: Some Implications for the Monetary Transmission Mechanism.* Federal Reserve Bank of Kansas City Economic Review.

Sterne G., T. Bayoumi (1993): *Temporary Cycles or Volatile Trends? Economic Fluctuations in 21 OECD Countries.* Bank of England, Working Paper Series No. 13.

Weth M. A. (2002): *The pass-through from market interest rates to bank lending rates in Germany.* Economic Research Centre of the Deutsche Bundesbank Discussion paper No. 11.

Worms A. (2001): *Monetary policy effects on bank loans in Germany: a panel-econometric analysis.* Economic Research Centre of the Deutsche Bundesbank Discussion Paper.

Zięba J. (2002): *Próba rozbicia PKB na składową długo- i krótkookresową według metody Blancharda-Quaha.* NBP, mimeo.