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## Econometric analysis of the influence of monetary policy instruments on the nominal sector of the economy

### 1. Introduction

Nobody more or less interested in the problems of central banking and its monetary policy doubts in the influence of monetary authorities on the economy. Although the existence of the effects of monetary policy instruments in the economy is not questionable, contradictory opinions appear when discussing mechanisms and delays of the impact of those instruments on economic processes. In this situation every central bank faces a very important task of becoming familiar with the transmission mechanism of monetary impulses in order to effectively plan and execute its policy and correctly influence the economy.

The purpose of this paper is to present the concept of the transmission mechanism of monetary policy impulses, the most important elements of the transmission theory as well as the econometric analysis of the impact of monetary policy decisions on the economy, with special attention given to its nominal sector.

### 2. Theoretical Remarks of Monetary Transmission Mechanism

The mechanism of transmission of monetary policy impulses (*MTM-Monetary Transmission Mechanism*) is defined as those actions of institutions and economic subjects which make up a route through which the central bank policy influences the decisions of economic subjects concerning prices and production. Monetary impulses represent price changes (interest rates, other profit rates, exchange rate) and changes in supply of financial instruments

existing in the economy. Therefore, monetary policy impulses are the monetary impulses resulting from the actions of the central bank, mainly from the changes in the instruments of the monetary policy<sup>1</sup>.

It is considered that the monetary transmission begins in the moment of the central bank taking the decision on the adjustment of interest rates to a new economic situation. The essence of the transmission process is presented in the below diagram.

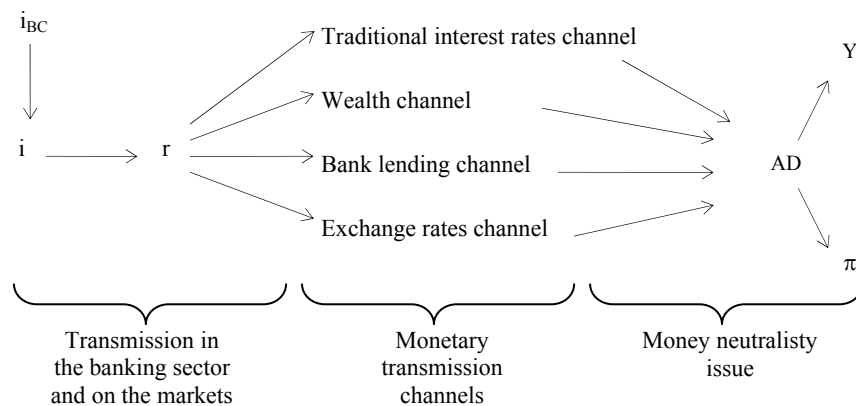


Diagram 1. Monetary transmission mechanism

Source: Warsaw School of Economics, [www.akson.sgh.waw.pl](http://www.akson.sgh.waw.pl).

The monetary transmission process can be divided into three basic stages:

1. Transmission in the banking sector and on financial markets – within its monetary policy the National Bank of Poland (NBP) changes basic interest rates (lombard rate, reference rate and deposit rate) which affect the loan interest on the international financial market. Due to the fact that the lombard rate determines the interest on one-day loans borrowed from NBP by commercial banks, the one-day interest rate of the financial market (WIBOR O/N) should never exceed the interest rate on lombard loans. Fluctuations of short-term interest rates are also restrained by the deposit rate at which banks can always place one-day deposit in NBP. The reference rate, on the other hand, defines the minimum interest on financial bonds used by NBP in the open market operations and to a large extent determines the level of the one-month interest rate WIBOR (Fig. 1).

<sup>1</sup> See Kokoszcyński (2002), p. 8.

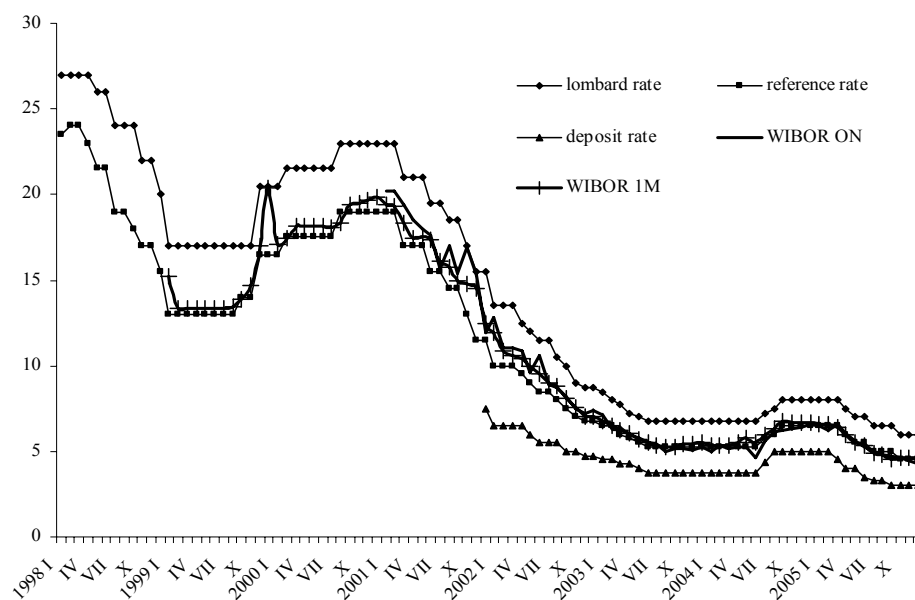


Fig. 1. Basic interest rates of the National Bank of Poland and international market rates in Poland in the period 1998–2005 (in %)

Source: own study on the basis of: National Bank of Poland, [www.nbp.pl](http://www.nbp.pl); Money.pl, [www.money.pl](http://www.money.pl).

Table 1. Correlation coefficients for pairs of interest rates lombard rate – WIBOR 1M and reference rate – WIBOR O/N

Correlation coefficient	
Lombard rate – WIBOR O/N	0.99
Reference rate – WIBOR 1M	0.99

Source: own study on the basis of: National Bank of Poland, [www.nbp.pl](http://www.nbp.pl); Money.pl, [www.money.pl](http://www.money.pl).

The level of the interest on loans in the financial market significantly affects the costs of credit in commercial banks borne by economic subjects (households and companies) and the interest on deposits. Furthermore, when talking about the monetary transmission one must mention its big role in the transmission of impulses of the stock market – treasury bonds (Continental Europe) and corporate stocks (United States).

2. Situation in the deposit-credit market influences the aggregate consumer and investment demand through transmission channels – the literature of the subject usually specifies four monetary transmission channels: interest rates channel, bank lending channel, exchange rate channel and wealth channel. The interest rates channel and the exchange rate channel are the first identified transmission channels. Interest rates influence the consumer demand of households thanks to a substitution effect in which the future consumption is preferred to the present consumption, which generates negative relationship between the real interest

rate and the consumer demand. It must be noted, however, that there are some processes in the economy which distort this relationship: almost unforeseeable direction of the income effect, inclination of people to smoothen the consumption path in time and to not react to short-term macroeconomic perturbations. The reaction of the investment demand to the interest rate's change is unequivocal and negative. The exchange rate channel is the fastest working of all transmission channels. It consists of two stages and their effects can be totally different (Diagram 2).



Diagram 2. Exchange rate transmission channel

Source: Warsaw School of Economics, [www.akson.sgh.waw.pl](http://www.akson.sgh.waw.pl).

In the first stage, the interest rates (i) affect the exchange rate (E) due to the improved attractiveness of domestic securities in relation to the foreign ones, which then attracts portfolio investments and in the end leads to the appreciation of the exchange rate. In the second stage, the exchange rate affects the inflation (π) in two ways: directly and indirectly. The direct influence of E on π results from the fact that the prices of imported goods take into account the appreciation and depreciation of domestic currency in relation to the foreign one. The direct influence is exerted also by means of net export (EX). The monetary policy affects the nominal and real sector of the economy through the wealth channel by means of a change of value of some financial and tangible assets owned by households. If the central bank increases the interest rates, the price of those assets will fall down, households will feel poorer and thus they will be more reluctant to increase their consumption. As for the bank lending channel, strict monetary policy leads to a reduction of credit supply by commercial banks.

3. Changes in aggregate demand are divided into real and nominal. A strict approach of the central bank in its monetary policy induces growth of real interest rates in the interbank market, which leads to an increase of the interest on bank credits and deposits and on other securities. Subsequently, the credit demand and supply fall down, the aggregate demand, production and inflation decrease and in time the production comes back to its potential level. Thus, it can be said that in the long term the monetary policy becomes neutral for real values in the economy<sup>2</sup>.

<sup>2</sup> Warsaw School of Economics, [www.akson.sgh.waw.pl](http://www.akson.sgh.waw.pl).

### 3. Empirical Analysis of Impulse Reactions to Monetary Policy Shocks

To help evaluate the speed of reaction of the most important macroeconomic factors to changes in the main monetary policy instruments, graphs shown below present impulse reactions of industrial production and the consumer price index to distortions in the sphere of monetary policy.

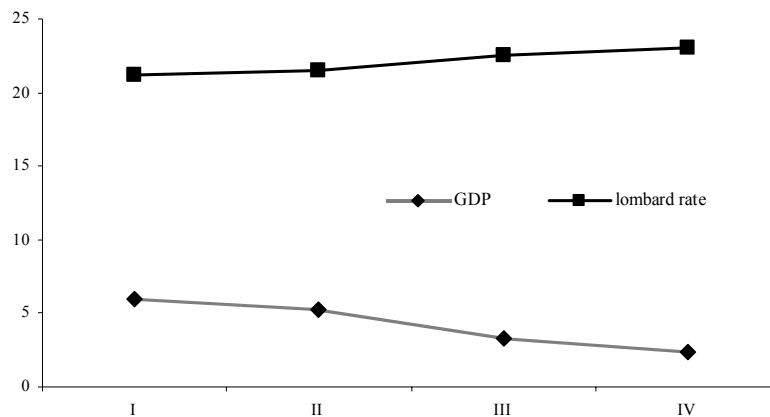


Fig. 2. The change of GDP and the lombard rate by 100 bp in the 1st quarter of 2000

Source: own study on the basis of: National Bank of Poland, [www.nbp.pl](http://www.nbp.pl); Money.pl, [www.money.pl](http://www.money.pl); Central Statistical Office, [www.stat.gov.pl](http://www.stat.gov.pl).

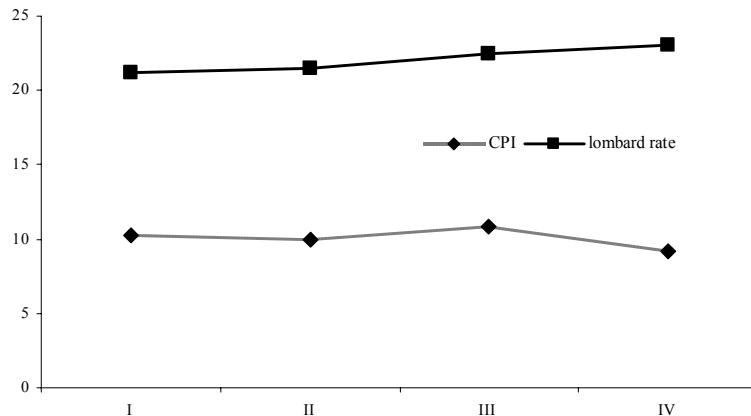


Fig. 3. The change of CPI and the lombard rate by 100 bp in the 1st quarter of 2000

Source: own study on the basis of: National Bank of Poland, [www.nbp.pl](http://www.nbp.pl); Money.pl, [www.money.pl](http://www.money.pl); Central Statistical Office, [www.stat.gov.pl](http://www.stat.gov.pl).

The above figures indicate a relatively quick reaction of production and inflation to changes in the sphere of the Polish monetary policy. The horizontal

axis scale of each graph displays quarters of a year and the vertical axis scale displays percentage.

This paper contains also the results of the econometric analysis of the influence of the monetary policy decisions taken by NBP on the nominal sector of the economy, especially on inflation. According to the results presented in the study, the monetary policy seems to strongly influence the behaviour of one of the most important macroeconomic indices.

The analysis was based on the idea of congruent dynamic modeling according to Zielinski. The dataset consists of monthly observations ( $t=1,2,3,\dots,72$ ) from the period January 1999 – December 2004. The preliminary analysis of the inner structure of the dependent process and explanatory processes provided the following results:

Table 2. Results of the analysis of the inner structure of inflation and explanatory processes

Variable	Degree of the multinomial model of trend	Seasonality	Order of autoregression
INF	2	+	1
import	1	+	2
expenditure	1	-	0
cash	1	-	2
production	1	+	3
credit	2	-	2
lombard rate	1	-	2
USD/PLN	2	-	1
EUR/PLN	2	-	1

Source: own study on the basis of: National Bank of Poland, [www.nbp.pl](http://www.nbp.pl); Money.pl, [www.money.pl](http://www.money.pl); Central Statistical Office, [www.stat.gov.pl](http://www.stat.gov.pl).

where:

INF denotes a CPI with monthly frequency of data observation (preceding period =100),

import represents the value of goods brought from abroad which were subject to customs clearance or inward processing (in mln PLN),

expenditure represents the expenditure of the state budget (in mln PLN),

cash stands for the money supply MO (in mln PLN),

production represents the sold industrial production (in mln PLN),

credit represents the outstandings from the non-financial sector (w mln PLN),

lombard rate is one of the main interest rates of the National Bank of Poland,

USD/PLN is the NBP exchange rate of the Polish currency to USD (in PLN),

EUR/PLN is the NBP exchange rate of the Polish currency to EUR (in PLN).

Final results of the econometric analysis of inflation process are presented below in the form of an estimated congruent dynamic model:

$$\begin{aligned}
INF_t = & -6.10985 - 0.11641t + 0.69309Q_{1t} + 0.8177Q_{2t} + 1.18162Q_{3t} + 0.76008Q_{4t} + 0.57361Q_{5t} \\
& + 0.35994Q_{6t} - 0.09304Q_{7t} - 0.04639Q_{8t} + 0.72837Q_{9t} + 0.59893Q_{10t} - 5.68176Q_{11t} + \\
& 0.00006 import_{t-2} + 0.00012 gotówka_{t-1} + 0.00008 produkcja_{t-1} + \\
& 0.00002kredyt_{t-1} - 6.54509stopalombardowa_{t-2} - 0.655 euro_{t-1} + e_t \\
R^2 = & 0.81798563 \\
DW = & 1.795866
\end{aligned} \quad (1)$$

Table 3. Correlation coefficients for pairs of inflation and explanatory variables

Correlation coefficient	
import	0.74
expenditure	0.79
cash	0.80
production	0.80
credit	0.98
lombard rate	-0.67
USD/PLN	-0.43
EUR/PLN	0.09

Source: own study on the basis of: National Bank of Poland, [www.nbp.pl](http://www.nbp.pl); Money.pl, [www.money.pl](http://www.money.pl); Central Statistical Office, [www.stat.gov.pl](http://www.stat.gov.pl).

#### 4. Conclusions

The goal of this study was to identify the influence of the monetary policy on nominal changes in the economy and this goal has been accomplished. The above congruent model is characterized by proper values of parameters informing about the matching degree of the model with the empirical data, which means that the degree of consistence of the econometric model with the observed values of the Consumer Price Index is high. The model contains six explanatory variables: import, money supply, sold industrial production, outstandings from the non-financial sector in commercial banks, NBP lombard rate and the exchange rate of the Polish currency to EUR. The structural parameters are of high statistical significance. Growth of import induced by depreciation of domestic currency in relation to a foreign currency causes the inflation to accelerate due to an increase in prices of imported goods and goods produced in big part of imported semi-finished products. Similarly, increase in the money supply eventually contributes to the increase of  $INF_t$ . The economic recovery is accompanied by the increase in prices caused by a series of indirect decisions taken by economic actors. The decision to increase the production volume of goods and services, e.g. as a result of an increase in autonomic demand of foreign consumers, involves employment increase and reduction of unemployment, which then leads to higher incomes and in consequence to an increase in consumer and investment demand. Increase in the values of credits

lent to households and companies by commercial banks will also induce the inflation increase. On the other hand, appreciation of the Polish currency in relation to EUR will lead to a fall of price level due to the fact that the goods purchased abroad will be relatively cheaper. The most important element of the model which indicates the influence of monetary impulses on inflation is the lombard rate. The sign of the structural parameter of this variable conforms to the economic theory and empiricism, which means that the increase of the basic interest rates of the central bank will eventually cause  $INF_t$  to fall.

### References

- Kokoszcyński, R., Łyziak, T., Pawłowska, M., Przystupa, J., Wróbel, E. (2002), Mechanizm transmisji polityki pieniężnej - współczesne ramy teoretyczne, nowe wyniki empiryczne dla Polski, *Materiały i Studia*, no. 151.
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