

The Impact of the Interest Rates on Investments in the Context of Financial Crisis

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Abstract—The main objective of this article is to examine the impact of interest rates on investments in Poland in the context of financial crisis. The paper also investigates the dependence of bank loans to enterprises on interbank market rates. The article studies the impact of interbank market rate on the level of investments in Poland. Besides, this article focuses on the research of the correlation between the level of corporate loans and the amount of investments in Poland in order to determine the indirect impact of central bank interest rates through the transmission mechanism of monetary policy on the real economy. To achieve the objective we have used econometric and statistical research methods like: econometric model and Pearson correlation coefficient.

This analysis suggests that the central bank reference rate inversely proportionally affects the level of investments in Poland and this dependence is moderate. This is also important issue because it is related to preparing of Poland to accession to euro area. The research is important from both theoretical and empirical points of view. The formulated conclusions and recommendations determine the practical significance of the paper which may be used in the decision making process of monetary and economic authorities of the country.

Keywords—Central bank, financial crisis, interest rate, investments.

I. INTRODUCTION

THE dependence between the interest rates and investments has been studied by many economists. These analyzes have been performed for different countries with different economic conditions. Analysis of investments depending on the interest rate is affected by a variety of factors which interfere with the impact of the central bank interest rates on investments. Various structural factors have an impact on the efficiency and time transfer of monetary policy impulses through the channels of the transmission mechanism to the real economy. In the empirical research it is not easy to separate the effects of monetary policy on investments from the influence of other factors. Significant element that is important in the transmission of monetary policy of the central bank, associated with the level of investments, is the cost of using capital (user cost of capital). In addition, changes in the investment demand often affect the level of interest rates. Mahadeva and Sinclair [1] among the factors that hinder to examine the dependence between the investments and interest rates is the fact that often the components of investments (machinery, stocks) are also influenced by exchange rates and their foreign prices.

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The concept of the impact of interest rates on investments in the economy is controversial and very significant. J. Taylor, M. Keynes believed that this dependence is important particularly in the context of the cost of capital [2]. Meanwhile, the economists such as: [3], [4] argued that the cost of capital is less important for enterprises than wages and prices in making investment decisions. Research on the influence of interest rates on investments was undertaken by [5], [6], measured the impact of interest rates on the individual components of the investments. These economists showed that interest rates have a strong impact on residential construction and less on investment companies. Kuttner and Mosser [6] stressed, however, that the increase in nominal interest rates is transferred to the increase in real interest rates and then the increase in the user cost of capital, which in turn affects the decline in investment spending.

Therefore, this article has studied the time lags with which the reference rate affects the economy, mainly the investments and the strength and direction of this dependence. Analysis of dependence between the relevant variables has allowed testing the hypothesis about the impact of central bank reference rate on investments in Poland. Put forward the following research hypothesis: the reference rate of the central bank affects inversely the level of investments in Poland. The study assumes that the econometric model will examine whether the inverse impact of interest rates on investments is confirmed by the Polish economy in the period of 1998 to 2011. The concept of the impact of interest rates on the economy becomes important when discussing the Polish accession to the euro zone.

In this paper the dynamic autoregressive model has been used, because one of the explanatory variables is delayed dependent variable. Econometric estimation of the model parameters has been performed by least squares. To describe the dependence between the investments and the reference rate of the central bank a logarithmic function has been used. There were presented two variants of the equation in order to monitor the effects of a range of different variables on the dependent variable. In the research the Pearson correlation coefficient between the respective variables has been used.

II. THEORETICAL FRAMEWORK

Cecchetti [7] wrote that the task of monetary policy makers is to change the interest rates and to provide knowledge of how the economy affects the maintenance of steady economic growth and stable prices.

The objective of the NBP is keeping annual index of consumer prices CPI (*Customer Price Index*) at 2.5%, with the

range for deviations of + / - 1 percentage point in the medium term [8].

Bennett, Loayza [9] indicated that the long-term goal of price stability encounters confounding factors, for example the lack of coordination between monetary policy and fiscal policy. The study of correlation between monetary and fiscal policy (policy mix) focuses on the effects of potential conflicts between them and the benefits of coordination of the decision-makers responsible for economic policy. Loose fiscal policy strategy is the most preferred by the government and tight monetary policy by the central bank.

The central banks using inflation targeting strategy strive to maintain a low level of inflation excluding other purposes, such as generating employment or a high level of investments [10]. Otherwise, [11] pointed out that the stabilization of inflation is important for the whole economy, including the level of investments in the economy.

Borio and Lowe [12] confirmed that low and stable inflation contributes to financial stability as opposed to unexpected fluctuations in the rate of inflation, which usually increases the susceptibility to crises.

Central bank through the instruments of monetary policy controls the short-term money market interest rates, which also affect other interest rates and financial quantities [13]. Overall, the heterogeneity of response of bank interest rates to market rates helps in understanding how the decisions of the monetary authorities are transmitted to the real economy [14]. B. Bernanke and A. Blinder [15] found that restrictive monetary policy has a significant impact on reducing the supply of bank loans, which has a negative impact on economic activity.

The level of interest rates, inter alia, affects the size of the investments, consumption, savings or unemployment. In the short or medium term interest rates should help in the stabilization of inflation and thus affects the stable economic growth [16]-[18]. The better the financial health of companies and other business entities is the better development of the banking sector. The greater the difference between the rate of return on the project and the long-term interest rate, the more stimulated the inclination of the investments. In turn, the smaller the difference between the interest rate and the rate of profit, companies are less interested in investing. Business entities usually conform to the laws of economics. In the event of rising interest rates, typically the level of loans decreases and the level of deposits increases. The decline in interest rates contributes to more loans granted by banks and results in the reduction of deposits by companies. This is confirmed by a study conducted for Poland by [19] and [20], who confirm that a restrictive monetary policy affects the reduction of credit supply (mainly in relation to smaller banks with low capitalization).

J. B. Taylor [2] presented the empirical evidence where he identified a significant impact of interest rates on investment expenditures through the cost of capital.

Interest rate rule proposed by J. B. Taylor called "Taylor rule" is important for this study because it draws attention to the interest rate as an important instrument of monetary

policy. It refers to the amount of short-term interest rates, which are associated with a deviation of inflation from the target, and the level of GDP from potential GDP. The classic Taylor rule of monetary policy [21] initially concerned the Federal Reserve System after 1986, and presented as:

$$i_t = \Pi_t + 0.5y_t + 0.5(\Pi_t - \Pi^*) + r^* \quad (1)$$

where: i_t - the nominal federal funds rate in period t, Π_t - the rate of inflation in period t (annual in %), Π^* - inflation target in period t (in %), y_t - GDP gap (demand) in period t (deviation of GDP from its potential level, in %), r^* - the real interest rate corresponding to the full employment (natural interest rate).

J. B. Taylor presented several important conclusions based on the research. First of all, Taylor said that monetary policy should respond not only to changes in economic activity, but also to the level of inflation. In Taylor's opinion the basic instrument of the central bank's impact on the economy should not be the money supply, but the interest rate. Taylor rule is called a flexible rule, and based on it; monetary policy is called a closed loop policy, because it takes into account the most recent information and data about the economic condition [22]. The rule developed by J.B. Taylor, based on a suitable shaping of the level of interest rates in order to stabilize inflation.

Lyziak, Przystupa, Wrobel [23] show that in the case of an increase in interest rates on the loans, the banks increase the supply of credit, and with the rise in the reference rate they limit the supply of credit.

The impact of interest rates on investment is not a simple phenomenon. The basic way to influence interest rates on investments is done by the user cost of capital. It should be noted, however, that the user cost of capital depends not only on the cost of financing, which is influenced largely by the interest rate, but also its effect on: depreciation, taxes and the relative price of capital in relation to production. The second aspect is related to the fact that changes in interest rates may be caused by an increase in investment demand. Another aspect relates to a component of investment (stocks, machinery, equipment), which are significantly in international trade, so that means that their shaping is affected by the exchange rate and foreign prices of these components [1], [24].

Guiso [24], in his study, used microeconomic data describing the investments of the individual enterprises. He received accurate estimates of the user cost of capital and on this basis he observed more powerful effect of interest rates on the level of the cost of capital than in studies based on aggregated data covering all enterprises.

In Poland, on account of studies, among others, A. Szymczak shows that in the years 1995-2002 there was a moderate negative dependence growth rate of real investment on the real interest rate. Pearson's correlation coefficient obtained by A. Szymczak was without time delays (-0.59). For that study he used rediscount rate of the National Bank of

Poland. In addition, the coefficient of determination was used, which indicated that 35% of the variation in investment outlays explains changes in interest rates. After a delay of 4 quarters variables the coefficient of determination increased to 60% [25].

M. Kowalski sets out the results of the correlation coefficient between the reference rate and the real investment costs with the annual delay at level (-0.80) in the years 1998-2003. This shows that investments react with a lag to changes in interest rates in Poland which results in prolonged decision-making and organizational process related to the investment initiative [26].

III. DATA AND METHODOLOGY

In this part of the article the description and data sources used in the econometric models and statistical calculations have been presented.

The numerical values were partly taken from the OECD National Accounts database [27]. Data from the period of 1998-2011 was converted into the real values and shown in the prices of 2005q1.

- IR - interest rate - the real reference rate (in real terms using the GDP deflator).
- SRE - nominal reference rate.
- IT - (total investments - gross fixed capital formation) total real investments (2005q1).
- GDP - Gross Domestic Product, the value of real GDP in the 2005q1.
- PGDP - GDP deflator (2005q1).
- PIT - gross fixed capital formation, market price deflator.

Gross fixed capital formation is developed according to the recommendations of the ESA 95 (European System of Accounts). These are expenditures that increase the value of fixed assets, including outlays on: property, plant and equipment, intangible assets and legal, repairs of fixed assets. The value of the tangible fixed assets include: outlays on their acquisition, outlays on production of fixed assets for their own purposes, outlays on fixed assets under construction, and improvements [28].

Nominal interest rates of the National Bank of Poland were taken from Annual Reports National Bank of Poland for the period of 1998-2011. Nominal rates in force at the end of each quarter of the year were used. Average interest rates on corporate loans were taken from the Annual Reports of the NBP for the period of 1998 to 2011. The weighted average interest rate on loans in PLN in commercial banks of last month of each quarter was used. WIBOR 3M (Warsaw Interbank Offered Rates 3 Month) were taken from the monthly bulletin of the National Bank of Poland for the period of 1998-2011. As quarterly data, WIBOR 3M downloaded in a month at the end of the quarter was used [29]-[43].

GDP growth in Poland presented as GDP growth on a quarterly basis, was taken from the Central Statistical Office data, using as fixed prices - average prices of the previous year. Receivables from enterprises in the banking system as quarterly data were taken from Central Statistical Office (in billion), as a state at the end of the period. Real GDP data was

calculated using the GDP deflator [44].

IV. EMPIRICAL VERIFICATION OF THE IMPACT OF THE CENTRAL BANK REFERENCE RATE ON INVESTMENTS: THE CASE OF POLAND IN 1998 – 2011

Econometric models have been used to verify the hypothesis that the central bank's reference rate inversely affects the level of business investments in Poland. In the economy where investments affect many factors, the econometric model is a tool that reflects the economic reality to a greater extent.

In these equations, as the dependent variable were used logarithms increments of outlays on gross fixed capital formation. Among the explanatory variables, the increments of the NBP reference rate, the logarithms increments of gross domestic product and the logarithms increments of delayed were used. Model parameters were estimated by least squares method. The regression equation used in the model is presented as:

$$y_t = \alpha_0 + \alpha_1 x_{1t} + \alpha_2 x_{2t} + \dots + \alpha_n x_{nt} + \varepsilon_t \quad (2)$$

where: y_t - dependent variable, $x_{1t} \dots x_{nt}$ - explanatory variables, ε_t - random component

Using statistical tests, the results were examined in terms of suitability in explaining a given problem. To verify the significance of the regression coefficients were used t - Student test, and to detect autocorrelation were used Durbin, Durbin - Watson and LM (Lagrange Multiplier) tests. The variability of residual variance was examined by White's test.

Analysis of variables stationarity was performed using the ADF test. The variables tested at levels were shown to be non-stationary (unit root occurrence). Test for the first increments of these variables allowed for rejection of H0 which showed the occurrence of the unit root (non-stationary variables) in the favor of H1 hypothesis of the absence of the unit root (stationary variables).

This analysis can be used as a basis for further research related to this topic by using more advanced research methods and more recent data.

A. Estimation and Statistical Verification

The model 1 for Poland is presented as:

$$\Delta \ln IT_t = \alpha_0 + \alpha_1 \Delta IR_t + \alpha_2 \Delta \ln GDP_t + \alpha_3 \Delta \ln IT_{t-1} + \alpha_4 \Delta \ln IT_{t-2} + \varepsilon_t \quad (3)$$

where: $\Delta \ln IT_t$ - investments (at the prices 2005q1), logarithms increments; ΔIR_t - real NBP reference rate (increments) $\Delta \ln GDP$ - the value of gross domestic product (at the prices 2005q1), logarithms increments; $\Delta \ln IT_{t-1}$ - investments delayed by one quarter (at the prices 2005q1), logarithms increments; $\Delta \ln IT_{t-2}$ - investments delayed by two quarters (at the prices 2005q1), logarithms increments.

Model 1 for Poland after the OLS estimate in the GRETL:

$$\Delta \ln IT_t = -0.0089 - 0.0045\Delta IR_t + 1.2823\Delta \ln GDP_t + 0.3019\Delta \ln IT_{t-1} + 0.3771\Delta \ln IT_{t-2} \quad (4)$$

Table I presents a results of estimation (model 1).

TABLE I
OLS ESTIMATION, USED 1998:2-2011:4 (N=55) OBSERVATIONS DEPENDENT VARIABLE (MODEL 1 FOR POLAND)

Variable name	Coefficient	Standard error	t-Student	p-value
Const	-0.0089	0.0032	-2.766	0.0079
ld_IR	-0.0045	0.0014	-3.170	0.0026
ld_GDP	1.2823	0.3346	3.8327	0.0004
ld_IT_1	0.3019	0.1192	2.5315	0.0146
ld_IT_2	0.3771	0.1099	3.4297	0.0012
R ² 0.7114				
Adjusted R ²	=0.6883			
F (4,50)	=30.8113	P-value	for F test	6.1e-13
Residuals	Autocorrelation	- rho1	=0.60411	
Durbin h	statistic:	=0.921372		
White Test:	LM = 20.4027	p-value	=P(Chi ² (14) >	20.403)
Doornik-Standard	Hansen Test error of	Chi ² =2.764 residuals	p-value	=0.1179 =0.2510 =0.0120

Model 2 for Poland is presented as:

$$\Delta \ln IT_t = \alpha_0 + \alpha_1 \Delta IR_t + \alpha_2 \Delta \ln GDP_t + \alpha_3 \Delta \ln IT_{t-2} + \varepsilon_t \quad (5)$$

where: $\Delta \ln IT_t$ - investments (at the prices 2005q1), logarithms increments; ΔIR_t - real NBP reference rate (increments) $\Delta \ln GDP$ - the value of gross domestic product (at the prices 2005q1), logarithms increments; $\Delta \ln IT_{t-2}$ - investments delayed by two quarters (at the prices 2005q1), logarithms increments.

Model 2 for Poland after the OLS estimate in the GRETL:

$$\Delta \ln IT_t = -0.0102 - 0.045\Delta IR_t + 1.5754\Delta \ln GDP_t + 0.5592\Delta \ln IT_{t-2} \quad (6)$$

TABLE II
OLS ESTIMATION, USED 1998:2-2011:4 (N=55) OBSERVATIONS DEPENDENT VARIABLE (MODEL 2 FOR POLAND)

Variable name	Coefficient	Standard error	t-Student	p-value
Const	-0.0102	0.0033	-3.0735	0.0034
ld_IR	-0.0045	0.0015	-2.9698	0.0045
ld_GDP	1.5754	0.3301	4.7722	1.57E-05
LD_IT_2	0.5592	0.0874	6.3954	4.90E-08
R ² 0.6744				
Adjusted R ²	=0.6552			
F (5,41)	=35.2115	P-value	for F test	=1.79e-12
Residuals	Autocorrelation	- rho1	=0.29557	
Durbin-	Watson statistic	=1.39779		
White Test:	LM = 16.0631	p-value	=P(Chi ² (9) >	16.0631)
Doornik-Standard	Hansen Test error of	Chi ² =3.052 residuals	p-value	=0.0656 =0.2174 =0.0126

Table II presents results of estimation (model 2).

In summary, all variables used in the two models for Poland, were statistically significant and economically valid. In model 1 the determination coefficient amounts to $R^2 = 0.7114$, which means that the model explains 71.2% of the variation of the examined variable. The coefficient of determination in model 2 is $R^2 = 0.6744$, which means that the model explains 67.4% of the variation of the examined variable. On the basis of econometric models for the Polish economy, it was found that investments in Poland depend on the reference rate inversely proportionally and this dependence is moderate.

B. Statistical Verification

The Pearson correlation coefficient is based on the correlational dependence between the two analyzed features, making it a measure less complicated compared to the econometric model.

To investigate the influence of the reference rate on the investment outlays used Pearson's correlation coefficient. The correlation coefficient of investments and the real reference interest rate amounted to (-0.57) for Poland. This means that outlays on gross fixed capital formation depend on the central bank reference rate in Poland to a moderate extent. To test the influence of the real interbank market rate WIBOR 3M on the investment outlays, Pearson's correlation coefficient was used. The correlation coefficient of investments and the real interbank market rate WIBOR 3M amounted to (-0.55) for Poland. This indicates that investments depend on the real interbank market rate WIBOR 3M in Poland to a moderate extent.

Table III presents a summary of results.

TABLE III
PEARSON CORRELATION COEFFICIENTS BETWEEN INVESTMENTS AND THE REAL REFERENCE RATE AND REAL INTERBANK MARKET RATE WIBOR 3M IN POLAND

The correlation coefficient	Investments and real the reference rate	Investments and WIBOR 3M rate
Investments and the reference rate without time lag	-0.569	-0.546
1 quarter lag	-0.608	-0.586
2 quarter lag	-0.649	-0.628
3 quarter lag	-0.690	-0.665
4 quarter lag	-0.724	-0.698
5 quarter lag	-0.755	-0.732
6 quarter lag	-0.786	-0.763
7 quarter lag	-0.813	-0.790
8 quarter lag	-0.833	-0.812

In Poland the dependence between the investments and the reference rate was high after 4 quarter lags. The dependence between investments and interbank rate WIBOR3M also was high after 5 quarter lags.

Interest rate policy of the central bank is determined by various factors. Then the central bank interest rates affect the interest rate of loans to enterprises (important for companies in terms of investment costs). The reaction of banks to monetary policy depends largely on factors such as their liquidity,

competition in the financial services sector, preference maturity of credit agreements, diversity of interest rates, risk premium or administrative costs. In general, many factors affect the effectiveness of central bank monetary policy by acting simultaneously on bank lending rates, and then on the real economy (including investments) [45]-[48]. Therefore, it is important to study the correlation between economic operators' investments and the reference rate of the central bank.

This paper presents the following detailed hypothesis:

- there is a relevant correlation between the NBP reference rate and the volume of loans to enterprises;
- the amount of loans to enterprises has a significant impact on the economic operators' investments;
- the real interbank market rates WIBOR 3M have a relevant impact on the level of loans to enterprises and affect the investment outlays in the economy.

Table IV presents the results of Pearson's correlation coefficient of the following variables in Poland.

Variables name	The Pearson correlation coefficient
NBP nominal reference rate and the loans to enterprises	-0.56
The real reference rate and the loans to enterprises	-0.52
Loans to enterprises and the investment outlays	0.89
The real interbank rate WIBOR 3M and the loans to enterprises	-0.49
The real interbank market rate WIBOR 3M and the investment outlays	-0.55

Pearson's correlation coefficient for the first dependence between the NBP nominal reference rate and the loans to enterprises amounted to -0.56 . This points to a moderate dependence of loans to enterprises from the NBP nominal reference rate. Moderate is also correlation coefficient (-0.52) between the real reference rate and the loans to enterprises in Poland. This means that the real reference rate has a moderate impact on the level of loans to enterprises. Next Pearson's correlation coefficient between the amount of business loans and investment outlays in Poland was calculated. The obtained value (0.89) indicates a high correlation between the loans granted to enterprises and investment outlays. The results confirm the veracity of specific hypotheses raised in the study, namely:

- there is a relevant correlation between the rate of the central bank's reference rate and the level of loans granted to enterprises by commercial banks;
- the amount of loans to enterprises has a relevant impact on the investment outlays of economic entities.

The next part of the study concerns the impact of real interbank rate WIBOR 3M on the loans to enterprises. The Pearson correlation coefficient level (-0.49) suggests a moderate dependence of the loans to enterprises from WIBOR 3M rate. In examining the dependence between the interbank market rate WIBOR 3M and the investment outlays, a

correlation coefficient of -0.55 was achieved. This shows that the investment outlays are moderate dependent on the level of interest rate in the interbank market WIBOR 3M. The results can be considered as confirmation of specific hypotheses: the real interbank market rates WIBOR 3M have a relevant impact on the level of loans to enterprises and affect the investment outlays in the economy.

Based on the reports of the NBP [29]-[42], the following conclusions were presented:

- In the period of 1998-2011 the NBP conducted an expansive monetary policy by lowering the reference rate from 24% in 1998 to 4.5% in 2011. At that time, there was also a significant decrease in average inflation measured by the CPI from 11.8 % to 4.6 % in 2011. This was a very significant drop in interest rates and inflation. In Poland during the periods of high inflation, the reference rate was raised, which resulted in a decrease in inflation and was in line with the inflation target.
- In Poland, the interbank market interest rates (for example, WIBOR 1M, WIBOR 3M) changed in the same direction as the reference rate of the central bank. In the analyzed period (1998-2011) in the wake of the significant decrease in the NBP reference rate, the interbank market rates were lowered (for example, WIBOR 3M from around 24.3% in 1998 to about 4.76% in 2011) and the average interest rates on loans to enterprises with 26.5% in the first quarter of 1998 to around 6.6 % in the fourth quarter of 2011.
- The average interest rate on loans to enterprises was changing in the wake of the NBP reference rate and interbank interest rates. In the years 1998-2011 with the fall in the average interest rates on loans (from 26.56% in 1998 to 6.6% in 2011) significant increase in the level of debt of companies in commercial banks was noticed (with more than 103 billion PLN in 1998 to more than 220 billion PLN in 2011). It seems that the decrease in the average interest rate on loans to enterprises in Poland significantly affect the level of debt of companies in the commercial banks.
- The decline in the real reference rate affected the growth of the investments in Poland measured by gross fixed capital formation. The investment outlays of enterprises significantly decreased during the economic downturn and financial crisis in Poland. Generally, within the period of 1998-2011 with a decline in the real reference rate the investment outlays in Poland increased from over 160 billion PLN in 1998 to about 305 billion PLN in 2011.

V. CONCLUSION

In conclusion, the article presented the analytical material associated with the use of an econometric model, which enabled the verification of the main research hypothesis that the central bank's reference rate influences inversely proportionally the level of investments outlays in Poland and allows concluding that:

- Dependence between the investment outlays and the central bank's reference rate in Poland in the period 1998 -

2011 was inversely proportional, moderate and statistically significant (based on econometric models).

- Dependence between the investments and the real reference rate in Poland in the years 1998 - 2011 was moderate (based on the Pearson correlation coefficient).

The article positively verified the main hypothesis and specific hypotheses and on this basis draws conclusions that the policy of the central bank's reference rate remains an important component of the economy and should take into account the impact on the individual components of GDP. It should be noted, however, that in the period of 1998-2011, the financial crisis was significantly a disturbing factor and it affected the variables under consideration.

In the face of the financial crisis [49] and the unstable situation in the euro area appropriate conclusions should be drawn regarding Polish preparations for accession to the Eurosystem. First of all, Poland must carefully prepare for changes in the Polish currency by completing the convergence criteria in a sustainable way, starting with the most important structural reforms before participating in ERM II (Exchange Rate Mechanism II). In order to avoid asymmetric shocks in Poland, particular attention should be paid to the level of the structural deficit, prudent fiscal policy, the flexibility of the product and labor markets and the effectiveness of financial supervision, which is not a small challenge. It seems that the unstable situation in the euro zone, the uncertainty in the global financial markets and the crisis of excessive budget deficits put aside in time the Polish accession to the euro area.

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