Warsaw School of Economics
Institute of Econometrics
Department of Applied Econometrics

Department of Applied Econometrics Working Papers
Warsaw School of Economics
Al. Niepodleglosci 164
02-554 Warszawa, Poland

Working Paper No. 6-11

Balance sheet effect in the Polish economy

Szymon Grabowski
Warsaw School of Economics

This paper is available at the Warsaw School of Economics
Department of Applied Econometrics website at: http://www.sgh.waw.pl/instytuty/zes/wp/

Abstract

Paper refers to the relations between real economic activity and the state of financial system. It presents how the balance sheet effect works and how it influences the real economic activity and the effectiveness of the monetary policy.
The empirical part of the paper presents the theoretical model, which is derived from classic assumptions. On the basis of this model, the balance sheet effect in the Polish economy is verified. The verification process is conducted on the basis of individual financial statements of 27 730 Polish companies encompassing period between 2002-2007.

Key words: CCAPM, economic growth, financial markets, term spreads, expectations.

JEL classification: G12, E44

1 Introduction

The financial crisis of the recent years showed that economists have to find a reasonable place for the financial system in their models. The recent papers in the financial economics attempt to incorporate financial system in the real economy. One of the first attempts was made by Bernanke, Gertler and Gilchrist (1998). They incorporated financial system into the Dynamic New Keynesian model. In their model the capital demand is driven by the difference between total expenditures on capital goods and net worth of the borrower. Since lenders are not able to observe the realised gross payoff to the capital of the borrowers they impose costly state verification mechanism as defined by Townsend (1979). Bernanke, Gertler and Gilchrist derived the equation, in which in the equilibrium capital expenditures are explained by the discounted expected return on capital and entrepreneurial net worth. Moreover, the firm's net worth is endogenised and depends on entrepreneurial equity (wealth accumulated by the entrepreneurs from operating firms) and entrepreneurial wage.

The conception of relating the value of the borrowed capital to the entrepreneurial net worth is present in most recent papers discussing the unconventional monetary policy of the central bank. In the paper by Kardi and Gertler (2009) the net worth and the leverage ratio play a crucial role. However, the economic model is more complicated than in the paper of Bernanke, Gertler and Gilchrist (1998). Here authors extended the basic model with financial intermediaries. They analyse how decrease of the quality of the capital of the financial intermediaries might influence the future real growth. Moreover, authors raise the question of the optimal monetary policy in the crisis. They evaluate changes in welfare under the unconventional monetary policy. The main goal of the unconventional monetary policy nested in the model is to push the endogenised external financial premium to the steady state level. The cost of unconventional monetary policy is than confronted with wealth gains in various scenarios.

The main issue of this paper is the balance sheet effect of the credit channel that the is incorporated in the *DSGE* models presented in the mentioned papers. The balance sheet effect describes why and how lender might differentiate enterprises by evaluating their creditworthiness. Existence of this effect in the particular economy would justify the assumptions that are incorporated in the lately constructed *DSGE* models.

One stream of the recently published literature refers to the net worth of the enterprises, its evolution in time and influence on the credit policy of banks. The presence of the net worth in the recently constructed models comes form earlier publications, that analysed the role of credit channel in the economy. Mainly the panel data research based on microlevel data identified the existence of the relation between the net worth of the company and its external finance premium. For example the balance sheet effect was identified for most of European Countries and the evidence are presented in papers of the Monetary Transmission Network (Butzen P. et al. (2001), Chatelain J.B. et al. (2001), Lunnemann P. et al. (2001), Valderrama M. (2001)).

The paper presents the results of the research that verifies the existence of the balance sheet effect in Poland in years 2002-2007. The empirical research is conducted on the basis of individual financial statements of Polish non-financial companies.

The results show that in years 2002-2007 the balance sheet effect operated in Poland. The increases of the interest rates have no influence on the investment outlays in the group of big companies. Changes in the interest rates in the analysed period influenced the level of investment outlays in the group of medium companies. In this sense the financial system in Poland was not neutral toward the real economic activity. Moreover, increases of the interest rates had no influence on investment decisions of the biggest companies in Poland, so the interest rate transmission channel was disturbed.

The paper is divided as follows. In the second section the theoretical background of the balance sheet effect is presented. In the third section the results of empirical study examining the existence of the balance sheet effect are discussed. In the final section the implications of balance sheet effect for the monetary policy and the conclusions are presented.

2 Balance sheet effect – the theoretical background

The balance sheet effect apart from credit rationing and commercial bank channel completes the mechanism of credit channel. This effect shows that lenders differentiate the costs of credit between enterprises and explains the mechanism that stands behind it. The balance sheet effect explains the cost differences among borrowers from a perspective of the individual characteristics of a company.

The balance sheet effect envisages the heterogeneity of the borrowers by means of collateral and the structure of their balance sheet. Increases in the level of the interest rates have mainly the following effects for the companies. Firstly, it increases the credit burden due to the higher costs of short term financing. In this way changes in interest rates influence the structure of the balance sheet of the company and its cash flows. Secondly, movements in the interest rates alter the current value of the collateral[1].

Those two effects influence the external finance premium of the particular company. The external finance premium is present in the real economy due to the existence of the moral hazard, information asymmetry (see Akerlof G. (1970)) and cost of credit monitoring. It is assumed that the external finance premium is the function of individual characteristics of the company, which inter alias depend on financial strength of the company. The external finance premium is not constant in time it alters with changes in the balance sheet structure of the entity.

Variation of the external finance premium might enable or disable company to draw additional obligation due to the higher costs. In fact, the cost factor inhibits the demand on the

[1]It might be explained for example by the Net Present Value model (NPV).

credit. The supply of the credit is assumed to be constant but the marginal cost of credit for the enterprises with higher external finance premium might be so high that will restrain them form drawing additional credit.

In order to verify the existence of the balance sheet effect in the economy the formal model is needed. In the article the accelerator model of investments is incorporated with the following notation:

- L_t – labour,
- K_t – capital stock,
- A_t – technology advancements,
- S_t – production level[2],
- C_t – the marginal cost of capital,
- I_t – investment outlays,
- δ – the rate of capital amortisation,
- ρ_{it} – the user cost of capital[3],
- $Trade_{it}$ – the participation of trade credit in short term financing[4],
- LIQ_{it} – Liquidity ratio I[5].

In the literature, which discusses the balance sheet effect, two approaches to derive the investment equation are encountered. First one, which is more general, derives the accelerator equation from CES (Constant Elasticity of Substitution) production function. Second one which is more specific, derives the accelerator equation from Cobb-Douglas function accepting additional assumptions.

The general case will be presented first. Following Eisner and Nadiri (1968) general approach assumes that every company have the CES production function, with constant returns to scale ($v = 1$)

[2]Production level is in the research proxied by incomes from sales of production

[3]In the presented research the user cost of capital is defined as an average weighted cost of capital. Since the available data offer no straight information about cost of capital three definitions have been tested in order to verify the robustness.

[4]The trade credit is defined as: liabilities from deliveries and services (regardless of their maturity) in short term liabilities.

[5]Liquidity ratio is the relation of short term investments (assets bought in order to achieve short term economic profits form changes in its fair value) to short term liabilities (to liabilities with maturity shorter than 12 months).

$$f(L_t, K_t) = TFP_i A_t \left(\beta_i L_t^{\frac{\sigma-1}{\sigma}} + \alpha_i K_t^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}v} = S_{it} \tag{1}$$

where:

σ – elasticity of substitution,

$\alpha_i + \beta_i = 1$,

$TFP_i A_t$ – total factor productivity,

v – elasticity of scale.

Moreover, the first order condition of a firm's optimisation problem leads to equality between the marginal product of capital and marginal user cost of capital. This implies that the relation (2) holds

$$\frac{\partial f(L_t, K_t)}{\partial K_t} = C_{it}. \tag{2}$$

Comparing the relation (2) with first derivative of the function (1) and writing all in logs leads to the following relation:

$$logK_{it} = \theta logS_{it} - \sigma logC_{it} + logH_{it}, \tag{3}$$

where:

$\theta = \left(\sigma + \frac{1-\sigma}{v}\right)$,

$H_t = (TFP_i A_t)^{\left(\frac{\sigma-1}{v}\right)} (v\alpha_i)^{\sigma}$.

Relation (3) explains how the working capital of the company is influenced by the user cost of capital and level of sales.

Following Valderrama (2002), the same relation might be derived assuming Cobb-Douglas production function. This, however, might be done only under additional assumptions[6]

$$f(L_t, K_t) = A_t L_t^{\beta} K_t^{\alpha} = S_t. \tag{4}$$

The marginal productivity of capital is given by (5):

$$\frac{\partial f(L_t, K_t)}{\partial K_t} = \alpha A_t L_t^{\beta} K_t^{\alpha-1}. \tag{5}$$

The marginal productivity of capital is equal to marginal cost of capital (C_t) so:

$$\alpha A_t L_t^{\beta} K_t^{\alpha-1} = C_t. \tag{6}$$

Rewriting the relation (6) and multiplying it by K_t it gives:

$$\alpha \frac{1}{C_t} \overbrace{A_t L_t^{\beta} K_t^{\alpha}}^{S_t} = K_t$$

[6]Note that, case of the Cobb-Douglas function might be straight derived form relation (3) by accepting the following assumptions: the elasticity of capital to sales is unity ($\theta = 1$), the production function has the constant return to scale ($v = 1$) and the elasticity of substitution ($\sigma = 1$) is unity.

$$\alpha \frac{S_t}{C_t} = K_t \tag{7}$$

The equation (7) shows that the amount of capital stock of the company is equal (with the α accuracy) the relation of the value of production (S_t) and marginal user cost of capital(C_t). Further, it assumes that it holds for every company and that the marginal cost of capital (C_{it}) is equal to the user cost of capital (i_{it}), which means that:

$$K_{it} = \alpha_i \frac{S_{it}}{i_{it}} \tag{8}$$

where:
i – is the number of the company,
t – presents the period number.

Writing the above relation in logarithms and relaxing the constraints of a proportional reaction of capital to output and proportional reaction of capital to user cost of capital the equation is as follows:

$$k_{it} = \alpha_i + \beta s_{it} - \gamma \rho_{it}. \tag{9}$$

In other words, the relation (3) and (9) are equal when:

- the elasticity of capital to sales is equal unity ($\theta = 1$), the return to scale is equal unity ($v = 1$) and the elasticity of substitution is equal unity ($\sigma = 1$) in equation (3),

  or

- constraints of a proportional reaction of capital to output and user cost of capital in equation (9) are relaxed.

The relation between user cost of capital and production capital of the companies derived in the standard assumption about company production function is the starting point for empirical research. However, in order to get final financial accelerator equation, the relation (9) is compared with (10).

The relation (10) shows that the logarithm of capital stock (k_{it}) is approximately equal to the relation of investment outlays and capital stock from the previous period $\frac{I_{it}}{K_{i,t-1}}$ less the rate of capital amortisation δ:

$$k_{it} = \Delta K_{it} = log\left(\frac{K_{it}}{K_{i,t-1}}\right) \tag{10}$$
$$= log\left(1 + \frac{\Delta K_{it}}{K_{i,t-1}}\right) \approxeq \frac{\Delta K_{it}}{K_{i,t-1}} \approxeq \frac{I_{it}}{K_{i,t-1}} - \delta.$$

Further, assuming that, every company strives to smooth its capital production in time and equalising the relations (9) and (10) the following equation might be derived[7]:

$$\frac{I_{it}}{K_{i,t-1}} = \alpha_i + \alpha_1 \frac{I_{i,t-1}}{K_{t,t-2}} + \alpha_2 \Delta s_{it} - \alpha_3 \Delta \rho_{it}. \tag{11}$$

Since the theoretical economic model does not exhaust all available for the companies sources of financing the basic (11) specification is extended with two control variables $Trade$ i LIQ[8].

The variable $Trade$ is added to the model in order to capture the banking credit substitution effect. In the short run non-financial companies might grant a credit to another non-financial institution. Here the trade credit is defined as postponed payments for the deliveries.

The basic model (11) is extended with short liquidity ratio (Liq) which is a relation between short term investments (assets) and short term liabilities. This variable is added to the model in order to show how the financial strength (independence) of the company is evolving in time.

The dynamic structure of the model is not imposed. The number of lags is tested in the empirical research.

The extended model describing the relative investment outlays of the companies is defined as follows:

$$\begin{aligned}\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \sum_{n=0}^{T} \alpha_{1,n} \left(\frac{I_{i,t-n-1}}{K_{i,t-n-2}} \right) + \sum_{j=0}^{T} \alpha_{2,j} \Delta s_{i,t-j} + \sum_{h=0}^{T} \alpha_{3,h} \Delta \rho_{i,t-h} \\ + \sum_{g=0}^{T} \alpha_{4,g} Trade_{i,t-g} + \sum_{\tau=0}^{T} \alpha_{5,\tau} LIQ_{i,t-\tau} + \epsilon_{it}.\end{aligned} \tag{12}$$

In order to identify the balance sheet effect in the Polish economy the asymmetric reaction of investment outlays should be found in the data. One way to identify this effect is to verify the statistical significance of the user cost of capital ($\rho_{i,t-h}$) in the relation (12) in different group of enterprises. Moreover, to get the robust result three different definitions of the user cost of capital are tested.

Since it is the user cost of capital that is the variable that captures the influence of the balance sheet effect in the equation (12) a few additional explanations need to be done. In general it is assumed that **individual user cost of capital** is the weighted average of cost of capital and cost of liabilities.

Since the precise information about cost of capital are not available on the individual basis three different specifications of individual user cost of capital are used. In order to present their definitions the following notations are imposed:

[7]The logarithm of sales (s_{it}) and user cost of capital (ρ_{it}) are identical with increments.

[8]In order to take into account all available financial sources of the enterprises leasing and factoring should be considered. However, the available sources of data do not allow to consider this financing in the analysis.

- i^b – the interest rate of loans and credits[9],
- i^c – yield of ten year government bonds plus premium on enterprise risk,
- $interests$ – credit and borrowing interests,
- $ROE(return\_on\_equity) = \frac{net\_income}{net\_assets}$[10],
- $ROE_{withingroup}$ – average return of capital in the selected group of enterprises,
- ROE_{it} – return of capital for the $i-th$ enterprise in $t-th$ period.

Version 1.

Implied financial costs is calculated on the basis of individual financial statement of the company according to the equation:

$$\rho_{it}^{implied} = ROE_{it}\frac{net\ assets_{it}}{total\ assets_{it}} + i_{it}^{b}\frac{liabilities_{it}}{total\ assets_{it}} = \frac{net\ income_{it} + interests_{it}}{total\ assets_{it}}.$$

Here the cost of capital is proxied by ROE_{it}. It is assumed that stake holders require the return on the capital that is equal to ROE.

Version 2.

The user cost of capital is defined as a cost characteristic for the selected group of enterprises (different cost for separate classes of enterprises – the comparison of the cost between groups – **within group** version of capital).

$$\rho_{it}^{withingroup} = ROE_{class,t}\frac{net\ assets_{it}}{total\ assets_{it}} + i_{it}^{b}\frac{liabilities_{it}}{total\ assets_{it}}.$$

Version 3.

Market cost of financing, where cost of capital is proxied by the government benchmark bonds with relatively long maturity enlarged with the credit premium on enterprises.

$$\rho_{it}^{market} = i_{it}^{c}\frac{net\ assets_{it}}{total\ assets_{it}} + i_{it}^{b}\frac{liabilities_{it}}{total\ assets_{it}}.$$

[9]It is the ratio of average value of interests recorded in four consecutive quarters and value of liabilities

[10]In denominator the value of net assets are used since in the available data no precise equivalent of capital is given.

3 Evidence of the balance sheet effect in Poland

The parameters of the relation (12) are estimated and the significance of long run multipliers is verified on the basis of individual data and panel econometrics technique. The unbalanced panel of Polish enterprises is built on the basis of shortened financial statements based on the F01 form. F01 forms are sent by firms to the Central Statistical Office on the quarterly basis. Unfortunately, the layout of F01 form had changed several times and all data needed for the research are available starting from 2002.

In order to properly understand the results of the estimations a few comments ought to be done. Firstly, relatively big companies have an obligation to send shortened financial statements to the Central Statistical Office. The threshold is the number of employees exceeding 49 people in the company. As a result, the data on relatively big companies are available in the sample.

Due to the threshold on the number for employees some companies might get into the analysed sample and some might get out of it. The number of companies has been increasing since the survey started. On average about 16 thousand of companies are present in the sample. In the analysed period 2002-2007 about 27 730 unique companies have been identified and about 9 360 companies are constantly present in the sample. The number of companies that is constantly changing suggests that the estimation of the parameters need to be done based on the unbalanced panel.

The variables describing the level of sales (Δs_{it}) and changes of individual user cost of capital (ρ_{it}) are expressed in the real terms. The basic statistics describing the characteristics of the used in the research data are presented in the table 1.

The identification of the balance sheet effect starts from the parameters estimation of the relation (12). Parameters are estimated by means of Arellano-Bond method. This implies that including additional lagged variable in the model enlarges the dimension of the instrument matrix. The empirical tests showed that relatively intensive lagging of variables does not alter the conclusions, however, it significantly aggravates the statistic properties of the model (see Roodman D. (2008)). This is the reason for choosing one period lag in the final model (12). Summing up the identification of the balance sheet channel in Poland relies on the following relation:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \alpha_{1,1}\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \alpha_{2,0}\Delta s_{i,t} + \alpha_{2,1}\Delta s_{i,t-1} + \alpha_{3,0}\Delta\rho_{i,t} + \alpha_{3,1}\Delta\rho_{i,t-1} \qquad (13)$$
$$+\alpha_{4,0}Trade_{i,t} + \alpha_{4,1}Trade_{i,t-1} + \alpha_{5,0}LIQ_{i,t} + \alpha_{5,1}LIQ_{i,t-1} + \epsilon_{it}\eta_i + \gamma_t + \epsilon_{it}.$$

The parameters of the model (13) are estimated by means of the two step Arellano-Bond method with the Windmeijer (2005) correction, which lowers the bias of the standard error estimators[11]. The significance of the particular parameters was also tested by means of one

[11] Arellano and Bond (1991) presented in the Monte Carlo simulations that the standard error estimators from the two step method is biased which causes that the H_0 hypothesis is to often rejected than it is required.

Table 1: The characteristics of the analysed data for the population of companies in the period 2000-2007

Variable	Average	Standard deviation
$\Delta\rho_{i,t}^{implied}$	0.0004	0.025
$\Delta\rho_{i,t}^{withingroup}$	0.001	0.015
$\Delta\rho_{i,t}^{market}$	-0.0004	0.006
$\frac{I_{i,t}}{K_{i,t-1}}$	0.037	0.046
$\Delta s_{i,t}$	0.018	0.187
$Trade_{i,t}$	0.556	0.218
$LIQ_{i,t}$	0.333	0.491

Note: $\rho_{i,t}^{implied}$ – implied cost of financing calculated on the basis of individual financial statement, $\rho_{i,t}^{withingroup}$ – financial cost that is characteristic for the particular group of companies (within group comparison of costs), where weighted average cost of capital in predefined groups of enterprises is defined as cost of capital (ROE), $\rho_{i,t}^{market}$ – market cost of financing, where the yield of long term benchmark government bonds plus risk premium defines the cost of financing, the remaining variables should be analysed according to the model specification.
Source: own calculations on the basis of GUS and NBP data.

step Arellano-Bond method and the conclusions from two methods were coherent.

The user cost of capital is treated as exogenous since only part of this variable might be endogenous. Namely, the external financial premium is endogenous since it depends on previous, current and future shocks hitting the firm balance sheet and its value of collateral. The residual part of the costs depends on the changes on the interbank market or on decisions of Monetary Policy Council. This changes are exogenous. The level of trade credit and liquidity ratio are treated as endogenous variables since shocks hitting other variables are influencing decisions made by management concerning desired level of liquidity and trade credit.

It is assumed that there exists the dichotomy between big and medium companies in the access to the cost of external financing. These groups might differ in user cost of capital. To identify this asymmetry the sample of companies is divided into homogeneous groups and statistical significance of the long run multipliers is tested in these groups. Especially, the magnitude and statistical significance of the long run multiplier describing the user cost of capital should be analysed thoroughly.

In order to verify the existence of the balance sheet effect the companies are divided according to the number of employees. The first sample diversification assumes that big companies employ over 250 people. Note that relatively big companies have the obligation to send the financial statement to the Polish Central Statistical Office. The threshold of 49 workers employed

Table 2: Long run multipliers for the diversification threshold equal to 250 employees

	Implied cost of capital		Withingroup cost of caital		Market cost capital	
	Medium firms	Big firms	Medium firms	Big firms	Medium firms	Big firms
$\Delta\rho_{i,t}$	**-0,589**	0,233	**-0,233**	0,164	**-0,685**	0,607
	(0,003)	(0,793)	(0,001)	(0,453)	(0,027)	(0,309)
$Trade_{i,t}$	0,060	-0,004	0,015	0,026	0,005	0,011
	(0,310)	(0,998)	(0,519)	(0,099)	(0,516)	(0,961)
$LIQ_{i,t}$	**0,057**	0,040	**0,070**	**0,062**	**0,079**	0,029
	(0,018)	(0,105)	(0,003)	(0,019)	(0,000)	(0,389)
$\Delta s_{i,t}$	0,020	0,119	0,034	**0,124**	**0,040**	**0,085**
	(0,066)	(0,337)	(0,194)	(0,032)	(0,000)	(0,008)
m2	0,457	0,343	0,068	0,231	0,003	0,452
Sargan	0,000	1,000	0,000	1,000	0,000	1,000

Note: the population of enterprises is divided into two separate subsamples according to the employment threshold equal to 250 workers; in rows the values of long run multipliers are presented with the *p-Value* of the Wald test on statistical significance of the long run multipliers; the empirical significance level (*p-Value*) is presented in brackets, in columns the parameters estimations are presented for the models that differ in individual user cost of capital according to the definitions presented in the section 2; the lines in bold mean the statistical significance on the level of at least 10%; m2 – depicts the empirical significance level for the Arellano and Bond test of autocorrelation of II order; *Sargan* – empirical significance level for the Sargan test.
Source: own calculations on the basis of NBP and GUS data.

implies that micro companies are not present in the sample. The results of the first estimates are presented in the table 2. The long run multipliers and the p-Values of joint Wald test of the statistical significance of the parameters making up the long run multipliers are presented.

The results of the estimations show that not all formal requirements of the Arellano-Bond estimation technique are fulfilled. The reason for this might be the artificial diversification of the sample. The implemented definition of the big company might be improper for the Polish economy. According to the definition that sets the threshold on the level of 250 employees only very few companies present in the sample are described as big, while majority of entities are labelled as medium. Moreover, as the threshold for the obligatory reporting to the Central Statistical Office is more than 49 workers, micro (very small) firms are not present in the sample.

Due to those reasons the threshold on the number of workers is examined more thoroughly.

Table 3: Long run multipliers for the diversification threshold equal to 120 employees

	Implied cost of capital		Market cost of capital	
	Medium firms	Big firms	Medium firms	Big firms
$\Delta\rho_{i,t}$	**-0,578**	-0,024	***-0,911***	-0,895
	(0,023)	(0,232)	(0,074)	(0,186)
$Trade_{i,t}$	0,071	0,001	0,027	-0,005
	(0,406)	(0,843)	(0,248)	(0,620)
$LIQ_{i,t}$	0,038	**0,044**	**0,065**	**0,051**
	(0,190)	(0,021)	(0,001)	(0,000)
$\Delta s_{i,t}$	-0,007	**0,099**	**0,036**	**0,137**
	(0,178)	(0,003)	(0,003)	(0,019)
m2	0,139	0,382	0,685	0,057
Sargan	1,000	0,973	0,391	1,000

Note: the population of enterprises is divided into two separate subsamples according to the employment threshold equal to 120 workers; in rows the values of long run multipliers are presented with the *p-Value* of the Wald test on statistical significance of the long run multipliers; the empirical significance level (*p-Value*) is presented in brackets, in columns the parameters estimations are presented for the models that differ in individual user cost of capital according to the definitions presented in the section 2; the lines in bold mean the statistical significance on the level of at least 10%; m2 – depicts the empirical significance level for the Arellano and Bond test of autocorrelation of II order; *Sargan* – empirical significance level for the Sargan test.
Source: own calculations on the basis of NBP and GUS data.

In the second attempt the threshold is set on the value of the median of the distribution of the number of workers. The threshold is set on the level of 120 workers employed. It means that big companies employ 120 or more workers while medium companies (and small) employ less than 120 people. In the following analysis presented below big and medium companies are distinguished on the basis of 120 employees threshold. The results of the parameters estimations of the model (13) are presented in the table 3.

The results of the second estimation show that all formal tests of Arellano Bond estimation technique are satisfied. The zero hypothesis of the Sargan test cannot be rejected as well as the hypothesis of the insignificant second order autocorrelation. Since all formal conditions of the Arellano-Bond method are fulfilled the drawn conclusions are binding.

The estimation results show that the user cost of capital is statistically significant only

for the group of medium companies that employ between 49 and 120 workers. The long run multiplier in the group of big companies is statistically insignificant. This means that changes in the user cost of capital (changes in the cost of external financing) do not influence the relative outlays on investments in big companies. In this group the long run multipliers describing changes in liquidity level and changes in the level of production are statistically significant. It means that in case of big companies liquidity and level of sales drives the level of investments. Lack of significance of the user cost of capital, however, does not mean that big companies do not use external sources to finance their investments. It means that changes of external cost in case of bigger companies are insignificant for the changes in investment outlays. It indirectly means that, changes in the interest rate do not influence the level of investments in case of bigger enterprises.

The presented analysis shows that the asymmetry in user cost of capital existed in Poland between 2002-2007. On the one hand, in the group of bigger companies changes in the market interest rates seem to have no statistical influence on the existence of finance premium and as a result on the investments outlays. On the other hand, they influence changes in the external finance premium and investment outlays in smaller entities. In this way the relation between financial system and real economy in Poland have been identified, and it was proved that the financial system was not neutral towards real economy in 2002-2007.

4 Conclusions

The balance sheet effect might be perceived as part of the credit channel. Three channels usually are mentioned in literature as parts of the credit channel: the channel of commercial banks, credit rationing and the balance sheet effect of creditors (in major cases of enterprises). The channel of commercial banks portrays how banks influence the economy. In majority of research discussing this channel it is shown, that due to the availability of alternative to the central bank sources of funding, banks might not lower the credit supply when it is desirable by the central bank. In this way monetary policy might be ineffective in controlling money supply[12].

The credit rationing concentrates on the reasons why some groups of companies might be constrained in access to the external sources of financing. The theories of credit rationing assume that economy might be in equilibrium and some companies might not get the credit. As many economist maintain this is due to the specific characteristics of the credit supply curve. This curve becomes negative after breaching the optimal level of interest rate. Economist come

[12]The empirical analysis of channel of the commercial banks conducted for Poland might be found inter alias in publications by: Łyziak T., Przystupa J., Wróbel E. (2008), Chmielewski (2005) or Pawłowska M., Wróbel E. (2002).

up with various explanations of this phenomenon. The most renowned one is discussed in the paper of Stiglitz and Weiss (1981) and is based on the idea of negative selection. However, there are as well explanations based on the moral hazard like paper of Bester and Hellwig (1987).

The balance sheet effect is the third phenomenon making up the credit channel. It shows how changes in cash flow and collateral induced by changes in the interest rates might differentiate the investment outlays among companies. The existence of the balance sheet effect affects the transmission channel of the monetary policy.

The paper presents the results of the research on the existence of the balance sheet channel in Poland. The research is conducted on the basis of individual financial statement of 27 730 Polish enterprises and encompasses the period 2002–2007.

The quantitative results show that there is an evidence that in the Polish economy in 2002–2007 the balance sheet channel was operating. In the period in question lenders differentiated between big and small companies in setting the costs of credits. The balance sheet effect operated through the structure of the balance sheet of the companies and through the value of collateral. As proved in the empirical research changes in the level of interest rates had no effect on the investment outlays in group of bigger (employing more than 120 workers) companies.

From the policy point of view two situations can be distinguished. On the one hand, in the period of credit boom changes in the interest rates might have no influence on the costs of capital in the group of bigger companies. As a result, using interest rates to bring the inflation back to the target might have limited influence. The reason for this is insignificant influence of the increasing costs of external financing on the investment outlays spent by the biggest companies as proven in the empirical research.

On the other hand, since the identified balance sheet channel depends on the market interest rates the investment outlays might be constrained by themselves since they rely on factors independent from the central bank. The resent financial crises showed that the lack of confidence on the financial markets drives the credit risk premium up significantly. This phenomenon increases the market interest rates on which short term credits depend. As it was proved in the empirical research, due to the balance sheet effect, the investment outlays will be limited in the smaller companies at first. This aspect of the subprime crisis is discussed for example in paper of Gertler (2009).

5 Reference

1. Akerlof G. (1970), The market for lemons: Quality uncertainty and the market mechanism, *Quarterly Journal of Economics*, Vol. 84.

2. Arellano M., Bond S. (1991), Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, *Review of Economic Studies*,

Vol. 58, No. 2.

3. Bernanke B., Gertler M., Gilchrist S. (1998), The financial accelerator in a quantitative business cycle framework, *Working Papers*, No. 6455, National Bureau of Economic Research, Cambridge.

4. Bester H., Hellwig M. (1987), Moral hazard and equilibrium credit rationing: An overview of the issues, *Discussion Paper*, No. 125, University of Bonn, Germany.

5. Butzen P., Vermeulen P., Fuss C. (2001), The interest rate and credit channels in Belgium: an investigation with micro-level firm data, *Working paper*, No. 107, EBC, Frankfurt.

6. Chmielewski T. (2005), Bank risks, risk preferences and lending, *Working paper*, University Library of Munich, Germany, Munich.

7. Chatelain J.B., Generale A., Hernando I., von Kalckreuth U., Vermeulen P. (2001), Firm investment and monetary transmission in the euro area, *Working paper*, No. 431, Bank of Italy, Rome.

8. Eisner R., Nadiri M. (1968), Investment behaviour and the neo-classical theory, *The review of economics and statistics*, No. 50

9. Gertler M., Karadi P. (2009), A model of Unconventional Monetary Policy, *Working Paper*, New York University, New York.

10. Łyziak T., Przystupa J., Wróbel E. (2008), Monetary policy transmission in Poland: a study of the importance of interest rate and credit channels, *Working Paper*, No. 1, SUERF - The European Money and Finance Forum.

11. Lunnemann P., and Matha T. (2001), Monetary transmission: empirical evidence from Luxembourg firm level data, *Working Paper*, No. 111, European Central Bank, Frankfurt.

12. Pawłowska M., Wróbel E. (2002), Monetary transmission in Poland: some evidence on interest rate and credit channels, *Materiały i studia*, No. 24, NBP, Warszawa.

13. Roodman D. (2008), A note on the theme of too many instruments, *Working Paper*, No. 125, Center for global developement, Washington D.C.

14. Stiglitz and Weiss (1981), Credit Rationing in Markets with Imperfect Information, *American Economic Review*, Vol. 71, No. 3.

15. Townsend R. (1979), Optimal contracts and competitive markets with costly state verification, *Federal Reserve Bank of Minneapolis*, Minneapolis.

16. Valderrama M. (2001), Credit channel and investment behaviour in Austria: a micro-econometric approach, *Working Paper*, No. 108, EBC, Frankfurt.

17. Windmeijer F. (2005), A finite sample correction for the variance of linear two-step GMM estimators, *Journal of Econometrics*, Vol.126, No. 1.