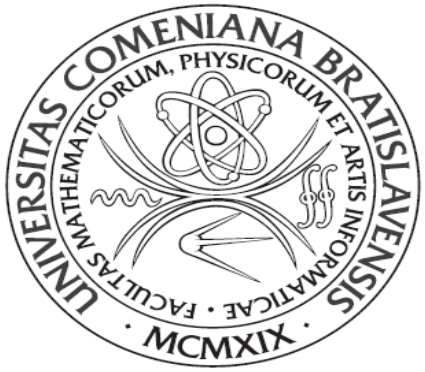
COMENIUS UNIVERZITY, BRATISLAVA

FACULTY OF MATHEMAICS, PHYSICS AND INFORMATICS

Department of Applied Mathematics and Statistics



Financial Accelerator and Interest Rate in Selected Countries

Bc. Lenka Babjaková

2010

COMENIUS UNIVERZITY, BRATISLAVA

FACULTY OF MATHEMAICS, PHYSICS AND INFORMATICS

Financial accelerator and interest rate in selected countries

Master Thesis

Bc. Lenka Babjaková

9.1.9 Applied Mathematics

Economic and Financial Mathematics

Department of Applied Mathematics and Statistics

Doc. Dr. Jarko Fidrmuc

BRATISLAVA 2010

UNIVERZITA KOMENSKÉHO V BRATISLAVE

FAKULTA MATEMATIKY, FYZIKY A INFORMATIKY

Finančný akcelerátor a úroková miera vo vybraných krajinách

Diplomová práca

Bc. Lenka Babjaková

9.1.9 Aplikovaná matematika

Ekonomická a finančná matematika

Katedra aplikovanej matematiky a štatistiky

Doc. Dr. Jarko Fidrmuc

BRATISLAVA 2010

I declare this thesis was written on my own, with the only help provided by my supervisor and the referred- to literature.

Bratislava, June 2010

.....

Lenka Babjaková

ACKNOWLEDGMENT

I would like to express special thanks to my supervisor doc. Dr. Jarko Fidrmuc for all support and guidance he offered throughout the elaboration of this thesis and also to my parents and friends for support during my study.

ABSTRACT

BABJAKOVÁ, Lenka: Financial accelerator and corporate interest rate in selected countries. [Master thesis] – Comenius University, Bratislava. Faculty of mathematics, physics and informatics; Department of Applied Mathematics and Statistics. – Supervisor: doc. Dr. Jarko Fidrmuc. Bratislava: FMFI UK, 2010, 35 p.

We conduct an analysis of the determinants of corporate interest rates and the financial accelerator in selected countries (Czech Republic, Hungary and Romania). Using a unique panel data from database Amadeus, we find that selected balance sheet indicators influence significantly the firm-specific interest rate in selected countries. In particular, total debt, debt structure and operating revenue have significant effects on interest rates, but it is various for each country. Consequently, we find evidence that monetary policy has stronger effects on smaller firms than on medium firms in Czech Republic and Romania. Finally, we find asymmetric effects in monetary policy over the business cycle in Czech Republic and effects of financial accelerator in Romania. Hungary has largely insignificant results.

Keywords: Transmission mechanism of monetary policy; financial accelerator; corporate interest rate; balance sheet channel; small firm; business cycle; panel data

ABSTRAKT

BABJAKOVÁ, Lenka: Finančný akcelerátor a úroková miera vo vybraných krajinách. [Diplomová práca] – Univerzita Komenského v Bratislave. Fakulta matematiky, fyziky a informácií; Katedra aplikovanej matematiky a štatistiky. – Vedúci: doc. Dr. Jarko Fidrmuc. Bratislava: FMFI UK, 2008, 35 s.

V tejto práci analyzujeme determinanty úrokovej miery pre jednotlivé podniky vo vybraných krajinách (Česká Republika, Maďarsko a Rumunsko). Pomocou panelových dát z databázy Amadeus sme našli indikátory účtovných súvah, ktoré signifikantne ovplyvňujú úrokové miery pre dané krajiny. Vo všeobecnosti, indikátory ako celkový dlh, štruktúra dlhu a prevádzkové príjmy majú signifikantný vplyv na úrokové miery, ale je to rôzne pre jednotlivé krajiny. V konečnom dôsledku dospejeme k dôkazu, že monetárna politika má silný dopad na menšie firmy ako na firmy stredné a veľké v Českej Republike a v Rumunsku. V závere práce objavíme asymetrické účinky monetárnej politiky počas hospodárskeho cyklu v Českej Republike a účinky finančného akcelerátora v Rumunsku. Na rozdiel od týchto krajín, vo väčšine prípadov má Maďarsko nesignifikantné výsledky.

Kľúčové slová: Transmisný mechanizmus monetárnej politiky; finančný akcelerátor; úroková miera pre podniky; kanál účtovnej súvahy; malá firma; hospodársky cyklus; panelové dáta

Contests

List of Illustrations and Tables

Illustrations

Tables

Introduction

Large empirical literature has presented substantial evidence, that firm investment is a function of liquidity and strength of the balance sheet. The financial accelerator theory offered by Bernanke, Gertler and Gilchrist (1999) uses the insights of this literature and links this evidence with cyclical movements of investment and output. Firms with weak balance sheets can amplify real or monetary policy shocks and this is the basic idea of the financial accelerator theory. This theory, which is closely related with the bank lending channel theory (Bernanke and Blinder, 1988), predicts that when banks are impaired to make loans by a drain on reserves, a restriction in loan supply might hit harder some firms then others. Where the credit channel focuses on balance sheets differences of banks, the supply of credit and monetary policy shocks, the financial accelerator theory focuses on differences in the balance sheet of firms and their implication for both real and nominal shocks.

There is considerable empirical evidence on the monetary policy transmission mechanism in the euro area, but there is insufficient research regarding the transmission mechanism in the European Union's new member states. Consequently, this work aims to bridge this gap by providing empirical evidence on the balance sheet channel in the selected countries in Central and Eastern Europe. A good understanding of the monetary transmission mechanism in the euro area is important for the efficient implementation of the ECB's single monetary policy. (Fidrmuc at all., 2009) Although there is a large literature that has focused on the macroeconomic implications of a change in policy-controlled interest rates in the various euro area countries, much less comparative work has been done based on microeconomic evidence.

The aim of this work is providing empirical evidence on whether the impact of monetary policy on corporate interest rates (controlling for balance sheet indicators) depends on the size of firms or business cycle in selected countries (Czech Republic, Hungary and Romania).[1]

The thesis is organized follows. In Chapter 1 we present a short review on transmission mechanisms and a brief discussion about the monetary rules and factors. We describe the two channels of transmission mechanism, interest rate channel and mainly

[1] The initial idea was providing empirical evidence also with Baltic States, but there were insufficient amount of information in database Amadeus for our researches.
[2] See Monetary Policy Committee, Bank of England, www.bankofengland.co.uk

credit channel and its two distinct channels: bank lending channel and broad lending channel. Following these information, we will observe the behaviour of firms.

In the Chapter 2 we describe the econometric methodology and we present the short review about the fixed and random effected models and the differences between them.

Chapter 3 provides a description of our dataset, presents descriptive statistics for selected variables and presents regression analysis on determinants of corporate interest rates.

In the Chapter 4 we describe financial accelerator, present regression analysis on two models, first include size dummy variables and second include dummy variables for business cycle. The results are in the summary tables.

Finally, the Appendix contains details on the construction of the variables.

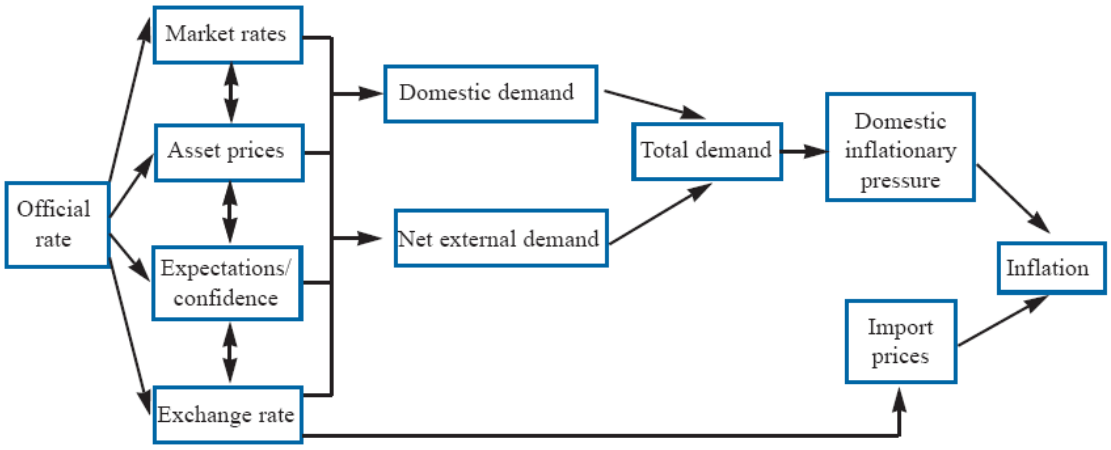
1. The Transmission Mechanism of Monetary Policy

The Monetary Policy Committee (MPC)[2] sets the short-term interest rate at which the National Bank deals with the money markets. Decisions about that official interest rate affect economic activity and inflation through several channels, which are known collectively as the 'transmission mechanism' of monetary policy. The purpose of this part is to describe the MPC's view of the transmission mechanism according these channels.

Monetary policy is a powerful tool, but one that sometimes has unexpected or unwanted consequences. The monetary authorities must have an accurate assessment of the timing and effect of their policies on the economy, thus requiring an understanding of the mechanisms through which monetary policy affects the economy. These transmission mechanisms include interest rate effects, exchange rate effects, other asset price effects and the credit channel. (Mishkin, 1995)

The key links in that mechanism are illustrated in the simply Figure 1 below.

Figure 1: The Transmission Mechanism of Monetary Policy



Source: The Monetary Policy Committee, Bank of England. Note: For simplicity, this figure does not show all interactions between variables, but these can be important.

First, official interest rate decisions affect market interest rates (such as mortgage rates and bank deposit rates), to varying degrees. At the same time, policy actions and announcements affect expectations about the future course of the economy and the

[2] See Monetary Policy Committee, Bank of England, www.bankofengland.co.uk

confidence with which these expectations are held, as well as affecting asset prices and the exchange rate.

Second, these changes in turn affect the spending, saving and investment behaviour of individuals and firms in the economy. For example, other things being equal, higher interest rates tend to encourage saving rather than spending, and a higher value of sterling in foreign exchange markets, which makes foreign goods less expensive relative to goods produced at home. So changes in the official interest rate affect the demand for goods and services produced in home country.

Third, the level of demand relative to domestic supply capacity – in the labour market and elsewhere – is a key influence on domestic inflationary pressure. For example, if demand for labour exceeds the supply available, there will tend to be upward pressure on wage increases, which some firms may be able to pass through into higher prices charged to consumers.

Fourth, exchange rate movements have a direct effect, though often delayed, on the domestic prices of imported goods and services, and an indirect effect on the prices of those goods and services that compete with imports or use imported inputs, and hence on the component of overall inflation that is imported.

In summary, though monetary policy-makers have direct control over only a specific short-term interest rate; changes in the official rate affect market interest rates (for example credit channel), asset prices, and the exchange rate. The response of all these will vary considerably from time to time, as the external environment, policy regime and market sentiment are not constant. Next we will describe in more detail channels of transmission mechanism.

1.1 The Interest Rate Channel

The transmission of monetary policy through interest rate mechanism has been a standard feature in the economics literature for over 50 years. It is the key monetary transmission mechanism in the basic Keynesian textbook model. The traditional Keynesian view of how a monetary tightening is transmitted to the real economy can be characterized by a schematic diagram,

$$M \downarrow => i \uparrow => I \downarrow => Y \uparrow ,$$

where $M \downarrow$ indicates a contractionary monetary policy leading to a rise in real interest rates ($i \uparrow$), which in turn raises the cost of capital, thereby causing a decline in investment spending ($I \downarrow$), thereby leading to a decline in aggregate demand and a fall in output ($Y \uparrow$). (Mishkin, 1995) Movements in the policy rate affect fixed investment through the user cost of capital. Higher interest rates raise the required return from investment projects and reduce the rate of business investment. Inventories are affected in much the same way; higher interest rates increase the 'user cost' of holding inventories and lead firms to economise on them. Interest rate movements move the exchange rate thereby altering price competitiveness and affecting net exports. (Bean et al., 2002)

1.2 The Exchange Rate Channel

Policy-induced changes in interest rates can also affect the exchange rate. The exchange rate is the relative price of domestic and foreign money, so it depends on both domestic and foreign monetary conditions. The precise impact on exchange rates of an official rate change is uncertain, as it will depend on expectations about domestic and foreign interest rates and inflation, which may themselves be affected by a policy change. However, other things being equal, an unexpected rise in the official will probably lead to an immediate appreciation of the domestic currency in foreign exchange markets, and vice versa for a similar rate fall. The exchange rate appreciation follows from the fact that higher domestic interest rates, relative to interest rates on equivalent foreign-currency assets, make sterling assets more attractive to international investors. The exchange rate should move to a level where investors expect a future depreciation just large enough to make them indifferent between holding sterling and foreign-currency assets.

Exchange rate changes lead to changes in the relative prices of domestic and foreign goods and services, at least for a while, though some of these price changes may take many months to work their way through to the domestic economy, and even longer to affect the pattern of spending. (Bank of England)

The schematic for the monetary transmission mechanism operating through the exchange rate is thus:

$$M \downarrow => i \uparrow => E \uparrow => NX \downarrow => Y \downarrow$$

When domestic real interest rates rise, domestic currency deposits become more attractive relative to deposits denominated in foreign currencies, leading to a rise in the value of domestic currency deposits relative to other currency deposits, that is, an appreciation of the domestic currency (denoted by $E \uparrow$). The higher value of the domestic currency makes domestic goods more expensive than foreign goods, thereby causing a fall in net exports ($NX \downarrow$) and hence in aggregate output. (Mishkin, 1995)

1.3 Asset Price Channel

Changes in the official rate also affect the market value of securities, such as bonds and equities. The price of bonds is inversely related to the long-term interest rate, so a rise in long-term interest rates lowers bond prices, and vice versa for a fall in long rates. If other things are equal (especially inflation expectations), higher interest rates also lower other securities prices, such as equities. This is because expected future returns are discounted by a larger factor, so the present value of any given future income stream falls. Other things may not be equal – for example, policy changes may have indirect effects on expectations or confidence.

1.4 Credit Channel

In recent years, a large literature has focused on credit markets as playing a critical role in the transmission of monetary policy actions to the real economy. Money has traditionally played a special role in macroeconomics and monetary theory because of the relationship between the nominal stock of money and the aggregate price level. The importance of money for understanding the determination of the general level of prices and average inflation rates, however, does not necessarily imply that the stock of money is the key variable that links the real and financial sectors of the most appropriate indicator of the short-run influence of financial factors on the economy.

The credit view stresses the distinct role played by financial assets and liabilities. Arguments of credit view is that macroeconomic models need to distinguish between different nonmonetary assets, either along the dimension of bank versus nonbank sources of funds or along the more general dimension of internal versus external financing. The credit view also highlights heterogeneity among borrowers, stressing that some borrowers

may be more vulnerable to changes in credit conditions than others. Investment may be sensitive to variables such as net worth or cash flow if agency costs associated with imperfect information or costly monitoring create a wedge between the cost of internal and external finance. A rise in interest rates may have a much stronger contractionary impact on the economy if balance sheets are already weak, introducing the possibility that nonlinearities in the impact of monetary policy may be important.

Imperfect information plays an important role in credit markets, and bank credit may be special, that is, have no close substitutes, because of information advantages banks have in providing both transactions services and credit to businesses. Small firms in particular may have difficulty obtaining funding from nonbank sources, so a contraction in bank lending will force these firms to contract their activities. (Walsh, 2003)

According to Bernanke and Blinder (1988), the traditional interest rate channel performs poorly as changes in the long-term real interest rate, as a measure of the cost of capital, appear only weakly related to changes in global demand and thereby fail to explain the amplification effect of short-term interest rates on output. Given this, they extend the transmission mechanism by introducing the credit channel, which, they argue, is an enhancement channel that amplifies the interest rate channel. The credit channel can be decomposed into two distinct channels:

1) the bank lending channel

2) the balance sheet channel (also termed broad lending channel or financial accelerator).

(Égert et al., 2006)

1.4.1 The Bank Lending Channel

The bank lending channel emphasizes the special nature of bank credit and the role of banks in the economy's financial structure. According the bank credit view, banks play a special role in the financial system because they are especially well suited to deal with certain types of borrowers, especially small firms where the problems of asymmetric information can be especially pronounced. After all, large firms can directly access the credit markets through stock and bond markets without going through banks. Thus, contractionary monetary policy that decreases bank reserves and bank deposits will have an impact through its effect on these borrowers. (Mishkin, 1995) Schematically, the monetary policy effect is:

$$M \downarrow => bank\ deposits \downarrow => bank\ loans \downarrow => I \downarrow => Y \downarrow$$

Central to the bank lending channel is the imperfect substitutability between credits and other financial assets in the bank's balance sheet on the one hand, and that between bank credits and other forms of financing on firm's balance sheet, on the other, which makes it possible for monetary policy to affect economic activity in two stages.

Imperfect substitution in bank's assets ensures that a tightening (loosening) of monetary policy brings about a contraction (expansion) in bank's credit supply (first stage). When facing a decrease in liquidity, banks decrease their credit supply instead of selling bonds they possess because they have a desired level of liquidity to face, for instance, unexpected deposit withdrawals. Alternatively, banks could also issue bonds or collect deposits from households or from the corporate sector rather than decrease credit. However, the ability of some banks to borrow from financial markets may be limited by financial market imperfections, such as adverse selection and moral hazard (imperfect substitutability between credits/bonds on the asset side and bonds/deposits on the liability side).

For monetary policy to be transmitted to the real economy, it is necessary that some firms are not capable of substituting bank credit to other forms of external funding on the capital markets (imperfect substitutability on the liability side of firms). In such a case, once credit supply decreased (increased) investment spending will be cut back because of the lack of external financial resources (second stage). (Égert et al., 2006)

1.4.2 The Balance Sheet Channel

The balance sheet channel for the transmission of monetary policy is based on the view that credit market imperfections are not limited to the market for bank loans but instead are important for understanding all credit markets. With agency costs creating a wedge between internal and external finance, measures of cash flow, net worth, and the value of collateral should affect investment spending in ways not captured by traditional interest-rate channels.(Walsh, 2003)

Hubbard (1995) and Bernanke, Gertler and Gilchrist (1996) list three empirical implications of the balance sheet channel. First, external finance is more expensive for borrowers than internal finance. This should apply particularly to uncollateralized external finance. Second, because the cost differential between internal and external finance arises from agency costs, the gap should depend inversely on the borrower's net worth. A fall in net worth raises the cost of external finance. (Walsh, 2003) Lower net worth of business

firms also increases the moral hazard problem because it means that owners have a lower equity stake in their firms, giving them more incentive to engage in risky investment projects. Since taking on riskier investment projects makes it more likely that lenders will not be paid back, a decrease in business firm's net worth leads to a decrease in lending and hence in investment spending. (Mishkin, 1995) Third, adverse shocks to net worth should reduce borrower's access to finance, thereby reducing their investment, employment, and production levels. (Walsh, 2003)

Monetary policy can affect firm's balance sheets in several ways. Contractionary monetary policy ($M\downarrow$), which causes a decline in equity prices ($P_e\downarrow$), lowers the net worth of firms and so leads to lower investment spending ($I\downarrow$) and aggregate demand ($Y\downarrow$), because of the increase in adverse selection and moral hazard problems. (Mishkin, 1995) This leads to the following schematic for the balance sheet channel of monetary transmission:

$$M\downarrow => P_e\downarrow => adverse\ selection\uparrow \,\&\, moral\ hazard\uparrow => lending\downarrow => I\downarrow => Y\downarrow$$

Contractionary monetary policy that raises interest rates also causes deterioration in firm's balance sheets because it reduces cash flow. (Mishkin, 1995) This leads to the following additional schematic for the balance sheet channel:

$$M\downarrow => i\uparrow => cash\ flow\downarrow => adverse\ selection\uparrow \,\&\, moral\ hazard\uparrow => lending\downarrow$$
$$=> I\downarrow => Y\downarrow$$

If, as emphasized under the balance sheet channel, agency costs increase during recessions and in response to contractionary monetary policy, then the share of credit going to low-agency-cost borrowers should rise. Bernanke, Gertler and Gilchrist characterize this as the flight to quality. Aggregate data are likely to be of limited usefulness in testing such a hypothesis, since most data on credit shocks and flows are not constructed based on the characteristics of the borrowers. Because small firms are presumably subject to higher agency costs than large firms, much of the evidence for broad credit channel has been sought by looking for differences in the behavior or large and small firms in the face of monetary contractions.

Gertler and Gilchrist (1994) document that small firms do behave differently than large firms over the business cycle, being much more sensitive to cyclical fluctuations.

Interest-rate increases in response to a monetary contraction lower asset values and the value of collateral, increasing the cost of external funds relative to internal funds. Since agency problems are likely to be more severe for small firms than for large firms, the linkage between internal sources of funds and investment spending should be particularly strong for small firms after a monetary contraction.

The broad credit channel is not restricted to the bank lending channel. Credit-market imperfections may characterize all credit markets, influencing the nature of financial contracts, raising the possibility of equilibrium with rationing, and creating a wedge between the costs of internal and external financing. This wedge arises because of agency costs associated with information asymmetries and the inability of lenders to monitor borrowers costlessly. As a result, cash flow and net worth become important in affecting the cost and availability of finance and the level of investment spending. A recession that weakens a firm's sources of internal finance can generate a financial-accelerator effect; the firm is forced to rely more on higher-cost external funds just at the time the decline in internal finance drives up the relative cost of external funds. Contractionary monetary policy that produces an economic slow-down will reduce firm cash flow and profits. If this policy increases the external finance premium, there will be further contractionary effects on spending. In this way, the credit channel can serve to propagate and amplify an initial monetary contraction.

Financial accelerator effects can arise from the adjustment of asset prices to contractionary monetary policy. Borrowers may be limited in the amount they can borrow by the value of their assets that can serve as collateral. A rise in interest rates that lowers asset prices reduces the market value of borrower's collateral. This reduction in value may then force some firms to reduce investment spending as their ability to borrow declines. (Walsh, 2003)

1.6 Firms

The main group of private sector agents in the economy is firms. They combine capital, labour and purchased inputs in some production process in order to make and sell goods or services for profit. Firms are affected by the changes in market interest rates, asset prices and the exchange rate that may follow a monetary policy change. However, the importance of the impact will vary depending on the nature of the business, the size of the firm and its sources of finance.

An increase in the official interest rate will have a direct effect on all firms that rely on bank borrowing or on loans of any kind linked to short-term money-market interest rates. A rise in interest rates increases borrowing costs (and vice-versa for a fall). Interest costs affect the cost of holding inventories, which are often financed by bank loans. Higher interest costs also make it less likely that the affected firms will hire more staff, and more likely that they will reduce employment or hours worked. In contrast, when interest rates are falling, it is cheaper for firms to finance investment in new plant and equipment, and more likely that they will expand their labour force.

Of course, not all firms are adversely affected by interest rate rises. Cash-rich firms will receive a higher income from funds deposited with banks or place in the money markets, thus improving their cash flow. This improved cash flow could help them to invest in more capacity or increase employment, but it is also possible that it will encourage them to shift resource into financial assets, or to pay higher dividends to shareholders.

Some firms may be less affected by the direct impact of short-term interest rate changes. This could be either because they have minimal short-term borrowing and/or liquid assets, or because their short-term liquid assets and liabilities are roughly matched, so that changes in the level of short rates leave their cash flow largely unaffected. Even here, however, they may be affected by the impact of policy on long-term interest rates whenever they use capital markets in order to fund long-term investments.

Changes in asset prices also affect firm's behaviour in other ways. Bank loans to firms (especially small firms) are often secured on assets, so a fall in asset prices can make it harder for them to borrow, since low asset prices reduce the net worth of the firm. This is sometimes called a 'financial accelerator' effect. Equity finance for listed companies is also generally easier to raise when interest rates are low and asset valuations are high, so that firm's balance sheets are healthy[3].

[3] See Monetary Policy Committee, Bank of England, www.bankofengland.co.uk

2. Econometric Methodology

2.1 Panel Data and Panel Models

In the recent decades, there is growing interest in analysis of panel data. Panel data allows compiling and testing models that describe fact better than time-series or cross-section models. Panel data have also become increasingly available in developing countries. In these countries, there may not have a long tradition of statistical collection. It is of special importance to obtain original survey data to answer many significant and important questions.

There are several major advantages over conventional cross-sectional or time-series data sets that the panel data sets possess for economic research. Panel data usually give the researcher a large number of data points, increasing the degrees of freedom and reducing the collinearity among explanatory variables – hence improving the efficiency of econometric estimates. More importantly, longitudinal data allow a researcher to analyze a number of important economic questions that cannot be addressed using cross-sectional or time-series data sets. (Hsiao, 2003)

Panel data regression differs from a regular time-series or cross-section regression in that it has a double subscript on its variables, i.e.

$$y_{it} = \alpha + X'_{it}\beta + u_{it} \quad i = 1, \dots, N; \;\; t = 1, \dots, T$$

with i denoting households, individuals, firms, countries, etc. and t denoting time. The i subscript, therefore, denotes the cross-section dimension whereas t denotes the time-series dimension. α is a scalar, β is $K \times 1$ and X_{it} is the itth observation on K explanatory variables. Most of the panel data applications utilize a one-way error component model for the disturbances, with

$$u_{it} = \mu_i + \upsilon_{it}$$

where μ_i denotes the unobservable individual-specific effect and υ_{it} denotes the remainder disturbance; μ_i is time- invariant and it accounts for any individual-specific effect that is not included in the regression and υ_{it} varies with individuals and time and can be thought of as the usual disturbance in the regression. (Baltagi, 2005)

Besides the advantage that panel data allow us to construct and test more

complicated behavioural models than purely cross-sectional or time-series data, the use of panel data also provides a means of resolving or reducing the magnitude of a key econometric problem that often arises in empirical studies, namely, the often heard assertion that the real reason one finds (or does not find) certain effects is the presence of omitted (immeasurable or unobserved) variables that are correlated with explanatory variables. By utilizing information on both the intertemporal dynamics and the individuality of the entities being investigated, one is better able to control in a more natural way for the effects of missing or unobserved variables. For instance, consider a simple regression model:

$$y_{it} = \alpha^* + \beta' x_{it} + \gamma' z_{it} + u_{it}\ , \qquad i = 1, \dots, N\ , \qquad t = 1, \dots, T$$

where x_{it} and z_{it} are $k_1 \times 1$ and $k_2 \times 1$ vectors of exogenous variables; α^* , β and γ are 1×1, $k_1 \times 1$ and $k_2 \times 1$ vectors of constants respectively; and the error term u_{it} is independently, identically distributed over i and t, with mean zero and variance σ_u^2 . It is well known that the least-squares regression of y_{it} on x_{it} and z_{it} yields unbiased and consistent estimators of α^* , β and γ. Now suppose that z_{it} values are unobservable, and the covariances between x_{it} and z_{it} are nonzero. Then the least-squares regression coefficients of y_{it} on x_{it} are biased. However, if repeated observations for a group of individuals are available, they may allow us to get rid of the effect of z. For example, if $z_{it} = z_i$ for all t (i.e., z values stay constant through time for a given individual but vary across individuals), we can take the first difference of individual observations over time and obtain

$$y_{it} - y_{i,t-1} = \beta'\left(x_{it} - x_{i,t-1}\right) + \left(u_{it} - u_{i,t-1}\right), \qquad i = 1, \dots, N, \quad t = 2, \dots, T$$

Similarly, if $z_{it} = z_t$ for all i (i.e., z values stay constant across individuals at a given time, but exhibit variation through time), we can take the deviation from the mean across individuals at a given time (Within Transformation) and obtain

$$y_{it} - \bar{y}_t = \beta'(x_{it} - \bar{x}_t) + (u_{it} - \bar{u}_t), \qquad i = 1, \dots, N, \quad t = 1, \dots, T$$

where $\bar{y}_t = (1/N)\sum_{i=1}^{N} y_{it}$, $\bar{x}_t = (1/N)\sum_{i=1}^{N} x_{it}$, and $\bar{u}_t = (1/N)\sum_{i=1}^{N} u_{it}$. In both cases least-squared regression provides unbiased and consistent estimates of β. Nevertheless if we have only a single cross-sectional data set ($T = 1$) for the former case ($z_{it} = z_i$), or a single time-series data set ($N = 1$) for the latter case ($z_{it} = z_i$), such

transformations cannot be performed. We cannot get consistent estimates of β unless there exist instruments that are correlated with x but are uncorrelated with z and u. (Hsiao, 2003)

The parameters that characterize all temporal cross-sectional sample observations are various and examine a number of specifications that allow for differences in behaviour across individuals as well as over time. For instance, a single-equation model with observations of y depending on a vector of characteristics x can be written in the following form:

1. Slope coefficients are constant, and the intercept varies over individuals:

$$y_{it} = \alpha_i^* + \sum_{k=1}^{K} \beta_k x_{kit} + u_{it}\ , \qquad i = 1, \dots, N\ ,\ \ t = 1, \dots, T$$

2. Slope coefficient are constant, and the intercept varies over individuals and time:

$$y_{it} = \alpha_{it}^* + \sum_{k=1}^{K} \beta_k x_{kit} + u_{it}\ , \quad i = 1, \dots, N\ ,\ \ t = 1, \dots, T$$

3. All coefficients vary over individuals:

$$y_{it} = \alpha_i^* + \sum_{k=1}^{K} \beta_{ki} x_{kit} + u_{it}\ , \quad i = 1, \dots, N\ ,\ \ t = 1, \dots, T$$

4. All coefficients vary over time and individuals:

$$y_{it} = \alpha_{it}^* + \sum_{k=1}^{K} \beta_{kit} x_{kit} + u_{it}\ , \quad i = 1, \dots, N\ ,\ \ t = 1, \dots, T$$

In each of these cases the model can be classified further, depending on whether the coefficients are assumed to be random or fixed. Models with constant slopes and variable intercepts are most widely used when analyzing panel data because they provide simple yet reasonably general alternatives to the assumption that parameters take values common to all agents at all times. (Hsiao, 2003)

2.2 The Fixed Effects Models

The obvious generalization of the constant-intercept-and-slope model for panel data is to introduce dummy variables to allow for the effects of those omitted variables that are specific to individual cross-sectional units but stay constant over time, and the effects that are specific to each time period but are the same for all cross-sectional units. For simplicity, we assume no time-specific effects and focus only on individual-specific effects. Thus, the value of the depend variable for the ith unit at time t, y_{it} , depends on K exogenous variables, $(x_{1it}, \dots, x_{Kit}) = X'_{it}$, that differ among individuals in a cross section at a given point in time and also exhibit variation through time, as well as on variables that are specific to the ith unit and that stay (more or less) constant over time. (Hsiao, 2003) We consider model:

$$y_{it} = \alpha_i^* + \beta' X_{it} + u_{it} \quad i = 1, \dots, N, \quad t = 1, \dots, T,$$

where β' is a $1 \times K$ vector of constants and α_i^* is a 1×1 scalar constant representing the effects of those variables peculiar to the ith individual in more or less the same fashion over time. The error term, u_{it} , represents the effects of the omitted variables that are peculiar to both the individual units and time periods. We assume that u_{it} is uncorrelated with $(x_{i1}, \dots, x_{iT})$ and can be characterized by an independently identically distributed random variable with mean 0 and variance σ_u^2; symbolically $u_{it} \sim IID(0; \sigma_u^2)$. This model is also called the analysis-of-covariance model. (Hsiao) Based on the assumption about the error term u_{it} we know, that OLS gives us the best linear unbend estimate of unknown parameters. Its use we get:

$$\hat{\beta}_{FE} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)'\right]^{-1}\left[\sum_{i=1}^{N}\sum_{t=1}^{T}(x_{it} - \bar{x}_i)(y_{it} - \bar{y}_i)\right]$$

$$\hat{\alpha}_i = \bar{y}_i - \hat{\beta}'_{FE}\bar{x}_i \qquad i = 1, \dots, N$$

The detailed derivation of these estimates is described by Hsiao (2003).

2.3 The Random Effects Models

In this section we treat the individual-specific effects, like u_{it} , as random variables. It is a standard practice in the regression analysis to assume that the large number of factors that affect the value of the dependent variable, but that have not been explicitly included as independent variables, can be appropriately summarized by a random disturbance. When numerous individual units are observed over time, it is sometimes assumed that some of the omitted variables will represent factors peculiar to both the individual units and time periods for which observations are obtained, whereas other variables will reflect individual differences that tend to affect the observations for a given individual in more or less the same fashion over time. Still other variables may reflect factors peculiar to specific time periods, but affecting individual units more or less equally. Thus, the residual, v_{it} , is often assumed to consist of three components:

$$v_{it} = \alpha_i + \lambda_t + u_{it} \ ,$$

where

$$E\alpha_i = E\lambda_t = Eu_{it} = 0 \ , \qquad E\alpha_i\lambda_t = E\alpha_i u_{it} = E\lambda_t u_{it} = 0 \ ,$$

$$E\alpha_i\alpha_j = \begin{cases} \sigma_\alpha^2 & if\ i = j, \\ 0 & if\ i \neq j, \end{cases}$$

$$E\lambda_t\lambda_s = \begin{cases} \sigma_\lambda^2 & if\ t = s, \\ 0 & if\ t \neq s, \end{cases}$$

$$Eu_{it}u_{js} = \begin{cases} \sigma_u^2 & if\ i = j, t = s \\ 0 & otherwise, \end{cases}$$

and

$$E\alpha_i X'_{it} = E\lambda_t X'_{it} = Eu_{it} X'_{it} = 0' .$$

The variance of y_{it} , conditional on X'_{it} , is $\sigma_y^2 = \sigma_\alpha^2 + \sigma_\lambda^2 + \sigma_u^2$. The variances σ_α^2 , σ_λ^2 and σ_u^2 are accordingly called variance components; each is a variance in its own right and is a component of σ_y^2 . Therefore, this kind of model is sometimes referred to as a variance-components (or error-components) model. (Hsiao, 2003)

The estimates of unknown parameters, we can calculate by general least-squares method (GLS) or maximum likelihood estimation. The estimate of parameter β by GLS is:

$$\hat{\beta}_{GLS} = \Delta\, \hat{\beta}_b + (I_K - \Delta)\hat{\beta}_{FE}$$

where

$$\hat{\beta}_b = \left[\sum_{i=1}^{N}(\bar{x}_i - \bar{x})(\bar{x}_i - \bar{x})'\right]^{-1}\left[\sum_{i=1}^{N}(\bar{x}_i - \bar{x})(\bar{y}_i - \bar{y})'\right]$$

$\hat{\beta}_{FE}$ is estimate of parameter β in the fixed effects model and Δ is a expression dependent on matrix X, number of period T and variances σ_u^2 , σ_α^2.

Detailed derivation of $\hat{\beta}_{GLS}$ and also estimate of parameter β by maximum likelihood estimation is described by Hsiao (2003).

2.4 Fixed Effects Models vs. Random Effects Models

As we showed in previous sections, the estimate of parameter β in the fixed effects model is different than in random effects model. It is very important, but not simple question to decide which models is the best option for testing.

If the effects of omitted variables can be appropriately summarized by a random variable and the individual (or time) effects represent the ignorance of the investigator, it does not seem reasonable to treat one source of ignorance (α_i) as fixed and the other source of ignorance (u_i) as random. It appears that one way to unify the fixed-effects and random-effects models is to assume from the outset that the effects are random. The fixed-effects model is viewed as one in which investigators make inferences conditional on the effects that are in the sample. The random-effects model is viewed as one in which investigators make unconditional or marginal inferences with respect to the population of all effects. It is up to the investigator to decide whether to make inference with respect to the population characteristics or only with respect to the effects that are in the sample. (Hsiao, 2003)

On the other hand, Mundlak criticized the random-effects model on the grounds that it neglects the correlation that may exist between the effects α_i and the explanatory variables x_{it}. There are reasons to believe that in many circumstances α_i and x_{it} are indeed correlated. For instance, consider the estimation of a production function using firm data. The output of each firm, y_{it} , may be affected by unobservable managerial ability α_i. Firms with more efficient management tend to produce more and use more inputs X_i. Less efficient firms tend to produce less and use fewer inputs. In this situation, α_i and X_i cannot be independent. Ignoring this correlation can lead to biased estimation.

The properties of various estimators depend on the existence and extent of the relations between the X´s and the effects. Therefore, it is important to consider the joint distribution of these variables. However, α_i are unobservable. Mundlak suggested approximating $E(\alpha_i|X_i)$ by a linear function. He introduced the auxiliary regression

$$\alpha_i = \sum_t x'_{it} a_t + \omega_i \ , \qquad \omega_i \sim N(0, \sigma_\omega^2) \ .$$

Clearly, $a = 0$ if (and only if) the explanatory variables are uncorrelated with the effects. Based on these assumption, there was suggested the following test:

$$H_0 : a = 0 \qquad against \qquad H_1 : a \neq 0$$

If we reject the null hypothesis, than we use the fixed-effects model, otherwise random-effects model. The test statistics is derived in Hsiao (2003).

Another approach was chosen by Hausman. He suggested that if the null hypothesis is true, than GLS estimate of parameter β in base model achieves the Rao-Cramer´s bound and it is biased if the alternative hypothesis is true. On the other hand, FE estimate is consistent in force of both hypotheses. Hausman´s test is testing, whether FE and GLS estimates differ significantly.

In practice, the fixed-effects model is used for small N and it is correct to suggest that difference between the numbers of N, which is described by α_i, are implementation of random variables. This situation is characteristic for macroeconomic models.

Random-effects model is rather used for large N. This is typical for microeconomic analysis, where we investigate, for example, firm´s data.

3. Determinants of Corporate Interest Rate

3.1 The Database

We exploit unique company records compiled by the database Amadeus, which is comprehensive, pan-European database containing financial information on over 11 million public and private companies in 41 European countries. It combines data from over 30 specialist regional information providers (IPs). Amadeus is a modular product; we can choose the level of coverage that we require. Standardised annual accounts (for up to 10 years), consolidated and unconsolidated, financial ratios, activities and ownership for approximately 11 million companies throughout Europe, including Eastern Europe.

The original unbalanced panel data set incorporates the annual financial statements of non-financial companies between years 1994 and 2006 and the number of firms differs from year to year but in general it is quite large. For instance, for Czech Republic this is about 28 000 firms, for Hungary it is about 15 000 firms and for Romania it is about 35 000 firms yearly. Although original balance sheet of each country contains a few thousand of firms, there were not available all information for each individual firm. Therefore, we have not worked with all given firm.

Before further work, we performed several consistency tests of the individual data. In particular, we checked selected rations. (Fidrmuc et al., 2009) The first indicator of balance sheet, total debt as a fraction of total assets, is an indicator of the general indebtedness or leverage of the firm. The second indicator, short-term debt as a fraction of total debt, attempts to measure the extent the firm has to finance itself short-term rather than long-term and is therefore related to its access to long-term finance. The third indicator, coverage ratio, or cash flow[4] on interest payments measures the extent to which cash flow is sufficient to pay for financial costs and is therefore related to credit worthiness. The direction in which these indicators convey weaker balance sheets are supposed to run as follows. The higher total debt as a fraction of total assets, it means the weaker the balance sheet. The higher short-term debt as a fraction of total debt, it implies the weaker the balance sheet. The higher the coverage ratio, it denotes the stronger the balance sheet. (Vermeulen, 2000) Nevertheless, we excluded several firms from the sample, which confirms the high quality of the data set for these rations. In order to have

[4] In our case, the variable cash flow is represented by variable operating revenue and this term we will be use next in work.

the most representative sample for each country, we exclude also possible outliers for selected ratio total debt to total assets and operating revenue to total assets (defined as the 10 percent of lowest and highest values of the ratios).

Although the original data set starts in 1994 and ends in 2006, we have checked number of available firms for every year and we have used only years of data set, which contained sufficient number of observations (for Czech Republic 1996 -2005, Hungary 1997 -2005, and Romania 1995 -2002).

3.2 The Implicit Corporate Interest Rate

Using the available information, we compute the implicit corporate interest rate, IR, for the firm i at time t as

$$IR_{it} = \frac{INREX_{it}}{DEBT_{it}} \tag{1}$$

where $INREX$ denotes the interest expenses from the balance sheet, and $DEBT$ stands for debt defined as a sum of fixed liabilities, bank loans and borrowings from the balance sheet. This measure based on year-end balance sheets may be "artificially" high if a firm reduces the amount of its debt substantially in the course of a financial year and this criticism has also been mentioned by Benito and Whitley (2003). To address the empirical relevance of this issue, we exclude possible outliers (defined as the 10 percent of the lowest and highest interest rates) and we examine correlation of our measure of interest rates and two-week repo rates (see Graphs 1-3). The empirical results suggest that this issue is only of limited relevance in our sample. (Fidrmuc et al., 2009)

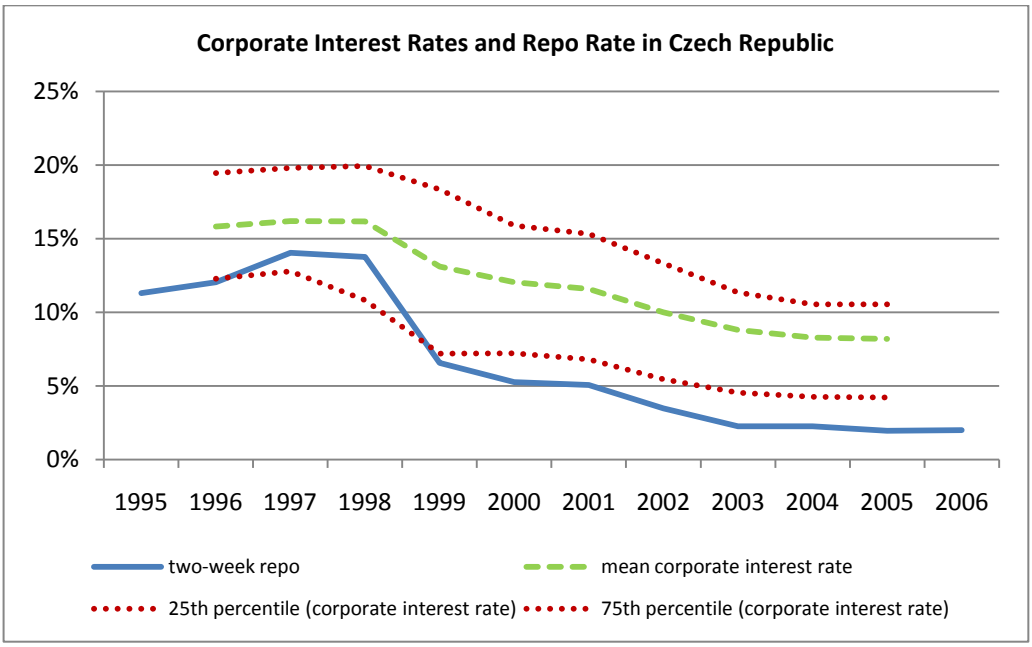
Next, we will compare this implicit interest rate with policy rate for each country and furthermore, we can compare the changes of these interest rates with behaviour of monetary policy or another impact of economy.

3.2.1 The Implicit Corporate Interest Rate in Czech Republic

The Czech Republic started a macroeconomic stabilization policy with an emphasis on a fixed exchange rate regime in 1991. The disinflationary policy started working after a couple of months, but the inflation rate got stuck at around 10% after some while. Together with a fixed exchange rate, this inflation produced a real appreciation because of the lack of a productivity growth. These issues combined with a tight monetary and a loose fiscal

policy led to higher interest rates which attracted capital inflow, kept inflation high, and widened the current account deficit. Meanwhile, the short-term interest rates became the operational instrument in the beginning of 1996; before that other targets/instruments, such as monetary base or free reserves, were being used. However, because of the increasing capital inflows, the economy became unstable through the end of 1996. This instability, together with uncertainties in financial markets and speculative attacks, forced the government and the Czech National Bank (CNB) authorities to abandon the fixed exchange rate regime on May 1997. After a short period of search for the right monetary policy, CNB decided to adopt inflation targeting on December 1997. At the end of 1998, CNB introduced some "exceptions" in its inflation targeting framework for which it cannot bear responsibility, and initiated meetings with trade unions and employees to reduce inflation expectations. In December 1999, CNB was ready to introduce a Long-term Monetary Strategy which was an indicator of a more credible central bank. Although CNB started with targeting the "net inflation" (i.e., basically the CPI inflation that excludes movements in regulated prices), it announced in April 2001 that it will continue with targeting the headline inflation starting from 2002. In April 2003, the Czech Republic's Treaty of Accession to EU was officially signed, and the Czech Republic entered EU on May 2004. (Yilmazkuday, 2008)

Graph 1: Comparison of Interest Rates in Czech Republic

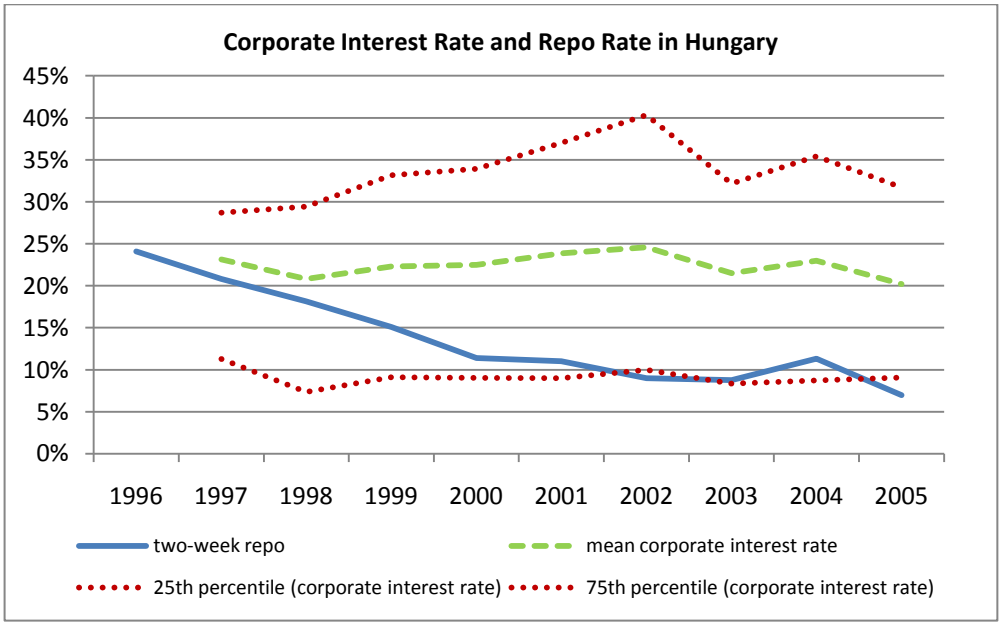


As we can see from Graph 1, our corporate interest rates are well correlated with the policy rate (two-week repo). Furthermore, during the downturns (1997 and 1998) the rates are the highest. It suggests that credit conditions worsen more than proportionally for certain firms during the downturns. The mean corporate interest rate stands at around 15.5 percent and increases to 16.5 percent during the downturn.

3.2.2 The Implicit Corporate Interest Rate in Hungary

Hungary was another transition country that adopted a fixed exchange regime in the early 1990s. Despite the ad hoc fluctuation band in the exchange rate, Hungary wasn't successful enough to prevent a devaluation of 8.3 percent in March 1995 due to large short-term capital inflows, after which Hungary replaced the ad hoc adjustment with a crawling band. This replacement worked and the inflation rate came down from about 30 percent in 1995 to below 10 percent in 1999. However, increasing oil prices together with increasing short-term capital inflows led the inflation rate increase one more time in the course of 2000. The increase in the inflation rate resulted in a decision on widening the band in May 2001. In August 2001, National Bank of Hungary (NBH) announced that an inflation targeting framework is going to be used. Nevertheless, NBH continued to consider the exchange rate as one of its policy instruments together with the inflation targeting framework. On May 2004, Hungary entered EU. (Yilmazkuday, 2008)

Graph 2: Comparison of Interest Rates in Hungary



Mean corporate interest rate for Hungary is well correlated with policy rate for year 1996, 1997 and since 2000. Although the repo rate is declining, the mean corporate interest rate is still between 20 percent and 25 percent. Following of the political situation, we can see from graph 2 that growth of rates in the mid of 2003 is a consequence of the subsequent entry into EU in 2004.

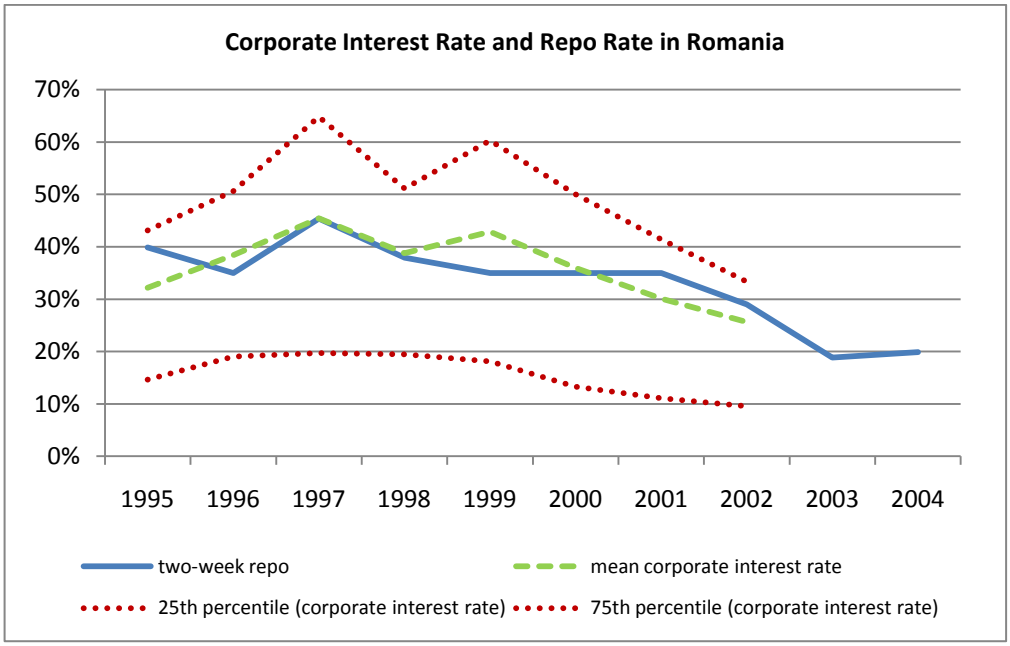
3.2.3 The Implicit Corporate Interest Rate in Romania

During 1990-1993, monetary policy of National Bank of Romania (NBR) has been hesitating and marked by many inconsistencies, where an anti-inflationist monetary policy, more steady, was initiated in Spring of 1994; only that this policy was again relaxed beginning with the second half of year 1995 and in year 1996. Considering the rich panoply of monetary policy instruments, which were found within the normative frame since 1994, NBR have used beginning with 1997 the systems of minimal compulsory reserves. The year 1997 was distinguished within the context of analysis specific to monetary policy instruments, related to NBR, since the first open-market operations have started to be managed. In 1998, reducing the inflation rate was due to decaying the balance on current account. The fundamental task of monetary policy in 1999 was represented by the continuation of disinflation process.

Since 2001, the open-market operations have become the main instrument used by NBR, in the view of sterilizing the liquidity excess. In 2002, NBR tried to adapt forward the instruments used on monetary policy, where the main modifications aimed towards the strengthening the part of interests within mechanism of transmission to monetary policy, produced upon the background of restoring the financial intermediation and of strengthening the monetary policy, in order to harmonize them with the set of instruments specific to ECB. In 2003, the open-market operations continued on increasing by their efficiency, where the emphasis was especially noticed towards attracting deposits by the central bank. In 2004, implementing the monetary policy was submitted much resolute towards assuring the continuity and steadiness on middle term, over the disinflation, taking into consideration the efforts of passing unto regime of reaching the inflation, in perspective of year 2005. In the same year, the set of instruments effectively used within

open-market operations was enlarged, and NBR launched the issuing of deposit certificates[5].

Graph 3: Comparison of Interest Rates in Romania



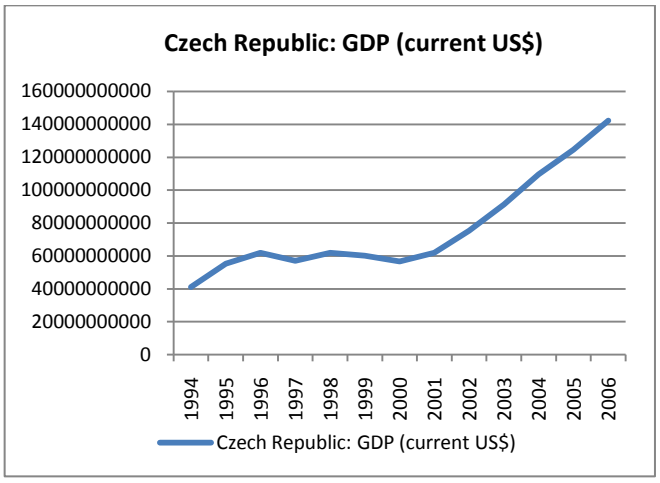
The mean interest rate is quite well correlated with repo rate, the highest rates are between years 1996 and 1999, and it was implication of situation described above. The both interest rates range between around the same values.

3.3 Determinant of Dummy Variables for each Country

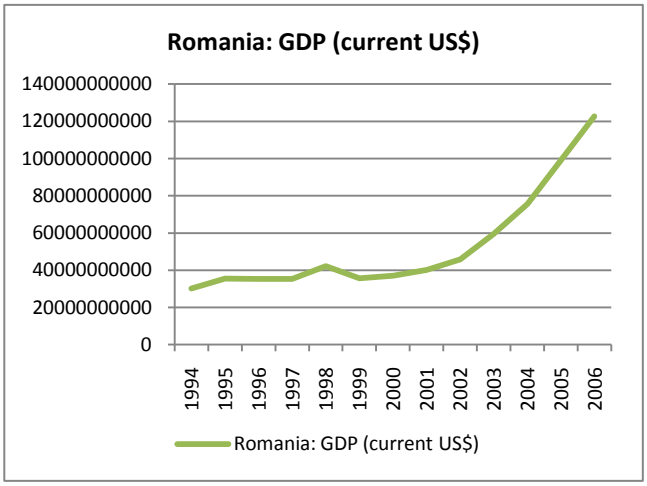
In order to test whether a financial accelerator is more potent during downturns or across the sizes of firm, we have to identify these dummy variables. Following Fidrmuc et al. (2009) we determine the downturns and recoveries by the GDP growth rates. As we can see from the Graphs 4 and 5, for the Czech Republic are the recession periods the years 1997 and 1998 (-0.73 percent and -0.76 percent), for Romania 1997, 1998 and 1999 (-6.1 percent, -4.79 percent and -1.2 percent) and for Hungary, there are not negative growth rates in our sample. The average rate of GDP growth for Hungary is 4.00%, so we determine the recession period as the period which has the GDP growth under this average and it is for year 2005.

[5] See Analysis to Instruments of Monetary Policy used by National Bank of Romania starting with 1990 in the context of European Union Integration

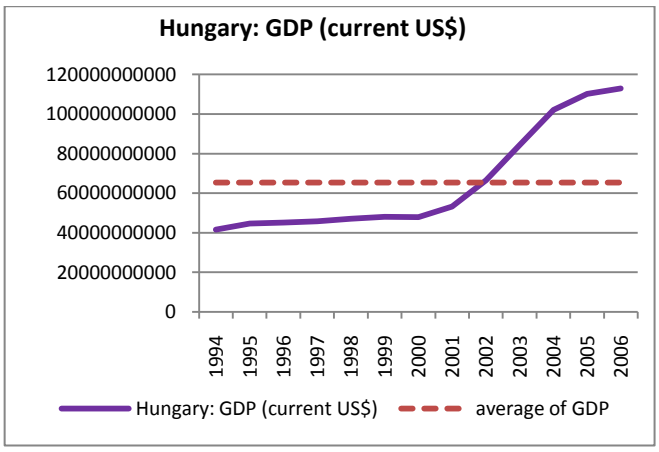
Graph 4: Gross Domestic Product in Selected Countries



Source: www.worldbank.org

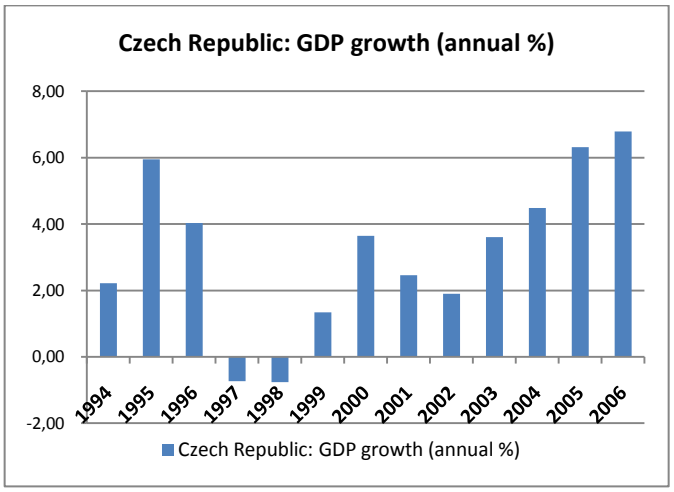


Source: www.worldbank.org

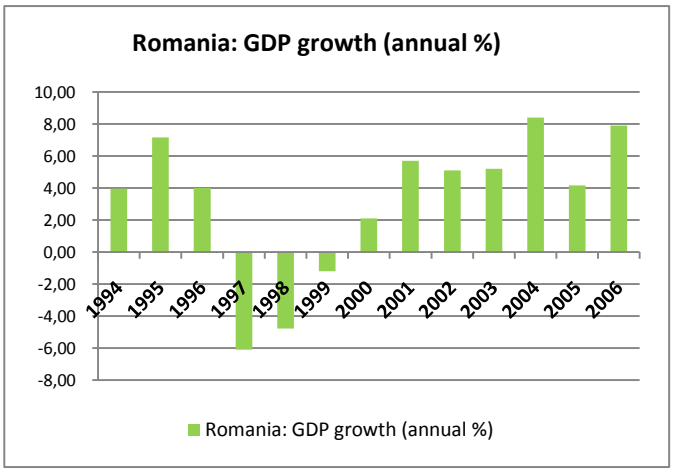


Source: www.worldbank.org

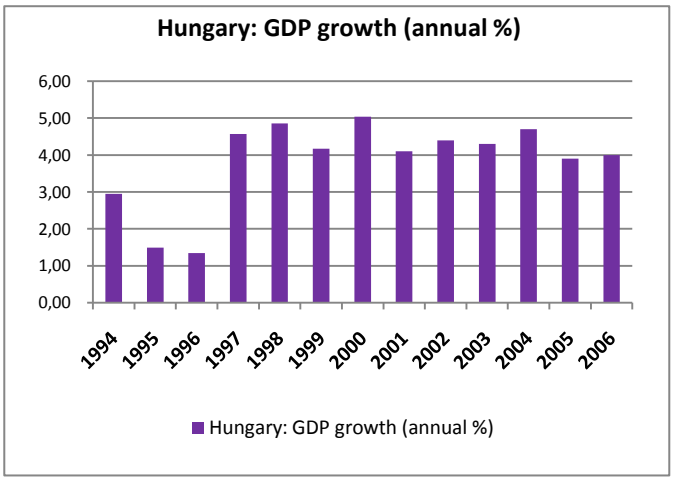
Graph 5: Real Growth of Gross Domestic Product in Selected Countries



Source: www.worldbank.org



Source: www.worldbank.org



Source: www.worldbank.org

The sizes of firms and their dummy variables we identify as the lower, medium and upper third of the firms according to their number of employees. Following this criterion, for Czech Republic, small firms are defined as number of employees less than 20 and large firms as number of employees more than 150 and for Romania, small firms are defined as number of employees less than 70 and large firms as number of employees more than 200. There was too little information about the number of employees for Hungary, so we identify the size of firms according to firm's total assets, small firms are defined as amount of total assets less than 1500 EUR and large firms as amount of total assets more than 3500 EUR.

Despite possible critique, the obvious advantage of using corporate interest rates is that they provide rich cross-sectional information, which is otherwise hardly available. Tables 1 -3 (below) present descriptive statistics of selected firm-specific indicators. In addition to the whole sample, we also report sub-samples according to different company size (identified above) and downturns or recoveries (denoted as booms in the Tables). Generally, the corporate interest rates are broadly related to the firm size. Although, our expectations were that interest rate for small firms will be the highest, as we can see from the Tables 1-3, the interest rate has increasing tendency across the sizes. Furthermore, interest rates are also higher during the downturn periods than during the recoveries just only in the Czech Republic and Romania. The balance sheet indicators also differ across firm size, although in some cases, we also expected a different trend. Descriptive statistics are used to describe the basic features of the data in a study and provide simple summaries about the sample and the measures. Univariate analysis incorporates the examination across cases on one variable at a time. Consequently, Tables 1-3 are only for information and next researches show if our expectations are well-founded correctly.

Table 1: Descriptive Statistics for Selected Balance Sheet Indicators in Czech Republic

	Small firms	*Medium firms*	*Large firms*	*Down*	*Boom*	*Total*
Corporate interest rates	**9.00**	**9.09**	**9.47**	**16.19**	**9.18**	**9.26**
	(6.12)	(6.17)	(6.14)	(5.7)	(6.1)	(6.15)
Total debt to Assets	**0.68**	**0.61**	**0.56**	**0.47**	**0.6**	**0.6**
	(0.2)	(0.21)	(0.21)	(0.19)	(0.21)	(0.21)
DSTR	**0.21**	**0.27**	**0.28**	**0.16**	**0.27**	**0.27**
	(0.26)	(0.26)	(0.24)	(0.19)	(0.25)	(0.25)
OR to Assets	**2.57**	**2.15**	**1.75**	**1.4**	**2.02**	**2.02**
	(1.32)	1.22	(0.99)	(0.71)	(1.17)	(1.16)
No. of observations	**1339**	**3249**	**4553**	**114**	**9027**	**9141**

Note: See Appendix for details on construction of variables. Standard deviations are in parentheses.

Table 2: Descriptive Statistics for Selected Balance Sheet Indicators in Hungary

	Small firms	*Medium firms*	*Large Firms*	*Down*	*Boom*	*Total*
Corporate interest rates	**21.66**	**24.00**	**25.58**	**20.96**	**23.26**	**23.22**
	(16.11)	(16.7)	(17.26)	(15.93)	(16.62)	(16.61)
Total debt to Assets	**0.59**	**0.58**	**0.58**	**0.66**	**0.59**	**0.59**
	(0.21)	(0.20)	(0.20)	(0.17)	(0.2)	(0.2)
DSTR	**0.2**	**0.21**	**0.19**	**0.18**	**0.2**	**0.2**
	(0.19)	(0.19)	(0.18)	(0.15)	(0.19)	(0.19)
OR to Assets	**2.73**	**2.24**	**2.01**	**2.18**	**2.43**	**2.43**
	(1.31)	(1.21)	(1.19)	(1.15)	(1.29)	(1.29)
No. of observations	**765**	**490**	**338**	**32**	**1561**	**1593**

Note: See Appendix for details on construction of variables. Standard deviations are in parentheses.

Table 3: Descriptive Statistics for Selected Balance Sheet Indicators in Romania

	Small firms	*Medium firms*	*Large firms*	*Down*	*Boom*	*Total*
Corporate interest rates	**34.57**	**34.97**	**34.93**	**42.18**	**31.30**	**34.70**
	(28.08)	(27.04)	(25.64)	(29.62)	(25.7)	(27.46)
Total debt to Assets	**0.71**	**0.61**	**0.56**	**0.63**	**0.67**	**0.66**
	(0.21)	(0.22)	(0.23)	(0.22)	(0.23)	(0.23)
DSTR	**0.11**	**0.11**	**0.12**	**0.09**	**0.12**	**0.11**
	(0.19)	(0.18)	(0.19)	(0.18)	(0.20)	(0.19)
OR to Assets	**2.56**	**2.08**	**1.84**	**2.38**	**2.33**	**2.35**
	(1.27)	(1.06)	(0.98)	(1.24)	(1.22)	(1.22)
No. of observations	**25561**	**6462**	**7646**	**12426**	**27243**	**39669**

Note: See Appendix for details on construction of variables. Standard deviations are in parentheses.

3.4 General Estimation Results of Corporate Interest Rate

Using the information from the balance sheet, we begin with a general analysis of determinants of corporate interest rate. In particular, we link the corporate interest rates to selected financial ratios, which have been identified in the literature as the most influential determinants of corporate interest rates. We include a dummy for small firms and for the downturn periods and we analyze whether small firms pay higher interest rates on average, and also if corporate interest rates increase during a downturn. We estimate the equation (1) linking the balance sheet indicators to corporate interest rates:

$$IR_{i,t} = \alpha_1 + \alpha_2 \frac{TDEBT_{i,t-1}}{A_{i,t-1}} + \alpha_3 \frac{OR_{i,t-1}}{A_{i,t-1}} + \alpha_4 DSTR_{i,t} + \alpha_5 DOWN_t + \alpha_6 S_i + \alpha_7 M_i + u_i + \\ + e_{i,t} \qquad (2)$$

The depend variable, IR, represents the corporate interest rate of the i-th firm at time t, computed from the firm's financial statements (as the ratio of interest rate expenses to debt, which was defined above). $TDEBT$ is the company total debt of i-th firm at time $t-1$, OR denotes the operating revenue of i-th firm at time $t-1$ and these variables are normalized by firm's total assets, A, in the time $t-1$. The debt structure is captured by $DSTR$, which is defined as one minus ratio of short-term debt to total debt. The variable $DSTR$ serves as a proxy for assessing the degree of market access for firms. The dummy variable $DOWN$ captures whether the country experiences aggregate negative growth rates in time t and then it equals 1 and 0 otherwise. The variable S is a dummy to assess whether

small firms face different (mainly higher) interest rates and takes a value of 1 when firm's employees (or total assets for Hungary) are smaller than the 33^{rd} percentile of the sample. The variable M is a dummy for medium firms and takes a value of 1 when firm's employees are between 33^{rd} and 66^{th} percentiles. Furthermore, u_i is an unobserved firm fixed effect, and e is the error term.[6]

In general, more leveraged firms are more likely to default and thus the lenders seek to be compensated by higher interest rates. Hence, α_2 is expected to yield a positive sign. The sign of α_3 should be negative as more liquid firms are likely to be charged lower interest rates. Furthermore, risky projects are unable to receive the long-term finance and are thus forced to finance their projects with short-term debt. In accordance with Horvath and Podpiera (2009), the interest rate on long-term debt is on average smaller than the rate on short-term liabilities. Thus, α_4 is expected to be negative.

In addition to firm specific data, macroeconomic development is also expected to influence corporate interest rate. In particular, the sign of α_5 is expected to be positive for several reasons. For example, banks may contract their lending during a downturn and furthermore, firms are more dependent on external financing during the downturns and banks may use this expectation for them with higher interest rate. Similarly, α_6 is likely to be positive, because small firms are more risky and may entail greater agency costs for borrowers. (Fidrmuc et al., 2009) The sign of α_7 is also expect positive and furthermore in accordance with our theory, we expect $\alpha_6 > \alpha_7$. Next, we compare the results for each country through the Tables 4- 6.

3.4.1 Estimation Results of Corporate Interest Rate by Countries

We present determinants of corporate interest rates in Tables 4 -6, toward which we are particularly interested in the influence of economic downturn and firm size (i.e., small firms). We study how a firm's balance sheet position affect the level of interest rates the firm is charged. Estimation is carried out by the panel data fixed effects estimator and the results are reported for five various specifications together to give some insight into the sensitivity of the estimates. Generally, all results confirm our assumptions, which we can see that almost all signs have correct sign, but there are a few insignificant variables, which we describe in more detail below for every country. The most insignificant variables are

[6] All variables are presented in more detail in the Appendix.

observed for Hungary. However two observations should make these results not too surprising. First, the "firms" used in these regressions are "representative firms" the variables of each "representative firm" are essentially averages over a number of firms. If each "representative firm" contains firms with "strong" and "weak" balance sheets, it is highly likely that the coefficients presented here are biased downward. Second, possible asymmetric effects of the accelerator: differences over the cycle and/or differences across size classes should invalidate these simple regressions. (Vermeulen, 2000) The Tables 4-6 are presented in the end of this part.

The results of Table 4 suggest that the variables total debt and operating revenue are the robust determinant of corporate interest rate in the Czech Republic. Firms with higher amount of total debt pay higher interest rates and that confirms assumes about leveraged firms and firms with higher amount of operating revenue pay less interest rates. Consequently, we find certain evidence that the leverage and liquidity indicators influence the corporate interest rates. All variables have the awaiting signs that we expect above. If we include all variables in the regression, specification (5), just only the debt structure becomes insignificant. Table 4 confirms also that the corporate interest rates are higher during the recession. It is difficult for lenders to monitor small firms and the results from Table 4 show that small firms pay higher interest rates than medium firms, although the variable for medium firms is insignificant in the specifications (4).

As it was mentioned above and we can see in the Table 5, Hungary results certify that almost all variables achieve the expected signs, but total debt, one of the main indicators, is insignificant in all specification of our model for corporate interest rate. On the other hand, debt structure and operating revenue are robust and significant determinants of corporate interest rate. Coefficients of downturn variable have positive signs, but insignificant in the regression. The most considerable feature for this model in Hungary is that the signs for small and medium firms are negative. The specifications (4) and (5) show that $\alpha_6 < \alpha_7$ and it means that small firms pay less interest rate than medium, which is in contrary with the theory about small firms. But, this indicates the impact of various programs supporting the small and medium firms.

Total debt, debt structure and operating revenue are robust determinants of corporate interest rates in Romania. Table 6 also confirms that interest rates are higher during the periods of economic downturn and that small firms pay higher interest rates.

The results show that all variables have expectative signs and furthermore, if we include all variables in to the regression, all become significant.

The results indicate that Czech and Romanian firms paid higher interest rates during economic downturn and furthermore small firms in these countries pay also higher interest rates. However, significant small firm and downturn variables in Czech Republic and Romania do not necessarily imply financial accelerator effects there. It may simply reflect the greater risk firms present during downturns or the greater risk inherent in small firms, respectively. For this reason, we investigate if monetary policy effects propagate more strongly to small firms (or during downturns), controlling for balance sheet indicators as a proxy for firm risk. (Fidrmuc et al. 2009) Although there were insignificant variables in Hungary, we will also observe the impact of monetary policy in this country.

Table 4: Determinants of Corporate Interest Rates in Czech Republic

	(1)	(2)	(3)	(4)	(5)
Total Debt to Assets	**5.82*** **	**6.01*** **	**6.03*** **	**5.95*** **	**5.98*** **
	(0.85)	(0.85)	(0.84)	(0.85)	(0.84)
DSTR		**-1.15***	**-0.84**	**-1.15***	**-0.84**
		(0.6)	(0.59)	(0.6)	(0.59)
OR to Assets	**-0.35** **	**-0.36** **	**-0.32** **	**-0.38*** **	**-0.35** **
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Down			**6.74*** **		**6.75*** **
			(0.55)		(0.55)
Small Firms				**1.43*** **	**1.44*** **
				(0.52)	(0.43)
Medium Firms				**0.04**	
				(0.37)	
Constant	6.44***	6.65***	6.39***	6.51***	6.26***
	(0.62)	(0.63)	(0.62)	(0.65)	(0.62)
R^2	0.01	0.003	0.0001	0.0003	0.0001
No. of observations	**9141**	**9141**	**9141**	**9141**	**9141**

Notes: Asymptotic standard errors in parenthesis. Total debt and OR are divided by total assets. ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. See Appendix for the details on the construction of variables.

Table 5: Determinants of Corporate Interest Rates in Hungary

	(1)	(2)	(3)	(4)	(5)
Total debt to Assets	**0.09**	**0.43**	**0.42**	**0.14**	**0.14**
	(3.24)	(3.23)	(3.23)	(3.21)	(3.22)
DSTR		**-11.15****	**-11.41****	**-11.00****	**-11.13****
		(4.76)	(4.77)	(4.73)	(4.75)
OR to Assets	**-2.13****	**-2.16*****	**-2.1****	**-1.95****	**-1.93****
	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)
Down			**3.79**		**1.79**
			(4.22)		(4.26)
Small Firms				**-9.36*****	**-9.14*****
				(3.09)	(3.13)
Medium Firms				**-5.13****	**-4.97****
				(2.49)	(2.52)
Constant	28.23***	30.34***	30.2***	36.06***	35.85***
	(2.8)	(2.93)	(2.93)	(3.52)	(3.56)
R^2	0.007	0.01	0.01	0.02	0.02
No. of observations	**1593**	**1593**	**1593**	**1593**	**1593**

Notes: Asymptotic standard errors in parenthesis. Total debt and OR are divided by total assets. ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. See Appendix for the details on the construction of variables.

Table 6: Determinants of Corporate Interest Rates in Romania

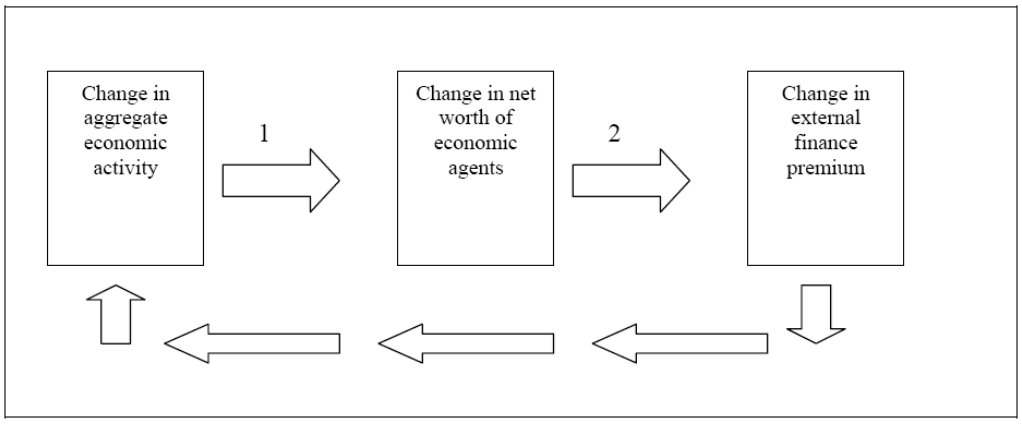
	(1)	(2)	(3)	(4)	(5)
Total debt to Assets	**7.55*****	**8.65*****	**8.71*****	**8.44*****	**8.54*****
	(0.6)	(0.59)	(0.59)	(0.60)	(0.59)
DSTR		**-23.00*****	**-21.19*****	**-22.94*****	**-21.18*****
		(0.96)	(0.95)	(0.96)	(0.95)
OR to Assets	**-0.37*****	**-0.48*****	**-0.87*****	**-0.51*****	**-0.88*****
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Down			**7.79*****		**7.73*****
			(0.30)		(0.31)
Small Firms				**3.60*****	**2.49*****
				(0.73)	(0.72)
Medium Firms				**1.91****	**1.8****
				(0.75)	(0.74)
Constant	31.15***	33.30***	31.5***	30.83***	29.75***
	(0.36)	(0.37)	(0.37)	(0.63)	(0.63)
R^2	0.003	0.02	0.05	0.02	0.05
No. of observations	**39669**	**39669**	**39669**	**39669**	**39669**

Notes: Asymptotic standard errors in parenthesis. Total debt and OR are divided by total assets. ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. See Appendix for the details on the construction of variables.

4. Financial Accelerator

The financial accelerator, also called financial propagation mechanism, implies that a firms' investment spending is influenced by its balance sheet position. Weak balance sheets can amplify shocks on firm spending. The mechanism usually being that asymmetric information makes firm access to investment finance a function of its balance sheet. Weak balance sheets than restrict firm investment financing and as a corollary firm investment. The initial shocks being amplified can be either real or nominal shocks. The financial accelerator therefore provides one (among many) possible transmission mechanism of real shocks or monetary policy shocks. (Vermeulen, 2000) Generally, this confirms that small initial economic shocks can be amplified and propagated by financial market imperfections. Figure 2 describes financial accelerator mechanism in a simply scheme. Arrow 1 depicts a positive relationship between changes in aggregate economic activity and agents' net worth. In turn, Arrow 2 depicts an inverse relationship between net worth and the size of the external finance premium. Finally, because the external financial premium is inversely related to investment, spending and production, the return arrow depicts pro-cyclical feedback into aggregate economic activity. (Ćorić et al., 2009)

Figure 2: The Financial Accelerator in Outline



Source: ĆORIĆ et al., 2009

Consequently, an important feature of the financial accelerator is its perceived double asymmetry, according to our sample: balance sheet effects should be stronger in downturns than in booms and stronger for small firms than for large firms. Or as stated by Gertler and Gilchrist (1993, 1994): "The financial propagation mechanism is likely to be asymmetric over the cycle – more potent in downturns than in booms." and "It is hopefully

not controversial to suggest that the financial propagation mechanism is more applicable to "small" borrowers." (Vermeulen, 2000)

4.1 The General Estimations of Financial Accelerator

In this part, we turn to the question whether monetary policy effects propagate more strongly to small firms and during the downturns, while we control for balance sheet indicators to proxy the corporate risk. It is especially important to control for the debt maturity structure as short-term debt may obviously react faster than long-term debt interest rates. However, we believe that empirically it is not very relevant in our case, because more than 90% of loans in Czech, Hungary and Romania economy have a variable interests (i.e. fixed interest rate for less than one year).Thus, we examine whether monetary policy has heterogeneous effects on firms according to firm size. Following the literature (see Bernanke et al., 1999; Mojon et al., 2002), the heterogeneous effects of monetary policy are indicative of financial accelerator phenomenon.

Following Mojon et al. (2002), we test for the presence of the financial accelerator in two steps. First, we estimate whether the response to monetary policy effects varies with firm size. Second, we assess whether monetary policy is more powerful during a downturn compared with an upturn. Thus, both equations can be expressed as:

$$IR_{i,t} = \alpha_1 + \alpha_2 \frac{DEBT_{i,t-1}}{A_{i,t-1}} + \alpha_3 \frac{OR_{i,t-1}}{A_{i,t-1}} + \alpha_4 DSTR_{i,t} + \gamma_1 RR_t + \gamma_2 RR_t S_i + \\ + \gamma_3 RR_t M_i + u_i + e_{i,t} \qquad (3)$$

$$IR_{i,t} = \alpha_1 + \alpha_2 \frac{DEBT_{i,t-1}}{A_{i,t-1}} + \alpha_3 \frac{OR_{i,t-1}}{A_{i,t-1}} + \alpha_4 DSTR_{i,t} + \delta_1 RR_t + \delta_2 RR_t DOWN_t + \\ + u_i + e_{i,t} \qquad (4)$$

Equation (3) again links the corporate interest rates to the previous balance sheet indicators. In addition to the estimation of (2), we include the product of the yearly average of two-week repurchase rate (the policy rate of the national central banks of our observed countries) denoted by RR, while S, M are dummy variables for the small and medium sized firms, respectively. Thus, $RR_t S_i$ and $RR_t M_i$ in (3) stand for the product of monetary policy

rate and the dummy for the size of firm. It is generally expected that $\gamma_2 > \gamma_3$, that is, that monetary policy effects have the strongest effects on small firms, as compared with the medium and large sized firms (see Mojon et al., 2002). In to the model, we also include the variable RR_t with the expected positive sign. Similarly, equation (4) assesses whether the effect of monetary policy on the corporate interest rates depends on the business cycle, controlling for the balance sheet indicators. Therefore, we include variable – the product of RR and $Down$, where the dummy variable $Down$ takes on a unit value if economic growth has been negative in a given year (for Hungary below the average growth rate). The earlier literature following the theory of financial accelerator suggest that δ_2 is expected to be positive . This means that monetary policy is more influential during the downturns (see Gertler and Gilchrist, 1994). We also include variable RR_t into this model. As mentioned, a detailed derivation of all the variables is presented in Appendix.

4.2 Estimation Results of Financial Accelerator by Countries

Tables 7-9 verify the heterogeneous impact of monetary policy on firms. Generally, almost all explanatory variables are significant with the expected signs in all specifications for Czech Republic and Romania. As it was observed in the previous section, the results of Hungary are different and essentially confirm the results of previous regressions. Tables 7-9 are presented in the end of this part.

Czech Republic

In the Table 7 for Czech Republic, we can see that the value of coefficients is typically stable across the specifications to a large extent. Controlling for the strength of balance sheet indicators, we find out that the interest rate level of small firms reacts stronger to monetary policy than medium and large firms, although the medium firms have insignificant coefficients. Larger firms still have close ties with the banks and monetary policy effects have less impact on these enterprises. Therefore, monetary policy effects have less impact on these enterprises. It is evident from the specifications of regression that the coefficient on the product of repo (policy) rate and the small firm dummy is strong significant and precisely estimated coefficient in equations. Investigating the magnitude of estimated coefficients for RR_t , especially in the specification (5), we can see the reaction of interest corporate rates. Growth of repo rate RR_t means that interest corporate rates

increase of 1.14 units. It means that banks borrow to firms with higher interest rate than they have from the Central Banks.

Table 7 also displays the results on the asymmetric effect of monetary policy over the business cycle. There are several studies investigating the asymmetry of monetary policy effects.[7] As we can see from the Table 7, the coefficient for $RR_t Down_t$ is negative which is in contrary with our assumptions. It means that these results do not suggest that monetary policy is more efficient during the downturns. These results also correspond to Fidrmuc et al. (2009) and their arguments that the lack of asymmetric effects of monetary policy may reflect the specific conditions at the Czech credit market during the economic reforms of the 1990s. The market was characterized by rather soft budget constraints at the outset of economic transition and subsequent credit rationing at the end of the 1990s.

Hungary

Table 8 and the results of Hungary again indicate that explanatory variables are not significant in all specifications and moreover, especially for size dummies we expected positive signs. Moreover, coefficients of RR_t is in the specifications (3) and (4) are negative and strong significant, which is difficult to interpret. It means that banks borrow to firms with less interest rate than they have from Central Bank, which is not so usual. This fact can be also caused by the possibility of existence of incorrect data in our database, which also may be associated with not correct accounting system in country. But this is just only our deductions and interpretations of these results.

Examining the coefficients of monetary policy over the business cycle, there is no evidence that monetary policy is more efficient during the recession periods (coefficient for $RR_t Down_t$ is insignificant). These results can be debatable, because we determined the recession periods according the average of GDP rate growth and it is not downturns in the true sense. According Vonnák (2006) there is also no research dedicated exclusively to the accelerator phenomenon. Kátay and Wolf (2004) arrive at the conclusion that although empirical evidence points towards the existence of the credit channel, for structural reasons they do not consider it to be a crucial ingredient in the transmission mechanism.

[7] Kaufmann (2002) finds that monetary policy effects are indeed asymmetric over the business cycle. Similarly, Peersman and Smets (2005) find asymmetric impact of monetary policy on industrial production in the euro area countries.

Romania

Table 9 for Romania confirms the impact of monetary policy on firms and also during the business cycle. All explanatory variables are significant with the expected signs in all specifications of regression. The corporate interest rate level of small firms reacts stronger to monetary policy than those of medium and large firms, although the coefficients γ_2 and γ_3 vary only slightly. It may indicate that there are not so large differences between firms according to their size to determine corporate interest rate. This finding can be also connected with various programs of support for small and medium enterprises. A reaction of small and medium firms is significantly lower than one and the results indicate that there is incomplete interest rate pass-through for these firms. On the other hand, there are also significant, positive but lower than one coefficients of RR_t. This fact is compensated by constant which we can be interpreted as the average interest rate.

Table 9 documents the results that monetary policy is more efficient during the recession periods, the coefficients for $RR_t Down_t$ are strong significant and confirms the assumptions that during the downturns, firms are more dependent on external financing and banks reflect this fact with higher interest rates.

Table 7: Determinants of Corporate Interest Rate in Czech Republic, Augmented Estimation

	(1)	(2)	(3)	(4)	(5)
Total debt to Assets		**4.36*** **		**4.00*** **	**4.04*** **
		(0.8)		(0.8)	(0.8)
DSTR		**-0.53**		**-0.58**	**-0.56**
		(0.56)		(0.56)	(0.56)
OR to Assets		**-0.18**		**-0.14**	**-0.16**
		(0.13)		(0.13)	(0.13)
RR	**0.96*** **	**0.94*** **	**1.18*** **	**1.14*** **	**1.14*** **
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
RR*Small Firm	**0.42*** **	**0.42*** **			**0.32** **
	(0.15)	(0.15)			(0.15)
RR*Medium Firm	**-0.02**	**-0.04**			**-0.1**
	(0.09)	(0.09)			(0.09)
RR*Down			**-0.31*** **	**-0.28*** **	**-0.28*** **
			(0.05)	(0.05)	(0.05)
Constant	6.26***	4.21***	5.8***	3.92***	3.9***
	(0.15)	(0.6)	0.16	(0.6)	(0.6)
R^2	0.05	0.03	0.05	0.04	0.03
No. of observations	**9141**	**9141**	**9141**	**9141**	**9141**

Notes: Asymptotic standard errors in parenthesis. Total debt and OR are divided by total assets. ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. See Appendix for the details on the construction of variables.

Table 8: Determinants of Corporate Interest Rate in Hungary, Augmented Estimation

	(1)	(2)	(3)	(4)	(5)
Total debt to Assets		**0.86**		**1.01**	**0.83**
		(3.23)		(3.23)	(3.24)
DSTR		**-9.36***		**-9.4***	**-9.56****
		(4.8)		(4.82)	(4.83)
OR to Assets		**-2.02****		**-2.09****	**-1.99****
		(0.82)		(0.82)	(0.82)
RR	**-0.16**	**-0.14**	**-0.48*****	**-0.42****	**-0.13**
	(0.30)	(0.30)	(0.18)	(0.18)	(0.30)
RR*Small Firm	**0.36**	**0.32**			**0.32**
	(0.25)	(0.25)			(0.25)
RR*Medium Firm	**-0.19**	**-0.17**			**-0.17**
	(0.21)	(0.21)			(0.21)
RR*Down			**0.28**	**0.28**	**0.28**
			(0.61)	(0.61)	(0.61)
Constant	28.31***	33.89***	29.26***	34.79***	33.65***
	(2.34)	(3.57)	(2.25)	(3.5)	(3.61)
R^2	0.01	0.02	0.001	0.01	0.02
No. of observations	**1593**	**1593**	**1593**	**1593**	**1593**

Notes: Asymptotic standard errors in parenthesis. Total debt and OR are divided by total assets. ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. See Appendix for the details on the construction of variables.

Table 9: Determinants of Corporate Interest Rate in Romania, Augmented Estimation

	(1)	(2)	(3)	(4)	(5)
Total debt to Assets		**10.98*** **		**9.3*** **	**9.16*** **
		(0.61)		(0.61)	(0.61)
DSTR		**-20.76*** **		**-20.86*** **	**-20.85*** **
		(0.96)		(0.96)	(0.96)
OR to Assets		**-0.46*** **		**-0.81*** **	**-0.83*** **
		(0.12)		(0.12)	(0.12)
RR	**0.49*** **	**0.58*** **	**0.06**	**0.14*** **	**0.10** **
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
RR*Small Firm	**0.11*** **	**0.07*** **			**0.05*** **
	(0.02)	(0.02)			(0.02)
RR*Medium Firm	**0.09*** **	**0.06*** **			**0.05** **
	(0.02)	(0.02)			(0.02)
RR*Down			**0.2*** **	**0.18*** **	**0.18*** **
			(0.01)	(0.04)	(0.01)
Constant	14.45***	9.25***	30.01***	26.45***	26.37***
	(1.21)	(1.39)	(1.4)	(1.68)	(1.68)
R^2	0.02	0.04	0.04	0.05	0.05
No. of observations	**39669**	**39669**	**39669**	**39669**	**39669**

Notes: Asymptotic standard errors in parenthesis. Total debt and OR are divided by total assets. ***, **, and * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. See Appendix for the details on the construction of variables.

4.3 Sensitivity Analysis

We applied several sensitivity tests to our results. First, we examine the heterogeneous impact of monetary policy with respect to changed definition of small firm. In our thesis, we used the definition of lower, medium and upper third of the firms according to their number of employees (total assets in the case of Hungary). When we change the term of small firm by definition that small firm is every firm with number employees less than 100, the results are not so different. We used this modification only for Czech Republic and Romania. The results suggest that monetary policy has still significant effects (relative to dummy of new small firm) on corporate interest rates in Romania and insignificant effect in Czech Republic. These results can be nice interpreted, because there were not so large different between small and medium-sized firms in Romania than it was in Czech Republic (see Table 7 and Table 9).

Second, we examine the heterogeneous impact of monetary policy after years of economic recessions. We also apply this change in the models of Czech Republic and Romania. When credit conditions are tight, it is likely that small policy changes trigger a greater reaction in corporate interest rates than otherwise. (Fidrmuc et al., 2009) We identify tight credit conditions for Czech Republic after year 1998 and for Romania after year 1999. Following Pruteanu (2004) these years can be characterized as credit rationing and during these analyzed years there is existed moderate excess demand for bank loans. The results suggest that monetary policy has significantly stronger effects on corporate interest rates in Czech Republic and not so strong and almost the same effects on corporate interest rates in Romania. These results also confirm Tables 7 and Tables 9, because during the economic downturns there were negative sings of product of RR and $Down$ in Czech Republic, so if the repo rate increase it means that corporate interest rates is less. If we include into the model only years after economic downturns, the coefficient of RR is larger and consequently, monetary policy has larger impact on the corporate interest rates. Otherwise in Romania, where the impact of product of RR and $Down$ was positive, so corporate interest rates was larger. In the case after years of economic downturns, the coefficient of RR is slightly larger. All results performed as sensitivity analysis are available upon request.

Conclusion

The aim of this thesis was examined the determinants of the corporate interest rates using a panel data set based on financial statements from selected countries (Czech Republic, Hungary and Romania) between the available years from database Amadeus. We assess the relationship between a firm's financial position and the cost of external financing and examine whether monetary policy has heterogeneous impacts on firms according to their size and whether the response to monetary policy effects depends on the business cycle. Examining the heterogeneity of monetary policy effects allows us to assess the presence of financial accelerator in the Czech Republic and Romania economy, the Hungary has largely insignificant results or results which don't confirm our theory.

Consequently, the results suggest that balance sheet indicators are necessary determinants of the corporate interest rates. We find that total debt and operating revenue are robust indicator in Czech Republic, debt structure in Hungary and all these variables are robust in Romania. In addition, the strength of balance sheet variables seems to vary with the firm size in Romania, dummy variable of small firms is significant and medium-sized firms are insignificant in Czech Republic and there are negative signs but significant dummy variables for small and medium-sized firms in Hungary. Overall, we also find certain evidence of the heterogeneous impact of monetary policy effects. Monetary policy has stronger effects on smaller firms in Czech Republic and Romania. We find evidence that monetary policy impacts depend on the business cycle only in Romania (positive signs of $RR_t Down_t$) and in Czech Republic (negative signs of $RR_t Down_t$). All in all, these results support the existence of theory of financial accelerator effects in our data set.

Bibliography

[1] APETRI, A.A. - CIBOTARIU, I.S. - MIHALCIUC, C.C. *Analysis to instruments of Monetary policy used by National Bank of Romania starting with 1990 in the context of European Union Integration*. University of Suceava, Faculty of Economic Science and Public Administration.

[2] BALTAGI, B. H. 2005. *Econometric Analysis of Panel data*. John Wiley &Sons, Ltd.

[3] BEAN, C. – LARSEN - J. AND NIKOLOV, K. 2002. *Financial frictions and the Monetary transmission mechanism: Theory, evidence and policy implications*. Working Paper No. 113, European Central Bank.

[4] BENITO, A. - AND WHITLEY, J. 2003. *Implicit interest rates and corporate balance sheets: an analysis using aggregate and disaggregated UK data*. Working paper no. 193, Bank of England.

[5] BERNANKE, B. - AND GERTLER, M. 1989. *Agency costs, net worth and business fluctuations*. The American Economic Review, Vol. 79, No. 1, pp. 14-31.

[6] BERNANKE B - GERTLER, M. 1995. *Inside the Black Box: The Credit Channel of Monetary Policy Transmission*. The Journal of Economic Perspectives, Vol. 9, No. 4, pp. 27-48.

[7] BERNANKE, B. - GERTLER, M. - GILCHRIST, S. 1996. *The financial accelerator and the flight to quality*. The Review of Economics and Statistics, Vol. 78, No. 1, pp. 1-15.

[8] BERNANKE, B. - GERTLER, M. - GILCHRIST, S. 1998. *The financial accelerator in a quantitative business cycle framework*. Working Paper 6455, National Bureau of Economic Research, MA.

[9] BOISSAY, F. 2001. *Credit rationing, Output gap, and business cycles*. Working Paper No. 87, European Central Bank.

[10] ĆORIĆ, B. - PUGH. G. 2009. *The Financial Accelerator, globalization and output growth volatility*. University of Split, Faculty of Economic.

[11] ÉGERT, B. - MacDONALD, R. 2006. *Monetary Transmission Mechanism in transition economies: Surveying the Surveyable*. CESifo Working Paper No. 1739.

[12] FIDRMUC, J. - HORVÁTH, R. - HORVÁTHOVÁ, E. 2009. *Corporate interest rates and the financial accelerator in the Czech Republic*. Discussion Papers in Economics.

[13] GILCHRIST, S. - HAIRAULT, J.O. 2002. *Monetary Policy and the financial accelerator in a Monetary Union*. Working Paper No. 175, European Central Bank.

[14] HORVÁTH, C. - Krekó, J. - Naszódi, A. *Is there a bank lending channel in Hungary?*. Magyar Nemzeti Bank.

[15] HORVÁTH, R. – PODPIERA, A. 2009. *Heterogeneity in Bank Pricing Policies: Estimation, Determinants and Policy Implications.* Czech National Bank mimeo.

[16] HSIAO, CH. 2003. *Analysis of Panel Data*. Cambridge University press.

[17] KAUFMANN, S. 2002. *Is there an Asymmetric Effect of Monetary Policy over Time?A Bayesian Analysis Using Austrian Data.* Empirical Economics 27:277-97.

[18] KIYOTAKI, N. - MOORE, J. 1995. *Credit cycles*. Working Paper No. 5083, National Bureau of Economic Research, MA.

[19] KOTOVOVÁ, K. 2005. *Modelovanie rovnovážneho výmenného kurzu pomocou panelových modelov*. Diplomová práca, FMFI UK.

[20] MISHKIN, F. S. 1995. *Symposium on the Monetary Transmission Mechanism.* The Journal of Economic Perspectives, Vol. 9, No. 4, 3-10.

[21] MOJON, B. - SMETS, F. - VERMEULEN, P. 2001. *Investment and Monetary policy in the Euro Area*. Working Paper No. 78, European Central Bank.

[22] NOVÁK, P. 2007. *Analýza panelových dat*. Acta Oeconomica Pragensia, roč. 15, č. 1.

[23] OLINER, S.D. - RUDEBUSCH, G.D. 1996. *Is there a broad credit channel for Monetary Policy?*. FRBSF Economic Review, No. 1.

[24] PEERSMAN, G. – SMETS, F. 2005. *The Industry Effects of Monetary Policy in Euro Area*. Economic Journal 115:319-42.

[25] PRUTEANU, A. 2004. *Was there Evidence for Credit Rationing in the Czech Republic?* Eastern European Economics 42: 58-72.

[26] SEDLÁČEK, P. *Institutional conditions of Monetary policy conduct in the Czech Republic*. Faculty of Economic and Public Administration, University of Economics, Prague.

[27] VERMEULEN, P. 2000. *Business fixed investment: Evidence of a financial accelerator in Europe*. Working paper No. 37, European Central Bank.

[28] VONNÁK, B. 2006. *The Hungarian transmission mechanism: an assessment*. Magyar Nemzeti Bank.

[29] WALSH, C.E. 2003. *Theory and Policy*. Massachusetts Institute of Technology.

[30] www.bankofengland.co.uk

[31] www.cnb.cz

[32] www.mnb.hu

[33] www.bnro.ro

[34] www.worldbank.org

Appendix

Construction of Variables

- $IR_{i,t}$ – corporate interest rate for i-th firm at time t, $IR_{it} = INREX_{it}/DEBT_{it}$. $INREX_{it}$ are interest expenses from the balance sheet, and $DEBT_{it}$ is debt, defined as sum of fixed current liabilities: loans and not current liabilities: long term debt from balance sheet.
- $DSTR_{i,t}$ – debt structure measured as 1 minus the ratio of short-term debt to total company debt. Short-term debt is the sum of current liabilities, fixed liabilities, bank loans and borrowings from balance sheets. This proxy estimates the extent of short-term financing.
- $TDEBT_{i,t-1}$ - total debt of the company i at time $t-1$ defined as sum of current liabilities and not current liabilities.
- $OR_{i,t-1}$ – operating revenue of the company i at time $t-1$.
- $Down_t$ - dummy, which equals 1 when GDP y-o-y growth is negative and 0 otherwise. Analogously, the $Boom_t$ dummy equals 1 when y-o-y growth is positive.
- RR_tS_i and RR_tM_i - product of the annual average of two-week repurchase rate of the Central Bank and dummy variables for small and medium sized firms. The S_i dummy takes a value of 1 when the firm's number of employees is smaller than the 33^{rd} percentile of the sample. The M_i dummy takes a value of 1 when firm's number of employees are between the 33^{rd} and 66^{th} percentiles. In the case of Hungary we take variable total assets take instead of number of employees.