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INTER-INDUSTRY DIFFERENCES IN CAPITAL STRUCTURE: THE EVIDENCE FROM CENTRAL EUROPE

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Prohlašuji, že jsem diplomovou práci vypracoval samostatně a použil pouze uvedené prameny a literaturu.

I do hereby declare that I have written this thesis independently and that I used only the sources listed.

Prague, 21st May 2004 **……**

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ABSTRAKT

Cílem této práce je empirický výzkum a analýza rozdílů v kapitálové struktuře mezi různými průmyslovými odvětvími. Analýza je prováděna na vzorku veřejně obchodovaných firem ze zemí střední Evropy (Česká republika, Maďarsko, Polsko, Slovenská republika). Metodami výzkumu byly zvoleny metoda jednostranné analýzy variance (ANOVA) a odhad metodou nejmenších čtverců (OLS). Po analýze základních determinant kapitálové struktury jako jsou velikost firmy, ziskovost, atd. je v této práci ukázáno, že průmyslové odvětví je jednou z určujících determinant kapitálové struktury resp. zadluženosti. Hodnota vysvětlujícího faktoru R^2 vzrostla u modelů zahrnující i průmyslové odvětví o více než 9%.

Po srovnání s ostatními podobnými studiemi je možné konstatovat, že průmyslová odvětví ve střední Evropě jsou relativně stejně zadlužená jako průmyslová odvětví v USA a v Japonsku s výjimkou odvětví potravinářského, které vykazovalo v období let 2000 a 2001 vysokou relativní zadluženost, kdežto v USA a Japonsku je vždy potravinářství uváděno jako méně zadlužený sektor.

ABSTRACT

The purpose of this paper is to empirically analyse the inter-industry differences of capital structure. The research is performed on the sample of publicly traded firms from the central European countries (Czech republic, Hungary, Poland, Slovakia). Using ordinary least square (OLS) method of estimate and one way analysis of variance (ANOVA) we have obtained following results: Industry class constitutes another significant determinant of leverage (beside factors like size, profitability, etc.). The value of explanatory R^2 increased by more than 9% when model included industry dummy.

The obtained results of relative leverage were compared to the similar studies and with the only exception (food industry) we can conclude that the industries in the central Europe are relatively leveraged just as American and Japanese companies.

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1 Introduction

The relationship between industry class and capital structure has received considerable attention. The industry in which a firm operates is likely to have a significant effect on its capital structure. Besides the corporate capital structure characteristics like size, tangibility, profitability, investment opportunities and non-debt tax shields, industry class constitutes another significant deterministic variable that has attracted reasonable amount of research on the field of corporate finance.

Harris and Raviv (1991) in their review of the capital structure literature noted that it is generally accepted that firms in a given industry have similar proportions of individual assets and liabilities.

Harris and Raviv have summarized findings of four studies, Bowen et al. (1982), Bradley at al. (1984), Long and Malitz (1985) and Kester (1986), which investigated leverage ratios for selected industries. These studies all found that specific industries have a common leverage ratio which, over time is relatively stable.

The correlation of capital structure and industry class also received empirical support in Schwartz and Arson (1967), Scott and Martin (1975) and Hamada (1972). DeAngelo and Masulis (1980) and Masulis (1983) use the documentation of the industry effect as one argument for the presence of an industry-related optimal capital structure and imply that it is the tax code and tax rate differences across industries that cause the intra-industry similarities in leverage ratios.

The main objective of this thesis is the empirical investigation of sample of central European companies' capital structure; more specifically: the extent to which firm's observed capital structure is similar to other firms across different industry classes.

The following hypothesis are examined:

H_1^0 : Size, tangibility, profitability and the growth opportunities are not significant determinants of capital structure.

H_1^A : Size, tangibility, profitability and the growth opportunities are significant determinants of capital structure.

H_2^0 : Capital structure is not determined by industry class.

H_2^A : Industry class is significant determinant of capital structure.

H_3^0 : Technology does not have any influence on the firm's capital structure.

H_3^A : Technology is significant determinant of capital structure.

All the prior research on the relationship between industry and capital structure has mostly focused on capital structure of the public, non-financial corporations with access to U.S or other developed capital markets.

The similar papers published on this field of capital structure is Krauseová (1995), who analyzed the Czech corporate sector, Polavková (2000), who analyzed Slovak firms and Bauer (2004), who made complete analyses of the central European countries' capital structure.

This thesis is based on the cooperation with Patrik Bauer, who was so grateful to provide me with the basic database that was further completed and enlarged by the author. Despite of some limited overlaps this work is focused on the industry class as another determinant of capital structure and further compares leverage in different industries.

The objective of this paper is to provide the evidence from the Czech republic, Slovakia, Poland and Hungary.

This paper is divided into two main parts: in the first the theory of capital structure is overviewed (section 2) and in the second the empirical analysis follows (section 3).

2 Capital structure theory

The study of capital structure attempts to explain the mix of securities and financing sources used by corporations to finance real investment. Most of the research on the capital structure has focused on the proportions of debt vs. equity observed on the right-hand side of corporations' balance sheets. To be more specific - the capital structure research has concentrated on public, non-financial corporations mainly in the countries with highly developed capital markets (USA, Japan, Germany, etc.) while these companies have the broadest menu of financing choices and can effectively adjust their capital structure thus with relatively low transaction costs.

Modigliani and Miller (1958) suggested and proved in their famous work, that the choice between debt and equity financing has no material affects on the value of the firm or on the cost of availability of capital. They assumed perfect and frictionless capital markets, in which financial innovation would quickly extinguish any deviation from their predicted equilibrium. The logic of Modigliani and Miller is now widely accepted; nevertheless, in reality financing clearly can matter.

Yet even 40 years after the Modigliani and Miller research the understanding of firms financing decisions is still limited, however, much more is known about financing strategy. Research on financing strategy confirms the importance of taxes, information differences and agency costs. Whether these factors have first-order effects on the overall level of debt vs. equity financing is still an open question.

Theories on optimal capital structure differ in their relative emphasizes on, or interpretations of, these factors. In sections 2.3 – 2.10 we will go through the main streams of theory in detail to see the main ideas and differences among them.

2.1 Basic concepts

To understand the following theories, let's introduce some brief basic concepts of corporate finance.

Two most basic assumptions are that companies are maximizing their profit and their market value[1]. When company is in position when there is a project with net present value (NPV) e.g. project with discounted cash flows higher than initial costs, than the company will be willing to invest and thus will have a need for capital. This capital can be obtained either from borrowers (as a debt) or from investors (as an equity)[2]. The investors and borrowers will thus have a claim to the company. The debt is relatively simple claim for return of interest and principal of the loan. On the other hand – equity claim is a claim to the residual value of the company after all other claimants have been satisfied and thus equity claim is much harder to valuate.

The capital providers are remunerated by interest (borrowers) or by dividends (in the case of equity investors).

The value of the company is than the value of the debt plus the value of the equity, while all debt should be repaid from the generated cash flows from NPV projects and equity holders will get the residual value in the form of dividends. Thus the value of the claims must always add up to the value of the company:

$$\mathbf{V = V(d) + V(e)} \qquad (2.1.1)$$

Where V is the value of the company, V(d) is the value of the debt and V(e) is the value of the equity.

If we look at the firm's balance sheet, on the left side there are assets and growth opportunities and on the right side there are the claims

[1] Maximizing the market value is to be understand as maximizing the value of stocks held by shareholders.
[2] This holds under the assumption of company with no retained profit, that could be used for further investments projects; retained earnings come in as an important source of financing in Pecking Order theory (section 2.9).

of investors and debt holders. The accounting parity must be satisfied on the balance sheet as well. Thus:

Accounting view:

Assets	*Liabilities*
Current assets, including cash, inventory and account receivable	Current liabilities, including account payable and short-term debt
Plant and Equipment	Long term debt
Growth opportunities	Preferred stock
	Equity
	Firm value

Source: Brealey and Myers (2003), p.528

This table can be expressed by following equation:

$$\mathbf{V(a) = V(d) + V(e) = V} \qquad (2.1.2)$$

Thus the value of the assests (and the value of the company) is equal to the sum of short and long term debts and equity.

If look at the equation (2.1.1) we can see that this equation can be restated in the form of market value and that the value of a company can be expressed in form of discounted cash flows revenues R, operating costs C and investments I as follows:

$$V = \sum_{t=1}^{n} \frac{1}{1+r} \{R - C - I\} \qquad (2.1.3)$$

Looking at this equation it is obvious that in the world without taxes and uncertainty the value of the firm is not determined by any financing decisions. This statement, of course, can not hold in the reality, when taxes, financial distress and uncertainty exist.

2.2 Theory overview in short

As Myers (2001) stated: ”There is no universal theory of debt-equity choice, and no reason to expect one”. Such a strong statement gives us almost no reason for further study of capital structure, however several useful conditional theories can help us to understand this argument. Each of the theory will be described in further detail in following sections of the thesis.

First we will look at the theory that was developed before Modigliani and Miller – *Naïve theory* (section 2.3). Naïve theory assumes that companies should minimize their cost of capital (WACC) and this can be reached by issuing debt, while issuing debt is considered to be less costly than issuing equity.

Modigliani and Miller (MM) developed the groundwork of modern capital structure theory in their famous work *Theory of Investment* (1958) and we will go in detail through their propositions (subchapters of section 2.4) to see the basic ideas hidden behind them. Other theories are derived from MM by relaxing some of the assumptions or employing some other restrictions;

For example the *Trade-off theory* (section 2.7) says that firms seek debt levels that balance the tax advantages of additional debt against the costs of possible financial distress caused by exaggerated borrowings. The tradeoff theory predicts moderate borrowing by tax paying firms.

The *Pecking Order theory* (section 2.9) says that the firm will borrow, rather than issuing equity, when internal cash flow is not sufficient to fund capital expenditures, thus the total amount of debt will reflect the firm’s cumulative need for external funds.

The *Signaling theory* (section 2.11) says that managers of the firm posses inside information and they are revealing it by the method of financing. If the future prospects are positive managers will issue more debt because they are willing to incur the increased risk of bankruptcy and its related costs associated with higher debt.

The *Free Cash Flow theory* says that dangerously high debt levels will increase value, despite the thread of financial distress, when firm's operating cash flow significantly exceeds its profitable investment opportunities. The free cash flow theory is designed for mature firms that are prone to over invest.

Let's look at each theory in further detail;

2.3 Naïve approach

Before Modigliani and Miller came with their famous propositions, the theory of capital structure was based on the idea of weighted average cost of capital (WACC). The principle of weighted average cost of capital is captured in this simple formula:

$$WACC = k_{WACC} = \sum_{i=1}^{N} w_i k_i \qquad (2.3.1)$$

where WACC is a weighted sum of N sources of financing, e.g w_i stands for weight of appropriate source i and k_i is the relevant cost of the source (understand as the return required by investor).

When we improve the model to reflect the case where only two sources of financing are available (we consider debt – D and equity – E), we obtain following model:

$$WACC = k_{WACC} = \frac{D}{D+E} k_D + \frac{E}{D+E} k_E \qquad (2.3.2)$$

where k_D is the required return on debt (interest demanded by debt holders – borrowers) and k_E is the cost of equity or required rate of return by equity holders. As we can see from formulas (2.1.1) and (2.1.2) the denominator gives us the value of the firm and each fragment means the relative weight of debt (respectively equity) on the financing and value of the firm as well.

Under the assumptions of the naïve model the cost of debt and equity remains unchanged regardless of the amount of debt and equity issued by firm. Moreover, debt and equity are fully substitutable (assumption of perfect capital markets). Further, the assumptions consider that the cost of debt is lower than the cost of equity. Thus when we reconstruct the model to the form that shows the value of the firm as a dependant variable and debt and equity as explanatory variables, we obtain the following formula:

$$V = D + E = \frac{k_D D + k_E E}{k_{WACC}} \qquad (2.3.3)$$

What leads to the only possible conclusion and that is that the value of the firm is maximized when the **debt** is the solely financing source.

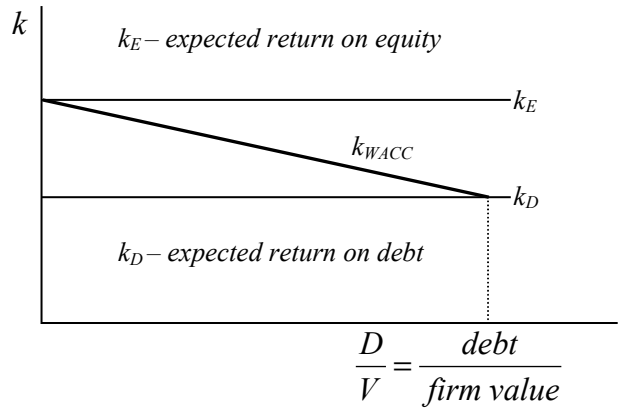
However this conclusion doesn't seem to reflect the reality very well, many firms use both the equity financing as well as debt financing. The weak point of the naïve theory is that it doesn't include the costs of financial distress[3]. As stated above one of the assumptions of the model is that the cost of debt will remain the same for all levels of leverage[4] what can reflect the reality but only when the changes in leverage are small. As long as the company is using more and more debt the debt holder might be concerned whether the firm will be able to meet its liabilities in the future. As a result of possible default and higher risk associated with the firm, the investors will demand higher return for their capital funds and thus the cost of debt must – at certain point in time – increase.

[3] For our demonstrating purposes we ignore the taxes for now.

[4] The simplest expression for leverage is the ratio of debt over total assets: *leverage = (Long + Short Term debt)/Total assets*. However, leverage could be measured as well as an equity ratio (*leverage = common equity/total assets.* The impact on empirical analysis concerning industries and capital structure is mentioned by Bowen et al. (1982, p. 12): "it is interesting to note, that studies that used an equity ratio (…) found statistically significant differences in industry leverage while studies that used debt in the numerator (…) did not."

The Naive approach can expressed by the following figure:

Figure 1: Naive view of the capital structure



Source: Brealey and Myers (2003, p.478, figure 17.4)

2.4 MM – Modigliani and Miller propositions

In 1954 Modigliani and Miller rejected the traditional view and founded new era of capital structure theory, their view of debt and equity.

Modigliani and Miller concluded (***Proposition I***) that levered companies can not command a premium over unlevered companies because investors have the opportunity of putting the equivalent leverage into their portfolio directly by borrowing on personal account.

The proof follows;

2.4.1 Proposition I

Starting point is an economy, where all assets are held by corporations and each asset yields certain "stream of profits" over time. However this stream of profits is uncertain in any event and need not to be constant over time. This stream of income, and hence the stream accruing to any share of common stock, will be regarded as extending indefinitely into the future. The mean value of the stream, or average profit per unit of time, is finite and represents a random variable subject to a (subjective)[5]

[5] individual investors may have different views on the probability distribution, however we assume that they all have the same view on expected return of certain stock. For further details, wider range of aspects, proofs of following propositions and possible discussion see Modigliani and Miller (1958 and 1963).

probability distribution. We shall refer to the average value over time of the stream accruing to a given share as the return of that share; and to the mathematical expectation of this average as the expected return of the share.

This can be analytically expressed as follows:

Stream of profit generated by assets of the *i*th firm:

$$X_i(1), X_i(2),\ldots X_i(T) \qquad (2.4.1)$$

where elements X_i are random variables subject to the joint probability distribution:

$$\chi_i\{X_i(1), X_i(2),\ldots X_i(t)\} \qquad (2.4.2)$$

and the return to the *i*th firm is defined[6] as:

$$X = \lim_{T\to\infty} \frac{1}{T} \sum_{t=1}^{T} X_i(t) \qquad (2.4.3)$$

Next step requires the assumption that all firms can be divided into special "equivalent return" classes such that the return on the shares issued by any firm in any given class is proportional to (and hence perfectly correlated with) the return on the shares issued by any other firm in the same class. Thus the ratio of the return to the expected return will have the probability distribution same in each class. It follows that each stock is now uniquely characterized by specifying (1) class to which it belongs and (2) its expected return.

[6] X_i is itself a random variable with a probability distribution $\Phi_i(X_i)$ whose form is determined uniquely by χ_i. The expected return $\overline{X}_i$ is defined as $\overline{X}_i = E(X_i) = \int x_i X_i \Phi_i(X_i) dX_i$. If N_i is the number of shares outstanding, the return of *i*th share is $x_i=(1/N)X_i$ with probability distribution $\Phi_i(x_i)dx_i=\Phi_i(Nx_i)d(Nx_i)$ and expected value $\overline{x}_i = (1/N)\overline{X}_i$

This assumption gives us the tool by which we are able to classify firms into groups within which the shares of different firms are "homogeneous", that is, perfect substitutes for one another[7].

From the above definition of "homogeneous" classes it follows in equilibrium in a perfect capital market the price per dollar's worth of expected return must be the same for all shares of any given class. Or equivalently, in any given class the price of every share must be proportional to its expected return. When we denote the factor of proportionality (for the *k*th class) $1/\rho_k$. Than if p_j denotes the price and $\bar{x}_j$ is the expected return per share of the *j*th firm in class *k*, we must have

$$p_j = \frac{1}{\rho_k}\bar{x}_J \qquad (2.4.4)$$

Or equivalently:

$$\frac{\bar{x}_J}{p_j} = \rho_k, \qquad (2.4.5)$$

where ρ_k is a constant for all firms *j* in class *k*.

The constant ρ_k can have several economic interpretations: (a) From (2.4.5) we see that each ρ_k is the expected return in the class *k*. (b) From (2.4.4) $1/\rho_k$ is the price which an investor has to pay for a dollar's worth of expected return in class *k*. (c) Again from (2.4.4), ρ_k can be regarded as the market rate of capitalization (further marked as *r*) for the expected value of the uncertain streams of the kind generated by the *k*th class of firms.

Now, if we relax the strict assumptions, and allow firms to issue bonds[8], the proportion of debt in the firms' capital structure will differ

[7] As Modigliani and Miller (1958, p. 266) stated "*We have, thus, an analogue to the familiar concept of the industry in which it is the commodity produced by the firm that is taken as homogeneous*".

[8] MM imposed these two restrictions (both will be relaxed later): 1) all bonds are assumed to yield a constant income over time, and this income is regarded as certain by all traders regardless of the issuer. 2) Bonds, like stocks, are traded in a perfect market with all its implications. It follows from assumption 1) that all bonds are in fact perfect substitutes up to the scale factor. It follows from assumption 2) that they must

among firms even in the same class and hence their shares will be subject to different degrees of financial risk or "leverage". Thus the shares will not be any more perfect "homogeneous" substitutes for one another.

Thus when considering any company j, D_j stands for the market value of the debt of the company, S_j stands for the market value of its common shares; than $V_j=(S_j+D_j)$ is the market value of all its securities or, as we shall say, the market value of the firm[9]. Than it follows that in equilibrium this equation (***Proposition I)*** must hold:

$$V_j = (S_j + D_j) = \frac{\overline{X}_j}{\rho_k} \text{ for any firm } j \text{ in class } k. \qquad (2.4.6)$$

That is, the *market value of any firm is independent of its capital structure and is given by capitalizing its expected return at the rate* ρ_k *appropriate to its risk class* (MM, 1958, p.268).

We can restate this proposition in an equivalent way in terms of the firms' average cost of capital:

$$\frac{\overline{X}_j}{(S_j + D_j)} = \frac{\overline{X}_j}{V_j} = \rho_k \text{ for any firm } j \text{ in class } k. \qquad (2.4.7)$$

That is, *the average cost of capital to any firm is completely independent of its capital structure and is equal to the capitalization rate of a pure equity stream of its class.* (MM, 1958, p.268/269)

sell at the same price per dollar's worth of return, or what amounts to the same thing must yield the same rate of return. This rate of return will be denoted *r* and referred to as the rate of interest or, equivalently, as the capitalization rate for sure streams.

[9]As can be easily seen this straightforward formula is just restated formula (2.1.1) or (2.1.2) already shown in chapter 2.1. – Basic Concepts.

2.4.2 Proposition II

From Proposition I Modigliani and Miller derived the following Proposition II concerning the rate of return on common stock in companies whose capital structure includes both debt and equity;

To derive the concerned equation MM used the equation for expected rate of return on equity, given by definition as:

$$i_j = \frac{\overline{X}_j - rD_j}{S_j} \qquad (2.4.8)$$

thus the expected rate of return is equal to the ratio of residual expected return (return after paying the costs of debt) over the market value of common stock.

An equation already known from Proposition I – equation (2.4.6) can be transformed to express expected return $\overline{X}$:

$$\overline{X}_j = \rho_k \left(S_j + D_j \right) \qquad (2.4.6)'$$

Than, substituting eq. (2.4.6)' into eq. (2.4.8) leads to eq. (2.4.9), thus the expected rate of return or yield, *i*, on the stock of any company *j* belonging to the *k*th class is a linear function of leverage and is expressed as follows:

$$i_j = \rho_k + \frac{(\rho_k - r)D_j}{S_j} \qquad (2.4.9)$$

That is, "*the expected yield of a share is equal to the appropriate capitalization rate* ρ_k *for a pure equity stream in the class, plus a premium related to financial risk equal to the debt-to-equity ratio times the spread between* ρ_k *and r*"(MM, 1958, p.271). Or equivalently, the market price of any share of stock is given by capitalizing its expected return at the continuously variable rate i_j of eq. (2.4.8).

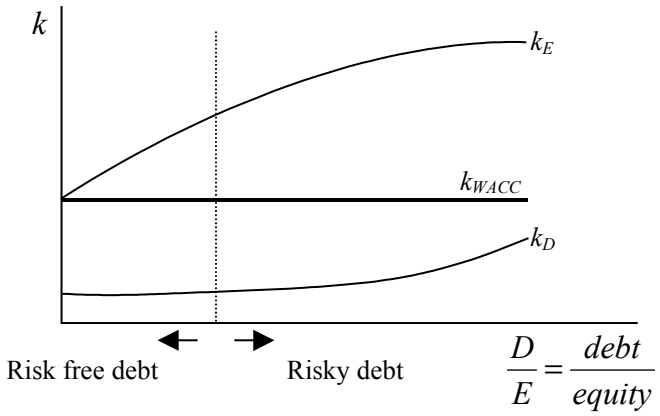
The Proposition II can be formally expressed by using eq. (2.3.2) as follows:

$$k_{WACC} = \frac{D}{D+E} k_D + \frac{E}{D+E} k_E \Rightarrow k_E = k_{WACC} + \left(k_{WACC} - k_D\right)\frac{D}{E} \qquad (2.4.10)$$

thus the required rate of return on equity increases when the ratio of debt to equity increases (higher leverage). It is assumed, that the cost of capital will remain constant because the increase in the cost of equity is exactly offset by the decrease in the cost of "cheaper" debt.

The second proposition can be illustrated as follows:

Figure 2: Proposition II



Source: Brealey and Myers (2003, p.474, figure 17.2)

The expected return on equity k_E increases linearly with the debt-equity ratio so long as debt is risk free. But if leverage increases the risk of the debt, debtholders demand a higher return on the debt. This causes the rate of increase in k_E to slow down.

2.4.3 Effects of taxing corporations

To approach the real world and real economy, MM introduced the effects of taxation, where the interest bore on loan is tax deductible, as MM stated: "*The deduction of interest in computing taxable corporate profits will prevent the arbitrage process from making the value of all firms in a given class proportional to the expected returns generated by their physical assets. Instead, it can be shown (...) that the market values of firms in each class must be proportional in equilibrium to their expected return net of taxes (that is, to the sum of the interest paid and expected net stockholder income)*" (MM, 1958, p.272). Thus after tax income generated by the firm should be expressed as follows:

$$\overline{X}_j^{\tau} = (\overline{X}_j - rD_j)(1-\tau) + rD_j = \overline{\pi}_j^{\tau} + rD_j \qquad (2.4.11)$$

where τ_j stands for average rate of corporate income tax, $\overline{\pi}_j^{\tau}$ stands for expected net income accruing to the common stockholder and rD_j is income for debt holder.

A tax paying firm that pays an extra dollar of interest receives a partially offsetting "interest tax shield"[10] in the form of lower taxes paid. Financing with debt instead of equity increases the total after-tax dollar return to debt and equity investors, and should increase firm value.

In the same way we can now adjust both Proposition I and Proposition II to reflect the taxation, thus Proposition I becomes:

$$\frac{\overline{X}_j^{\tau}}{(S_j + D_j)} = \frac{\overline{X}_j^{\tau}}{V_j} = \rho_k^{\tau} \qquad (2.4.12)$$

and Proposition II adjusted to taxation becomes:

[10] The presence of corporate tax shield and its substitutes (e.g. depreciation, depletion, amortization and investment tax credits) was further analyzed by DeAngelo and Masulis (1980) who demonstrated that each firm will have "unique interior optimum leverage decision with or without leverage related costs." (p.3). More about DeAngelo and Mausilis's research regarding industries and capital structure can be found in section 3.2.1 –overview of literature concerning industry and capital structure.

$$i_j = \frac{\overline{\pi}_j^{\tau}}{S_j} = \rho_j^{\tau} + \frac{(\rho_k^{\tau} - r)D_j}{S_j} \qquad (2.4.13)$$

where ρ_k^{τ} is the capitalization rate for income net of taxes in class *k*.

2.4.4 Plurality of bonds and interest rates

As MM realized the return demanded by debt holders is not always constant and is changing together with maturity, technical provision of the loan and as well with the financial condition of the borrower. Thus MM suggest very simple approximation for return demanded by debt holders:

$$r = r\left(\frac{D}{S}\right) \qquad (2.4.14)$$

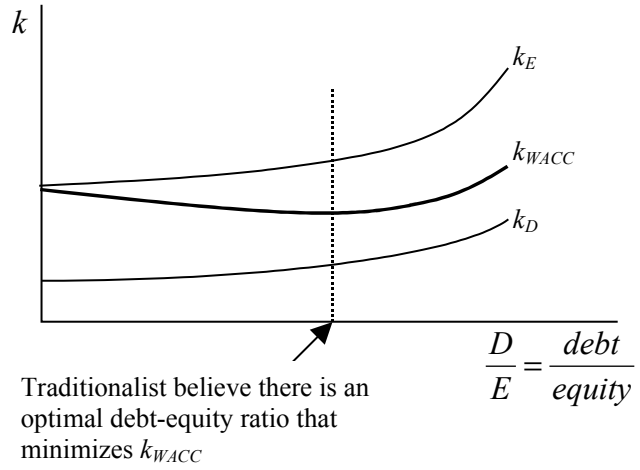
thus, the interest rate is increasing with increasing leverage, because leverage increases the risk of the debt and debt holders will demand higher return on riskier debt. But on the other side, the shareholders will face lower risk and thus should require lower return on equity. Modigliani and Miller suggested, that these two effects exactly offset each other and thus leave the weighted average cost of capital unchanged.

2.5 Traditional theory

Traditional theory was based on the naive theory and included both the present value of a tax shield and the costs of financial distress in the model. The difference against prior models is in the changes of required rate of return demanded by debt holders on one side and equity holders on the other side. The equity holders demand lower increase in return when the leverage of the firm is relatively low, but it increases faster when the leverage of the firm is relatively high. These assumptions allow for the optimum capital structure. As presented on the Figure 3 the minimum cost of capital will be reached at the point where the equity holders will consider the company to be more than moderately leveraged and with higher risk connected to higher leverage they will demand higher return for their equity.

The traditional theory can illustrated as follows:

Figure 3: Traditional view of leverage



Source: Brealey and Myers (2003, p. 479, figure 17.5)

2.6 The Tradeoff theory

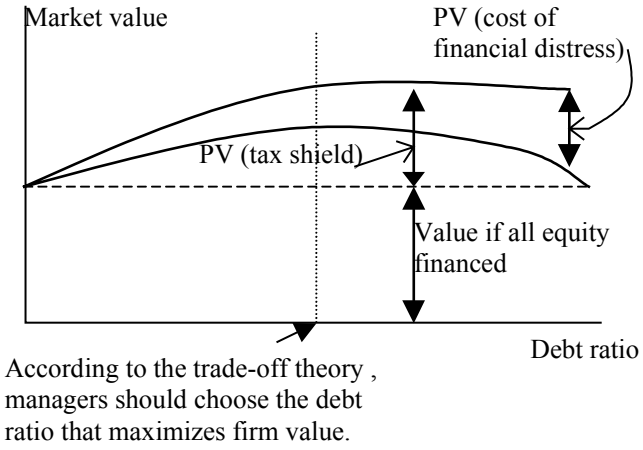
In 1958 Modigliani and Miller showed and proved that under special assumptions like perfect capital market, no taxes and perfect and cost-less information, a firm can not create value by choosing a specific capital structure. The reality however is suggesting that capital structure does matter and seems to be relevant in question of company value.

The trade-off theory of capital structure states that it is a consequence of several imperfections. As showed by Modigliani and Miller (1963) in the world where interest payments are tax-deductible and dividend payments are not, debt financing is associated with a high tax advantage and one would then expect firms to be (nearly) fully debt-financed. This result is, in general, not confirmed by empirical evidence. The increase in expected costs of financial distress with which additional debt financing is associated[11], would explain why this is the case. Firms could balance the costs and benefits of debt financing and choose the debt level where the marginal cost of debt financing equals its marginal benefit. This would result in the existence of an optimal capital structure. Once the optimal capital structure is reached, the (tax) advantage of additional debt is offset by the increase in the cost of financial distress. Firms for which the tax advantage is lower (e.g. firms with non-debt tax shields) and firms with higher costs of financial distress (e.g. firms with more volatile earnings) will have lower leverage[12].

[11] See e.g. DeAngelo and Masulis (1980)
[12] See e.g. DeAngelo and Masulis (1980)

The Tradeoff theory can be illustrated by the following figure:

Figure 4: Tradeoff theory



Source: Brealey and Myers (2003, p.498, figure 18.2)

It is now quite common to include agency-theoretical aspects in this trade-off framework as well. As debt financing causes monitoring by lenders and reduces the free cash flow, debt can be used as an instrument to align the interests of managers and shareholders[13]. Firms with more shareholder-management conflicts would thus use more debt financing. However, debt financing may also cause conflicts of interests between shareholders and debt holders, which could e.g. lead to sub optimal investment policies[14]. Firms that are vulnerable to this type of conflicts – firms for which growth opportunities are important – would use less debt financing. A well-chosen mix of debt and equity financing minimizes total agency costs, and maximizes firm value.

A common argument against the trade-off theory of capital structure is that it predicts high leverage ratios, whereas in practice (American) firms have relatively low debt ratios. Research on the determinants of capital structure provides in general little support for the trade-off theory, and in particular little evidence is found that taxes play

[13] See e.g. Jensen and Meckling (1976), or Jensen (1986)
[14] See e.g. Smith and Warner (1977), Myers (1977), Stultz (1990)

an important role. However, Berens and Cuny (1995) argue that (growing) firms may achieve complete tax shielding without being fully debt financed. This is especially the case if leverage is measured in terms of market value. Indeed, the market value of equity already accounts for future growth opportunities, although it is not yet necessary to shield income from future investments. Thus the debt ratio does not fully capture the firm's tax shielding. One should rather look at the amount of taxes the firm pays – or rather, does not pay. Berens and Cuny (1995, p. 1204) propose an alternative instrument: the debt tax shielding ratio (TSR): "the fraction of the (…) tax rate times income not actually paid as tax (…) with each component summed across years". Such a ratio measures the tax payments avoided by the use of interest-bearing debt financing.

2.7 Static tradeoff theory vs. dynamic theory

A substantial amount of the intuition about optimal capital structure comes from simple static trade-off models. In these models, Firms select their debt-equity ratios at some initial date, and depending on subsequent cash flows, either benefit from the debt tax shields and other advantages of leverage or suffer the consequences of too much debt and financial distress.

The implications of these models that are likely to suffer the greatest financial distress costs and benefit the least from the debt tax shield choose to be less levered are roughly consistent with the empirical evidence. However, it is not clear how the implications of simple static models carry over to a framework where the capital structure choice is dynamic, i.e., when firms choose their current capital structures knowing that they may need to be refinanced in the future. Specifically, in the absence of additional market imperfections, Firms should be able to enjoy the benefits of debt, and avoid the possibility of financial distress, by committing to new equity infusions whenever their earnings or debt ratings

fall to a level that would otherwise create an imminent threat of financial distress.

Under this type of arrangement even firms with high financial distress costs could optimally choose high leverage ratios. In reality, we do not observe firms implementing dynamic capital structure strategies that involve high debt ratios along with equity issuance when they are doing poorly.

There are many potential reasons why this might be the case. The first possibility, considered in Fisher, et. al. (1989), is that there exist transaction costs associated with issuing equity. However, these costs are not likely to be large relative to the tax benefits associated with higher leverage. A second possibility has to do with the time-inconsistency of the equity-issuance choice. While issuing equity may be ex ante desirable, ex post, firms may hesitate to do it because of either wealth transfers to bondholders or concerns about dilution (Myers and Majluf (1984)). However, this second argument applies the least to the firms with the greatest financial distress costs since they have the most to gain from shoring up their balance sheets. Furthermore, the previous argument does not address why firms are reluctant (or incapable) to commit to issuing equity contingent on triggering events, such as a fall in its financial ratios.

A potential missing element of the extant analysis of the dynamic capital structure problem relates to the information that is generated when firms raise external capital. Specifically, the dynamic strategy, that allows firms to avoid financial distress costs despite high leverage, requires them to issue equity during downturns, an activity that, for a variety of reasons, is likely to generate information about the firm. This information may be directly generated by the underwriting process since underwriters are required to produce information as part of their "due diligence". Or investors, who will have a greater incentive to do so if the act of issuing equity makes the market for the firms' stock temporarily more liquid, might gather the information.

We take for granted that more levered firms need to access capital markets more often and that, when they do raise external capital, they are scrutinized by market participants and information is generated. It is in this sense that we say that more highly levered firms are more transparent.

Easterbrook (1984) makes the point that firms that are forced to pay out a higher fraction of their cash flow are subject to greater scrutiny because of their need to access external capital and argues that this greater scrutiny benefits firms by reducing agency problems between shareholders and managers. In addition, since more transparent firms are likely to be more efficiently priced, they are also likely to make better investment choices, which make them more valuable on average. In contrast, some analysis indicates that transparency and hence leverage, can be costly in other situations. These situations arise when a firm's profitability depends, at least in part, on how the firm is perceived by its shareholders, e.g., its employees, customers, and suppliers. Specifically, when assumed that the shareholders are willing to do business with the firm on better terms when the firm is perceived to be a "winner" - say, one of the most innovative firms in the industry. As a result, the firm benefits when favorable information is generated and is hurt when unfavorable information is generated. As Almazan et. al. (2002) show that when the cost associated with unfavorable information exceeds the benefit associated with favorable information, thus transparency is costly and firms will tend to choose lower leverage ratios.

2.8 Pecking Order theory

The pecking order theory was first mentioned and developed by Myers (1984) and by Myers and Majluf (1984). The pecking order theory of capital structure is among the most influential theories of corporate leverage.

According to Myers (1984), due to adverse selection[15], firms prefer internal to external finance. When outside funds are necessary, firms prefer debt to equity because of lower information costs associated with debt issues. Equity is rarely issued.

Suppose that there are three sources of funding available to firms: retained earnings, debt, and equity. Retained earnings have no adverse selection problem. Equity is subject to serious adverse selection problems while debt has only a minor adverse selection problem. From the point of view of an outside investor, equity is strictly riskier than debt. Both have an adverse selection risk premium, but the premium is large on equity. Therefore, an outside investor will demand a higher rate of return on equity than on debt.

From the perspective of those inside the firm, retained earnings are a better source of funds than debt, and debt is a better deal than equity financing. Accordingly, the firm will fund all projects using retained earnings if possible. If there is an inadequate amount of retained earnings, then debt financing will be used. Thus, for a firm in normal operations, equity will not be used and the financing deficit should match the net debt issues.

These ideas were refined into a key testable prediction by Shyam-Sunder and Myers (1999), who suggest that the financing deficit should normally be matched dollar-for-dollar by a change in corporate debt. As a result, if firms follow the pecking order, then in a regression of net debt

[15]Adverse selection is defined by Brealey and Myers (2003, p. 1039) as follows: "A situation in which a pricing policy causes only the less desirable customers to do business, e.g., a rise in insurance prices that leads only the worst risks to buy insurance." The Adverse Selection problem was first discussed by Akerlof (1970)

issues on the financing deficit, a slope coefficient of one should be observed.

Shyam-Sunder and Myers (1999)[16] find that the pecking order model is statistically rejected. However it does provide a good first-order approximation of their sample of 157 U.S. firms that were traded continuously over the period 1971 to 1989. This is an attractive and influential result. The pecking order is offered as a possible empirical model of corporate leverage that is descriptively reasonable. Of course, 157 firms is a relatively small sample from the set of all publicly traded American firms. It is therefore important to understand whether the pecking order theory is broadly applicable.

Myers (2001) reports that external finance covers only a small proportion of capital formation and that equity issues are minor, with the bulk of external finance being debt. These key claims do not match the evidence for publicly traded American firms, particularly during the 1980s and 1990s. External finance is much more significant than is usually recognized in that it often exceeds investments. Equity finance is a significant component of external finance. On average, net equity issues commonly exceed net debt issues. Myers (2001) points out, that particularly striking is the fact that net equity issues track the financing deficit much more closely than do net debt issues, what is actually the opposite than what is predicted by pecking order theory.

In their paper, Klein, et. al. (2002) study the extent to which the pecking order theory of capital structure provides a satisfactory account of the financing behavior of publicly traded American firms over the 1971 to 1998 period. Their analysis has three basic elements. First, they provide evidence about the broad patterns of financing activity. This provides the empirical context for the more formal regression tests. It also serves as a

[16] Shyam-Sunder and Myers (1999) focused on a regression test of the pecking order. In this test they computed the financing deficit from information from the corporate accounts. The financing deficit was constructed from an aggregation of dividends, investment, change in working capital and internal cash flows. If the pecking order theory is correct, then the construction of the financing deficit variable is a justified aggregation. Under the pecking order, each component of financing deficit should have the predicted dollar-for-dollar impact on corporate debt.

check on the significance of external finance and equity issues. Second, they examine a number of implications of the pecking order in the context of Shyam-Sunder and Myers' (1999) regression tests. Finally, they check to see whether the pecking order theory receives greater support among firms that face particularly severe adverse selection problems. They concluded that the evidence does not support the pecking order hypothesis.

According to the pecking order theory, financing behavior is driven by adverse selection problem. Thus the theory should perform best among firms that face particularly severe adverse selection problems. Small high-growth firms are often thought of as firms with large information asymmetries.

According to Klein (2002), contrary to the theory, small high-growth firms do not behave accordingly to the pecking order theory. In fact, the pecking order works best in samples of large firms that continuously existed during the 1970s and the 1980s. Large firms with long uninterrupted trading records are not usually considered to be firms that suffer the most acute adverse selection problems.

Previous literature provides other evidence pertinent to a general assessment of the pecking order theory. The pecking order theory predicts that high-growth firms, typically with large financing needs, will end up with high debt ratios because of a manager's reluctance to issue equity. Barclay, et. al. (2001) suggest precisely the opposite. High-growth firms consistently use less debt in their capital structure.

According to the pecking order theory the securities with the lowest information costs should be issued first, before the firm issues securities with higher information costs. This suggests that short-term debt should be exhausted before the firm issues long-term debt. Capitalized leases and secured debt should be issued before any unsecured debt is issued. Barclay and Smith (1995) find that 50% of their firm-year observations have no debt issued with less than one-year maturity, 23% have no secured debt, and 54% have no capital leases. It seems difficult to understand this evidence within a pure pecking order point of view.

Chirinko and Singha (2000) question the interpretation of the Shyam-Sunder and Myers (1999) regression test. Chirinko and Singha show that equity issues can create a degree of negative bias in the Shyam-Sunder and Myers' test. Suppose that firms actually follow the pecking order theory, but that these firms issue an empirically observed amount of equity. In that case, they show that the predicted regression coefficient should be actually 0.74 rather than one. This amount of bias is not trivial, but it still leaves the coefficient very far from the magnitudes of slope coefficients that are observed. Chirinko and Singha also point out that if, contrary to the pecking order, firms follow a policy of using debt and equity in fixed proportions, then the Shyam-Sunder and Myers regression will identify this ratio. As a result, finding a coefficient near one would not disprove the tradeoff theory. Chirinko and Singha's cautionary note reinforces an important methodological point. Most empirical tests have various weaknesses. It is therefore important to examine the predictions of a theory from a number of points of view rather than relying solely on a single test.

Even if this theory is not strictly correct, when compared to other theories it might still do a better job of organizing the available evidence. The pecking order is a competitor to other mainstream empirical models of corporate leverage and it derives much of its influence from a view that it fits naturally with a number of facts about how companies use external finance.

2.9 The Signaling theory

Firms seeking outside funds to finance their investment opportunities naturally face an adverse selection problem as insiders of a firm know more about its operations than outside investors do. Outside investors anticipate insiders' desire to sell overpriced securities and therefore react negatively if firms announce to issue new securities. Myers and Majluf (1984) argue that the adverse selection problem is particularly striking if firms issue equity to finance their investments. Firms should therefore issue debt when they can and only issue equity if their debt capacity is exhausted. In other words there is a pecking-order of financial instruments in which debt precedes equity.

Stiglitz and Weiss (1981) however show that when there is asymmetric information between insiders of a firm and outside investors (banks) then the Adverse Selection problem created by debt finance may lead to rationing, i.e. a situation in which firms' demand for funds is not fully satisfied. Since firms may not obtain the funds they need via debt finance they should seek equity finance instead. Equity then dominates debt since it avoids rationing[17].

Here we are actually facing a puzzle: when insiders of a firm have more information than outside investors then the desire to sell overpriced securities leads to two contradictory results. On the one hand, it leads to the Pecking-Order in which debt dominates equity and on the other hand it leads to Credit Rationing with the consequence that equity dominates debt as a result of rationing.

In their paper Stiglitz and Weiss (1981) resolve the puzzle by allowing firms to issue both debt and equity together and by having a general notion of what it is that insiders know more about.

[17] The preceding Pecking-Order and rationing literatures have either considered debt or equity separately (Bester (1987), Hellmann and Stiglitz (2000)) or they have made very strong assumptions about the nature of asymmetric information (Brennan and Kraus (1987), Constantinides and Grundy (1989), Nachman and Noe (1994)) or they have done both (Stiglitz and Weiss (1981), Myers and Majluf (1984), Bester (1985), Besanko and Thakor (1987a), de Meza and Webb (1987)).

Stiglitz and Weiss concluded that combinations of debt and equity can be used to credibly signal information to the market. Contrary perhaps to one's intuition, firms with safe investments issue more equity and less debt than firms with risky investments. The reason is that a financing decision can only be a useful signal if it is credible since insiders have an incentive to sell overvalued claims. Equity credibly signals safe investment projects since firms with risky projects find it too costly to use it.

Equity is a convex claim so that its value increases with the risk of the underlying assets. Since the value of a claim is a cost to the firm, equity is particularly costly for risky firms. Similarly, debt credibly signals that investment projects are risky. Debt is a concave claim whose value decreases with risk. Since safe firms'debt is very valuable they find it very costly to issue. As a result, safe firms are unwilling to mimic risky firms'decision to issue debt.

As inside information is credibly transmitted to outside investors, there will be no general adverse selection effect and the financing decision will be efficient, i.e. all investment projects.

There is plenty of evidence that the stock price reacts negatively to the announcement of a new security issue, see for example Asquith and Mullins (1986), Masulis and Korwar (1986) or Mikkelson and Partch (1986).

2.10 The Free Cash Flow theory

The Free Cash Flow theory (Jensen, 1986) says that dangerously high debt levels will increase value, despite the thread of financial distress, when firm's operating cash flow significantly exceeds its profitable investment opportunities.

As debt financing causes monitoring by lenders and reduces the free cash flow, debt can be used as an instrument to align the interests of managers and shareholders[18]. Firms with more shareholder-management conflicts would thus use more debt financing. However, debt financing may also cause conflicts of interests between shareholders and debt holders, which could e.g. lead to sub optimal investment policies[19].

Firms that are vulnerable to this type of conflicts – firms for which growth opportunities are important – would use less debt financing. A well-chosen mix of debt and equity financing minimizes total agency costs, and maximizes firm value.

The Free Cash Flow theory thus suggests that debt reduces the agency costs. Debt financing ensures that the management is disciplined to make efficient investment decisions and that managers are not pursuing individual objectives as this would increase the probability of bankruptcy (Harris and Raviv, 1990).

On the other side, when managers are obligated to meet the liabilities from servicing the relatively high debt, they might miss an NPV project because of insufficient funds for new investments, thus the free cash flow theory is designed for mature firms that are prone to over invest.

[18] See e.g. Jensen and Meckling (1976), or Jensen (1986)
[19] See e.g. Smith and Warner (1977), Myers (1977), Stultz (1990)

3 Empirical analysis

Preceding studies on the leverage and countries[20] succeeded in explaining about 30% of the total variance in leverage using linear regression. In these regressions, taxes and firm specific determinants were used as independent variables. However, it is not so clear in which setting industry effects the regression.

For this reason, this work divides the determinants of financing choice into two groups. Corporate finance theory suggests certain independent variables to be the major determinants of the capital structure. These factors are named ***primary factors*** (section 3.1 and respective subsections) throughout this paper. For example, primary factors are company size, growth, asset tangibility, profitability, firm tax rate, non-debt tax shield and market-to-book ratio. These factors are based on theoretical background and there is a plenty of empirical findings supporting or in other cases contradicting influence of these determinants on corporate capital structure.

However, since the data contain more useful information, these factors are not sufficient in this case. For instance, the country and industry affiliation of a company might provide beneficial information and these two determinants are called ***secondary factors*** (section 3.2).

The idea behind this dividing of factors is following: As previous studies show, country and industry factors can have significant influence on the capital structure of a company. From this finding one can construct two alternative hypotheses. Secondary factors could constitute a class of determinants of their own. For example, cultural effects might play a role in certain countries and influence the capital structure of all companies.

Secondary factors, on the other hand, could be a pool of primary factors, which are part of one of the secondary factors. For example, there

[20] E.g., Andritzky (2003), Antoniou et al. (2002), Booth et al. (2001), Bowen et al. (1982), Das and Roy (2001), Harris and Raviv (1991) and Kremp at al. (1999).

might be concrete regulatory influences on certain industries. Even if this regulatory influence may be firm-specific and depend on individual firm characteristics (e.g. the business exposure to the regulated activity), a direct firm-specific measure cannot be found in the available balance sheet data. In this case the secondary factor of industry affiliation serves as proxy for a pool of primary effects and thus should not have any strong explanatory power.

In this analysis the goal is mainly to identify the impact of industry class as a secondary factor[21] on the capital structure. This thesis, concentrates on the basics of empirical analysis. For this reason, the debt ratio is the centre of interest.

I believe that using ordinary least squares (OLS) estimation method in this case is acceptable. OLS seems to be good approximation since the results from Tobit regressions, non-linear least squares (NLS) and ordinary least squares give nearly comparable results as reported by Rajan and Zingales (1995) and Bauer (2004).

The ordinary least squares econometric procedure is used throughout this paper unless mentioned otherwise.

3.1 Primary factors

This thesis is focused on the influence of industry class on the capital structure and thus for our demonstrating purposes it appears reasonable to work with limited number of determinants only. It will help keeping the core of the thesis more transparent and as well it is acceptable approach in similar papers[22].

The other determinants also deserve certain attention as well, however the author yields it to other researchers for further study.

[21] For detail analysis of primary factors in Visegrad countries please refer to Bauer (2004).
[22] See e.g. Andritzky (2003) or Rajan and Zingales (1995).

3.1.1 Size of the firm

It is generally accepted that size is an inverse proxy for the probability of bankruptcy (Rajan and Zingales, 1995). Thus larger firms, because of diversification, are likely to have higher debt capacity and are expected to borrow more to maximize the tax benefit.

Fama (1985) argues that the information content of small and large firms is not the same due to monitoring costs being relatively higher for smaller firms. Thus larger firms, due to lower information asymmetry, are likely to have easier access to debt markets and are able to borrow at lower cost.

Consistent with the predictions of the 'differential information hypothesis', Titman and Wessels (1988) argue that if a size effect exists it should be associated with very small firms. Numerous studies argue that size can be a powerful explanation for cross-sectional differences in debt-equity ratios.[23] Since the probability of bankruptcy is inversely related to size, such cost might be less important for large firms while raising debt capital. Large firms can generally be easier and more diversified and the transaction costs are relatively lower when issuing debt on the financial markets.

Although its relation to leverage is not sufficiently straightforward, size is generally agreed to be positively associated with leverage.

The positive correlation between long-term debt ratio measured at book value and firm size represented by market value of total asset has been proved by Rajan and Zingales (1995)[24] and by Booth et al. (2001)[25]. However, as Rajan and Zingales state, if the costs of financial distress are low, the positive relationship should not be strong. This proposition is empirically supported by the findings of Ferri and Jones (1979) and Kim and Sorensen (1986).

[23] See, for instance, Michaelas et al., 1999

[24] The study concentrated on G-7 countries, the relationship was confirmed with the only one exception: Germany (Rajan, Zingales, 1995, p. 1453). This was explained by legal specialties of German corporate and bankruptcy law and by special relationship between German small and medium-size firms and their banks.

[25] Booth at el. (2001) have analyzed 10 developing countries.

SIZE is in most studies approximated as a natural logarithm of sales or as a natural logarithm of total assets[26].

3.1.2 Profitability

The Pecking Order theory of capital structure (Myers 1984) suggests that firms prefer to finance new investments from retained earnings and raise debt capital only if the internal capital is insufficient[27]. As the availability of internal capital (retained earnings) depends on profitability of the firm, one could expect an inverse relation between leverage and profitability.

Jordan et al. (1998) argue that as small and medium-sized enterprises have restricted access to the financial capital markets and their capital structure should be consistent with this prediction. However, they find only limited empirical support to the predictions of the Pecking Order theory.

On the other hand, the Free Cash Flow theory (Jensen, 1986) suggests that debt reduces the agency cost of free cash flow. Debt financing ensures that the management is disciplined to make efficient investment decisions and that they are not pursuing individual objectives as this would increase the probability of bankruptcy (Harris and Raviv, 1990). In situations of information asymmetry, increases in the debt ratios of a profitable firm can signal quality financial management. Therefore, this theory implies a positive association between leverage and profitability.

The findings of Kester (1986), Titman and Wessels (1988), Rajan and Zingales (1995)[28] and Booth et al. (2001)[29], empirically confirm an inverse relation between the leverage ratio and profitability.

Profitability is defined as a ratio of operating income (EBIT - earnings before interest and taxes) over total assets.

[26] More about size proxies can be found in section 3.6 – Introducing industries as a leverage determinant and in the appendix section 5.2 – Choosing better variable for Size factor.
[27] According to information asymmetry about new investment project or investment opportunities, the retention may be the cheapest source of funds. For detail discussion of POT please refer to section 2.9.
[28] Rajan and Zingales (1995), p. 1425.
[29] Booth et al. (2001), p. 106.

3.1.3 Tangibility of assets

As the value of intangible assets disappears (almost entirely) in the cases of bankruptcies the presence of tangible assets is expected to be important in external borrowing as it is easy to pledge them. Similarly, it reduces agency costs since debts can be secured with known tangible assets that have alternative re-deployable uses in case of default.

Furthermore, as Stulz and Johnson (1985) argue, a firm's opportunity to engage in asset substitution is reduced by secured debt. In firms with more intangible assets the costs of controlling capital outlays are higher as monitoring is more difficult. Similarly, Johnson (1997) argues that it is more difficult for firms holding secured debt to shift to riskier projects if they have more tangible assets. Thus, the creditors might impose restrictions to the firms with relatively less tangible assets.

This general discussion converges to conclude that there should be positive relationship between leverage and fixed assets. This relationship was empirically confirmed by Rajan and Zingales (1995), Booth et al. (2001) proved a low but significant negative relation between total debt and asset tangibility and a slightly significant positive relation between long-term debt and asset tangibility.[30] The collateral is more relevant in traditional bank lending systems than in countries where borrowing from capital markets is usual.

The majority of studies define the asset tangibility ratio as the ratio of net tangible (fixed) assets to total assets.

3.1.4 Market-to-book ratio

Market-to-Book Ratio (MBR) measures market's expectation of the value of the investment opportunities and growth of the firm. An increase in the probability of success of a positive NPV investment opportunity increases the MBR as the investors will prefer higher quality projects. Johnson (1997) highlights the problem of asset substitution in this conjuncture since the growth opportunities related to MBRs are deemed intangibles in the sense that firms with proportionately more

[30] Booth et al. (2001), p. 106ff.

collateralisable tangible assets for secured debt would experience some difficulties in shifting to riskier projects.[31]

Rajan and Zingales (1995) offer other two main reasons for a negative relationship between MBR and leverage. Firstly, it is expected that as MBR increases so does (through the related risk) the cost of financial distress. Secondly, firms prefer to issue equity when the stocks are overvalued[32].

Moreover, Myers (1977) argues that firms with growth opportunities should use less debt in order to soften agency problems. Thus, an inverse relationship between MBR and debt ratio is expected as well. Firms are less likely to use debt for funding during periods of rapid growth as the increased risk for debt holders to suffer from exploitation as mangers take more risk to raise return on equity will lead to an increase in the interest rate and/or the agreement of limitations of managers' ability to engage in new investment projects in the debt contracts.

On the other hand, faster growing firms are likely to be in need of external funds to finance their positive investment opportunities. As suggested by the Pecking Order theory, if firms require external finance they prefer debt relative to the external equity. This causes the debt to go up and hence MBR should be positively associated with leverage (see, for example, Kremp et al., 1999).

However, the strength and role of this variable is likely to vary across the sample countries. For example, as reported by Rajan and Zingales (1995), lenders German firms, especially the banks, are frequently represented in the supervisory board of the companies and work in close contact with the management. Thus, the lenders are likely to be fully aware of the quality of investment opportunities. This minimizes information asymmetry, which in turn affects the borrowing ability of the firms and the risk premium demanded by the lenders. On the other hand, British firms have distant relationships with their lenders. Thus, lenders

[31] The difficulties would arise from new-investment restrictions that are by default embedded in the loan contracts.
[32] See Signaling theory – section 2.10

are unlikely to be fully aware of the quality of investment opportunities and hence they demand higher risk premiums (higher rates of interest) on their investment (loan). A higher interest rate is likely to deter firms from borrowing.

3.1.5 Effective tax rate

As the interest on loan is tax-deductible, firms with higher tax liability have an incentive to use more debt. Therefore, as Haugen and Senbet (1986) state, a positive relationship between effective tax rate and leverage ratio is expected. This argument holds only if firms have a sufficient amount of taxable income.

On the other hand, higher corporate tax rates would result in lower internal funds as well as higher cost of capital. As a result, fixed capital formation and demand for external funds would decrease (Kremp et al., 1999). This implies an inverse relationship between the level of debt and the effective tax rate.

However, Titman and Wessels (1988), among others, failed to find any significant effect of corporate tax on financial decisions. Due to these complexities the overall relationship between effective tax rate and leverage remains an empirical matter.

The effective tax rate is measured as the ratio of total tax to total taxable income of the firm.

3.1.6 Earnings volatility

Firms with high earnings volatility carry the risk of earnings level dropping below the level of their debt service commitments. This may result in arranging funds at high cost to service the debt or face the risk of bankruptcy.

On the other hand, firms financed by equity may choose not to pay dividend during the period of financial difficulties. Therefore, firms with highly volatile earnings borrow the least and prefer equity to debt. This suggests an inverse relation between earnings volatility and leverage ratio.

Bradley at al. (1984) found that the volatility of earnings is a strong inverse determinant of debt and that earnings volatility may be industry related, this may also affect the relationship of industry class and capital structure decisions. Following Jenson and Mecking (1976) the free cash flow argument, it seems that individual industries may be characterized by their growth rates which may influence debt levels in their capital structure.

However, the potential cost of failing to service debt depends upon the source of debt and the relationship of the firm with its lender. A close relation between the firm and its lender reduces such costs. The cases of German firms fall in this category as they have close ties with the banks. Therefore, the effective cost of failing to service debt would be expected to be relatively low for German firms. On the other hand, British firms raise loan capital from capital markets and have distant relations with lenders. Hence, the cost of failing to service market debt is high.[33]

To measure properly the influence of earnings volatility on capital structure, it would be reasonable to work with data from stock exchanges and balance sheets for at least five or more years. Unfortunately our database is not so rich and includes observations from years 2000 and 2001 only and thus will not allow us to perform earnings volatility analysis.

[33] Almazan, Suarez and Titman (2002) empirically confirmed this relations for both German a British firms.

3.1.7 Other Market Related Factors

Equity premium

Equity premium measures the cost of equity in relation to the return on risk free investment. Evidence shows that the equity premium varies over time. Higher equity premium causes higher cost of equity capital. Thus, if a firm requires external capital during the period of high equity premium managers are likely to choose debt than equity. This implies a positive relationship between leverage ratio and equity premium.

On the other hand, if the observed high equity premium is due to bullish stock market (stocks are overvalued), managers are likely to issue equity. This implies an inverse relation between equity premium and leverage. Therefore, the nature of the effects of equity premium on leverage is dependent on the source of change in equity premium. To allow for decision time lagged equity premium can be used.

Term-structure of interest rates

In spite of the tax savings on interest, higher interest rates cause higher weighted average cost of capital resulting in a decline in the value of the firm. Since the interest on loan is a relatively long-term fixed commitment, firms do not prefer to raise loan capital when the market rate of interest is high. Moreover, firms with higher interest commitments face higher risk of bankruptcy should the earnings level drop below the level of interest liability. Such liability increases with the increase in the rate of interest. Thus, managers are likely to consider the market rate of interest while deciding the capital structure. Since the term-structure of interest rates contains more information than the rate of interest on a particular type of financial asset, the term-structure might be included as an explanatory variable in the model and an inverse relationship between this variable and corporate leverage ratio in all countries can be expected.

Share price performance

It is often argued that managers prefer to issue equity after share price increase. Marsh (1982) states that in choosing between debt and equity, firms are heavily affected by the past history of stock prices and market conditions. As explained by the Pecking Order theory, information asymmetry between managers and outside investors forces managers to sell the equity at a discount. Managers offer such discount when the benefit of raising external equity capital outweighs the cost of discount.

When shares are overvalued discount could be offered without any loss in the wealth of existing shareholders. This is possible if equity is issued after a share price increase[34]. This suggests an inverse relationship between the increase in share price and leverage ratio. However, such an inverse relationship with market-leverage may be observed due to artificial statistical distortions as the market value of equity increases with the change in market price even if there has not been any further equity issue. However, book leverage should remain independent of this statistical effect.

3.1.8 Liquidity

As described by the Pecking Order theory, the managers prefer internal sources of finance. Therefore, they would like to create liquid reserves from retained earnings to finance future investments. Firms with sufficient liquid asset do not require to raise external capital (debt) and hence are expected to have lower leverage.

3.1.9 Lagged Leverage

The effect of one period lagged leverage is useful in understanding whether firms have optimal capital structure, and if any, the degree of divergence (convergence) from (to) the target. Banerjee et al. (2000) argue that if adjustment costs (legal fees, flotation costs, etc.) are too high,

dividend policy can be used to change the current capital structure without any transaction in capital markets.

3.1.10 Summary of primary factors

The influence of primary factors on the leverage summarizes the following table:

Theoretical results:

Factor	***Theory***
Size	+/0
Profitability	+/-
Tangibility	+
Market to book r.	-
Effective tax rate	+
Liquidity	-
Volatility	+/-

According to the theory, positive only relation is expected between tangibility and effective tax rate and leverage, positive or null relation is expected between size and leverage. In the case of profitability and volatility the theory is not uniform and suggests both positive and negative relationships. When considering the influence of market to book ratio and liquidity, the theory suggest purely negative relationship.

[34] As can be easily realized, this approach is kind of Signaling theory (section 2.10) just viewed from the managers' perspective.

3.2 Secondary factors

3.2.1 Literature overview

Many other studies have constructed quite obvious connections between capital structure and factors like size, asset tangibility, etc. (see section 3.1), and further more competition, business risk, dividend policy, and regulation. These determinants are often characteristic to a specific industry. A number of empirical studies have already tested this relationship.

Different results about the relevance of the industry to the capital structure motivated the study of Scott and Martin (1975). They solve the methodological problems of previous studies by using parametric and non-parametric methods[35]. Refuting the results of Remmers et al. (1974), they show that there are significant differences in debt ratios between the industries.

Lev (1974) compared operating leverage to industry membership and to systematic risk and found a positive relationship. Building on Lev's study, Mandelker and Rhee (1984) empirically lends support to the conjecture that firms engage trade-off between operating leverage and financial leverage and argued that due to this trade-off a firm's industry may have some influence on capital structure decisions.

Bowen et al. (1982) uses cross sectional and time series data to test the relationship between debt ratio and industry classification[36]. One question of the study is whether the companies try to adapt to the industry specific leverage ratio.

Bowen et al. support the hypothesis that the movements of the debt ratio are not purely random but tend towards the mean of the particular industry.

[35] Scott and Martin 's approach applies a variance analysis and the Kruskal-Wallis test. The sample included around 200 U.S. companies divided into 12 industry classes, Scott and Martin analyzed sample from time period 1967 – 1972.
[36] Bowen at al (1982) included in their sample 1,800 companies over the period 1951 – 1969.

DeAngelo and Masulis (1980) and Masulis (1983) continued in this direction of research and further argued that when firms which issue debt are moving toward the industry average from below, the market will react more positively than when the firm is moving away from the industry average.

This hypothesis was tested by Hatfield et al. (1994), who analyzed sample of 183 debt issue announcements in order to capture the market reaction, and concluded that "relationship between a firm's debt level and that of its industry does not appear to be of concern to the market … overall, that the market does not consider industry averages for leverage as discriminators for firms' financial leverage" (p.8). In other words that means, that there is no single optimal industry debt level, but the industries statistically differ in leverage.

Bowen et al. also succeed to explain the differences between industries by a non-cash tax shelter factor. This factor stands for tax deductions that are independent of the debt load. These tax deductions can for example stem from R&D expenses or investments in immaterial assets.

Kahle and Walking (1996) postulate a very high influence of the industry affiliation on the optimal capital structure. Their approach includes the firm-specific determinants like income volatility, tax deductions and expenses for marketing and R&D. The debt ratio in Kahle and Walking's paper consists of long-term debt over long-term debt plus equity at market value and excludes short-term debt. In their sample they confirm that the mean debt ratio differs between industries. In regression, the firm-specific variables explain a great proportion of the variance in debt ratios, but industry factors further increase this measure.

Some more working papers more recently focus on the topic of industry relevance. Most of them, similarly to this work, are often focused on a specific geographical region or country.

Another set of research has compared differences in the capital structure between countries. Booth et al. (2001) use corporate balance sheet data of ten developing countries to show in a cross-sectional

regression whether the capital structure theory is relevant in developing countries. They compare their results to Rajan and Zingales (1995), who have used a related approach for companies from the G7 countries. Booth et al. show that the financial structure in developing and developed countries is affected by mainly the same factors like company size, tax rates, asset tangibility, business risk, return on asset and the market to book ratio as well as macroeconomic determinants.

Demirgüc-Kunt and Maksimovic (1999) present a very comprehensive overview. They use data of 19 developed economies and eleven developing economies for the period from 1980 to 1991, based on firm-level data from Global Vantage and IFC[37]. For their regression they create independent country indicators for stock market activity, bank sector performance, legal system, and government subsidies to determine the joint impact on short- and long-term debt in large and small companies.

Even if there is already moderate amount of literature concerning description of industry characteristics with regard to corporate finance topics, in the area of country studies there is indeed a vacant space for empirical study of central European countries. This is where this empirical study is positioned.

3.2.2 Other factors

These above mentioned theories and factors that are generally accepted can be supplemented by the following lines of reasoning which give attention to differentiating characteristics between industries.

Building on Maksimovic and Zechner (1991), Almazan and Molina (2001) argue that there is a connection between production technology and financing structure. The technology choice influences the composition of input factors. Resulting differences in cash flows are reflected in the capital structure.

Shleifer and Vishny (1992) show that debt capacity depends on the existence of secondary markets for assets. The higher the liquidation value

of assets within an industry, the lower are the bankruptcy costs. This may induce a higher leverage within the industry.

Furthermore, Barclay et. al. (1995) show the evidence that regulation has an effect on the capital structure. Heavily regulated industries normally operate with less exposure to business risk. In the U.S., the deregulation of the telecommunications industry has reduced the mean leverage from 45% in the 70ths to only 25% in the 90'[38].

3.3 Database description[39]

Data used in the analysis was collected from financial reports of listed companies. In the case of the Czech Republic, financial reports were utilized as available on the Prague Stock Exchange website and in the Securities Centre of the Czech Republic database; prices of ordinary shares at the year-end were obtained from 'Burzovní noviny', the official stock-market supplement to the 'Hospodářské noviny' daily. Financial reports are based on Czech Accounting Standards (the only data available for all companies). In the case of Hungary, financial reports were collected from the fomax.hu and eco.hu databases; prices of ordinary shares at the year-end were obtained from the Budapest Stock Exchange (2001) and Budapest Stock Exchange (2002). Reports are based on International Accounting Standards. In the case of Poland, financial reports of companies were procured from the Parkiet.com database; prices of ordinary shares at the year-end were obtained from the Warsaw Stock Exchange (2001) and Warsaw Stock Exchange (2002). Reports are based on International Accounting Standards. In the case of the Slovak Republic, financial reports of companies were provided by the Bratislava Stock Exchange; prices of ordinary shares at the year-end were obtained from the Bratislava Stock Exchange website. Reports are based on Slovak Accounting Standards.

[37] International Finance Corporation, member of the World Bank Group.
[38] See Barclay, Smith and Watts (1995)
[39] Database is used as in Bauer (2004), which the author helped to create. However, because of different aims of this thesis, the sample selection is different.

Only companies which were listed on the respective stock exchange during the observed period from 2000 to 2001 were included in the sample. Companies which exhibited negative equity in any year of the analysis were consequently dropped from the sample (17 companies in the case of Poland, 1 company in the case of the Czech Republic, 1 company in the case of the Slovak Republic). The sample size is described in Table 1 and Table 2.

Table 1: Number of listed companies on national stock exchanges compared to our sample:

	2000		2001	
	Listed	In sample	Listed	In sample
Czech Republic	151	73	102	73
Hungary	60	37	56	34
Poland	225	167	230	162
Slovak Republic	866	68	888	58

Source: Prague Stock Exchange (2001, 2002), Budapest Stock Exchange (2001, 2002), Warsaw Stock Exchange (2001, 2002), Bratislava Stock Exchange (2001, 2002)

In the second column of Table 1 labeled Listed, the total number of listed companies traded on the respective stock exchange is expressed. It comprises also financial companies which are not subjects of our interest here. This is the main reason why the number of companies in the sample is significantly smaller than the total number of listed companies. Moreover, some companies were delisted and some newly listed during the period of our analysis, which also increases the difference between the total number of listed companies and sample size.

It is possible to state that for the Czech Republic, Hungary and Poland the sample comprises almost all listed non-financial companies which fulfilled the above mentioned conditions to be included in the sample. In the case of the Slovak Republic the sample size is relatively small. Unfortunately, it was not feasible to obtain data for more companies. However, the sample includes all companies traded on the Market of Listed Securities, and companies with substantial turnover

traded on the other markets. Therefore, the sample covers relatively high share of turnover and market capitalization of the Bratislava Stock Exchange despite the small size.

Table 2: Capitalization of listed companies compared to our sample (in EUR millions)

	2000			2001		
	Listed	In sample	%	Listed	In sample	%
Czech Republic	12,275	10,869	88,55	10,421	9,076	87,09
Hungary	12,851	10,759	83,72	11,576	9,603	82,96
Poland	33,836	23,361	69,04	29,403	16,483	56,06
Slovak Republic	3,522	1,062	30,15	3,935	1,244	31,61

Source: Prague Stock Exchange (2001, 2002), Budapest Stock Exchange (2001, 2002), Warsaw Stock Exchange (2001, 2002), Bratislava Stock Exchange (2001, 2002)

The industry affiliation and number of employees were added according to the Amadeus database, which includes both NACE and SIC codes. Unfortunately not all companies were described with such a data, in that case the company was excluded from our research.

3.4 Industry classification – NACE codes

In order to analyze the impact of industry classification on the capital structure it is necessary to implement reasonable industry groups that would help us to sort the firms into the groups of same or similar kind of production or services.

As Bowen et al. (1982) stated: "When relating "industry" groupings and "leverage" empirical findings may be sensitive to how the two concepts are operationalized. …it is possible that rather inconsistent classifications are causing some of the results" (page 11).

The main activity classification is ISIC (International Standard Industrial Classification of all economic activities) maintained by the United Nations and used at the world level, however in the EU countries the NACE codes are used. The NACE-code system is based on the European standard for industry classifications and was introduced in 1970. In 1990 a revised version became applicable. NACE means "Nomenclature

Generale des Activites Economiques dans I`Union Europeenne" (roughly translated - General Industrial Classification of Economic Activities within the European Communities).

In this work, NACE industry codes were chosen to differ among industries. The main argument for using NACE industry codes is that NACE is more natural to use in the European countries.

In most of the research papers the classification into industries is done by SIC (standard industrial classification) code, which is commonly used in the United States of America.

The first four digits of the NACE code are the same in all European countries. The fifth digit might vary from country to country and further digits are sometimes placed by suppliers of databases. The 16 markets (manufactures, agriculture, etc.) are denoted by letters form A to Q. A further 59 principals groups have been given two-digit NACE-codes, which can then be subdivided into 640 individual groups (four-digit NACE-codes).

Table 3: Example of NACE codes

D	Market manufacturer
NACE-code 15	Manufacturer of food and beverages
NACE-code 15.5	Milk processing
NACE-code 15.52	Production of ice cream

The complete overview of NACE classification can be found in the section Appendix 5.1.

3.5 Dependent variables

As mentioned in theoretical part, there are two leverage ratios to measure leverage: MTL (leverage in market value expressed by formula:

$$MTL = \frac{Total\ liabilities}{(Total\ Liabilities + market\ value\ of\ equity)} \qquad (3.5.1)$$

and TL (leverage in book value):

$$TL = \frac{Total\ liabilities}{Total\ Assets} \qquad (3.5.2)$$

Table 4:Distribution parameters for MTL and TL debt ratios (2000):

MTL (2000)	***Cz***	***Hu***	***Pl***	***Sk***	**All**
Mean	0.613937	0.390459	0.498524	0.581283	0.527667
Median	0.645643	0.365317	0.515464	0.656110	0.553449
Std. Dev.	0.236395	0.229941	0.233495	0.286955	0.253301
TL (2000)					
Mean	0.425286	0.370402	0.488585	0.435906	0.452133
Median	0.454980	0.391214	0.485111	0.443277	0.456997
Std. Dev.	0.198362	0.163537	0.214523	0.212995	0.209237
Observations	73	37	167	68	345

Source: Own computation

Table 5:Distribution parameters for MTL and TL debt ratios (2001):

MTL (2001)	***Cz***	***Hu***	***Pl***	***Sk***	**All**
Mean	0.611511	0.429359	0.581773	0.563515	0.569326
Median	0.658475	0.434832	0.621034	0.596781	0.609215
Std. Dev.	0.235192	0.208019	0.243357	0.291732	0.251497
TL (2001)					
Mean	0.408068	0.375409	0.526766	0.425548	0.466577
Median	0.401788	0.388053	0.519766	0.435407	0.470823
Std. Dev.	0.200834	0.163314	0.216091	0.237654	0.219722
Observations	73	34	162	58	327

Source: Own computation

From these tables we can observe, that Czech and Slovak companies are more leveraged in comparison to Polish and Hunagarian firms when using market value expression for leverage, but when using TL ratio than the Polish firms are the most leveraged. Hungarian firms are in both cases the least leveraged.

As can be observed from tables 4 and 5, leverage expressed in TL ratio shows lower standard deviation in all countries in both years 2000 and 2001. Thus when choosing between these two ratios, the one with lower standard deviation should be preferred.

3.6 Introducing industry as a leverage determinant

As described in section 3.1 and its subsections, there are four main primary factors that will be used as variables for demonstrating industry influence on capital structure.

There are two proxies for the SIZE factor of the firm, one expressed as a natural logarithm of sales and second as a natural logarithm of total assets. In order to simplify the models, when several models were computed, it was decided to use the proxy of natural logarithm of sales, because it was proved that models including log(sales) variable show higher R-squared and the proxy for SIZE expressed by natural logarithm of sales was more significant. See appendix 5.2 for examples of models using log(SALES) and log(TA) variables as a proxy for size.

In order to establish some comparative base, first we run estimation without any industry neither country dummies. When estimating the impact of the primary factors on leverage in all four countries we will use the following variables[40]:

Leverage (TL) – dependent variable. As noted by Bowen et al. (1982), it could be measured by either equity ratio or debt ratio. According to the fact that not all companies in the sample are traded frequently and skepticism about the efficiency of central European capital markets, it is assumed to prefer debt ratio rather than equity ratio for leverage expression. This choice is moreover supported by lower standard deviation as shown in tables 4 and 5.

Size of the firm (log(sales)) – measured by the natural logarithm of sales. Taking into consideration that all countries under this analysis

belong to EURO area, its more natural to convert the sales to EURO currency than to US Dollars. Thus, all sales are converted at the appropriate year-end exchange rate.

Tangibility (TANG) – measured by ratio of fixed assets over total assets.

Profitability (ROA) – measured by ratio of EBIT (earning before interest and taxes) over total book assets.

Market to book ratio (PB) – measured by the ratio of market price over the book price of equity.

Thus the following equation is to be estimated:

$$TL(\textit{firm } i) = c + \beta_1 \log(SALES)_i + \beta_2 TANG_i + \beta_3 ROA_i + \beta_4 PB_i + \varepsilon_i \qquad (3.6.1)^{41}$$

3.6.1 Test of equality (pooled OLS)

One of the basic assumption of OLS estimation is homoskedasticity of the residuals, e.g. that the residuals have the same normal distribution in all parts of the gathered sample.

Test of equality is a test for the presence of heteroskedasticity in the residuals from the least squares regression (White, 1980). Ordinary least squares estimates are consistent in the presence of heteroskedasticity, but the conventional computed standard errors are no longer valid.

White's test is a test of the null hypothesis of no heteroskedasticity against heteroskedasticity of some unknown general form. The test statistic is computed by an auxiliary regression, where we regress the squared residuals on all possible (nonredundant) cross products of the regressors. Actually, the modern econometric software will perform the test for us.

White also describes this approach as a general test for model misspecification, since the null hypothesis underlying the test assumes that

[40] For detail discussion of variables, please refer to section 3.1 - Primary factors, or to section 3.2 – Secondary factors.
[41] This is model was used by e.g. Rajan and Zingales (1995), or by Andritzky (2003).

the errors are both homoskedastic and independent of the regressors, and that the linear specification of the model is correct. Failure of any one of these conditions could lead to a significant test statistic. Conversely, a non-significant test statistic implies that none of the three conditions is violated.

The results of the test of equality for years 2000 and 2001 are presented in the tables 6 and 7 respectively

Table 6: Test of equality – year 2000

Test for Equality of Variances Between Series			Year 2000
Method	df	Value	Probability
Bartlett	3	9.133553	0.0276
Levene	(3, 341)	2.681903	0.0468
Brown-Forsythe	(3, 341)	2.717137	0.0446

Category Statistics

Variable	Count	Std. Dev.	Mean Abs. Mean Diff.	Mean Abs. Median Diff.
RESID01CZ	73	0.148614	0.117592	0.116786
RESID01HU	37	0.144609	0.123306	0.120517
RESID01PL	167	0.191639	0.155399	0.155013
RESID01SK	68	0.187839	0.146924	0.146708
All	345	0.177215	0.142287	0.141588

Bartlett weighted standard deviation: 0.177993

Table 7: Test of equality – year 2001

Test for Equality of Variances Between Series			Year 2001
Method	df	Value	Probability
Bartlett	3	6.327461	0.0967
Levene	(3, 320)	1.562552	0.1984
Brown-Forsythe	(3, 320)	1.576395	0.1950

Category Statistics

Variable	Count	Std. Dev.	Mean Abs. Mean Diff.	Mean Abs. Median Diff.
RESID01CZ	73	0.163055	0.129811	0.128956
RESID01HU	33	0.144310	0.114158	0.114117
RESID01PL	162	0.191158	0.151539	0.151468
RESID01SK	56	0.199508	0.153345	0.153026
All	324	0.181608	0.143148	0.142861

Bartlett weighted standard deviation: 0.182457

In the year 2000 the test statistics rejects the null hypothesis of equal variance of the residuals across countries at 5% level, providing

strong evidence of the presence of groupwise heteroskedasticity. In the year 2001 the evidence is not so clear. The Bartlett method rejects the null hypothesis at 10% level, however the other two methods don't suggest the presence of groupwise heteroskedasticity. Anyway, we may want to adjust the denominator degrees of freedom to take into account the number of estimated parameters in the regression. The tests are, however, consistent even without the degrees of freedom adjustment.

3.6.2 Regression without secondary factors

Now, when we now that heteroskedasticity is present we can approach to the estimation of the equation (3.6.1) using ordinary least squares with White heteroskedasticity-consistent standard errors. Following results were obtained for regression without industry and country dummies:

Table: 8

Dependent Variable: TL
Method: Least Squares
Included observations: 345
White Heteroskedasticity-Consistent Standard Errors & Covariance

Year 2000		Year 2001	
Variable	Coefficient	Variable	Coefficient
C	-0.261631***	C	-0.271453***
LOG(SALES)	0.044961***	LOG(SALES)	0.047803***
ROA	-0.399978***	ROA	-0.383295***
TANG	-0.177120***	TANG	-0.251834***
PB	0.018985***	PB	0.015341***
R-squared	0.214555	R-squared	0.241734
Adj. R-squared	0.205315	Adjusted R-squared	0.232226
S.E. of regression	0.186524	S.E. of regression	0.191773
Sum squared resid	11.82906	Sum squared resid	11.73186
Log likelihood	92.30609	Log likelihood	77.85048
Durbin-Watson stat	1.985122	Durbin-Watson stat	1.993169

where *** stands for significance at 1% level.

As we can observe in the table 8, all coefficients are significant at the 1% level, the value of R-squared is in similar range as in other papers concerning capital structure. The signs of coefficients for Size and profitability are in line with the prediction of theory e.g. the influence of size on leverage is positive, profitability (ROA) has negative influence. On

the other hand the effects of tangibility and price to book ratio have exactly opposite effect than what is predicted by the theory. The sign by Tangibility could be possibly explained by specific institutional characteristics that countries in transition "suffer". One of them could be e.g. non-perfect bankruptcy law, that doesn't allow the debtor to get all of the pledged property back. The sign by price to book ratio is also opposite to the theory, however the coefficient is very low. The explanation of these "anomalies" could be an object for further research. The results are summarized in the table below.

Table 9

Factor	***Theory***	***Results***
Size	+/0	+
Profitability (ROA)	+/-	-
Tangibility	+	-
Price to book r.	-	+

3.6.3 Effects of country dummies – LSDV model

In order to analyse the effects of countries more properly, we have to make some assumptions. First one is that the slope coefficients are constant across countries and second, that the intercept varies across the countries. This approach is known as a Least-squares dummy variable model (LSDV). The results are reported in table 10.

In order not to fall into the dummy variable trap (i.e. the situation of perfect collinearity), and to obtain explicit intercept values for each country separately, we dropped the common intercept *C*.

Table 10

Dependent Variable: TL
Method: Least Squares
White Heteroskedasticity-Consistent Standard Errors & Covariance

	Year 2000		Year 2001	
	Included observations: 345		Included observations: 326[42]	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
CZ	-0.373901***	0.095154	-0.408430***	0.107952
HU	-0.462779***	0.101203	-0.485855***	0.112088
PL	-0.348239***	0.094563	-0.336758***	0.105316
SK	-0.311600***	0.093108	-0.323689***	0.098683
LOG(SALES)	0.050334***	0.005435	0.052656***	0.005950
ROA	-0.351248***	0.131143	-0.344832***	0.119919
TANG	-0.173041***	0.048866	-0.227037***	0.048716
PB	0.019004***	0.005713	0.013464	0.009532
R-squared	0.249746		0.291472	
Adjusted R-squared	0.234162		0.275777	
S.E. of regression	0.183108		0.186255	
Sum squared resid	11.29907		10.96231	
Log likelihood	100.2133		88.84139	
Mean dependent var	0.452133		0.468801	
S.D. dependent var	0.209237		0.218862	
Akaike info criterion	-0.534570		-0.499021	
Schwarz criterion	-0.445444		-0.405669	
Durbin-Watson stat	2.070914		2.078209	

Where ***, **, * stands for the significance at 1%, 5% and 10% level.

As can be seen the dummy variables for countries are significant at 1% level. All variables are significant at 1% level (except PB ratio in year 2001 which is significant as far as at 16% level).

Again, as we can see from observed values, the ROA and tangibility coefficients show repeatedly significant negative signs and both show values, that are opposite to the theory.

The R-squared value increased when compared to model without country dummies.

[42] As we can observe the number of firms included in the analysis does not correspond to the prior models, because of incomplete information set by some companies (usually the case of missing data for one year), these were subsequently dropped from the sample without effecting the industry analysis.

First we have found out if the country dummies have any significance and now we analyse the countries separately. Thus following equation is to be estimated:

$$TL_i = d_j COUNTRY + \beta_1 \log(SALES)_i + \beta_2 TAN_i + \beta_3 ROA_i + \beta_4 PB_i + \varepsilon_i \quad (3.6.2)$$

Now, furthermore we release the assumption of slope coefficients constant in all countries and run regression on each country separately. Therefore this time we don't have to use White heteroskedasticity-consistent standard errors & covariance.

The results are reported in tables 11 and 12.

Table 11

Year 2000 (TL)	Czech Republic	Hungary	Poland	Slovak Republic
Constant	-0.467364***	0.171835	-0.611820***	-0.132508
Log (sales)	0.054892***	0.017728	0.066634***	0.038640***
ROA	-0.421833**	-0.845765**	-0.390340***	-0.245117
TANG	-0.166318**	-0.124982	-0.195825**	-0.160034*
PB	0.034642***	-0.002165	0.010499*	0.020848***
R^2	0.438693	0.218082	0.206753	0.222260
Adj. R^2	0.405675	0.120342	0.187166	0.172880

Table 12

Year 2001 (TL)	Czech Republic	Hungary	Poland	Slovak Republic
Constant	-0.480291***	-0.355268	-0.427684**	-0.044802
Log (sales)	0.054960***	0.046353**	0.056713***	0.039493***
ROA	-0.442153*	-0.698403**	-0.389528***	-0.238323
TANG	-0.225452***	-0.062083	-0.205357***	-0.361631***
PB	0.083429*	-0.059032	0.023258*	0.012135*
R^2	0.340837	0.240131	0.217451	0.270744
Adj. R^2	0.302063	0.131578	0.197514	0.213548

Where ***, **, * stands for the significance at 1%, 5% and 10% level.

From the tables 11 and 12 we can see that the country results are in line with the previous models. The signs by profitability (ROA) and

tangibility remain opposite to the theory and the coefficients are significant in most of the cases.

The R-squared is in both years highest in the case of Czech republic and thus the model fits this country best. In other countries the R-squared valued remained approximately in the same range as in prior models.

The results for the primary determinants and country dummies can be summarized by following table:

Table 13[43]

Factor	***Theory***	***CZ***	***HU***	***PL***	***SK***	***All***
Size	+/0	+	0	+	+	+
Profitability (ROA)	+/-	-	-	-	0	-
Tangibility	+	-	0	-	-	-
Price to book r.	-	+	0	+	+	+

In order to explore the secondary determinants, we have established the basic models to understand the influence of the industry classification on leverage.

3.6.4 Effects of industry dummies

The null hypothesis to be tested in this section, is that firms in different industries have the same financial structures.

Das and Roy (2001) presented their result that the null hypothesis is rejected in all years[44] at the 1% level.

The following equation is to be tested in this section:

$$TL_i = d_j IND + \beta_1 \log(SALES)_i + \beta_2 TAN_i + \beta_3 ROA_i + \beta_4 PB_i + \varepsilon_i \qquad (3.6.3)$$

where the lower index by *dIND* stands for the respective industry group dummies.

[43] The signs of those parameters are presented which have the same signs for both years 2000 and 2001 and both signs are significant at least at 10% significance level.
[44] Das and Roy (2001) have analyzed 20-year period (1979/80 – 1998/99) in Indian firms, they used 12 industries as dummy variables.

Because of the small volume of firms traded on the central European capital markets, when estimating the influence of industry class on the capital structure in each country separately, the problem of insufficient number of observations per industry would arise in most of the cases and thus we will estimate the influence of industry class on the capital structure in all four countries gathered together into one sample.

Even than some of the gathered industries will not have enough members to validate the estimation. The tables with industries sorted into industry dummy groups and industries excluded from the analyses can be found in table 14 and 15 respectively.

We have seen in previous section that the results we have obtained from gathered sample were in line with the results for each country separately. This factor and the simple reality of not enough observations per industry group can justify gathering the industries across the four concerned countries into groups of similar firms.

The following industries have enough observations to qualify for more validate estimation[45]:

[45] Industries with more than 5 observations qualified, the author is aware, that the number of observation is not sufficient for reliable econometric analysis. The number chosen was kind of rule of thumb and was set by post and telecommunication industry class, that is one of the most compared industries in other papers.

Table 14: Industry dummy groups:

Industry group	***NACE[46] codes***	***SIC codes***	**Description**	# of firms in the sample 2000	2001
Mining	10,11,12, 13,14	10, 12, 13, 14	Mining of coal, lignite, uranium, thorium ores, metal ores, extraction of peat and other mining and quarrying, extraction of crude petroleum and natural gas	12	12
Fbt	15,16	20,21	Manufacture of food, beverages and tobacco products	41	39
Text	17,18,19	22,23	Manufacture of textiles, wearing apparel, dressing and dyeing of fur, tanning and dressing of leather, manufacture of luggage, handbags, saddlery and footwear	18	17
Wood	20,21,36	24,25,26	Manufacture of wood, cork, wooden products, pulp, paper and paper products, manufacture of furniture	13	11
chemic	23,24,25, 26	28,29, 30,31,32	Manufacture of coke, refined petroleum products, nuclear fuel, chemicals and chemical products, rubber and plastic products and other non metallic mineral products	44	41
metal	27,28	33,34	Manufacture of basic metals and fabricated metal products	19	19
machinery	29,30,31	35	Manufacture of machinery, equipment, office machinery, computers and electrical machinery and apparatus	30	30
instr	33	38	Manufacture of medical, precision and optical instruments, watches and clocks	7	7
utilit	40	49	Electricity, gas, steam and hot water supply	33	34
constr	45	15,16,17	Construction	31	27
trade	51,52	50,51	Wholesale trade and commission trade, retail trade except for motor vehicles and motorcycles, repair of personal and household goods	28	25
posttel	64	43,48	Post and telecommunications services	6	6
Comp	72	N/A	Computer and related activities	10	11
Otherb	74	99	Accounting, architecture, technical testing, advertisement, labour recruitment, investigation and security activities etc.	14	12
TOTAL in the sample				**305**	**291**

Table 15

NACE #	**Description**	***# of firms*** **2000**	**2001**
1	Agriculture	4	4
22	Media	5	5
34	Manufacture of motor vehicles, trailers	4	4
35	Manufacture of transport equipment	1	1
41	Collection and purification of water	1	1
50	Motor vehicles retail	2	2
55	Hotels and restaurants	1	1
60	Land and pipeline transport	1	1
63	Auxiliary transport	4	4
65	Financial intermediation	4	3
67	Activities auxiliary to financial intermediation	4	3
70	Real estate activities	4	2
73	Research and development	1	1
85	Health and social work	2	2
90	Sewage and refuse disposal	1	1
TOTAL		38	35

[46] By both SIC and NACE codes only first two digits of four-digit code are presented.

Estimating the equation 3.6.3, the following results were obtained:

Table 16

Dependent Variable: TL
Method: Least Squares
Included observations: 305
White Heteroskedasticity-Consistent Standard Errors & Covariance

	Year 2000		Year 2001	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
C	-0.314173***	0.094189	-0.406961***	0.123937
CONSTR	0.165525***	0.044949	0.196714***	0.059336
FBT	0.105659**	0.044485	0.154592***	0.056482
MACHINERY	0.053586*	0.037950	0.106450*	0.059195
INSTR	-0.015716	0.071211	0.090051	0.083602
MINING	-0.109674**	0.047997	-0.054149	0.074331
METAL	0.104523**	0.043009	0.171438***	0.065584
TEXT	0.003961	0.048538	0.069751	0.065372
TRADE	0.183582***	0.041685	0.270898***	0.060639
UTILIT	0.028220	0.040205	0.083542	0.062168
WOOD	0.054932	0.060951	0.107839	0.073854
CHEMIC	-0.056529*	0.037983	0.009736	0.057990
OTHERB	0.093014*	0.061465	0.176355**	0.071006
POSTTEL	-0.028976	0.070971	0.057102	0.092446
LOG(SALES)	0.041996***	0.005912	0.046369***	0.006867
ROA	-0.311375**	0.122641	-0.381894***	0.077298
TANGIBILITY	-0.059001	0.050795	-0.126449**	0.057191
PB	0.019600***	0.005115	0.013927***	0.005574
R-squared	0.336438		0.342246	
Adjusted R-squared	0.301835		0.301436	
S.E. of regression	0.173956		0.181913	
Sum squared resid	9.864975		9.067346	
Log likelihood	122.7691		92.59277	
Durbin-Watson stat	1.973816		1.943827	
Mean dependent var	0.453411		0.477571	
S.D. dependent var	0.208190		0.217652	
Akaike info criterion	-0.609123		-0.510909	
Schwarz criterion	-0.408159		-0.284260	
F-statistic	9.722799		8.386415	
Prob(F-statistic)	0.000000		0.000000	

Where ***, **, * stands for the significance at 1%, 5% and 10% level.

The result coming up from the table is straightforward: the null hypothesis of equal capital structure for all industries is rejected for both years 2000 and 2001.

As we can observe, the following industry groups exhibited significantly different capital structure in both years: Construction, food-beverages-tobacco producers, manufactures of machinery, manufactures of metals, wholesale and commission trade firms and other business activities group of firms. Furthermore, there were two industries that were

significantly different at least in one year: Mining industry group and manufacturers of chemical products.

All four primary variables remained highly significant in both years (with the only exception of tangibility in year 2000) and again they kept the same signs as in prior models. Notable is the increased value of (adjusted) R-squared when compared to prior models of gathered sample.

Now, when we know that the leverage is determined by industry class we can find the firms or industry groups with the relatively high or relatively low leverage (table 15). Our results are than compared to the results summarized and presented by Myers (2001, p. 334-5) in the table 19.

Table 17: TL - descriptive statistics by industry groups[47]

Year 2000	Mean	Median	Max.	Min.	Std. Dev.	Prob.	# of firms	leverage
MINING*	0,294	0,261	0,542	0,104	0,131	0,632	12	Low
INSTR	0,336	0,269	0,619	0,144	0,180	0,697	7	Low
CHEMIC*	0,370	0,417	0,809	0,010	0,187	0,570	44	Low
COMP	0,373	0,414	0,699	0,090	0,203	0,762	10	Low
TEXT	0,397	0,368	0,865	0,171	0,187	0,258	18	Low
MACHINERY*	0,446	0,412	0,961	0,086	0,197	0,104	30	Medium
UTILIT	0,446	0,487	0,637	0,120	0,144	0,252	33	Medium
WOOD	0,446	0,477	0,838	0,166	0,198	0,917	12	Medium
POSTTEL	0,459	0,387	0,743	0,252	0,196	0,698	6	Medium
OTHERB*	0,504	0,502	0,888	0,052	0,260	0,809	11	High
FBT*	0,509	0,529	0,983	0,043	0,226	0,575	41	High
METAL*	0,535	0,556	0,764	0,216	0,147	0,704	19	High
CONSTR*	0,600	0,606	0,917	0,296	0,155	0,840	31	High
TRADE*	0,610	0,638	0,915	0,261	0,171	0,577	28	High

Source: Own computation

Sorting the respective industries into one of the three leverage categories is kind of arbitrary. The differences in means between the industry with lower respective higher mean was decisive.

To confirm our results we have run the **Mean equality test**[48]. This test is based on a single-factor, between-subjects, analysis of variance (ANOVA). The basic idea is that if the subgroups have the same mean, then

[47] In this table all industries have been included. Industries which showed significantly different capital structure in previous part are marked with an asterisk (*).
[48] The basic econometrics concerning the Mean equality test can be found in the Appendix section 5.3

the variability between the sample means (between groups) should be the same as the variability within any subgroup (within group).

Table 18

Test for Equality of Means Between Series

Method	df	Value	Probability
Anova F-statistic	(13, 288)	5.356962	0.0000

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	13	2.390996	0.183923
Within	288	9.888022	0.034333
Total	301	12.27902	0.040794

Category Statistics

Variable	Count	Mean	Std. Dev.	Std. Err. of Mean
MINING	12	0.294381	0.131152	0.037860
INSTR	7	0.336219	0.180468	0.068211
CHEMIC	44	0.370338	0.187213	0.028223
COMP	10	0.373307	0.203174	0.064249
TEXT	18	0.396900	0.186999	0.044076
WOOD	12	0.445988	0.198492	0.057300
UTILIT	33	0.446172	0.143621	0.025001
MACHINERY	30	0.446277	0.197480	0.036055
POSTTEL	6	0.459287	0.195516	0.079819
OTHERB	11	0.504250	0.260147	0.078437
FBT	41	0.509113	0.225808	0.035265
METAL	19	0.534791	0.147086	0.033744
CONSTR	31	0.600233	0.154528	0.027754
TRADE	28	0.609521	0.171340	0.032380
All	302	0.468652	0.201975	0.011622

The mean equality test rejects the null hypothesis that the firms in different industries have the same financial structure at the 1% level. Thus now, we know that the capital structure differs among industries and we can approach the comparison part.

Table 19: Comparison of obtained results

Industry Leverage Rankings[49]							
Author/period	**BJK**	**BDH**	**LM**	**Kester**	**SM**	**BM**	**Egrt**
Industry	1962-1981	1951-1969	1978-1980	1982/1983	1967-1972	1963-1969	2000/2001
Drugs	Low[50]		Low	Low	Low		
Cosmetics	Low		Low	Med[51]			
Instruments	Low		Low[52]	Low[56]			Low
Metal mining	Low				Low		Low
Publishing	Low						
Electronics	Low		Low[53]	Low			
Machinery	Low			Med[54]	Low		Med
Food	Low			Low[55]			High[56]
Computer Rel. Act.							Low
Petroleum Explr.	Med				Low		
Construction	Med						High
Petroleum Refining	Med	Low[57]	High	High			
Metal Working	Med						High
Chemicals	Med	Med		High	Med	Low	Low
Apparel	Med			Med		Med	Low
Lumber	Med				Low		Med
Motor Vehicle Part	Med	Med	Low[58]	Med	Med	Low	
Paper	Med		High	High			
Textile Mill Product	High	Med	High	High			
Rubber	High			Med			
Retail Depart. Stores	High	Med			High	High	High
Retail Groc. Stores	High	Med				Med	
Trucking	High						
Steel	High	Low	High	High	Med	Med	
Telephone	High						Med
Electr. and Gas Utilities	High						Med
Airlines	High	High			High	High	
Cement			High	High			
Glass				High	Med		

Source: Myers (2001), Scott and Martin (1975), Boquist and Moore (1984) and own computation.

[49] In order to keep to the original results, the SIC codes are used in the notes.
[50] Drugs (SIC code 2830) and Cosmetics (SIC code 2840) are combined.
[51] Soap and Detergents (SIC code 2841) part of Cosmetics (SIC code 2840) only.
[52] Photographic Equipment (SIC code 3861) part of Instruments (SIC code 3800) only.
[53] Radio and TV receiving (SIC code 3651) part of Electronics (SIC code 3800) only.
[54] Construction and Agriculture machinery and Machine tools (SIC codes 3530, 3520, 3540).
[55] Confectionery and alcoholic beverages (SIC codes 2065, 2082, 2085) part of Food (SIC code 2000) only.
[56] Includes also beverages and tobacco production (SIC code 1500, 1600)
[57] Oil-integrated Domestic (SIC code 2912) part of Petroleum Refining (SIC code 2900) only.
[58] Aircraft (SIC code 3721) part of Motor Vehicles Parts (SIC code 3700) only.

As Myers (2001, p. 334) comments: "Ranking of industries by leverage ratio are reported based on four studies: Bradley et. al. (1984, Table 1) {denoted BJK}, Bowen et. al. (1982, Exhibit 1) {BDH}, Long and Malitz (1985, Table 3) {LM} and Kester (1986, Exhibit 2). We have listed industries from lowest to highest based on average debt-to-value ratio over the period 1962-1981using Bradley et. al. The classification into "low", "med" (medium leveraged) and "high" is our own and is somewhat arbitrary. The rankings in Bowen et. al. are an average of rankings over the period 1951-1969 based on long-term plus short-term debt divided by total assets. For Long and Malitz, "Low" ("High") means that the industry was one of the five lowest (highest) in the leverage ratio (book value of long-term funded debt divided by total funded capital) out of a sample of 39 firms. The rankings for Kester are based on the average of net debt divided by market value of equity for a sample of 344 Japanese and 452 U.S. companies in 27 industries over the period April, 1982 through March, 1983."

Column named "SM" represents the results of Scott and Martin (1975) who used the common equity ratio to express the leverage. Scott and Martin used twelve industries to demonstrates that industry class is a significant determinant of financial structure.

The column marked as BM represents the study of Boquist and Moore (1984) for U.S. companies over the period 1963-1969. The companies were divided into seven industries. The arbitrary selection to "low", "med" and "high" was done like this: 2 highest levered industries, 2 lowest and 3 medium levered industries were chosen to include full sample of seven industries.

The fifth column represents our own results. The sample was split into thirds according to the leverage ratio and relative leverage marks (low, medium and high) were assigned to them accordingly to the results presented in the Table 17.

The leverage in our case is expressed as the book value of short-term plus long-term debt over total assets. The results are generally similar

to those presented by prior researches. Only the industry group FBT (food, beverages and tobacco producers) was expected – according to prior researches - to show lower leverage. One of the possible explanation is that it might be the result of the group's composition. While in our study the industry group FBT contains food, beverages and tobacco producers, in the study presented by Bowen et. al. (1982) industry group Food contains the food producers only, and in the study of Kester (1986) the tobacco producers are not included. Other explanation offers the arbitrary selection of relative leverage group, if we would change the ranges or if we had more highly leveraged industry groups, the FBT industry group could fall in "lower" group, but still would not be in the lowest leveraged group.

In general the results correspond to other studies and the FBT group is the only exception, that is exactly on the opposite site. The reason for this might be an interesting subject for further study.

4 Conclusions

To a certain extent, the leverage of companies can be explained by firm-specific variables like firm size, tangibility, profitability and price to book ratio (*primary factors).* Additionally, companies of a certain industry class are expected to have many similarities – among other things their capital structure.

In this thesis the theory of capital structure is in detail described and major theoretical concepts are mentioned in section 2.

In section 3 the empirical analysis follows. First, the primary factors are analysed and their influence on capital structure is confirmed. The signs of coefficients for company size and profitability confirm the prediction of the theory e.g. the influence of size on leverage is positive and profitability (ROA) has negative influence. On the other hand the effects of tangibility and price to book ratio have exactly opposite effects than what is predicted by the theory. The sign by tangibility could be possibly explained by specific institutional characteristics that countries in transition "suffer". One of them could be e.g. non-perfect bankruptcy law, that doesn't allow the debtor to get all of the pledged property back.

Finding the reason why tangibility and profitability show the opposite signs than suggested by theory in all analyzed countries could be a subject for further theoretical research.

In section 3.6.4 the industry dummies are introduced (*secondary factor)*. In analysing the inter-industry variation in capital structure of central European firms, it is evident that the capital structures of firms are systematically different across industry classes so far as the debt financing as a proportion of total capital is concerned.

The mean equality test rejects the null hypothesis that the firms in different industries have the same financial structure at the 1%

Industry group turned out to be another significant determinant of capital structure. By introducing industry dummies into the model the value of explanatory R^2 rose by more than 9%.

The obtained results of relative leverage were compared to the similar studies and with the only exception (food industry) we can conclude that the industries in the central Europe are relatively leveraged just as American and Japanese companies. Finding the reason why food (together with beverage and tobacco) producers report higher leverage than is reported in similar studies might be a subject for further study.

Interesting research could be done when the age of the firms would be introduced into the analysis and we could examined whether the differences in the capital structure of the firms across industries arise because of the fact that some are young and some are mature firms, which have distinctly different credit history and financing patterns.

5 Appendices

5.1 Description of Industry Classification

NACE	
10	Mining of coal and lignit; extraction of peat
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
12	Mining of uranium and thorium ores
13	Mining of metal ores
14	Other mining and quarrying
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of pulp, paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastic products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c
30	Manufacture of office machinery and computers
31	Manufacture of electrical machinery and apparatus n.e.c
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c
40	Electricity, gas, steam and hot water supply
41	Collection, purification and distribution of water
45	Construction
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
55	Hotels and restaurants
60	Land transport; transport via pipelines
63	Supporting and auxiliary transport activities; activities of travel agencies
64	Post and telecommunications
70	Real estate activities
72	Computer and related activities
73	Research and development
74	Other business activities
85	Health and social work
90	Sewage and refuse disposal, sanitation and similar activities

5.2 Choosing better variable for SIZE factor

Dependent Variable: TL	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.261631	0.095693	-2.734073	0.0066
LOG(SALES)	0.044961	0.005536	8.121141	0.0000
ROA	-0.399978	0.088655	-4.511602	0.0000
TANGIBILITY	-0.177120	0.045088	-3.928328	0.0001
PB	0.018985	0.003826	4.961614	0.0000
R-squared	0.214555			
Adjusted R-squared	0.205315			
Dependent Variable: TL				
C	-0.154037	0.122876	-1.253594	0.2109
LOG(TA)	0.038017	0.007078	3.020570	0.0027
ROA	-0.366528	0.093903	-3.903245	0.0001
TANGIBILITY	-0.163969	0.047449	-3.455655	0.0006
PB	0.017002	0.003999	4.251254	0.0000
R-squared	0.135540			
Adjusted R-squared	0.125370			

The following factors are suggesting that the variable Log(sales) is better to use than the variable Log(TA) as a proxy for size: the standard error term is lower in the first model, the t-statistics is higher and thus the probability is lower. Furthermore, the both R-squared and adjusted R-squared are higher in the model where Log(sales) variable is used.

5.3 ANOVA – basic econometrics

This test is based on a single-factor, between-subjects, analysis of variance (ANOVA). The basic idea is that if the subgroups have the same mean, then the variability between the sample means (between groups) should be the same as the variability within any subgroup (within group).

Denote the *i-th* observation in group *g* as $x_{g,i}$, where $i=1,\ldots,n_g$ for groups $g=1,2,\ldots G$. The between and within sums of squares are defined as:

$$SS_B = \sum_{g=1}^{G} n_g \left(\bar{x}_g - \bar{x}\right)^2 \qquad (5.3.1)$$

$$SS_W = \sum_{g=1}^{G} \sum_{i=1}^{n_g} n_g \left(x_{ig} - \bar{x}_g\right)^2 \qquad (5.3.2)$$

where $\bar{x}_g$ is the sample mean within group *g* and $\bar{x}$ is the overall sample mean. The F-statistic for the equality of means is computed as:

$$F = \frac{SS_B /(G-1)}{SS_W /(N-G)} \qquad (5.3.3)$$

where ***N*** is the total number of observations. The F-statistic has an F-distribution with ***G-1*** numerator degrees of freedom and ***N-G*** denominator degrees of freedom under the null hypothesis of independent and identical normal distribution, with equal means and variances in each subgroup.

The analysis of variance table shows the decomposition of the total sum of squares into the between and within sum of squares, where

Mean Sq. = Sum of Sq./df

The F-statistic is the ratio

F = Between Mean Sq./Within Mean Sq.

5.4 The irrelevance of technology proxy

The basic assumptions of this model are as follows: The companies in one industry class have homogeneous output, that is being manufactured by different technology. The technology level is captured by the ratio of tangible assets over the labour force. The model is based on the classical assumption of production function which considers Working Capital and Labour Force to be substitutes[59]. Of course, the proxy-ratio capturing the technology is questionable, however for our demonstrating purposes it should be sufficient. The model for firm *i* is in eq. 5.4.1.

$$TL_i = c + D_j tech + \beta_1 \ln(sales)_i + \beta_2 TAN_i + \beta_3 ROA_i + \beta_4 PB_i + \varepsilon_i \qquad (5.4.1)$$

where $D_j tech$ is one of three dummy variables that capture the firm's relative technology position within the industry. For the firms with least tangible assets per worker (the 1st quartile) the dummy is named as *Ltech* and for the firms with the highest ratio (4th quartile) of TA per worker is called *Htech*. Accordingly the dummy variable for the firms between these two groups (2nd and 3rd quartile) *Mtech*. The following results were obtained:

Dependent Variable: TL
Method: Least Squares

Variable	Trade	Metal	FBT	Constr	Chemic
C	-0.127172	-1.282594*	0.276821	0.194161	-0.094013
LTECH	-0.070302	0.036017	0.096524	0.096321	0.056318
HTECH	0.089990	-0.040006	0.016640	0.202108	0.091333
LOG(SALES)	0.046399*	0.106938**	4.57E-05	0.029250	0.024597
ROA	-0.765550**	-1.297930**	0.054328	-0.404834	-0.984920***
TANGIBILITY	-0.025289	-0.420405*	0.425340**	-0.349351	0.086229
PB	-0.029388*	0.145322	0.018156*	-0.047818	0.002569
N of observations	24	18	35	28	39
R-squared	0.600747	0.451134	0.254796	0.321715	0.521705
Adj. R-squared	0.459835	0.151752	0.095109	0.127919	0.432025

By these results the irrelevance of technology proxy to capital structure is confirmed.

[59] The reasoning behind this model: imagine two identical mining companies, if one company issues debt to buy new machine which can substitute the work of 50 workers, than the company will show higher leverage and higher tangible assets per worker as well.

6 References

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