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CAPITAL STRUCTURE OF LISTED COMPANIES IN VISEGRAD COUNTRIES

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Abstract:
This paper analyzes capital structure of listed companies in Visegrad countries during the period from 2000 to 2001. The results are based on the database, which assembles financial reports of listed firms. In general, leverage of these firms is relatively low if measured in book value, but it is relatively high if assessed in market value. Quasi-maximum likelihood estimation is used in order to investigate the determinants of capital structure. According to the results, leverage of a company is positively correlated with size and it is negatively correlated with profitability, tangibility and non-debt tax shields. There is a negative relationship between leverage measured in market value and growth opportunities. Moreover, leverage decreases with volatility, albeit on a lower level of statistical significance.

Keywords: capital structure, determinants of capital structure, leverage, Visegrad countries

JEL Classification: G32

1. Introduction

The modern theory of capital structure was established by Modigliani and Miller (1958). What do we really know about corporate capital structure choice fourty six years later? As Rajan and Zingales (1995, p. 1421) claim: "Theory has clearly made some progress on the subject. We now understand the most important departures from the Modigliani and Miller assumptions that make capital structure relevant to a firm's value. However, very little is known about the empirical relevance of the different theories."

Thus, there exist several theories of capital structure, but very little is known about their empirical relevance. Moreover, the existing empirical evidence is based

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mainly on data from developed countries (G7 countries). Findings based on data from developing countries have not appeared until recently (for example, Booth et al., 2001, cases of Brazil, Mexico, India, South Korea, Jordan, Malaysia, Pakistan, Thailand, Turkey, and Zimbabwe, and Huang and Song, 2002, the case of China). Concerning Visegrad countries, i.e., the Czech Republic, Hungary, Poland, and the Slovak Republic, Krauseová (1995) describes the capital structure of Czech firms in the period from 1990 to 1993. Bauer and Bubák (2003) test for existence of optimal capital structure and for relevance of signalling theory. Bauer (2004) focuses on determinants of capital structure. Both studies, however, explore only the case of the Czech Republic. There were published also studies, which provide some empirical evidence about capital structure (e.g., Lízal, 2002), however, they do not focus on this topic.

This study provides empirical evidence about the capital structure of listed firms in Visegrad countries and it analyzes potential determinats of leverage. Furthermore, the differences in capital structure of listed firms across Visegrad countries are provided.

The structure of this paper is as follows. In Chapter 2 the most prominent theoretical and empirical findings are surveyed. In Chapter 3 the potential determinants of capital structure are summarized and theoretical and empirical evidence concerning these determinants is provided. Chapter 4 is the empirical part of the paper. Here the data is described, measures of leverage are defined, the extent of leverage is characterized and the impact of potential determinants of capital structure on leverage is tested. Chapter 5 provides conclusions of the study.

2. Theoretical and Empirical Findings

As Myers (2001, p. 81) declares: "There is no universal theory of the debt-equity choice, and no reason to expect one." However, there are several useful conditional theories[1)] – each of those helps to understand the debt-to-equity structure, which firms choose. These theories can be divided into two groups – either they predict the existence of the optimal debt-equity ratio for each firm (so-called static trade-off models) or they declare that there is no well-defined target capital structure (pecking-order hypothesis).

Static trade-off models understand the optimal capital structure as an optimal solution of a trade-off. There exists the trade-off between a tax shield and costs of financial distress in the case of trade-off theory. According to this theory the optimal capital structure is achieved when the marginal present value of the tax shield on additional debt is equal to the marginal present value of costs of financial distress on additional debt. The trade-off between benefits of signalling and costs of financial distress in the case of signalling theory implies that a company chooses debt ratio as a signal about its type. Therefore in the case of a good company the debt must be large enough to act as an incentive compatible signal, i.e., it does not pay off for a bad company to mimic it. In the case of agency theory the trade-off between agency costs[2)] stipulates that the optimal capital structure is achieved when agency

1) The most prominent theories are the trade-off theory, the signalling theory (first mentioned by Ross, 1977), the agency theory (see Jensen and Meckling, 1976; Myers, 1977), the free cash-flow theory (see Jensen, 1986), and the pecking-order theory (see Myers and Majluf, 1984 and Myers, 1984). For more details about conditional capital structure theories see Bauer and Bubák (2003).

2) Agency costs arise from two agency relations – relation between owners and debt holders and relation between owners and managers (non-owners), i.e., principal-agent relation.

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costs are minimized. Finally, the trade-off between costs of financial distress and increase of efficiency in the case of free cash-flow theory, which is designed mainly for firms with extra-high free cash-flows suggests that the high debt ratio disciplines managers to pay out cash instead of investing it below the cost of capital or wasting it in organizational inefficiencies.

On the other hand, the pecking-order theory suggests that there is no optimal capital structure. Firms are supposed to prefer internal financing (retained earnings) to external funds. When internal cash flow is not sufficient to finance capital expenditures, firms will borrow, rather than issue equity. Therefore there is no well-defined optimal leverage, because there are two kinds of equity, internal and external, one at the top of the pecking order and one at the bottom.[3)]

Existing empirical evidence is based mainly on data from developed countries. For example Bradley et al. (1984), Kim and Sorensen (1986), Friend and Lang (1988), Titman and Wessels (1988) and Chaplinsky and Niehaus (1993) focus on United States companies, Kester (1986) compares United States and Japanese manufacturing corporations, Rajan and Zingales (1995) examine firms from G7 countries and Wald (1999) uses data for G7 countries except Canada and Italy. Findings based on data from developing countries have appeared only in recent years, for example, Booth et al. (2001) and Huang and Song (2002).

To author's best knowledge, no study has been published focusing on empirical testing of capital structure theories in Visegrad countries, except for Bauer and Bubák (2003). They test for existence of optimal capital structure and for relevance of signalling theory in the case of Czech listed firms. Their results support existence of optimal capital structure and they are in accordance with the signalling theory. As far as determinants of capital structure of firms in Visegrad countries are concerned, Bauer (2004) explores the case of the Czech listed companies. According to his results, leverage of a firm is positively correlated with size and it is negatively correlated with profitability and non-debt tax shields. There is a negative relationship between leverage measured in market value and growth opportunities. Moreover, leverage is positively correlated with volatility and tax and negatively correlated with tangibility, albeit on a lower level of statistical significance.

3. Determinants of Capital Structure

As Harris and Raviv (1991, p. 334) state: "Several studies shed light on the specific characteristics of firms and industries that determine leverage ratios … These studies generally agree that leverage increases with fixed assets, non-debt tax shields, growth opportunities, and firm size and decreases with volatility, advertising expenditures, research and development expenditures, bankruptcy probability, profitability and uniqueness of the product." However, the results of both theoretical and empirical studies are not always unambiguous. Based on the data availability, following determinants of capital structure are analyzed in this paper: size, profitability, tangibility, growth opportunities, non-debt tax shields and volatility.

3. 1 *Size*

From the theoretical point of view, the effect of size on leverage is ambiguous. As Rajan and Zingales (1995, p. 1451) claim: "Larger firms tend to be more diversi-

3) For a comprehensive survey of capital structure theories see Harris and Raviv (1991), for theories based on asymmetric information see Klein et al. (2002).

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fied and fail less often, so size (computed as the logarithm of net sales) may be an inverse proxy for the probability of bankruptcy. If so, size should have a positive impact on the supply debt. However, size may also be a proxy for the information outside investors have, which should increase their preference for equity relative to debt."

Empirical studies do not provide us with clear information either. Some authors find a positive relationship between size and leverage, for example, Huang and Song (2002), Friend and Lang (1988), and Rajan and Zingales (1995) for all G7 countries except for Germany. On the other hand, in some studies a negative relationship is reported, for example, by Kester (1986), Kim and Sorensen (1986), and Titman and Wessels (1988). Moreover, the results are very often weak as far as the level of statistical significance is concerned.

To proxy for the size of a company, the natural logarithm of sales is used in this study (as it is in the most studies of similar character). Another possibility is to proxy for the size of a company by the natural logarithm of total assets; this, however, would not change the qualitative results of the empirical analysis.[4)]

3. 2 *Profitability*

There are no consistent theoretical predictions on the effect of profitability on leverage. From the point of view of the trade-off theory, more profitable companies should have higher leverage, because they have more income to shield from taxes. The free-cash flow theory would suggest that more profitable companies should use more debt in order to discipline managers, to induce them to pay out cash instead of spending money in inefficient projects. However, from the point of view of the pecking-order theory, firms prefer internal financing to external one. So more profitable companies have a lower need of the external financing, therefore they should have lower leverage.

Most empirical studies observe a negative relationship between leverage and profitability. For example, Huang and Song (2002), Booth et al. (2001), Titman and Wessels (1988), Friend and Lang (1988), Kester (1986), and Rajan and Zingales (1995) for G7 countries except for Germany. In this study, profitability is proxied by return on assets (defined as earnings before interest and taxes divided by total assets).

3. 3 *Tangibility*

It is assumed, from the theoretical point of view, that tangible assets can be used as a collateral. Therefore higher tangibility lowers the risk of a creditor and increases the value of the assets in the case of bankruptcy. As Booth et al. (2001, p. 101) state: "The more tangible the firm's assets, the greater its ability to issue secured debt." Thus a positive relationship between tangibility and leverage is predicted.

Several empirical studies confirm this suggestion, as Rajan and Zingales (1995), Friend and Lang (1988), and Titman and Wessels (1988) find. On the other hand, for example, Booth et al. (2001), and Huang and Song (2002) experience a negative relationship between tangibility and leverage. In this study, tangibility is defined as tangible assets divided by total assets.

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4) It was verified in the analysis by using ln (TA) instead of ln (Sales) as a proxy for SIZE (see Chapter 4).

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3. 4 *Growth Opportunities*

According to Myers (1977), firms with high future growth opportunities should use more equity financing, because a higher levered company is more likely to pass up profitable investment opportunities. As Huang and Song (2002, p. 9) claim: "such an investment effectively transfers wealth from stockholders to debtholders." Therefore a negative relation between growth opportunities and leverage is predicted. As market-to-book ratio is used in order to proxy for growth opportunities, there is one more reason to expect a negative relation – as Rajan and Zingales (1995, p. 1455) point out: "The theory predicts that firms with high market-to-book ratios have higher costs of financial distress, which is why we expect a negative correlation."

Some empirical studies confirm the theoretical prediction, as Rajan and Zingales (1995), Kim and Sorensen (1986), and Titman and Wessels (1988) report. However, for example, Kester (1986), and Huang and Song (2002) demonstrate a positive relation between growth opportunities and leverage. In this study, the P/B ratio (market-to-book ratio) is used as a proxy for growth opportunities.

3. 5 *Non-debt Tax Shields*

Other items apart from interest expenses, that contribute to tax payments decrease are labelled as non-debt tax shields (for example, the tax deduction for depreciation). According to DeAngelo and Masulis (1980, p. 21): "Ceteris paribus, decreases in allowable investment related tax shields (e.g., depreciation deductions or investment tax credits) due to changes in the corporate tax code or due to changes in inflation which reduce the real value of tax shields will increase the amount of debt that firms employ. In cross-sectional analysis, firms with lower investment related tax shields (holding before-tax earnings constant) will employ greater debt in their capital structures." So they argue, that non-debt tax shields are substitutes for a debt related tax shield and therefore the relation between non-debt tax shields and leverage should be negative.

Some empirical studies confirm the theoretical prediction, for example, Kim and Sorensen (1986, p. 140) declare: "DEPR[5)] has a significantly negative coefficient … This is consistent with the notion that depreciation is an effective tax shield, and thus offsets the tax shield benefits of leverage." A negative relation between non-debt tax shields and leverage find also Huang and Song (2002), and Titman and Wessels (1988). However, some studies observe a positive relation, as Bradley et al. (1984), and Chaplinsky and Niehaus (1993). Depreciation divided by total assets is used in order to proxy for non-debt tax shields in this study.

3. 6 *Volatility*

Volatility of profitability may be understood as a proxy for the risk of a firm (probability of bankruptcy). Therefore it is assumed that volatility is negatively related to leverage. However, as Huang and Song (2002, p. 9) state based on findings of Hsia (1981): "as the variance of the value of the firm's assets increases, the systematic risk of equity decreases. So the business risk is expected to be positively related to leverage."

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5) Kim and Sorensen (1986, p. 138) define DEPR as the average rate of depreciation, i.e., depreciation charges divided by fixed assets.

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A positive relation between volatility and leverage is confirmed by Kim and Sorensen (1986), and Huang and Song (2002). Conversely, a negative relation is found, for example, by Bradley et al. (1984), and Titman and Wessels (1988). In this study, standard deviation of return on assets is used as a proxy for volatility. Table 1 provides a brief summary of theoretical and empirical findings.

Table 1
Summary of Theoretical and Empirical Findings

	Theoretical prediction	G7 countries	Developed countries	Developing countries	China
Size	+/-	+[1)]	-[2)](+[2)])	+(-)	+
Profitability	+/-	-[1)]	-(+[2)])	-	-
Tangibility	+	+	+	-(+)	-
Growth opportunities	-	-	-[2)](+)	+(-)	+
Non-debt tax shields	-		+(-)		-
Volatility	+/-		-(+)	-(+)	+

1) Except for Germany.

2) According to Harris and Raviv (1991, p. 336): "Indicates that the result was either not statistically significantly different from zero at conventional significance levels or that the result was weak in a nonstatistical sense."

Source: G7 countries – Rajan and Zingales (1995); Developed countries – Harris and Raviv (1991), i.e., survey of following empirical studies: Bradley, et al. (1984), Chaplinsky and Niehaus (1990), Friend and Hasbrouck (1988), Friend and Lang (1988), Gonedes, et al. (1988), Long and Malitz (1985), Kester (1986), Kim and Sorensen (1986), Marsh (1982), and Titman and Wessels (1988); Developing countries – Booth et al. (2001); China – Huang and Song (2002).

4. Empirical Analysis

4. 1 *Data Description*

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 (PSE) website and in the Securities Centre of the Czech Republic data base; prices of ordinary shares at the year-end were obtained from the *Burzovní noviny*, an official stock-market attachment of the *Hospodářské noviny* daily. Financial reports are based on the 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 (BSE, 2001) and BSE (2002). Reports are based on the 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 (WSE, 2001) and WSE (2002). Reports are based on the International Accounting Standards. In the case of the Slovak Republic, financial reports of companies were provided by the Bratislava Stock Exchange (BSSE), prices of ordinary shares at the year-end were obtained from the BSSE web page. Reports are based on the Slovak Accounting Standards.

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). The sample size is described in Table 2.

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Table 2
Number of Listed Companies and Sample Size

	2000		2001	
	All	Sample	All	Sample
Czech Republic	151	72	102	72
Hungary	60	40	56	40
Poland	225	166	230	166
Slovak Republic	866	27	888	27

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 2 labelled All, 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 BSSE despite the small size.

4. 2 *International Comparison of the Extent of Leverage*

This study uses data based on the different accounting standards and hence the comparison of the results obtained for other countries can be inaccurate. Each country, in fact, has its own specific accounting practices, which cause difficulty in comparison (for example, Rajan and Zingales, 1995, use Global Vantage database for G7 countries and still they experience differences in accounting practices). Therefore any comparison undertaken ought to keep this shortage in mind. In the empirical analysis, it is controlled for the country-specific effects, which includes also the differences in accounting standards.

Table 3 reports the average balance sheet for years 2000 and 2001. Only items used in later analysis are described. Poland is treated as a reference group, because the share of Polish companies in the sample is the highest from all four Visegrad countries and therefore this reference group should be the most stable of all possible choices.

Several interesting observations can be made from the average balance sheet as reported in Table 3. Above all, statistically significant differences in the majority of items within the group of Visegrad countries can be seen. However, more interesting comparison can be done between Visegrad countries and G7 countries.[6] On

6) It is possible to compare the average balance sheet with G7 countries as reported in Rajan and Zingales (1995, p. 1428). Unfortunately, the comparison is not based on the same year (G7 countries report is based on the year 1991), however, it is made just for illustration of basic differences across countries.

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Table 3
Selected Items of the Average Balance Sheet (N = 305 companies)

Item	2000	PI	DC	DH	DS	2001	PI	DC	DH	DS
Total assets	100	100	0	0	0	100	100	0	0	0
Tangible assets	42	37	17***	8**	5	42	37	15***	8*	8*
TL+SF	100	100	0	0	0	100	100	0	0	0
SF	55	51	7**	13***	0	53	47	12***	15***	4
Liabilities	40	42	-2	-9**	3	42	45	-8***	-11***	-1
Long-term liab.	8	8	1	1	3	8	8	-4	2	3
Short-term liab.	31	34	-6***	-10***	-2	33	37	-10***	-12***	-7*
Other liabilities	5	7	-5***	-4***	-3*	5	7	-4***	-4***	-3**

Remarks: TL denotes Total Liabilities, SF stands for Shareholders Funds.

First, the respective item for each firm was scaled by total assets and then averaged across all firms in the relevant subsample. Subsequently it was multiplied by 100, thus, the reported values are in % of total assets.

In the column under the year, average value across all observations is noted. In the column under PI, which denotes Poland as a reference group, the respective share is expressed. DC stands for the difference for the Czech Republic, DH for the difference for Hungary, DS for the difference for the Slovak Republic. *,**,*** refer to the statistically significant difference at the 10%, 5%, 1% level. For example, in the case of the year 2000, average value of tangible assets in the whole sample is 42 % of total assets. In the case of Poland, this share is 37 %. In the case of the Czech Republic, it is 37 %+17 % = 54 %, the difference between Poland and the Czech Republic is statistically significant at the 1% level.

the assets side of the balance sheet, the proportion of tangible assets in Visegrad countries is relatively high, higher than in the case of six from the group of G7 countries. Only Canada exhibits higher value. On the side of liabilities, companies in Visegrad countries show higher proportion of equity than companies in G7 countries. They also use lower share of long-term liabilities than companies in most of G7 countries and the dominant role in total liabilities is represented by short-term liabilities.

Here, the problem arises how to measure the leverage of a company. As Rajan and Zingales (1995, p. 1427) state: “Clearly, the extent of leverage – and the most relevant measure – depends on the objective of the analysis.” The discussion concerning the different measures of leverage can be found in Rajan and Zingales (ibid.).

In this study, the basic definition of leverage, i.e., the ratio of total liabilities to total assets[7)] is used in order to analyze determinants of capital structure. Leverage is used expressed in book value (Book Total Liabilities Ratio, TL, defined as total liabilities divided by the sum of total liabilities and book value of equity) as well as in market value (Market Total Liabilities Ratio, MTL, defined as total liabilities divided by the sum of total liabilities and market value of equity).

Table 4 compares the extent of leverage within Visegrad countries as well as between Visegrad countries and selected developed and developing countries.

As it is reported in Table 4, TL in the Czech Republic and Hungary is lower than in Poland and the Slovak Republic. Visegrad countries exhibit lower value of TL than G7 countries and they demonstrate median value if compared to developing countries. In general, developing countries seem to have lower value of TL than G7 countries, so the firms in developing countries have higher share of equity in total assets. Different results are obtained when leverage is measured in market value.

7) This definition can be understood as the non-equity share of total assets – therefore one minus this measure can be interpreted as “what is left for shareholders in the case of liquidation”.

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Table 4
Extent of Leverage in Selected Countries; median (mean)

Country	Observations	Period	TL	MTL
Visegrad	305	2000 – 2001	0.47 (0.46)	0.60 (0.56)
Czech Republic	72	2000 – 2001	0.42 (0.41)	0.66 (0.62)
Hungary	40	2000 – 2001	0.39 (0.37)	0.41 (0.41)
Poland	166	2000 – 2001	0.51 (0.51)	0.58 (0.54)
Slovak Republic	27	2000 – 2001	0.48 (0.49)	0.74 (0.72)
USA	2580	1991	0.58 (0.66)	0.44 (0.44)
Japan	514	1991	0.69 (0.67)	0.45 (0.45)
Germany	191	1991	0.73 (0.72)	0.60 (0.56)
France	225	1991	0.71 (0.69)	0.64 (0.61)
Italy	118	1991	0.70 (0.67)	0.70 (0.67)
UK	608	1991	0.54 (0.57)	0.40 (0.42)
Canada	318	1991	0.56 (0.61)	0.49 (0.47)
China	954	2000	0.45 (0.46)	0.12 (0.14)
Brazil	49	1985 – 1991	0.30	N/A
Mexico	99	1984 – 1990	0.35	N/A
India	99	1980 – 1990	0.67	N/A
South Korea	93	1980 – 1990	0.73	N/A
Jordan	38	1983 – 1990	0.47	N/A
Malaysia	96	1983 – 1990	0.42	N/A
Pakistan	96	1980 – 1987	0.66	N/A
Thailand	64	1983 – 1990	0.49	N/A
Turkey	45	1983 – 1990	0.59	N/A
Zimbabwe	48	1980 – 1988	0.42	N/A

Source: Visegrad countries – own calculations; G7 countries – Rajan and Zingales (1995); China – Huang and Song (2002); other countries – Booth et al. (2001).

Because of low P/B ratio in Visegrad countries (for more details, see below), the value of MTL is higher than in non-continental-European G7 countries. Continental-European G7 countries exhibit equal or higher values of MTL. China presents a very special case, the reason is given below where P/B ratios are discussed. Unfortunately, values for other developing countries are not available.

4. 3 *Determinants of Capital Structure*

As it is stated in Chapter 3, six possible determinants of leverage are analyzed in this study. They are SIZE (defined as the natural logarithm of sales), ROA (earnings before interest and taxes divided by total assets), TANG (tangible assets divided by total assets), PB (P/B ratio), NDTS (depreciation divided by total assets), and VOLTY (standard deviation of ROA).

In Table 5 international comparison of descriptive statistics of six possible determinants (and also ln TA as an alternative proxy for the size of the company) is reported.

As Table 5 informs, in general, the firm SIZE is higher in G7 countries than in developing countries including Visegrad countries. Concerning Visegrad countries, listed firms are bigger in the Czech Republic and Hungary than in Poland. In the case of the Slovak Republic, the SIZE is biased by the small sample size, which includes primarily big companies. Within G7 countries, values of firm size are very

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Table 5
International Comparison of Descriptive Statistics; mean (standard deviation)

	SIZE	Ln TA	ROA	TANG	PB	NDTS	VOLTY
Visegrad	17.63 (1.71)	17.79 (1.48)	0.03 (0.01)	0.42 (0.23)	0.96 (1.15)	0.05 (0.03)	0.04 (0.06)
Czech R.	17.89 (2.16)	18.60 (1.23)	0.06 (0.10)	0.52 (0.26)	0.50 (0.41)	0.05 (0.03)	0.03 (0.04)
Hungary	18.00 (1.87)	18.17 (1.69)	0.06 (0.09)	0.44 (0.22)	1.12 (0.95)	0.06 (0.03)	0.03 (0.05)
Poland	17.51 (1.42)	17.39 (1.38)	0.02 (0.14)	0.37 (0.20)	1.21 (1.39)	0.05 (0.03)	0.04 (0.07)
Slovak R.	17.17 (1.61)	17.55 (1.42)	0.03 (0.10)	0.43 (0.22)	0.41 (0.37)	0.05 (0.03)	0.03 (0.04)
USA	n.a.	21.61	0.07 (0.08)	0.36	1.65	0.10 (0.04)	0.07 (0.12)
Japan	n.a.	21.83	0.05 (0.03)	0.29	1.67	n.a.	0.02 (0.04)
UK	n.a.	20.59	0.09 (0.08)	0.41	1.35	n.a.	0.06 (0.09)
Germany	n.a.	21.65	0.06 (0.04)	0.33	1.57	n.a.	0.04 (0.06)
France	n.a.	21.69	0.07 (0.05)	0.24	1.26	n.a.	0.04 (0.05)
Italy	n.a.	n.a.	n.a.	0.32	1.00	n.a.	n.a.
Canada	n.a.	n.a.	n.a.	0.52	1.36	n.a.	n.a.
China	19.7 (1.0)	n.a.	0.08 (0.04)	0.34 (0.16)	3.19 (1.24)	0.02 (0.02)	0.04 (0.04)
Brazil	13.1 (1.0)	n.a.	0.07 (0.12)	0.68 (0.19)	n.a.	n.a.	0.09 (0.05)
Mexico	11.2 (1.4)	n.a.	0.08 (0.08)	0.33 (0.30)	n.a.	n.a.	0.06 (0.03)
India	18.4 (1.0)	n.a.	0.07 (0.07)	0.41 (0.18)	1.4 (1.1)	n.a.	0.05 (0.03)
South Korea	18.9 (0.9)	n.a.	0.04 (0.04)	0.49 (0.15)	0.7 (0.7)	n.a.	0.03 (0.02)
Jordan	9.80 (0.3)	n.a.	0.07 (0.11)	0.47 (0.22)	1.4 (0.7)	n.a.	0.08 (0.04)
Malaysia	17.4 (1.6)	n.a.	0.07 (0.07)	0.58 (0.22)	2.3 (1.8)	n.a.	0.05 (0.03)
Pakistan	17.1 (1.1)	n.a.	0.09 (0.10)	0.38 (0.20)	0.9 (0.7)	n.a.	0.06 (0.04)
Thailand	16.7 (1.3)	n.a.	0.13 (0.07)	0.36 (0.17)	3.2 (2.1)	n.a.	0.03 (0.03)
Turkey	17.2 (1.7)	n.a.	0.10 (0.09)	0.41 (0.19)	1.9 (1.3)	n.a.	0.06 (0.03)
Zimbabwe	16.7 (1.6)	n.a.	0.12 (0.09)	0.44 (0.13)	0.6 (0.6)	n.a.	0.06 (0.06)

Remarks: Number of observations and the year under analysis are the same as reported in Table 4. PB in the case of China means Tobin´s *Q* (defined as market-to-book ratio of total assets); the corresponding value of P/B ratio is 5.24 (calculated from Huang and Song, 2002). TANG in the case of Booth et al. (2001) is defined as total assets less current assets divided by total assets. Values for G7 countries were obtained as follows – TANG and PB were calculated from Rajan and Zingales (1995); VOLTY, ROA and ln TA from Wald (1999), where the same time period as in Rajan and Zingales (1995) is used. NDTS for USA are from Kim and Sorensen (1986), however, the values are from the period 1975 – 1980.

Source: Visegrad countries – own calculations; G7 countries – see remarks below; China – Huang and Song (2002); other countries – Booth et al. (2001).

similar. Conversely, the size of listed firms in developing countries is very different among countries.

The value of ROA in Visegrad countries is lower than in G7 countries and much lower than in developing countries. The highest profitability within Visegrad countries exhibit firms in the Czech Republic and Hungary.

Tangibility in Visegrad countries is higher than in G7 countries except Canada. In general, tangibility is higher in the case of developing countries than in the case of developed countries. From Visegrad countries, the highest value of tangibility shows the Czech Republic.

In Visegrad countries, the P/B ratio is lower than one, as well as in three other developing countries (South Korea, Pakistan and Zimbabwe). The lowest value of PB exhibit the Slovak Republic and the Czech Republic. On the contrary, Hungary and Poland show the P/B ratio above one. Within G7 countries, the lowest P/B ratio is exhibited by Italy (exactly one). In all other countries the value of the P/B ratio is above one. China is a very special case, the average value of the P/B ratio is over

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five; therefore leverage expressed in market value is much lower than leverage assessed in book value.

The value of NDTS is not available, except for Visegrad countries, the USA, and China. The sensible comparison is, therefore, not possible. However, the value of NDTS is the highest in the case of the USA and the lowest in the case of China. Within Visegrad countries, the values of NDTS are very similar.

The value of VOLTY is higher in developing countries than in G7 countries. Within Visegrad countries, the value of VOLTY is similar.

Empirical analysis of capital structure's determinants in Visegrad countries follows. Because dependent variable is restricted to the unit interval (0,1)[8] the linear model for $E(y|x)$ cannot be a good description of the effects of respective regressors on the dependent variable. Primarily because of the fact that for estimated coefficients there would be feasible values of explanatory variables such that predicted dependent variable are outside the unit interval. As Papke and Wooldridge (1996, p. 620) state: "Thus, the drawbacks of linear models for fractional data are analogous to the drawbacks of the linear probability model for binary data." And they add: "The most common alternative … has been to model the log-odds ratio as a linear function. If y is strictly between zero and one then a linear model for the log-odds ratio is $E(\log[y/(1-y)] \mid x) = x\beta$. [This] is attractive because $\log[y/(1-y)]$ can take on any real value as y varies between 0 and 1, so it is natural to model its population regression as a linear function." However, there are two potential drawbacks of this approach. First, when y takes on values *0* or *1*, an adjustment has to be made before computing the log-odds ratio. This does not cause any problem in our case, because y is strictly between zero and one. The second drawback is more important – without further assumptions, $E(y|x)$ cannot be recovered.[9] To avoid this problem, $E(y|x)$ can be modelled as a logistic function:

$$E(y|x) = \frac{\exp(x\beta)}{1+\exp(x\beta)}$$

This approach leads to predicted values of y within a unit interval (0,1). The interpretation of estimated results is very similar as in the case of logit model for binary data.

How to estimate β in such a model? As Wooldridge (2002, p. 662) proposes: "One approach to estimate β is non-linear least squares." However, as he admits (ibid.): "The assumption that implies relative efficiency of NLS – namely, Var $(y|x) = \sigma^2$ – is unlikely to hold for fractional y." Therefore Papke and Wooldridge (1996) propose to estimate β by quasi-maximum likelihood estimation, where the quasi-log likelihood for observation i is:

$$\ell_i = y_i \log[G(x_i\beta)] + (1 - y_i)\log[1 - G(x_i\beta)]$$

In our case, when $E(y|x)$ is modelled as a logistic function, G is defined as:

$$G(x_i\beta) = \frac{\exp(x_i\beta)}{1+\exp(x_i\beta)}$$

In Table 6, the estimations of β using quasi-MLE are reported. Fully robust standard errors are reported in parentheses.[10]

8) This type of data is called in literature fractional data, for more details see Wooldridge (2002).

9) $E(y|x)$ can be estimated using, for example, Duan's (1983) smearing method.

10) Because heteroskedasticity was detected, White (1980) estimator of variance was used (for more details see Greene, 2003).

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Table 6
Estimation Results (quasi-maximum likelihood estimation), **N = 305**

	2000				2001			
	TL (SE)	*z*	MTL (SE)	*z*	TL (SE)	*z*	MTL (SE)	*z*
Intercept	-3.955 (0.479)	*-8.25* ***	-2.342 (0.510)	*-4.59* ***	-3.882 (0.514)	*-7.55* ***	-1.864 (0.537)	*-3.47* ***
SIZE	0.249 (0.028)	*8.89* ***	0.201 (0.031)	*6.41* ***	0.251 (0.030)	*8.35* ***	0.195 (0.032)	*6.09* ***
ROA	-2.274 (0.594)	*-3.83* ***	-3.055 (0.573)	*-5.33* ***	-2.906 (0.504)	*-5.77* ***	-3.466 (0.595)	*-5.82* ***
TANG	-0.257 (0.245)	*-1.05*	-0.356 (0.271)	*-1.31*	-0.559 (0.232)	*-2.41* **	-0.709 (0.259)	*-2.74* ***
PB	0.068 (0.036)	*1.89* *	-0.476 (0.096)	*-4.96* ***	0.116 (0.060)	*1.92* *	-0.586 (0.092)	*-6.35* ***
NDTS	-7.012 (2.009)	*-3.49* ***	-6.155 (2.333)	*-2.64* ***	-4.336 (1.609)	*-2.69* ***	-3.518 (2.182)	*-1.61*
VOLTY	-0.035 (1.094)	*-0.03*	-0.256 (0.998)	*-0.26*	-1.676 (0.955)	*-1.75* *	-2.819 (1.327)	*-2.12* **
DCZ	-0.236 (0.105)	*-2.23* **	0.226 (0.122)	*1.86* *	-0.360 (0.113)	*-3.18* ***	-0.050 (0.126)	*-0.40*
DHU	-0.531 (0.129)	*-4.12* ***	-0.492 (0.143)	*-3.44* ***	-0.580 (0.128)	*-4.53* ***	-0.531 (0.135)	*-3.92* ***
DSK	0.133 (0.140)	*0.95*	0.662 (0.184)	*3.60* ***	0.049 (0.156)	*0.32*	0.324 (0.179)	*1.81* *
Adj. R^2	0.29		0.47		0.33		0.40	

Remarks: figures under the values estimated represent standard errors (in parentheses); numerals in italics stand for *z*-statistics, significant at the *** = 1%,** = 5%,* = 10% level.

The sign of β reveals the sign of relationship between dependent variable and respective regressor as well as the statistical significance shows the statistical significance of the relationship. However, because the relationship between regressors and dependent variable is non-linear, the size of the effects cannot be seen from Table 6 directly. However, the marginal effects and elasticities can be defined as follows:

$$\text{Marginal effect} \Rightarrow \text{ME}_k = \frac{\partial E(y|x)}{\partial x_k} = \frac{\exp(x\beta)}{[1+\exp(x\beta)]^2}\beta_k$$

$$\text{Elasticity} \Rightarrow \text{Elasticity} = \frac{\partial E(y|x)}{\partial x_k}\frac{x_k}{E(y|x)} = \frac{1}{1+\exp(x\beta)}\beta_k x_k$$

In Table 7, two marginal effects are reported. First the average marginal effect (mean and standard deviation of marginal effects across all observations) and second the marginal effect for the hypothetical observation with mean characteristics (this marginal effect is roughly comparable to the OLS estimates from the linear regression of *y* on *x*). The elasticity is reported for the hypothetical observation with mean characteristics. For dummy variables the respective marginal effect is calculated as the difference between predicted dependent variable for $x_k = 1$ and $x_k = 0$. The definitions of reported marginal effects and elasticity are as following:

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$$ME_k^1 = \frac{1}{N}\sum_{i=1}^{N} \mathrm{ME}_{ki}\ ,\ \text{where}\ \mathrm{ME}_{ki} = \frac{\exp\left(x_i\,\hat{\beta}\right)}{\left[1+\exp\left(x_i\,\hat{\beta}\right)\right]^2}\hat{\beta}_k$$

$$ME_k^2 = \frac{\exp\left(\bar{x}\hat{\beta}\right)}{\left[1+\exp\left(\bar{x}\hat{\beta}\right)\right]^2}\hat{\beta}_k$$

$$\text{Elasticity} = \frac{1}{1+\exp\left(\bar{x}\hat{\beta}\right)}\hat{\beta}_k\,\bar{x}_k$$

Table 7
Effects of Explanatory Variables on Leverage, N = 305

	2000				2001			
	TL		MTL		TL		MTL	
	ME^1 (SD)	ME^2 Elas.	ME^1 (SD)	ME^2 Elas.	ME^1 (SD)	ME^2 Elas.	ME^1 (SD)	ME^2 Elas.
SIZE	0.059	0.062***	0.047	0.050***	0.059	0.062***	0.045	0.047***
	(0.001)	2.402	(0.002)	1.677	(0.002)	2.334	(0.002)	1.407
ROA	-0.539	-0.563***	-0.708	-0.762***	-0.685	-0.724***	-0.792	-0.838***
	(0.013)	-0.061	(0.028)	-0.071	(0.020)	-0.030	(0.032)	-0.028
TANG	-0.061	-0.064	-0.082	-0.089	-0.132	-0.139**	-0.162	-0.171***
	(0.002)	-0.059	(0.003)	-0.071	(0.004)	-0.124	(0.006)	-0.122
PB	0.016	0.017*	-0.110	-0.119***	0.027	0.029*	-0.134	-0.142***
	(0.000)	0.040	(0.004)	-0.244	(0.001)	0.051	(0.005)	-0.202
NDTS	-1.661	-1.737***	-1.426	-1.535***	-1.022	-1.081***	-0.804	-0.850
	(0.042)	-0.198	(0.056)	-0.151	(0.030)	-0.127	(0.032)	-0.080
VOLTY	-0.008	-0.009	-0.059	-0.064	-0.395	-0.418*	-0.644	-0.681**
	(0.000)	-0.001	(0.002)	-0.004	(0.012)	-0.032	(0.026)	-0.042
DCZ	-0.056	-0.058**	0.052	0.056*	-0.086	-0.089***	-0.011	-0.012
	(0.002)		(0.002)		(0.003)		(0.000)	
DHU	-0.129	-0.127***	-0.118	-0.122***	-0.140	-0.140***	-0.126	-0.131***
	(0.004)		(0.004)		(0.005)		(0.005)	
DSK	0.031	0.033	0.140	0.158***	0.012	0.012	0.071	0.076*
	(0.001)		(0.010)		(0.000)		(0.004)	

Remarks: SD (in parentheses) represents standard deviation of the respective ME^1; statistical significance is linked to the estimation results as reported in Table 6.

Theoretical prediction of the relationship between size and leverage is ambiguous. Empirical studies experience mainly a positive relationship. This is also the result of our study. SIZE is statistically significant at the 1% level in all four models, the sign is always positive. Thus the theory that size is an inverse proxy for the probability of bankruptcy is supported by the results.

There is no consistent theoretical prediction of the influence of profitability on leverage. However, in the majority of empirical studies, a negative relationship between profitability and leverage is observed. This study provides the same result. ROA is statistically significant in all four models, the sign is always negative. This result confirms the pecking-order theory rather than static trade-off models.

From the theoretical point of view, a positive relationship is expected between leverage and tangibility. However, based on the results of this study, the relationship is negative. This is also the result of empirical studies for other developing countries,

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whereas developed countries exhibit a positive relationship. This can be partly explained by the institutional environment, which causes difficulties and lowers the value of the assets in the case of firm bankruptcy in developing countries, compared to developed countries. However, such effect could explain no relationship, but it is not very likely to cause a negative relationship, which is observed in the analysis. Therefore some additional explanation should be offered by the theory. The relationship between tangibility and leverage is negative in all four models, albeit it is statistically significant in only two models.

Theoretically, the expected relation between growth opportunities and leverage is negative. The results of this study confirm this expectation, as do empirical studies for developed countries. However, PB is statistically significant only in cases when leverage is expressed in market value. When leverage is measured in book value, rather a positive relation is detected, as is also the case of empirical studies for developing countries. However, statistical significance of the relationship in this case is lower than in the previous case.

For non-debt tax shields, the results confirm theoretical prediction, i.e., a negative relationship to leverage. NDTS is statistically significant in three models, the sign is always negative.

Theoretical prediction of the relationship between volatility and leverage is not clear. This study does not provide us with a clear empirical result, because of relatively low statistical significance of VOLTY. However, the relation between volatility and leverage is always negative. This result supports a view of volatility as a proxy for the risk of a firm.

Concerning dummy variables, they are used in order to control for the country-specific effects (especially for the differences in accounting standards).

According to the values of adjusted coefficient of determination (Adj R^2), explanatory power of models is higher when the leverage is expressed in market value than when it is assessed in book value. Explanatory power of models presented in this study is, in general, relatively high in comparison to studies of similar character. For greater clarity, results are summarized in Table 8.

Table 8
General Results

	Regressor	Sign
Significant relationship	SIZE ROA	+ -
Less significant	TANG PB* NDTS	- - -
Slightly significant	VOLTY	-

Remark: * denotes that PB is statistically significant only when leverage is expressed in market value.

5. Conclusions

In this paper there is analyzed capital structure of listed companies in Visegrad countries. In general, listed firms in Visegrad countries exhibit lower leverage than listed firms in G7 countries and median value of leverage among developing coun-

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tries (eleven in-this-study-reported developing countries), when measured by Book Total Liabilities Ratio. Different results are obtained when leverage is expressed in market value. Because of relatively low P/B ratio, leverage in Visegrad countries is higher than in non-continental-European G7 countries, whereas continental-European G7 countries exhibit equal or higher values of leverage. Thus, firms in Visegrad countries show relatively low leverage measured in book value, but relatively high leverage assessed in market value.

Based on data availability, six potential determinants of capital structure are analyzed in this paper – size, profitability, tangibility, growth opportunities, non-debt tax shields and volatility. According to the results of empirical analysis, leverage of listed firms in Visegrad countries is positively correlated with size. This result supports the view of size as an inverse proxy for the probability of bankruptcy. Leverage is negatively correlated with profitability, this finding is consistent with the pecking-order hypothesis rather than with static trade-off models. A negative relationship between tangibility and leverage is in contradiction with theoretical prediction. Similar result experience also empirical studies for other developing countries, whereas developed countries exhibit positive relation. This can be partly explained by the institutional environment, which causes difficulties and lowers the value of the assets in the case of firm bankruptcy in developing countries, compared to developed countries. However, such effect could explain no relationship, but it is not very likely to cause a negative relationship, which is observed in the analysis. Therefore some additional explanation should be offered by the theory. The relationship between leverage and the P/B ratio (proxy for growth opportunities) is negative, given that the leverage is measured in market value. This result confirms theoretical prediction that firms with higher future growth opportunities use more equity financing. Negative relationship between leverage and non-debt tax shields is in accordance with theoretical prediction and shows non-debt tax shields as substitutes to debt related tax shield. It can be stated, on the lower level of statistical significance, that leverage is negatively correlated with volatility. This result supports a view of volatility as a proxy for the risk of a firm.

As far as size, profitability and non-debt tax shields are concerned, the results are similar to the conclusions of most other empirical papers. In the case of tangibility, the findings of this study correspond to the results obtained for developing countries whereas in the case of growth opportunities the findings are in accordance with the results obtained for developed countries. Results and comparisons are not clear in the case of volatility.

In general, leverage of listed firms in Visegrad countries seems to be determined by the same factors as leverage of listed firms in G7 countries and in developing countries reported in this paper. The explanatory power of models used in this study is relatively high.

Finally, several comments should be made with regard to possible limitations and prospective extensions of this study.

First, as data used in this study is based on different accounting standards, comparison within Visegrad countries as well as with other countries is not always appropriate. However, in empirical analysis, we control for the country-specific effects, which includes also differences in accounting practices.

Second, the results for the Slovak Republic are very hard to be interpreted, because of substantial bias. This bias is caused by the small size of the sample compared to the number of listed companies. However, the sample covers relatively high share of turnover and market capitalization of the Bratislava Stock Exchange despite the small size.

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