THE ROLE OF FINANCIAL FACTORS INTERACTIONS IN THE CAPITAL STRUCTURE DETERMINATION

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Abstract

This article is devoted to the exploration of the mechanism of making decision about the company's financing structure. It is shown that the interaction between various financial characteristics of company plays statistically significant role in the capital structure determination. Namely their possible values space may be split into several areas in which different, but might intersected, sets of financial indicators impact statistically significant on the capital structure. Moreover, the same indicator in different areas may have a differential impact on the capital structure. Also there were formulated several hypothesis about the potential direction of influence of various financial indicators on the capital structure assuming the truth of pecking order or trade off hypotheses. And one of the accompanying results of research was the getting facts in favor of the packing order theory for the companies in the chosen branch. Regression trees in combination with linear regression models were used to build the corresponding model of statistical relationship between the measure of capital structure and the set of company's financial indicators. Model training and testing of the set of hypothesis were done using data about annual Russian companies reporting in the branch of automobile retail.

Keywords: capital structure, regression tree, structural change model, interaction of variables, automobile retail

JEL: G32, C51, C58, C14, D22

Introduction

Our research is aimed to explore the statistical relationship between the firm's capital structure and various indicators characterizing the financial state of the firm, to summarize good or bad practice of financial management. Its results might be useful for both financial managers and lenders to support making decisions. The main idea of our research is that might it is interaction between financial characteristics of any company that plays significant role in the capital structure choice. That is various combinations of their values might determine the set of statistically significant capital structure choice determinants and the direction of their impact. The main instrument of research here is statistical modeling, in which some measure of capital structure is considered as response or dependent variable and some group of financial indicators are considered as independent variables or predictors. The model which may be built will represents the statistical relationship between the response variable and predictors and thus accumulate current practice of corporate finance management.

Traditionally model properties may be interpreted as arguments in favor of one of two main hypotheses in the corporate finance – pecking order and trade-off theories. Without going into details the question is which of the theories is true. Researches of such kind have already been presented in a lot of publications but scientists haven't got the unique answer yet. There is a feeling that it cannot be obtained. We think that it'll be more effective to analyze the broader issue – if the strength and the direction of statistical relationship between capital structure measures and above mentioned financial indicators depend on the values of these indicators. That is, if different combinations of these indicators values lead to the different principals of capital structure determination. If we solve this problem the test of above mentioned hypothesis will might be done as byproduct of such research. The expected result obviously is much broader. The roadmap is following. We choose several traditional metrics as measures of capital structure and several financial indicators that are traditionally used

in the corporate finance as possible determinants of capital structure. Within a chosen industry we attempt to allocate sets of companies (segments of industry) that possess three important properties:

- they are similar in some sense, i.e. some financial indicators from the selected set takes close values;
- they have close capital structure;
- each of the above mentioned set of companies has its own set of statistically significant capital structure determinants, that are different for different sets of companies, but may intersect.

In this article we define capital structure as the ratio of sources of financing that includes the long-term debt (e.g. long-term credits), the short-term debt (e.g. short-term credits) and equity. The list of factors that might has significant impact on the capital structure and there measures are well defined in the rich literature about the capital structure choice.

Linear regression and related techniques are traditional instruments of modeling in researches of capital structure determination. In most cases researcher use some kind of regression (linear, panel, dynamic and so on) of the capital structure measure on the set of financial indicators to test theoretical hypothesis. One of the great problems here is the choice of functional form for the regression model. We avoid it by the use of regression trees – the instrument of statistical modelling which has a lot in common with linear regression, but doesn't require preliminary definition of functional form. Also we use the regression model with structural change to explore the difference between sets of capital structure choice determinants in various segments of selected branch.

The structure of article is following. Part "1. Nuts and bolts" is devoted to the history and modern state of the capital structure choice theory. In part "2. How determinants may impact the capital structure choice" several hypotheses about the direction of statistical relationship between the capital structure and factors that describes state of the firm and market environment are presented. They should be considered as requirements to the structure of the capital structure choice model. Part "3. Regression trees: benefits and construction" presents in short the concept of regression tree, its properties and benefits for researcher. Part "4. Data and models" contains the description of response (dependent) variables, that is, measures of the capital structure, predictors (independent variables), that is, possible determinants of the capital structure choice, branch, massive of data and the set of models, which will represent various aspects of the statistical relationship between dependent and independent variables. Empirical results are presented in part "5. Capital structure choice in different segments of branch". It contains the branch segmentation and the detection of statistically significant capital structure choice determinants for each segment. Also, it contains results of trade-off and pecking order theories testing. We can mention that there are a lot of arguments in favor of pecking order theory for this branch of Russian economy. Part "6. Conclusion" contains at first the description of the analysis methodology that can be used to analyze any set of companies, and secondly the survey of main results which was obtained in this research and some problems.

Nuts and bolts

The greatest breakthrough in theory of optimal capital structure came with Modigliani and Miller's theorem (Modigliani, Miller, 1959). They hypothesized that in perfect markets, it does not matter what capital structure a company uses to finance its operations, and the market value of a firm is determined by its earning power and by the risk of its underlying assets. They made a correction in 1963, when the influence of corporate taxes was introduced (Modigliani, Miller, 1963). This proposition recognizes the tax benefit from interest payments. So bonds issuing effectively reduces a company's tax liability, but paying dividends on equity, however, does not. Third step in capital structure theory was first suggested by Baxter (1967). Bankruptcy costs were introduced. In this way, the value of the firm in bankruptcy is reduced by the fact that payments must be made to third parties other than bond- or shareholders.

As was mentioned in Arshanapalli and Nelson (2014), a new theory was started by Jensen and Meckling (1976). They introduced the so called *agency theory*, which is based on the assumption of no

conflict of interest between different 'parties', especially management, shareholders and debtholders. The use of debt by firms leads to agency costs. Debt agency cost arises due to conflict of interest between debt providers on one side, shareholders and managers on the other side. Shareholders are tempted to follow self-seeking strategies. Also, there are conflicts of interest in the company, where the firm manager being likened to agent while debt holders and shareholders are the principals. In most cases, the agent may decide not to maximize the principal wealth. Jensen and Meckling argue that managers have a tendency to spend excess free cash flow on their interests at the expense of stockholder's interest. The theory tries to resolve the conflicts between owners and managers over the control of corporate resources through the use of contracts that seek to allocate decision rights and incentives. Also, since debt has to be paid in, cash debt invariably reduced the amount of cash flow derived by managers. It serves as a mechanism to discipline managers from engaging in self-serving activities e.g. prerequisite consumption, empire building etc. and also provide the means for controlling the opportunistic behavior of managers by reducing the cash flow available for discretionary spending (Roy, Mingfang, 2002). Manager's attention would be clearly focused on those activities that are likely to ensure that debt payments are made, rather than indulging in prerequisite and choosing only inputs and outputs that satisfies their own desire. One may conclude that the use of secured debt might reduce the agency cost of debt. The use of short term sources of debt may mitigate the agency problem too. This is so because any attempt by shareholders to extract wealth from debt holders is likely to hinder the firm's access to short term debt in the near future.

According to the *trade-off theory* (Kraus, Litzenberger, 1973; Baltac, Ayaydn, 2014), capital structure choices are determined by a trade-off between the benefits and costs of debt. It's also called the tax based theory (Bassey, Arene, Okpukpara, 2014). In the trade-off theory increased investment opportunities are associated with a lower debt ratio. This is the tendency for stockholders to accept high risk projects to profit on the upside potential and allow bondholders to suffer the losses if the project fails. Risk shifting is another type of agency cost. It was mentioned in Lopez-Gracia, Sogorb-Mira, 2008 and Brendea (2014), that Frank and Goyal (2005) break Myers's earlier notion of trade-off into two parts: the static trade-off theory (the firm's leverage is determined by a single period trade-off) and target-adjustment behavior (the firm's leverage gradually reverts to the target over time). Later some authors developed dynamic trade-off models in an attempt to provide a unified framework (Hennessy, Whited 2005; Leary, Roberts 2005). There is one significant problem in the trade-off theory. It claims that the optimal level of a firm's debt is achieved by weighing debt financing against the cost of potential financial distress. But in Bassey, Arene and Okpukpara (2014), it is argued from the dynamic viewpoint that optimal leverage level can change due to changes in a firm's profitability level, non-debt tax shield etc., therefore, even though a firm debt ratio changes in yearly basis, the theory cannot be rejected because the optimal leverage level itself may differ over time.

As was mentioned in Brendea(2014) and Baker and Wurgler (2002) rejected the existence of adjustment behavior toward the target capital structure and introduced the market timing theory, according to which managers are able to time the equity market and issue equity when its value is high. This ability of managers affects the given company's security issuance decision and eventually the capital structure of that company.

The *pecking order model* of Myers and Majluf (1984) takes into account transactions and asymmetric information types of costs (Arshanapalli, Nelson, 2014). The transaction costs are highest with new equity, debt securities are next, and retained earnings has no fees. The asymmetric information costs arise from the investors' belief that the managers have better information about the firm's prospect than investors. Thus, if prospects are good the management is unlikely to issue equity to share the profits with investors. Since management understands investor's perception and wishes to avoid the underpricing, they set a hierarchy of financing and prefer internal sources to external financing. The first choice is retained earnings. Next is debt and new equity is issued reluctantly. There is no concept of target capital structure for a firm in the pecking order theory.

To sum up, while the trade-off and agency theories imply the existence of a target debt ratio and the adjustment behavior of firms with respect to this target, the other capital structure theories (i.e., pecking-order, market timing) reject the existence of adjustment behavior of firms, assuming instead

the influence of some external and internal factors on the financing decisions of firms.

The empirical evidence of determinants of capital structure is mixed. For example, Huang and Ritter (2009) show that when the cost of equity is high, firms behave as if they are following pecking order theory. It doesn't same when the cost of equity is low. Under this condition pecking order does not explain the composition of the capital structure of the firms. Mukherjee and Mahakud (2012) show that trade off and pecking order theories are more complementary than mutually exclusive.

How determinants may impact the capital structure choice

On the basis of the review above we submit several hypotheses about the reasons of capital structure choice. Testing them, i.e. testing what direction of statistical relationship between capital structure choice and corresponding financial indicators taking place in practice, may help one to determine circumstances in which managers follow one or another model. Sometimes managers might will follow one of the models and sometimes, if conditions change, the other one.

H1: "The influence of the profitability" (Babu, Chalam, 2014; Baltac, Ayaydn, 2014; Brendea, 2014). According to the pecking-order theory profitability should have a negative impact on the leverage. It postulates that firms with high internally generated funds prefer to borrow less because it is easier and more cost effective to finance from internal sources. In contrast, trade-off theory suggests that this relationship would be positive. Since profitable firms are less likely to go bankrupt, and hence can avail more debt at cheaper rates of interest. So they have more taxable income to shield. Therefore, according to this theory, when firms are profitable they are likely to prefer debt to other sources in order to benefit from the tax shield.

H2: "The influence of the size" (Babu, Chalam, 2014; Baltac, Ayaydn, 2014; Brendea, 2014). On the one hand, one can mention that larger firms are expected to have lower information asymmetries making equity issues more attractive, in other words, the larger firms face lower information costs and can raise equity capital more easily than the small firms. So in the context of the pecking order theory relationship between firm size and leverage should be negative. On the other hand, larger firms tend to be more diversified, have more stable cash flows and, thus, less prone to bankruptcy. So, larger firms have better access to credit markets compared to smaller firms. The firm size itself is trustworthy collateral for guaranteeing the service of debt or the payment of the residual cash in case of liquidation. Therefore, according to the trade-off theory one may expect a positive relation between leverage and firm size.

H3: "The influence of the tangibility" (Babu, Chalam, 2014; Baltac, Ayaydn, 2014; Harris, Raviv, 1991; Brendea, 2014; Titman, Wessel, 1988). On the one hand, the pecking order theory predicts that firms with law ratio of fixed-to-total assets face have higher information costs and, thus, prefers debt to equity. In other words, collateral and target leverage are negatively related. On the other hand, firms with a higher ratio of fixed-to-total assets are subject to lower costs of financial distress, as tangible assets suffer from a smaller loss of value in case of bankruptcy. Also, tangible assets are easier to value for outsiders, resulting in lower information asymmetry, less pronounced agency costs of debt, and a higher debt capacity. Tangible assets often are used as collateral. Therefore, the trade-off theory predicts a positive relationship between tangibility and leverage.

H4: The influence of growth opportunities" (Babu, Chalam, 2014; Baltac, Ayaydn, 2014; Bassey, Arene, Okpukpara, 2014; Brendea, 2014). On the one hand, firms with higher growth opportunities indicate the greater demand of capital. Also firms with high growth opportunities are anticipated to have higher information asymmetries. So they are expected to have more of debt and less of equity in their capital structure, external fund is preferred through debt financing. Pecking order theory suggests positive relationship between growth opportunities and leverage (Titman, Wessels, 1988). On the other hand, growth opportunities are viewed as intangible assets of firm. Firms with significant future growth opportunities are likely to face difficulties in raising finance from debt market because intangible assets are not fully collateral stable. Also, firms with high growth opportunities are likely to suffer from financial distress and the debt overhang problem from the perspective of agency costs. Thus, firms with high intangible growth opportunities will use more of equity rather

than debt in their capital structure. One must take into account that growing firms normally present growing cash flows too, so debt financing is usually replaced by internal funding. They are riskier, so the financial distress cost should be higher, hence implying less debt (Loncan, Caldeira, 2014). The trade-off theory expects that growth opportunities should have negative impact on leverage (Rajan, Zingale, 1995; Al-Sakran, 2001).

H5: "The influence of the uniqueness" (Titman, Wessels, 1988). Customers, workers, and suppliers of firms with unique production processes suffer relatively high costs in the case of bankruptcy. For these reasons, uniqueness is expected to be negatively related to debt ratios.

Regression trees: benefits and construction

The need for preliminary model specification, that is, the choice of independent variables set and the definition of the regression functions parametric family is a hard problem of the traditional regression analysis. The solution of this problem can't be formalized. It generates strong dependence of the result on the experience and private opinion of researcher. We try to avoid this problem using the model of the regression tree.

Regression tree (Ripley, 1996; Venables, Ripley, 2002; Berk, 2008) is a nonparametric regression model. It was created to predict values of numerical variable with the help of the mix of quantitative and qualitative regressors. It's rarely used in econometric practice, so we describe in short its sense, the algorithm of tree building, and optimization of the model which may remove the effect of over-fitting. In fact the regression tree is a method of piecewise constant approximation of the "true" regression, that is conditional expectation of the dependent variable given the set of independent variables. So researcher should not define functional form of model. Furthermore, the algorithm of regression tree building automatically selects important for prediction independent variables from the initial set of ones.

Algorithm of regression tree building. Let Z be the training set of volume T, that is, $Z: \{y_t, x_{1t}, x_{2t}, ..., x_{nt}\}$ $t = \overline{1, T}$, where y_t — the dependent variable and $\{x_{1,t}, x_{2,t}, ..., x_{n,t}\}$ — the set of independent variables. For any subset of Z ($U \subseteq Z$) define:

- predicted values of the variable y_t as the arithmetic mean of the elements of U — $\bar{y}_U$;

- the risk of the prediction function as $RSS_U = \sum_{y_t \in U} (\bar{y}_U - y_t)^2$.

The objective of the algorithm is to build the partition of Z $\left(Z = \bigcup_{k=1}^{M} Q_k, \forall i, j \leq M, Q_i \cap Q_j = \varnothing \right)$ which minimizes total risk of prediction, that is, $RSS_{\Sigma} = \sum_{k=1}^{M} RSS_{Q_k} \to \min$. If there isn't any restrictions e.g. on the volume of Q_k, it's obviously that any of Q_k contains only one element of Z.

The algorithm of tree building is iterative. On any new step it splits each of the subsets from the previous step into fixed number of subsets (here into two subsets) according to the values of one of the independent variables. The algorithm selects best independent variable and best way of splitting its values that minimizes total risk of prediction for child subsets of Z. The algorithm starts from the total training set Z and stops in the case of constraints violation. Work of the algorithm may be represented as tree-like graph, this explains name of the model. Results of intermediate splits are called "nodes"; child nodes of final splits are called "leafs".

Regression tree optimization (prunning). Together with rising of structure complexity (the number of leafs) the regression tree largely reflects properties of the training set rather than properties of general population. And these properties may absent in general population. This phenomenon is known as over–fitting. So with the growth of complexity the regression tree predictive ability initially is improved, but later, starting from some level of structure complexity it begin to worsen. It is necessary to combine some extra leafs that reflects unique properties of the training set to eliminate this phenomenon. On the tree-like graph this operation looks like pruning. In fact it de-

crease the complexity of the regression tree, that is, the number of splits or that the same thing the number of leafs. There are several possible strategies of the tree optimization. We use the cost-complexity pruning, which is described in details in Breiman at al. (1984), Ripley (1996) and Berk (2008). Following this strategy researcher use the cost-complexity measure of tree «T» with "K" terminal nodes $A_k, k = \overline{1, K}$: $R_\alpha(T) = R(T) + \alpha K$ $A_k, k = \overline{1, K}$, where R(T) is the risk of the tree «T» $R(T) = \sum_{k=1}^{M} P(A_k) R(A_k)$, that is the sum over all terminal nodes of the risk associated with each node times the probability of cases falling in that node. The idea of this criterion is much like the idea of Akaike information criterion. It was proved (Ripley, 1996; Berk, 2008) that for every given α there is only one subtree T_α of tree «T» which minimize this measure. The choice of the parameter α value is done using the procedure of cross–validation (Ripley, 1996; Berk, 2008; Hastie et all, 2001). Without going into details this procedure let us choose the structure of the model (the number of splits in this case) which possesses the best prediction properties. Instead of α the parameter $\varphi = \alpha / R(T_0)$ is generally used, where $R(T_0)$ risk of prediction for the trivial three, i.e. tree with single node, without splitting. As a result we obtain the tree with optimal structure that balances the aposteriori risk with the structure complexity and possesses the best prediction properties.

Data and models

Research methodology and data

Since the capital of commercial organization consists of the equity, long-term and short-term debts, then there may be various measures of the capital structure, which will reflect various features of it (Ivashkovskaja, Solnceva, 2008). We, according to the established tradition, took the following measures of capital structure:

- STDR (Short Term Debt Ratio) — the ratio of the short-term debt to the sum of the equity and the total debt;

- LTDR (Long Term Debt Ratio) — the ratio of the long-term debt to the sum of the equity and the total debt;

- TDR (Total Debt Ratio) — the ratio of the total debt to the sum of the equity and the total debt;

- STDRA (Book Value Short Term Debt Ratio) — the ratio of the short-term liabilities to the carrying amount of assets;

- LTDRA (Book Value Long Term Debt Ratio) — the ratio of the long-term liabilities to the carrying amount of assets;

- TDRA (Book Value Total Debt Ratio) — the ratio of the total liabilities to the carrying amount of assets.

Table 1 contains the list of potential capital structure choice determinants and corresponding hypothesis. We use values of these factors for two consecutive years (2012 and 2013). It might seem strange, that we include in the model financial indicators for the current year — the year when dependent variable is measured. Financial manager of course doesn't know their values when he makes decisions, which affect the capital structure of the company. But his decision is largely grounded on his expectations about future values of important financial indicators. So we include current values of them as measures of financial manager expectations.

Table 1

Factors potentially influencing the capital structure

Name	Way of settlement	Hypothesis
	Measures for collateral value of assets	H3
intas	The ratio of the book value of intangible assets to the total value of assets	

tas	The ratio of the sum of the book values of tangible assets and the stocks to the total value of assets	
tasm	The ratio of the book value of tangible assets to the total value of assets	
Measures for growth		H4
capex	The ratio of the change for the year the book value of tangible assets to the book value of total assets in the former year	
dtas	The ratio of the change for the year the book value of total assets to the book value of total assets in the former year	
quit	The ratio of the change for the year the number of employees to the number of employees in the former year	
rev	The ratio of the change for the year the book value of revenue to the book value of revenue in the former year	
Measures for uniqueness		H5
selexp	The ratio of the book value of business expenses to the book value of revenue	
Measures for size		H2
size	Logarithm of book value of revenue	
sizea	Logarithm of book value of total assets	
eurosize	Company size categories: very large companies (operating revenue ≥ 100 million EUR, total assets ≥ 200 million EUR, employees ≥ 1,000) large companies (operating revenue ≥ 10 million EUR, total assets ≥ 20 million EUR, employees ≥ 150) medium sized companies (operating revenue ≥ 1 million EUR, total assets ≥ 2 million EUR, employees ≥ 15) small companies – all others.	
Measures for profitability		H1
profa	The ratio of the book value of profit on sales to the book value of revenue	
profb	The ratio of the book value of profit on sales to the book value of total assets	
profc	The ratio of the book value of net income to the book value of total assets	
profd	The ratio of pre-interest after-tax earnings to the book value of total assets. Value of pre-interest after-tax earnings was estimated in following way: value of marginal tax rate (taxlim) was calculated as ratio of the change for the year the book value of tax on profits to the change for the year the book value of profit before tax; value of pre-interest after-tax earnings was calculated as sum of profit after tax and interest paid mutiplied by (1-taxlim).	
Additional variables		
tax	The ratio of the book value of tax on profits to the book value of profit before tax	
intp	The ratio of the book value of iterest paid to the book value of gross debt.	
legfor	Legal form of firm.	
type	Joint-stock or private company.	

There are some common words about data. Authors used data from the agency Credinform (through Ruslana, the database of «Bureau Van Dijk»). Database represents financial statements of 3205711 registered in Russia commercial organizations provided Federal Statistics Service and Federal Tax Service, updated annually. For comparison, there were 3974474 active commercial legal entities in Russia in December, 2014, according to General State Register of Enterprises (Companies House). Term «branch» doesn't well defined, so authors used the NACE revision 2.0 codes to define branch. There were selected joint stock companies and limited liability companies, which submit annual financial statements in 2011, 2012 and 2013 years and specified values of indexes: total assets, fixed assets, stocks, accounts receivables, liabilities, equity, charter capital, revenues from sales, profit.

Authors included in this research companies from the automobile retail according to the NACE revision 2.0 codes: the cars sale (code 4511), the cars maintenance and reconditioning (code 4520), the sale of spare car parts (code 4531), the sale of motorcycles and motorcycle spare parts (code 4540). In summary, there were 1620 financial statements extracted from database. Further, cleaning of data was performed. There were removed organizations with non-positive values of — revenue, retained earnings, profit before tax, net profit and book value of assets in current and preceding years. Also organizations were removed with negative long-run and short-run obligations in current and preceding years. The reason was that such data is a mistake or, if it is correct, in our opinion, such com-

panies can't control capital structure because don't have internal sources of financing. Finely, 971 organizations were presented on the analysis. Internal structure of sample (training set) is presented in Table 2.

Structure of sample in automobile retail

Size	Nace Rev. 2				Total
	4511	4520	4531	4540	
Very large	483	106	174	2	765
Large	54	25	45	3	127
Middle	14	17	41	0	72
Small	0	2	4	1	7
Total	551	150	264	6	971

It may be mentioned that most of the companies in this branch are very large and presented in the segment of cars sales.

The set of models

According to the statement of the problem above, the first thing that was done is the attempt to allocate groups of companies with close capital structure, which are similar in some sense, i.e. to find suitable split of the independent variables space (IVS). Regression trees were used to reach this objective. They were built for each capital structure measure and the optimization (pruning) was done. In some cases the result of pruning was trivial — the regression tree didn't bring any significant improvement in the data description. Such measures were excluded from further analysis of the branch. In the case of meaningful results of pruning, the list of important variables, i.e. variables that were automatically selected for tree building, and the structure of tree leafs, i.e. the split of the independent variables space (IVS), were saved for future analysis.

Second, several regression models were specified on the basis of the results of the previous step to complete our research. The first kind of the regression models that was specified and estimated in our research was simple linear regression of the capital structure measure on the set of all independent variables that was introduced earlier (see Table 1).

$$y(x) = b_0 + \sum_{k=1}^{m} b_k x_k + v(x) \qquad (1)$$

This model was introduced for the purpose of comparison only, because it doesn't take into account the split of the independent variables space (IVS) that was found earlier. Also, we built the model of capital structure measure regression on the independent variables that were selected by the tree building algorithm.

$$y(x) = b_0 + \sum_{k=1}^{n} b_k x_k + v(x) \quad n \leq M \qquad (2)$$

It was done to explore if the set of excluded variables corresponds to the set of variables with insignificant linear impact on the capital structure measure.

Next three models are special cases of the linear regression model with multiple structural changes (Bai, Perron, 1998) with discrete shifts in parameters values. We do not impose the restriction that the regression function is continuous at the turning points.

As was mentioned in Berk (2008), if the regression tree is built, it can be represented as the regression of the depended variable on the set of indicator variables of all lists — $I_A(x) = \begin{cases} 1, x \in A \\ 0, x \notin A \end{cases}$ where x — is a vector of important independent variables. Given $E = \left\{ S_k \subset IVS, k = \overline{1,n} \right\}$ the set of re-

gression tree leafs, i.e. the split of the independent variables space (IVS), the prediction is done in compliance with the regression model

$$y(x) = \sum_{k=1}^{n} a_k I_{S_k}(x_k) + v(x),$$ (3)

that was estimated in our research too. This model reflects the idea of possible significant impact of independent variables interaction on dependent variable average level. One can mention that model doesn't include constant term because its' presence will lead us to the multicollinearity.

Also, we considered modification of the model (3) which includes independent variables mentioned above (2). This model might will possess better descriptive properties than preceding one because it takes into account levels of independent variables. It is assumed that independent variables interactions don't impact linear regression coefficient values. Thus, that model less complex than the next one.

$$y(x) = \sum_{k=1}^{n} a_k I_{S_k}(x_k) + \sum_{k=1}^{m} b_k x_k + v(x),$$ (4)

The third kind of regression models considered in this research was the class of models that reflects possible different impact of independent variables on dependent one (3).

$$y(x) = \sum_{k=1}^{n} a_k I_{S_k}(x_k) + \sum_{j=1}^{n} \sum_{k=1}^{m} b_k I_{S_j}(x_k) x_k + v(x).$$ (5)

The capital structure choice in different segments of branch

The aim of this part is to submit empirical results of research. We succeed in splitting the set of companies into suitable subsets with close capital structure, which are similar in some sense and have different, but sometimes intersected, sets of statistically significant capital structure choice determinants. We should mention that similarity of companies here is a very weak feature which assumes only that some of their financial indicators take values in the same intervals.

Results of regression tree building

Meaningful results have been got for TDRA measure of capital structure for all companies. Six independent variables were selected by the tree building algorithm and the subsequent pruning: dtas (2013 year) , profb (2012 year), profb (2013 year), profc (2012 year), profc (2013 year), selexp (2013 year) (Table 1). View of the tree which was built and optimized is presented on the diagram (Figure 1). It can be well seen that regression tree has 8 leafs. Each node of the tree represents some subset of initial training set. Its image on the tree diagram contains information about corresponding subset: average value of dependent variable (here TDRA) in the upper part and the cardinality (percentage) of subset in the lower part. Table 3 contains description of all regression tree leafs. Dependent variables are placed in order of splitting (1 — 4).

Table 3

Leafs of regression tree

Level of splitting	1	2		3		4		Cardinality	Ave{TDRA}
	profc11	profb12	profc12	dtas12	selexp12	profb11	selexp12		
Leaf 1	≥0.068	≥0.18						108	0.38
Leaf 2	≥0.068	<0.18		<0.34			<0.0024	22	0.31
Leaf 3	≥0.068	<0.18		<0.34			>0.0024	191	0.54
Leaf 4	≥0.068	<0.18		>0.34				74	0.72
Leaf 5	<0.068		≥0.046					93	0.66

Leaf 6	<0.068		<0.046		<0.0002	<0.0036		13	0.39
Leaf 7	<0.068		<0.046		<0.0002	≥0.0036		39	0.75
Leaf 8	<0.068		<0.046		≥0.0002			431	0.84

Can we rely on the numbers in the Table 3? In our opinion, it can be done with caution only. Split points for independent variables in the tree build might depend on the properties of training set and could change for another data. The most reliable way of interpreting this split is qualitative one. But due to the lack of alternatives we'll use exactly this split for further analysis.
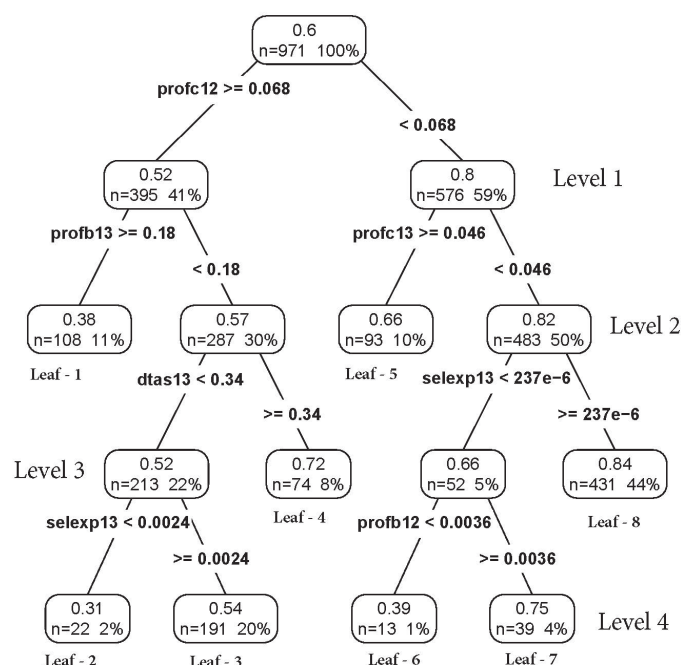

Figure 1. Optimized regression tree for measure TDRA

It can be seen from Table 3 that cardinalities of leafs quite different thus the accuracy of mean values estimation will be different too. Such way it's important to check the significance of difference between mean values in different leafs, i.e. the significance of the model in general. Since we know nothing about the probability distribution of TDRA observations, we used Kruskal – Wallis criterion to test the hypothesis about equality of leafs effects (equality of mean values in leafs) and it was rejected at the significance level less than 1%.

Statistically significant capital structure choice determinants

It can be mentioned (Table 3, Figure 1) that the profitability in the preceding year plays the most important role in capital structure definition for companies in the chosen branch. More specifically, the ratio of the profit of sales to the assets in the preceding year has the greatest impact on the capital structure. We think that it's very natural result, because, if financial manager is making decisions which should optimize (in some sense) capital structure, i.e. he choosing the sources of financing, he'll first of all take into account preceding financial result of his organization. At the same time he hasn't known the result of current year yet and may only predict it. The important role of such predictions (expectations) in the process of capital structure definition is represented in the importance of profitability in current year. Also we may note on that the algorithm of tree building uses two different measures of the current profitability on the second level of splitting.

On the first level of splitting the algorithm of tree building divide sample into two subsamples. The first group (leafs with numbers from one to four, Table 3) can be named "Previously More Profitable" (PMP). It contains 41% of common sample set. The second one (leafs with numbers from five to eight) can be named "Previously Less Profitable" (PLP). We cannot say, that former have necessarily smaller average proportion of liability in capital then latter or vice versa without formal testing. Comparison of TDRA mean values from this two groups of firms on the basis of nonparametric

Kruskal – Wallis criterion let us state that mean value in former group less than one in latter group at the significance level less than 1%. It's argument in favor of pecking-order theory, but only at an average.

One can look into this groups and explore the capital structure in different leafs which constitutes them. First, it can be mentioned, that the largest leaf in PLP (leaf number eight) has the largest average proportion of debt in capital. It follows from Table 3 that firms from this group didn't expect high profitability in current year but expect relatively high level of business expenses. It might make such firms to borrow more. It's argument in favor of pecking-order theory. Also, this fact contradicts the hypothesis "H5". However, they may have high level of business expenses not due to the uniqueness, but due to low effectiveness of management. In contrary firms from leaf number one (the member of PMP) expected high level of profitability and hence borrow less. Average TDRA value for this group is one of the least ones. It supports pecking-order theory too.

Second, firms from PMP which expect less level of profitability (leafs with numbers from three to four) have larger average proportion of debt in the capital. One can mention that firms in the leaf number three expected relatively high level of business expenses in current year, so they might want to compensate for that. In comparison with firms from leaf number two, which expect lower level of business expenses, these firms have larger proportion of debt in their capital. Thus, we are able to reject hypothesis "H5", but it needs to control the effectiveness of their management. In turn firms which belong to the leaf number four have high velocity of growth and it could be reason to have larger proportion of debt in the capital. The expectation of low level of profitability and the need to finance growth resulted in searching external sources of financing. It can be suggested, that possible asymmetry of information in such conditions makes them unattractive for investors and leads to very high proportion of debt in their capital. One can compare this firms with firms from leafs two and three that have lower velocity of growth and lower proportion of debt. It supports pecking-order theory.

Let us again pay attention to the firms in the leaf number two. It's very interesting group of 22 firms from PMP, which didn't expect high profitability in the current year, didn't grow and didn't expect to spend a lot. We name them "Falling asleep".

So it can be stated that there are a lot of facts in favor of pecking-order theory for that branch and period of time on the basis of regression tree model. As was mentioned above the significant advantage of regression tree is including the interaction of variables. It follows from Table 3, that growth rate impact the capital structure only for PMP firms. Business expenses have same importance for capital structure for PLP firms. It has a little less impact on capital structure for PMP firms.

In order to clarify findings we used several above mentioned regression models. First, lets consider models that use constant values of parameters, i.e. models (1) and (2). Table 4 contains results of MLS estimation of these models.

Table 4

Estimation of regression models (1), (2)

	(1.1)	(1.2)
(Constant)	0,39 *** (0,08)	0,75 *** (0,01)
intas13	-2,26 (6,02)	
intas12	1,67 (6,44)	
tas13	0,05 (0,06)	
tas12	-0,07 (0,06)	
tasm13	-0,26 (0,17)	
tasm12	0,01 (0,16)	
capex13	0,09 (0,13)	
dtas13	-0,00045 (0,00068)	0,00095 (0,00060)
rev13	0,00004 (0,00043)	
selexp13	-0,03 (0,14)	0,03 (0,07)

selexp12	0,08 (0,15)	
size13	-0,01 (0,02)	
size12	0,02 (0,02)	
sizea13	0,13 *** (0,02)	
sizea12	-0,12 *** (0,02)	
profa13	-0,25 * (0,14)	
profa12	0,08 *** (0,03)	
profb13	0,04 (0,08)	0,07 (0,08)
profb12	0,07 (0,06)	0,04 (0,06)
profc13	-0,35 ** (0,15)	-0,26 ** (0,13)
profc12	-0,73 *** (0,10)	-0,62 *** (0,10)
profd13	0,26 *** (0,08)	
tax13	0,08 (0,05)	
tax12	0,01 (0,02)	
R^2	,291	,188
Observations	971	971

Note. *, **, *** – significance at 10, 5, 1% levels. There are standard errors in parenthesis.

It can be mentioned, that model (2) possesses worse descriptive properties than model (2) in terms of R^2. It might can be due the fact that regression tree building algorithm discarded some statistically significant independent variables from model (1). So one can conclude, that model (1) outperforms model (2).

Now, we'll consider models, which take into account interaction between independent variables, i.e.

models (3) and (4). For simplification of results representation we denote variables of type $I_{S_k}(x)$ as "leaf_k".

Table 5

Estimation of regression models (3), (4)

	(3)	(4)	(4) without constant term		(2)
(Constant)	0,38 *** (0,02)	0,45 *** (0,03)	leaf_1	,38 *** (,02)	0,75 *** (0,01)
leaf_2	–0,08 * (0,05)	–0,12 ** (0,05)	leaf_2	,31 *** (,04)	
leaf_3	0,16 *** (0,02)	0,13 *** (0,03)	leaf_3	,54 *** (,02)	
leaf_4	0,34 *** (0,03)	0,30 *** (0,03)	leaf_4	,72 *** (,02)	
leaf_5	0,27 *** (0,03)	0,23 *** (0,04)	leaf_5	,66 *** (,02)	
leaf_6	0,0022 (0,06)	–0,05 (0,06)	leaf_6	,39 *** (,06)	
leaf_7	0,37 *** (0,04)	0,31 *** (0,04)	leaf_7	,75 *** (,033)	
leaf_8	0,46 *** (0,02)	0,41 *** (0,03)	leaf_8	,84 *** (,01)	
profc12		–0,07 (0,10)		–0,07 (0,10)	–0,62 *** (0,10)
profb13		0,06 (0,07)		0,06 (0,07)	0,07 (0,08)
profc13		–0,17 (0,11)		–0,17 (0,11)	–0,26 ** (0,13)
dtas13		0,00075 (0,0005)		0,00075 (0,0005)	0,00095 (0,00060)
selexp13		–0,08 (0,06)		–0,08 (0,06)	0,03 (0,07)
profb12		–0,01 (0,05)		–0,01 (0,05)	0,04 (0,06)
R^2	,421	,429			,188
Observations			971		

Note. *, **, *** – significance at 10, 5, 1% levels. There are standard errors in parenthesis.

First, one can mention, that model with interaction variables (least_1, least_2, and so on) possesses much more descriptive power than pool model (2) in terms of R^2. Obviously, the coefficients of these variables are equal to the average values of dependent variable (TDRA) across the corresponding tree leafs (see Table 5, model (4) without constant term). Second, addition of independent variables, which were selected by tree building algorithm, don't lead us to the statistically significant result — all estimates of corresponding coefficients are insignificant. Also, it gives us a little improvement in the model quality in terms of R^2. It can be explained by the fact that the impact of independent variables on the dependent variable fully presented by the impact of interaction terms.

Finally, we consider model (5) which takes into account the possibility that values of independent variables coefficients might be different in different tree leafs. For simplification of presentation only we submit results of estimation without constant terms. At the same time, we submit R^2 value for the model with constant term to get the ability to compare this model with previous ones.

Table 6

Estimation of regression model (5) without constant term

	leaf_1	leaf_2	leaf_3	leaf_4	leaf_5	leaf_6	leaf_7	leaf_8
(Constant)	0,37 *** (,035)	0,25 *** (,097)	0,66 *** (,035)	0,91 *** (,056)	0,72 *** (,060)	0,05 ** (,083)	0,74 *** (,058)	0,90 *** (,016)
profc12	−0,01 (0,24)	−0,89 (0,55)	−0,24 (0,40)	−0,48 (0,32)	0,17 (1,17)	8,45 *** (3,93)	0,17 (2,63)	−2,00 *** (0,63)
profb13	0,52 * (0,30)	-0,0048 (1,87)	0,50 * (0,29)	−0,45 (0,50)	−0,15 (0,11)	4,24 (1,27)	0,34 (1,44)	0,18 (0,12)
profc13	−0,57 * (0,32)	1,94 (2,00)	−0,95 ** (0,38)	−1,28 ** (0,55)	−0,83 *** (0,27)	0,17 (6,66)	−3,54 (3,33)	−1,59 * (0,88)
dtas13	−0,03 (0,05)	0,14 (0,29)	0,04 (0,08)	0,000089 (0,00068)	0,10 ** (0,04)	0,27 * (0,15)	0,11 (0,07)	0,08 *** (0,02)
selexp13	−0,20 (0,14)	−78,62 (96,28)	−0,27 * (0,16)	0,09 (0,46)	0,23 (0,19)	NA	−3667,69 *** (1139,76)	−0,11 (0,07)
profb12	0,02 (0,19)	0,45 (0,40)	−0,10 (0,31)	0,17 (0,26)	−0,26 (0,22)	−4,18 *** (1,08)	1,07 (0,88)	−0,01 (0,06)
cardinality	108	22	191	74	93	13	39	431
R^2	,519 (with constant term)							
Observations	971							

*Note. *, **, *** – significance at 10, 5, 1% levels. There are standard errors in parenthesis. NA – value is absent (can't be estimated).*

First, one can note on that this model possesses maximum descriptive power among previous ones, in terms of R^2, so that it outperforms all of them. Second, there are different sets of variables that impact the capital structure significantly for different tree leaves. Third, in almost all leaves there is significant negative influence of the future net profitability (variable "profc13") expectation on the capital structure. Coefficients of the variable "profc13" seems to be different in different leafs, but Wald test can't reject hypothesis about their equality (Chi-square statistics – 4.87, DF – 7, p–level 0.68). So, one don't have reasons to state that the future net profit expectation has different impact on the capital structure in different leaves. Also, it must be mentioned, that expectations of operational profitability (variable "profb (2013 year)") and net profitability (variable "profc (2013 year)") have multidirectional significant influence on the capital structure in some leaves. In contrary with pecking order theory the impact of the operational profitability expectations on the capital structure is significant and positive. Authors explain it in such a way. With one hand, operational profit is much more predictable than net profit, because latter depends on the taxes and interests that will be paid at the end of the financial year. These payments depend on the lot of external and especially internal factors which may not be fully taken into account in the middle and much less at the beginning of the year by the lender. Thus, optimistic operational profit expectations might improve relationship between creditor and borrower and make it easier to get a loan. On the other hand, financial manager has much more information about internal factors than lender, moreover, in most cases he or she is

able to impact on the financial policy of the firm and consequently on the net profit. Thus, his net profit expectations may be placed in the basis of capital structure decision. As a result, the proportion of obligations will rise if financial manager expects the increase of operational profit and decrease of net profit.

Conclusion

Let's consider more carefully the results of the above submitted research. The main conclusion for the selected branch is following – the average proportion of obligations in the capital of the firm and the set of capital structure determinants depends greatly on the interactions between factors characterizing its financial state. The space of independent variables possible values may be split into several areas according to the significant interaction between predictors. Areas may vary significantly by the average value of the capital structure measure and/or by the set of capital structure determinants. Sets of firms in each area will be considered as similar in some sense with common practice of capital structure decisions and should be analyzed separately.

Thus, the best model that describes statistical relationship between some capital structure measure (here TDRA) and several financial indicators is the linear regression model with structural changes which regimes correspond to the above mentioned areas. The possible technique to construct such a model is presented above in this research. First, the required partitioning of IVS may be obtained through the use of regression tree algorithm. Second, the common set of possible capital structure determinants will be identified and the corresponding structural change model will be estimated.

Analysis of automobile branch showed that there are two main factors which impact significantly on the proportion of obligation in the capital of firm — profitability in the preceding and current years, which acts as proxy variable for financial manager profitability expectations in current year. Former factor let us divide firms into to global parts, which were named "Previously More Profitable" (PMP) and "Previously Less Profitable" (PLP). The letter one let us divide each part into two subsequent parts too. One can note on the fact that the set of less profitable (or possible less profitable) in some sense firms has in average less proportion of obligations in the firms capital. We can mention that firms which belong to the PMP set relay more on the operational profitability expectations, maybe because they confident in strong relationship between their operational and net profit. In contrary, firms which constitute PLP take into account net profit expectations. Thus, there is significant interaction between these two types of profitability expectations.

Another two factors which influent significantly on the capital structure are the ratio of the change for the year the book value of total assets to the book value of total assets in the former year and the ratio of the book value of business expenses to the book value of revenue. The former one is important only for PMP firms. Thus, it interacts significantly with profitability in preceding year. It's obvious that more profitable firms have more abilities for self-development. The letter factor is important for both PMP and PLP firms and authors belief that its interactions with other financial indicators aren't very important for capital structure definition.

The algorithm of tree building splits the independent variables values space into eight areas, which vary significantly by the average value of the capital structure measure (TDRA) and the cardinality. The largest one consists of 431 PLP firms, which don't expect large net profitability in the current year but expect high ratio value of business expenses. Model (5) let us look into each area more carefully and identify factor important for capital structure definition in each area. One may note on two interesting facts here. First, there is the multidirectional influence of the operational and net profitability on the proportion of obligations in the firm capital. As was mentioned above, this might be the consequence of the information asymmetry. Profitability expectations of lenders may differ significantly from financial managers' expectations. Second, relative increase in total assets is significant factor for almost all subsets of PLP firms. It doesn't contradict the above mentioned statement about the role of this factor for average value of capital structure measure definition. The relative increase in total assets isn't so important for it in comparison with profitability for PLP firms. But within each group of similar in some sense firms it might impact significantly on the capital structure.

And finally authors want to mention, that submitted above results are based on the stable part of the regression tree, which was obtained as a result of tree pruning. Of course, it doesn't guarantee that the effect of overestimation was completely removed, but it let us to hope that the results wouldn't change dramatically with the new or partially new data.

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