

OPTIMAL DEBT LEVEL AS PART OF ENTERPRISE FINANCIAL HEALTH PREDICTION

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Abstract: *The paper presents a brief procedure of adjustment and application of the optimal debt model created by Czech economists Inka Neumaierová and Ivan Neumaier on the example of a selected enterprise, namely the transportation company operating in the Slovak Republic. This is a model that links the debt to the return on equity (ROE) and shareholder value (SHV). The theoretical basis of the model comprises the Modigliani and Miller theory and compromise theory of capital structure. The model's application is preceded by the adjustment of data obtained from the accounting of the analysed company with regard to the current accounting legislation of the Slovak Republic, followed with calculation and discussion about partial issues.*

Key words: *prediction of financial health, debt ratio, optimal debt, optimization criteria*

JEL classification codes: *G, M*

INTRODUCTION

Financing of an enterprise is connected with the need to create an effective financial structure, i.e. such structure of capital that will bring specific economic effects to the enterprise in relation to defined objectives with respecting the principle to achieve maximum benefit (outputs) with minimum source consumption (inputs). This generally formulated principle is concretized from the perspective of creation of a suitable structure of capital providers the search for optimal debt level on the grounds of selected optimization criterion and objective function expressing the relation between the capital structure and said criterion. Financial theories provide several model solutions for this purpose, often based on different assumptions, different definition of financial structure and especially on different optimization criteria. Correct understanding of economic quantities defined by the model and effects of simplifying assumptions for the interpretation of results belong, in addition to availability of necessary data, to basic conditions for successful application of these models in practice.

The optimal debt level is from the long-term perspective one of necessary preconditions for the future financial health of the enterprise and therefore requires special attention of enterprise's financial management.

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AIM AND METHODOLOGY

Our model example will show the calculation of optimal debt of the selected enterprise as a solution of a task of mathematic (optimal) programming. The aim of the optimisation task solution will be to find the optimal debt level of the company as of a certain moment with selected optimisation criterion and working contents definition of terms. The financial structure of the company is formed in the model by: equity (E), interest-bearing loan capital (LC) and foreign capital not bearing interest (OL, other current and long-term liabilities) – table 1. Following relations apply for items in the table:

Table 1
Financial structure of selected company

(1) EQUITY - E	(2) Liabilities (Debt) == Assets - Equity
	(3) Current Liabilities
	(3*) LOAN CAPITAL - LC
	(1) + (3*) = COST CAPITAL
	(4) Long-term Liabilities
	(4*) OTHER LIABILITIES - OL
	OTHER CAPITAL
	(accounting) ITEMS
FINANCIAL STRUCTURE OF THE COMPANY	

Legend: E (Equity) – owner's or stockholder's equity

LC (Loan Capital) – short- and long-term liabilities that have a due date and bear interest

OL (Other Liabilities) – all (especially current) liabilities that are do not bear interest

Source: author

$$E / \text{Assets} + (LC + OL) / \text{Assets} = 1 \quad (1)$$

$$\text{or: } E / \text{Assets} + LC / \text{Assets} + OL / \text{Assets} = 1 \quad (2)$$

The relation $(LC + OL) / \text{Assets}$ expresses a total debt of assets in the model and the relation LC / Assets expresses debt of assets by foreign capital bearing interest. **These facts are very important for correct interpretation of results.**

Following relations apply in the bookkeeping of entrepreneurs in the Slovak Republic:

$$\text{ASSETS} = \text{CAPITAL} \quad (3)$$

$$\text{Assets} = \text{Intangible and Tangible Assets} + \text{Current Assets} + \text{Accrued Assets} \quad (4)$$

$$\text{Capital} = \text{Equity} + \text{Loans} + \text{Other (non-interest) Liabilities} + \text{Accrued Liabilities} \quad (5)$$

$$\text{Equity} = \text{Stockholder's Equity} + \text{Profit Funds and Other Funds} + \text{Retained Earnings} + \text{Earnings of the Current Accounting Year} \quad (6)$$

$$\begin{aligned} \text{Loan Capital} = & \text{Short-term and Long-term Bank Loans} + \text{Current} \\ & \text{Financial (non-bank) Loans} + \text{Other Short-term and Long-term} \\ & \text{Interest Loans (bills, bonds, etc.)} \end{aligned} \quad (7)$$

$$\begin{aligned} \text{Other Liabilities} = & \text{Reserves} + \text{Non-interest Liabilities} + \text{Accrued} \\ & \text{Items of Capital} \end{aligned} \quad (8)$$

The relation (7) must be adjusted under particular conditions with all items of foreign sources for which the enterprise pays interest to their providers (accounting item: 562-Interest). The item Other Short-term and Long-term Interest Loans is not explicitly specified in the accounting statement (financial statement of entrepreneurs using doubly-entry bookkeeping, part balance sheet items); it includes all short-term and long-term liabilities bearing interest toward creditors of non-bank nature, with the exception of Current Financial Non-bank Loans, which were provided with interest and which are defined by the Decree of the Ministry of Finance of the Slovak Republic (in brief as Accounting Procedures). That was for the accounting/bookkeeping part of the solution.

According to conditions given in the model (Neumaierová, I., Neumaier, I., 1996) the company has the **optimal debt level with such proportion of own sources and foreign sources bearing interest where the return on equity is the highest**. From the mathematical perspective this is a solution of a task of optimal programming, i.e. searching for an extreme × maximum of the objective function, expressing the relation between the optimization criterion (return on equity = net profit/equity) and debt level expressed in the model indirectly as the proportion equity/assets. As we already mentioned, this is a supplement to 1 to the indicator total indebtedness ratio.

The objective function expressing the relation between the return on equity (the dependent variable y) and indebtedness (the independent variable x) goes (Neumaierová, Neumaier, 1996):

$$y = \frac{a}{x} \cdot [b - g(x) \cdot (1 - x - d)] \quad (9)$$

$$a = \frac{\text{Net Profit}}{\text{Earnings} - \text{tax burden}} \quad (10)$$

$$b = \frac{\text{EBIT}}{\text{Assets}} \quad (11)$$

- productive force

$$d = \frac{OL}{Assets} \quad (12)$$

-indebtedness of assets with foreign capital not bearing interest (OL)

where: a, b and d are constants according to model assumptions, for which following relations apply:

It is assumed that the indicator net profit/profit has always positive values.

In the case of loss we can add a simplifying assumption to the model that the loss before taxation equals loss after taxation (neglecting the tax on revenue interest and adjustments of trading profit/loss for tax base) and then their share is also a constant equaling 1 (zero tax burden). This adjustment has relevance from the perspective of completeness of conditions; its practical relevance gradually disappears further ahead. The constant d also acquires only positive values. The optimal indebtedness, i.e. maximum return on equity, will be according to the working definition achieved in the extreme of the function (9), i.e. at the point in which the first derivation of this function, if applicable, equals zero, what can be mathematically expressed as:

$$y' = 0 \Leftrightarrow \frac{a}{x^2} = 0 \vee \left\{ x^2 \cdot g'(x) - b - [x \cdot g'(x) - g(x)] \cdot (1 - d) \right\} = 0 \quad (13)$$

If we assume that a/x^2 is always a positive number, then the enterprise has optimal debt when:

$$x^2 \cdot g'(x) - b - [x \cdot g'(x) - g(x)] \cdot (1 - d) = 0 \quad (14)$$

Real positive roots, if applicable, express optimal indebtedness, i.e. the optimal ratio of equity and foreign sources (liabilities, i.e. LC + OL) with respecting the optimisation criterion, which is the maximum ROE. It should be reminded here that we consider the ratio OL/Assets to be a constant, which means that **any change of financial structure relates under the model conditions only to the mutual ratio of equity and foreign capital bearing interest (LC)**. From the perspective of model usability and reasonable interpretation of results the validity of condition that says that only enterprise where following equation applies should create debt (i.e. increase the share of debt bearing interest in its financial structure) should be tested prior to the calculation of optimal debt (Neumaierová, Neumaier, 1996):

$$\frac{EBIT}{Assets} > \frac{Interest}{LC} \cdot \left(1 - \frac{OL}{Assets} \right) \quad (15)$$

$$\frac{EBIT}{Assets} > \frac{Interest}{LC} \cdot \frac{E+LC}{Assets} \quad \Bigg/ \cdot \frac{1}{\frac{E+LC}{Assets}} \quad \dots \quad \frac{E+LC}{Assets} \neq 0,$$

The condition (15) can be adjusted to the following form:

$$\text{then} \quad \frac{EBIT}{E+LC} > \frac{Interest}{LC} \quad (16)$$

what means that the **return of cost capital should be higher than the interest rate** borne by the foreign capital. The growing financial leverage acts on the return on equity positively only in this case. If the interest rate exceeds the return of cost capital, the growing share of foreign sources bearing interest acts on the ROE negatively. When the interest rate and return of cost capital equal, a point of indifference occurs, when from the perspective of effect on ROE it doesn't matter how the financial leverage changes.

Model application and discussion

According to authors, this model enables work with both market and accounting values of input quantities. The analysed transportation company is a joint-stock company which does not have publicly traded shares. The financial structure of the company consists of items of equity and foreign sources, where non-interest liabilities prevail. In the structure of foreign sources bearing interest (loan capital) long-term bank loans prevail. Long-term notes payable, current financial non-bank loans and long-term non-bank loans recorded in the Slovak bookkeeping as other long-term liabilities represent a negligible part of foreign capital bearing interest (loan capital). The basic aim of company's business is to achieve profit and create value for owner. Emphasis will be placed on this fact in the selection of optimization criterion (Bartošová, 2005).

Solution procedure

We will perform the calculation of optimal debt in two steps (Bartošová, 2005):

1. We will test whether the basic condition for the suitability of creating debt is met, i.e. what is the relation between the return of cost capital and interest rate. The model determines the optimal debt as of a certain moment in time – we will perform the calculation on the grounds of accounting data as of December 31 of the analyzed period.
2. In case the condition (15) or (16) is met, we will search for the optimal debt level expressed implicitly by means of the share of equity in assets. A specific form of the function $g(x)$ will be added into the model. This is a function of inversely proportional nature, i.e. the price of foreign capital,

the dependent variable $g(x)$, will grow with the falling value of the independent variable x :

$$g(x) = \frac{k}{x} \quad (17)$$

where: k - constant we select.

$$\frac{EBIT}{Assets} > \frac{Interest}{LC} \cdot \left(1 - \frac{OL}{Assets}\right) \quad \text{or} \quad \frac{EBIT}{E + LC} > \frac{Interest}{LC}$$

Testing the condition for creating debt

Data – table 2.

Table 2
Company data as of December 31

<i>Indicator</i>	<i>in monetary units</i>	<i>Indicator</i>	<i>in monetary units</i>
EBIT	410 568	E/ Assets	0,6260
EBIT*	3 000 000	EBIT/ Assets	0,0084
Interest	615 507	EBIT/ Assets*	0,0613
Assets	48 978 832	Interest/LC	0,0507
Equity	30 662 916	OL/ Assets	0,1259
Loan Capital (LC)	12 149 583	(1- OL/ Assets)	0,8741
Other Liabilities (OL)	6 166 333	EBIT/(E + LC)	0,0096
Total Cost Capital	42 812 499	EBIT/(E + LC) *	0,0701

$$\frac{EBIT}{Assets} = 0,0084 \quad \frac{Interest}{LC} \cdot \left(1 - \frac{OL}{Assets}\right) = 0,0507 \cdot 0,8741 = 0,0443$$

0,0084 < 0,0443, and then: $\frac{EBIT}{Assets} < \frac{Interest}{LC} \cdot \left(1 - \frac{OL}{Assets}\right)$

Results as of December 31:

Return of cost capital is lower than the interest rate, what implies already in the first step that the company should not, with regard to ROE, increase the share of foreign capital bearing interest (LC) – the company does not have sufficient productive force. Growing financial leverage acts negatively on the return on equity. The presence of stock and flow positions in the structure of indicators must be taken into account in calculations.

Determination of constant in function $g(x)$

Before transposing values into the equation (14), we have to determine the constant k in the function $g(x)$ expressing the relation between the interest rate and

indebtedness. It depends on its value how the interest rate will change with the growing indebtedness – in our case with decreasing share of equity. There are several options how to determine k. We will use the interest rate calculated on the grounds of accounting data (Interest/LC):

$$g(x) = \frac{k}{x} \quad 0,0507 = \frac{k}{0,6260} \quad k = 0,0317$$

We will assume that the interest rate from received LC will change with decreasing share of equity (E) according to the relation:

$$g(x) = \frac{0,0317}{x}$$

It is probable that the function of the interest rate will be much more complex in reality when compared to our procedure. The distortion can be partially eliminated in our case with the choice of constant k so that the function g(x) will be as close as possible to real conditions for loans. Another method for the calculation of interest rate can also be considered. It is very important to calculate the LC item in the method of calculation we used, as it cannot be determined directly from the balance sheet.

Calculation of optimal debt upon change of EBIT

As the testing of condition (15) on actual data did not result in favor of debt increase, we will use for full demonstration of the model a fictional number of achieved EBIT in the amount of 3 000 000 (in monetary units) and we will perform the calculation under otherwise unchanged conditions. The calculation will use data from the table 2 (items marked *). Testing of the condition (15):

$$\frac{EBIT}{Assets} = \frac{3\,000\,000}{48978832} = 0,0613 \quad \frac{Interest}{LC} \cdot \left(1 - \frac{OL}{Assets}\right) = 0,0443$$

$$0,0613 > 0,0443, \text{ i.e. } \frac{EBIT}{Assets} > \frac{Interest}{LC} \cdot \left(1 - \frac{OL}{Assets}\right)$$

The condition is met. We will determine the optimal debt by transposing values into the equation (14):

$$x^2 \cdot \left(\frac{0,0317}{x}\right)' - 0,0613 - \left[x \cdot \left(\frac{0,0317}{x}\right)' - \frac{0,0317}{x} \right] \cdot (1 - 0,1259) = 0$$

$$x^2 \cdot \left(-\frac{0,0317}{x^2}\right) - 0,0613 - 0,8741 \cdot \left[x \cdot \left(-\frac{0,0317}{x^2}\right) - \frac{0,0317}{x} \right] = 0$$

$$0,1020x = 0,0634 \quad \Rightarrow \quad x = 0,625$$

The condition for creating debt was met in the case of EBIT in the amount of 3 million of monetary units. The optimal share of equity on assets is 62,5% **what means indebtedness with foreign capital bearing interest 24,9% and with foreign capital not bearing interest 12,6%**. The return on equity is with this share at maximum level. The return on equity is smaller with any other combination of own sources and LC, share of OL constant.

CONCLUSION

The calculated value determines, under conditions given by the model, the optimal debt level of the company as of a certain moment in time. It enables to assess the indebtedness in connection with return on equity (and value for the owner) on the grounds of actual data (ex post), but also on the grounds of plan (ex ante). The emphasis is in the solution of optimization task placed on the cost of capital and not on its due date. The model works with both accounting and market values of indicators.

To predict development of financial situation of an enterprise means to take into account many factors and facts in its evaluation. When assessing the optimal debt level, we can select also optimization criterion other than used in our example, e.g. we can pursue minimization of cost of capital or focus on analysis and evaluation of other indicators and do not solve the task as a task of optimal programming, but in relation to selected indicators and their values, which express, in our opinion, the optimal debt level and financial health of an enterprise.

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