Leverage Effect between ROA and ROE During the Covid-Crisis Based on a Hungarian Company Database

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SUMMARY

This paper is devoted to examining two extremely popular financing principles in the practice of Hungarian companies during the Covid-crisis. The leverage effect explains how the Return on Equity can be improved compared to the Return on Assets, the risk matching principle states that the risky assets should be financed mostly from equity and the secure assets should be financed mostly from debt. The Covid-crisis is an excellent opportunity to study the relevance of these principles. The validity of these principles is examined in a sample containing about 30.000 company financial reports. The most important findings are the following: The profitability does not determine the leverage, but the high leverage determines the low profitability. The profitability is the consequence of former decisions about the debt-equity relationship, the debt/equity ratio would be the consequence of the profitability. The risk matching principles cannot be justified by the used sample.

Keywords: leverage effect, risk matching principle, ROA, ROE

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INTRODUCTION, RESEARCH QUESTION

This paper is devoted to examining two immensely popular financing principles in the practice of Hungarian companies during the Covid-crisis. The leverage effect explains how the Return on Equity can be improved compared to the Return on Assets (Brealey & Myers, 2013), the risk matching principle (Coleman, 2011) states that the risky assets should be financed mostly from equity and the secure assets should be financed mostly from debt. The Covid-crisis is an excellent opportunity to study the relevance of leverage effect, since the Hungarian economy faced strong recession in 2020 which was followed by a quick recovery in 2021.

The research question of this study, if the companies of different sectors follow the leverage effect rule or not. By that rule, the companies with higher ROA than cost of finance will increase their leverage, and the opposite companies will reduce their leverage.

At first the concept of ROA and ROE is determined among the various ROI indicators, since they are important in point of both testing principle (Engler, 1987). Then the methodology and the introduction of the sample is demonstrated. The analysis of the data can be found in the analysis and result chapter. The paper ends with the conclusions.

LITERATURE OVERVIEW

The ROA and the ROE are accounting indicators derived from the general concept of ROI (Chen & Mansa, 2007). The ROI has countless versions known both in the theoretical literature and in practice. (Lipták et al., 2022) This is because the indicator has several uses. It is used to measure the profitability of individual investments, specific processes (e.g., research, market acquisition, learning). (Phillips & Phillips, 2005)

ROI is an efficiency indicator that compares the net income of a program with its net cost. (Duermyer, 2020)

$$ROI = \frac{Net\ income\ (Benefits - Costs)}{Costs}$$

In the literature we have found three interpretations of financial ROI.

In our interpretation, ROI can be considered as return on assets. This indicator can be used to evaluate the company's profitability as a whole or to appraise a project/investment.

$$ROI = \frac{Profit\ of\ investment}{Invested\ amount}$$

The profit of an investment usually means the operating profit produced by the investment. In this case, the ROI can be directly compared to the cost of financing (loan interest rate, expected return on equity, or a combination of these).

At the company level, profit can be the contribution, the operating profit, or the net income. The denominator can be the average of non-current assets, or net assets (non-current assets + net working capital).

There are several other names and calculations of profitability on assets. Several specialist literatures also refer to the following ratios as ROI.

ROA - Return on Assets - Typically the ratio between operating profit and total assets, but some author considers the profit as profit after tax.

RONA - Return on Net Assets - The ratio of profit to net assets. Net assets are the difference between total assets and current liabilities.

ROCE - Return on Capital Employed - The ratio of profit to capital employed. Capital Employed is the same as net assets but is calculated from the liability and equity side. Capital Employed is the sum of equity and long-term liabilities. The long-term liabilities can be considered of IFRs, where accruals and provisions do not form a separate main balance sheet group, but part of liabilities.

ROE - Return on Equity – Profit of the owners. Here, the nominator shows the net income. (Jewell & Mankin, 2011)

From the above-mentioned ROI terms, we focus the difference between ROA and ROE. The ROA measures the profitability of the core operation regardless the source of finance, and can be defined in the following way:

$$ROA = \frac{Operating\ profit}{Total\ Assets}$$

The ROE is the annual profit earned by the owners of the company from the annual operation of the company. Its formula is the following:

$$ROE = \frac{Net\ income}{Total\ Equity}$$

The relationship between ROA and ROE is called leverage effect, which is described with the following equation:

$$ROE = ROA + (ROA - R_d) \times \frac{D}{E}$$

where ROE – Return on Equity,
    ROA – Return on Assets,
    R_d – average interest rate of borrowings,
    D – book value of debt,
    E – book value of equity.
This is called leverage effect. The D/E ratio is called leverage. The reason of this equation is demonstrated by a brief example.

Let us compare the income statements of two companies! The asset structure of the two companies should be completely identical. The only difference should be in the leverage (Debt to Equity ratio). The first company is fully financed by equity of one hundred currency unit, while the second company should have 50 unit of equity and 50 million of loan at a 10% interest rate. Both companies achieve an operating profit of twenty million in a good year, 10 million in an average year, and HUF 5 million in a bad year. Let us ignore the taxes! What will be the capital gains of the two companies in each year?

Table 1 shows the result.

Table 1

The ROE of a levered and an unlevered company

Unlevered company (Equity of 100 million)			
Term	*Good*	*Average*	*Bad*
Operating profit	20	10	5
Interest expense	-	-	-
Net income	20	10	5
ROE	20%	10%	5%
Levered company (Loan of 50 million, Equity of 50 million)			
Operating profit	20	10	5
Interest expense	5	5	5
Net income	15	5	0
ROE	30%	10%	0%

Source: own calculations

The Return on Assets of the two companies is the same because both companies have the same operating profit and total assets in each year (which is equal to total resources). This value is 20% in the first year, 10% in the second, and 5% in the third.

However, their ROE is significantly different, since the second company faces a fixed interest expense of 5 million. (This is 10% of the 50 million loan). Its Debt-to-Equity ratio is 1, since $50/50 = 1$. While the ROE indicators of the first company are the same as the ROA indicator values, the ROE indicators of the second company can be obtained using the formula above.

$$ROE_{good} = 20\% + (20\% - 5\%) \times \frac{50}{50} = 30\%$$

$$ROE_{average} = 10\% + (10\% - 5\%) \times \frac{50}{50} = 10\%$$

$$ROE_{bad} = 5\% + (5\% - 5\%) \times \frac{50}{50} = 0\%$$

The example above shows that the wealth of the owners increases if the loan interest rate lower than the return on assets (ROA). In this case, the ROE is higher than the ROA. However, if the ROA falls below the interest rate on loans, the ROE is lower than the ROA.

This relationship works only ex-post. The ROA can only be planned, while the loan interest rate is fixed in the contract. The higher is a company's leverage (D/E), the more volatile its ROE. A company with a higher leverage can get a loan at a higher interest rate. (Süveges, 2021)

If we study the above relationship, the following conclusion can be drawn: If the company's ROA is volatile, then the company Debt to Equity should be low, consequently the risky assets should be finance from secure sources – mean equity. If the assets are secure, then the companies use more debt. (Ross et al., 2022)

The risk of the company's assets depends not only on the management decision but also on the nature of business sector. Assets are considered risky in capital intensive sectors like heavy chemicals, metallurgy, and agriculture. Classically low-risk industries are supermarket chains, the production of pleasure goods, and the food industry.

MATERIALS AND METHODS

The aim of this research is to evaluate the validity of leverage effect and risk matching principle during the two years of Covid-crisis of the Hungarian economy.

The following research questions were raised:
- Is it true, if the companies with higher ROA than rate of lending uses more debt than companies with lower ROA than lending rate?

- Is it true if the higher ROA volatility leads lower leverage?

To answer the first question, two groups were created by each sector. The first one behaves by the rule, the second behave against the rule. The examination is made in 2020 and in 2021.

To answer the second question, the difference between the 2021 ROA and 2020 ROA was calculated, similarly the difference between the 2021 leverage and the 2020 leverage. The data are grouped by main NACE (comes from the French 'Nomenclature statistique des Activites economiques dans la Communaute Europeenne'-Statistical classification of economic activities in the European Community) sectors. (Eurostat, 2008)

The sectorial distribution is calculated to detect which were the highly levered sectors and which were the lower ones.

To evaluate the leverage effect, the assumptions behind the concept should be considered and the used ratios should be cleared from the hidden assumptions.

The assumptions behind the model are the followings:
1. There is no (corporate) tax. To ignore the effect of taxation, the pre-tax profit is used in the nominator of ROE, rather than the net income. (Füredi & Várkonyiné, 2023)
2. The liabilities consist only of borrowings. The borrowings are used as a proxy of debt like loans, issued securities (bond, bill of exchange) and credits. The non-borrowings are ignored like provisions, account receivables, passive accruals. To balance the asset side, not the total assets but the total assets – non-borrowings is used by calculating the ROA. (Ramsay, 2005)
3. The company has not got financial incomes, the whole profit come from the core operation. To manage this assumption, the financial revenues are added to the operating profit, and the total financial expenses are used as a proxy to the cost of borrowings. (Kántor, 2021)

Finally, the following testable indicators are used in the examinations:

$$MROA = \frac{Operating\ profit + Financial\ revenues}{Total\ Assets - Non - borrowings}$$
$$MROE = \frac{Net\ income + Tax\ paid}{Total\ Equity}$$
$$ML = \frac{Borrowings}{Total\ Equity}$$
$$Return = \frac{Financial\ expenses}{Borrowings}$$

The findings of this article are based on the database provided by Crefo. The company database was purchased from the CrefoPort company (CrefoPort, 2022) by the Faculty of Economics of the University of Miskolc. This database contains the financial reports of Hungarian enterprises from 2004 to 2021 in text files, from which the data was uploaded to an MSSQL database. In addition to balance sheet and income statement data, the database contains information on the name and address of the enterprises, the number of employees, the core activity sector, the territorial location of the enterprises and their legal status (operating or liquidated).

Originally the database contains 245 579 data, but the database was queried to those companies, whose sales are larger than HUF 100 million and total assets are larger than HUF 100 million. The examined population was reduced to 30 443 enterprises.

The examinations were made by SPSS 25.0.

DISCUSSION OF MAIN FINDINGS AND THEIR RELATION TO THE REVIEWED LITERATURE

At first, we have tested, if our modified indicators are good proxy for the leveraged effect, namely it is true, that.

$$MROE = MROA + (MROA - Return) \times ML$$

The Pearson correlation between the MROE and the right side of the equation was calculated for 2020 and 2021. The result was the following:

Table 2

Pearson correlation between the raw ROE and the calculated ROE

Year 2020		Right side of equation
MROE20	Pearson Correlation	1,000**
	Sig. (2-tailed)	
	N	30443

**. Correlation is significant at the 0.01 level (2-tailed).

Year 2021		Right side of equation
MROE21	Pearson Correlation	1,000**
	Sig. (2-tailed)	,000
	N	30443

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Own calculations on Crefo database

In next step, the number of companies were calculated by each NACE main sectors, if their ROE is lower or higher than ROA. If ROE is higher, it means that they were able to increase the owners return by using debt, however if the ROE is lower than ROA, they decrease the owners return by using debt. Table 3 shows the distribution of these two groups in 2020.

In the table below, you can see the number of companies where the ROE was higher than ROA (good practice) and the number of companies where ROE was lower than ROA (bad practice) and the average leverage of both groups.

Table 3

Number of companies following good or bad practice with leverage in 2020

2020	NACE sectors	Good practice		Bad practice		Total
		Count	Leverage	Count	Leverage	
A	Agriculture, forestry, and fishing	1617	1.3	373	14,8	1990
B	Mining and quarrying	67	0.8	12	0,6	79
C	Manufacturing	3645	1.8	1285	3,3	4930
D	Electricity, gas, steam, and air conditioning	139	10.5	57	11,6	196
E	Water supply, sewerage, waste management	259	2.5	58	3,2	317
F	Construction	3651	2.2	365	11,7	4016
G	Wholesale and retail trade	7325	2.7	1338	4,0	8663
H	Transporting and storage	1310	2.3	382	32,1	1692
I	Accommodation and food service	481	2.2	201	6,6	682
J	Information and communication	1128	5.5	162	8,7	1290
K	Financial and insurance activities	205	3.0	53	23,0	258
L	Real estate activities	1513	5.9	424	10,6	1937
M	Professional, scientific, and technical activities	2102	6.0	276	19,3	2378
N	Administrative and support service	997	4.0	179	10,2	1176
O	Public administration and defence	13	1.3	3	4,6	16
P	Education	102	1.0	13	1,6	115
Q	Human health and social work	344	1.6	68	31,1	412
R	Arts, entertainment, and recreation	110	4.7	41	8,1	151
S	Other services	114	1.2	31	2,5	145
	Total	25122	3,0	5321	7.6	30443

Source: own calculation based on Crefo database

Even in the bad 2020 year, about three quarter of the companies earned higher ROE than ROA. The share of companies following good practice is higher than the average in the construction industry, the information and communication sector, professional, scientific, and technical activities, education and human health and social work. These are the sectors which were unharmed by the consequences of the Covid-crisis. The share of companies following bad practice is higher than the average in manufacturing, transporting and storage, accommodation, and food service.

Comparing the average leverage of the companies with good and bad practice we can detect that the companies following bad practice have got significantly higher leverage (higher debt to equity), than the opposite group. This indicates that those companies' ROE is lower than ROA, who were over-indebted. The difference in leverage between good and bad companies are extremely high in agriculture, construction, financial and insurance activities (they are not banks but financial enterprises). This indicates that the companies did not follow this bad practice voluntarily, but this was the consequence of their former decision to raise debt. Naturally during a crisis period, they paid the price for it.

Table 4

Number of companies following good or bad practice with leverage in 2021

2021	NACE sectors	Good practice		Bad practice		Total
		Count	Leve-rage	Count	Leve-rage	
A	Agriculture, forestry, and fishing	1608	0.9	382	1.8	1990
B	Mining and quarrying	63	0.6	16	0.4	79
C	Manufacturing	3747	1.4	1183	5.6	4930
D	Electricity, gas, steam, and air conditioning	139	7.7	57	20.8	196
E	Water supply, sewerage, waste management	266	1.9	51	9.0	317
F	Construction	3582	1.6	434	17.1	4016
G	Wholesale and retail trade	7504	2.4	1159	3.5	8663
H	Transporting and storage	1320	2.1	372	3.1	1692
I	Accommodation and food service	578	1.8	104	2.9	682
J	Information and communication	1098	3.8	192	14.4	1290
K	Financial and insurance activities	203	3.7	55	5.2	258
L	Real estate activities	1499	2.6	438	7.4	1937
M	Professional, scientific, and technical activities	2033	2.3	345	47.4	2378
N	Administrative and support service	1002	3.9	174	5.1	1176
O	Public administration and defence	13	2.0	3	0.2	16
P	Education	91	0.7	24	1.1	115
Q	Human health and social work	345	1.5	67	3.9	412
R	Arts, entertainment, and recreation	115	3.9	36	10.9	151
S	Other services	124	1.3	21	10.0	145
Total		25330	2.1	5113	5.6	30443

Source: own calculation based on Crefo database

2021 was an extremely good year for the Hungarian economy, since the economic growth was the highest in the XXI. century. Surprisingly, this economic boom did not reflect in the profitability of the analysed companies. The number of companies following good practice increased slightly, but not dramatically.

However, the gap between the leverage of the two groups narrowed significantly. Both company group can drastically build down their indebtedness thanks to the government programs launched during the Covid-crisis. Two populous sector is exception, the manufacturing and construction industry, their leverage increased from 2020 both in the good practice and bad practice group due to the targeted loan facilities for these sectors.

Let us answer the first question, namely „Is it true, if the companies with higher ROA than rate of lending uses more debt than companies with lower ROA than lending rate?"

Based on these data, the answer is No. The debt financing depends not on profitability issues, but on other influencing factors like the sectorial characteristics and the financing needs of companies. The leverage is higher in those companies where the core profitability of the company is lower than the average lending rate. It means that the casualty is totally the opposite. Not the profitability determines the leverage but the (high) leverage determines the (low profitability). The profitability is the consequence of former decisions about the debt-equity relationship, the debt/equity ratio would be the consequence of the profitability.

Let us look the relationship between the volatility of ROA and the leverage! By the theory, if the volatility of ROA is high, thus the assets are risky, then you should finance your company from equity. If the volatility of ROA is low, thus the assets are secure, you should use more debt.

To measure the volatility of ROA between 2020 and 2021, the 2020 figure was deducted from the 2021 figure. Similarly, the difference between the 2021 and 2020 leverage was calculated.

$$Difference\ in\ ROA = ROA_{2021} - ROA_{2020}$$
$$Difference\ in\ leverage = Leverage_{2021} - Leverage_{2020}$$

To get rid from the outliers, the analysis tool of Descriptive Statistics/Explore in SPSS 25.0 was used. The following values remain in the analysis.

leverage20>=0 and leverage21>=0 and lendingrate20>=0 and lendingrate21>=0 and leverage20<3.72 and leverage21<3.47 and lendingrate20<0.119 and lendingrate21<0.108

Table 5

Cases used in the analysis

Name of variable	Description	Minimum value	Maximum value
leverage20	Leverage in 2020	0	3.72
leverage21	Leverage in 2021	0	3.47
lendingrate20	Lending rate in 2020	0	11.9%
lendingrate21	Lending rate in 2021	0	10.8%

Source: own calculations on Crefo database

The result of the examination is shown by table 6.

Table 6

Sectors which followed the rules and sectors which did not follow the rule

Nace name	DROA	leve-rage20	Number of cases	Risky	Indebt-edness	Rule
Accommodation and food service	0.06	0.82	599	Risky	Risky	No
Administrative and support service	-0.08	0.85	851	Risky	Risky	No
Agriculture, forestry, and fishing	0.01	0.58	1757	Secure	Secure	No
Arts, entertainment, and recreation	-0.02	0.62	123	Secure	Secure	No
Construction	-0.04	0.74	3273	Secure	Secure	No
Education	-0.10	0.44	100	Risky	Secure	Yes
Electricity, gas, steam, and air conditioning	0.01	0.79	125	Secure	Risky	Yes
Financial and insurance activities	-0.17	0.59	171	Risky	Secure	Yes
Human health and social work	-0.05	0.62	353	Risky	Secure	Yes
Information and communication	-0.10	0.72	915	Risky	Secure	Yes
Manufacturing	0.00	0.78	3400	Secure	Secure	No
Mining and quarrying	-0.01	0.55	65	Secure	Secure	No
Other services	0.01	0.76	125	Secure	Secure	No
Professional, scientific, and technical activities	-0.35	0.74	1703	Risky	Secure	Yes
Public administration and defence	-0.08	0.69	12	Risky	Secure	Yes
Real estate activities	-0.08	0.82	1399	Risky	Risky	No
Transporting and storage	-0.02	0.89	1125	Secure	Risky	Yes
Water supply, sewerage, waste management	0.03	0.72	246	Secure	Secure	No
Wholesale and retail trade	-0.01	0.88	6147	Secure	Risky	Yes
Total	-0.05	0.79	22489			

Source: own calculation based on Crefo database

Column DROA contains the difference in ROA, leverage20 is the borrowing/equity ratio in 2020, number of cases is the number of companies in the sector.

The average DROA in 2020 in the examined population was -0.05, which means that the ROA decreased from 2020 to 2021. The sector was considered risky, if the absolute value of DROA is higher, than the absolute value of -0,05. The sector was secure if the average is lower. The same method was used in case of leverage. The financing of the sector was considered risky, if the borrowings to equity ratio is higher than 0.79, which was the average indebtedness. The financing was considered secure if the average was lower than 0.79.

The result is mixed. Some sectors followed the rules, mostly the sectors of the service providers. But the agriculture, mining, manufacturing construction did not follow this rule.

Empirically the risk matching principle cannot be justified by the examination.

The empirical literature is also mixed. Chen and his coauthors (2021) examined this relationship with multivariate regression and found weak correlation between profitability and leverage. Christensen (Christensen, 2015) found, that the risk-return relationship is important only during crisis, otherwise insignificant. Artikis (2011) detected even negative relationship between leverage and profitability.

CONCLUSIONS

This examination has some limitations.
1. The examined period was very brief, but the dedicated theories suppose long-term relationships.
2. The original theory regards the long-term financing, but this study uses the long and short-term borrowing as a proxy. The reason is, that the annual repayment of long-term debt is among the short-term liabilities, and the financial expenses are not separated by interest payment of long- and short-term loans, thus only the overall indebtedness can be examined.
3. The financial expenses contain not only the interest expenses, but exchange losses, financial fees, which artificially increases the cost of lending, and the exchange losses have not got direct relationship with the cost of finance.
4. The nominal main sector of the company may not reflect to its real activity and the main NACE sectors cover vastly different subsectors in nature. The use of average hides these differences.

Based on the data of analysis, we draw the following conclusions.
1. It is not true that the companies with higher ROA than rate of lending uses more debt than companies with lower ROA than lending rate, totally the opposite is true. The leverage is higher in those companies where the core profitability of the company is lower than the average lending rate.
2. The debt financing depends not on profitability issues, but on other influencing factors like the sectorial characteristics and the financing needs of companies.
3. The profitability does not determine the leverage, but the high leverage determines the low profitability. The profitability is the consequence of former decisions about the debt-equity relationship, the debt/equity ratio would be the consequence of the profitability.
4. The risk matching principle, which means that the risky assets should be financed from equity and the secure assets should be financed from debt, cannot be justified due to the above-mentioned limitation of the study.

Based on these results, one suggestion should be made for the companies. Never exceeds the perceived risk limit of their borrowings. If the lender began to worry about the riskiness of their outstanding, they will increase the interest rate of loans further deteriorating the profitability of the company.

Author's contribution

Sándor Bozsik was responsible for 50% of the overall work. His tasks included data collection, analysis, and crafting the discussion and conclusion sections. Judit Szemán contributed 50% to the study. She conceived and designed the study, penned the introduction and the literature review, and also provided supervision throughout the study.

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