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RESEARCH ARTICLE

A new approach to assessing a company's financial indicators: Taking into account business and financial risks

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ABSTRACT

There are two main methods for estimating the value of assets. The first method is the well-known CAPM (Capital Asset Pricing Model), which uses the risk-free rate as the initial return and takes into account only the business risk associated with investing in a specific asset, and not in the market as a whole. The second method is associated with the use of one of two main theories of capital structure (Brusov–Filatova–Orekhova (BFO) theory and Modigliani–Miller (MM) theory), which take into account only the financial risk associated with the use of debt financing and allow the calculation of all financial indicators of a company of arbitrary age (BFO theory) or perpetuity one (MM theory).

The article develops a new approach related to the use of the company's current profitability, taken from the annual report, as a seed profitability of an asset (company). As part of the new approach, a methodology has been developed that makes it possible to calculate all the main financial indicators of a company within the framework of capital structure theories, taking into account both financial and business risks. Transition from CAPM to a new methodology significantly improves the accuracy of the estimate. The new approach, unlike CAPM, has forecasting capabilities.

Keywords: CAPM; CAPM 2.0; business risk; financial risk, capital structure; Modigliani–Miller (MM) theory; Brusov–Filatova–Orekhova (BFO) theory; MSC: 91G50; 91G80

1. Introduction

There are two main methods for estimating the value of assets. The first method is the well-known CAPM (Capital Asset Pricing Model), which uses the risk-free rate as the initial return and takes into account only the business risk associated with investing in a specific asset, and not in the market as a whole [1-10]. The second method is associated with the use of one of two main theories of capital structure (Brusov–Filatova–Orekhova (BFO) theory [11-19] and Modigliani–Miller (MM) theory [20,21], which take into account only the financial risk associated with the use of debt financing and allow the calculation of all financial indicators of a company of arbitrary age (BFO theory) or perpetuity one (MM theory).

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Some modifications of CAPM (Fama and French [22-25]; Hamada [26,27]; Brusov et al [13,14,18,28] brought the model closer to economic practice.

Below a fundamentally new approach to assessing the profitability of an asset is proposed. Transition from CAPM, which takes the same risk-free return for all assets as an initial assessment, to a new methodology, in which the average return of an asset, cleared of leverage, with the addition of a premium for business risk (market or industry) is taken as a seed return, significantly improves the accuracy of the estimate. As a result, generalized approaches (CAPM – BFO and CAPM – MM) were developed that take into account both types of risk: systematic (business) and financial. The application of developed approach to Norilsk Nickel company (GMKN) has been done.

The outline of the article is as follows

CAPM formulas are discussed;

the methodology of the new approach is presented;

an application of a new approach to the Norilsk Nickel company was given;

an analysis of three assessment methods and their comparison is provided;

conclusion.

2. CAPM model

CAPM (Capital Asset Pricing Model) valuates the profitability of asset and is described by the following formula

$$k_i = k_f + \beta_i \left(k_m - k_f \right). \tag{1}$$

(we denote assets profitability as k (like cost of equity) instead of μ.)

Here k_f is risk free profitability, β is the β–coefficient of the company. It shows the dependence of the return on the asset and the return on the market as a whole. The β–coefficient is described by the following formula

$$\beta_i = \frac{\mathrm{cov}_{im}}{\sigma_m^2} = \rho_{im} \frac{\sigma_i}{\sigma_m}. \tag{2}$$

Here σ_i is the risk (standard deviation) of *i*–th asset, σ_m is market risk (standard deviation of market index), cov_{im} is covariance between *i*–th asset and market portfolio.

An investor invests in risky securities only if their return is higher than the return on risk–free securities, so always $k_i > k_f$ and $k_m > k_f$.

2.1. Industry approach

CAPM has an alternative approach that refers to the industrial index rather than the market.

$$k_i = k_f + \beta_i \left(k_I - k_f \right). \tag{3}$$

Here, k_f is risk free profitability, β is the β–coefficient of the company. In this case it shows the dependence of the return on the asset and the return on the industry as a whole. The β–coefficient now is described by the following formula

$$\beta_i = \frac{\text{cov}_{iI}}{\sigma_I^2} = \rho_{iI}\frac{\sigma_i}{\sigma_I}. \tag{4}$$

Here σ_i is the risk of *i*–th asset, σ_I is industry risk (standard deviation of industry index), cov_{iI} is covariance between *i*–th asset and industry index. Note, that the industry approach better describes the return on an asset than the market approach.

3. New Approach and Methodology

We take the company's profitability μ_i from its financial statements.

Then we clean this value from leverage

$$\mu_i \to \mu_0 \tag{5}$$

and find the value of the cost of equity at zero leverage μ_0, which is one of the main parameters in both theories: BFO and MM.

$$\mu_i = \mu_0 + L(\mu_0 - k_d)\cdot(1-t) \tag{6}$$

$$\mu_0 = \frac{\mu_i + Lk_d\cdot(1-t)}{1+L\cdot(1-t)} \tag{7}$$

We use $k_0 = \mu_0$.

We consider three cases:

Accounting only financial risk

$$k_0 = \mu_0 \tag{8}$$

Accounting for financial risk + industry business risk

$$k_0 = \mu_0 + \beta_{iI}(\mu_I - \mu_F) \tag{9}$$

Account financial risk + market business risk

$$k_0 = \mu_0 + \beta_{im}(\mu_m - \mu_F) \tag{10}$$

For calculations according to MM theory, the following formulas are used to derive indicators:

$$WACC = k_0\cdot(1-w_d t) \tag{11}$$

$$V = \frac{CF}{WACC} = \frac{CF}{k_0\cdot(1-w_d t)} \tag{12}$$

$$k_e = k_0 + L(k_0 - k_d)\cdot(1-t) \tag{13}$$

For calculations according to BFO theory, the following formulas are used to derive indicators:

$$\frac{1-(1+WACC)^{-n}}{WACC}=\frac{1-(1+k_0)^{-n}}{k_0\cdot\left(1-w_d t\left[1-(1+k_d)^{-n}\right]\right)} \tag{14}$$

$$V=\frac{CF}{WACC}\cdot\left(1-(1+WACC)^{-n}\right) \tag{15}$$

$$k_e=WACC\cdot(1+L)-L\cdot k_d\cdot(1-t) \tag{16}$$

4.1. An application of a new approach to the Norilsk nickel company (GMKN)

Norilsk Nickel company (GMKN) is the leader in the mining and metallurgical industry in Russia and in the world. It produces metals needed to develop a low-carbon economy and clean transport.

It produces 17% Ni (№1 in the world); 43% of Pd (№1 in the world); 12% of Pt (№4 in the world); 8% Rh (№5 in the world); 2% of Cu; 2% of Co as well as Au, Se, Ag, S, Ru, Ir, Te.

Below we will evaluate the financial indicators of Norilsk Nickel for 2018-2022 and study their dependence on debt financing.

$k_i;k_I;k_m$ (μ_i; μ_I; μ_m) stand for company, industry and market returns; $\sigma_i;\sigma_I;\sigma_m$ are standard deviation for company, industry and market returns; $\beta_{iI};\beta_{im}$ are Beta coefficients company to industry and to market; L is leverage level; k_d is the cost of debt.

All necessary data is collected in **Table 1**. The calculated values of k_0 in 2018-2021 are given in **Table 2**.

Norilsk Nickel share price data: https://ru.investing.com/equities/gmk-noril-nickel_rts-historical-data

Moscow Exchange Index data MOEX: https://ru.investing.com/equities/gmk-noril-nickel_rts-historical-data

Industry Index Data Source MOEXMM: https://ru.investing.com/indices/mcxmm-historical-data

As a risk-free rate, the rate on federal loan bonds with a 10-year term has been used, which is published on the website of the Bank of Russia https://www.cbr.ru/hd_base/zcyc_params/zcyc/

Industry average financial leverage values are published on the website: https://www.testfirm.ru

Data for calculations are taken from the balance sheet and income statement

For 2022:

https://www.nornickel.ru/upload/iblock/094/lx8zuduktyo27i4i4xrvozcsmgmu3n2r/godovaya_buhgalterskaya_finansovaya_otchetnost_za_god_2022.pdf

For 2021:

https://www.nornickel.ru/upload/iblock/751/buhgalterskaya_finansovaya_otchetnost_pao_gmk_nn_za_2021_g.pdf

Table 1. Calculation of the expected return on Norilsk Nickel shares.

Level	index	2018	2019	2020	2021	2022
Company	μ	12.33%	40.50%	13.86%	– 6.01%	– 30.19%
	σ_i	0.054	0.052	0.076	0.052	0.10
	L_i	3.29	3.22	2.42	3.47	5.84
	k_d	4.58%	4.30%	3.96%	2.29%	3.94%
	β_{im}	0.72	0.30	0.67	– 0.47	0.65
	ρ_{im}	0.32	0.13	0.64	– 0.32	0.74
Industry (index MOEXMM)	μ_I	5.01%	9.05%	40.66%	9.43%	– 42.59%
	σ_I	0.026	0.028	0.06	0.043	0.12
	L_I	1.92	1.97	1.87	1.72	No data
	β_{iI}	1.088	1.47	0.81	0.95	0.81
	ρ_{iI}	0.52	0.8	0.63	0.80	0.94
Market (index MOEX)	μ_m	3.46%	20.82%	6.9%	15.57%	– 38.98%
	σ_m	0.024	0.022	0.074	0.036	0.12
	β_{im}	0.72	0.30	0.67	– 0.47	0.65
μ_F		8.78%	6.41%	6.27%	8.44%	10.31%
μ		12.33%	40.50%	13.86%	– 6.01%	– 30.19%
μ_i **(**Industry**)**		4.68%	10.30%	34.02%	9.39%	– 32.73%
μ_i **(**Market**)**		4.97%	10.76%	6.69%	5.12%	– 21.89%

Table 2. Cost of equity capital of an unleveraged company in 2018-2021.

$k_0 = \mu_0$	2018	2019	2020	2021
Company	6.71%	14.42%	7.33%	0.09%
Industry	2.61%	18.31%	35.08%	1.04%
Market	2.90%	18.78%	7.75%	-3.23%

Calculations below will be carried out for those cases when k_0 is positive (years 2018, 2019 and 2020). The case where k_0 is negative (as in 2021 and 2022) requires a different approach, which has been developed by Anastasia Brusova (2011).

It is seen from Figure 1, that WACC(L) decreases with leverage level L in all three cases. This means that debt financing is important and should be used by company – it leads to decrease of attracting capital cost with leverage level L. There is a large difference between the case of accounting for pure financial risk (1) and accounting for financial risk plus business risk (2 and 3), while the difference between accounting for industry and market business risks (2 and 3) is much smaller.

4.1.1. Mm theory 2018

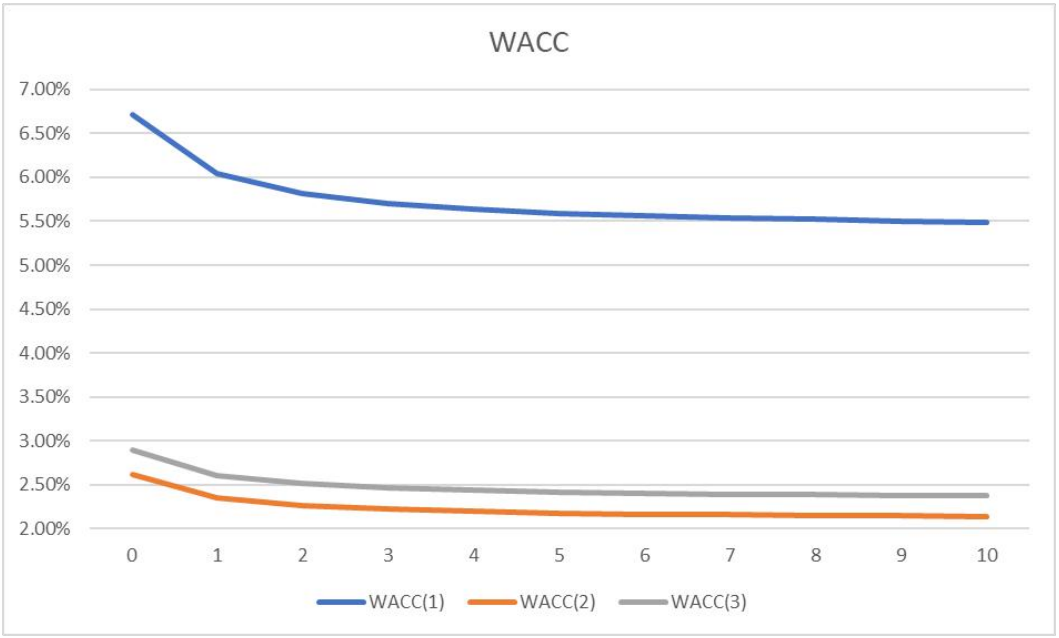

Figure 1. Dependence of WACC (weighted average cost of capital) on leverage level L according to the MM theory in 2018 (financial risk only (1); plus industry (2) and plus market (3) business risk).

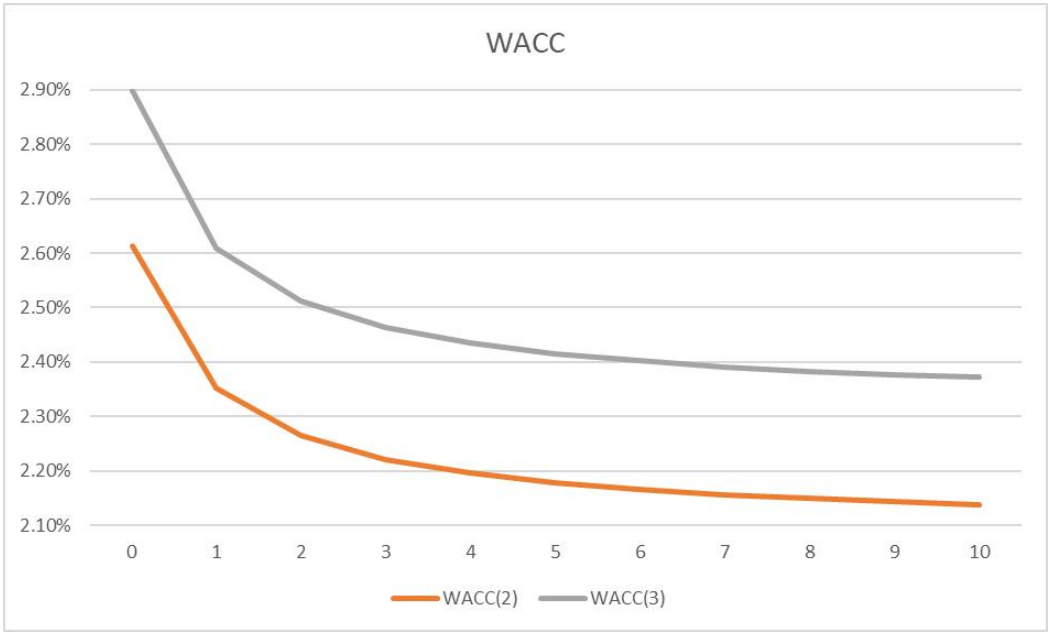

Figure 2. Dependence of WACC (weighted average cost of capital) on leverage level according to the MM theory in 2018 (financial risk plus industry (2) and plus market (3) business risk).

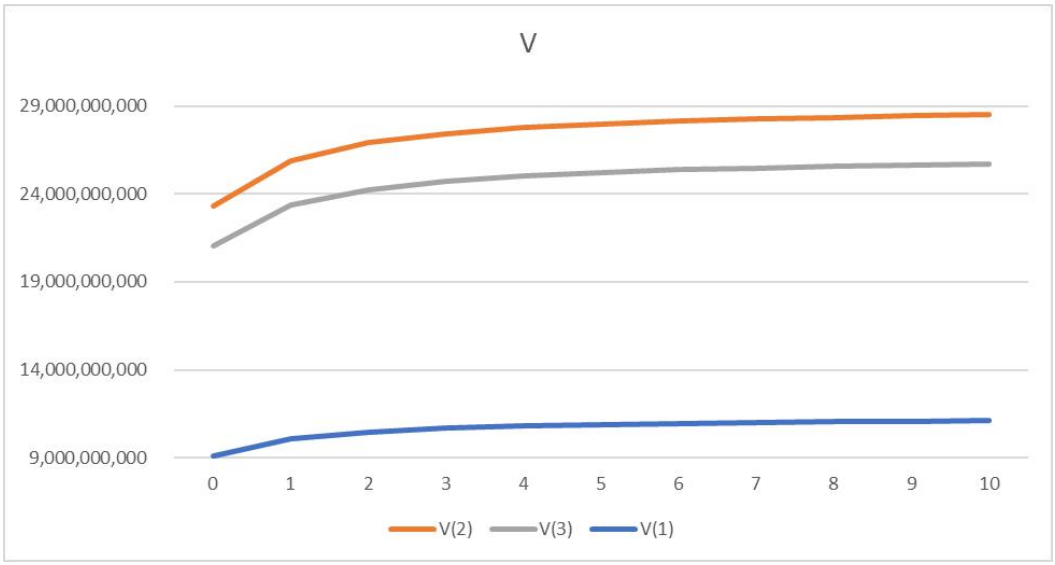

Figure 3. Dependence of company value, V, on leverage level according to the MM theory in 2018 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 3**, that company value V(L) increases with leverage level L in all three cases. There is a large difference between the case (1) and cases (2 and 3), while the difference between cases (2 and 3) is much smaller.

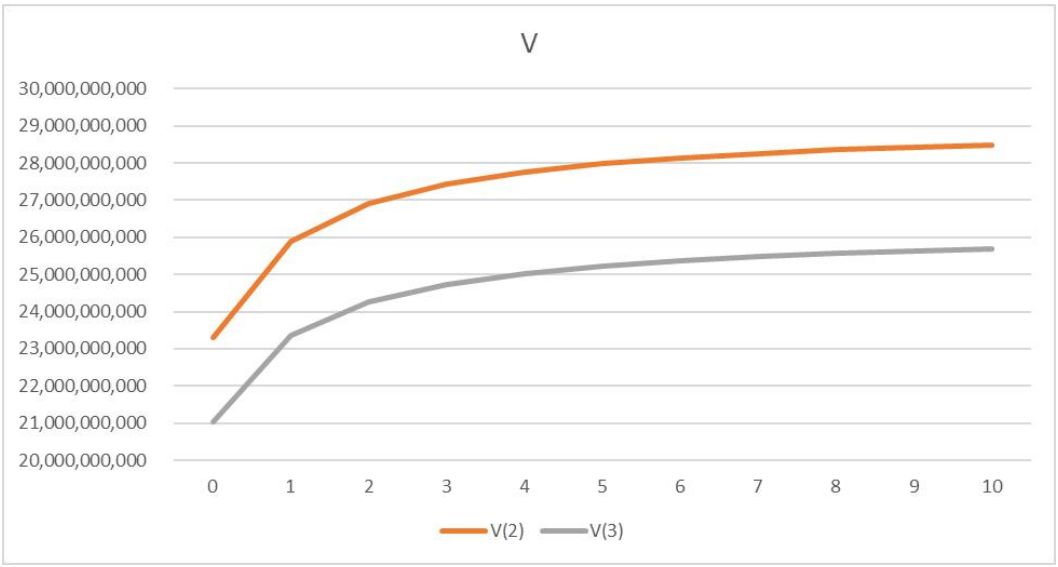

Figure 4. Dependence of company value, V, on leverage level according to the MM theory in 2018 (financial risk plus industry (2) and plus market (3) business risk).

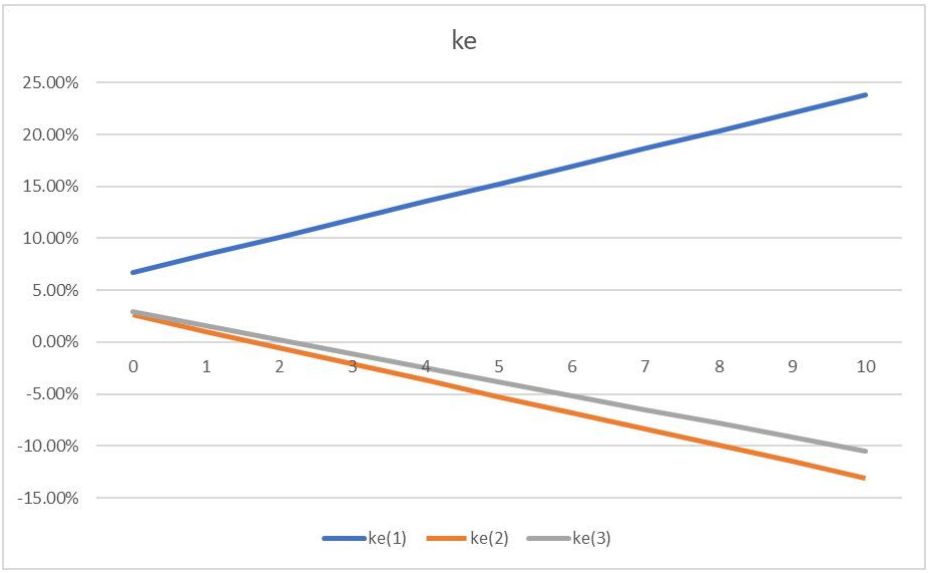

Figure 5. Dependence of equity cost, ke, on leverage level according to the MM theory in 2018 (financial risk only (1); plus industry (2) and plus market (3) business risk).

4.1.2. Bfo Theory 2018

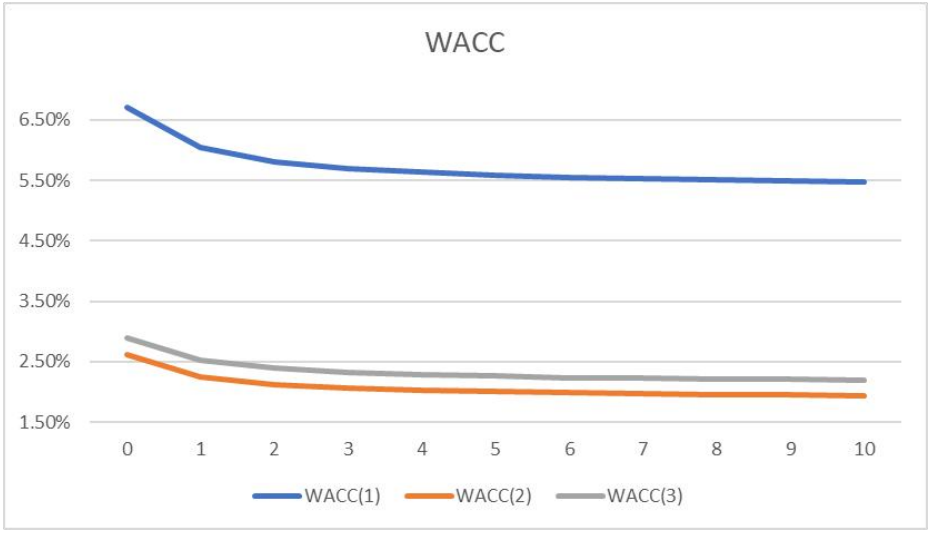

Figure 6. Dependence of WACC (weighted average cost of capital) on leverage level according to the BFO theory in 2018 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 6**, that WACC(L) decreases with leverage level L in all three cases. This means that debt financing is important and should be used by company – it leads to decrease of attracting capital cost with leverage level L. There is a large difference between the case of accounting for pure financial risk (1) and accounting for financial risk plus business risk (2 and 3), while the difference between accounting for industry and market business risks (2 and 3) is much smaller.

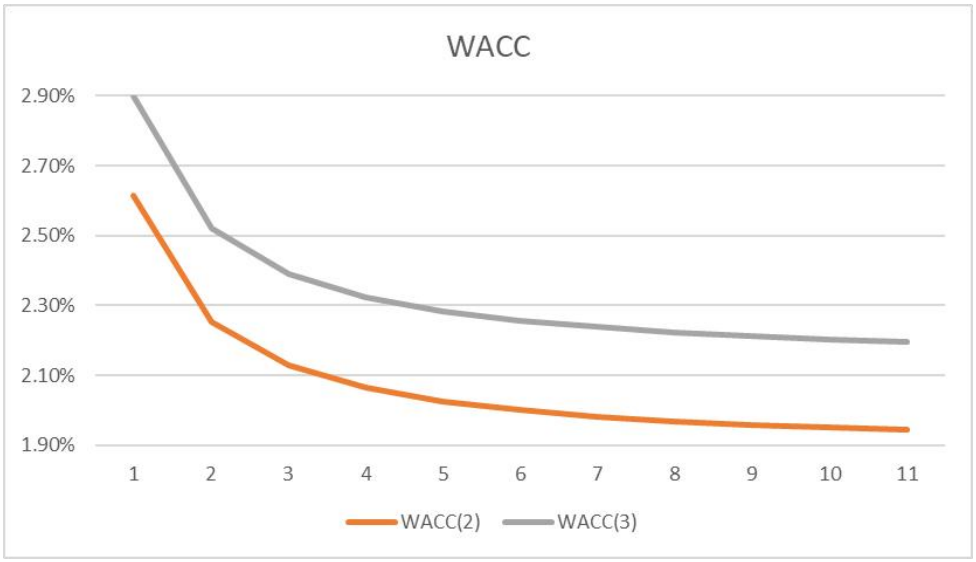

Figure 7. Dependence of WACC (weighted average cost of capital) on leverage level according to the BFO theory in 2018 (financial risk plus industry (2) and plus market (3) business risk).

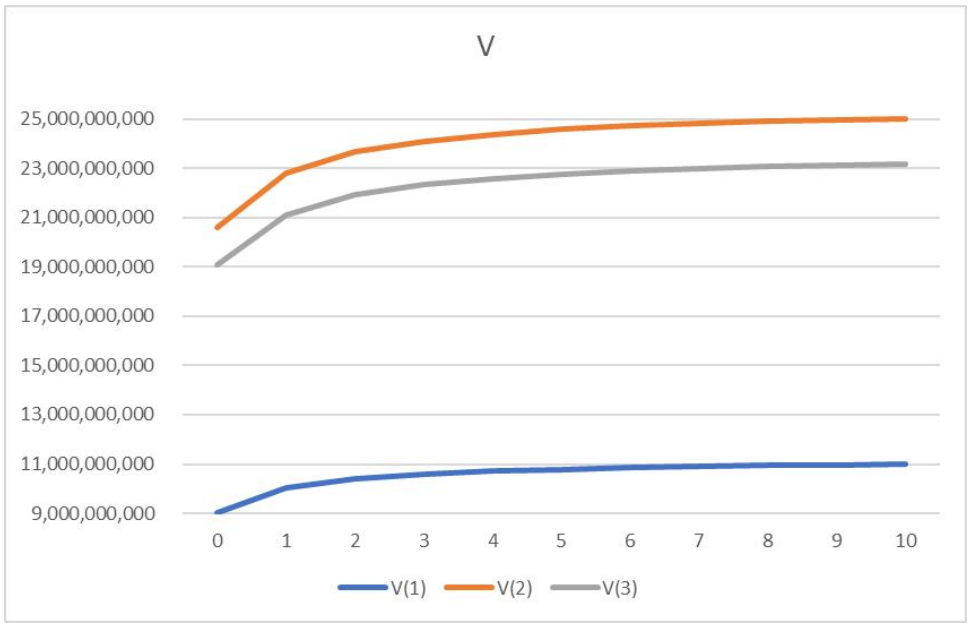

Figure 8. Dependence of company value, V, on leverage level according to the BFO theory in 2018 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 8**, that company value V(L) increases with leverage level L in all three cases. There is a large difference between the case (1) and cases (2 and 3), while the difference between cases (2 and 3) is much smaller.

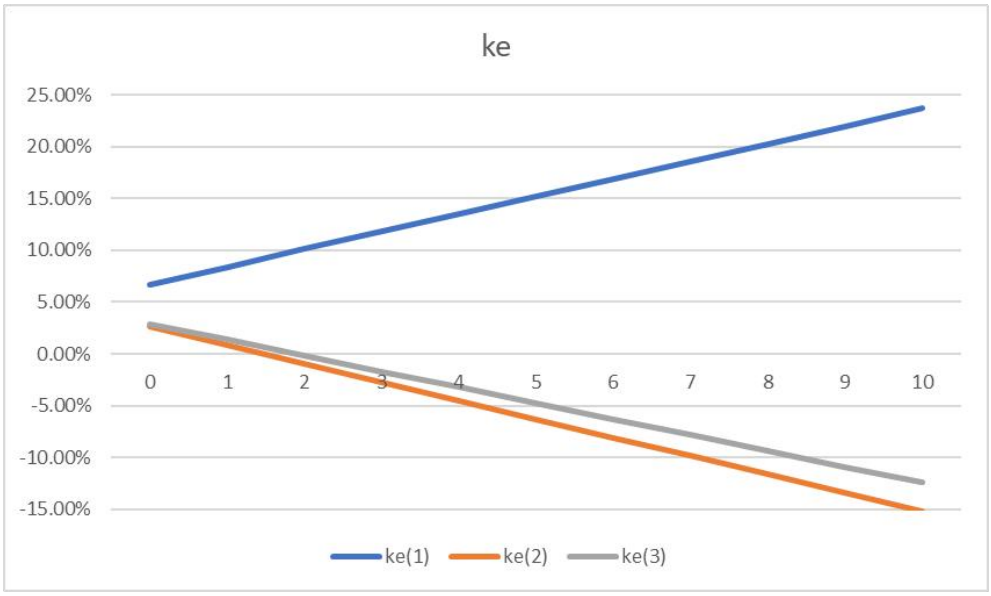

Figure 9. Dependence of cost of equity, ke, on leverage level according to the BFO theory in 2018 (financial risk only (1); plus industry (2) and plus market (3) business risk).

From **Figure 9** in is seen, that the cost of equity capital ke increases with increasing leverage level L for case (1) and decreases for cases (2) and (3). The difference in inclination angles in cases (2 and 3) is small. This means the existence of an anomalous effect depending on cost of equity on leverage level L. Note, that the equity cost determines the value of dividends.

4.1.3. Mm Theory 2019

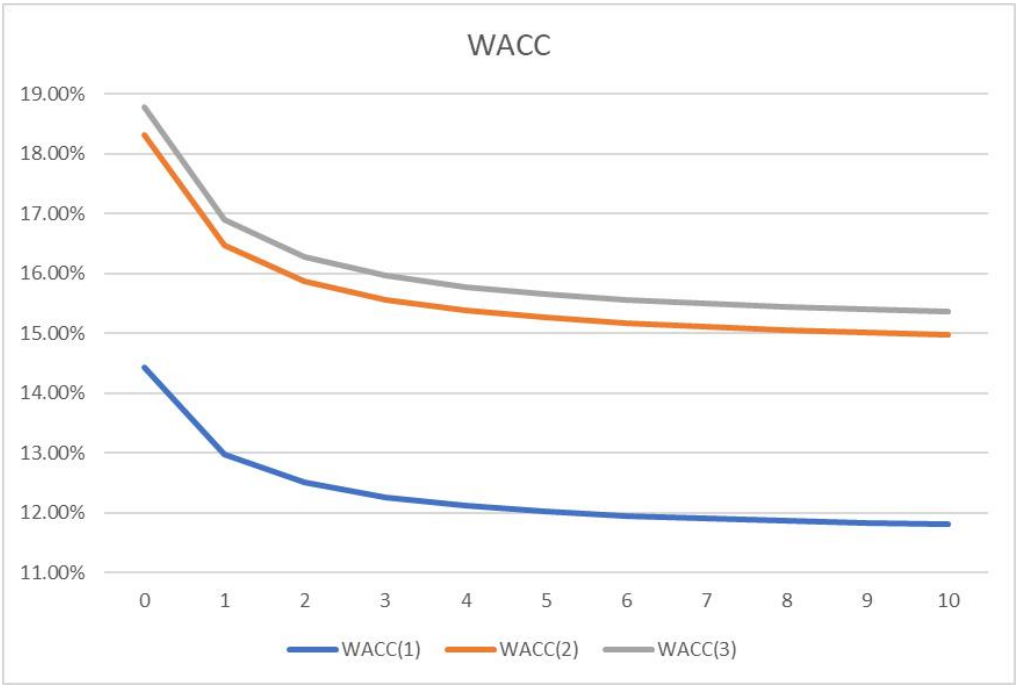

Figure 10. Dependence of WACC (weighted average cost of capital) on leverage level according to the MM theory in 2019 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 10**, that WACC(L) decreases with leverage level L in all three cases. This means that debt financing is important and should be used by company – it leads to decrease of attracting capital

cost with leverage level L. There is a large difference between the case of accounting for pure financial risk (1) and accounting for financial risk plus business risk (2 and 3), while the difference between accounting for industry and market business risks (2 and 3) is much smaller.

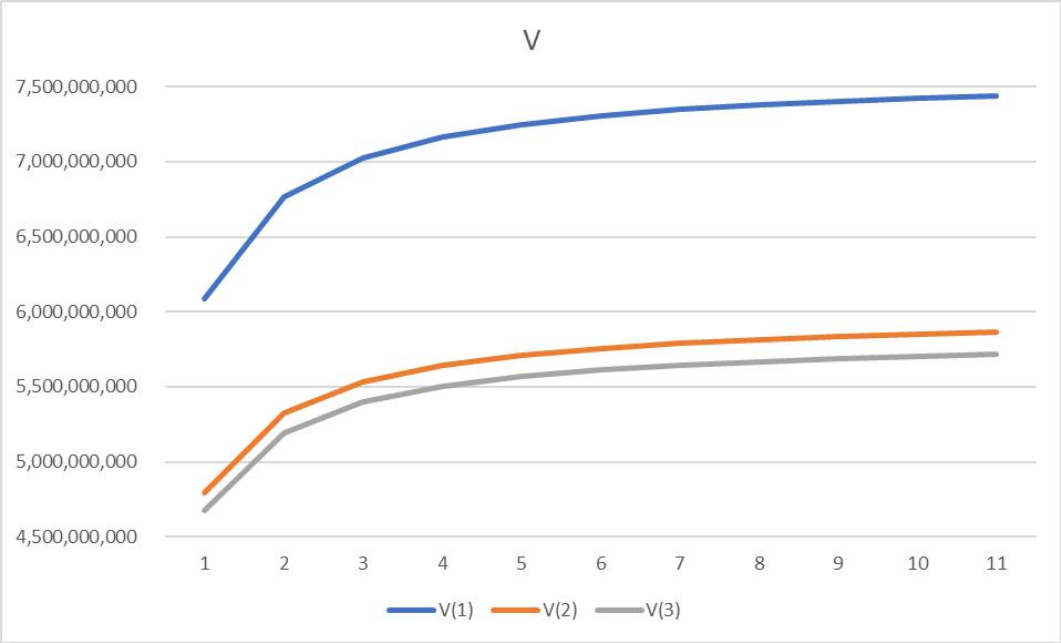

Figure 11. Dependence of company value, V, on leverage level according to the MM theory in 2019 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 11**, that company value V(L) increases with leverage level L in all three cases. There is a large difference between the case (1) and cases (2 and 3), while the difference between cases (2 and 3) is much smaller.

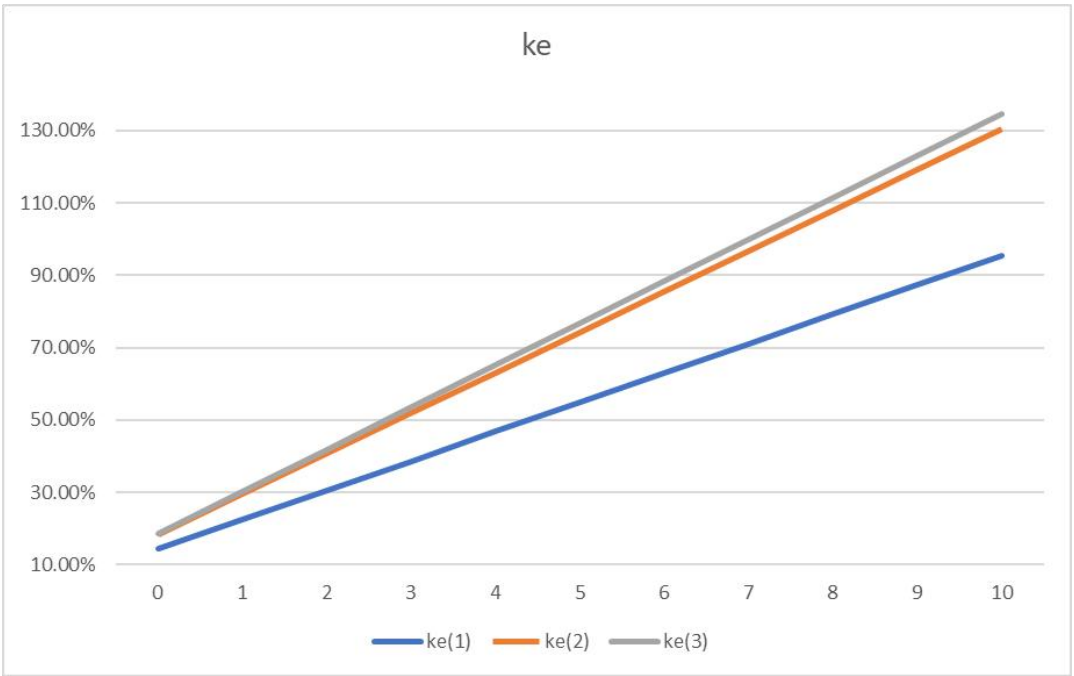

Figure 12. Dependence of cost of equity, ke, on leverage level according to the MM theory in 2019 (financial risk only (1); plus industry (2) and plus market (3) business risk).

From **Figure 12** in is seen, that the cost of equity capital ke increases with increasing leverage level L for all three cases. The difference in inclination angles in cases (1) and (2 and 3) is significant, and for cases (2) and (3) it is significantly less Note, that the equity cost determines the value of dividends.

4.1.4. Bfo theory 2019

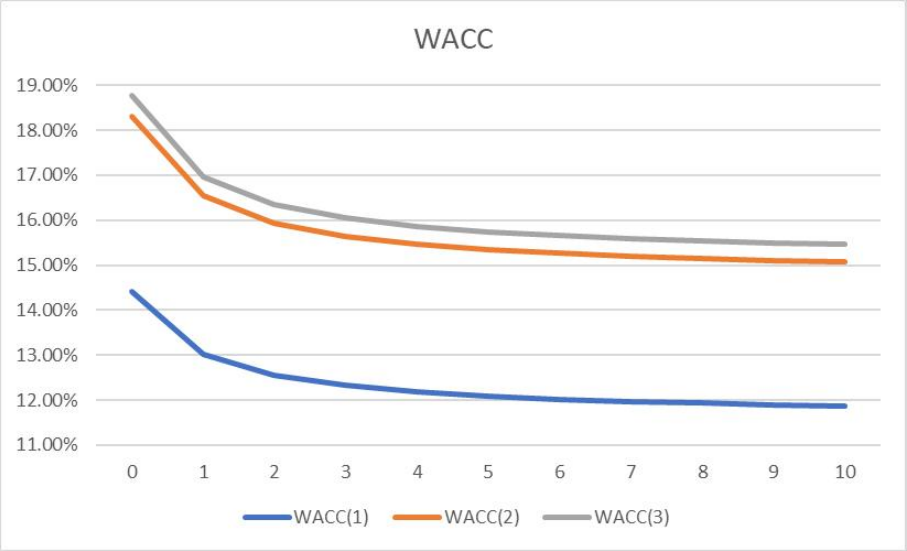

Figure 13. Dependence of WACC (weighted average cost of capital) on leverage level according to the BFO theory in 2019 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 13**, that WACC(L) decreases with leverage level L in all three cases. This means that debt financing is important and should be used by company – it leads to decrease of attracting capital cost with leverage level L. There is a large difference between the case of accounting for pure financial risk (1) and accounting for financial risk plus business risk (2 and 3), while the difference between accounting for industry and market business risks (2 and 3) is much smaller.

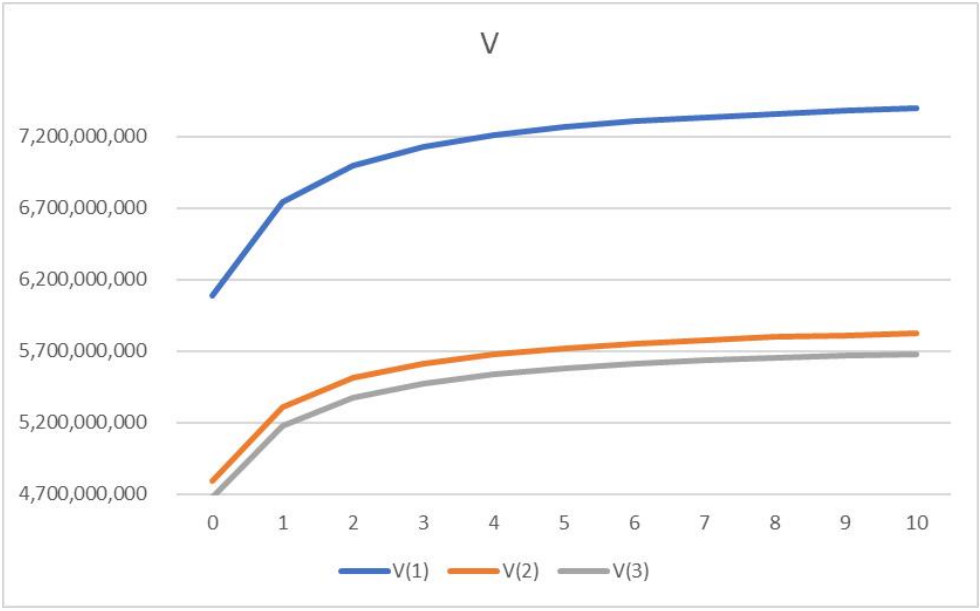

Figure 14. Dependence of company value, V, on leverage level according to the BFO theory in 2019 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 14**, that company value V(L) increases with leverage level L in all three cases. There is a large difference between the case (1) and cases (2 and 3), while the difference between cases (2 and 3) is much smaller.

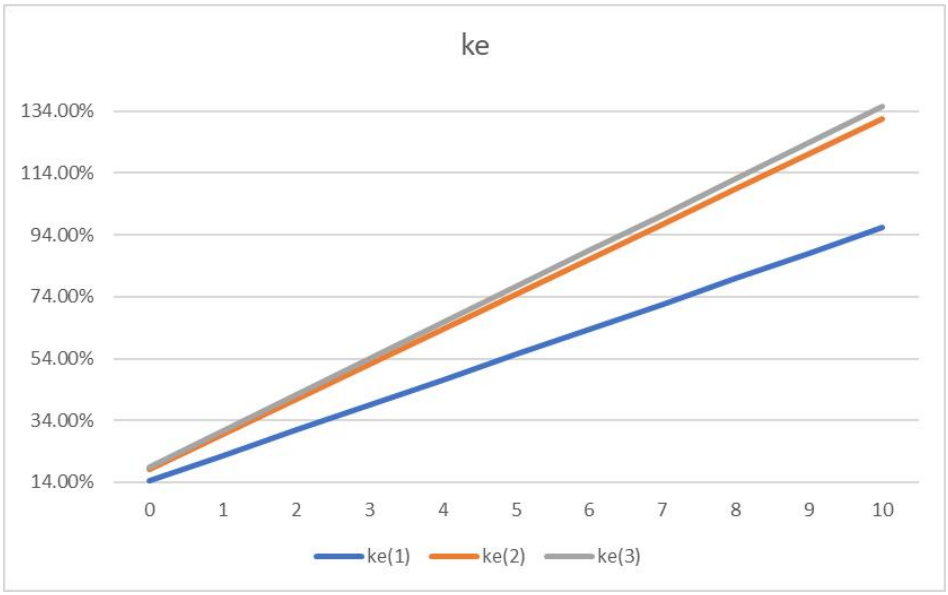

Figure 15. Dependence of cost of equity, ke, on leverage level according to the BFO theory in 2019 (financial risk only (1); plus industry (2) and plus market (3) business risk).

From **Figure 15** in is seen, that the cost of equity capital ke increases with increasing leverage level L for all three cases. The difference in inclination angles in cases (1) and (2 and 3) is significant, and for cases (2) and (3) it is significantly less. Note, that the equity cost determines the value of dividends.

4.1.5. Mm Theory 2020

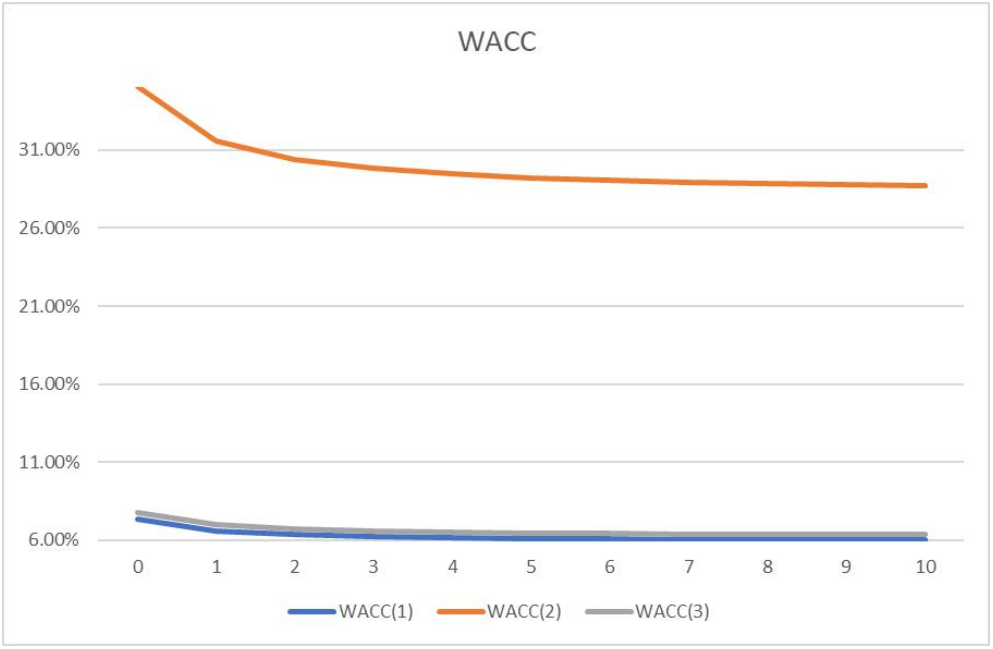

Figure 16. Dependence of WACC (weighted average cost of capital) on leverage level according to the MM theory in 2020 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 16**, that WACC(L) decreases with leverage level L in all three cases. This means that debt financing is important and should be used by company – it leads to decrease of attracting capital cost with leverage level L. There is a large difference between the case (2) and cases (1 and 3), while the difference between cases (1 and 3) is much smaller.

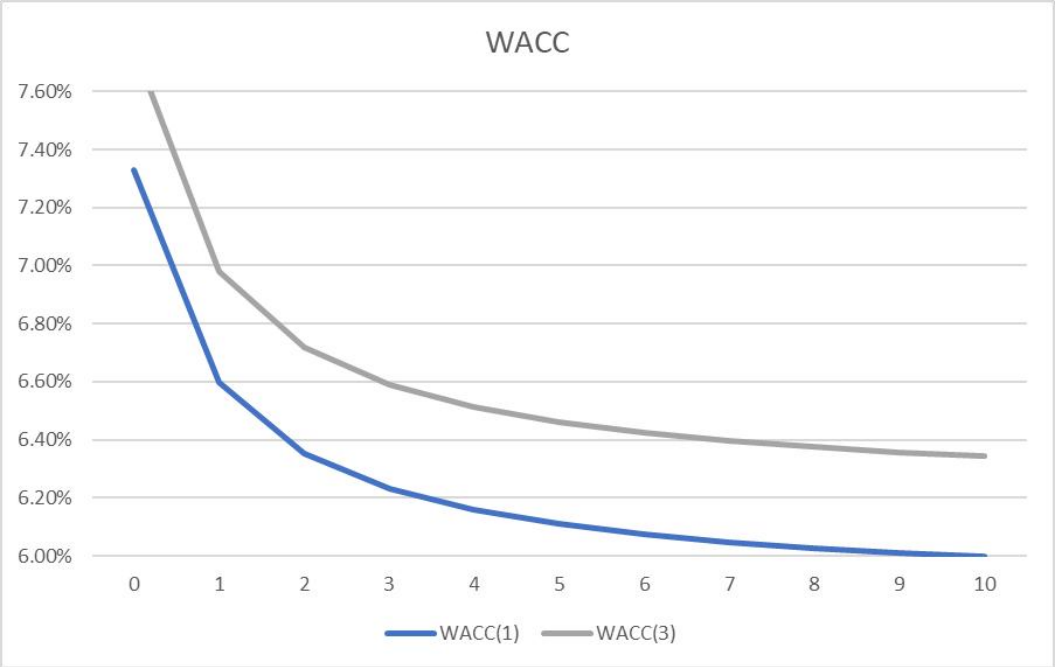

Figure 17. Dependence of WACC (weighted average cost of capital) on leverage level according to the MM theory in 2020 (financial risk only (1) and plus market (3) business risk).

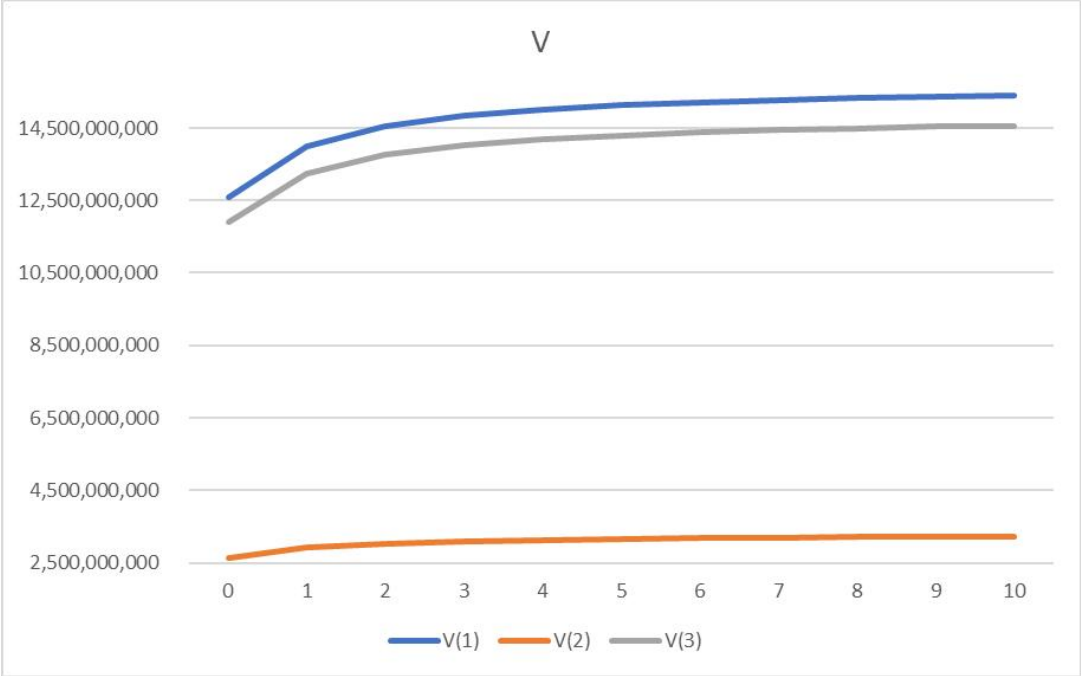

Figure 18. Dependence of company value, V, on leverage level according to the MM theory in 2020 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 18**, that company value V(L) increases with leverage level L in all three cases. There is a large difference between the case (2) and cases (1 and 3), while the difference between cases (1 and 3) is much smaller.

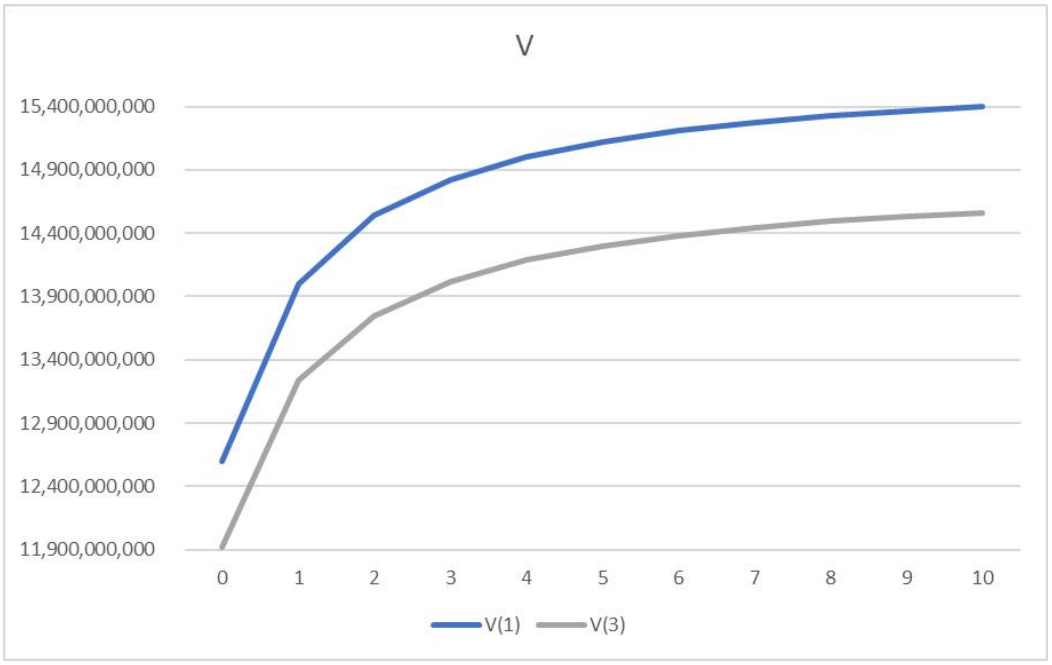

Figure 19. Dependence of company value, V, on leverage level according to the MM theory in 2020 (financial risk only (1) and plus market (3) business risk).

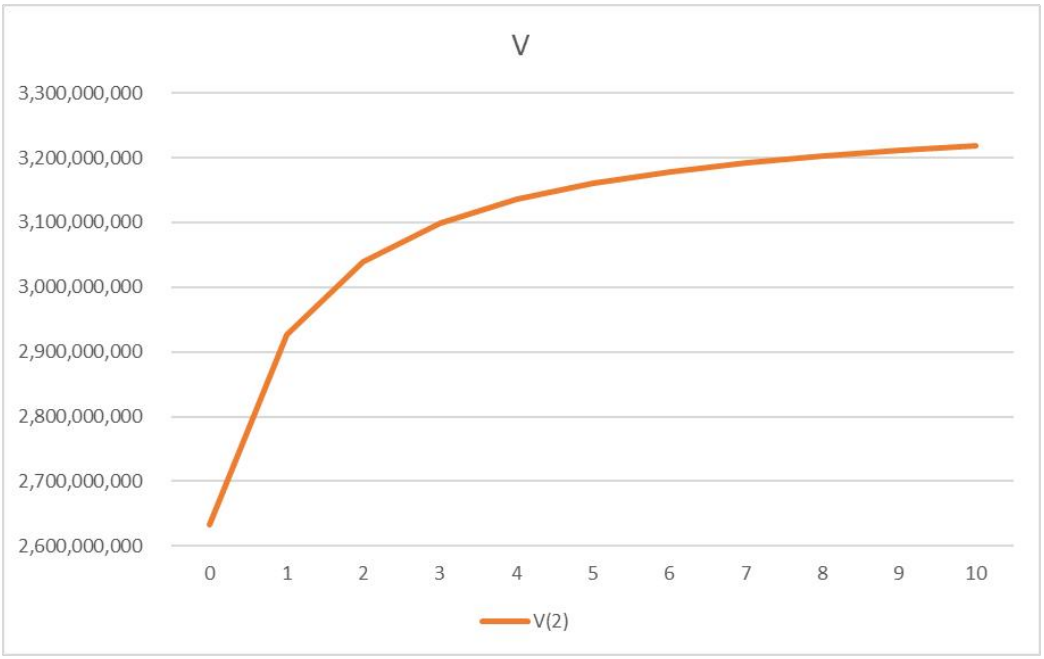

Figure 20. Dependence of company value, V, on leverage level according to the MM theory in 2020 (financial risk plus industry (2) business risk).

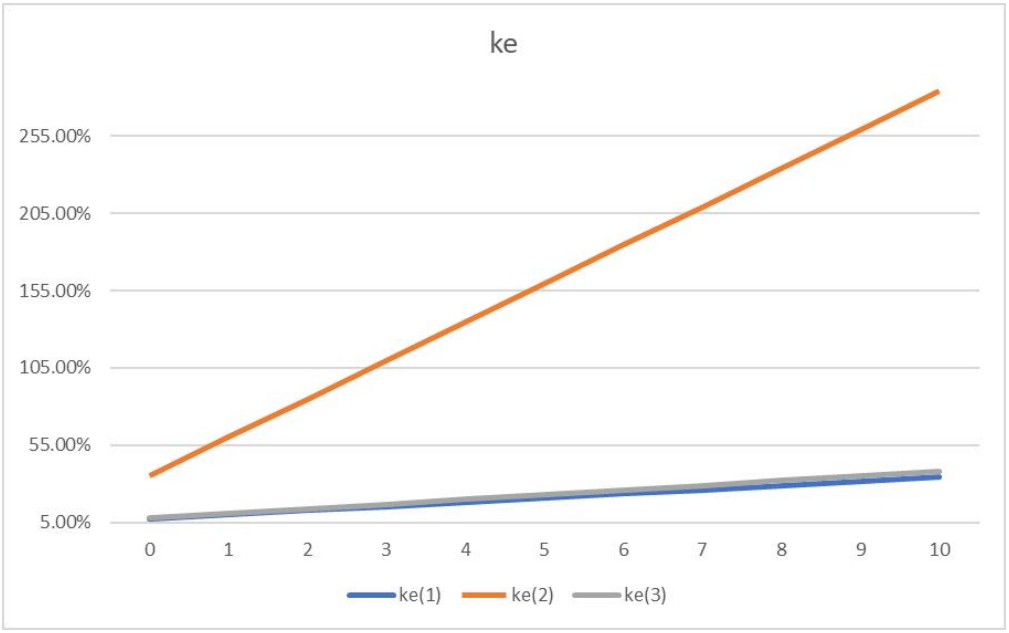

Figure 21. Dependence of cost of equity, ke, on leverage level according to the MM theory in 2020 (financial risk only (1); plus industry (2) and plus market (3) business risk).

From **Figure 21** in is seen, that the cost of equity capital ke increases with increasing leverage level L for all three cases. The difference in inclination angles in cases (1) and (2 and 3) is significant, and for cases (2) and (3) it is significantly less. Note, that the equity cost determines the value of dividends.

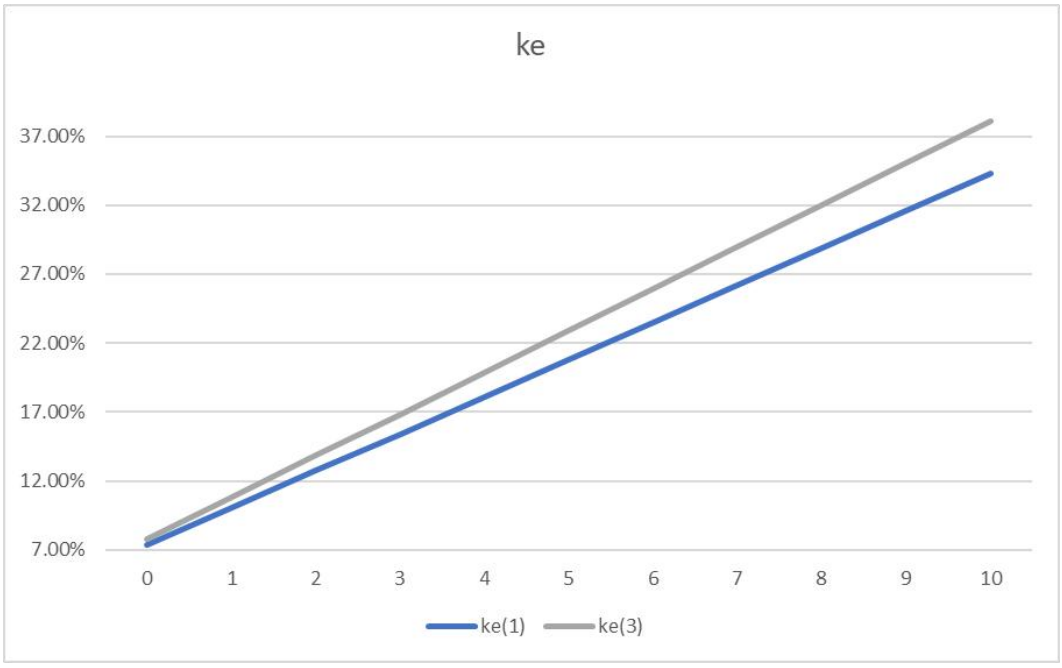

Figure 22. Dependence of cost of equity, ke, on leverage level according to the MM theory in 2020 (financial risk only (1) and plus market (3) business risk).

4.1.6. Bfo theory 2020

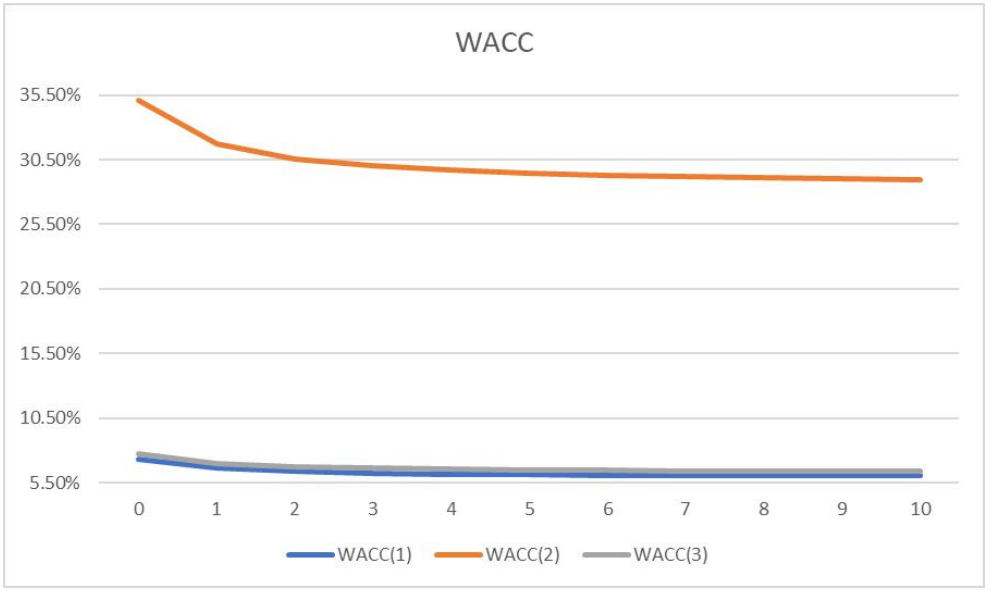

Figure 23. Dependence of WACC (weighted average cost of capital) on leverage level according to the BFO theory in 2020 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 23**, that WACC(L) decreases with leverage level L in all three cases. This means that debt financing is important and should be used by company – it leads to decrease of attracting capital cost with leverage level L. There is a large difference between the case (2) and cases (1 and 3), while the difference between cases (1 and 3) is much smaller.

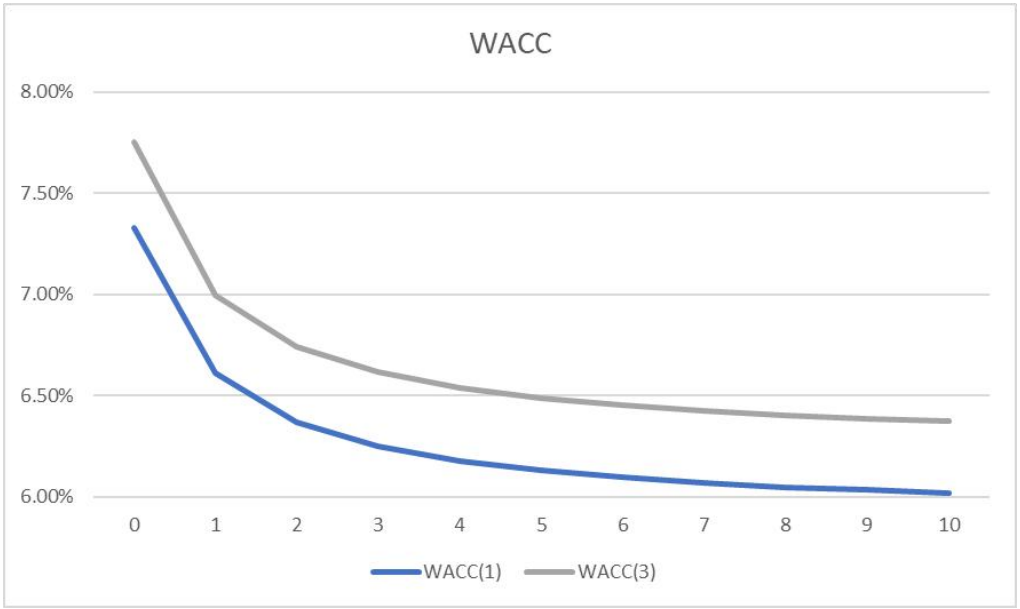

Figure 24. Dependence of WACC (weighted average cost of capital) on leverage level according to the BFO theory in 2020 (financial risk only (1) and plus market (3) business risk).

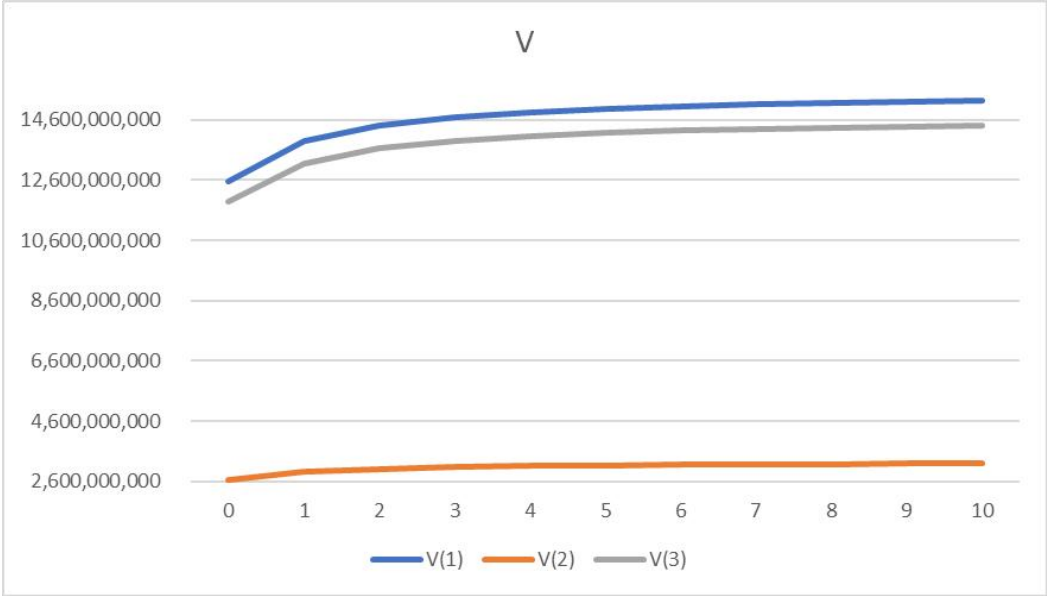

Figure 25. Dependence of company value, V, on leverage level according to the BFO theory in 2020 (financial risk only (1); plus industry (2) and plus market (3) business risk).

It is seen from **Figure 25**, that company value V(L) increases with leverage level L in all three cases. There is a large difference between the case (2) and cases (1 and 3), while the difference between cases (1 and 3) is much smaller.

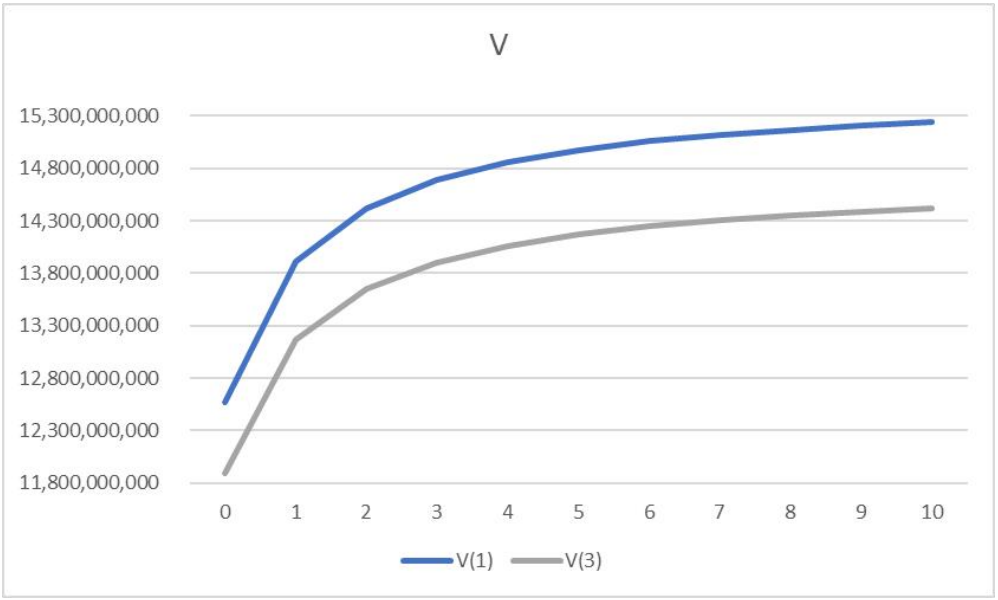

Figure 26. Dependence of company value, V, on leverage level according to the BFO theory in 2020 (financial risk only (1) and plus market (3) business risk).

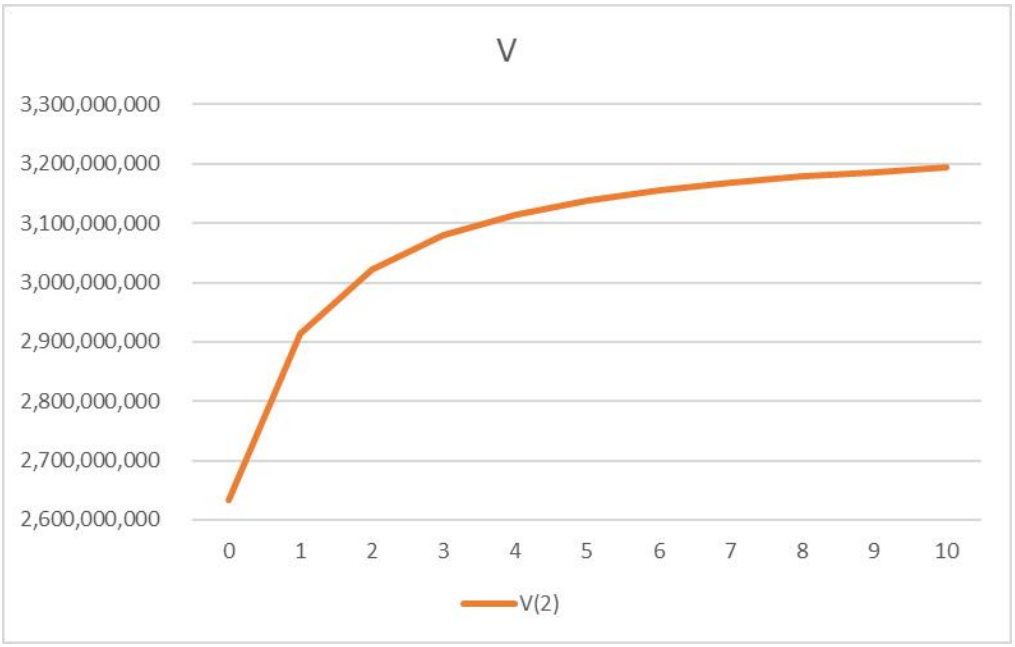

Figure 27. Dependence of company value, V, on leverage level according to the BFO theory in 2020 (financial risk plus industry (2) business risk).

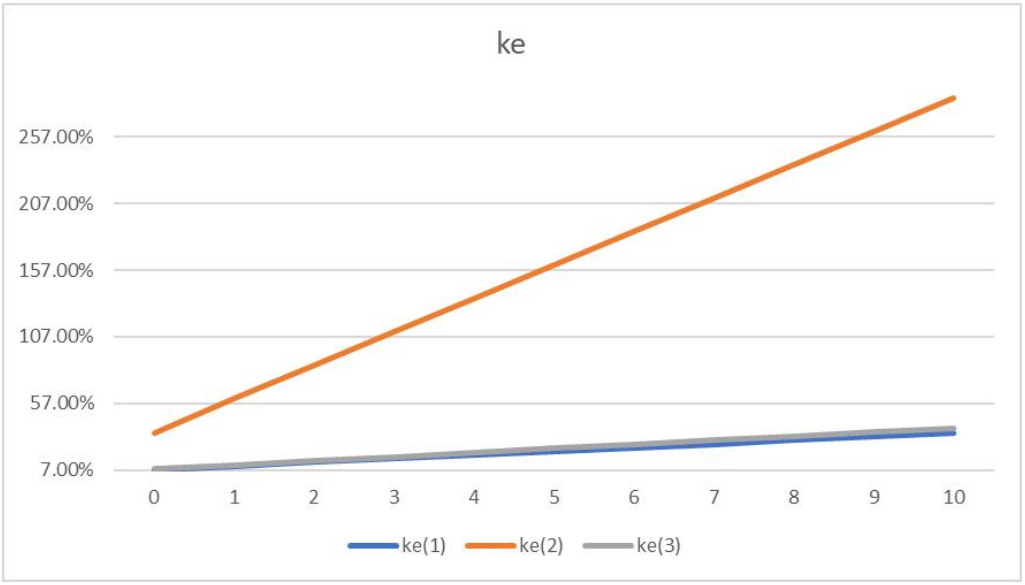

Figure 28. Dependence of cost of equity, ke, on leverage level according to the BFO theory in 2020 (financial risk only (1); plus industry (2) and plus market (3) business risk).

From **Figure 21** in is seen, that the cost of equity capital ke increases with increasing leverage level L for all three cases. The difference in inclination angles in cases (1) and (2 and 3) is significant, and for cases (2) and (3) it is significantly less Note, that the equity cost determines the value of dividends.

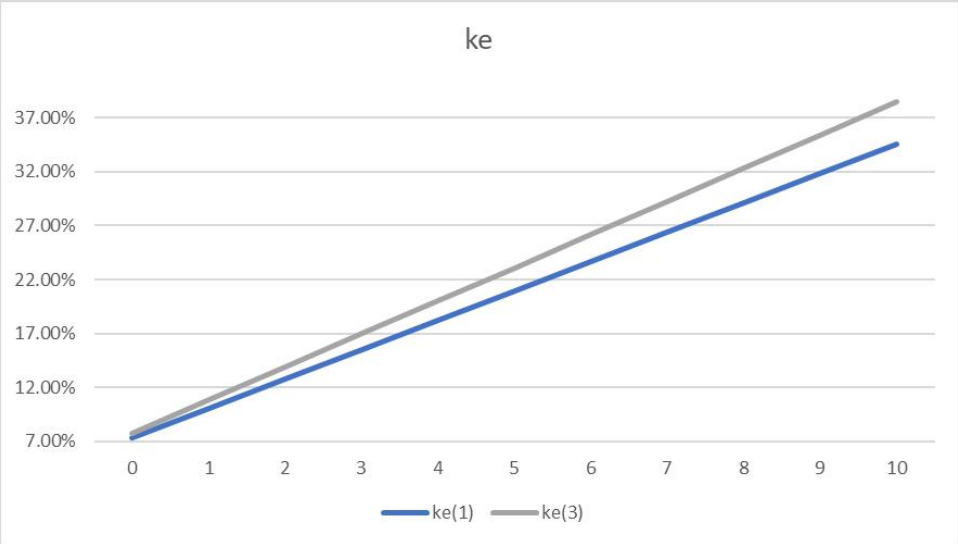

Figure 29. Dependence of cost of equity, ke, on leverage level according to the BFO theory in 2020 (financial risk only (1) and plus market (3) business risk).

5. Analyze of results

The results show that in 2018 and 2019 there is a large difference between the case of accounting for pure financial risk and accounting for financial risk plus business risk, while the difference between accounting for industry and market business risks is much smaller. However, this difference should be taken into account.

In contrast to 2018 and 2019, there is a big difference in 2020 between the case of industry business risk accounting and the other two cases, with pure financial risk and financial risk accounting plus market business risk being close to each other. This can be explained by the fact that the level of leverage in 2020 (L=2.42) is lower than in previous years (L=3.29;3.22), and this reduces financial risk.

For 2018 it is seen, that in opposite to the 2019-2020 the cost of equity capital ke increases with increasing leverage level L for case (1) and decreases for cases (2) and (3). The difference in inclination angles in cases (2 and 3) is small. This means the existence of an anomalous effect depending on cost of equity on leverage level L. Note, that the equity cost determines the value of dividends.

6. Conclusions

A fundamentally new approach to assessing the profitability of an asset is proposed. Transition from CAPM, which takes the same risk-free return for all assets as an initial assessment, to a new methodology, in which the average return of an asset, cleared of leverage, with the addition of a premium for business risk (market or industry) is taken as a seed return, significantly improves the accuracy of the estimate. As a result, generalized approaches (CAPM – BFO and CAPM – MM) were developed that take into account both types of risk: systematic (business) and financial. The application of developed approach to Norilsk Nickel company (GMKN) has been done. The results show that in 2018 and 2019 there is a large difference between the case of accounting for pure financial risk and accounting for financial risk plus business risk, while the difference between accounting for industry and market business risks is much smaller. However, this difference should be taken into account. In contrast to 2018 and 2019, there is a big difference in 2020 between the case of industry business risk accounting and the other two cases, with pure financial risk and financial risk accounting plus market business risk being close to each other. This can be explained by the fact that the level of leverage in 2020 (L=2.42) is lower than in previous years (L=3.29;3.22), and this

reduces financial risk. For 2018 it is seen, that in opposite to the 2019-2020 the cost of equity capital ke increases with increasing leverage level L for case (1) and decreases for cases (2) and (3). The difference in inclination angles in cases (2 and 3) is small. This means the existence of an anomalous effect depending on cost of equity on leverage level L. Note, that the equity cost determines the value of dividends.

We would like to mention the areas for improvement of current investigation in our future study:

1. Broader applicability of the model: extending the application of suggested model to companies in different industries and/or different countries, which might help validate its broader applicability.

2. Limitations of the model: Limitations of the model is connected with well-known limitations of CAPM and of two main theories of capital structure - Brusov–Filatova–Orekhova (BFO) theory and Modigliani–Miller (MM) theory. The authors' creation of the CAPM 2.0 model removes the limitations of the classical CAPM and expands its applicability in the real economy [28].

3. Account of additional risks: We focus on financial and business risks, while it will be interesting exploring how external factors such as environmental or geopolitical risks affect asset valuations. It might enrich the relevance of the model, particularly in today's volatile global market.

Abbreviations

CAPM: Capital Asset Pricing Model; ***MM***: the Modigliani – Miller theory; $k_i; k_I; k_m$ (μ_i; μ_I; μ_m) stand for company, industry and market returns; $\sigma_i; \sigma_I; \sigma_m$ are standard deviation for company, industry and market returns; $\beta_{iI}; \beta_{im}$ are Beta coefficients company to industry and to market; L is leverage level; k_d is the cost of debt.

Author contributions

Conceptualization, P.B. and T.F.; methodology, P.B.; software, V.K.; validation, V.K.; formal analysis, P.B. and T.F.; investigation, P.B. and T.F.; resources, V.K.; data curation, P.B.; writing—original draft preparation, P.B. and T.F.; writing—review and editing, P.B. ; visualization, T.F.; supervision, P.B.

All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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