

Can CAPM (Capital Asset Pricing Model) accurately value assets?

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ABSTRACT

A comprehensive analysis of CAPM (Capital Asset Pricing Model) was carried out. Our analysis within CAPM for several dozen listed companies from different countries, as well as numerous results of other authors, showed that the CAPM results differ significantly from the real returns of companies. The reasons for this discrepancy are discussed, which are related to the internal properties and shortcomings of the model, as well as its possible modifications that can bring the model closer to real life. Among the latter, accounting for financial risk in CAPM along with business risk, various amendments such as the Fama-French corrections, Arbitrage Pricing Theory (APT) and the incorporation of CAPM into modern capital structure theories. Accounting for financial risk in CAPM along with business risk was made by Brusov, Filatova and Kulik recently analytically (CAPM 2.0 model), in contrast to the phenomenological model of Hamada, and a large difference in these results was emphasized. In addition to the renormalization of the beta-coefficient, obtained in the Hamada model, two additional terms are found: the renormalized risk-free return and the term dependent on the cost of debt kd. Disadvantages of Hamada's model are discussed. Two versions of CAPM (market and industry) are considered and it is shown that the latter is closer to real life.

Keywords: Business and financial risks, capital structure, Modigliani–Miller (MM) theory, Brusov–Filatova–Orekhova (BFO) theory, risk and profitability, Fama–French model

INTRODUCTION

The famous Capital Asset Pricing Model (CAPM), based on the portfolio theory by Harry Markowitz, was developed independently by Jack Traynor (1961), William F. Sharp (1964), John Lintner (1965) and Jan Mossin (1966). The Capital Asset Pricing Model (CAPM) is still widely used to estimate the return on assets and investments. But as our CAPM analysis for several dozen listed companies from different countries, as well as numerous results from other authors, has shown, CAPM results differ significantly from the actual profitability of companies. The reasons for this discrepancy are discussed, related to the internal properties and shortcomings of the model. As well we discuss possible modifications of CAPM (Hamada, R. 1969, 1972; Fama E. 1965; Fama, E. and French 1992, 1993, 1995; Brusov, Filatova, Kulik 2023) that can bring the model closer to real life. Among the latter is the account of financial risk in CAPM along with business risk, which was recently correctly done by Brusov, Filatova, Kulik (2023), and the first attempt to take financial risk into account (not completely successful) was made by Hamada R. (1969, 1972). Initial Capital Asset Pricing Model (CAPM) takes into account only business risk. In practice, companies use debt financing and operate at non-zero levels of leverage. This means that it is necessary to take into account the financial risk associated with the use of debt financing along with business one. Brusov, Filatova, Kulik (2023) simultaneously take into account the business and financial risk. A new approach to CAPM has been developed that takes into account both business and financial risk. They combine the theory of

CAPM and the Modigliani–Miller (MM) theory. The first is based on portfolio analysis and accounting for business risks in relation to the market (or industry). The second one (the Modigliani–Miller (MM) theory) describes a specific company and takes into account the financial risks associated with the use of debt financing. The combination of these two different approaches makes it possible to take into account both types of risks: business and financial ones. Brusov, Filatova, Kulik (2023) combine these two approaches analytically, while Hamada (1969, 1972) did it phenomenologically. Using the Modigliani–Miller (MM) theory, it is shown that the Hamada’s model, first model, used for this purpose half a century ago, is incorrect. In addition to the renormalization of the beta-coefficient, obtained in the Hamada model, two additional terms are found: the renormalized risk-free return and the term dependent on the cost of debt k_d . A critical analysis of the Hamada model was carried out. The vast majority of listing companies use debt financing and are levered, and the Hamada model is not applicable to them in contrast to a new (Brusov, Filatova, Kulik) approach applicable to leveraged companies. Implemented a new approach to specific companies. A comparison of the results of the new approach with the results of the conventional CAPM is shown. Two versions of CAPM (market or industry) are considered (Brusov, Filatova, Kulik 2023).

One more modification of the CAPM has been done in 1992, by Y. Fama and K. French, who proved that future returns are also affected by factors such as company size and industry affiliation. They have developed three- and five- factor models (Fama, E. and French 1992, 1993, 1995).

Alternative to CAPM is the Arbitrage Pricing Theory (APT), created by Stephen Ross in 1976. In opposite to the CAPM, which has only one factor and one beta, the APT formula has multiple factors that include non-company factors, which requires the asset's beta with respect to each separate factor. The APT does not explain what these factors are, and APT model users should analytically determine factors that might affect the asset's returns. The factor used in the CAPM is the difference between the market rate of return and the risk-free rate of return.

The CAPM is a single-factor model and is easier to use, which is why investors prefer to use it to estimate the expected rate of return rather than using the APT, which requires users to estimate multiple factors.

DERIVATION OF THE CAPM FORMULA

To derive the CAPM formula, we create a portfolio of asset i and the market portfolio M ; $(\alpha, 1 - \alpha)$, with the price share of the security in the portfolio $\alpha \in [0,1]$ (Sigman Karl 2005). The rate of return is thus $\mu(\alpha) = \alpha\mu_i + (1 - \alpha)\mu_M$. Asset i is assumed not efficient; it's point lies in the feasible region but not on the efficient frontier. Thus as α varies this portfolio's point traces out a smooth curve in the feasible (σ, μ) region $\alpha \rightarrow (\sigma(\alpha), \mu(\alpha))$ parametrized by α , where

$$\mu(\alpha) = \alpha\mu_i + (1 - \alpha)\mu_M = \alpha(\mu_i - \mu_M) + \mu_M \quad (1)$$

Using well known formula for portfolio dispersion

$$\sigma^2(\alpha) = \alpha^2\sigma_i^2 + (1 - \alpha)^2\sigma_M^2 + 2\alpha(1 - \alpha)\sigma_{M,i}, \quad (2)$$

one gets

$$\begin{aligned} \sigma(\alpha) &= \sqrt{\alpha^2\sigma_i^2 + (1 - \alpha)^2\sigma_M^2 + 2\alpha(1 - \alpha)\sigma_{M,i}} = \\ &= \sqrt{\alpha^2(\sigma_i^2 + \sigma_M^2 - 2\sigma_{M,i}) + \sigma_M^2 + 2\alpha(\sigma_{M,i} - \sigma_M^2)} \end{aligned} \quad (3)$$

When $\alpha = 0$ $(\sigma(0), \mu(0)) = (\sigma_M, \mu_M)$ and when $\alpha = 1$ $(\sigma(1), \mu(1)) = (\sigma_i, \mu_i)$. Thus the curve touches the capital market line at the market point (σ_M, μ_M) , but otherwise remains off the capital market line but (of course) within the feasible region where it also hits the point (σ_i, μ_i) . We conclude that the curve is tangent to the capital asset line at point (σ_M, μ_M) and therefore when $\alpha = 0$ the curve's derivative

$$\frac{d\mu(\alpha)}{d\sigma(\alpha)}_{\alpha=0} \quad (4)$$

is identical to the slope of the capital asset line at point M. The slope (the price of risk) of the line is given by (2). We thus conclude that when $\alpha = 0$

$$\frac{d\mu(\alpha)}{d\sigma(\alpha)} = \frac{\mu_M - \mu_f}{\sigma_M}. \quad (5)$$

The composition rule from calculus yields

$$\frac{d\mu(\alpha)}{d\sigma(\alpha)} = \frac{d\mu(\alpha)/d\alpha}{d\sigma(\alpha)/d\alpha}. \quad (6)$$

Differentiating (1) and (3) and evaluating at $\alpha = 0$ yields

$$\frac{d\mu(\alpha)}{d\sigma(\alpha)} = \frac{\mu_i - \mu_M}{(\sigma_{M,i} - \sigma_M^2)/\sigma_M} \quad (7)$$

From (5) we deduce that

$$\frac{\mu_i - \mu_M}{(\sigma_{M,i} - \sigma_M^2)/\sigma_M} = \frac{\mu_M - \mu_f}{\sigma_M} \quad (6)$$

Solving this equation for μ_i , we obtain the CAPM formula for the asset I (CAPM formula for single asset i)

$$\mu_i - \mu_f = \beta_i \cdot (\mu_M - \mu_f), \quad (7)$$

as was to be shown. For the more general portfolio result, observe that

$$\mu_p - \mu_f = -\mu_f + \sum_{i=1}^n \alpha_i \mu_i = \sum_{i=1}^n \alpha_i (\mu_i - \mu_f) = \sum_{i=1}^n \alpha_i \beta_i (\mu_M - \mu_f) = (\mu_M - \mu_f) \sum_{i=1}^n \alpha_i \beta_i \quad (8)$$

Note that when $\beta_p = 1$ then $\mu_p = \mu_M$; the expected rate of return is the same as for the market portfolio. When $\beta_p > 1$, then $\mu_p > \mu_M$; when $\beta_p < 1$, then $\mu_p < \mu_M$.

In case of negatively correlated asset i with M, $\sigma_{M,i} < 0$, then $\beta_i < 0$ and $\mu_i < \mu_f$; the expected rate of return is less than the risk-free rate. Effectively, such a negatively correlated asset serves as insurance against a drop in the market returns, and might be viewed by some investors as having enough such advantages so as to make it worth the low return. Such an example could be investing in gold.

CAPM (CAPITAL ASSET PRICING MODEL) PROPERTIES

CAPM is a simple, but widely used, one-factor model that describes the relationship between the expected return on assets (stocks, investments, etc.) and the risk-free rate, taking into account systematic (business) risk. This relationship is described by the equity risk premium, which depends on the asset's beta (which describes the asset's correlation or sensitivity to the market), the risk-free rate (say, the Treasury bill rate or the central bank's key rate), and the expected return in the market. CAPM assumes an idealized open market structure where all risky assets refer to all tradable shares available to everyone. In addition, we have a risk-free asset (for borrowing and/or lending in unlimited quantities) with an interest rate of k_f . One assumes that all information is available to everyone, such as covariances, variances, average stock returns and so on. It is also assumed that the investor is a rational, risk-averse, who uses the same Markowitz portfolio theory.

The Assumptions are Made Within the CAPM Model

The following assumptions are made within the CAPM model:

- 1) All investors are risk averse and have the same time frame to evaluate information.
- 2) Unlimited capital exists to borrow at the risk-free rate.
- 3) Investments can be divided into unlimited parts and sizes.
- 4) Taxes, inflation and transaction costs are absent.
- 5) Return and risk are linearly related.

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

$$k_i = k_f + \beta_i(k_m - k_f). \tag{9}$$

(Note, that here and below we will denote assets profitability as k (like cost of equity) instead of r .)

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

$$\beta_i = \frac{\text{COV}_{im}}{\sigma_m^2} = \rho_{im} \frac{\sigma_i}{\sigma_m}. \tag{10}$$

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 $k_m > k_f$.

The beta-coefficient of a security, β , has the meaning of the amount of riskiness of this security. It follows from formula (9) that:

- 1) if $\beta=1$ the yield of the security is equal to the yield of the average market portfolio ($k_i = k_f$);
- 2) if $\beta > 1$, the security is more risky than the average on the security market ($k_i > k_f$);
- 3) if $\beta < 1$, the security is less risky than the average on the security market ($k_i < k_f$).

Securities betas are calculated using statistical data on returns on specific securities and the average market returns on securities traded on the market.

Disadvantages of the CAPM model

CAPM has some well-known disadvantages.

1. The CAPM formula only works under assumption that the market is dominated by purely rational players who make decisions that favor only investment returns. This, of course, is not always true.
2. CAPM assumes that each market participant acts on the basis of the same information. In reality, relevant information is distributed unevenly among the public, so some participants may make decisions based on information that others do not.
3. Using beta as the main part of the formula. But beta takes into account only changes in the stock price in the market. However the share price can change for reasons other than the market. Stocks can rise or fall in value for deliberate reasons, not just volatility.
4. CAPM only uses historical data. But historical stock price changes are not enough to determine the overall risk of an investment. Other factors should be considered, such as economic conditions, industry peculiarities and competitor characteristics, and internal and external activities of the company itself.

So, the model has a number of limitations: the model does not take into account taxes, transaction costs, non-transparency of the financial market, etc.

Finally, to predict future returns, a retrospective level of market risk is used, which leads to a forecast error.

MODIFICATIONS OF THE CAPITAL ASSET PRICING MODEL (CAPM)

The CAPM approach is still evolving and we will describe some of the directions of this development below.

The Distribution Function: The Symmetric CAPM

One of the remaining internal problems of CAPM is the distribution function. The Capital Asset Pricing Model (CAPM) assumes a Gaussian or Normal distribution. In practice, this assumption may be violated. In paper (Leal D. et al. 2023) a symmetric CAPM is proposed, assuming distributions with lighter or heavier tails than the normal distribution. Elliptic distributions (normal, exponential and Student-t) are considered. This consideration is of a general nature. Authors conducted a detailed case study to apply the obtained results estimating the systematic risk of the financial assets of a Chilean company with real data. A Chilean company is just illustration of obtained results. In addition, Leal D. et al. (2023) study the methods of leverage and local impact for diagnostics in a symmetric CAPM. It is concluded that the considered models give better results than the CAPM with Gaussian distribution.

In (Zhou, G. 1993; Lange, K. et al. L. 1989 and Chen, J.; Wu, Y.; Xu, Y. 2021) an empirical studies were carried out under the assumption that stock returns have distributions with heavier tails than the normal distribution. The Student-t distribution instead of the normal distribution was considered in (Lange, K. et al. L. 1989) and in (Blattberg, R.C.; Gonedes, N.J. 1974), taking into account the maximum likelihood method for estimating its parameters. Paper (Chen, J.; Wu, Y.; Xu, Y. 2021) concluded that asset valuation should be carried out within the framework of the CAPM and the discounted dividend model.

The Multiple Factors Models

The CAPM operates on only one factor that affects the future performance of a stock.

There are several models with multiple factors that modify the CAPM in this regard. Among them are Fama-French (three- and five-factor models) and APT (Arbitrage Pricing Theory) models.

Fama-French model

In 1992, Y. Fama and K. French (Fama and French, 1992) proved that future returns are also affected by factors such as company size and industry affiliation. They have developed three- and five- factor models.

Fama-French Three-factor Model

Fama-French three-factor model takes into account two additional risk factors, namely, size and book to market equity along with market beta

$$k_e = k_f + \beta_U(k_m - k_f) + s \cdot SMB + h \cdot HML \quad (11)$$

were *SMB* – the difference between the returns of companies with large and small capitalization;
HML – the difference between the returns of companies with low and high intrinsic value (*indicator B/P*).

Fama-French Five-factor Model

The equation of Fama-French five-factor model (Fama and French, 1993, 1995) in addition to the difference between the returns of companies with large and small capitalization (*SMB*) and the difference between the returns of companies with low and high intrinsic value (*indicator B/P*)(*HML*) accounts return on equity and company capital expenditure and has a view

$$k_e = k_f + \beta_U(k_m - k_f) + s \cdot SMB + h \cdot HML + r \cdot RMW + c \cdot CMA, \quad (12)$$

where *RMW* – return on equity; *CMA* – company capital expenditure.

Arbitrage Pricing Theory (APT)

In the Arbitrage Pricing Theory (APT model), the return on an asset can be expressed by the following formula:

$$r_i = a_i + \beta_{i1}F_1 + \beta_{i2}F_2 + \dots + \beta_{in}F_n + \varepsilon_i, \tag{13}$$

where a_i is a constant per asset; F_i is a systematic factor, such as a macroeconomic or company-specific factor; β_i is the sensitivity of the asset in relation to the factor F_i ; and ε_i is a random variable with an expected mean of zero.

APT formula has the form:

$$E(r_i) = r_f + \beta_{i1}\hat{F}_1 + \beta_{i2}\hat{F}_2 + \dots + \beta_{in}\hat{F}_n, \tag{14}$$

where r_f is the risk-free rate of return, β_{ik} is the sensitivity of the asset i with respect to factor k , \hat{F}_k is the risk premium for factor k .

In opposite to the CAPM, which has only one factor and one beta, the APT formula has multiple factors that include non-company factors, which requires the asset's beta with respect to each separate factor. The APT does not explain what these factors are, and APT model users should analytically determine factors that might affect the asset's returns. The factor used in the CAPM is the difference between the market rate of return and the risk-free rate of return.

The CAPM is a one-factor model and is simpler to use, thus investors prefer use it to estimate the expected rate of return rather than using APT, which requires users evaluate the multiple factors.

Below we describe a couple more modifications of CAPM, which account the business and financial risks.

ACCOUNT OF BUSINESS AND FINANCIAL RISKS

Two models - Hamada model, by R. Hamada (1961) and CAPM 2.0 model, by Brusov–Filatova–Kulik (2023) account the business and financial risks. The first author did this phenomenologically, and the second authors - analytically. Below we describe both these theories in details and compare their results, showing that Hamada results are incorrect.

Hamada Model

The Modigliani–Miller theory with taxes (Modigliani and Miller, 1963) has been united with CAPM (Capital asset pricing model) in 1961 by R. Hamada. For the cost of equity of a leveraged company, the below formula has been derived.

$$k_e = k_f + \beta_U(k_m - k_f) + \beta_U(k_m - k_f)\frac{D}{S}(1-t) \tag{15}$$

The first term represents risk-free profitability k_f , the second term is business risk premium, $\beta_U(k_m - k_f)$, and the third term is financial risk premium $\beta_U(k_m - k_f)\frac{D}{S}(1-t)$.

In the case of an unlevered company ($D = 0$), the financial risk (the third term) is zero, and its shareholders receive only a business risk premium.

Hamada used an empirical approach in incorporating the level of leverage into the CAPM. One of the main objectives in his research was to distinguish companies without leverage from companies with leverage. The latter make up almost the majority of real companies. In 1972, he surveyed 304 companies, among which he found 102 non-leveraged and 202 leveraged (Hamada 1972). Comparing equity returns of two types of companies, he got his formula for the β_U -factor, which takes into account the level of leverage.

The incorrectness of the Hamada approximation will be shown below in the framework of the new approach **CAPM 2.0**, which has been developed by by Brusov–Filatova–Kulik (2023), which account both business and financial risk.

CAPITAL ASSET PRICING MODEL 2.0 (CAPM 2.0)

In this section, we describe a new approach that describes both business and financial risk. We call this approach CAPM 2.0. (Brusov–Filatova–Kulik 2023), as opposed to conventional CAPM, which accounts only business risk.

Derivation of the Main Formula CAPM 2.0

Let's combine CAPM (Capital asset pricing model) and the Modigliani–Miller theory (Modigliani and Miller 1963) not phenomenologically, like Hamada (1969, 1972), but analytically.

Substituting the CAPM formula

$$k_0 = k_f + \beta_U(k_m - k_f) \tag{16}$$

into Modigliani–Miller formula for equity cost

$$k_e = k_0 + L(k_0 - k_d)(1-t), \tag{17}$$

one gets the following result

$$\begin{aligned} k_e &= k_0 + L(k_0 - k_d)(1-t) = \\ &= k_f + \beta_U(k_m - k_f) + L(k_f + \beta_U(k_m - k_f) - k_d)(1-t) = \\ &= k_f(1 + L(1-t)) + \beta_U(k_m - k_f)(1 + L(1-t)) - Lk_d(1-t) \end{aligned} \tag{18}$$

The second term is the same as in Hamada's formula (15), but the first term is renormalized value of risk free profitability and the last term, which depends on the cost of debt k_d , is missing from Hamada's formula (15).

So the difference with Hamada's formula is:

while in Hamada's formula only beta coefficient is renormalized, in formula (18) the first term (risk–free return) is also renormalized by the same factor $(1 + L(1-t))$ and the last term, depending on the cost of debt k_d , appears, which is absent in Hamada's formula.

Factor $(1-t)$ (tax corrector) exists due to the tax shield.

The incorrectness of Hamada's approximation becomes obvious.

We could rewrite expression (8) as a sum of two parts, one of which is the Hamada expression, and the second is an additional term that we received

$$\begin{aligned} k_e &= k_f + \beta_U(k_m - k_f)(1 + L(1-t)) + k_f L(1-t) - Lk_d(1-t) = \\ &= k_f + \beta \cdot (k_m - k_f) + L(1-t)(k_f - k_d) = k_{e,CAPM} + \Delta \end{aligned} \tag{19}$$

Here

$$\Delta = L(1-t)(k_f - k_d). \tag{20}$$

This formula takes into account both business and financial risk and is the main result of the work. Below in section 4 we will apply developed by us approach to several companies, calculate their profitability using formula (9) and compare the results with conventional CAPM that take into account only business risks (with some notes).

From the formula (20) it follows, that the value added to the company's return (Δ) with respect to results of conventional CAPM does not depend on the industry (see below) or market version of CAPM and turns out to be the same for both cases.

INDUSTRY APPROACH

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

$$k_i = k_f + \beta_i(k_I - k_f). \tag{21}$$

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

$$\beta_i = \frac{\text{COV}_{il}}{\sigma_i^2} = \rho_{il} \frac{\sigma_i}{\sigma_I} \quad (22)$$

Here σ_i is the risk of i -th asset, σ_I is industry risk (standard deviation of industry index), COV_{il} 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.

METHODOLOGY AND FEATURES OF THE APPLICATION OF THE NEW APPROACH (CAPM 2.0)

It is clear that the vast majority of companies are leveraged ones because they use debt financing. The use of debt financing is determined by several factors.

1. All listing companies are quite large and participate in expanded reproduction, which requires the attraction of borrowed capital.
2. The use of debt financing allows you to take advantage from the tax shield: reduce the cost of capital raised and increase the company value.

This means that the standard CAPM formula takes into account business risk and part of the financial risk accounted for by the leveraged beta coefficient in the form of Hamada. This reduces the importance of Hamada's formula, since the covariance found from the statistical reporting and Beta-coefficient already contains the level of leverage and does not need to be renormalized. While the additional term(s) found by us must be taken into account in order to correctly determine the premium for financial risk.

If we consider the almost never occurring case of a non-leveraged company, then we need to apply the standard CAPM formula with a non-leveraged beta. However, if we want to make a forecast for assessing the profitability of the company, taking into account the future level of leverage, it is necessary to take into account all three of the above additives related to taking into account debt financing.

APPLICATION OF CAPM 2.0 APPROACH TO

The application of the new approach is carried out through the following steps:

– **At the first stage**, it is necessary to collect and process statistical data at three levels: company, industry and market. We need the following parameters:

- 1) For company $k_i; L; k_d; \sigma_i; \beta_{il}; \beta_{im};$
- 2) For industry $k_I; L; k_d; \sigma_I; \beta_{il};$
- 3) Market $k_m; \sigma_m; \beta_{im}$

Here $k_i; k_I; k_m$ stand for company, industry and market returns;

$\sigma_i; \sigma_I; \sigma_m$ are standard deviation for company, industry and market returns;

$\beta_{il}; \beta_{im}$ are beta coefficient company to industry and to market;

L is leverage level; k_d is the cost of debt.

It is also necessary to use methods for their processing, since we will operate with average annual values, and the data on the sites usually give daily quotes.

– **At the second stage** we evaluate the company's profitability within the traditional CAPM.

– **At the third stage** one needs to use formulas (19) and (20) to estimate the company return under taking into account both business and financial risk.

– **At the fourth stage**, the company's profitability is compared on the traditional CAPM approach and on the new CAPM 2.0 approach.

Application of the New CAPM 2.0 Approach to Walt Disney Company

Below we provide an example of applying the new CAPM 2.0 approach to the Walt Disney Company and comparing it with the results of the classic CAPM.

Estimation of the return of Walt Disney Company: DIS for the period 2018–2022 by CAPM

Summary of indicators for Walt Disney Company: DIS shares, industry an market indexes in the period 2018–2022 could be found in Table 1.

Table 1. Summary table of indicators for Walt Disney Company: DIS shares, industry (SPLRCD) and market (S&P500) indexes in the period 2018–2022

Level	Index	2018	2019	2020	2021	2022
Company	k_i	1.99%	31.90%	25.27%	-14.51%	-43.91%
	σ_i (ΠΟ μ)	0.041	0.088	0.132	0.069	0.108
	L_i	0.43	0.53	0.70	0.61	0.51
	k_d	3.27%	2.65%	2.81%	2.84%	3.20%
	β_{im}	0.57	0.93	1.54	1.23	1.18
Industry (SPLRCD)	k_I	-0.49%	26.20%	32.07%	23.66%	-37.58%
	σ_I (ΠΟ μ)	0.057	0.046	0.090	0.041	0.089
	L_I	0.20	0.20	0.15	0.15	0.33
	β_{iI}	0.355	0.695	1.081	0.049	0.816
	k_i	1.78%	18.94%	34.55%	2.96%	-29.94%
Market (S&P500)	k_m	-6.24%	28.88%	16.26%	26.89%	-19.44%
	σ_m	0.044	0.037	0.075	0.032	0.066
	β_{im}	0.57	0.93	1.54	1.23	1.18
	k_F	3.020%	2.389%	1.646%	1.905%	3.975%
	k_i	-2.28%	27.13%	24.14%	32.61%	-23.64%
	k_i , Company	1.99%	31.90%	25.27%	-14.51%	-43.91%
	k_i , Industry	1.78%	18.94%	34.55%	2.96%	-29.94%
	k_i , Market	-2.28%	27.13%	24.14%	32.61%	-23.64%

Table 2. Comparison of Walt Disney Company: DIS shares profitability estimates for the period 2018–2022 on CAPM and on the new CAPM 2.0 approach

Year	2018	2019	2020	2021	2022
k_F	3.02 %	2.39 %	1.646%	1.91 %	3.98 %
Δ	-0.08%	-0.11 %	-0.64%	-0.45%	0.31%
k_i , Company	1.99%	31.90%	25.27%	-14.51%	-43.91%
k_i , Industry	1.78%	18.94%	34.55%	2.96%	-29.94%
k_i , Market	-2.28%	27.13%	24.14%	32.61%	-23.64%
k_i CAPM (Industry)	1.70%	18.83%	33.91%	2.51%	-29.63%
New CAPM 2.0 approach					
k_i CAPM (market)	-2.36%	27.02%	23.50%	32.16%	-23.33%
New CAPM 2.0 approach					

From Tables 1–2 and from results for other dozens companies we come to the following conclusions:

1. When k_d exceeds k_f , the financial risk premium becomes negative.
2. As well for companies from the extractive industries, such as Rosneft etc, whose leverage level, due to the specifics of the industry is quite high, the premium for financial risk is high as well.
3. At the same time, companies with a typical level of leverage from 0.5 to 1 (1.5) have a low financial risk premium compared to a business risk. This is well seen for Walt Disney Company (L is of order 0.5) and for Pfizer INC. (L is of order 1–1.5).

CONCLUSIONS

A comprehensive analysis of CAPM (Capital Asset Pricing Model) was carried out. Our analysis within CAPM for several dozen listed companies from different countries, as well as numerous results of other authors, showed that the CAPM results differ significantly from the real returns of companies. The reasons for this discrepancy have been discussed, which are related to the internal properties and shortcomings of the model, as well as its possible modifications that can bring the model closer to real life. Among the latter, accounting for financial risk in CAPM along with business risk, various amendments such as the Fama–French corrections, Arbitrage Pricing Theory (APT) and the incorporation of CAPM into modern capital structure theories. Two versions of CAPM (market and industry) are considered and it is shown that the latter is closer to real life. Accounting for financial risk in CAPM along with business risk was made by Brusov, Filatova and Kulik recently analytically (CAPM 2.0 model), in contrast to the phenomenological model of Hamada, and a large difference in these results was emphasized. In addition to the renormalization of the beta-coefficient, obtained in the Hamada model, two additional terms are found: the renormalized risk-free return and the term dependent on the cost of debt k_d . Disadvantages of Hamada's model have been discussed. From Tables 1–2 and from results for other dozens companies we come to the following conclusions:

1. When k_d exceeds k_f , the financial risk premium becomes negative.
2. As well for companies from the extractive industries, such as Rosneft etc, whose leverage level, due to the specifics of the industry is quite high, the premium for financial risk is high as well.
3. At the same time, companies with a typical level of leverage from 0.5 to 1 (1.5) have a low financial risk premium compared to a business risk. This is well seen for Walt Disney Company (L is of order 0.5) and for Pfizer INC. (L is of order 1–1.5).

It has been shown, that the value added to the company's return () within CAPM 2.0 model with respect to results of conventional CAPM does not depend on the industry or market version of CAPM and turns out to be the same for both cases. The results obtained show that accounting for financial risk properly significantly affects the assessment of the return on assets. The proposed approach allows making forecasts on the company's profitability without using the theory of capital structure. Estimated financial risk premiums depend on the level of leverage (capital structure) and the cost of borrowings. By planning the values of these parameters, the manager can predict the profitability of the company in the future. The novelty of the CAPM 2.0 model lies in the development of a new approach that generalizes CAPM to account for both business and financial risks.

One of the directions of future investigation is the incorporation of CAPM into modern capital structure theories: Brusov–Filatova–Orekhova theory and the Modigliani–Miller (MM) theory.

Abbreviations

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

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