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Cost of Equity and Dividend Policy

P.N. Brusov[a], T.V. Filatova[b], V.L. Kulik[c]
[a, b] Financial University under the Government of the Russian Federation, Moscow, Russian Federation;
[c] T-Bank Ltd., Moscow, Russian Federation

ABSTRACT

The economically justified amount of dividends is equal to the equity cost, assuming that investors use a dividend discounting model. The evaluation of the latter is an extremely difficult task. It is possible to do this within modern capital structure theory — Brusov-Filatova-Orekhova (BFO) — or within its perpetual limit — the Modigliani-Miller (MM) theory. After the recent generalization of both theories, taking into account the real conditions of the functioning of the companies, it becomes possible to estimate the cost of equity in these conditions. Dependence of the cost of equity on the level of leverage for different ages of the company, different values of k_0 (cost of equity at zero leverage level L) and debt costs, different frequencies of income tax payment, advance payments of income tax and payments at the end of periods, variable income of companies, etc. are being studied. Several very important innovative effects have been discovered, which significantly change the company's dividend policy. The developed methodology and results will help the company's management to develop an adequate and effective dividend policy. As well, the approach to dividend theory described here can be applied to business valuation and company value.

Keywords: dividend policy; equity cost; Brusov-Filatova-Orekhova theory; variable income; frequent payments of tax on income; WACC; Modigliani-Miller theory

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INTRODUCTION

As is well known, valuation of equity cost, which determines the amount of dividends, is an extremely complex task. It is possible to do this within one of the two main capital structure theories: either the Modigliani-Miller (MM) theory or the Brusov-Filatova-Orekhova (BFO) one. The first one is valid for perpetual companies only, while the second describes the companies of arbitrary ages. Until recently, both of these theories did not take into account some real conditions for the functioning of companies, such as the variable income of companies, the frequent payments of income tax, types of income tax payments (advance payments and payments at the end of reporting periods), etc. This was some gap in the study of the problem of the cost of equity. The challenge was to adapt both theories to these conditions and use the generalized Brusov-Filatova-Orekhova (BFO) and Modigliani-Miller (MM) theories in studying the problem of the cost of equity.

The correct dividend policy of the company, based on the correct assessment of the cost of equity, has both macroeconomic and microeconomic aspects.

From a macroeconomic point of view, it plays an important role in ensuring economic growth and economic efficiency, as well as the position in the financial and investment markets. At the macroeconomic level as well, an adequate dividend policy leads to increased investment and economic growth.

From a microeconomic point of view, the importance of a correct assessment of the cost of equity and the establishment of an adequate dividend policy of the company is determined by the following.

The rights of shareholders to receive adequate profit may be violated if the management of the company pursues an incorrect and inefficient dividend policy, due to the inability of management to correctly determine the amount of dividends (the economically justified amount of which is the cost of equity), or with a deliberate violation of the rights of shareholders in this sphere.

After the recent generalization of both theories, taking into account the real conditions of the functioning of the companies, it becomes possible to estimate the cost of equity in these conditions. Dependence of the cost of equity on the level of leverage for different ages of the company, different values of equity and debt costs, different frequencies of income tax payment, advance payments of income tax and payments at the end of periods, variable income of companies, etc. are being studied. The behavior and properties of the cost of equity are explored within the framework of the BFO theory. Several very important innovative effects have been discovered, which significantly change the company's dividend policy. Among them are the abnormal dependence of equity cost on leverage level at different growth rates of variable income, at different ages of the company, at different frequencies of income tax payment, at different debt costs etc. The developed methodology and results will help the company's management to develop an adequate and effective dividend policy.

A comprehensive analysis was carried out of one of the most striking and significant phenomena in corporate finance in general and in the capital structure in particular — the anomalous dependence of the cost of equity on the leverage level, L. The first qualitative theory of the capital structure — Modigliani-Miller theory [1–3] had numerous limitations, the main ones being its perpetual nature and the absence of taxes: corporate and individual. Many scientists have tried to modify the Modigliani-Miller theory in different aspects [4–16].

In 2008 the main limitation of the Modigliani-Miller theory — the eternity of companies — was removed by Brusov et al. [16], and modern theories of the cost of capital and capital structure — Brusov-Filatova-Orekhova theory (BFO-theory) were created for companies of arbitrary age (BFO-1 theory) and for companies of arbitrary lifetime (BFO-2 theory) [17–20]. The well-known theory of the cost of capital and capital structure of Nobel laureates Modigliani and Miller has been replaced by Brusov-Filatova-Orekhova (BFO) theory. The authors departed from the Modigliani-Miller assumption about the eternity (infinity of life) of companies and developed a quantitative theory for estimating the main parameters of the financial activity of companies of arbitrary age. The results of the modern BFO theory turn out to be quite different from the results of the Modigliani-Miller theory. They show that the latter, due to its perpetuity, underestimates the cost of raising capital (WACC and equity) and significantly overestimates the company value. Such an incorrect assessment of key performance indicators of companies' financial activities led to an underestimation of the associated risks and the impossibility or serious difficulties in making adequate management decisions, which was one of the latent causes of the 2008 global financial crisis, which began with the crisis in the MBS (mortgage-backed securities) market.

In the Modigliani-Miller theory, there is no time factor (time is equal to infinity), which does not allow us to investigate the dependence of the company's financial performance on the time factor. But the theories of Brusov-Filatova-Orekhova (BFO-theories) are created for companies of arbitrary age and allow studying the dependence of a company's financial performance on the time factor.

Over the past couple of years, two main theories of the capital structure — Brusov-Filatova-Orekhova and Modigliani-Miller — have been adapted to the established financial practice of the functioning of companies, taking into account the real conditions of their work (see [19] and references there). This made it possible to investigate the impact of frequent income tax payments p with advance income tax payments and payments at the end of reporting periods, as well as the impact of the company's variable income on its main financial results. In paper [19], an analysis of all existing theories of the capital structure (with their advantages and disadvantages) was carried out in order to understand all aspects of the problem and make the right management decisions in practice. The role of the capital structure lies in the fact that the correct determination of the optimal capital structure allows the company's management to maximize the capitalization of the company and fulfill the long–term goal of the functioning of any company. In paper [19], the state of the theory of the structure of capital and the cost of capital is considered from the middle of the last century, when the first quantitative theory was created, to the present. The two main theories of Modigliani-Miller (MM) and Brusov-Filatova-Orekhova (BFO) are discussed and analyzed, as well as their numerous modifications and generalizations. The Brusov-Filatova-Orekhova (BFO) theory, its methodology, and results are widely known [19–31]. Many authors (see, for example, [26–28]) use the BFO theory in practice.

In addition to the approach of Modigliani and Miller, there are alternative approaches: Harris and Pringle [32], Miles and Ezzell [33].

Below we discuss them.

The following notation will be used in the text below.

k_d, $w_d = \dfrac{D}{D+S}$ — the debt capital cost and debt capital share, $k_e, w_e = \dfrac{S}{D+S}$ — the equity capital cost and the equity capital share, and $L = D/S$ — the value of financial leverage, D — the debt capital value, S — the equity capital value, k_0 — the equity capital cost at zero leverage level, g — income growth rate, p — frequency of tax on income payments, $WACC$ — the weighted average cost of capital, t — tax on profit, n — company age.

Alternate WACC Formula

An alternate formula for the *WACC* has been suggested [8, 33–35]. It has the form below

$$WACC = k_0\left(1 - w_d t\right) - k_d t w_d + k_{TS} t w_d . \quad (1)$$

Here, k_0, k_d, and k_{TS} are the returns on the financially independent company, the debt, and the tax shield, respectively, t is the corporate tax rate, and w_d is the debt share.

Although Equation (1) is quite general, additional conditions are needed for practical applicability. When the *WACC* remains constant over time, the value of a leveraged company can be found by discounting the unleveraged free cash flows using the *WACC*. In this case, specific formulas can be found in textbook [11].

In the Modigliani-Miller theory [1–3], the debt value D is constant. V_0 is also constant, as the expected after-tax cash-flow of the financially independent company is fixed. By assumption, $k_{TS} = k_d$ and the tax shield value is $TS = tD$. Therefore, the company value V is a constant and the alternate *WACC* formula (1) simplifies the MM formula:

$$WACC = k_0\left(1 - w_d t\right). \quad (2)$$

The "classical" MM theory, suggesting that the returns on the debt k_d and the tax shield k_{TS} are equals (both these values have debt nature), is much more reasonable, so this is why we modify the "classical" MM theory, namely.

The Miles-Ezzell Model Versus the Modigliani-Miller Theory

Becker (2021) [12] discussed the differences between the Modigliani-Miller theory [1–3] and the Miles-Ezzell model [32], which deal with the stochasticity of free cash flows. The Modigliani-Miller theory considers a stationary process, while in the Miles-Ezzell model the process is stochastic. The author conducts a numerical experiment that allows you to determine the values and discount rates using a risk-neutral approach. He analyzes three formulas:

Modigliani-Miller theory [1–3]:

$$WACC = k_0\left(1 - w_d t\right); \quad (3)$$

Miles-Ezzell model [33]:

$$WACC = k_0 - w_d t k_f \frac{1 + k_0}{1 + k_f}; \quad (4)$$

Cooper and Nyborg (2006) [36]:

$$WACC = k_0 - w_d k_f t, \quad (5)$$

where k_f stands for the risk-free rate, which equals the required return of the debt holders.

The author shows that in the Miles-Ezzell model, all cash flows and the values depend on the path, in contrast to the Modigliani-Miller theory. Additionally, in the Miles-Ezzell model, all discount rates are time independent, with the exception of the discount rate used to discount tax shields, which depends on the duration of the cash flows. Conversely, in the Modigliani-Miller theory, all discount rates change over time except for the constant tax shield discount rate. This affects the applicability of the well-known formula for annuities and the development of models for estimating both finite and perpetual cash flows.

In this paper, Becker (2021) [12] raises the issue of paying the debt body together with the payment of interest on the debt. Regarding this issue, we would like to note that in both classical MM and BFO theories, the body of the debt is not paid. In the framework of the Modigliani-Miller theory, such an account is fundamentally impossible, while in the BFO theory it can be conducted and was conducted in the framework of the BFO-2 theory, where the amount of debt D decreases with time. This decrease in the value of debt D results in a decrease in the tax shield (see BFO-2 theory) [18, 37, 38–41].

Dividend Policy under Asymmetric Information

As we mentioned above, the economically justified amount of dividends is equal to the cost of equity. The task of calculating the cost of equity capital is one of the most difficult in financial management. Because of this problem, management decisions made by company managers are not always correct.

The rights of shareholders to receive adequate profits may be violated when the management of the company pursues an incorrect and ineffective dividend policy due to the inability of management to correctly determine the amount of dividends (the economically justified amount of which is the cost of equity capital), or with a deliberate violation of the rights of shareholders in this area.

The asymmetric information means that the company's managers know more than outside investors about the true state of the company's current earnings.

Miller and Rock [39] extended the standard financial model of dividend/investment/financing decisions of a company for conditions of asymmetric information. They showed that once stock trading along with asymmetric information is included in the model, Fisher's criterion for optimal investment becomes time–inconsistent: the market's belief that a company follows Fisher's rule creates incentives to violate the rule.

(Fisher's rule postulates that in the presence of efficient capital markets, a company's choice of investments is independent of the investment preferences of its owners, and therefore the company should be motivated only to maximize profits.)

Miller and Rock [39] showed that an informationally consistent signaling equilibrium exists under asymmetric information and stock trading, which restores the temporal consistency of investment policy but generally leads to lower levels of investment than the optimal achievable under perfect information and/or no trading. Contractual provisions that modify information asymmetry or the ability to profit from it could eliminate both temporary inconsistency and inefficiency in investment policies, but these contractual provisions are also likely to incur sunk costs.

In this study we do not use an econometric model, but rather a first principles approach. Both theories (MM and BFO) use this approach. However, there are empirical studies where scientists have considered the influence of various factors on the cost of equity capital using simpler models. One of them is as follows.

The paper [42] examines the impact of environmental, social and governance (ESG) disclosures on the cost of equity capital in the food and beverage (F&B) sector.

This study analyses a sample of 171 internationally listed firms pertaining to the F&B sector and headquartered in North America, Western Europe and Asia Pacific (developed), forming an unbalanced panel of 1.316 observations, spanning the period 2010–2019. Authors run a fixed-effects panel regression model to test the relationship between ESG disclosure and the cost of equity capital. The authors' empirical outcomes suggest a significant negative relationship between ESG disclosure and the cost of equity capital. Authors find support for the notion that increased levels of ESG disclosure are linked to improved access to financial resources for firms.

The hypotheses of the current study are as follows [41]: (1) the actual operating conditions of companies affect the dependence of the cost of equity on debt financing and the company's dividend policy; (2) the abnormal dependence of the cost of equity on the company's debt financing can radically change the company's dividend policy. The presence and magnitude of the anomalous effect can be changed and controlled by changing such parameters as the cost of equity, k_e and debt capital, k_d, the frequency and method of paying income tax, the growth of the income rate, the age of the company, etc. The aims of this paper is to study the influence of the conditions of the real functioning of companies on the dependence of the cost of equity on debt financing, as well as on the anomalous effect: on its existence and management. The following research methods are used: the generalized Brusov-Filatova-Orekhova (BFO theory) and calculations by Microsoft Excel the equity cost depends on debt financing at different parameters, such as k_0 and k_d, the frequency and method of paying income tax, the growth of the income rate, the age of the company, etc. The anomalous effect affects the company's dividend policy and requires careful and detailed study. It's done here. The motivation of the study is to investigate one of the most striking effects in corporate finance — the anomalous dependence of the cost of equity on the company's debt financing. The significance of this study is determined by the importance of the anomalous effect that significantly affects the company's dividend policy. The limitation of the study is due to the fact that the case of a constant income growth rate is considered. In future publications, the case of a variable income growth rate will be considered. One more limitation of the consideration is related to the known limitations of the WACC approximation.

The structure of the paper is as follows:

We briefly discuss the literature review below. In 1 we will discuss the theoretical basis of our consideration and give the main formulas for *WACC* and k_d, which will be used to calculate *WACC* and k_e, and the influence of all considered factors on the dependence of equity cost k_e on the level of debt financing, L.

In 2 the influence of the following factors on the dependence of equity cost k_e on the level of debt financing, L is considered. In 2.1. Increase of tax on profit is considered; in 2.2. Variable income is considered; In 2.2.1. Influence of growth rate g is considered for tax on income payments at the ends of periods. In 2.2.2. Influence of growth rate g is considered with a comparison of results with advance income tax payments and payments at the end of periods. In 2.3. Frequent income tax payments is considered. In 2.3.1. Income tax payments at the ends of periods are considered. In 2.3.2. Frequent tax on income payments is considered with comparing the results for advance payments of tax on income and payments at the ends of periods. In 2.4. Simultaneous influence of the growth rate g and the frequency of income tax payment, p is considered. In 2.5. Influence of company age, n is considered. In 3 the explanations of the observed effects have been done. In 4 Conclusions are made.

1. THEORETICAL BASIS

The Brusov-Filatova-Orekhova (BFO) theory and its perpetual limit — the Modigliani-Miller theory have recently been generalized to the established practice of the functioning of companies. This generalization took into account the real operating conditions of companies, such as variable income, frequent income tax payments, advance income tax payments, etc. This made it possible to investigate the impact of these conditions on its main financial performance [21]. In this paper we use the generalized Brusov-Filatova-Orekhova (BFO) theory as well as the generalized Modigliani-Miller theory to study the influence of the conditions of the real functioning of companies on the dependence of the cost of equity on debt financing, as well as on the anomalous effect: on its existence and management.

Below we give a summary of the WACC formulas for BFO-theory as well as for MM-theory [21].

The classical BFO equation for *WACC*

$$\frac{1-(1+WACC)^{-n}}{WACC}=\frac{1-(1+k_0)^{-n}}{k_0\cdot\left(1-w_d t\left[1-(1+k_d)^{-n}\right]\right)} \quad (6)$$

and its limit for perpetuity companies (MM limit)

$$WACC=k_0\cdot(1-w_d t). \quad (7)$$

The formula for the equity cost comes from the definition of *WACC*

$$WACC=k_e w_e+k_d w_d(1-t), \quad (8)$$

accounting that

$$w_e=\frac{1}{1+L};\ w_d==\frac{L}{1+L} \quad (9)$$

and is as following

$$k_e=WACC(1+L)-Lk_d(1-t). \quad (10)$$

The *WACC* formulas for BFO-theory and for MM-theory under the conditions of the real functioning of companies are presented below [21].

1.1. Variable Income Case

1.1.1. Income Tax Payments at the Ends of Periods

$$\text{BFO: } \frac{1-\left(\frac{1+g}{1+WACC}\right)^n}{WACC-g}=\frac{1-\left(\frac{1+g}{1+k_0}\right)^n}{(k_0-g)\cdot\left(1-w_d t\left[1-(1+k_d)^{-n}\right]\right)}, \quad (11)$$

$$\text{MM: } WACC=(k_0-g)\cdot(1-w_d t)+g. \quad (12)$$

1.1.2. Advance Income Tax Payments

$$\text{BFO: } \frac{1-\left(\frac{1+g}{1+WACC}\right)^n}{WACC-g}=\frac{1-\left(\frac{1+g}{1+k_0}\right)^n}{(k_0-g)\cdot\left(1-w_d t\left[1-(1+k_d)^{-n}\right]\cdot(1+k_d)\right)}. \quad (13)$$

$$\text{MM: } WACC=(k_0-g)\cdot\left(1-w_d t\cdot(1+k_d)\right)+g. \quad (14)$$

1.2. Frequent Income Tax Payments

1.2.1. Income Tax Payments at the Ends of Periods

$$\text{BFO: } \frac{1-(1+WACC)^{-n}}{WACC}=\frac{1-(1+k_0)^{-n}}{k_0\cdot\left(1-\frac{k_d w_d t}{p}\frac{\left[1-(1+k_d)^{-n}\right]}{(1+k_d)^{1/p}-1}\right)}, \quad (15)$$

$$\text{MM: } WACC = k_0 \cdot \left(1 - \frac{k_d w_d t}{p \cdot \left[\left(1+k_d\right)^{1/p} - 1\right]}\right). \tag{16}$$

1.2.2. Advance Income Tax Payments

$$\text{BFO: } \frac{1-\left(1+WACC\right)^{-n}}{WACC} = \frac{1-\left(1+k_0\right)^{-n}}{k_0 \cdot \left(1 - \frac{k_d w_d t}{p} \frac{\left[1-\left(1+k_d\right)^{-n}\right] \cdot \left(1+k_d\right)^{1/p}}{\left(1+k_d\right)^{1/p} - 1}\right)}, \tag{17}$$

$$\text{MM: } WACC = k_0 \cdot \left(1 - \frac{k_d w_d t \cdot \left(1+k_d\right)^{1/p}}{p \cdot \left[\left(1+k_d\right)^{1/p} - 1\right]}\right). \tag{18}$$

1.3. Simultaneous Accounting of Variable Income in Case of Frequent Income Tax Payments

1.3.1. Income Tax Payments at the Ends of Periods

$$\text{BFO: } \frac{1-\left(\frac{1+g}{1+WACC}\right)^{n}}{WACC - g} = \frac{1-\left(\frac{1+g}{1+k_0}\right)^{n}}{\left(k_0 - g\right) \cdot \left(1 - \frac{k_d w_d t}{p} \frac{\left[1-\left(1+k_d\right)^{-n}\right]}{\left(1+k_d\right)^{1/p} - 1}\right)}, \tag{19}$$

$$\text{MM: } WACC - g = \left(k_0 - g\right) \cdot \left(1 - \frac{k_d w_d t}{p \cdot \left(1+k_d\right)^{1/p} - 1}\right). \tag{20}$$

1.3.2. Advance Income Tax Payments

$$\text{BFO: } \frac{1-\left(\frac{1+g}{1+WACC}\right)^{n}}{WACC - g} = \frac{1-\left(\frac{1+g}{1+k_0}\right)^{n}}{\left(k_0 - g\right) \cdot \left(1 - \frac{k_d w_d t}{p} \frac{\left[1-\left(1+k_d\right)^{-n}\right] \cdot \left(1+k_d\right)^{1/p}}{\left[\left(1+k_d\right)^{1/p} - 1\right]}\right)}, \tag{21}$$

$$\text{MM: } WACC - g = \left(k_0 - g\right) \cdot \left(1 - \frac{k_d w_d t \cdot \left(1+k_d\right)^{1/p}}{p \cdot \left(1+k_d\right)^{1/p} - 1}\right). \tag{22}$$

The general formula for equity cost, k_e, is as following

$$k_e = WACC\left(1+L\right) - Lk_d\left(1-t\right). \tag{23}$$

To study the dependence of the cost of equity capital, k_e, on various variables, it is first necessary to find the value of WACC and substitute it into formula (23).

2. RESULTS AND DISCUSSIONS

Below we study the influence of the conditions of the real functioning of companies on the dependence of the cost of equity on debt financing, as well as the conditions for the existence of the "anomalous effect" and the possibility of controlling it in accordance with the program stated above.

Our consideration combines theoretical and numerical results: the latter are based on calculations in Microsoft Excel using some typical data on the cost of equity and debt capital of companies, as well as on the actual data of a particular company (see clause 3.5 and *Figs. 30–35*, where calculations were made for PJSC GAZP). The data are taken from company reports: profitability, leverage level, cost of debt, etc. Then the data is processed to obtain the necessary calculation parameters, the most important of which is k_0, the cost of equity at zero leverage level *L*.

2.1. Increase of Tax on Profit

Within the Modigliani — Miller theory formula for equity cost, k_e, has a view

$$k_e = k_0 + L(k_0 - k_d)(1-t). \quad (24)$$

Using formula (19) we calculate the dependence of cost of equity, k_e, on leverage level, *L* at different tax on profit rates *t*.

It could be seen from *Fig. 1*, where the dependence of cost of equity, k_e, on leverage level, *L* at different tax on profit rates *t* is shown for the case $k_0 = 10\%;\ k_d = 8\%$ (line 1 corresponds to tax on profit rates $t = 0$; line 2 corresponds to tax on profit rates $t = 0.1$; line 3 corresponds to tax on profit rates $t = 0.2$; line 4 corresponds to tax on profit rates $t = 0.3$; line 5 corresponds to tax on profit rates $t = 0.4$; line 6 corresponds to tax on profit rates $t = 0.5$; line 7 corresponds to tax on profit rates $t = 0.6$; line 8 corresponds to tax on profit rates $t = 0.7$; line 9 corresponds to tax on profit rates line 10 corresponds to tax on profit rates $t = 0.9$; line 11 corresponds to tax on profit rates $t = 1$), that the slope k_e (*L*) decreases with t and becomes zero at $t = 1$. In this case (at $t = 1$) the line k_e (*L*) is horizontal. This behavior can be explained by the presence of a multiplier (1 — *T*) (tax corrector).

The situation for the finite age company, described by the Brusov-Filatova- Orekhova (BFO) theory is completely different: there is an anomalous dependence of the cost of equity, k_e, on the level of leverage *L*: the cost of equity k_e decreases with the level of leverage *L*. This effect radically changes the principles of the company's dividend policy: shareholders receive smaller dividends with an increase in debt financing (which leads to financial difficulties and the risk of bankruptcy). In *Fig. 2* the dependence of cost of equity k_e on leverage level *L* at different tax on profit rate *t* ($n = 5, k_0 = 10\%, k_d = 8\%$)(1 — $t = 0$; 2 — $t = 0.2$; 3 — $t = 0.4$; 4 — $t = 0.6$; 5 — $T = 0.8$; 6 — $t = 1$) is shown.

From *Fig. 2* it can be seen that starting from certain values of the income tax rate (in this case, from $t^* = 40\%$), the cost of equity of a company with leverage does not increase, but decreases. Note, that t^* value (as well as the presence or the absence of such an abnormal effect) depends on particular values of parameters n, k_0, k_d, and at other values of parameters n, k_0, k_d critical values of tax on profit rate t^* could be lower.

The anomalous effect could only take place for a finite-age company and is not observed in the eternal Modigliani-Miller limit.

This effect exists within the framework of the BFO theory NOT at all parameters values: below we give an example of the usual behavior similar to the Modigliani-Miller limit one (see *Table 1* and *Fig. 3*).

Let us calculate the dependence of the critical value of the income tax rate, t^*, on the age of the company, *n*. To do this, we must first calculate the *WACC* value over a set of parameters, including the age of the company, *n*, by solving the classical BFO equation (1). Then obtained value of *WACC* at a fixed n should be substituted into equation (18) and the right side should be equated to k_0.

$$k_0 = WACC(1+L) - Lk_d(1-t). \quad (25)$$

By solving this equation, one can obtain the critical value of the income tax rate t^* for a fixed *n*. At *Fig. 4* the results of such calculations are shown: the dependence of the critical value of tax on profit rate t^* on the age of the company, *n*, under variation of the difference between k_0 and k_d

$(\Delta k = k_0 - k_d = 2\%;4\%;6\%;8\%)$ (1 – k_d = 6%, k_0 = 8%; 2 – k_d = 6%, k_0 = 10%; 3 – k_d = 6%, k_0 = 12%; 4 – k_d = 6%, k_0 = 14%).

From the *Fig. 4* it follows, that:

1. The critical value of tax on profit rate t^* increases with the difference $\Delta k = k_0 - k_d$, therefore a small difference between the value of cost of equity (at $L = 0$) k_0 of the company and the credit rate k_d favor to existence of a new effect.

2. The critical value of tax on profit rate t^* decreases monotonically with the age of the company (only for 10 — years

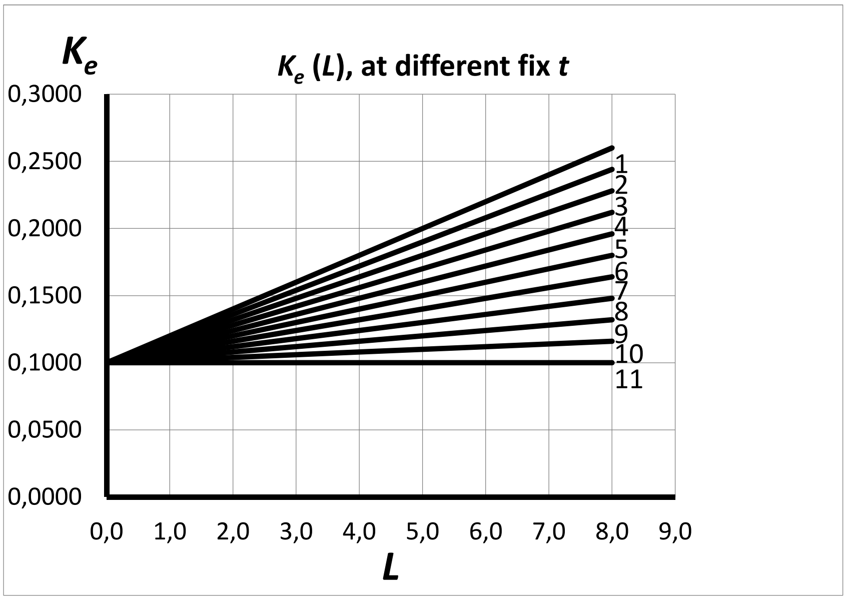

Fig. 1. **Dependence of Cost of Equity on Leverage Level *L* at Different Tax on Profit Rates *t***

Source: Compiled by the authors.

in case of $\Delta k = k_0 - k_d = 2\%$ it has a minimum). Therefore the probability of the anomaly effect is higher for "adult" companies.

3. Recapitulating 1 and 2, one can note, that a small difference between the value of cost of equity (at *L* = 0) k_0 of the company and the credit rate k_d as well as old enough age of the company favor to existence of a new effect.

Below (*Table 2*) the dependence of the critical value of tax on profit rate t^* on the company age, *n*, under different values of k_0 and k_d at constant difference between them $\Delta k = k_0 - k_d = 2\%$ is studied.

In *Fig. 5* the dependence of the critical value of tax on profit rate, t^*, on the company age, *n*, is shown at different values of k_0 and k_d at constant difference between them $\Delta k = k_0 - k_d = 2\%$ (1 – $k_0 = 8\%$; 2 – $k_0 = 10\%$; 3 – $k_0 = 12\%$; 4 – $k_0 = 14\%$; 5 – $k_0 = 16\%$; 6 – $k_0 = 20\%$; 7 – $k_0 = 24\%$).

The following conclusions could be made:

1. All curves are convex and the critical value of tax on profit rate t* reaches minimum, which value decreases with k_0.

Min *t** = 22.2% at $k_0 = 24\%$, min *t** = 24.35% at $k_0 = 20\%$, min *t** = 28.1% at $k_0 = 16\%$, min *t** = 30.43% at $k_0 = 14\%$, min *t** = 33.92% at $k_0 = 12\%$, min *t** = 38.92% at $k_0 = 10\%$, min *t** = 46.4% at $k_0 = 8\%$. Therefore the higher value of k_0 and the higher value of k_d at constant difference between them $\Delta k = k_0 - k_d = const$ favor for existence of a new effect.

2. The critical value of tax on profit rate t^* reach minimum at company age, decreasing with k_0: $n = 4{,}5$ years at $k_0 = 24\%$, $n = 5{,}5$ years at $k_0 = 16\%$, $n = 6{,}5$ years at $k_0 = 12\%$ and $n = 10{,}5$ years at $k_0 = 8\%$.

3. Thus, a parallel shift up of rates k_0 and k_d favor a for new effect, while company age, favorable a new effect, decreases with k_0.

The dependence of the critical value of tax on profit rate t^* on k_0 (equity cost at zero leverage level, *L*) at constant difference between them $\Delta k = k_0 - k_d = 2\%$ is shown at *Fig. 6*, where (1 – $n = 2$; 2 – $n = 3$; 3 – $n = 5$; 4 – $n = 7$; 5 – $n = 10$; 6 — $n = 15$; 7 – $n = 20$; 8 – $n = 25$).

What is the practical value of the effect? Does it exist in real life, or is its discovery of purely theoretical interest? Since the new effect takes place at an income tax rate that is greater than a certain value of *t**, it is necessary to compare this value with the real income tax rates established in different countries. The biggest tax on profits of corporation rates is in USA — 39.2%. In Japan it exceeds a little bit 38%. In France tax on profits of corporations varies from 33.3% for small and medium — sized companies, up to 36% for the major ones. In England tax on profits of corporations is in the range of 21% to 28%. In the Russian Federation tax on profits of corporations is installed in the amount of 20%.

In considered by us examples the value *t** strongly depends on the ratio between k_0, k_d, n and reaches a minimal value of 22.2%, and it is quite likely even lower values of t^* with other ratios between k_0, k_d, n.

In this way, we come to the conclusion that at some ratios between equity cost, debt cost and company age k_0, k_d, n

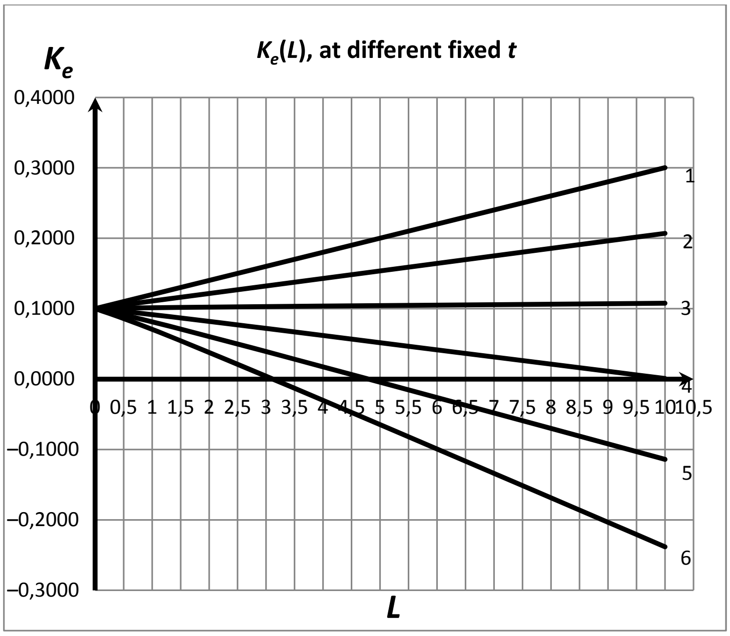

Fig. 2. **Dependence of Cost of Equity k_e on Leverage Level *L* at Different Tax on Profit Rate *T***

Source: Compiled by the authors.

Table 1

Dependence of Cost of Equity k_e on Leverage Level L at Different Fix Tax on Profit Rates *T* for the Case

$$n = 7, k_0 = 20\%, k_d = 10\%$$

T/L	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10
0	0.2000	0.3000	0.4000	0.5000	0.6000	0.7000	0.8000	0.9000	1.0000	1.1000	1.2000
0.2	0.2000	0.2842	0.3682	0.4522	0.5362	0.6202	0.7042	0.7874	0.8713	0.9551	1.0389
0.4	0.2000	0.2677	0.3344	0.4008	0.4672	0.5335	0.5998	0.6661	0.7323	0.7986	0.8649
0.6	0.2000	0.2504	0.2984	0.3457	0.3928	0.4397	0.4865	0.5334	0.5802	0.6265	0.6731
0.8	0.2000	0.2323	0.2601	0.2861	0.3117	0.3369	0.3619	0.3867	0.4116	0.4364	0.4612
1	0.2000	0.2132	0.2185	0.2210	0.2223	0.2229	0.2231	0.2233	0.2231	0.2228	0.2224

Source: Compiled by the authors.

discovered by us effect takes place at tax on profits of corporation rate established in most developed countries, that provides the practical value of the effect.

Its account is important in improving tax legislation and may change dividend policies of the company.

Opening the effect expands our view of the rules of the game in the economy.

If prior to that it was widely known that, with the rising of leverage, the cost of equity is always growing, that is associated with the decrease in financial sustainability of the companies, with an increase in the share of borrowing, when the shareholders require a higher rate of return on the share.

But now it becomes clear that this is not always the case, and the dependence of cost of equity on leverage depends on the ratio between the parameters k_0, k_d, n , and, ultimately, on the tax on profit rate.

This effect has never been known, therefore, it was not taken into account by controls tax legislation, but possibilities here are opening tremendously.

The effect is also important for the development of the dividend policy of the company.

It turns out that the rule adopted by shareholders since time immemorial to demand a higher rate of return per share when increasing the share of debt capital does not always work now.

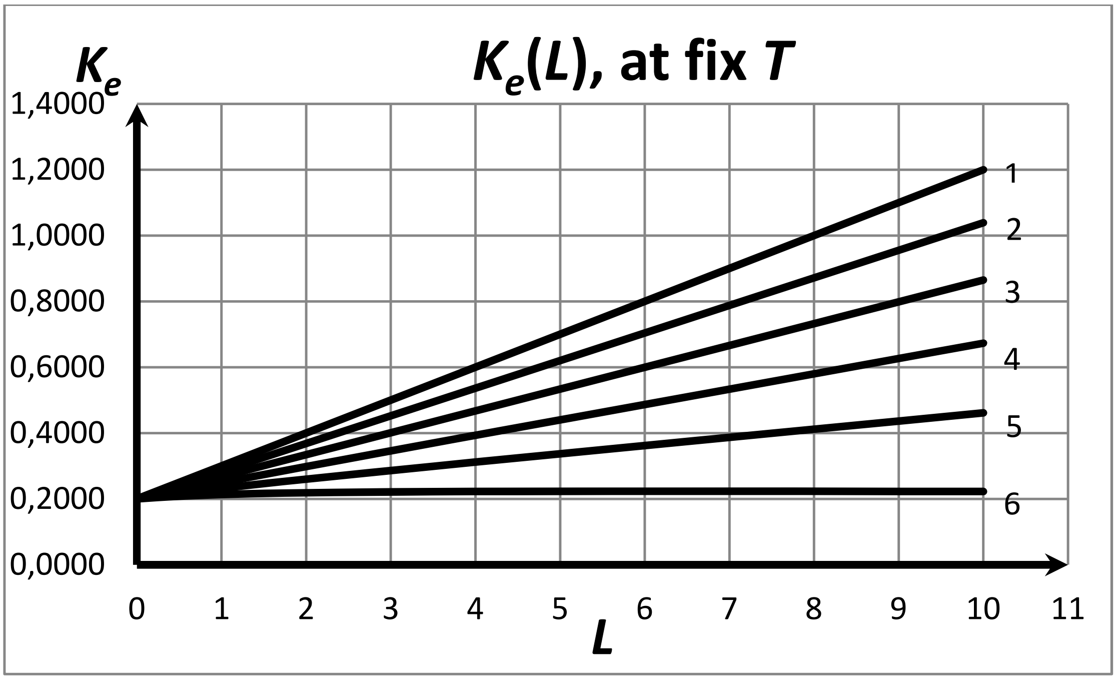

Fig. 3. **Dependence of Cost of Equity k_e on Leverage Level *L* at Different Tax on Profit Rate *T***
($n = 7, k_0 = 20\%, k_d = 10\%$) (1 – $T = 0$; 2 – $T = 0.2$; 3 – $T = 0.4$; 4 – $T = 0.6$; 5 – $T = 0.8$; 6 – $T = 1$)
Source: Compiled by the authors.

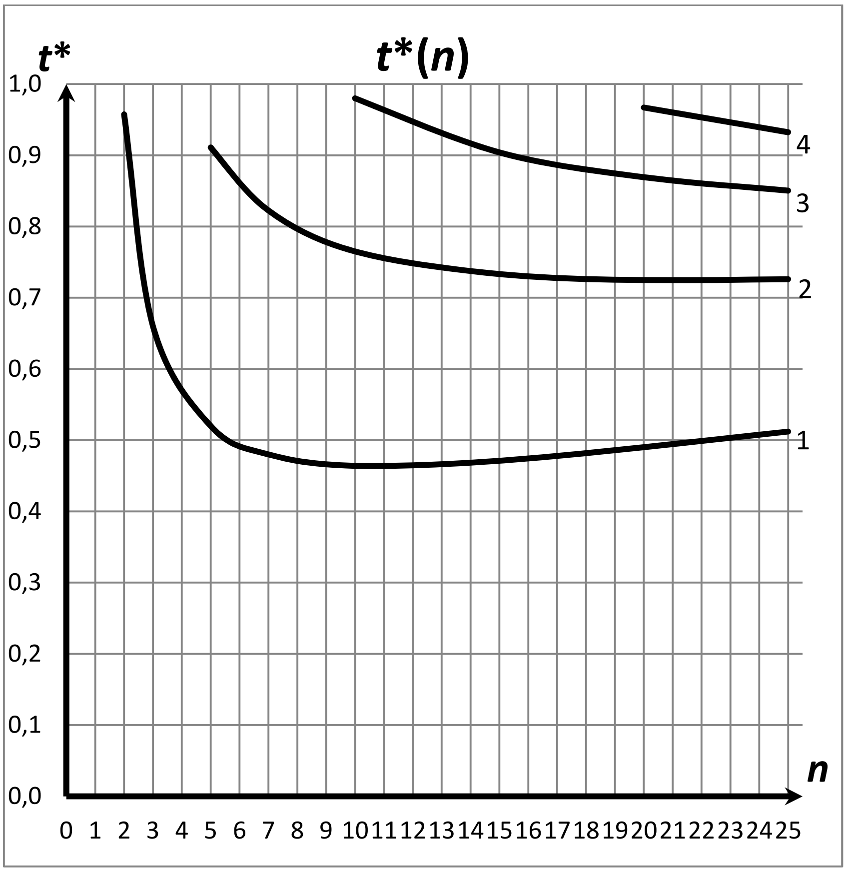

Fig. 4. **The Dependence of the Critical Value of Tax on Profit Rate t^* on the Age of the Company**
Source: Compiled by the authors.

Table 2

The Dependence of the Critical Value of Tax on Profit Rate t^* on the Age of the Company Under Different Values of k_0 and k_d at Constant Difference Between them $\Delta k = k_0 - k_d = 2\%$

ke(t)\n	2	3	5	7	10	15	20	25
k_d = 6%. k_0 = 8%	0.9575	0.6600	0.5200	0.4800	0.4640	0.4710	0.4903	0.5121
k_d = 8%. k_0 = 10%	0.7313	0.5125	0.4140	0.3905	0.3892	0.4138	0.4453	0.4803
k_d = 10%. k_0 = 12%	0.6000	0.4280	0.3510	0.3392	0.3467	0.3840	0.4285	0.4733
k_d = 12%. k_0 = 14%	0.5125	0.3687	0.3110	0.3043	0.3218	0.3697	0.4239	0.4788
k_d = 14%. k_0 = 16%	0.4437	0.3266	0.2810	0.2821	0.3043	0.3636	0.4277	0.4904
k_d = 18%. k_0 = 20%	0.3625	0.2710	0.2435	0.2549	0.2895	0.3677	0.4468	0.5221
k_d = 22%. k_0 = 24%	0.3100	0.2370	0.2220	0.2400	0.2875	0.3818	0.4759	0.5588

Source: Compiled by the authors.

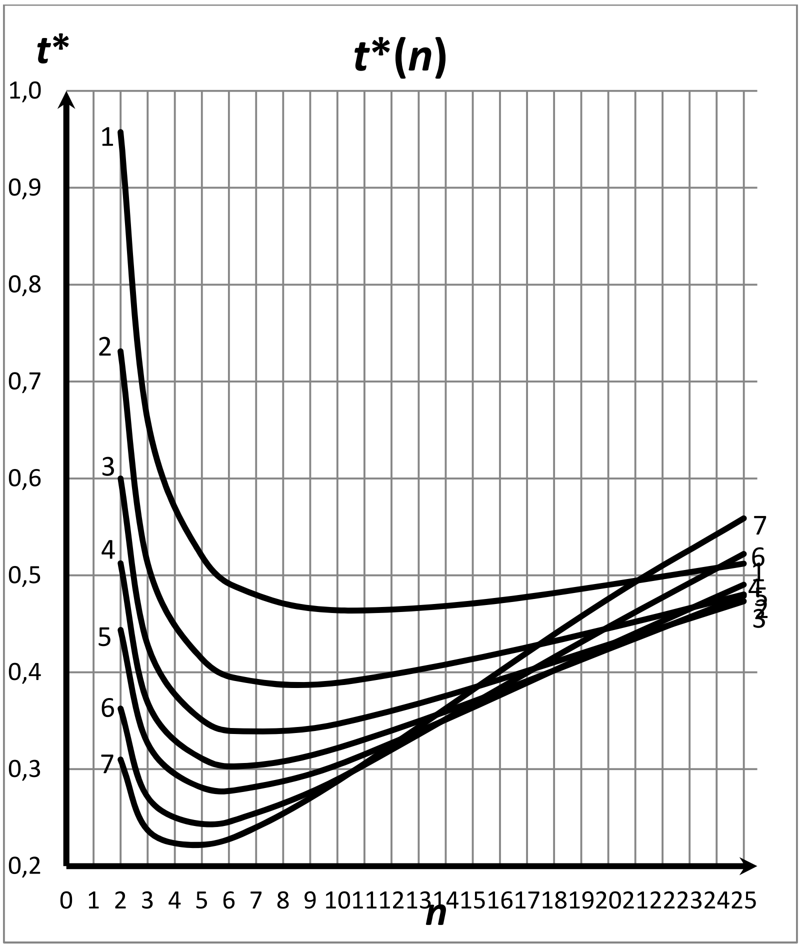

Fig. 5. **The Dependence of the Critical Value of Tax on Profit Rate t^* on the Company Age, *n***

Source: Compiled by the authors.

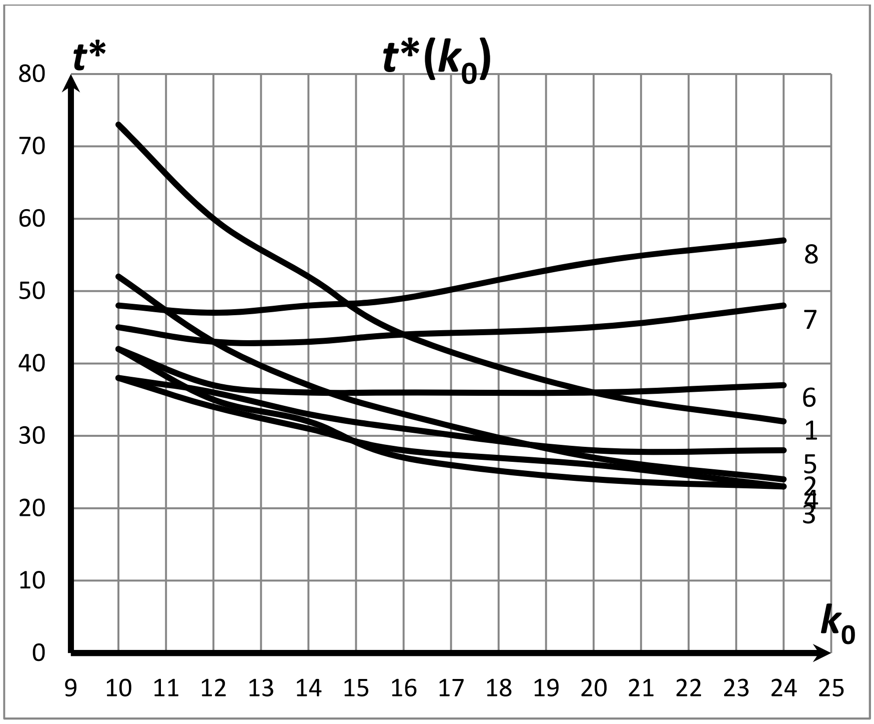

Fig. 6. **The Dependence of the Critical Value of Tax on Profit Rate t^* on k_0 at Constant Difference Between them $\Delta k = k_0 - k_d = 2\%$**

Source: Compiled by the authors.

This will allow the company's management to pursue a more realistic dividend policy, limiting shareholders' appetites to an economically justified amount of dividends.

As we mentioned in 2, the Brusov-Filatova-Orekhova (BFO) theory and its eternal limit — the Modigliani-Miller theory have recently been generalized to the established practice of the functioning of companies, such as variable income, frequent income tax payments, advance payments on income tax, etc. Below, we use the generalized theory of Brusov-Filatova-Orekhova (BFO) to study the existence and behavior of an anomalous effect in a wide range of the financial parameters of the company. We start from the case of variable income.

2.2. Variable Income

2.2.1. Influence of Growth Rate G: Tax on Income Payments at the Ends of Periods

Below we study the influence of growth rate of income g in case of tax on income payments at the ends of periods.

2.2.1.1. Six Year Company

Figure 7 shows the dependence of equity cost, k_e, on leverage level, L, for six year company at $p = 1$; $k_0 = 0.16$; $k_d = 0.14$; $t = 0.2$; at different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$ with payments of tax on income at the end of periods.

From *Fig. 7* it is seen, that with an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases. The anomalous effect for six year company at $k_0 = 0.16$; $k_d = 0.14$ takes place at $g < -1$: the slope of the curve $k_e(L)$ is negative.

Figure 8 shows the dependence of equity cost, k_e, on leverage level, L, for six year company at $p = 1$; $k_0 = 0.16$; $k_d = 0.12$; $t = 0.2$; at different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$ with payments of tax on income at the end of periods.

From *Fig. 8* it is seen, that, like previous case, with an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases. The anomalous effect for six year company at $k_0 = 0.16$; $k_d = 0.12$ is absent at all g values: the slope of the curve $k_e(L)$ is positive.

2.2.1.2. Three Year Company

Let us consider three year company.

From *Fig. 9* it is seen, that, like previous case, with an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases. The anomalous effect for three year company at $k_0 = 0.16$; $k_d = 0.14$ is absent at all g values: the slope of the curve $k_e(L)$ is positive.

From *Fig. 10* it is seen, that, like previous case, with an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases. The anomalous effect for three year company at $k_0 = 0.16$; $k_d = 0.12$ is absent at all g values: the slope of the

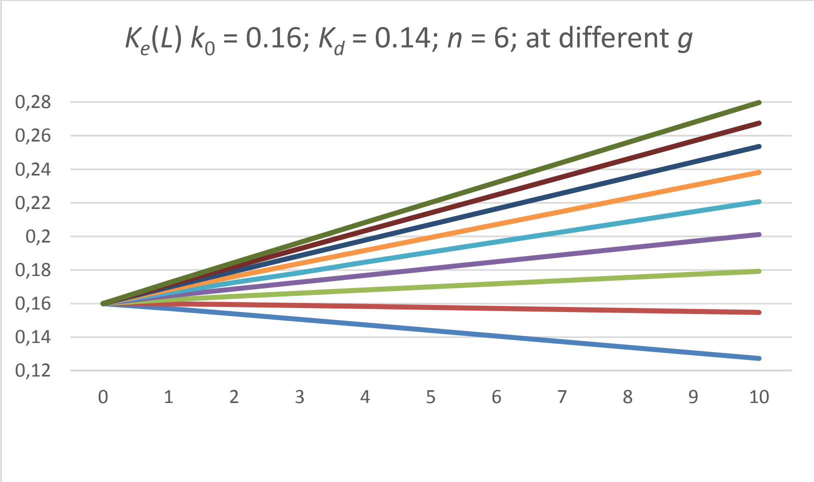

Fig. 7. **The Dependence of Equity Cost, K_e, on Leverage Level, L, at p = 1; k_0 = 0.16; k_d = 0.14; t = 0.2; n = 6 at different g = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 (from the Bottom to the Top) with Payments of Tax on Income at the End of Periods**

Source: Compiled by the authors.

curve $k_e(L)$ is positive. The width of the bundle of straight lines $k_e(L)$ narrows with decreasing k_d.

From *Figs. 7–11* we could conclude the following:

1. With an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases, since in this case shareholders can count on larger dividends.

2. The anomalous effect exists for a small difference between k_0 and k_d $(k_0 - k_d)$ and is absent for a larger value of this difference.

2.2.2. Influence of Growth Rate g: Comparison of Results with Advance Income Tax Payments and Payments at the End of Periods

Below we continue study the influence of growth rate g. We consider the case of advance income tax payments for six year and three year companies. The results for advance income tax payments are shown at *Figs. 12–16.*

Six Year Company

From *Fig. 12* it is seen, that with an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases. The anomalous effect for six year company with advance payments of tax on income at k_0 = 0.16; k_d = 0.14 takes place at g < 0: the slope of the curve $k_e(L)$ is negative for all negative g.

From *Fig. 13* it is seen, that with an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases. The anomalous effect for six year company with advance payments of tax on income at k_0 = 0.16; k_d= = 0.12 is absent: the slope of the curve $k_e(L)$ is positive for all g values.

Three Year Company

Let us make calculation for three year company.

From *Fig. 14* it is seen, that with an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases. The anomalous effect for three year company with advance payments of tax on income at k_0 = 0.16; k_d = 0.14 takes place at g < −0.1: the slope of the curve $k_e(L)$ is negative for g < −0.1. Note, that for six year company with advance payments of tax on income at k_0 = 0.16; k_d = 0.14 the anomalous effect takes place at bigger g < 0. From *Figs. 15* and *16* it is seen, that with an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases. The anomalous effect for three year company with advance payments of tax on income at k_0 = 0.16; k_d = 0.12 is absent: the slope of the curve $k_e(L)$ is positive for all g values. The width of the bundle of straight lines k_e narrows with decreasing k_d.

From *Figs. 12–16* the following conclusions follows:

1. With an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases, since in this case shareholders can count on larger dividends.

2. The anomalous effect exists for a small difference between k_0 and k_d $\Delta k = k_0 - k_d$ and is absent for a larger value of this difference.

3. The width of the bundle of straight lines k_e narrows with decreasing k_d.

4. Advance income tax payments are favorable for the existence of the anomalous effect.

The dependence of the existence of anomalous effect the $\Delta k = k_0 - k_d$, company age, n, and value of g^*, below which ($g < g^*$) this effect exists is shown in *Table 1.*

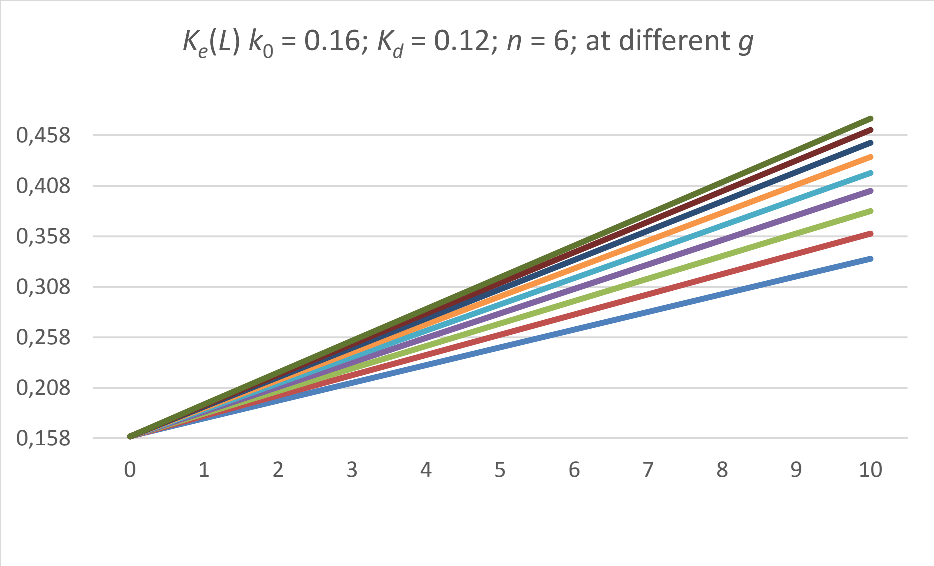

Fig. 8. **The dependence of equity cost, k_e, on leverage level, L, at p = 1; k_0 = 0.16; k_d = 0.12; t = 0.2; n = 6 at different g = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 (from the Bottom to the Top) with Payments of Tax on Income at the End of Periods**

Source: Compiled by the authors.

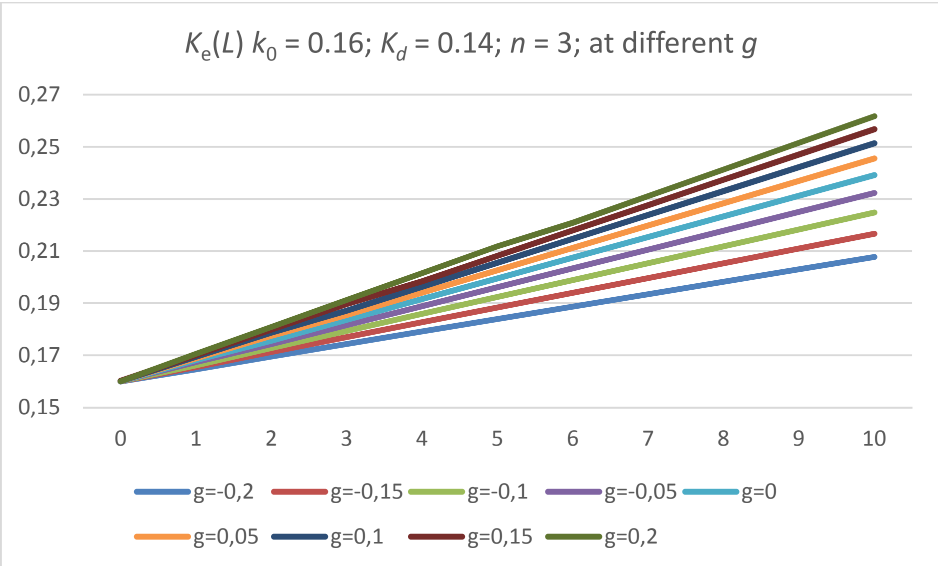

Fig. 9. **The Dependence of Equity Cost, k_e, on leverage level, L, at p = 1; k_0 = 0.16; k_d = 0.14; t = 0.2; n = 3 at different g = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 (from the Bottom to the Top) with Payments of Tax on Income at the End of Periods**

Source: Compiled by the authors.

From the *Table 3* it is seen that at company age n = 6 the effect exists at Δk = 2% only in both cases [for payments of tax on income at the ends (1) of periods as well as for advance payments of tax on income (2)] at that the g^*value increases under transition from (1) type of payments to (2) from −0.125 to zero. At company age n = 3 the effect exists at Δk = 2% only in the case of advance payments of tax on income at the g^* = −0.125.

Small value of Δk favorable to existence of effect, as well as bigger age of company and advance payments of tax on income.

2.2.3. Influence of Debt Cost k_d

Below, we examine the impact of the cost of debt k_d on the existence of an anomalous effect for advance income tax

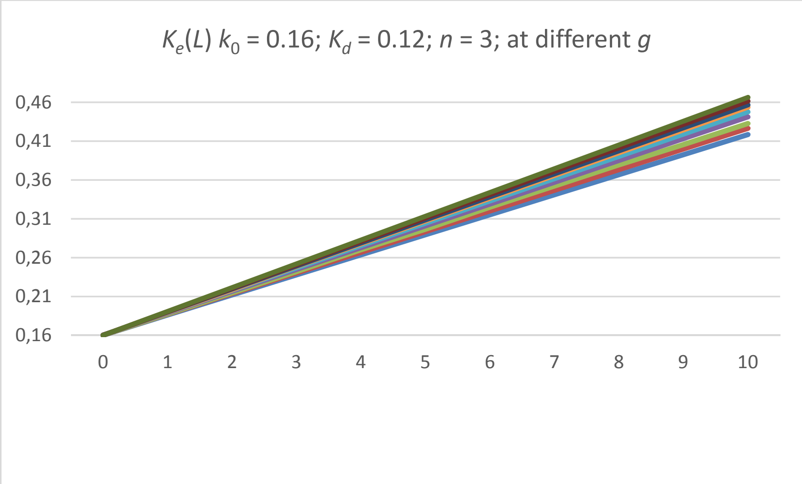

Fig. 10. **The Dependence of Equity Cost, k_e, on Leverage Level, L, at $p = 1$; $k_0 = 0.16$; $k_d = 0.12$; $t = 0.2$; $n = 3$ at Different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$ (from the Bottom to the Top) with Payments of Tax on Income at the End of Periods**

Source: Compiled by the authors.

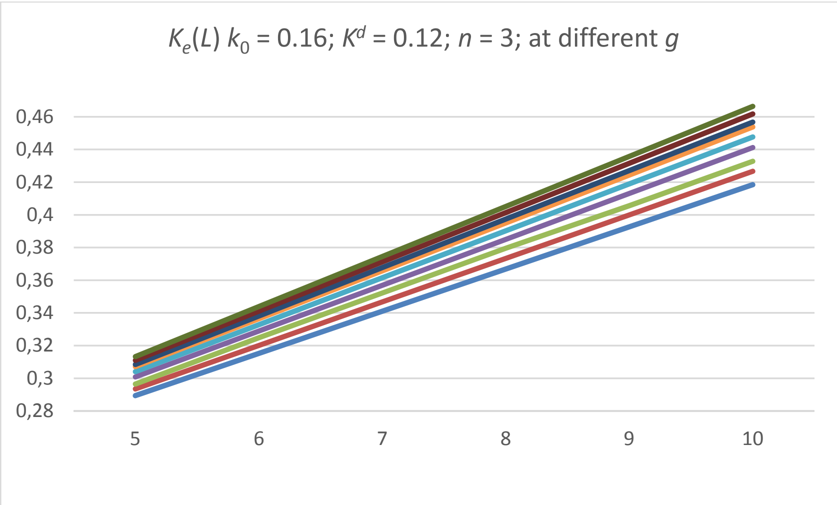

Fig. 11. **The Dependence of Equity Cost, k_e, on leverage level, L, at $p = 1$; $k_0 = 0.16$; $k_d = 0.12$; $t = 0.2$; $n = 3$ at Different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$ (from the Bottom to the Top) with Payments of Tax on Income at the End of Periods (Lager Scale)**

Source: Compiled by the authors.

payments and income tax payments at the end of periods, both in the case of falling and rising profits.

It can be seen from *Fig. 17* that the slope of the curve $k_e(L)$ decreases with the value of k_d for both cases of income tax payment (for payments at the end of periods (1) and also for advance payments (2)). In this case, all curves (except curve at $k_d = 0.05$) related to case (1) have a greater slope compared to the curves related to case (2). It can be seen *Fig. 18* that the slope of the curve $k_e(L)$ decreases with the value of k_d for both cases of income tax payment [for payments at the end of periods (1) and also for advance payments (2)]. In this case, all curves (except curve at $k_d = 0.05$) related to case (1) have a greater slope compared to the curves related to case (2).

2.3. Frequent Income Tax Payments

2.3.1. Frequent Tax on Income Payments: Compare the Results for Advance Payments of Tax on Income and Payments at the Ends of Periods

Below we investigate the impact of frequent income tax payments on the existence and behavior of the anomalous effect for advance payments of tax on income and payments at the ends of periods for three- and six-year companies. For

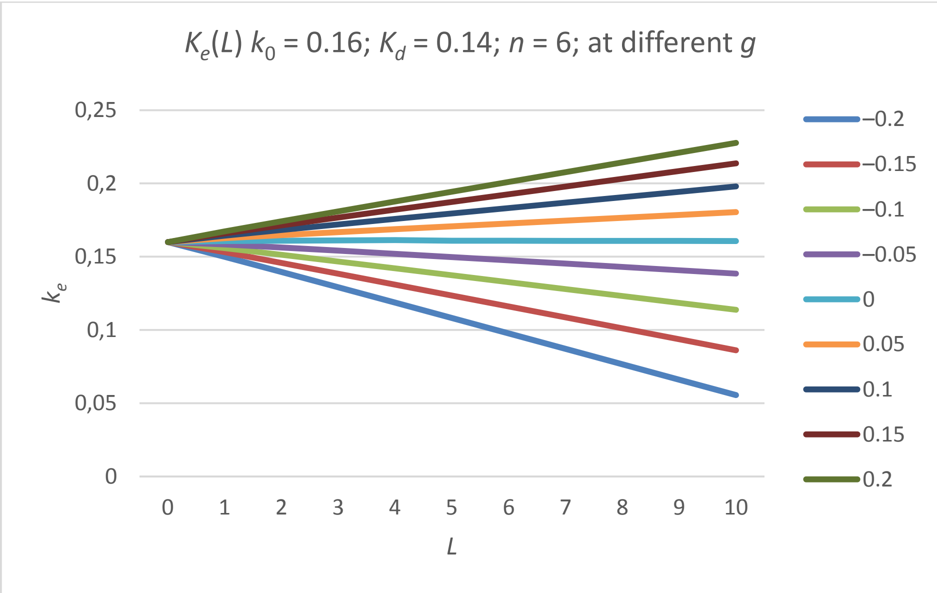

Fig. 12. **The Dependence of Equity Cost, k_e, on leverage level, L, at $p = 1$; $k_0 = 0.16$; $k_d = 0.14$; $t = 0.2$; $n = 6$ at different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$ (from the Bottom to the Top) with Advance Payments of Tax on Income**

Source: Compiled by the authors.

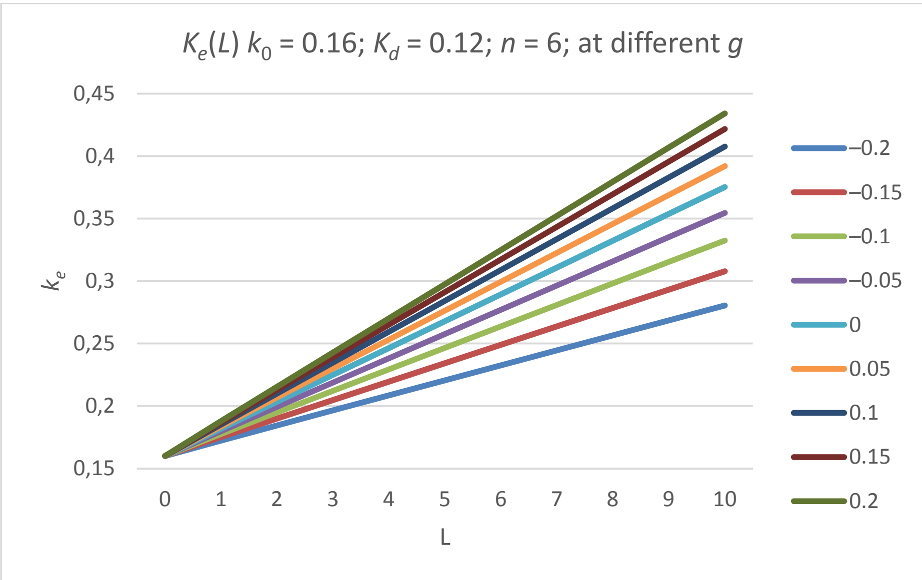

Fig. 13. **The Dependence of Equity Cost, k_e, on Leverage Level, L, at $p = 1$; $k_0 = 0.16$; $k_d = 0.12$; $t = 0.2$; $n = 6$ at Different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$ (from the Bottom to the Top) with Advance Payments of Tax on Income**

Source: Compiled by the authors.

this, we calculate the dependence of equity cost, k_e, on leverage level, L, at different $p = 1; 2; 4; 6; 12$; $k_0 = 0.22$; at $k_d = 0.2$; $t = 0.2$; $n = 3$ with advance payments of tax on income (p') and payments of tax on income at the ends of periods (p). Results for three year company are shown in *Table 4* and *Fig. 19* and for six year company are shown in *Table 5* and *Fig. 20*.

The slope $k_e(L)$ decreases with p when income tax is paid at the end of periods and becomes negative at $p > 4$ and higher for $n = 3$ and at $p > 2$ and higher for $n = 6$ (*Fig. 20*). For advance income tax payments, the slope $k_e(L)$, which is negative for any income tax frequency payments, increases (decreases modulo) with a frequency p, but never intersects with the curves $k_e(L)$

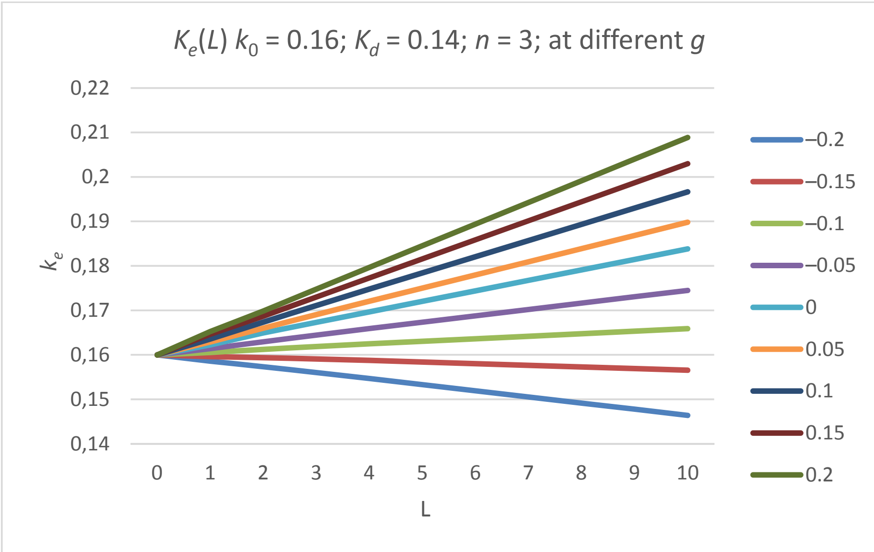

Fig. 14. **The Dependence of Equity Cost, k_e, on Leverage Level, L, at p = 1; k_0 = 0.16; k_d = 0.14; t = 0.2; n = 3 at Different g = –0.2; –0.15; –0.1; –0.05; 0; 0.05; 0.1; 0.15; 0.2 (from the Bottom to the Top) with Advance Payments of Tax on Income**

Source: Compiled by the authors.

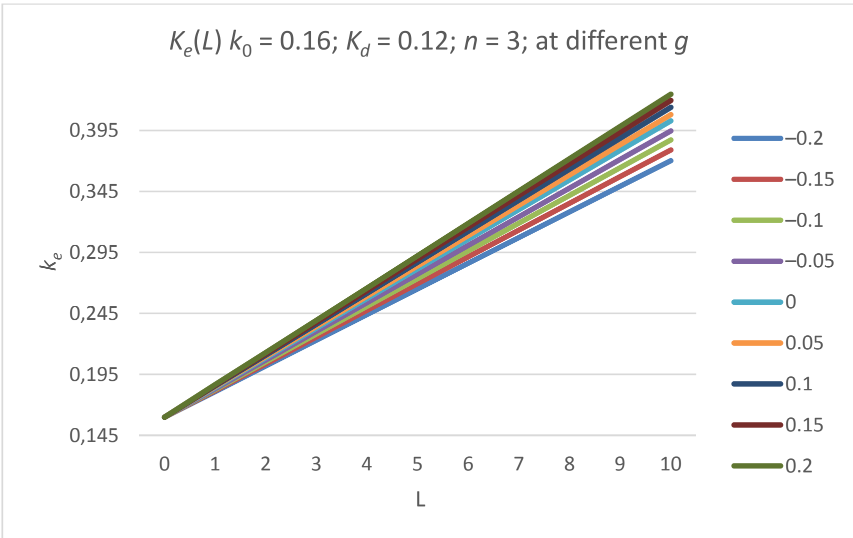

Fig. 15. **The Dependence of Equity Cost, k_e, on Leverage Level, L, at p = 1; k_0 = 0.16; k_d = 0.12; t = 0.2; n = 3 at Different g = –0.2; –0.15; –0.1; –0.05; 0; 0.05; 0.1; 0.15; 0.2 (from the Bottom to the Top) with Advance Payments of Tax on Income**

Source: Compiled by the authors.

in case of income tax payment at the end of the periods. The anomalous effect disappears at $\Delta k = 4\%$ and above (see *Fig. 21*).

The slope of $k_e(L)$ is positive for all p and both payment methods: this means that there is no anomalous effect. The slope $k_e(L)$ decreases with p when income tax is paid at the end of the period and increases when income tax advances are paid. The order of the curves $k_e(L)$ corresponding to these two methods of payment turns out to be mixed. This can lead to very interesting effects, providing new opportunities and the ability to manage the payment of income tax in accordance with tax laws (*Fig. 21*).

2.4. Simultaneous Infliuence of the Growth Rate *g* and the Frequency of Income Tax Payment, *p*

2.4.1. Tax Payments at the End of Periods

Below (see *Fig. 22, 23*), we examine the impact of growth rate g and income tax frequency payments, p on the existence of

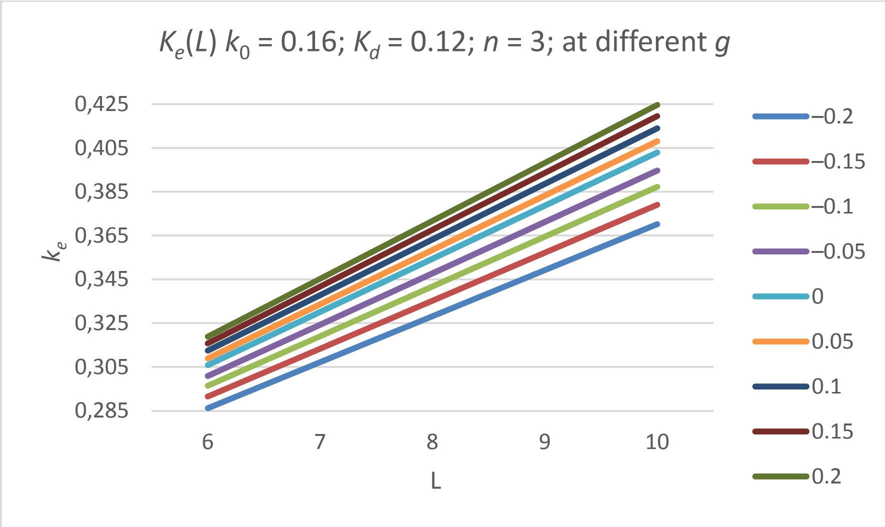

Fig. 16. **The Dependence of Equity Cost, k_e, on Leverage Level, L, at p = 1; k_0 = 0.16; k_d = 0.12; t = 0.2; n = 3 at Different g = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 (from the Bottom to the Top) with Advance Payments of Tax on Income**

Source: Compiled by the authors.

Table 3

The Dependence of the Existence of Anomalous Effect on the Δk, Company Age, n, and Value of g^*, Below Which ($g < g^*$) this Effect Exists

Company age	Δk	Payments of tax on income at the ends of periods		Advance payments of tax on income	
		Existence of effect	g^* value	Existence of effect	g^* value
n = 6	2%	+	−0.125	+	0
	4%	–		–	
	6%	–		–	
n = 3	2%	–		+	−0.125
	4%	–		–	
	6%	–		–	

Source: Compiled by the authors.

an anomalous effect for income tax payments at the end of periods, both in the case of falling and rising profits.

The slope $k_e(L)$ decreases with p and becomes negative at $p > 2$ (p = 4; 6; 12).

The slope $k_e(L)$ decreases with p and remains positive at all p.

The slope $k_e(L)$ decreases with p and remains positive at all p. Comparing to the case $g = 0$ the slope $k_e(L)$ is higher, this means, that the slope $k_e(L)$ growths with g (*Fig. 24*).

2.4.2. Advance Tax Payments

Below, we examine the impact of the frequency of income tax payments on the existence of an anomalous effect for advance income tax payments, both in the case of falling and rising profits.

At negative growth rate g the slope $k_e(L)$ increases with frequency of payments of tax on profit, p, being negative at p = 1 and about zero.

At p = 1 the slope $k_e(L)$ increases with growth rate g, being negative at g = −0.2.

At p = 2 the slope $k_e(L)$ increases with growth rate g, being positive at all g.

At p = 6 the slope $k_e(L)$ increases with growth rate g, being positive at all g.

At p = 12 the slope $k_e(L)$ increases with growth rate g, being positive at all g. From *Figs. 25–29* it follows, that the slope of all curves $k_e(L)$ increase with frequency of advance payments of tax on income.

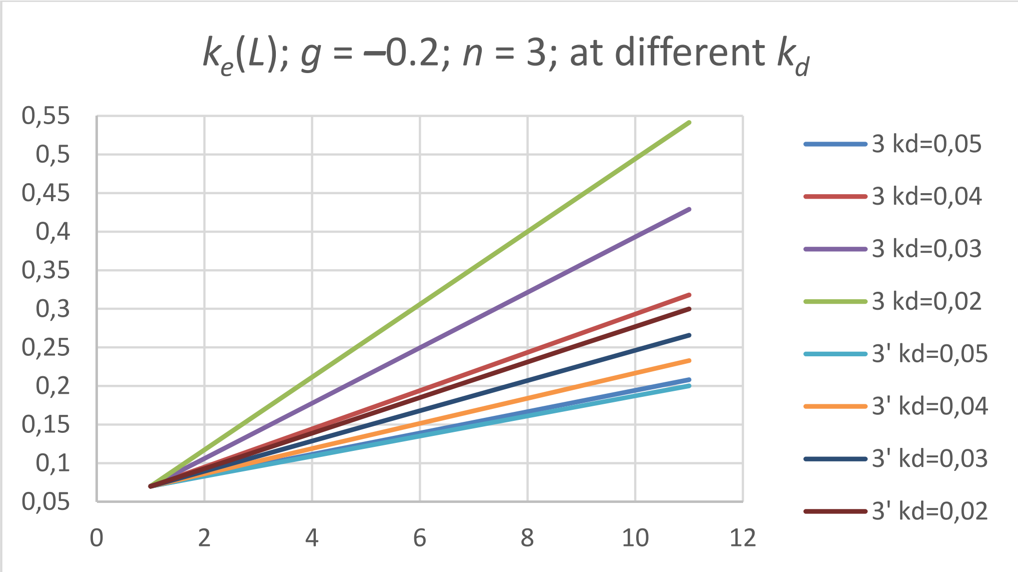

Fig. 17. **The Comparison of the Dependences of Equity Cost, k_e, on Leverage Level, L, at p = 1; k_0 = 0.07; at Different k_d = 0.02; 0.03; 0.04; 0.05; t = 0.2; n = 3 at negative g = –0.2 with Advance Payments of Tax on Income (3') and Payments of Tax on Income at the Ends of Periods (3)**

Source: Compiled by the authors.

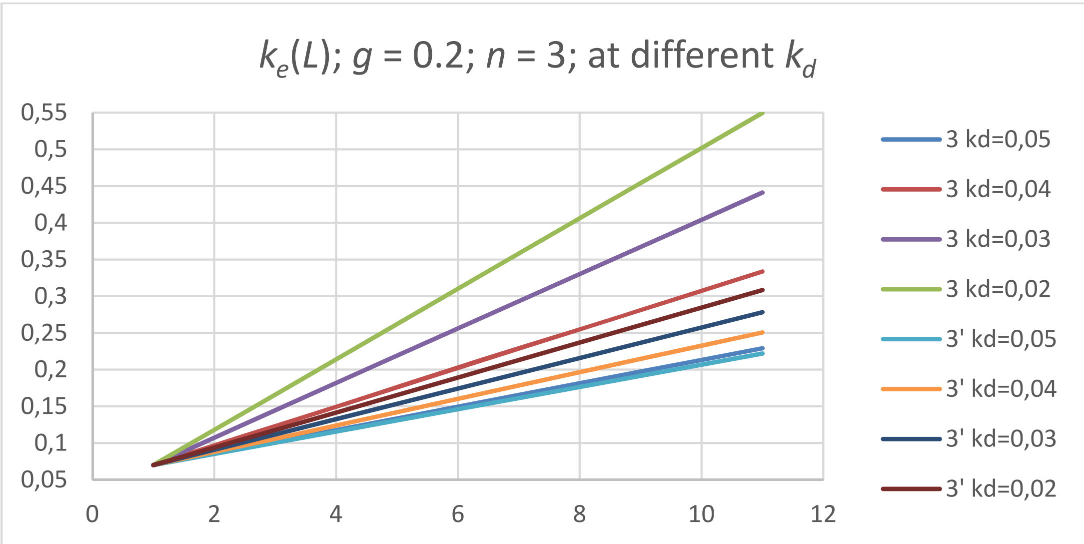

Fig. 18. **The Comparison of the Dependences of Equity Cost, k_e, on Leverage Level, L, at p = 1; k_0 = 0.07; at Different k_d = 0.02; 0.03; 0.04; 0.05; t = 0.2; n = 3 at Positive g = 0.2 with Advance Payments of Tax on Income (3') and Payments of Tax on Income at the Ends of Periods (3)**

Source: Compiled by the authors.

2.5. Impact of Company Age

The dependence of the cost of equity, k_e, on the level of leverage, L, at different ages of the company, n, was studied. It was shown that there are two kind of dependences of slope $k_e(L)$ on company age, n: monotonic decrease of tilt angle $k_e(L)$ with n (see *Fig. 30*) and seems random addiction of tilt angle $k_e(L)$ with n (see *Fig. 31*).

At *Fig. 30* at negative g = –0.05 the following ordering of curves $k_e(L)$ takes place: n = 1; n = 3; n = 5; n = 7; n = 10; n = 15; n =20; n = 25; n = 30. This ordering is monotonic.

At *Fig. 31*, at positive g = 0.05 the following ordering of curves $k_e(L)$ takes place n = 1; n = 30; n = 25; n = 20; n = 15; n = 3; n = 10; n = 5; n = 7. This ordering is not monotonous, but seemingly random. The reason for the existence of two types

Table 4

The Comparison of the Dependences of Equity Cost, k_e, on Leverage Level, L, at Different p = 1; 2; 4; 6; 12; k_0 = 0.22; at k_d = 0.02; t = 0.2; n = 3 with Advance Payments of Tax on Income (p') and Payments of Tax on Income at the Ends of Periods (p)

L	0	1	2	3	4	5	6	7	8	9	10
*P*1	0.2202527	0.224593	0.228886	0.23312	0.237315	0.241494	0.245665	0.249829	0.25399	0.258148	0.262305
*P*2	0.2202527	0.221983	0.223697	0.225345	0.226963	0.228565	0.230162	0.231751	0.233333	0.234894	0.236496
*P*4	0.2202527	0.221029	0.220729	0.221286	0.221551	0.221801	0.222043	0.22228	0.222513	0.222744	0.222974
*P*6	0.2202527	0.220172	0.220075	0.219908	0.220674	0.220139	0.219594	0.219043	0.218488	0.217931	0.217371
*P*12	0.2202527	0.219711	0.219149	0.218517	0.217855	0.217179	0.216495	0.215805	0.215112	0.214416	0.213718
P'1	0.2199314	0.213774	0.207216	0.20056	0.193864	0.187147	0.180416	0.173609	0.166787	0.159962	0.153135
P'2	0.2199314	0.216589	0.212896	0.209117	0.205303	0.201472	0.19763	0.193783	0.189931	0.186075	0.182212
P'4	0.2199314	0.217965	0.21567	0.213294	0.210886	0.208461	0.206028	0.203588	0.201144	0.198697	0.196249
P'6	0.2199314	0.218419	0.216585	0.214672	0.212727	0.210766	0.208796	0.20682	0.204841	0.202858	0.200874
P'12	0.2199314	0.218871	0.217495	0.216041	0.214558	0.213058	0.211549	0.210035	0.208517	0.206996	0.205473

Source: Compiled by the authors.

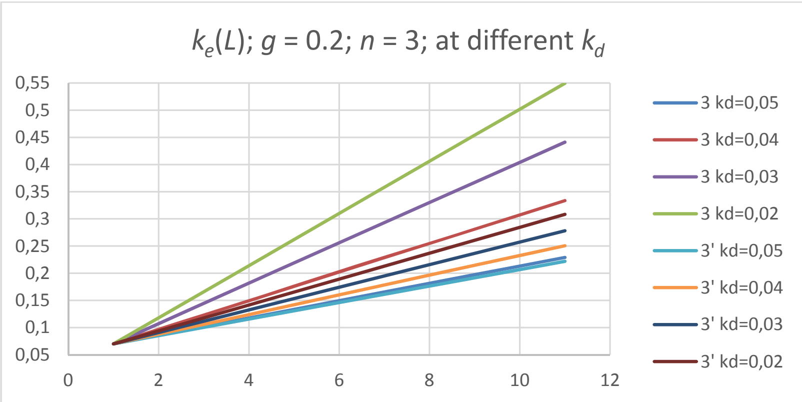

Fig. 19. **The Comparison of the Dependences of Equity Cost, k_e, on Leverage Level, L, at Different p = 1; 2; 4; 6; 12; k_0 = 0.22; at k_d = 0.2; t = 0.2; n = 3 with Advance Payments of Tax on Income (p') and Payments of Tax on Income at the Ends of Periods (p)**

Source: Compiled by the authors.

of dependences of the slope $k_e(L)$ on the age of the enterprise, n: a monotonous decrease in the slope angle $k_e(L)$ with n and a seemingly random dependence of the slope angle $k_e(L)$ with n, is the absence or presence of the so-called "golden age" company effect [21].

The so-called "golden age" of the company effect is the situation, when the cost of capital raised (*WACC*) is below the perpetuity limit, and the company's value is higher. The absence or presence of the "golden age" company effect could explain the ordering of curves $k_e(L)$ (of slopes of curves $k_e(L)$) (see *Figs. 32–34*):

- in case of the absence of the "golden age" company effect, the ordering of curves $k_e(L)$ is monotonic (*Fig. 32*).
- in case of the presence of the "golden age" company effect, the ordering of curves $k_e(L)$ is not monotonous (*Fig. 33*).

From *Fig. 34* it is seen, that the main factor affecting the slope $k_e(L)$ (between the cost of debt k_d and the growth rate g) is the cost of debt k_d. From *Fig. 34* it can be seen that the slope $k_e(L)$ decreases as the cost of debt k_d increases. We deliberately choose a leverage level, L = 10, where the difference between the cost of equity values is the largest, in order to make this difference more noticeable. Of the doublet of curves corresponding to the fixed cost of debt k_d, the upper curve refers to the larger growth rate g. Note, that the shape of the $k_e(n)$ curve is similar to the shape of the *WACC*(n) curve.

2.6. Simultaneously Impact of Company Age, *n*, and Growth Rate, *g*

The conclusions from *Fig. 35* are as following:

- The slope of curves, $k_e(L)$, decreases with company age, n, and increases with growth rate, g.
- The curves corresponding to different company ages mix at different growth rates g. This can lead to interesting

Table 5

The Comparison of the Dependences of Equity Cost, k_e, on Leverage Level, L, at Different p = 1; 2; 4; 6; 12; k_0 = 0.22; at k_d = 0.2; t = 0.2; n = 6 with Advance Payments of Tax on Income (p') and Payments of Tax on Income at the Ends of Periods (p)

P / L	0	1	2	3	4	5	6	7	8	9	10
P1	0.220001	0.223948	0.227332	0.230598	0.234363	0.237707	0.241035	0.244354	0.247667	0.250975	0.25428
P2	0.220001	0.221308	0.222079	0.222713	0.223284	0.223825	0.224352	0.224865	0.225367	0.225839	0.226362
P4	0.220001	0.219931	0.219315	0.218552	0.217729	0.216874	0.216737	0.215709	0.214677	0.213643	0.212606
P6	0.220001	0.219464	0.218373	0.217133	0.215831	0.214498	0.213147	0.211785	0.210415	0.209039	0.20766
P12	0.220001	0.218774	0.217249	0.215655	0.214025	0.21238	0.210725	0.209065	0.2074	0.205734	0.202836
P'1	0.219896	0.212774	0.20494	0.196401	0.188102	0.179762	0.1714	0.163023	0.154636	0.146243	0.137844
P'2	0.219896	0.215592	0.210457	0.205549	0.200371	0.195157	0.189921	0.184673	0.179415	0.174151	0.168883
P'4	0.219896	0.21697	0.213446	0.209762	0.20601	0.202225	0.19842	0.194603	0.190777	0.186946	0.18311
P'6	0.219896	0.217424	0.214366	0.21115	0.207869	0.204555	0.201221	0.197875	0.194521	0.191161	0.187798
P'12	0.219896	0.217876	0.215281	0.212531	0.209717	0.206871	0.204006	0.201128	0.198243	0.195353	0.192458

Source: Compiled by the authors.

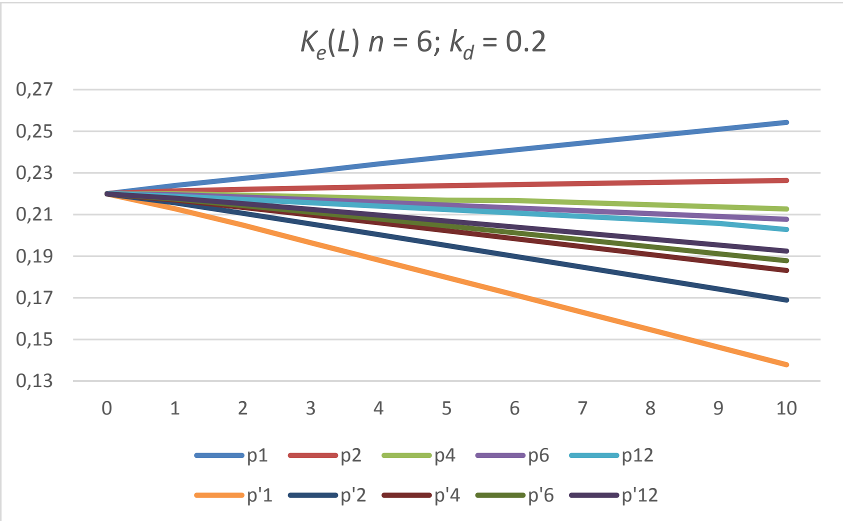

Fig. 20. **The Comparison of the Dependences of Equity Cost, k_e, on Leverage Level, L, at Different p = 1; 2; 4; 6; 12; k_0 = 0.22; at k_d = 0.2; t = 0.2; n = 6 with Advance Payments of Tax on Income (p') and Payments of Tax on Income at the Ends of Periods (p)**

Source: Compiled by the authors.

effects and create new options for the company's dividend policy.

3. THE EXPLANATIONS OF THE OBSERVED EFFECTS

3.1. Increase of ke with *L*

$k_e(L)$ rises with L, because as L increases, financial distress and the risk of bankruptcy increase, shareholders demand higher returns per share.

3.2. Tax Rate Increases

As taxes increase, the slope $k_e(L)$ decreases via tax corrector, which decreases with tax on profit rate.

3.3. Influence of the Rate of Income Growth *g*

With an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases, since in this case shareholders can count on larger dividends.

At $g < 0$ earnings per share decreases.

3.4. Influence of the Frequency of Income Tax Payments

For income tax payments at the ends of periods slope $k_e(L)$ decreases with p, thus earnings per share decreases (properties of ordinary annuity). The increase in PV and FV of cash flows with the growth of p follows from their behavior in the

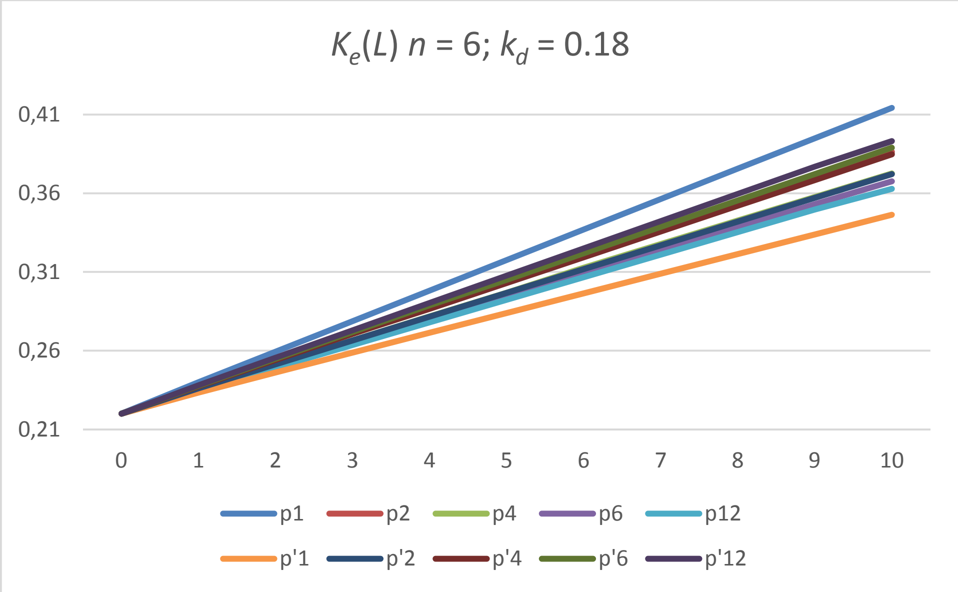

Fig. 21. **The Comparison of the Dependences of Equity Cost, k_e, on Leverage Level, *L*, at Different p = 1; 2; 4; 6; 12; k_0 = 0.22; at k_d = 0.18; t = 0.2; n = 6 with Advance Payments of Tax on Income (p') and Payments of Tax on Income at the Ends of Periods (p)**

Source: Compiled by the authors.

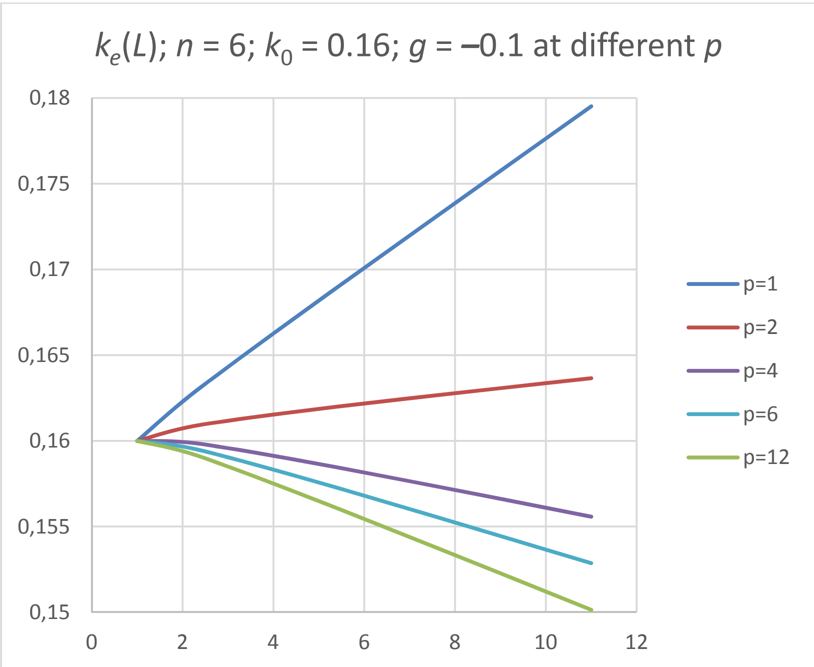

Fig. 22. **The Dependences of Equity Cost, k_e, on Leverage Level, *L*, at Different p = 1; 2; 4; 6; 12; k_0 = 0.16; at k_d = 0.14; t = 0.2; n = 6, g = –0.1 with Payments of Tax on Income at the Ends of Periods**

Source: Compiled by the authors.

ordinary p-term annuity with the growth of p. Both of them increase because an increase in p gives a percentage gain: their earlier accrual. **For advance income tax payments** the slope $k_e(L)$ increases with p, thus earnings per share increases (properties of annuity due). Advance income tax payments correspond to the case of p-term annuity due: the decrease in PV and FV of cash flows with increasing p follows from their behavior in the p-term annuity due with increasing p. They

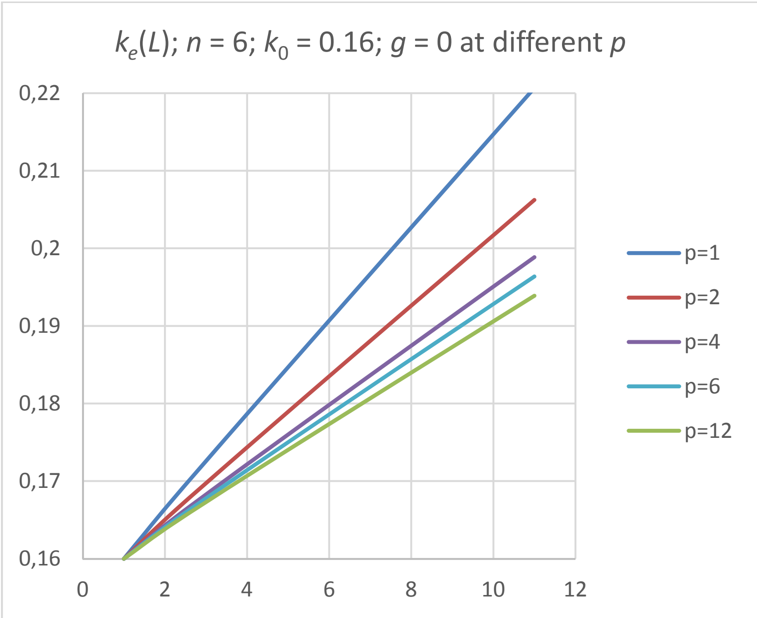

Fig. 23. **The Dependences of Equity Cost, k_e, on Leverage Level, L, at Different p = 1; 2; 4; 6; 12; k_0 = 0.16; at k_d = 0.14; t = 0.2; n = 6, g = 0 with Payments of Tax on Income at the Ends of Periods**

Source: Compiled by the authors.

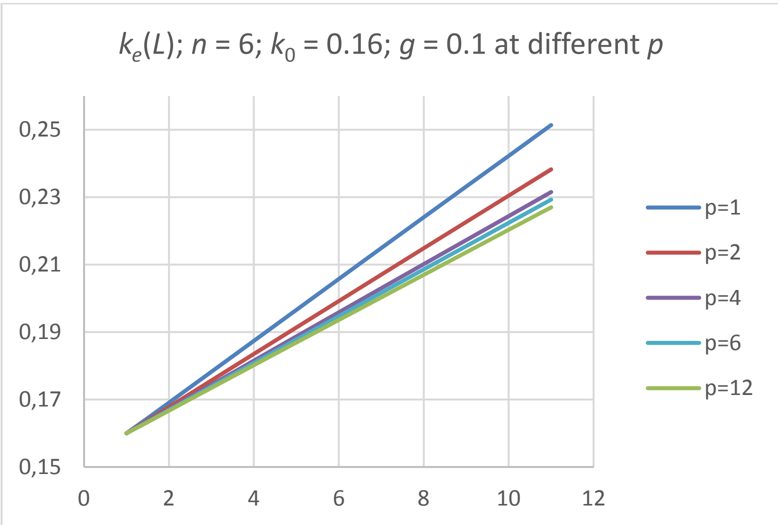

Fig. 24. **The Dependences of Equity Cost, k_e, on Leverage Level, L, at Different p = 1; 2; 4; 6; 12; k_0 = 0.16; at k_d = 0.14; t = 0.2; n = 6, g = 0.1 with Payments of Tax on Income at the Ends of Periods**

Source: Compiled by the authors.

both decrease because an increase in p gives an interests decrease via charging interest on the smaller value of the annuity payment R/p instead of R.

CONCLUSIONS

The contribution of the current results to the theory is related to the use of generalized theories of capital structure (both BFO and MM) to estimate the cost of equity capital in real-life operating conditions of companies. A study was conducted of the dependence of the cost of equity on the level of leverage for different ages of the company, different values of the leverage level, of the cost of debt capital for different frequencies of payment of income tax, advance payments of income tax and payments at the end of periods, the company's variable income, etc. As a result, it becomes possible to estimate the cost of equity in these conditions. The behavior and properties of the cost of equity are explored within the framework of the BFO theory. Several very important innovative effects have

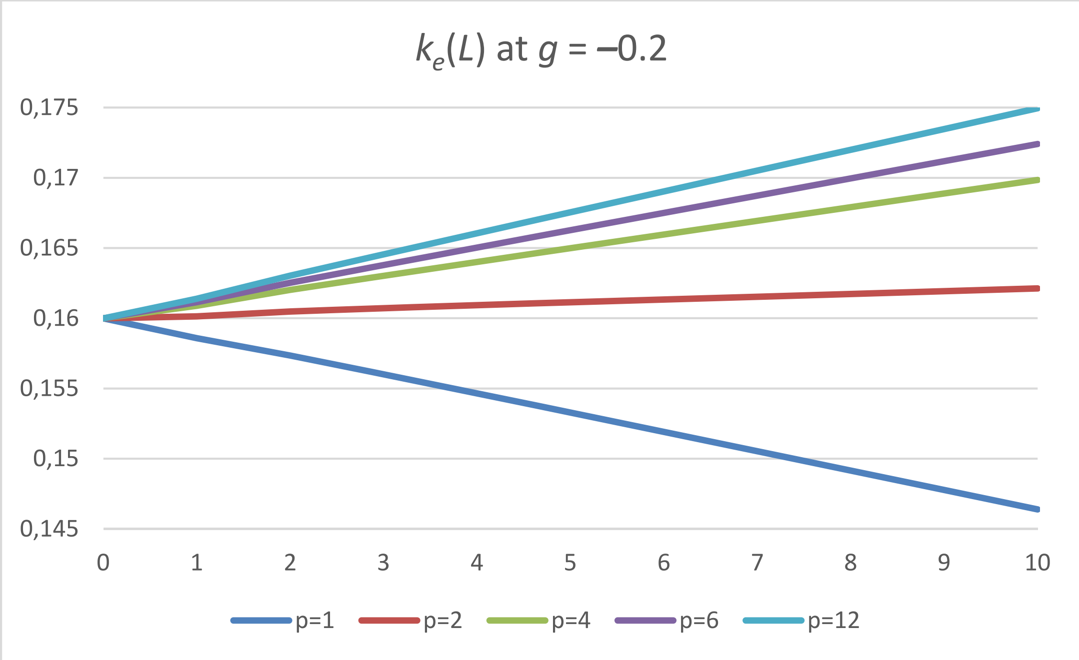

Fig. 25. **The Dependences of Equity Cost, k_e, on Leverage Level, L, at Different p = 1; 2; 4; 6; 12; k_0 = 0.16; at k_d = 0.14; t = 0.2; n = 6, g = –0.2 with Advance Payments of Tax on Income**

Source: Compiled by the authors.

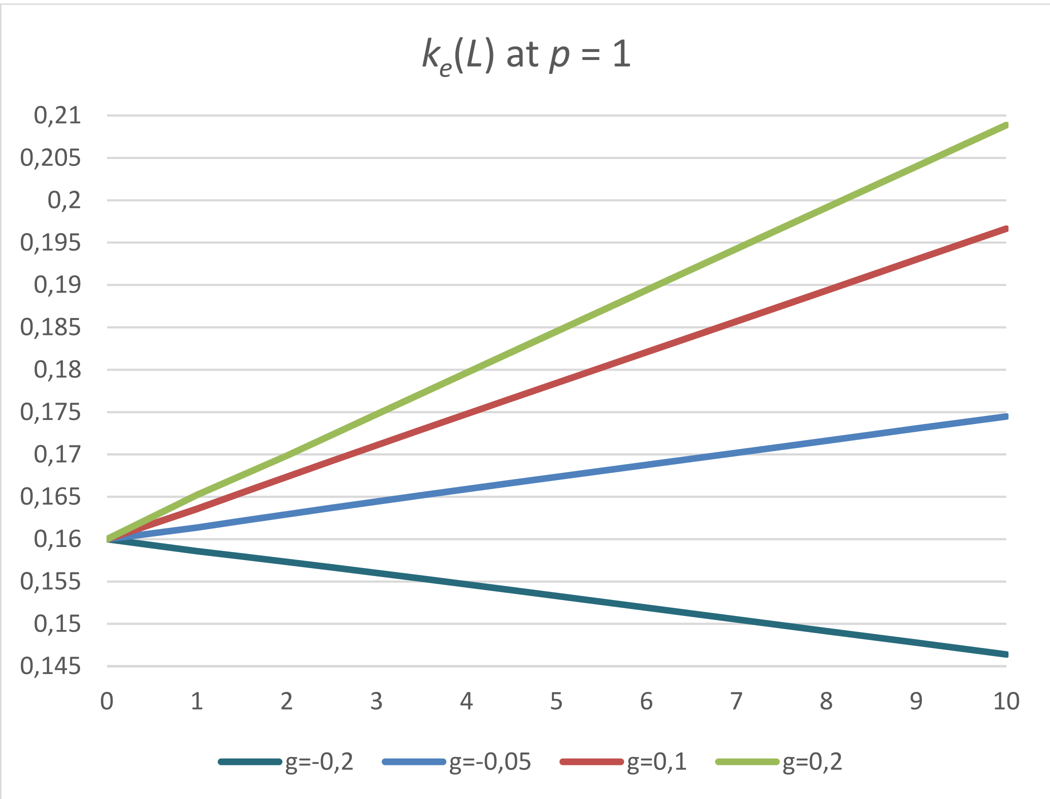

Fig. 26. **The Dependences of Equity Cost, k_e, on Leverage Level, L, at p = 1; k_0 = 0.16; at k_d = 0.14; t = 0.2; n = 6, at different g = –0.2;–0.05; 0.1; 0.2 with Advance Payments of Tax on Income**

Source: Compiled by the authors.

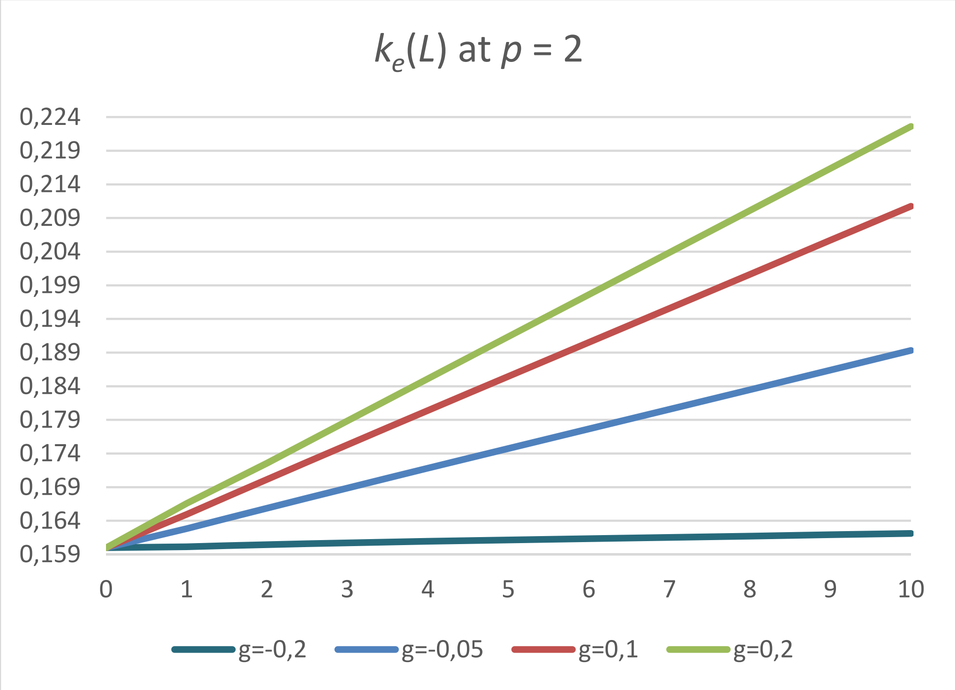

Fig. 27. **The Dependences of Equity Cost, k_e, on Leverage Level, L, at p = 2; k_0 = 0.16; at k_d = 0.14; t = 0.2; n = 6, at different g = −0.2;−0.05; 0.1; 0.2 with Advance Payments of Tax on Income**

Source: Compiled by the authors.

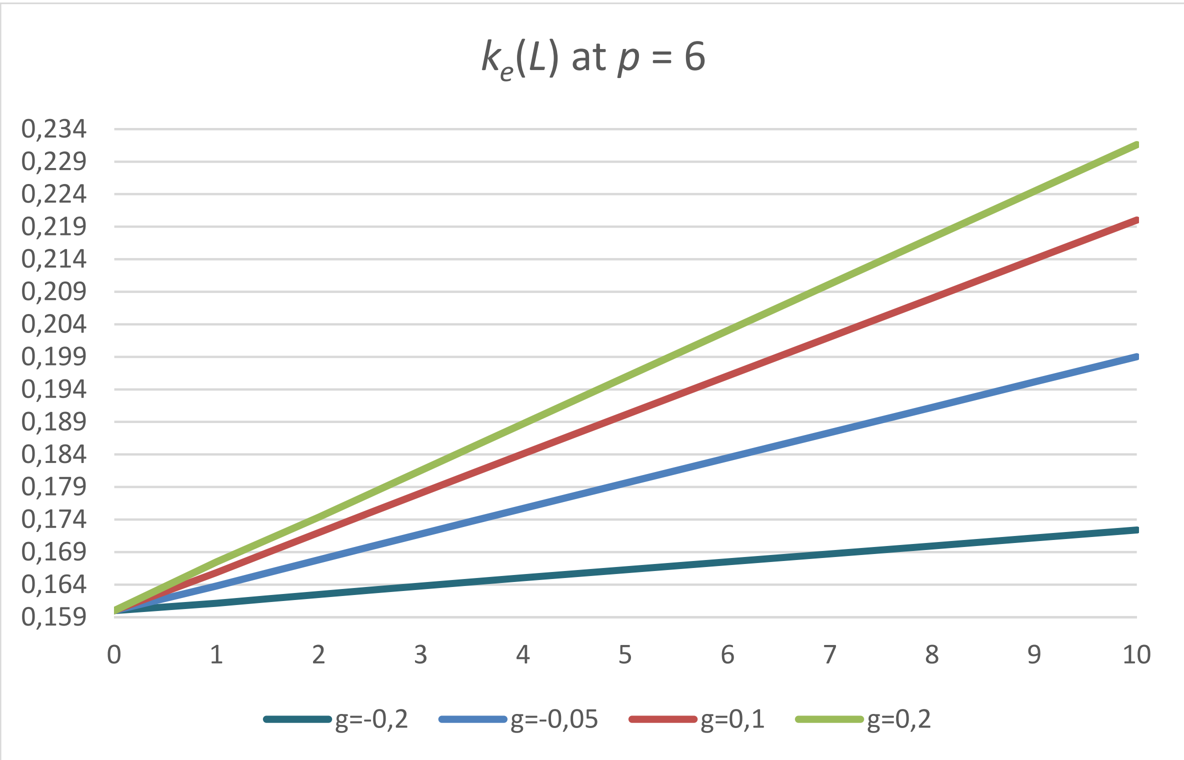

Fig. 28. **The Dependences of Equity Cost, k_e, on Leverage Level, L, at p = 6; k_0 = 0.16; at k_d = 0.14; t = 0.2; n = 6, at different g = −0.2;−0.05; 0.1; 0.2 with Advance Payments of Tax on Income**

Source: Compiled by the authors.

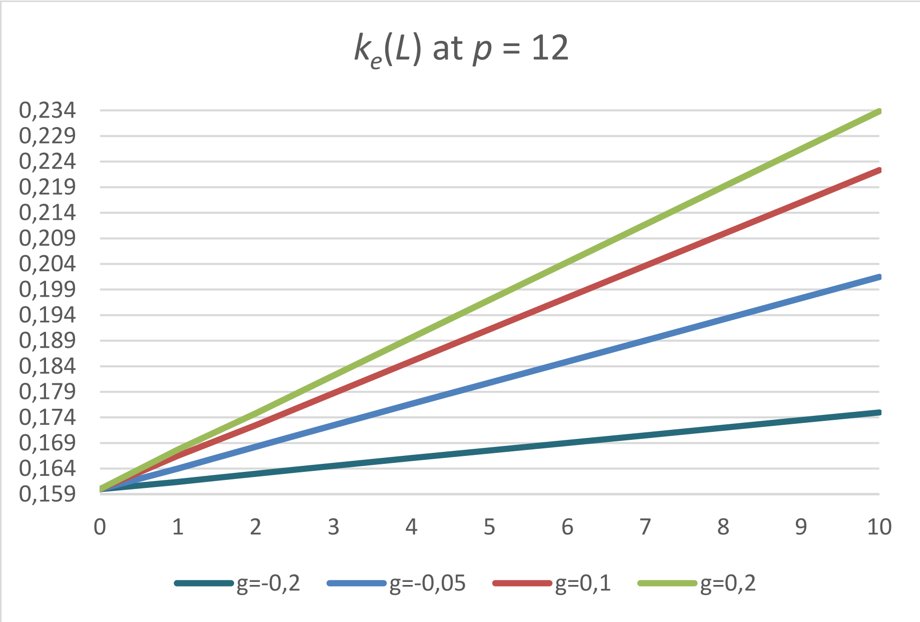

Fig. 29. **The Dependences of Equity Cost, k_e, on Leverage Level, L, at p = 2; k_0 = 0.16; at k_d = 0.14; t = 0.2; n = 6, at different g = –0.2;–0.05; 0.1; 0.2 with Advance Payments of Tax on Income**

Source: Compiled by the authors.

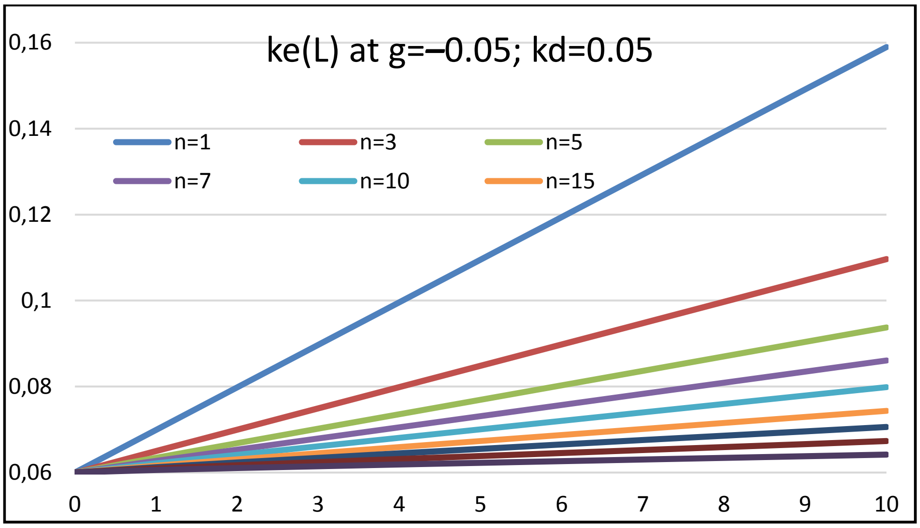

Fig. 30. **The Dependences of Equity Cost, k_e, on Leverage Level, L, at p = 1; k_0 = 0.06; at k_d = 0.05; t = 0.2; at Negative g = –0.5 and at Different Company Age n with Payments of Tax on Income at the End of Periods**

Source: Compiled by the authors.

been discovered, which significantly change the company's dividend policy. Among them are the abnormal dependence of equity cost on leverage level at different growth rates of variable income, at different ages of the company, at different frequencies of income tax payment, at different debt costs etc.

The developed approach can be applied to any country, you just need to use the tax rate for a specific company in a specific country. And the methods of paying income tax: advance payments or at the end of periods and with what frequency: annually, semi–annually, quarterly or monthly.

The following results have been obtained:

1. $k_e(L)$ rises with L, because as L increases, financial distress and the risk of bankruptcy increase, shareholders demand higher returns per share.

2. As taxes increase, the slope $k_e(L)$ decreases via tax corrector, which decreases with tax on profit rate.

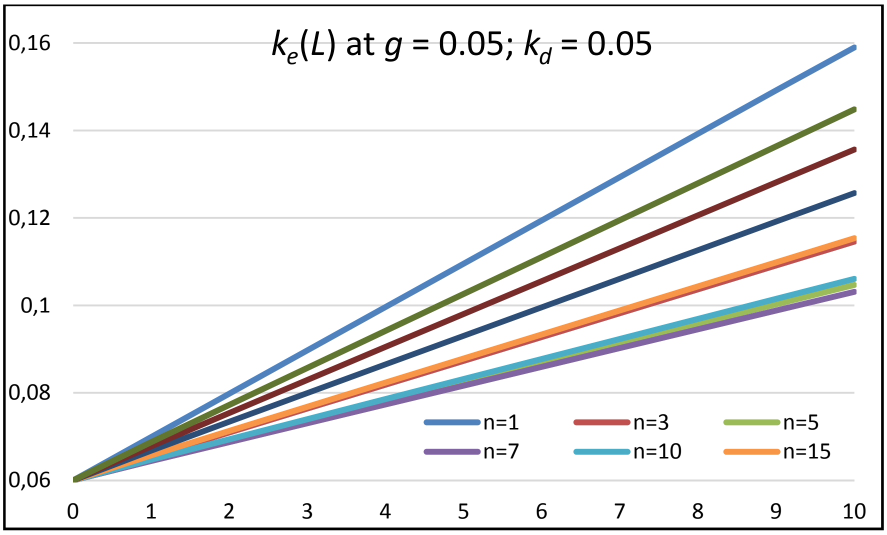

Fig. 31. **The Dependences of Equity Cost, k_e, on Leverage Level, *L*, at $p = 1$; $k_0 = 0.06$; $k_d = 0.05$; $t = 0.2$; at Positive $g = 0.5$ and at Different Company Age *n* with Payments of Tax on Income at the End of Periods**

Source: Compiled by the authors.

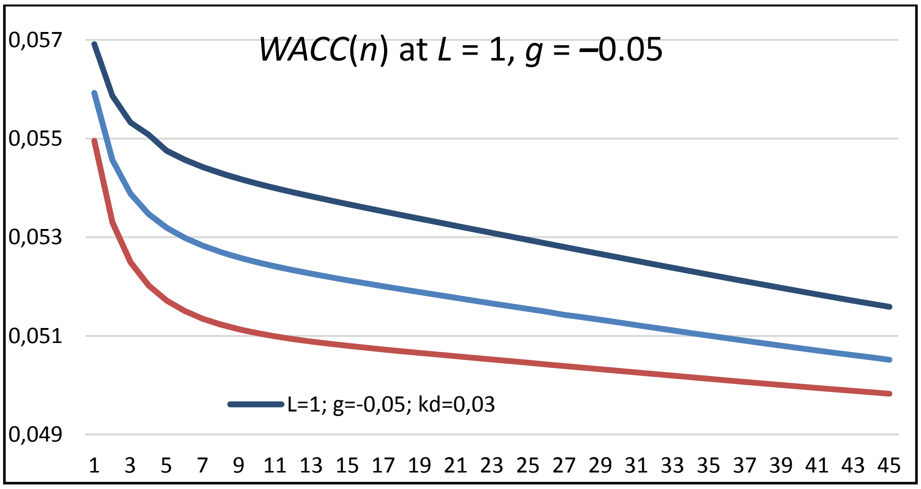

Fig. 32. **The Absence of the "Golden Age" Company Effect. The Dependences of Equity Cost, k_e, on Leverage Level, *L*, at $p = 1$; $k_0 = 0.06$; $k_d = 0.03$; 0.04; 0.05; $t = 0.2$; at Negative $g = -0.5$ and at Different Company Age *n* with Payments of Tax on Income at the End of Periods**

Source: Compiled by the authors.

3. With an increase in the rate of income growth g, the slope of the curve $k_e(L)$ increases, since in this case shareholders can count on larger dividends. At $g < 0$ earnings per share decreases.

4. For income tax payments at the ends of periods slope $k_e(L)$ decreases with the frequency of income tax payments p, thus earnings per share decreases (properties of ordinary annuity). The increase in PV and FV of cash flows with the growth of p follows from their behavior in the ordinary p-term annuity with the growth of p. Both of them increase because an increase in p gives a percentage gain: their earlier accrual.

For advance income tax payments the slope $k_e(L)$ increases with p, thus earnings per share increases (properties of annuity due).

5. It was found two types of dependences of the slope $k_e(L)$ on the age of the enterprise, n: a monotonous decrease in the slope angle $k_e(L)$ with n and a seemingly random dependence of the slope angle $k_e(L)$ with n. The reason for the existence of is the absence or presence of the so-called "golden age" company effect [21].

The so-called "golden age" of the company effect is the situation, when the cost of capital raised (WACC) is below the

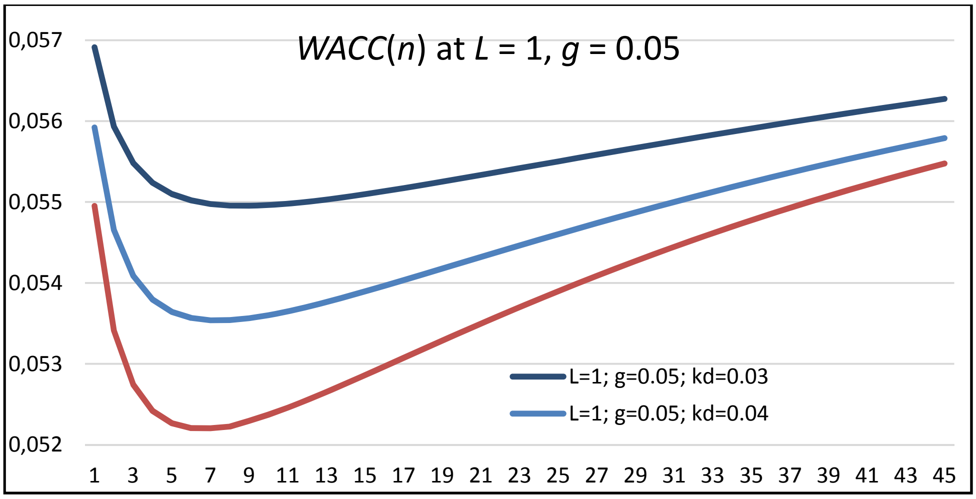

Fig. 33. **The presence of the "golden age" company effect. The Dependences of Equity Cost, k_e, on Leverage Level, L, at p = 1; k_0 = 0.06; k_d = 0.03; 0.04; 0.05; t = 0.2; at Positive g = 0.05 and at Different Company Age n with Payments of Tax on Income at the End of Periods**

Source: Compiled by the authors.

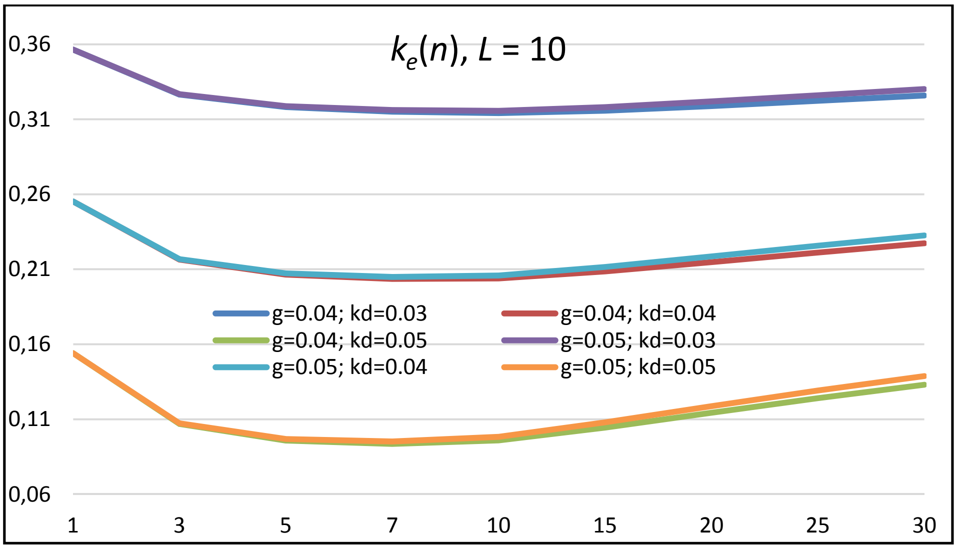

Fig. 34. **The Dependence of the Cost of Equity, k_e, on Company Age at Different Cost of Debt k_d and Growth Rate g at Leverage Level L = 10 for Advance Payments of Tax on Income**

Source: Compiled by the authors.

perpetuity limit, and the company's value is higher. The absence or presence of the "golden age" company effect could explain the ordering of curves $k_e(L)$ (of slopes of curves $k_e(L)$) (see *Figs. 32–34*):

- in case of the absence of the "golden age" company effect the ordering of curves $k_e(L)$ is monotonic (*Fig. 32*);
- in case of the presence of the "golden age" company effect the ordering of curves $k_e(L)$ is not monotonous (*Fig. 33*).

The developed methodology and results will help the company's management to develop an adequate and effective dividend policy, taking into account the real conditions for the functioning of companies, such as variable income of companies, frequent income tax payments, types of income tax payments. (Advance payments and payments at the end of reporting periods), etc. This allows, when developing a dividend policy, the use of qualitatively new effects that we have discovered, such as the anomalous dependence of the cost of equity on the level of leverage at different growth rates of variable income, at different company ages (the "golden age" effect), at different frequencies of income tax payments, at different costs of debt, etc.

The limitation of the study is due to the fact that the case of a constant income growth rate is considered. In future publications, the case of a variable income growth rate will be considered. One

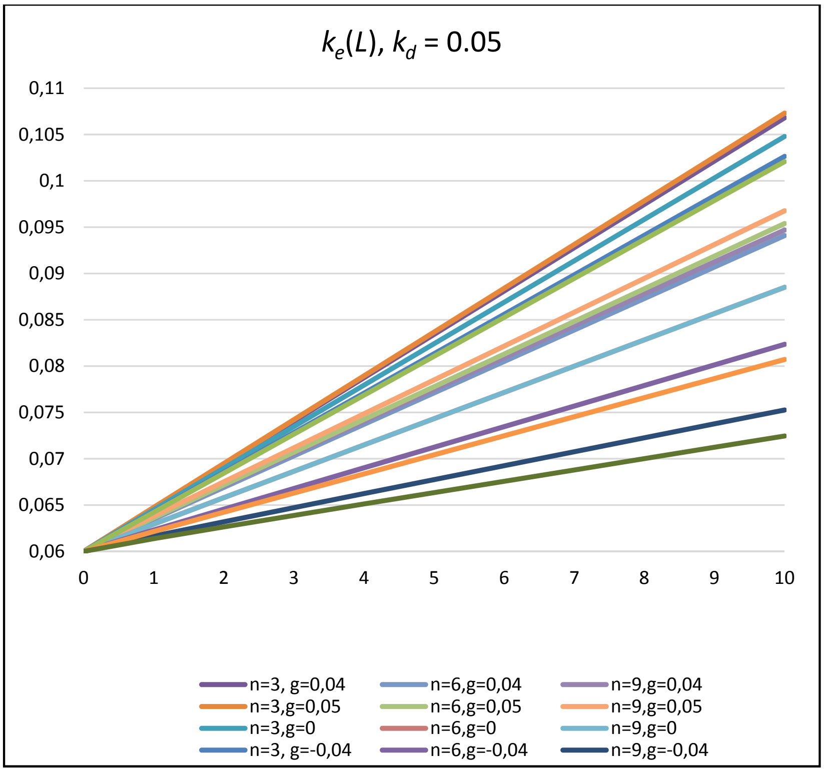

Fig. 35. **The Dependence of Equity Cost, k_e, on leverage level, L, at p = 1; k_0 = 0.06; k_d = 0.05; t = 0.2; at g = −0.05; −0.04; 0; 0.04; 0.05 and at Different Company Age n = 3; 6; 9 with Advance Payments of Tax on Income**

Source: Compiled by the authors.

more limitation of the consideration is related to the known limitations of the *WACC* approximation.

Concerning the direction of further research: the authors plan to take into account both business and financial risks when assessing the financial performance of companies, including the cost of equity.

Direction for Further Research

When studying the cost of equity capital within the framework of BFO and MM theory, we take into account only the financial risks associated with the use of debt financing. There is the Capital Asset Pricing Model (CAPM) that also looks at return on equity, but only considers business risks that relate to the investment in the portfolio rather than in the risk-free assets. 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. A new approach to CAPM has been developed recently [35] that takes into account both business and financial risk. The authors 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. The authors [37, 38] combine these two approaches analytically, while Hamada [4, 40] did it phenomenologically. Using the Modigliani-Miller (MM) theory [1–3, 43], it is shown that the Hamada's model, the 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 in [37, 38]. The vast majority of listing companies use debt financing and are leveraged, and the Hamada model is not applicable to them in contrast to a new approach applicable to leveraged companies. Two versions of CAPM (market or industry) have been considered. A recent application of the dividend theory to business valuation is described in [44–45], where a new approach to business valuation was developed, including the monograph [45].

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ABOUT THE AUTHORS

Peter N. Brusov — Dr. Sci. (Phys. and Math.), Prof., Department of modeling and systems analysis, Financial University under the Government of the Russian Federation, Moscow, Russian Federation
http://orcid.org/0000-0003-3144-5574
Corresponding author:
pnbrusov@fa.ru

Tatiana V. Filatova — Cand. Sci. (Econ.), Prof., Department of Financial and Investment Management, Financial University under the Government of the Russian Federation, Moscow, Russian Federation
http://orcid.org/0000-0001-7175-3286
tvfilatova@fa.ru

Veniamin L. Kulik — Account Manager, T-bank Ltd, Moscow, Russian Federation
http://orcid.org/0000-0002-9492-7055
venya.kulik@mail.ru

***Authors' declared contribution*:**
P.N. Brusov — conceptualization, writing-original draft preparation.
T.V. Filatova — methodology.
V.L. Kulik — validation, formal analysis, investigation.

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