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Application of the Company's "Golden Age" Effect in the Economic Practice

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ABSTRACT

Taking into account the conditions of the real functioning of companies, one of the most striking effects in financial management is investigated: the "golden age" of the company (when the cost of capital raised is below the perpetuity limit, and the company's value is higher). With this aim the dependence of cost of raising capital, WACC, on the age of company, *n*, is studied at various leverage levels, at various values of equity and debt costs, at different frequencies of tax on income payments, p, with advance payments of tax on income and payments at the end of periods, at variable income of the companies. The existence of the weighted average cost of capital, WACC, minimum and its behavior at wide range of above parameters is investigated. All calculations are made within modern theory of capital cost and capital structure by Brusov-Filatova-Orekhova (BFO theory), generalized to the conditions of the real functioning of the company. Practical recommendations for using and maintaining the "golden age" effect are given. It is shown, that "the golden age" depends on the financial indicators of the company. It can change and be controlled by changing parameters such as the cost of capital (equity and debt), frequency and method of tax on income payments, growth income rate etc. The study of the dependence of *WACC* on the age of the company *n*, *WACC*(*n*), which can only be carried out within the framework of the BFO theory, turns out to be very important in the income approach to business valuation. This allows you to link a retrospective analysis of a company's financial condition with a representative analysis as part of a business valuation.

Keywords: the "golden age" of the company; the Brusov-Filatova-Orekhova theory; variable income; frequent payments of tax on income; the weighted average cost of capital; WACC; the Modigliani-Miller theory

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ОРИГИНАЛЬНАЯ СТАТЬЯ

Применение эффекта «золотого возраста» компании в экономической практике

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АННОТАЦИЯ

С учетом условий реального функционирования компаний исследуется один из наиболее ярких эффектов в финансовом менеджменте: «золотой возраст» компании [когда стоимость привлеченного капитала ниже перпетуитетного предела (предела ММ), а стоимость компании выше]. С этой целью изучается зависимость стоимости привлечения капитала, *WACC*, от возраста компании, *n*, при различных уровнях левериджа, различных значениях стоимости собственного капитала и долга, различной частоте уплаты налога на прибыль, с авансовыми выплатами налога на прибыль и выплатами в конце периодов, при переменных доходах компаний. Исследовано существование минимума средневзвешенной стоимости капитала, *WACC*, и его поведение в широком диапазоне вышеуказанных параметров. Все расчеты производятся в рамках современной теории стоимости и структуры капитала Брусова-Филатовой-Ореховой (теории БФО), обобщенной на условия реального функционирования компании. Даны практические рекомендации по использованию и поддержанию эффекта «золотого возраста». Показано, что «золотой возраст» зависит от финансовых показателей компании. Его можно изменять и контролировать путем изменения таких параметров, как стоимость капитала (собственного и заемного), частота и метод уплаты налога на прибыль, темп роста доходов и др. Исследование зависимости *WACC* от возраста компании *n*, *WACC*(*n*), которое можно провести только в рамках теории БФО, оказывается очень важным при доходном подходе к оценке бизнеса. Это позволяет связать ретроспективный анализ финансового состояния компании с репрезентативным анализом в рамках оценки бизнеса.

Ключевые слова: «золотой возраст» компании; теория Брусова-Филатовой-Ореховой; переменный доход; частые уплаты налога на прибыль; средневзвешенная стоимость капитала; *WACC*; теория Модильяни-Миллера

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INTRODUCTION

This paper examines one of the most striking effects in financial management in general and in the capital structure in particular — "golden age" of the company (when the cost of capital raised is below the perpetuity limit, and the value of the company is higher).

The research hypotheses are as follows: the "golden age" depends on the company's financial performance. It can be changed and controlled by changing such parameters as the cost of capital (own and borrowed), the frequency and method of tax on income payments, the growth of the income rate, etc. The purpose of the study is to investigate the influence of the conditions of the real functioning of companies on the effect of the "golden age": on their existence and management. The research methods used are as follows: the generalized Brusov-Filatova-Orekhova (BFO theory) and calculations within this theory of the dependence of *WACC* on company age by Microsoft Excel at different financial parameters. The motivation of research is to study the brightest effect in financial management — "the golden age" effect. The significance of the current study is determined by the importance of "the golden age" effect, which reduces the cost of raising capital and increases the value of the company.

The modern theory of the capital structure started from the papers by Modigliani and Miller [1–3]. The Modigliani-Miller theory had numerous limitations, the main of which were its perpetual nature and the absence of taxes: corporate and individual. Many scientists have tried to modify the Modigliani-Miller theory in different aspects [4–15].

Unification of Capital Asset Pricing Model (CAPM) with Modigliani-Miller Model

The unification of the Capital Asset Pricing Model (CAPM) with Modigliani-Miller model with accounting taxes was done in 1961 by Hamada [4]. He has derived the following formula for equity cost of the levered company:

$$k_e = k_F + (k_M - k_F) b_U + (k_M - k_F) b_U \frac{D}{S}(1-T),$$

here b_U is the β — coefficient of the unlevered company. First term represents risk — free profitability k_F, second term — business risk premium, $(k_M - k_F) b_U$, and third term — financial risk premium

$$(k_M - k_F) b_U \frac{D}{S}(1-T).$$

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.

See, however, the conclusive remarks, that show that Hamada's formulas are incorrect.

Miller model

Miller [5] has accounted the corporate and individual taxes and has gotten the following formula for the value of a company without borrowed funds, V_U,

$$V_U = \frac{\text{EBIT}(1-T_C)(1-T_S)}{k_0}.$$

Here T_C is the corporate tax on income rate, T_S is the tax rate on profits of an individual investor from his ownership by stock of corporation, T_D — tax rate on interest profits from the provision of investor — individuals of credits to other investors and companies. A factor $(1-T_S)$ accounts the individual taxes.

Alternative Expression for *WACC*

From the *WACC* definition and the balance identity (see [6]) an alternative formula for the *WACC*, different from Modigliani-Miller one has been derived in [6–9]:

$$WACC = k_0(1 - w_d T) - k_d t w_d + k_{TS} t w_d,$$

where k_0, k_d and k_{TS} are the expected returns, respectively, on the unlevered company, the debt and the tax shield.

Becker [12] discussed the difference between Modigliani-Miller and Miles-Ezzell and its consequences for the valuation of annuities.

In textbooks [8,13–14] formulas for the special cases, where the *WACC* is constant, could be found.

Myers [16] considered one year companies and have shown, that the weighted average cost of capital *WACC* is higher than in the Modigliani-Miller limit, and the company's capitalization is lower. Myers concluded that valuation of the weighted average cost of capital, *WACC*, in the perpetual limit of the Modigliani-Miller theory is the lowest, and the valuation of the company value, *V*, is maximum. This means that *WACC* decreases monotonically with company age *n* (*Fig. 1*).

One of the main limitations of the Modigliani-Miller theory on the perpetuity of companies was removed by

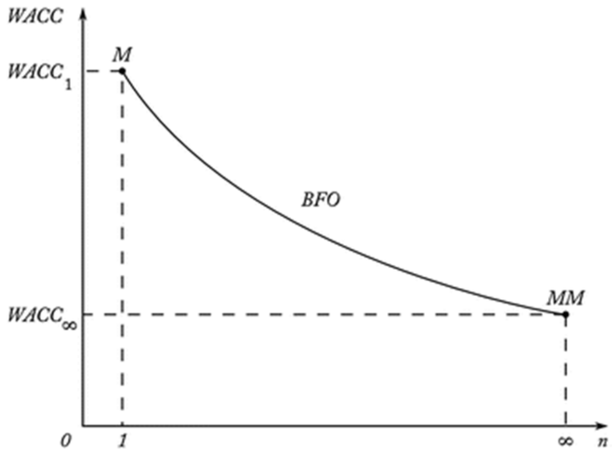

Fig. 1. **Monotonic Dependence of *WACC* on the Age of the Company *n* (*WACC* $_1$ is the *WACC* Value for One-Year Company and *WACC* is the *WACC* Value for Perpetual Case)**

Source: Compiled by the authors.

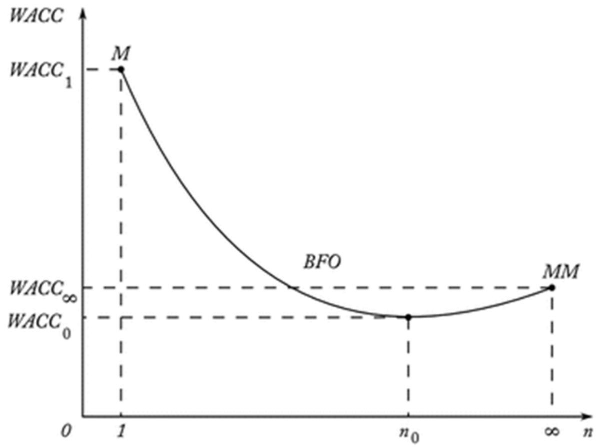

Fig. 2. **Dependence of *WACC* on the Company Age *n*, Showing Descending of *WACC* with Passage Through Minimum and then Showing a Limited Growth to Perpetuity (MM) Limit**

Source: Compiled by the authors.

Brusov et al. in 2008 [17], 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) [18].

Brusov-Filatova-Orekhova (BFO) theory, replaced the well-known theory of the cost of capital and capital structure of Nobel laureates Modigliani and Miller. The authors departed from the Modigliani-Miller assumption about the eternity (infinity of life) of companies and additionally developed a quantitative theory for estimating the main parameters of the financial activity of companies with an arbitrary lifetime.

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, because to its perpetuity, underestimates the company's weighted average cost of capital and cost of equity while significantly overestimating the company's value.

Such an incorrect assessment of key performance indicators of companies' financial performance led to an underestimation of the associated risks and the impossibility or serious difficulties in making adequate management decisions, which was one of the implicit causes of the 2008 global financial crisis (for more details see [18].

In the Modigliani-Miller theory, there is no time factor (time is equal to infinity), which does not allow us to study the dependence of the company's financial performance on the time factor. But Brusov-Filatova-Orekhova theory (BFO-theory) was created for companies of arbitrary age and allows to study the dependence of the company's financial performance on the time factor. Brusov et al. in 2015 [19] studied the dependence of the cost of raising capital *WACC* on the age of the company n at different levels of debt load, at different values of the cost of equity and borrowed capital in order to determine the minimum cost of raising capital. It was shown that there are two types of dependence of *WACC* on company age n: a monotonic decrease in *WACC* with n and a decrease in *WACC* with passage through minimum (which is called "the golden age" of the company), followed by a limited increase (*Fig. 2*). Companies with the latter type of dependence of *WACC* on the age of the company n can take advantage of the discovered effect at a certain stage of development. Thus, in [19], for the first time, it was concluded that the *WACC* valuation in the Modigliani and Miller (MM) theory is not minimal, and the valuation of the company is not the maximum: the "golden age" of the company exists. This conclusion seems to be very significant and important. The study of the properties of the "golden age" effect was continued in [20].

Thus, generally speaking, the conclusion by Myers [16], that the valuation of the weighted average cost of capital, *WACC*, in the Modigliani-Miller theory is the lowest, and the valuation of the company value, *V*, is maximum. turns out to be wrong, and in the life of company, there is a "golden age", when the cost of raising capital becomes minimal (less than perpetual limit) and company value becomes maximal (bigger than perpetual limit). Moreover, since a company's golden age depends on the company's capital costs, k_e and k_d, by controlling them (for example, by changing the amount of dividend payments that reflect the cost of equity, etc.), the company can prolong its golden age. When the cost of raising capital becomes minimal (below the perpetuity limit), and the capitalization of companies becomes maximum (above the perpetuity estimate) within a given time interval.

For a more detailed description of the two types of dependence of *WACC* on company age *n*, see *Fig. 3*.

Over the past couple of years, the two main theories of capital structure — Brusov-Filatova-Orekhova

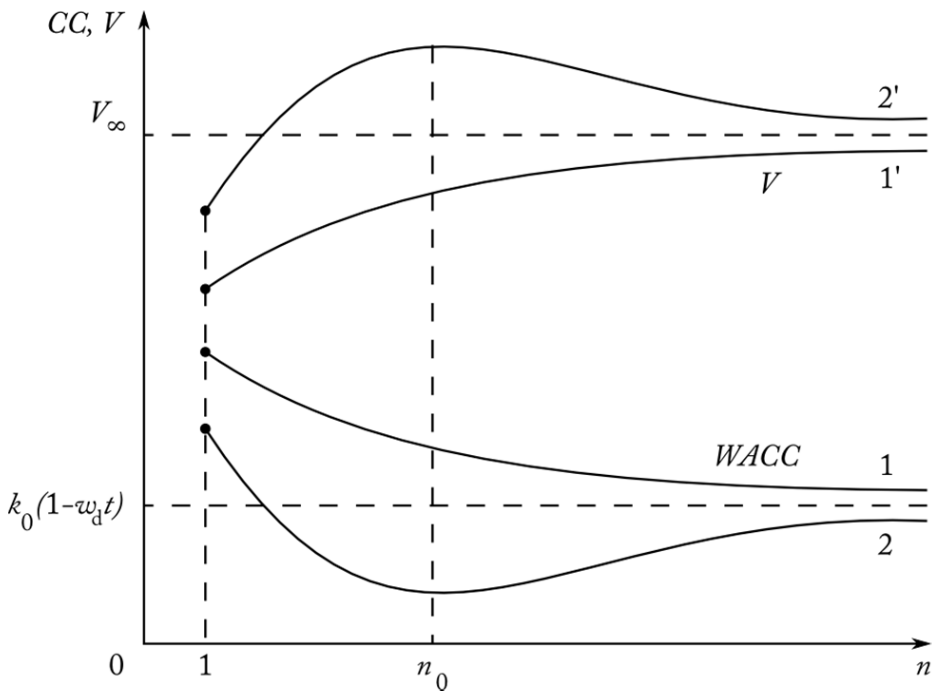

Fig. 3. **Two Kinds of Dependences of *WACC* and Company Capitalization, *V*, on the Age of the Company *n***

Source: Compiled by the authors.

Note: 1–1′ — monotonic descending of *WACC* and monotonic increase of company value, *V*, with the age of the company *n*; 2–2′ — descending of WACC with passage through minimum and then showing a limited growth, and increase of company value, *V*, with passage through maximum (at n_0) and then a limited descending to perpetuity (MM) limit.

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 [21] 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 a company's variable income on its main financial performance.

In [21], 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 fulfil the long-term goal of the functioning of any company. [21] examines the state of the theory of the structure of capital and the cost of capital 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.

In the current paper, the effect of the "golden age" of the company is investigated, taking into account the conditions of the real functioning of companies. With this purpose, the dependence of cost of raising capital, *WACC*, on the age of company, *n*, is studied at various leverage levels, *L*, at various values of equity, ke, and debt, kd, costs, at different frequencies of tax on income payments, *p*, with advance payments of tax on income and payments at the end of periods, at variable income of the companies. Important conclusions were made about the "golden age" effect and recipes for managing the effect, and recommendations for the company's management with this respect have been developed. The limitation of the study is due to the fact that we are considering the case of a constant income growth rate. In future publications, the case of a variable income growth rate will be considered.

THEORETICAL BASIS

The following notation will be used in the text below.

$$k_d,\ w_d = \frac{D}{D+S}$$

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 — growth rate, p — frequency of tax on income payments, $WACC$ — the weighted average cost of capital, t — tax on profit, n — company age.

Over the past couple of years, the two main theories of the capital structure (Brusov-Filatova-Orekhova (BFO) and Modigliani-Miller (MM)) have been adapted by the authors to the established financial practices of the functioning of companies, taking into account the real conditions of their work. They are generalized to the case of variable income (this is extremely important), as well as to the case of paying income tax with arbitrary frequency, to the case of advance payments of income tax, and to the combinations of these effects [21]. An account of these effects has changed the results of both theories significantly and made the Modigliani-Miller theory (which is perpetual limit of Brusov-Filatova-Orekhova) closer to Brusov-Filatova-Orekhova one, although they will never intersect, since the MM theory does not have a time factor, and the BFO describes companies of arbitrary age.

In this paper, we use the generalized Brusov-Filatova-Orekhova (BFO) theory as well as the generalized Modigliani-Miller theory to study the existence of the minimum in weighted average cost of capital, *WACC*, and its behavior at a wide range of the above parameters.

The basic BFO equation for *WACC* (before account mentioned above effects of variable income, frequent paying income tax, advance payments of income tax, and combinations of these effects) has the following form:

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

as well as its limit for perpetuity companies (MM limit)

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

Formula (2) could be easily obtained from (1) under $n=\infty$. For the derivation of these formulas, their meaning, and their application, see [18].

The Brusov-Filatova-Orekhova (BFO) theory, its methodology, and results are well known (see, for example, [22–31]). A lot of authors of [26–28] use the BFO theory in practice.

Below we give a summary of the *WACC* formulas for Brusov-Filatova-Orekhova (BFO) — theory as well as for Modigliani-Miller (MM) — theory [21] adapted by the authors to the established financial practice of the functioning of companies, taking into account the real conditions of their work.

Variable Income Case

Income Tax Payments at the Ends of Periods

The Brusov-Filatova-Orekhova equation for *WACC* for the case of variable income with income tax payments at the ends of periods takes the following form:

$$BFO:\frac{1-\left(\frac{1+g}{1+WACC}\right)^n}{WACC-g}=\frac{1-\left(\frac{1+g}{1+k_0}\right)^n}{(k_0-g)\cdot\left(1-w_d t\left[1-(1+k_d)^{-n}\right]\right)}. \quad (3)$$

The Modigliani-Miller equation for *WACC* for the case of variable income with income tax payments at the ends of periods takes the following form:

$$\text{MM: } WACC=(k_0-g)\cdot(1-w_d t)+g. \quad (4)$$

Advance Income Tax Payments

The Brusov-Filatova-Orekhova equation for *WACC* in the case of variable income with advance income tax payments takes a following form:

$$BFO:\frac{1-\left(\frac{1+g}{1+WACC}\right)^n}{WACC-g}=\frac{1-\left(\frac{1+g}{1+k_0}\right)^n}{(k_0-g)\cdot\left(1-w_d t\left[1-(1+k_d)^{-n}\right]\cdot(1+k_d)\right)}. \quad (5)$$

The Modigliani-Miller equation for *WACC* in the case of variable income with advance income tax payments takes the following form:

$$\text{MM: } WACC=(k_0-g)\cdot(1-w_d t\cdot(1+k_d))+g. \quad (6)$$

Frequent Income Tax Payments

Income Tax Payments at the Ends of Periods

The Brusov-Filatova-Orekhova equation for *WACC* for the case of frequent payments of income tax at the ends of periods takes the following form:

$$BFO:\frac{1-(1+WACC)^{-n}}{WACC}=\frac{1-(1+k_0)^{-n}}{k_0\cdot\left(1-\frac{k_d w_d t}{p}\frac{\left[1-(1+k_d)^{-n}\right]}{(1+k_d)^{1/p}-1}\right)}. \quad (7)$$

The Modigliani-Miller equation for *WACC* for the case of frequent payments of income tax at the ends of periods takes the following form:

$$\text{MM: } WACC=k_0\cdot\left(1-\frac{k_d w_d t}{p\cdot\left[(1+k_d)^{1/p}-1\right]}\right). \quad (8)$$

Advance Income Tax Payments

The Brusov-Filatova-Orekhova equation for *WACC* for the case of advanced frequent payments of income tax takes the following form:

$$BFO:\frac{1-(1+WACC)^{-n}}{WACC}=\frac{1-(1+k_0)^{-n}}{k_0\cdot\left(1-\frac{k_d w_d t}{p}\frac{\left[1-(1+k_d)^{-n}\right]\cdot(1+k_d)^{1/p}}{(1+k_d)^{1/p}-1}\right)} \quad (9)$$

The Modigliani-Miller equation for *WACC* for the case of advanced payments of income tax takes the following form:

$$\text{MM: } WACC=k_0\cdot\left(1-\frac{k_d w_d t\cdot(1+k_d)^{1/p}}{p\cdot\left[(1+k_d)^{1/p}-1\right]}\right). \quad (10)$$

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

The Brusov-Filatova-Orekhova equation for *WACC* for the case of simultaneous accounting of variable income in the case of frequent income tax payments at the ends of periods takes the following form:

Income Tax Payments at the Ends of Periods

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

The Modigliani-Miller equation for *WACC* for the case of simultaneous accounting of variable income in case of frequent income tax payments at the ends of periods takes the following form:

$$WACC-g=(k_0-g)\cdot\left(1-\frac{k_d w_d t}{p\cdot\left[(1+k_d)^{1/p}-1\right]}\right). \quad (12)$$

Advance Income Tax Payments

The Brusov-Filatova-Orekhova equation for *WACC* for the case of simultaneous accounting of variable income in case of advance frequent income tax payments takes the following form:

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

The Modigliani-Miller equation for *WACC* for the case of simultaneous accounting of variable income in case of advance frequent income tax payments takes the following form:

$$WACC-g=k_0\cdot\left(1-\frac{k_d w_d t\cdot(1+k_d)^{1/p}}{p\cdot\left[(1+k_d)^{1/p}-1\right]}\right). \quad (14)$$

RESULTS

To find out the possibility of managing the golden age of the company: its existence and the possibility of shifting in time and extending the duration of the effect below, we investigate the dependence of the cost of raising capital, *WACC*, on the age of company, n, at various values of equity and debt costs, at different frequencies of tax on income payments, p, with advance payments of tax on income and payments at the end of periods, at variable income of the companies and at various leverage levels, L.

In all variants of the Modigliani-Miller theory, the time factor is absent, therefore, when studying the dependence of *WACC* on n, we work in the framework of the Brusov-Filatova-Orekhova theory. The Modigliani-Miller theory is used by us only to estimate the limiting eternity values of *WACC*.

Regarding the study of the impact of the cost of debt, k_d, on dependence *WACC* on company age, n. In classical Modigliani-Miller theory *WACC* does not depend on debt cost, k_d, as it can be seen from the standard Modigliani-Miller formula (2). But as one can see from formulas (6), (8), (10), (12) in Modigliani-Miller theory, modified by Brusov at al. [21] *WACC* depends on k_d.

Frequent Income Tax Payments
Income Tax Payments at the Ends of Periods

As it is seen from *Table 1* the difference of *WACC* minimum, Δ, between values at $p = 1$ and $p = 12$ increases with the debt cost, k_d, as well as the difference between perpetuity values at $p = 1$ and $p = 12$. Note that the first value is greater than the second.

Gap depth *WACC*(n) increases with the debt cost, k_d, from 0.65% up to 1.41% at monthly payments of tax on income and from 0.58% up to 1.23% at annual payments of tax on income. At all debt costs, k_d, the values gap depth *WACC*(n) at monthly payments of tax on income is bigger than at annual payments of tax on income.

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

Using formulas (7) and (9) we compare the results for frequent tax on income payments (p = 1; 2; 4; 6; 12) at $g = 0$, with advance payments of tax on income and payments at the ends of periods. At $g = 0$ we consider

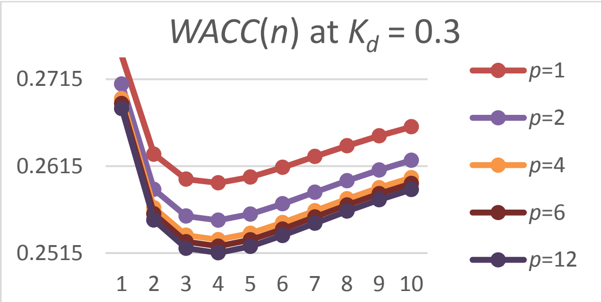

Fig. 4. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.32; k_d = 0.3; *t* = 0.2 (*n* from 1 to Ten Years)**

Source: Compiled by the authors.

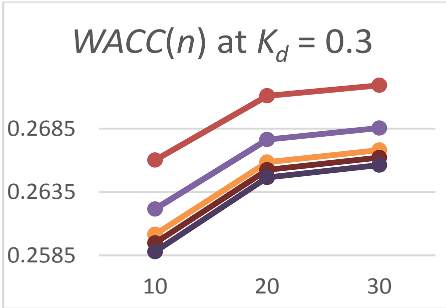

Fig. 5. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.32; k_d = 0.3; *t* = 0.2 (*n* from 10 to 30 Years)**

Source: Compiled by the authors.

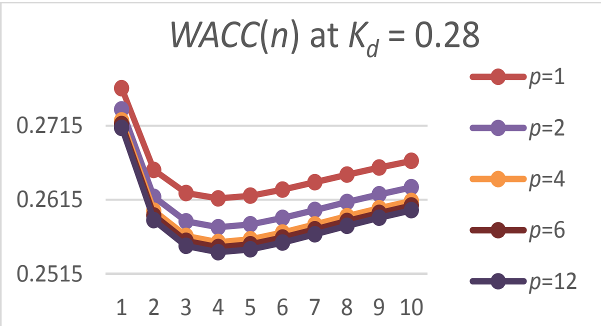

Fig. 6. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.32; k_d = 0.28; *t* = 0.2 (*n* from One to Ten Years)**

Source: Compiled by the authors.

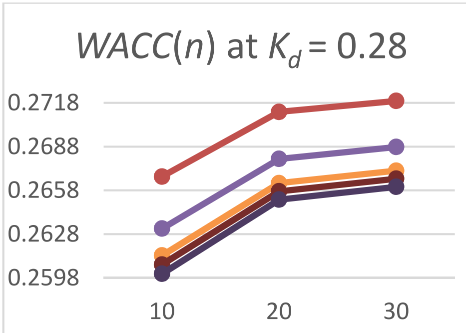

Fig. 7. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.32; k_d = 0.28; *t* = 0.2 (*n* from 10 to 30 Years)**

Source: Compiled by the authors.

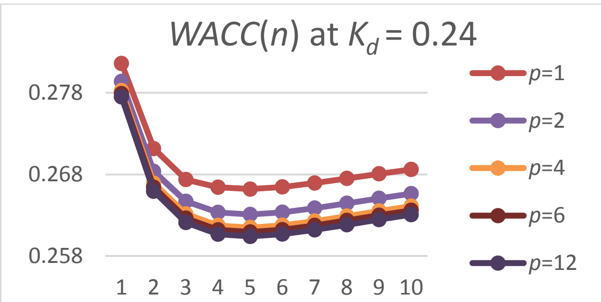

Fig. 8. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.32; k_d = 0.24; *t* = 0.2 (*n* from One to Ten Years)**

Source: Compiled by the authors.

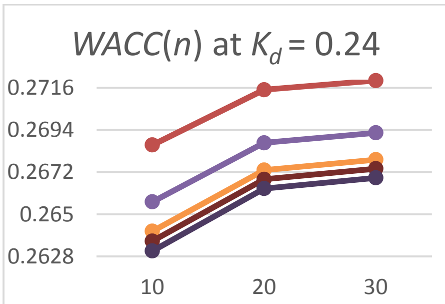

Fig. 9. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.32; k_d = 0.24; *t* = 0.2 (*n* from 10 to 30 Years)**

Source: Compiled by the authors.

the cases of k_0 = 0.05, a few values k_d = 0.02; 0.03; 0.035 and a couple leverage level values *L* = 1 and 3.

It is seen from Fig. 10, that minimum in dependence of *WACC*(*n*) takes place at n_0 = 9.7 years, thus "the golden age" is equal to 9.7 years.

It is seen from *Fig. 11*, that *WACC* minimum in dependence of *WACC*(*n*) takes place at n_0 = 9.7 years, thus "the golden age" is equal to 9.7 years. Comparing *Fig. 10* and *11*, it can be seen that the value of n_0 practically does not change when moving from *L* = 1 to *L* = 3, but the distance between the curves decreases significantly.

It is seen from *Fig. 12*, that *WACC* minimum in dependence of *WACC*(*n*) takes place at n_0 = 18 years, thus "the golden age" is equal to 18 years. Comparing *Fig. 10* and *11*, it can be

Table 1

The Dependence of Difference of WACC Minimum, Between Values at p = 1 and p = 12 and Between Perpetuity Values at *p* = 1 and *p* = 12 on debt cost k_d = 0.24; 0.28; 0.30

k_d = 0.30				
p = 1	%	25.96	27.19	1.23
p = 12	%	25.15	26.56	1.41
Δ	%	0.81	0.63	
k_d = 0.28				
p = 1	%	26.17%	27.19	1.02
p = 12	%	25.44%	26.60	1.16
Δ	%	0.73%	0.59	
k_d = 0.24				
p = 1	%	26.62	27.20	0.58
p = 12	%	26.04	26.69	0.65
Δ	%	0.58	0.51	

Source: Compiled by the authors.

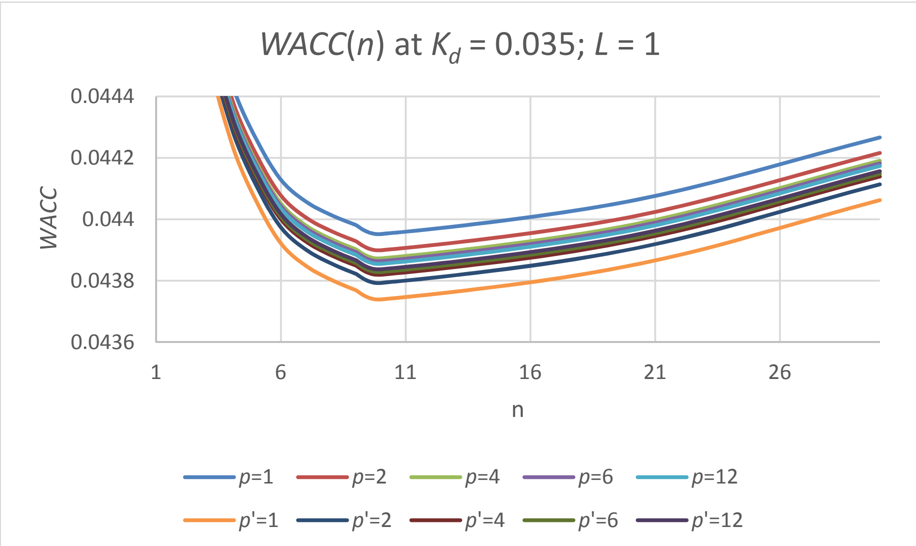

Fig. 10. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.035; *t* = 0.2; *L* = 1 (*n* from 10 to 30 years) with Advance Payments (*p'*) of Tax on Income and Payments at the End of Periods (*p*)**

Source: Compiled by the authors.

seen that under change k_d from 0.035 to 0.03 the value of n_0 increases significantly: from 9.7 years to 18 years. This means that it is possible to control the golden age by changing the cost of debt k_d.

It is seen from *Fig. 13*, that minimum of *WACC* in dependence of *WACC*(*n*) takes place at n_0 = 17.5 years, thus "the golden age" is equal to 17.5 years.

It is seen from *Fig. 14*, that at k_d = 0.02 minimum of *WACC* in dependence of *WACC*(*n*) is absent as well "the golden age" effect.

It is seen from *Fig. 15*, that at k_d = 0.02 minimum of *WACC* in dependence of *WACC*(*n*) absent, as well "the golden age" effect.

From *Fig. 10–15* it can be seen that with an increase in the difference $\Delta k = k_0 - k_d$, the "golden age" first increases and then disappears, but the depth of the gap decreases.

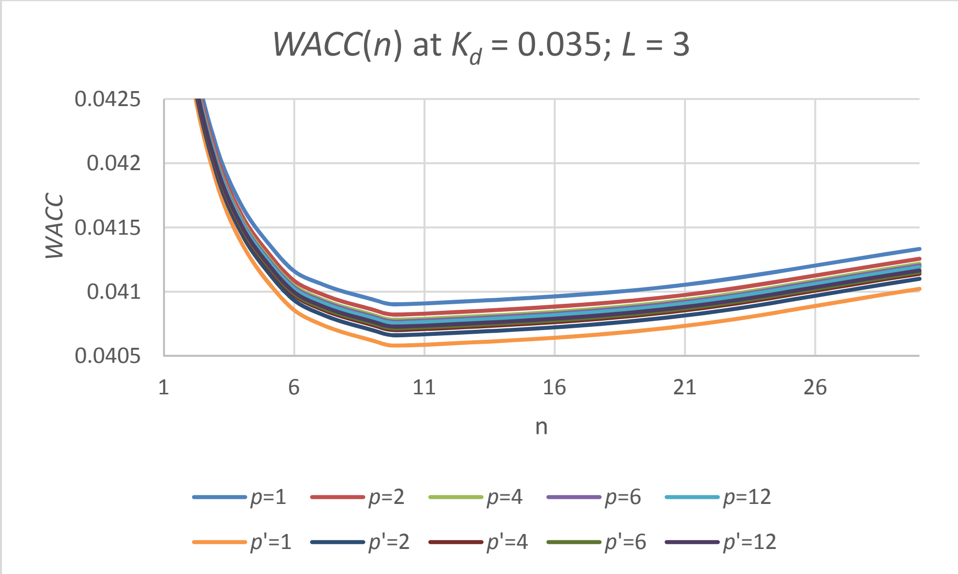

Fig. 11. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit p = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.035; t = 0.2; L = 3 (*n* from 10 to 30 years) with Advance Payments (*p*') of Tax on Income and Payments at the End of Periods (*p*)**

Source: Compiled by the authors.

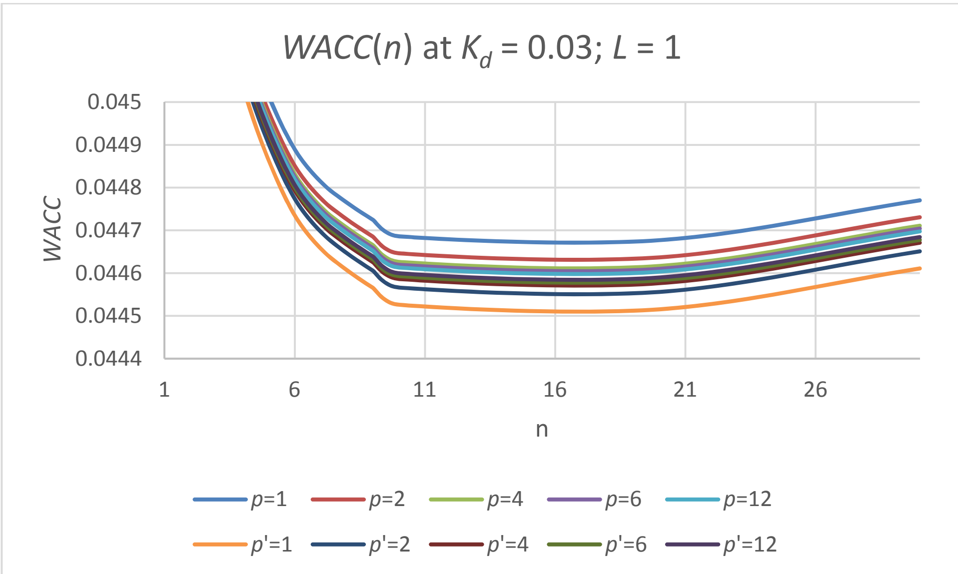

Fig. 12. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit p = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.03; t = 0.2; L = 1 (*n* from 1 to 30 Years) with Advance Payments (*p*') of Tax on Income and Payments at the End of Periods (*p*)**

Source: Compiled by the authors.

The gap depth, Δ, is the difference between minimum of *WACC*(*n*) and perpetuity values of *WACC*(∞).

A Larger Scale Figures: The Separation between the Curves is More Visible

It is seen from *Fig. 16*, that minimum of *WACC* in dependence of WACC(n) takes place at n_0 = 9.7 years, thus "the golden age" is equal to 9.7 years.

It is seen from *Fig. 17*, that minimum of *WACC* in dependence of *WACC*(*n*) takes place at n_0 = 9.7 years, thus "the golden age" is equal to 9.7 years.

It is seen from *Fig. 18*, that minimum of *WACC* in dependence of WACC(n) takes place at n_0 = 17.5 years, thus "the golden age" is equal to 17.5 years.

It is seen from *Fig. 19*, that minimum of *WACC* in dependence of *WACC*(*n*) takes place at n_0 = 18 years, thus "the golden age" is equal to 18 years.

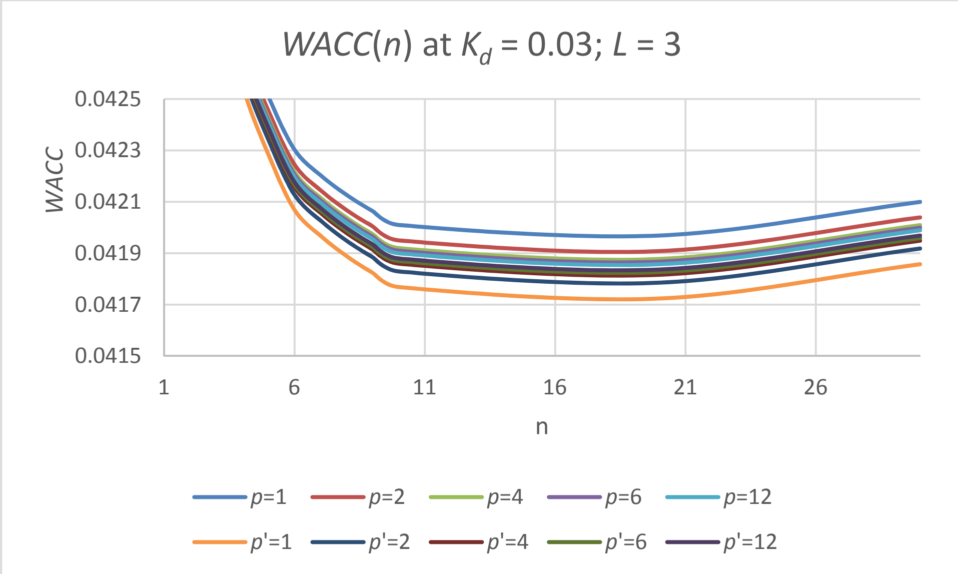

Fig. 13. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.03; *t* = 0.2; *L* = 1 (*n* from 1 to 30 years) with Advance Payments (*p*') of Tax on Income and Payments at the End of Periods (*p*)**

Source: Compiled by the authors.

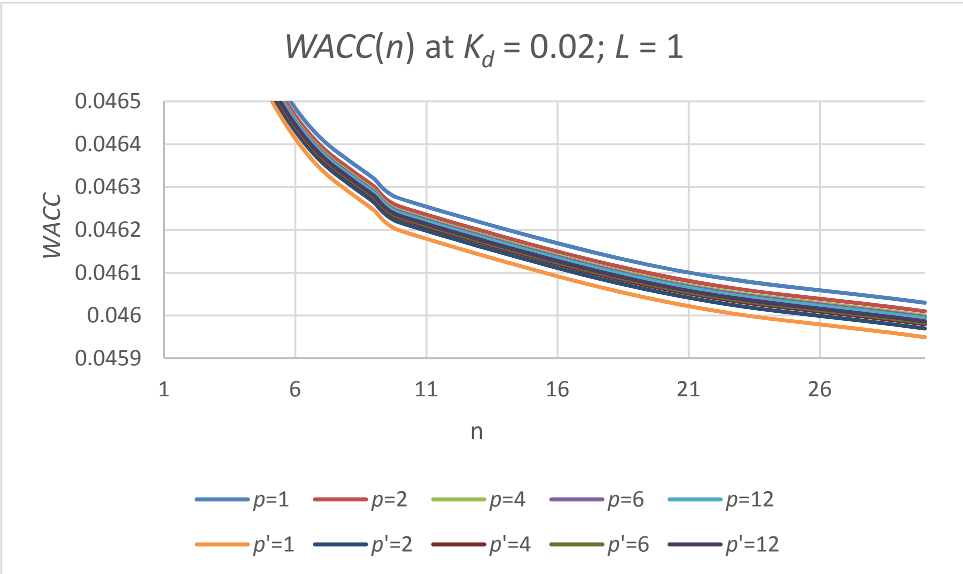

Fig. 14. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.02; *t* = 0.2; *L* = 1 (*n* from 1 to 30 Years) with Advance Payments (*p*') of Tax on Income and Payments at the End of Periods (*p*)**

Source: Compiled by the authors.

It is seen from *Fig. 20*, that at k_d = 0.02 minimum of *WACC* in dependence of *WACC*(*n*) absent, as well "the golden age" effect.

We compare the results for frequent tax on income payments (p = 1; 2; 4; 6; 12) at g = 0, with advance payments of tax on income and payments at the ends of periods. At g = 0 we consider the cases of k_0 = 0.05, a few values k_d = 0.02; 0.03; 0.035 and a couple leverage level values L=1 and 3.

From *Fig. 16–20* it can be seen that with an increase in the difference $\Delta k = k_0 - k_d$, the "golden age" first increases and then disappears, but the depth of the gap decreases. By controlling this difference, the company can control both "the golden age" itself and the duration of the effect (the behavior of *WACC* in the vicinity of "the golden age").

The summary of above results in the following:

1. For payments at the ends of periods, *WACC*(n) values shift down with frequency p.

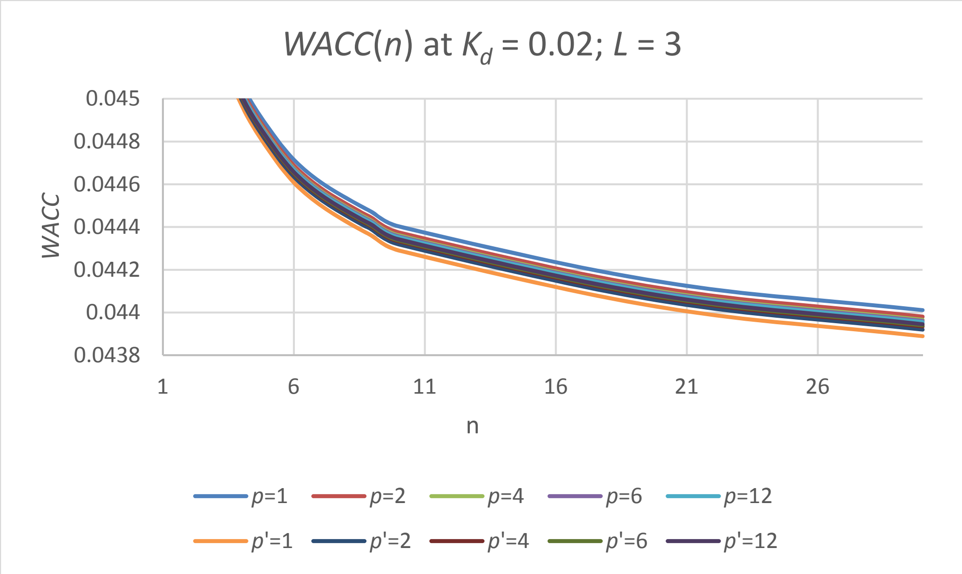

Fig. 15. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.02; *t* = 0.2; *L* = 3 (*n* from 1 to 30 Years) with Advance Payments (*p'*) of Tax on Income and Payments at the End of Periods (*p*)**

Source: Compiled by the authors.

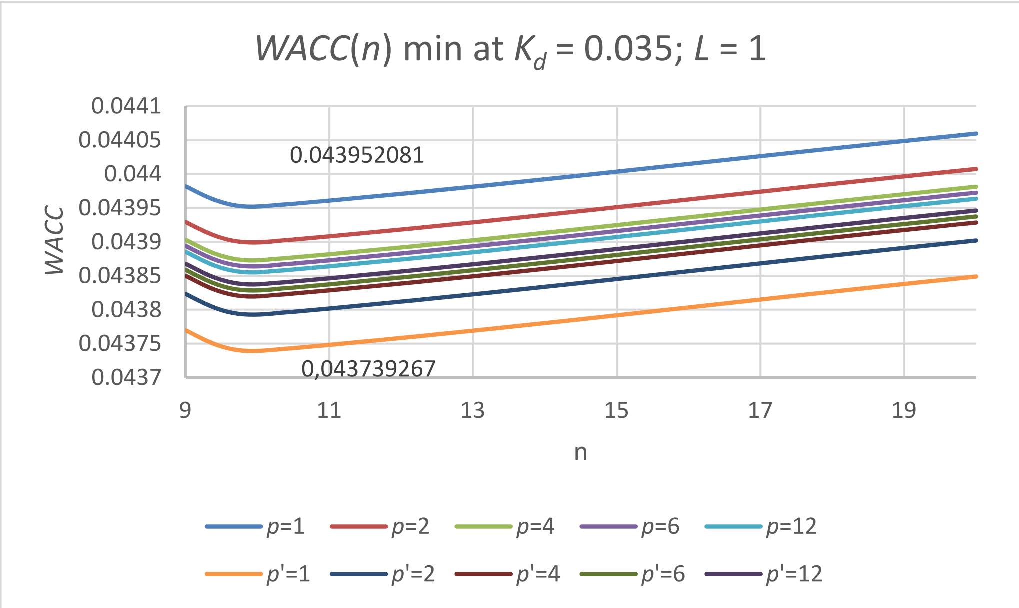

Fig. 16. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.035; *t* = 0.2; *L* = 1 (*n* from 9 to 20 years) with Advance Payments (*p'*) of Tax on Income and Payments at the End of Periods (*p*) (Larger Scale)**

Source: Compiled by the authors.

2. For advance payments of tax on income, *WACC*(*n*) values shift up with frequency *p*.

3. It turns out that the values of *WACC*(*n*) decrease in the first case, and increase in the second. But they never overlap. For example, for *p* = 12 in the first case (monthly payments of tax on income) min *WACC*(*n*) is equal to 4.079% while in the second case max *WACC*(*n*) is equal to 4.077% (at k_d = 0.035).

4. All of the above means that it is always better for an enterprise to pay income tax in advance, in which case the payments should be made annually. If a company pays income tax at the end of the reporting period, then it is beneficial to pay income tax monthly.

5. When k_d decreases from 0.035 to 0.02, the "golden age" effect decreases and disappears at k_d = 0.02.

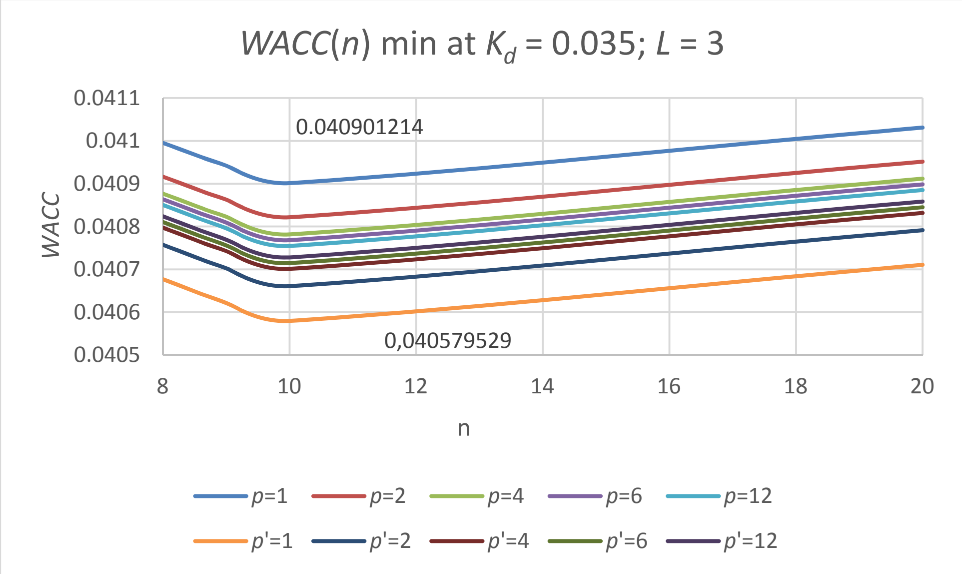

Fig. 17. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.035; *t* = 0.2; *L* = 3 (*n* from 8 to 20 years) with Advance Payments (*p*') of Tax on Income and Payments at the End of Periods (*p*) (larger scale)**

Source: Compiled by the authors.

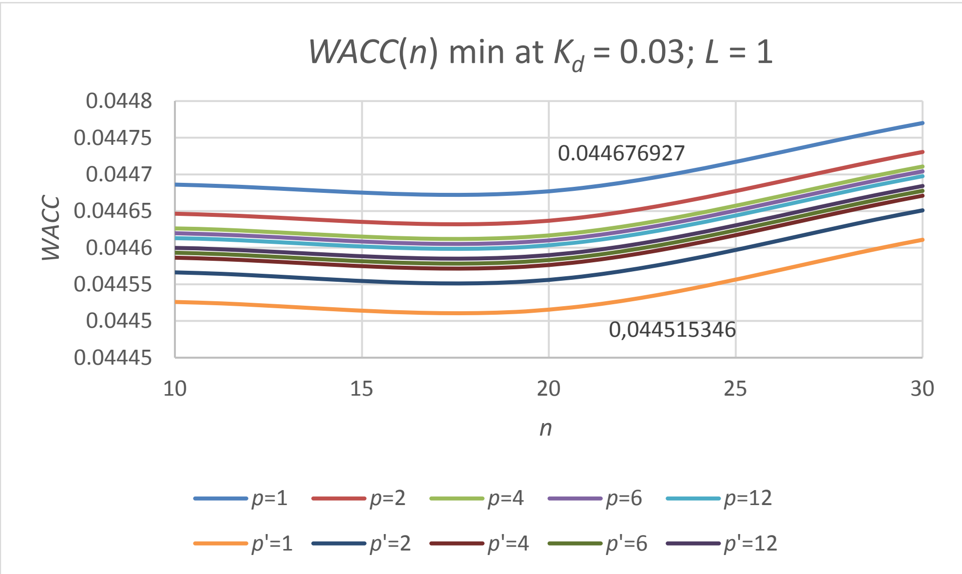

Fig. 18. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.03; *t* = 0.2; *L* = 1 (*n* from 10 to 30 years) with Advance Payments (*p*') of Tax on Income and Payments at the End of Periods (*p*) (Larger Scale)**

Source: Compiled by the authors.

Influence of Leverage Level, L

The gap depth, Δ, is the difference between minimum, *WACC*(*n*) and perpetuity values *WACC*(∞):

$$\Delta = WACC(\infty) - \min WACC.$$

From *Table 2* it follows:

1. *WACC*(∞) values increase with leverage level, *L*. Accounting that, as it is seen from *Fig. 11*, the curves *WACC*(*n*) at low leverage level lie lower for bigger leverage level, *L*, values, there are overlap of *WACC*(n) curves: this leads to very important practical consequences for application of the "golden age" effect.

2. The gap depth, Δ increases with leverage level, *L*. Because large gap depth, Δ means small value cost of raising capital and a large company value, *V*, to use the "golden age" effect, companies should try to work at a large leverage level, *L*. Note that companies must find a

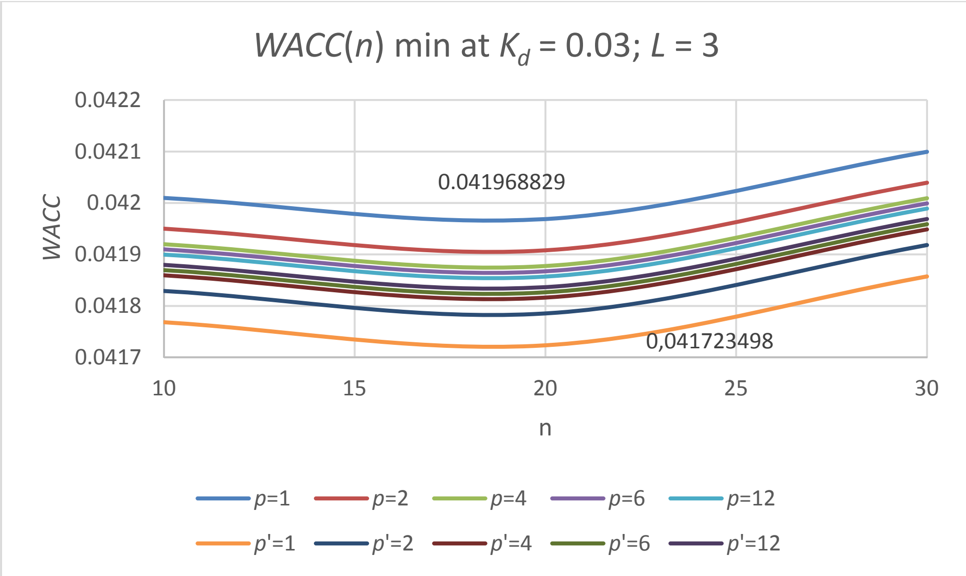

Fig. 19. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.03; *t* = 0.2; *L* = 3 (*n* from 10 to 30 years) with Advance Payments (*p*') of Tax on Income and Payments at the End of Periods (*p*) (Larger Scale)**

Source: Compiled by the authors.

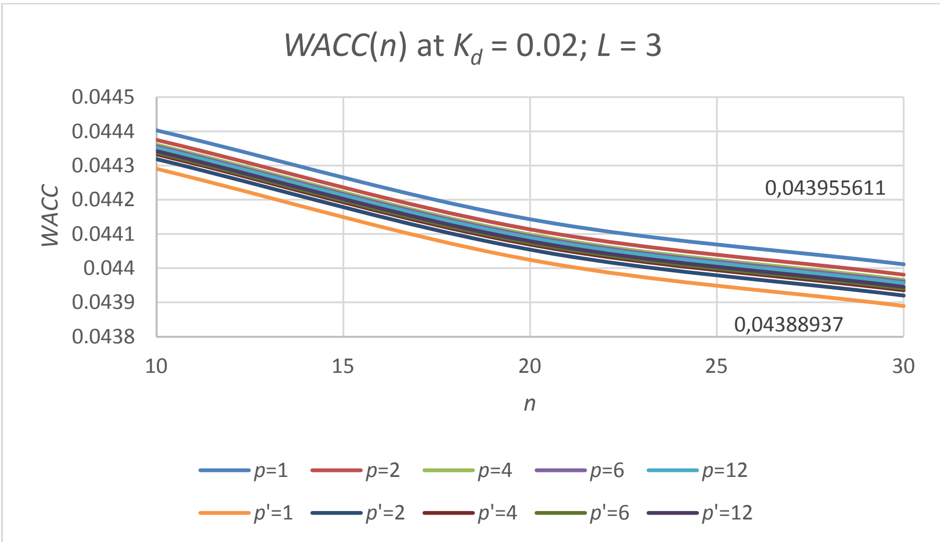

Fig. 20. **The Dependence of *WACC* on Company Age, *n*, with Frequent Payments of Tax on Profit *p* = 1; 2; 3; 6; 12 at k_0 = 0.05; k_d = 0.02; *t* = 0.2; *L* = 3 (*n* from 10 to 30 years) with Advance Payments (*p*') of Tax on Income and Payments at the End of Periods (*p*) (Larger Scale)**

Source: Compiled by the authors.

trade-off between the benefit of using "the golden age" effect and the financial hardship that comes with high levels of leverage, *L*.

It is important and interesting to note (see *Fig. 22*), that for positive (and zero) growth rate g ($g \geq 0$) "the golden age" effect exists, while for negative growth rate g ($g < 0$) "the golden age" effect is absent: *WACC*(*n*) decreases monotonically.

Comparison of the results of *Fig. 21* and *23* shows that in the case of advance income tax payments, all *WACC*(*n*) curves shift downward relative to the case of tax on income paid at the end of periods. This could be as well illustrated in *Fig. 24*, where the results for these two cases (advance payments of tax on income and payments at the ends of periods) are shown.

Influence of Growth Rate *g*

Influence of Growth Rate g: Tax on Income Payments at the Ends of Periods

Below, we investigate the influence of growth rate g on the "golden age" effect. The dependence of *WACC* on

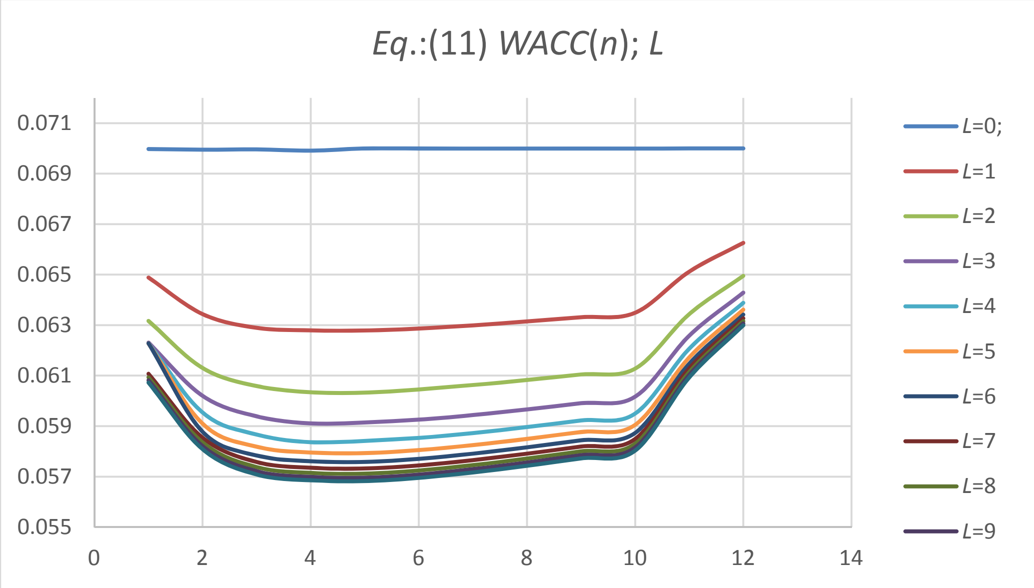

Fig. 21. **The Dependence of *WACC* on Company Age, *n*, at *p* = 1; k_0 = 0.07; k_d = 0.05; *t* = 0.2; *g* = 0.2 at Different *L* = 1; 2; 3;...10 (*n* from 1 to 12 Years)**

Source: Compiled by the authors.

Table 2

The Dependence of Perpetuity Values of WACC and the Gap Depth, Δ, in WACC (n) on Leverage Value, L, at p = 1; k0 = 0.07; kd = 0.05; t = 0.2; g = 0.2

L		0	1	2	3	4	5	6	7	8	9	10
WACC(∞)	%	7	8.3	8.73	8.95	9.08	9.17	9.23	9.275	9.31	9.34	9.36
Δ	%	0	2.01	2.7	3.04	3.24	3.37	3.47	3.54	3.6	3.64	3.67

Source: Compiled by the authors.

company age, *n*, (*n* from 1 to 30 years) within Brusov-Filatova-Orekhova theory (BFO theory) at *p* = 1; k_0 = 0.16; k_d = 0.1; 0.14; *t* = 0.2; *L* = 1; 10 at different *g* = –0.2; –0.15; –0.1; –0.05; 0; 0.05; 0.1; 0.15; 0.2 with advance payments of tax on income and payments at the end of periods. Let us start with the tax on income payments at the end of periods.

It is seen from *Fig. 25–28*, that:

1. For positive growth rate *g* ($g \geq 0$) "the golden age" effect exists, while for negative growth rate *g* ($g < 0$) "the golden age" effect is absent: *WACC* (*n*) decreases monotonically.
2. The curves *WACC*(*n*) shift up with growth rate *g*.
3. The gap depth increases with the growth rate *g*.

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

Below, we compare the results with advance income tax payments and payments at the end of **periods** at *p* = 1; k_0 = 0.16; k_d = 0.1; 0.14; *t* = 0.2; *L* = 1 at different *g* = –0.2; –0.15; –0.1; –0.05; 0; 0.05; 0.1; 0.15; 0.2

There is a doublet of curves in *WACC*(*n*): one of them corresponds to advance payments of tax on income and the other corresponds to tax on income payments at the end of periods. The first doublet lies below the second. The curves of these two doublets overlap, which can lead to very interesting effects.

There is the possibility to manage the golden age by changing the debt cost k_d, leverage level, *L*, type of payments (advance or at the end of the period etc.).

Comparison of the Dependence of *WACC* on the Age of the Company *n* with a Decrease and Increase in Income

Below is a comparison of the dependence of *WACC* on the age of the company n with falling and growing incomes. Let us take as an example the company Gazprom, for which the parameter k_0 = 0.06 is estimated by us, and we carried out calculations for two values of the cost of debt k_d = 0.03; 0.04 and for negative *g* = –0.05 and positive *g* = 0.05. The results are shown on *Fig. 33* and *34*.

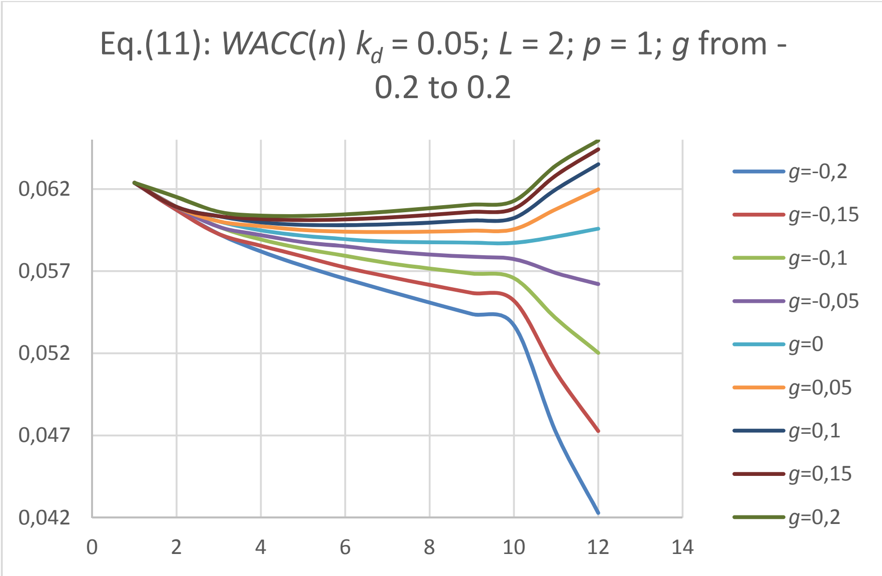

Fig. 22. **The Dependence of *WACC* on Company Age, *n*, (*n* from 1 to 12 years) at $p = 1$; $k_0 = 0.07$; $k_d = 0.05$; $t = 0.2$; at Different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$**

Source: Compiled by the authors.

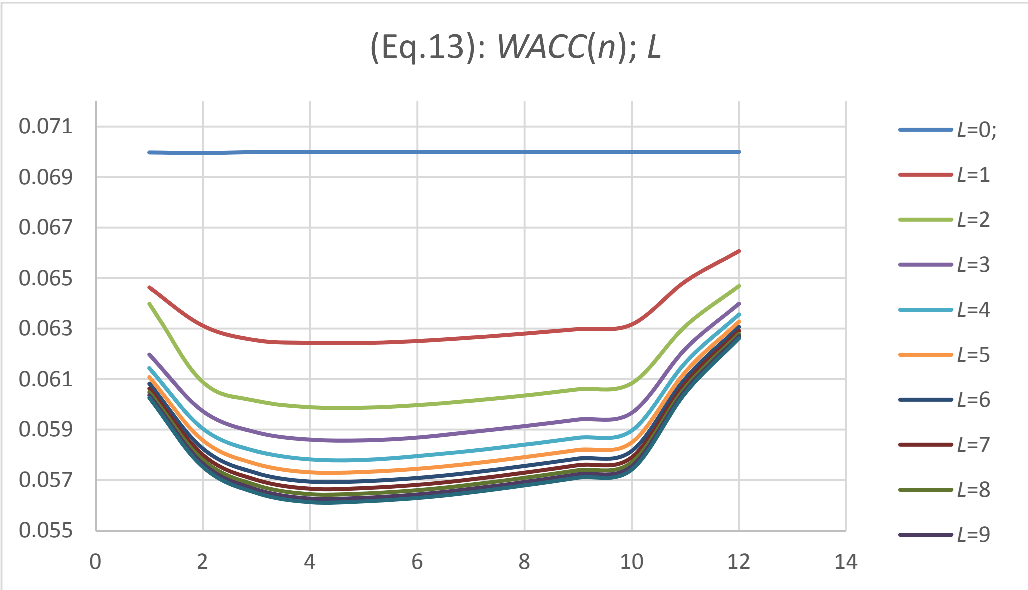

Fig. 23. **The Dependence of *WACC* on Company Age, *n*, at $p = 1$; $k_0 = 0.07$; $k_d = 0.05$; $t = 0.2$; $g = 0.2$ at Different Leverage Levels $L = 1; 2; 3;...10$ (*n* from 1 to 12 Years) Under the Advance Tax on Income Payments**

Source: Compiled by the authors.

Fig. 33 and 34 show that the golden age effect exists in the case of positive g, when income increases, and is absent in the case of negative g, when income decreases. Note that the golden age effect exists in the case of $g = 0$ (the case of constant income) for some values of the parameters k_0 and k_d.

DISCUSSION AND CONCLUSIONS

In the current paper, the effect of the "golden age" of the company is investigated, taking into account the conditions of the real functioning of companies. With this purpose, the dependence of the cost of raising capital, *WACC*, on the age of company, *n*, is studied at various leverage levels, *L*, at various values of equity, k_e, and debt, k_d, costs, at different frequencies of tax on income payments, *p*, with advance payments of tax on income and payments at the end of periods, at variable income of the companies. The frequency of income tax payments and the method of payment (in advance payments or at the end of the reporting period) are

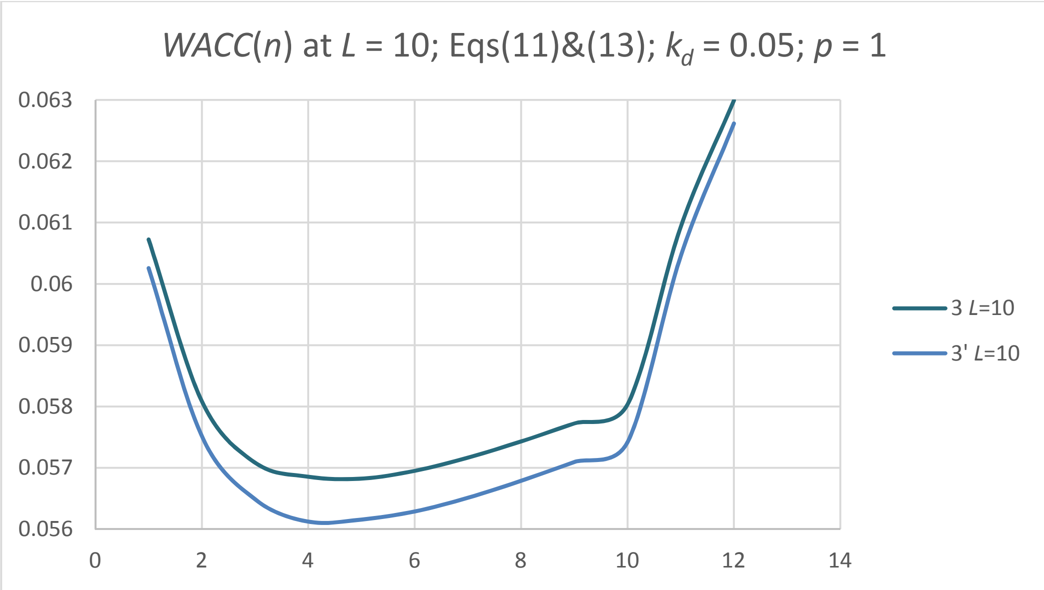

Fig. 24. **Comparison of the Dependence of *WACC* on Company Age, *n*, at *p* = 1; k_0 = 0.07; k_d = 0.05; *t* = 0.2; *g* = 0.2 at *L* = 10 (*n* from 1 to 12 years) with Advance Payments of Tax on Income and Payments at the Ends of Periods**

Source: Compiled by the authors.

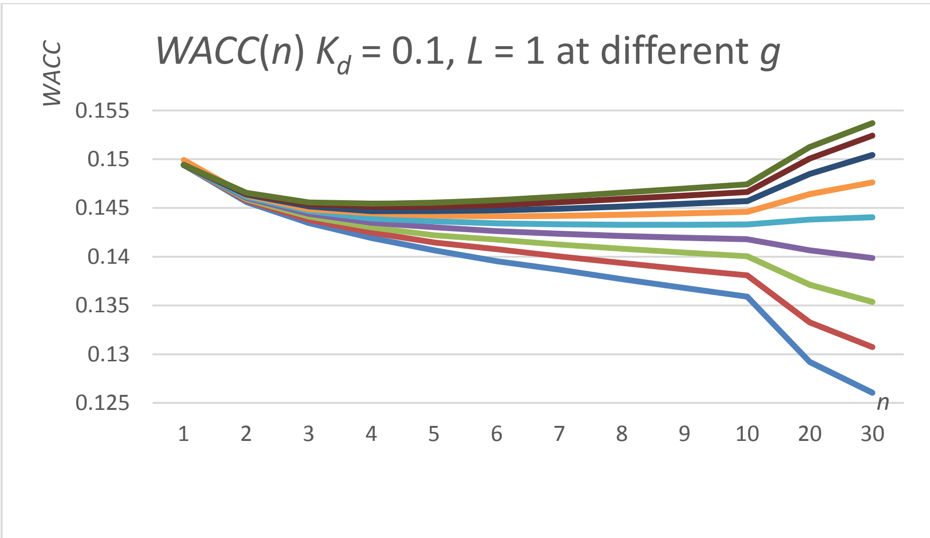

Fig. 25. **The Dependence of *WACC* on Company Age, *n*, (*n* from 1 to 30 years) at *p* = 1; k_0 = 0.16; k_d = 0.1; *t* = 0.2; *L* = 1 at Different *g* = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 (from Bottom to the Top)**

Source: Compiled by the authors.

regulated by tax legislation and depend on the amount of income received (or forecasted). Thus, studying the influence of these two factors is very important for economic practice.

In all variants of the Modigliani-Miller theory, the time factor is absent, therefore, when studying the dependence of *WACC* on *n*, we work in the framework of the Brusov-Filatova-Orekhova theory. The Modigliani-Miller theory is used by us only to estimate the limiting eternity values of *WACC*.

Important conclusions were made about the "golden age" effect, and recipes for managing the effect and recommendations for the company's management with this respect have been developed.

Let us emphasize a few new results, obtained in the paper:

- The effect exists for companies with growing (or constant) income ($g \geq 0$) and is absent for companies with falling income ($g < 0$) (see *Fig. 33, 34*).
- The depth of the gap depends on the frequency of income tax payments, *p*. Thus, the cost of capital

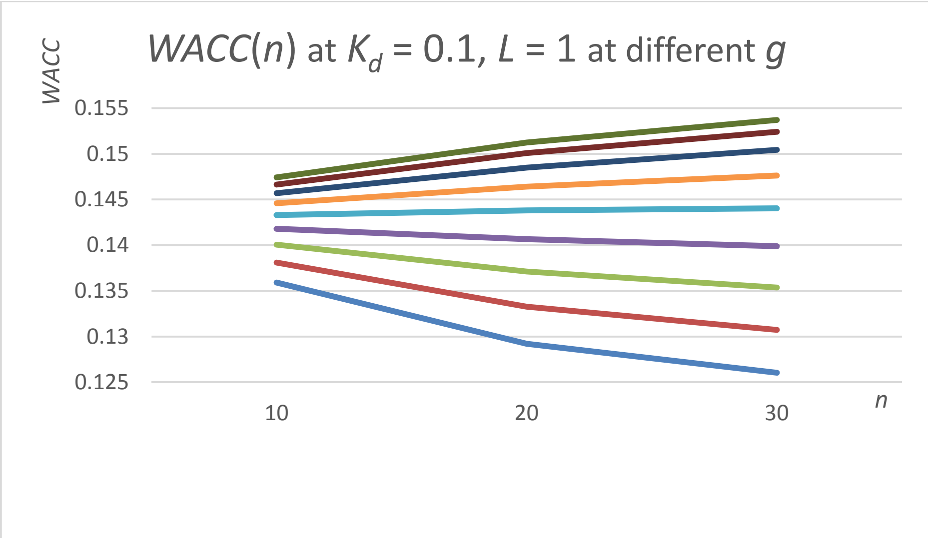

Fig. 26. **The Dependence of *WACC* on Company Age, *n*, (*n* from 10 to 30 years) at $p = 1$; $k_0 = 0.16$; $k_d = 0.1$; $t = 0.2$; $l = 1$ at Different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$ (from Bottom to the Top) (Larger Scale)**

Source: Compiled by the authors.

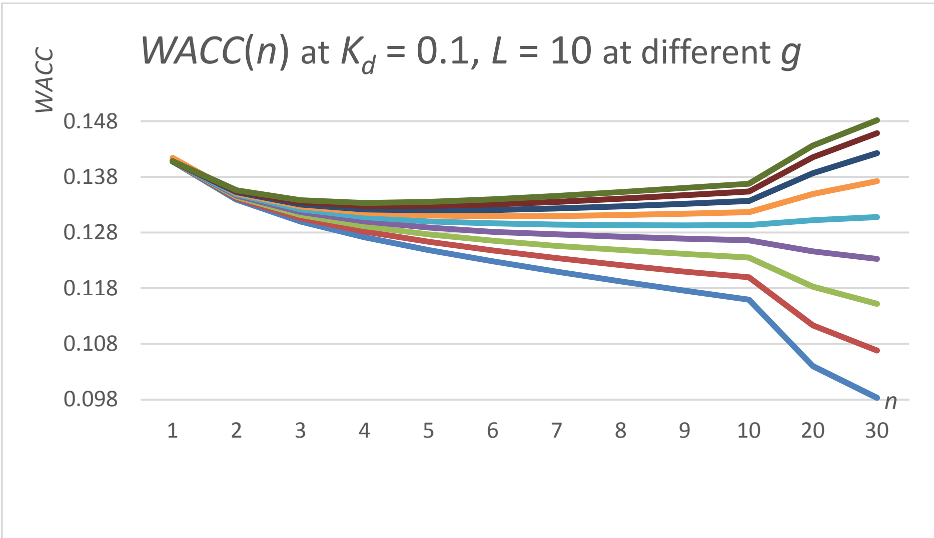

Fig. 27. **The Dependence of *WACC* on Company Age, *n*, (*n* from 1 to 30 years) at $p = 1$; $k_0 = 0.16$; $k_d = 0.1$; $t = 0.2$; $L = 10$ at Different $g = -0.2; -0.15; -0.1; -0.05; 0; 0.05; 0.1; 0.15; 0.2$ (from Bottom to the Top)**

Source: Compiled by the authors

raised (*WACC*) and the value of the company depend on p and can be controlled by changing the frequency of income tax payment, *p* within the framework of tax legislation.

- The value of the Golden Age (n_0) depends on the cost of debt k_d, so you can control it and the shape of *WACC* min by changing the cost of debt k_d. The extension of the Golden Age is very important for the company.

One can find more novelties below and, in the section, "Recommendations for the company's management".

1. "The golden age" effect exists for positive (and zero) growth rate g ($g \geq 0$), while for negative growth rate g ($g < 0$) "the golden age" effect is absent.

2. $WACC(\infty)$ values increase with leverage level, *L*. Accounting that, as it is seen from *Fig. 11*, the curves *WACC*(*n*) lie lower for bigger leverage level, L, values, there are overlap of *WACC*(*n*) curves: this leads to very important practical consequences for application of the "golden age" effect.

3. The gap depth, Δ increases with leverage level, *L*. Because a large gap depth, Δ means a small value cost

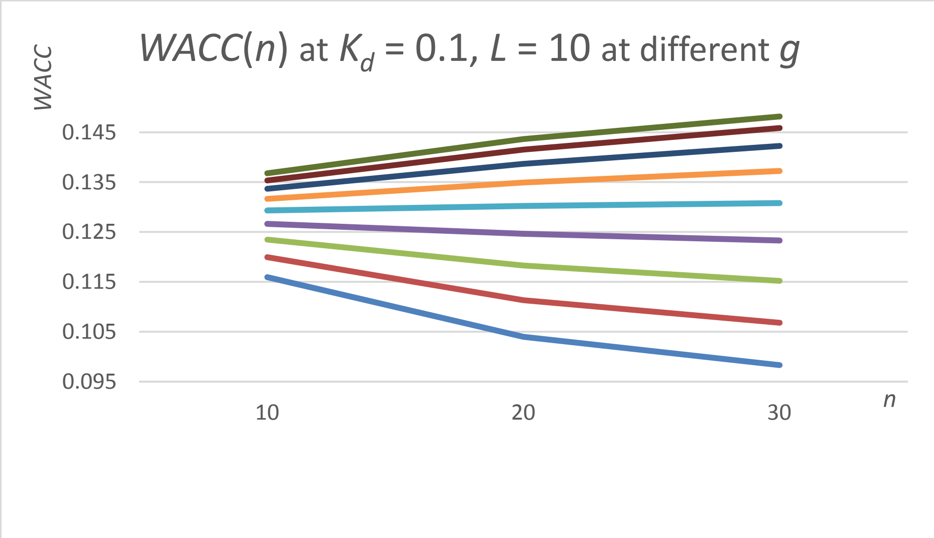

Fig. 28. **The Dependence of *WACC* on Company Age, *n*, (*n* from 10 to 30 years) within at *p* = 1; k_0 = 0.16; k_d = 0.1; *t* = 0.2; *L* = 10 at Different *g* = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 (from Bottom to the Top) (Larger Scale)**

Source: Compiled by the authors.

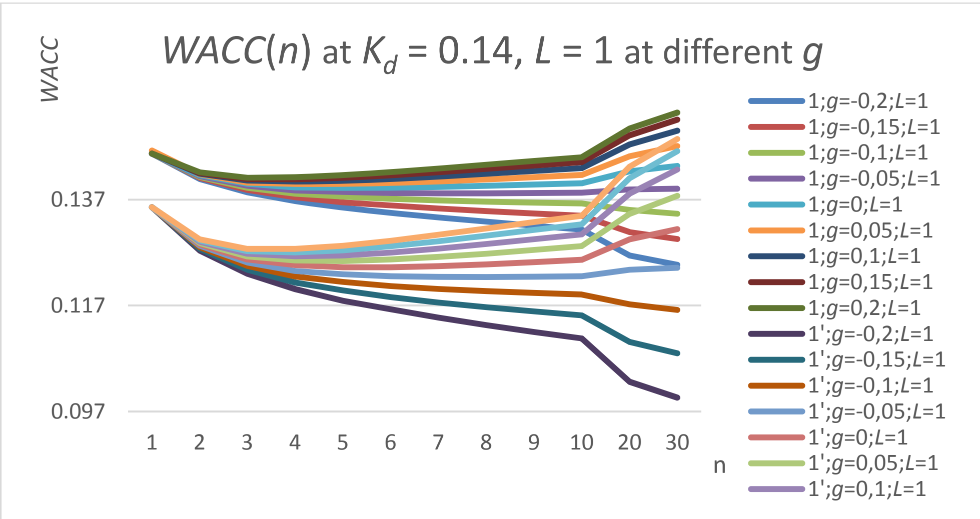

Fig. 29. **The Dependence of *WACC* on Company Age, *n*, (*n* from 1 to 30 years) at *p* = 1; k_0 = 0.16; k_d = 0.14; *t* = 0.2; *L* = 1 at Different *g* = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 with Advance Payments (1') of Tax on Income and Payments at the End of Periods (1)**

Source: Compiled by the authors.

of rising capital and big company value, *V*, to use the "golden age" effect, companies should try to work at a large leverage level, *L*. Note that companies must find a trade-off between the benefit of using the golden age effect and the financial hardship that comes with high levels of leverage.

4. For payments at the ends of periods, *WACC*(*n*) values shift down with frequency p, thus, in this case, monthly payments are preferable.

5. For advance payments of tax on income *WACC*(*n*) values shift up with frequency *p*, thus, less frequent payments permitted by tax laws are preferred.

6. It turns out that the values of *WACC*(*n*) decrease in the first case, and increase in the second. But they never overlap. For example, for *p* = 12 in the first case (monthly payments of tax on income) min *WACC*(*n*) is equal to 4.079% while in the second case max *WACC*(*n*) is equal to 4.077% (at k_d = 0.035).

7. All of the above means that it is always better for company to pay income tax in advance, in which case the payments should be less frequent. If a company pays income tax at the end of the reporting period, then it is beneficial to pay income tax monthly.

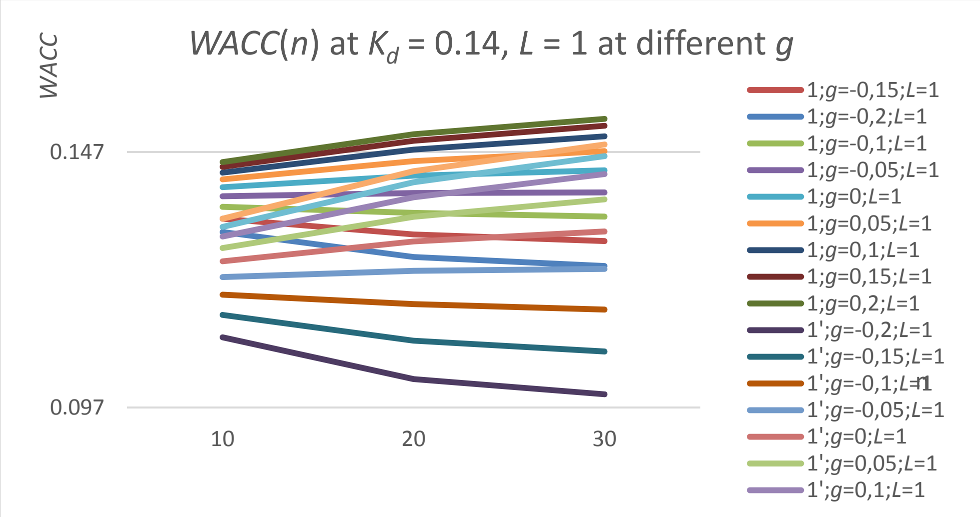

Fig. 30. **The Dependence of *WACC* on Company Age, *n*, (*n* from 10 to 30 years) at *p* = 1; k_0 = 0.16; k_d = 0.14; *t* = 0.2; *L* = 1 at different *g* = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 with Advance Payments (1') of Tax on Income and Payments at the End of Periods (1) (Larger Scale)**

Source: Compiled by the authors.

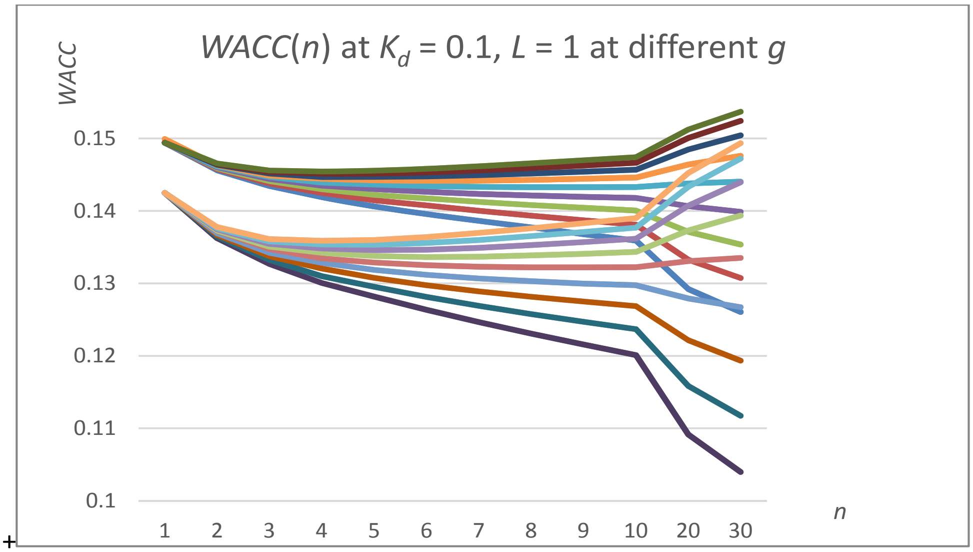

Fig. 31. **The Dependence of *WACC* on Company Age, *n*, (*n* from 10 to 30 years) at *p* = 1; k_0 = 0.16; k_d = 0.1; *t* = 0.2; *L* = 1 at different *g* = −0.2; −0.15; −0.1; −0.05; 0; 0.05; 0.1; 0.15; 0.2 with Advance Payments (1') of Tax on Income and Payments at the End of Periods (1)**

Source: Compiled by the authors.

8. Size of effect depends on debt cost k_d. For example, as we seen above at k_0 = 0.05, when k_d decreases from 0.035 to 0.02, the "golden age" effect decreases and disappears at k_d = 0.02.

9. It is possible to control the shape of the *WACC*(*n*) curve at the minimum point n_0, thereby expanding the area near this minimum and the company's golden age.

Recommendations for the Company Management

The "golden age" effect occurs only for companies with growing or constant income.

Advance payments are more advantageous. Advance payments are more advantageous, and in this case, less frequent payments permitted by tax laws are preferred.

Overlap of curves allows to choose the method of payment (advance or at the end of reporting periods), but in accordance with tax laws.

Working at a high level of leverage, *L* more profitable, which leads to an increase in the effect. Note that companies must find a trade-off between the benefit of using the "golden age", effect and the financial hardship that comes with high levels of leverage *L*.

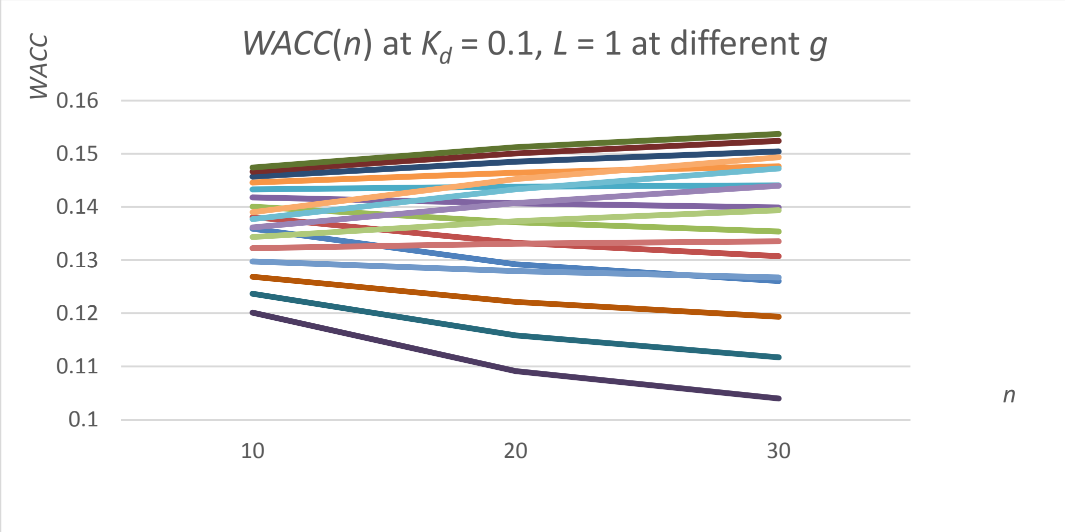

Fig. 32. **The Dependence of *WACC* on Company Age, *n*, (*n* from 10 to 30 years) at *p* = 1; k_0 = 0.16; k_d = 0.1; *t* = 0.2; *L* = 1 at different *g* = –0.2; –0.15; –0.1; –0.05; 0; 0.05; 0.1; 0.15; 0.2 with Advance Payments (1') of Tax on Income and Payments at the End of Periods (1) (Larger Scale)**

Source: Compiled by the authors.

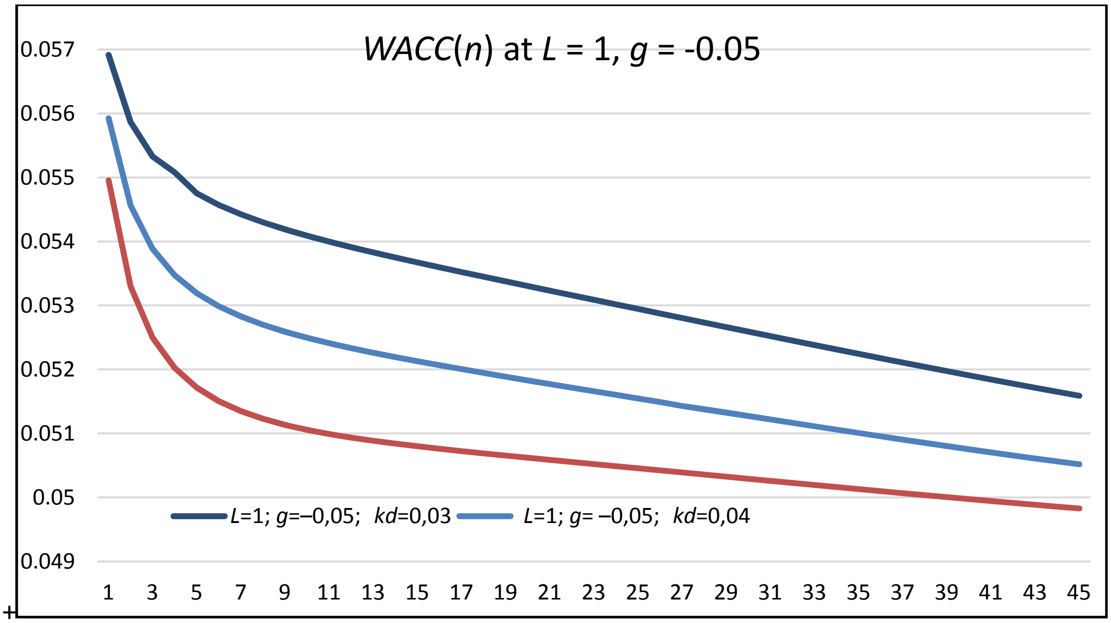

Fig. 33. **The Dependence of *WACC* on Company Age, *n*, at *p* = 1; k_0 = 0.06; k_d = 0.03; 0.04; *L* = 1 for Negative *g* = –0.05**

Source: Compiled by the authors.

The difference between the cost of equity k_0 and the cost of debt k_d should not be too large: if the difference is large, the effect disappears.

You can control the effect (golden age value, n_0, pit depth in *WACC*(*n*) dependence, the duration of "golden age" and other parameters) by changing the difference between the cost of equity k_0 and the cost of debt k_d, k_d value, leverage level, *L*, frequency, *p*, and method of income tax payments. To change the cost of equity k_0 company could change the paid dividends, and the cost of debt k_d, is equal to the loan cost.

In conclusion, we note that recently, the authors [33–35] generalized CAPM to take into account both business and financial risks and developed a new model CAPM 2.0. They showed that R. Hamada's attempt to take into account both business and financial risks [4] was untenable, and the formulas he obtained, which are widely used in practice, are incorrect. The authors of [33–35] derived correct formulas that take into account both business and financial risks. The application of the new CAPM 2.0 model to a number of companies

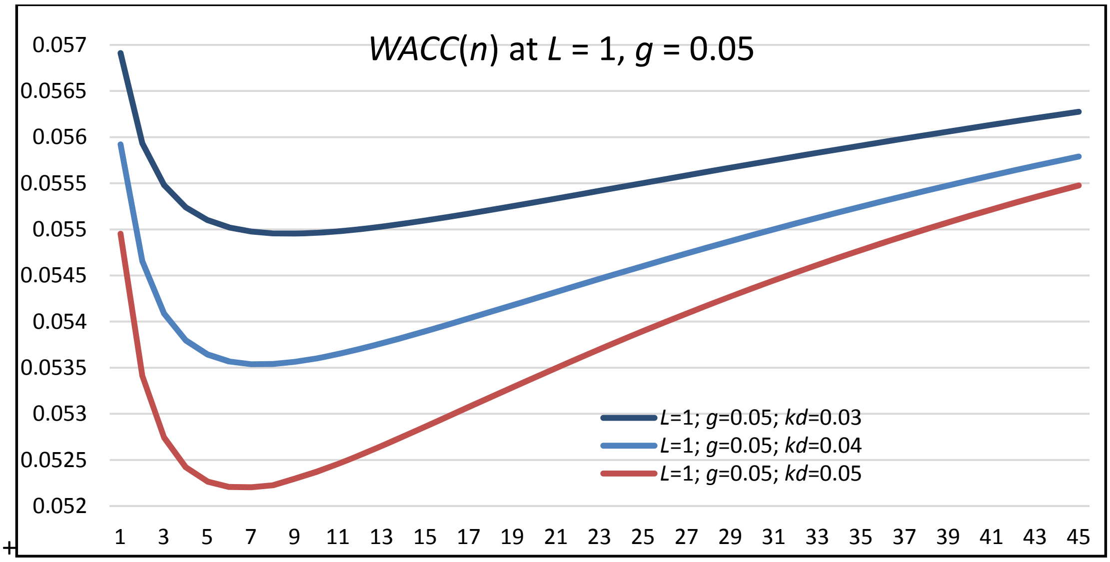

Fig. 34. **The Dependence of *WACC* on Company Age, *n*, at *p* = 1; k_0 = 0.06; k_d = 0.03; 0.04; *L* = 1 for Positive *g* = −0.05**

Source: Compiled by the authors.

is considered and the difference between the results obtained within the framework of CAPM 2.0 and CAPM is demonstrated.

The study of the dependence of *WACC* on the age of the company *n*, WACC(*n*), which can only be carried out within the framework of the BFO theory, turns out to be very important in the income approach to business valuation. This allows you to link a retrospective analysis of a company's financial condition with a representative analysis as part of a business valuation [36, 37].

In the future, the authors intend to study the existence of this effect at variable rates of income growth of the company.

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