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Generalization of the Brusov–Filatova–Orekhova Theory for the Case of Variable Income

Peter Brusov [1] and **Tatiana Filatova** [2,*]

[1] Department of Mathematics, Financial University under the Government of Russian Federation, 125167 Moscow, Russia
[2] Department of Financial and Investment Management, Financial University under the Government of Russian Federation, 125167 Moscow, Russia
* Correspondence: tvfilatova@fa.ru

Abstract: To expand the applicability in practice of the modern theory of cost and capital structure, the theory of Brusov–Filatova–Orekhova (BFO), which is valid for companies of arbitrary age, is generalized for the case of variable income. The generalized theory of capital structure can be successfully applied in corporate finance, business valuation, banking, investments, ratings, etc. income. A generalized Brusov–Filatova–Orekhova formula for the weighted average cost of capital, *WACC*, is derived using a formula in MS Excel, where the role of the discount rate shifts from *WACC* to *WACC*–g (here g is the growth rate) for financially dependent companies and k_0–g for financially independent companies is shown. A decrease in the real discount rates of *WACC*–g and k_0–g with g ensures an increase in the company's capitalization with g. The tilt of the equity cost curve, $k_e(L)$, increases with g. Since the cost of equity justifies the amount of dividends, this should change the dividend policy of the company. It turns out that for the growth rate $g < g^*$, the tilt of the curve $k_e(L)$ becomes negative. This qualitatively new effect, discovered here for the first time, can significantly change the principles of the dividend policy of the company. The obtained results are compared with the results of the MM theory with variable income.

Keywords: generalized Brusov–Filatova–Orekhova theory; growth rate; variable income; company's capitalization; the weighted average cost of capital; *WACC*; equity cost

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1. Introduction

Among the theories of capital structure, the two main ones are the Brusov–Filatova–Orekhova (BFO) theory and the Modigliani–Miller (MM) theory, which is the eternal limit of the BFO theory. Both of them consider the case of constant income, although in practice, a company's income is, of course, variable. The generalization of these two theories of capital structure for the case of variable income is very important, since it allows them to expand their applicability in practice. Recently, we have generalized the case of variable income the Modigliani-Miller theory [1], and here we have generalized for the first time the case of variable income of the Brusov–Filatova–Orekhova theory. This generalization significantly expands the applicability of the modern capital structure theory, which is valid for companies of any age, and in practice, for investments, corporate finance, business valuation, banking, ratings, etc.

1.1. Literature Review

The Brusov–Filatova–Orekhova (BFO) theory and its perpetual limit—the theory of Nobel laureates Modigliani and Miller—study capital structure problems. Capital structure is the ratio between the company's own and borrowed capital, and asks whether capital structure affects key company metrics, such as weighted average cost of capital, *WACC*, cost of equity, k_e, earnings, company value, and others, and if so, how? The determination of the optimal capital structure, that is, the determination of capital structure in which *WACC* is minimal and the company value is maximized, is one of the main problems, solved by the company's management. The Modigliani and Miller paper [2] was the first quantitative study of the influence of capital structure on a company's financial parameters. Prior to this, there was a traditional approach based on empirical data analysis.

1.2. Before the Modigliani and Miller Work

In the traditional approach, the *WACC* and the value of the company, V, depend on the level of leverage, L (and, therefore, on the capital structure). Debt is always cheaper than equity, since the former has less risk, and because in the event of bankruptcy, the claims of creditors are satisfied earlier than the claims of shareholders.

Thus, an increase in the share of cheaper borrowed capital of the total capital structure to the limit that does not violate financial stability and does not increase the risk of bankruptcy leads to a decrease in the *WACC* and an increase in the value of the company, V.

Further increase of debt financing could lead to financial stability violation and an increase in the bankruptcy risk. *WACC* increases and the company value, V, decreases. The competition of advantages of debt financing and its shortcomings at low and at high leverage levels forms the optimal capital structure where *WACC* is minimal and the company value, V, is maximum. These traditional approach results have been used in the trade-off theory.

1.3. Modigliani–Miller Theory

1.3.1. Modigliani–Miller Theory without Taxes

Modigliani and Miller (MM) [2], under a lot of assumptions, including the absence of corporate and individual taxes, the perpetuity of all companies and all cash flows, etc., obtained results that are completely different from the results of the traditional approach: capital structure does not affect capital cost and company value.

Under the above restrictions, Modigliani and Miller have shown that without taxes, the company value, V, is equal

$$V = V_0 = \frac{EBIT}{k_0} \tag{1}$$

Here, *EBIT* is Earnings Before Interest and Taxes, k_0 is discount rate, and V_0 stands for the unlevered company value.

From (1) it is easy to obtain *WACC*:

$$WACC = k_0 \tag{2}$$

k_0 is the cost of equity for a company without borrowed funds, and for a company with borrowed capital, k_0 is the cost of equity with a zero level of borrowed funds ($L = 0$).

From (1) and the expression for *WACC*

$$WACC = k_0 = k_e w_e + k_d w_d. \tag{3}$$

One can obtain the cost of equity, k_e

$$k_e = \frac{k_0}{w_e} - k_d\frac{w_d}{w_e} = \frac{k_0(S+D)}{S} - k_d\frac{D}{S} = k_0 + (k_0 - k_d)\frac{D}{S} = k_0 + (k_0 - k_d)L \tag{4}$$

Here, *WACC* is weighted average cost of capital; L is leverage level; D is debt capital value; S is equity capital value; k_d and w_d are the cost and share of the company's debt capital; and k_e and w_e are the equity capital cost and share. From (4), it follows that the equity cost increases linearly with the leverage level.

1.3.2. Modigliani–Miller Theory with Taxes

Taking into account income tax, in 1963, Modigliani and Miller [3,4] obtained the following result for the value of the levered company, V,

$$V = V_0 + D \cdot t \tag{5}$$

Here, V_0 stands for the unlevered company value, t is the tax on income, and D is debt value.

From (5), it is easy to derive the expression for the $WACC$

$$WACC = k_0 \cdot (1 - w_d t) \tag{6}$$

From (6), one can obtain the formula for equity cost, k_e, within the Modigliani–Miller theory with taxes

$$k_e = k_0 + L \cdot (k_0 - k_d)(1 - t) \tag{7}$$

Formula (7) differs from Formula (4) (MM without taxes) by the factor $(1 - t)$, which is called the tax corrector. This is less than one, so the tilt of the $k_e(L)$ curve decreases with taxes.

1.4. Unification of Capital Asset Pricing Model (CAPM) with Modigliani–Miller Model

Unification of Capital Asset Pricing Model (CAPM) with the Modigliani–Miller model was done in 1969 [5]. Hamada derived the below formula for the cost of equity of a levered company, which included the financial and business risks of a company:

$$k_e = k_F + (k_M - k_F)b_U + (k_M - k_F)b_U \frac{D}{S}(1 - T), \tag{8}$$

where b_U is the β–coefficient of the company of the same group of business risk, that the company under consideration, but with L = 0. The Formula (8) consists of three terms: risk-free income ability k_F, compensating shareholders a time value of their money, business risk premium $(k_M - k_F)b_U$, and financial risk premium $(k_M - k_F)b_U \frac{D}{S}(1 - T)$.

For a financially independent company, the financial risk is equal to zero (the third term disappears), and its owners will only receive the business risk premium.

Miller Model

In [6], Miller has accounted for corporate and individual taxes to obtain the following formula for unlevered company value, V_U,

$$V_U = \frac{EBIT(1 - T_C)(1 - T_S)}{k_0}. \tag{9}$$

Here, T_C—tax rate on corporate income, T_S—the tax rate on incomes of an individual investor from his ownership through corporation stocks.

1.5. Brusov–Filatova–Orekhova (BFO) Theory

The perpetuity of all company cash flow and of a company's lifetime was one of the main restrictions of the Modigliani–Miller (MM) theory, which has been lifted up in 2008 by Brusov–Filatova–Orekhova [7,8]. They generalized the MM theory for the case of the company of any age, n, and derived the following Brusov–Filatova–Orekhova formula for the $WACC$

$$\frac{1 - (1 + WACC)^{-n}}{WACC} = \frac{1 - (1 + k_0)^{-n}}{k_0\left[1 - w_d T\left(1 - (1 + k_d)^{-n}\right)\right]} \tag{10}$$

To obtain the Modigliani–Miller formula for the $WACC$ from (10), one should substitute $n \to \infty$.

It was shown [7,8] that a number of innovative effects, discovered in the BFO theory, are absent in the MM theory [2–4].

Some main existing principles of financial management spanning many decades have been destroyed by the BFO theory; among them is the keystone of optimal capital structure formation—trade-off theory, and the bankruptcy of this theory has been proven within the BFO theory [7,8].

1.6. Alternate WACC Formula

An alternate formula for the *WACC* has been suggested [9–12]. It has the form below (Equation (18) in [9])

$$WACC = k_0(1 - w_d t) - k_d t w_d + k_{TS} t w_d \tag{11}$$

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 (11) 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 [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 (11) simplifies the MM formula:

$$WACC = k_0(1 - w_d t)$$

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 in [1], we modify the “classical” MM theory, namely.

1.7. Trade-Off Theory

In the study of the problem of optimal capital structure of the company during many decades, the cornerstone was the world-famous trade-off theory. It is still widely used now for decisions on capital structure. In [13], the relative importance of different factors in capital structure decisions of publicly traded American companies has been studied. The most important factors to explain leverage level are: median industry leverage (+ effect on leverage), log of assets (+), market-to-book assets ratio (−), inflation (+), tangibility (+), and incomes (−). It was noted that companies that pay dividends tend to have lower leverage levels. The related effects have been found under considering book leverage. Authors found empirical data consistent with some trade-off theory versions.

In [14], authors compare the applicability of the trade-off theory and pecking order theory for small and medium-sized companies’ decisions about capital structure. It was found that the most lucrative and oldest companies have smaller leverage levels, which confirms the forecasts of the pecking order theory. Larger companies have a higher level of leverage, which is consistent with the predictions of the trade-off theory and pecking order theory. It is concluded that the trade-off theory and pecking order theory for small and medium-sized companies are not mutually exclusive when explaining capital structure decisions.

However, in 2013, Brusov et al. [7,8] proved the inconsistency of the trade-off theory in the framework of the BFO theory they created. It is shown that the assumption of risky debt financing does not lead to an increase in the *WACC*, which still decreases with increasing leverage. Thus, there is no minimum depending on the level of *WACC* leverage and no maximum depending on the value of the company from the level of leverage. Therefore, in the world-famous theory of trade-offs, there is no optimal capital structure. Brusov et al., in 2013 [7,8], having analyzed the equity cost dependence on the level of leverage under the assumption that debt capital is risky, gave an explanation for this fact.

The Modigliani–Miller theory proved that tax shields provided substantial gains to the company. In [15], the theoretical study of tax shields was continued. It was noted that companies may have tax deductibles other than debt. Such non-debt tax shields are investment tax credits, depreciation, and net-loss carry forwards. In [16], the tax effects suggested in [15] have been tested. In contrast to the prediction in [15], it was shown that debt is positively related to non-debt tax shields, as measured by investment tax credits and depreciation. The results of [14] do not provide support for an effect on debt ratios arising from nondebt tax shields. In [17], it was pointed out that a positive relationship between such proxies for non-debt tax shield and debt may result if a company invests heavily and borrows to invest. Any substitution effects between debt and non-debt tax shields could be suppressed by a mechanical positive relation of this type.

The Brusov–Filatova–Orekhova (BFO) theory methodology and results are well known in the literature (for example, see references [18–28]). Papers [22–24,28] use the BFO theory in practice. The impact on capital structure decisions of the overconfidence of finance managers of family-run businesses in India has been studied in [23]. The study concludes that manager decisions about capital structure could be explained by measurable managerial characteristics. In [24], the correlation between capital structure and company risk was studied using datasets from Pakistani companies. It was shown that the role of capital structure and risk valuation is vital for the increase in the wealth of shareholders and the sustainable growth of companies. In [25], the adjusted present value method, the free cash flow (FCF) method, the flow-to-equity method and the relationships between these methods have been considered. The authors used a stationary FCF method and the Miles and Ezzell method instead the Modigliani–Miller method to derive DCF valuation formulas for annuities. In [26], the influence of internal and external corporate governance mechanisms on the financial performance of banks in the MENA region is studied. It was shown that the corporate governance had positive effects on the financial indicators of banks. The energy companies capital costs by including an investor and market risk approach have been evaluated in [27]. The *WACC* intra-industry analysis of the companies has been done. The connection of capitalization and income ability in the BRICS banking sector has been examined in [28] under the signaling theory, the bankruptcy cost theory, the agency theory, the pecking order theory, the Modigliani and Miller theory, and the general theory of the cost of capital and capital structure—the Brusov–Filatova–Orekhova (BFO) theory. Over the past two years, the theory of capital structure has received a new impetus. A large-scale modification of both main theories of the capital structure, BFO and MM, has been carried out and continues in order to better take into account the conditions for the real functioning of companies, such as variable income, advance income tax payments, frequent income tax payments, their combinations, etc. [1,29,30]. A study of different aspects of emerging markets was carried out in [31–38]. In [34], the impact of intellectual capital on firm performance within a modified and extended VAIC model has been studied.

In the near future, the authors plan to publish a large review, which will examine in detail the problems of capital structure.

1.8. Materials and Methods

We combine analytical and numerical methods. First, we derive formulas for the company's leveraged value, V; the leverage less value of the company, V_0; the tax shield *TS,* and finally the *WACC* in the case of variable income.

Then, using Microsoft Excel, we study the dependences of the following values: weighted average cost of capital, *WACC*, discount rate, *WACC*–g, company value, V, and the cost of equity, k_e, on the level of leverage, L, at different values of the growth rate, g. We have created a large database for sets of cost of equity k_0 and cost of debt k_d, which is available upon request.

2. Modification of the BFO Theory for the Case of Companies with Variable Incomes

2.1. The Levered Company Value, V

Below, for the first time, we generalize the modern theory of the capital cost and capital structure—the Brusov–Filatova–Orekhova theory—to the case of variable income. We start by deriving the capitalization formula for a financially dependent company, assuming that income for the period grows with the growth rate g.

When accounting for the cost of any asset being equal to the sum of discounted values of incomes generated by this asset, one could write the capitalization for a financially dependent company's V of age, n, as the following expression

$$V = \frac{CF}{1+WACC} + \frac{CF(1+g)}{(1+WACC)^2} + \frac{CF(1+g)^2}{(1+WACC)^3} + \ldots + \frac{CF(1+g)^{n-1}}{(1+WACC)^n} \quad (12)$$

Here, $WACC$ is the weighted average cost of capital, CF is an annual income of company, and (12) is geometric progression with denominator

$$g = \frac{(1+g)}{(1+WACC)} \quad (13)$$

Summarizing (12), we get the expression for the capitalization, V, of the levered company of age n

$$V = \frac{CF}{1+WACC} \cdot \frac{1-\left(\frac{1+g}{1+WACC}\right)^n}{1-\frac{1+g}{1+WACC}} = \frac{CF}{WACC-g} \cdot \left(1-\left(\frac{1+g}{1+WACC}\right)^n\right) \quad (14)$$

In the perpetuity limit ($n \to \infty$), we get the following formula for the levered company value, V,

$$V = \frac{CF}{WACC-g} \quad (15)$$

This formula shows that the discount rate is $WACC$–g, and not $WACC$.

2.2. The Unlevered Company Value, V_0

Let us now derive the capitalization formula for a financially independent company, assuming that income for the period grows with the growth rate g.

$$V_0 = \frac{CF}{1+k_0} + \frac{CF(1+g)}{(1+k_0)^2} + \frac{CF(1+g)^2}{(1+k_0)^3} + \ldots + \frac{CF(1+g)^{n-1}}{(1+k_0)^n} \quad (16)$$

(16) is geometric progression with denominator

$$g = \frac{(1+g)}{(1+k_0)} \quad (17)$$

Summarizing (16), we get the expression for the value V_0 of unlevered company of age n

$$V_0 = \frac{CF}{1+k_0} \cdot \frac{1-\left(\frac{1+g}{1+k_0}\right)^n}{1-\frac{1+g}{1+k_0}} = \frac{CF}{k_0-g} \cdot \left(1-\left(\frac{1+g}{1+k_0}\right)^n\right) \quad (18)$$

In the perpetuity limit ($n \to \infty$), we get the following formula for the unlevered company value, V_0,

$$V_0 = \frac{CF}{k_0-g} \quad (19)$$

This formula shows that the discount rate is $k_0 - g$, and not k_0.

2.3. The Tax Shield Value

The tax shield for n–years is equal to

$$(TS)_n = \frac{tk_d D}{1+k_d} + \frac{tk_d D}{(1+k_d)^2} + \ldots + \frac{tk_d D}{(1+k_d)^n} \tag{20}$$

(20) is geometric progression with denominator

$$g = \frac{1}{(1+k_d)} \tag{21}$$

Summarizing (20), for the tax shield, we have

$$(TS)_n = \frac{tk_d D}{1+k_d} \cdot \frac{1-(1+k_d)^{-n}}{1-\frac{1}{1+k_d}} = Dt\Big(1-(1+k_d)^{-n}\Big) \tag{22}$$

$$(TS)_n = Dt\Big(1-(1+k_d)^{-n}\Big) \tag{23}$$

Using an analog of the first theorem by Modigliani–Miller for finite time, one gets

$$V = V_0 + (TS)_n \tag{24}$$

Substituting

$$D = w_d V \tag{25}$$

we arrive to the following expression

$$V\Big(1 - w_d t\Big(1-(1+k_d)^{-n}\Big)\Big) = V_0 \tag{26}$$

Substituting into this equation the values of an unlevered company, V_0 (18) and of levered company, V, (14) one gets the following expression

$$\frac{CF \cdot \left(1 - \left(\frac{1+g}{1+WACC}\right)^n\right) \cdot \left(1 - w_d t\left[1-(1+k_d)^{-n}\right]\right)}{WACC - g} = \frac{CF \cdot \left(1 - \left(\frac{1+g}{1+k_0}\right)^n\right)}{(k_0 - g)} \tag{27}$$

Dividing both parts by $\Big(1 - w_d t\Big(1-(1+k_d)^{-n}\Big)\Big)$, we get the BFO equation for the *WACC* of the company with variable income

$$\frac{1 - \left(\frac{1+g}{1+WACC}\right)^n}{WACC - g} = \frac{1 - \left(\frac{1+g}{1+k_0}\right)^n}{(k_0 - g) \cdot \left(1 - w_d t\left[1-(1+k_d)^{-n}\right]\right)} \tag{28}$$

This is the main theoretical result of the current paper.

In the perpetuity limit ($n \to \infty$), we get the following equation for *WACC* in the case of variable income [1]

$$WACC - g = (k_0 - g) \cdot (1 - w_d t) \tag{29}$$

$$WACC = (k_0 - g) \cdot (1 - w_d t) + g \tag{30}$$

3. Results and Discussion

In order to understand the impact of a variable growth rate g on the main financial indicators of a company within the framework of the generalized theory of Brusov–Filatova–Orekhova (GBFO), we study the dependences of the following values: weighted average cost of capital, *WACC*, discount rate, $WACC - g$, company value, V, and the cost of equity, k_e, on the level of leverage L at different values of the growth rate, g. We have created a large database for sets of cost of equity k_0 and cost of debt k_d, which is available upon request. To illustrate the results obtained and the conclusions drawn below, we present below the results for the following financial parameters of the company:

$$k_0 = 0.18;\ k_d = 0.16;\ t = 0.2;\ CF = 100;\ n = 2 \text{ and } n = 4;\ g = 0.2;\ 0.1;\ 0.0;\ -0.1;\ -0.2$$

Here, k_0 is the equity cost at zero leverage level; k_d is the debt cost; t is the tax on income; CF is income per period; n is the company age; L is the leverage level; and g is the growth rate.

Note that if the results for different parameters could be and are numerically different, then the qualitative effect of the variable growth rate g on the main financial indicators is similar.

3.1. Calculations for Two-Year Company

3.1.1. Calculations of Weighted Average Cost of Capital, *WACC*

As can be seen from Table 1 and Figure 1, for different values of g all curves $WACC(L)$ start from one point (0; k_0 = 0.18). These curves $WACC(L)$ demonstrate the decrease of $WACC$ with leverage level L at all g values. The curves $WACC(L)$ increase with growth rate, g.

Table 1. The *WACC* depending on the level of leverage L at different growth rates g in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

L	**$WACC$, n = 2**				
	g = 0.2	**g = −0.1**	**g = 0**	**g = 0.1**	**g = 0.2**
0	0.1799864	0.1799858	0.179995	0.1799849	0.1799844
1	0.1583502	0.1583545	0.1591545	0.1594954	0.1597882
2	0.15084	0.1513935	0.1521805	0.1523026	0.1526805
3	0.1472744	0.1478992	0.148688	0.1489255	0.1493521
4	0.1451307	0.1457982	0.1465907	0.1468947	0.1473505
5	0.1436999	0.1443958	0.1451917	0.1455391	0.1460143
6	0.142677	0.1433932	0.1441921	0.1445699	0.145059
7	0.1419093	0.1426408	0.1434421	0.1438425	0.144342
8	0.141312	0.1420553	0.1428587	0.1432764	0.1437841
9	0.140834	0.1415867	0.1423919	0.1428234	0.1433376
10	0.1404427	0.1412033	0.1420099	0.1424527	0.1429721

The results for a two-year company differ from the results for a perpetual limit—the theory of Modigliani and Miller [1]. In the latter case, the $WACC(L)$ curves decrease with the level of leverage L at $g < k_0$ and increase at $g > k_0$. k_0 is the threshold value g separating the increasing $WACC(L)$ curves from the decreasing ones, and for $g = k_0$ $WACC = \text{const} = k_0$. In the first case (BFO theory), the $WACC(L)$ curves decrease with increasing leverage L for all values of the growth rate g. The $WACC(L)$ curves increase with the rate g both in the Brusov–Filatova–Orekhova theory and in the Modigliani and Miller theory. This is the first indication that $WACC$ is no longer a discount rate, since it is intuitive that the discount rate must decrease in order to increase the value of company V. As we will see below, $WACC$–g and $WACC$–k_0 play the role of the discount rate.

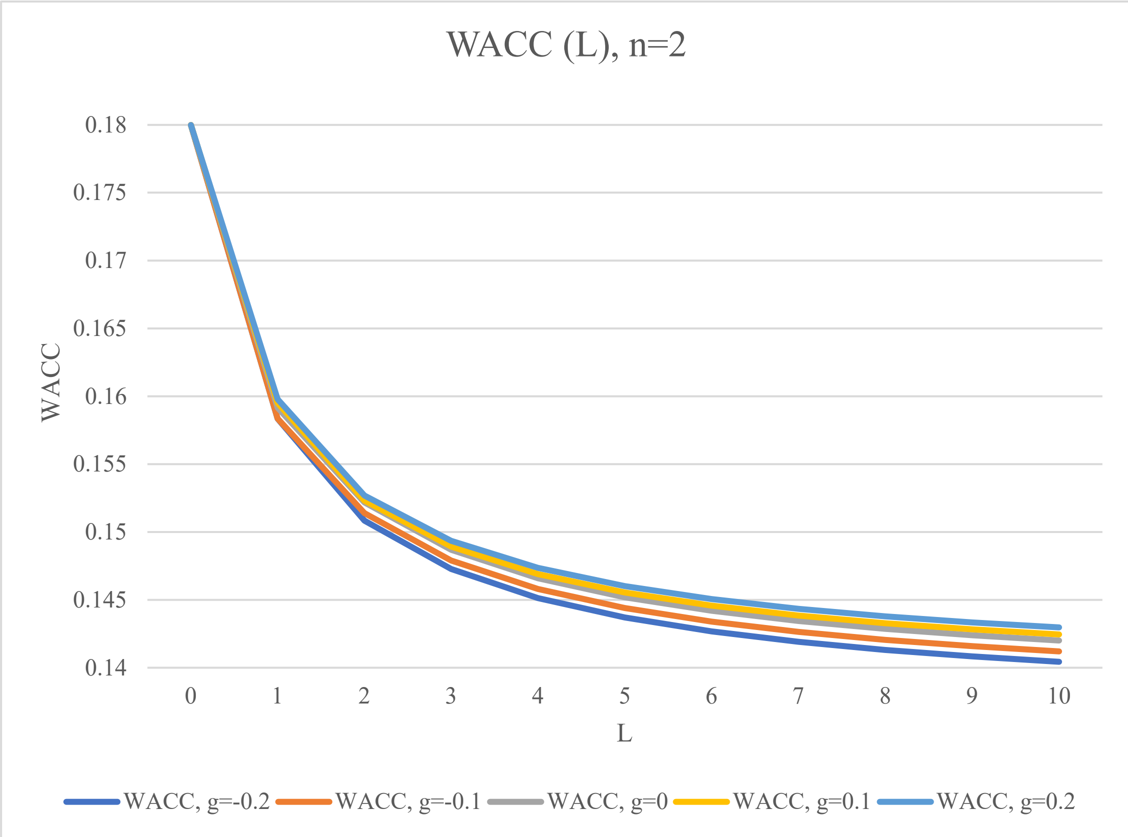

Figure 1. The *WACC* depending on the level of leverage *L* at different growth rates *g* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

The discount rate moves for a financially dependent company from the weighted average cost of capital, *WACC*, to *WACC*–*g* (where *g* is the growth rate), for a financially independent company from k_0 to k_0–*g*. As we intuitively understood above, this means that *WACC* and k_0 are no longer discount rates, as is the case for the classical Brusov–Filatova–Orekhova constant income theory. Below, we study the dependence of the discount rate *WACC*–*g* on the level of leverage *L* in the Generalized theory of Brusov–Filatova–Orekhova (the GBFO theory) at k_0 = 0.18 and different values of *g* (−0.2; −0.1; 0.0; 0.1; 0.2) for a two- and four-year company.

3.1.2. Calculations of the Discount Rate, *WACC*–*g*

As can be seen from Table 2 and Figure 2, the curves (*WACC*–*g*)(*L*) demonstrate the decrease of *WACC*–*g* with leverage level *L* at all *g* values. The curves (*WACC*–*g*)(*L*) decrease with growth rate, *g*.

This behavior of the (*WACC*–*g*)(*L*) curves can be explained as follows: all *WACC*(*L*) curves originate from the same point (*L* = 0; *WACC* = 0.18). The (*WACC*–*g*)(*L*) curves will be ordered as follows for *L* = 0: the larger *g*, the lower the starting point and hence the entire graph lies, since the curves do not intersect. As we will see below, the decrease of (*WACC*–*g*)(*L*) with growth rate, *g*, will lead to an increase of the company value, *V*, with *g*.

Table 2. The discount rate *WACC–g* depending on the level of leverage *L* at different growth rates *g* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

L	(*WACC–g*), *n* = 2				
	$g = -0.2$	$g = -0.1$	$g = 0$	$g = 0.1$	$g = 0.2$
0	0.3799864	0.2799858	0.179995	0.0799849	−0.020016
1	0.3583502	0.2583545	0.1591545	0.0594954	−0.040212
2	0.35084	0.2513935	0.1521805	0.0523026	−0.047319
3	0.3472744	0.2478992	0.148688	0.0489255	−0.050648
4	0.3451307	0.2457982	0.1465907	0.0468947	−0.052649
5	0.3436999	0.2443958	0.1451917	0.0455391	−0.053986
6	0.342677	0.2433932	0.1441921	0.0445699	−0.054941
7	0.3419093	0.2426408	0.1434421	0.0438425	−0.055658
8	0.341312	0.2420553	0.1428587	0.0432764	−0.056216
9	0.340834	0.2415867	0.1423919	0.0428234	−0.056662
10	0.3404427	0.2412033	0.1420099	0.0424527	−0.057028

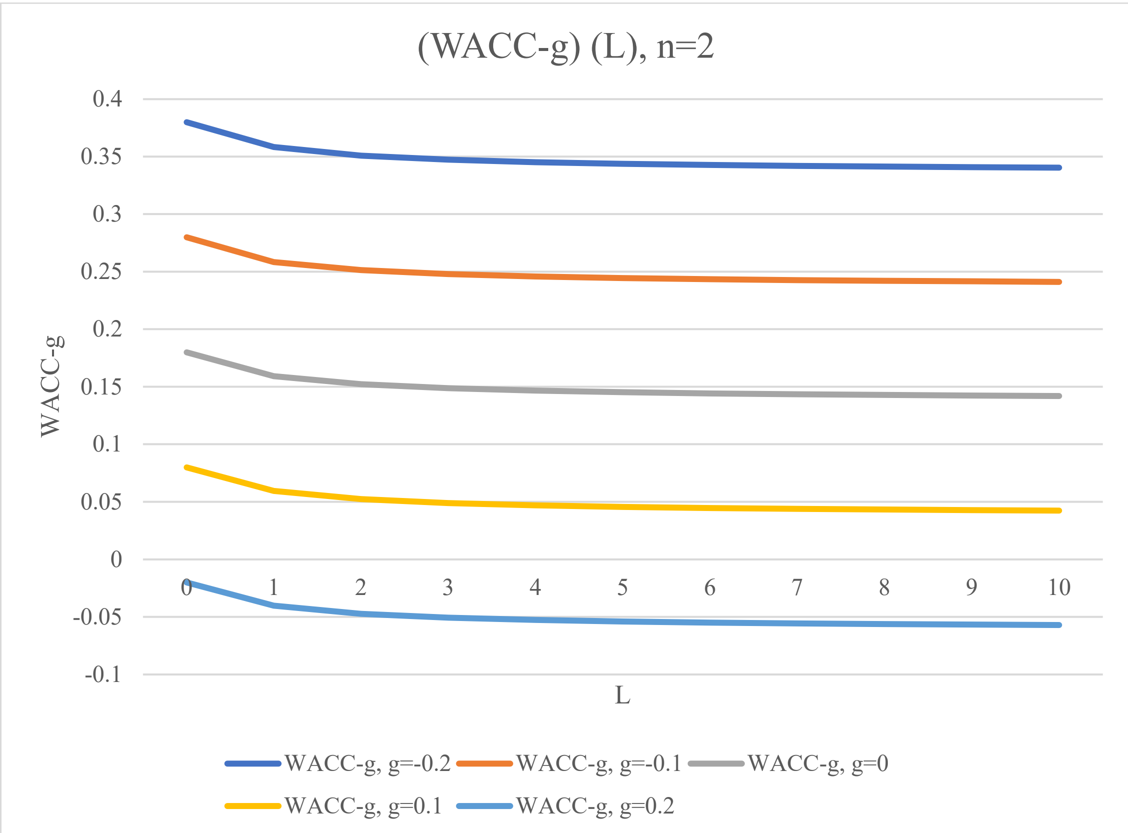

Figure 2. The discount rate *WACC–g* depending on the level of leverage *L* at different growth rates *g* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

3.1.3. Calculations of the Company Value, *V*

It is seen from Table 3 and Figure 3 that the company value *V* at fixed growth rate *g* increases with leverage level *L* in the Generalized Brusov–Filatova–Orekhova theory (GBFO theory). The company value *V* as well increases with growth rate *g*. This is a consequence of a decrease in the discount rate (*WACC*–*g*)(*L*) with an increase in the growth rate *g*.

Table 3. The company value, *V*, depending on the level of leverage *L* at different growth rates *g* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

L	***V*, *n* = 2**				
	$g = -0.2$	**$g = -0.1$**	**$g = 0$**	**$g = 0.1$**	**$g = 0.2$**
0	142.20282	149.38493	156.56518	163.74916	170.93128
1	145.95218	153.40417	160.69451	168.06349	175.43476
2	147.29627	154.73958	162.12039	169.62647	177.07002
3	147.94237	155.41792	162.84303	170.36931	177.84511
4	148.3333	155.82837	163.27978	170.81878	178.31411
5	148.5953	156.10344	163.57228	171.12001	178.62842
6	148.78312	156.30063	163.78186	171.33596	178.85374
7	148.92435	156.44891	163.93941	171.49835	179.02318
8	149.03442	156.56448	164.06217	171.6249	179.15523
9	149.12261	156.65707	164.16051	171.7263	179.26104
10	149.19486	156.73293	164.24106	171.80938	179.34772

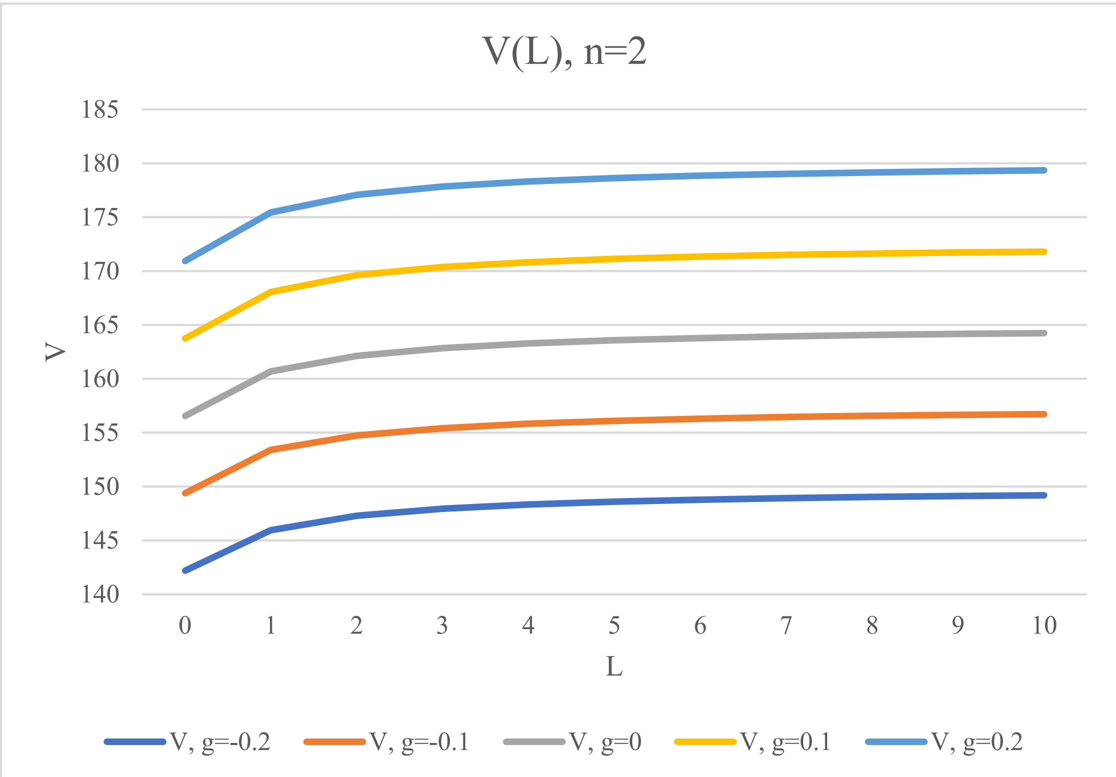

Figure 3. The company value, *V*, depending on the level of leverage *L* at different growth rates *g* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

Below, we have studied the dependence of cost of equity, k_e, on leverage level *L* and on growth rate, *g*, in the Generalized Brusov–Filatova–Orekhova theory (GBFO theory) at $k_0 = 0.18$; $k_d = 0.16$; and $g = 0$; ±0.1; ±0.2.

3.1.4. Calculations of the Equity Cost, k_e

As is seen from Table 4 and Figure 4, the equity cost, k_e, practically linearly grows with leverage level L at all growth rate g values. The tilt angle $k_e(L)$ grows with g.

Table 4. The equity cost, k_e, depending on the level of leverage L at different growth rates g in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

L	$k_e, n = 2$				
	$g = -0.2$	$g = -0.1$	$g = 0$	$g = 0.1$	$g = 0.2$
0	0.1799864	0.1799858	0.179995	0.1799849	0.1799844
1	0.1887005	0.1887091	0.1903091	0.1909909	0.1915764
2	0.19652	0.1981805	0.2005415	0.2009079	0.2020416
3	0.2050974	0.2075966	0.2107521	0.2117018	0.2134083
4	0.2136535	0.2169911	0.2209535	0.2224736	0.2247527
5	0.2221991	0.2263748	0.2311504	0.2332344	0.236086
6	0.2307387	0.2357525	0.2413446	0.243989	0.2474131
7	0.2392746	0.2451264	0.2515371	0.2547397	0.2587362
8	0.247808	0.2544978	0.2617285	0.2654878	0.2700568
9	0.2563397	0.2638674	0.271919	0.2762342	0.2813755
10	0.2648701	0.2732358	0.282109	0.2869792	0.292693

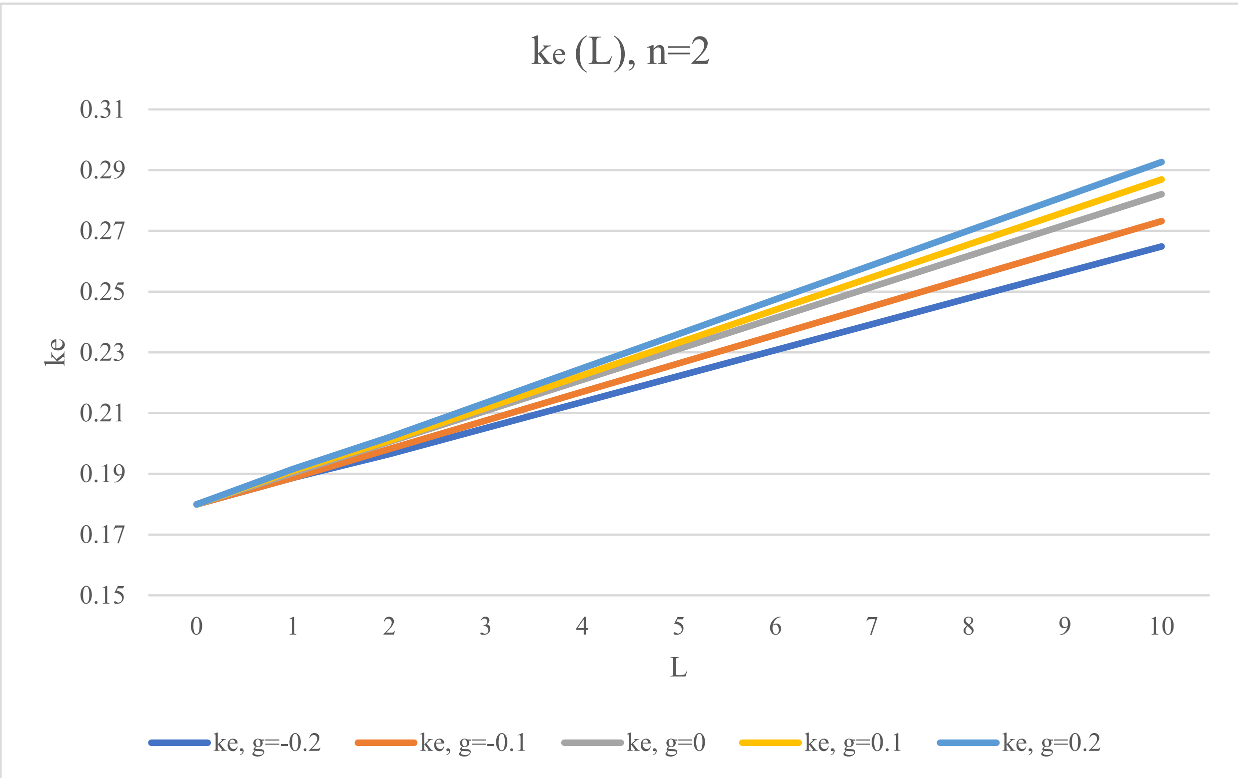

Figure 4. The equity cost, k_e, depending on the level of leverage L at different growth rates g in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

3.2. Calculations for Four-Year Company

Below, we study the dependence of $WACC$, $WACC$–g, V, and k_e on leverage level L in the Generalized Brusov–Filatova–Orekhova theory (GBFO theory) at k_0 = 0.18; k_d = 0.16;

$t = 0.2$; $g = 0.2$; 0.1; 0.0; -0.1; -0.2 for a four-year company and compare obtained results with ones for a two-year company (see above).

3.2.1. Calculations of Weighted Average Cost of Capital, *WACC*

From Table 5 and Figure 5, it follows that different values of g all curves $WACC(L)$ start from one point (0; $k_0 = 0.18$). These curves $WACC(L)$ demonstrate the decrease of $WACC$ with leverage level L at all g values. The curves $WACC(L)$ increase with growth rate, g. In this part, the results for a four-year company are similar to ones for a two-year company. There is quantitative difference between them; the splitting of the curves $WACC(L)$ Δ for $g = 0.2$ and $g = -0.2$ increases with g (at $L = 10$ $\Delta = 0.0018$ for $n = 2$, while for $n = 4$ $\Delta = 0.009$). In the perpetual case, ($n = \infty$) $\Delta = 0.073$) [1].

Table 5. The *WACC* depending on the level of leverage L at different growth rates g in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

L	***WACC***				
	$g = -0.2$	$g = -0.1$	$g = 0$	$g = 0.1$	$g = 0.2$
0	0.1799864	0.1799858	0.179995	0.1799849	0.1799844
1	0.1538597	0.1554667	0.1567983	0.1579005	0.1588493
2	0.1450677	0.1472039	0.1489781	0.1504635	0.1517081
3	0.1406528	0.1430555	0.1450509	0.1467206	0.1481196
4	0.1379983	0.1405609	0.1426891	0.1444691	0.145877
5	0.1362263	0.1388955	0.1411122	0.1429656	0.1445542
6	0.1349595	0.1377048	0.1399846	0.1418905	0.1434877
7	0.1340088	0.1368112	0.1391383	0.1410836	0.1427137
8	0.1332689	0.1361157	0.1384797	0.1404555	0.1421113
9	0.1326768	0.1355592	0.1379526	0.1399529	0.1416291
10	0.1321922	0.1351036	0.1375212	0.1395414	0.1412344

The results for a four-year company, as it was seen for a two-year company, differ from the results for the perpetual limit—the theory of Modigliani and Miller [1]; the $WACC(L)$ curves decrease with increasing leverage L for all values of the growth rate g. As is known from [1], in the case of Modigliani and Miller, the $WACC(L)$ curves decrease with the level of leverage L for $g < k_0$ and increase for $g > k_0$. Therefore, k_0 is the threshold value g separating the increasing $WACC(L)$ curves from the decreasing ones, and for $g = k_0$ $WACC = \text{const} = k_0$. As we mentioned above, the increase in $WACC(L)$ with the growth rate of g is the first indication that $WACC$ is no longer a discount rate, since it is intuitive that the discount rate must decrease with growth rate g in order to increase the value of company V. As we will see below, $WACC$–g and $WACC$–k_0 play the role of the discount rates and satisfy the above condition.

3.2.2. Calculations of the Discount Rate, *WACC*–*g*

Table 6 and Figure 6 show all the curves ($WACC$–g)(L) with leverage level L at all g values. The ($WACC$–g) values at fixed leverage level L decrease with growth rate g. This means that $WACC$–g is a suitable candidate for the discount rate.

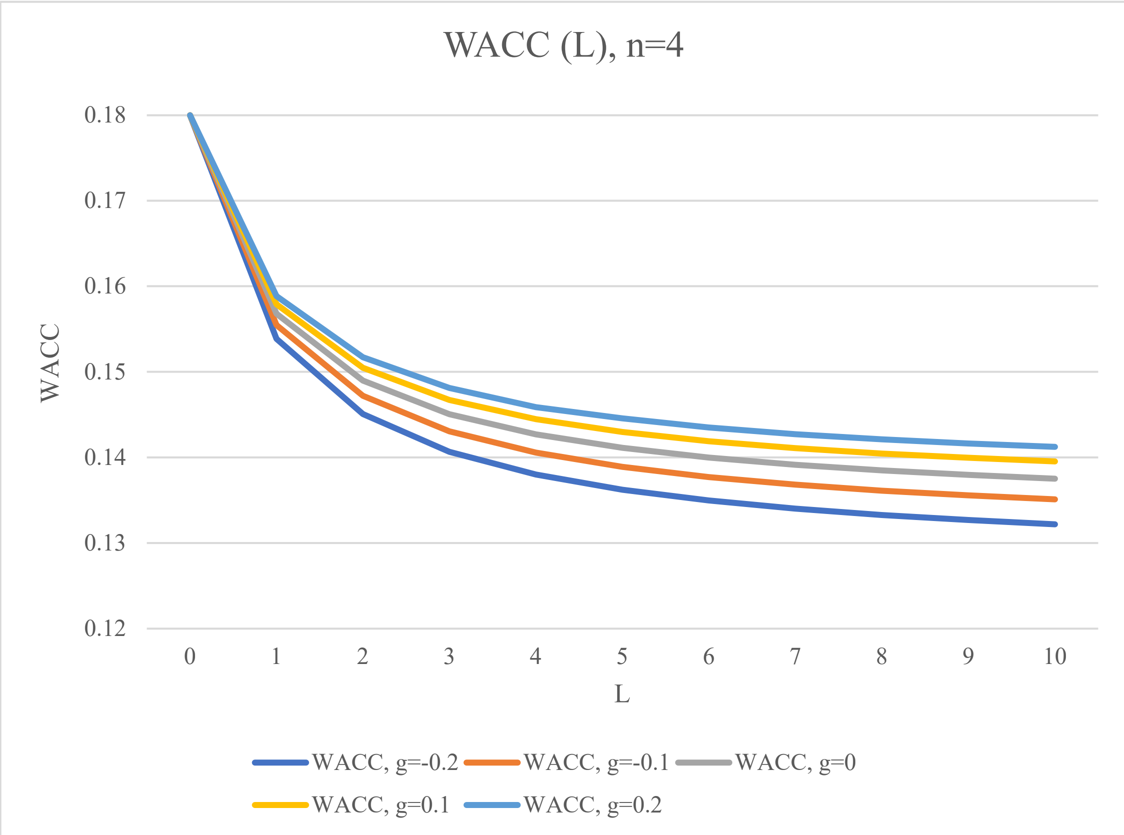

Figure 5. The *WACC* depending on the level of leverage *L* at different growth rates *g* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

Table 6. The discount rate, *WACC–g*, depending on the level of leverage *L* at different growth rates *g* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

L	**(*WACC–g*), *n* = 4**				
	$g = -0.2$	$g = -0.1$	$g = 0$	$g = 0.1$	$g = 0.2$
0	0.3799864	0.2799858	0.179995	0.0799849	−0.020016
1	0.3538597	0.2554667	0.1567983	0.0579005	−0.041151
2	0.3450677	0.2472039	0.1489781	0.0504635	−0.048292
3	0.3406528	0.2430555	0.1450509	0.0467206	−0.05188
4	0.3379983	0.2405609	0.1426891	0.0444691	−0.054123
5	0.3362263	0.2388955	0.1411122	0.0429656	−0.055446
6	0.3349595	0.2377048	0.1399846	0.0418905	−0.056512
7	0.3340088	0.2368112	0.1391383	0.0410836	−0.057286
8	0.3332689	0.2361157	0.1384797	0.0404555	−0.057889
9	0.3326768	0.2355592	0.1379526	0.0399529	−0.058371
10	0.3321922	0.2351036	0.1375212	0.0395414	−0.058766

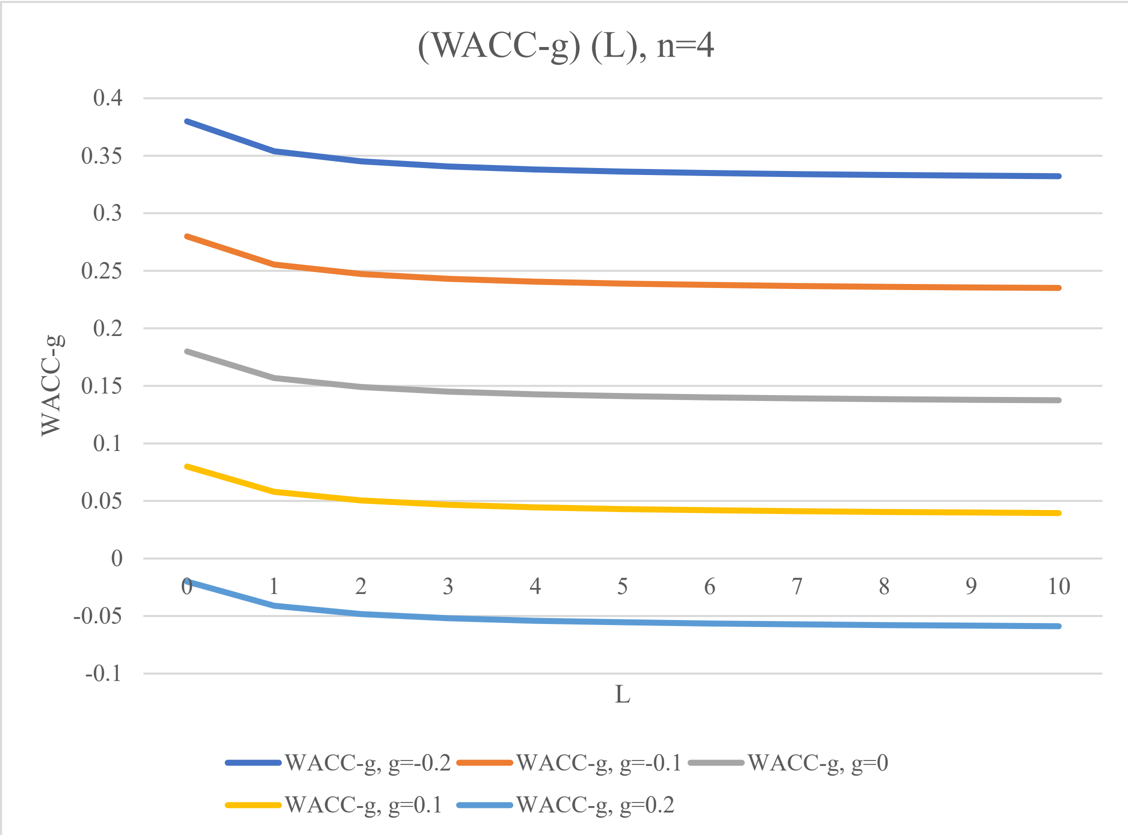

Figure 6. The discount rate, *WACC*–*g*, depending on the level of leverage *L* at different growth rates *g* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

As in the case of the two-year company, the behavior of (*WACC*–*g*)(*L*) with *g* growth can be explained as follows: all *WACC*(*L*) curves originate from the same point (*L* = 0; *WACC* = 0.18). The (*WACC*–*g*)(*L*) curves will be ordered as follows for *L* = 0: the larger *g*, the lower the starting point and hence the entire graph lies, since the curves do not intersect. As we will see below, the decrease of (*WACC*–*g*)(*L*) with growth rate, *g*, will lead to an increase of the company value, *V*, with *g*.

3.2.3. Calculations of the Company Value, *V*

As can be seen from Table 7 and Figure 7, the company value *V* at fixed growth rate *g* increases with leverage level *L* in Generalized Brusov–Filatova–Orekhova theory (GBFO theory). The company value *V* increases at fixed leverage level *L* with growth rate *g* at fixed as well. This is the consequence of a decrease in the discount rate (*WACC*–*g*)(*L*) with an increase in the growth rate *g*. Comparing with the results for the two-year-old company, we see that the value of the company *V* increases with the age of the company: we have a range from 149 to 157 with *L* = 1 for *g* from −0.2 to 0.2 for the two- year-old company and a range from 217 to 364 with *L* = 1 for *g* from −0.2 to 0.2 for a four year old company. This is the obvious conclusion, because it is well known that the value of any asset (company, stock, bond etc.) is equal to the sum of the discounted returns generated by this asset. Since this value is proportional to the lifetime of this asset, the capitalization of the company will grow with its age.

Table 7. The company value, V, depending on the level of leverage L at different growth rates g in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

L	$V, n = 4$				
	$g = -0.2$	$g = -0.1$	$g = 0$	$g = 0.1$	$g = 0.2$
0	207.56615	236.28862	269.00881	306.05136	347.71061
1	217.29735	247.3597	281.61599	320.39442	363.9946
2	220.75339	251.2914	286.08901	325.47139	369.77167
3	222.5253	253.30558	288.37987	328.07604	372.72979
4	223.60263	254.53001	289.7723	329.65911	374.59742
5	224.32687	255.35305	290.70818	330.72309	375.70606
6	224.84716	255.94428	291.38042	331.48732	376.60369
7	225.23902	256.38954	291.88667	332.06283	377.25722
8	225.54478	256.73695	292.28165	332.51185	377.7671
9	225.79	257.01557	292.59842	332.87195	378.176
10	225.99105	257.244	292.85811	333.16716	378.51122

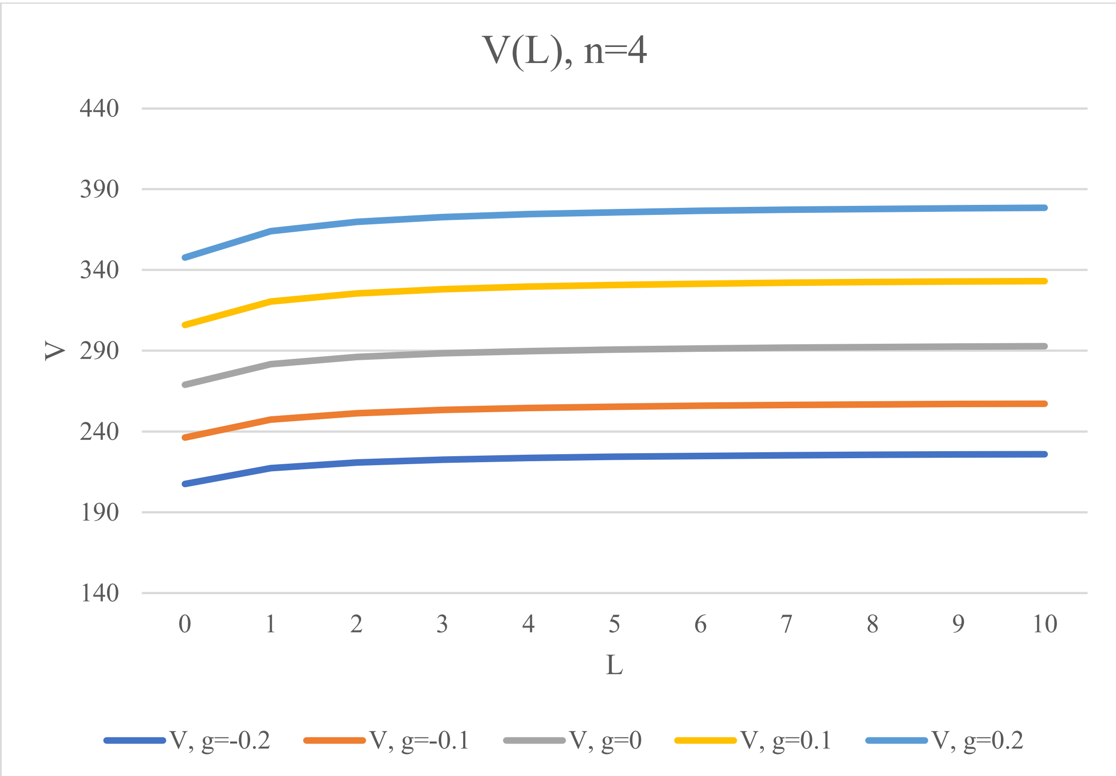

Figure 7. The company value, V, depending on the level of leverage L at different growth rates g in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

The dependence of the cost of equity k_e on the level of leverage L in the Generalized theory of Brusov–Filatova–Orekhova (GBFO theory) was studied below for a four-year company with growth rates $g = 0$; ± 0.1; and ± 0.2.

3.2.4. Calculations of the Cost of Equity k_e

From Table 8 and Figure 8, it can be seen that the cost of equity k_e increases practically linearly with leverage level L at all growth rates g (except for $g = -0.2$ where we see a decrease in k_e with leverage level L). The slope angle $k_e(L)$ increases with g. This should change the dividend policy of an enterprise with variable income since, economically, the reasonable amount of dividends is equal to the cost of equity.

Table 8. The equity cost, k_e, depending on the level of leverage L at different growth rates g in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

L	k_e, $n = 4$				
	$g = -0.2$	$g = -0.1$	$g = 0$	$g = 0.1$	$g = 0.2$
0	0.1799864	0.1799858	0.179995	0.1799849	0.1799844
1	0.1797193	0.1829333	0.1855967	0.187801	0.1896985
2	0.1792032	0.1856116	0.1909343	0.1953906	0.1991244
3	0.1786111	0.1882219	0.1962038	0.2028824	0.2084783
4	0.1779915	0.1908046	0.2014454	0.2103453	0.2173852
5	0.1773581	0.1933733	0.2066729	0.2177938	0.2273252
6	0.1767166	0.1959339	0.2118923	0.2252338	0.2364136
7	0.1760702	0.1984895	0.2171066	0.2326686	0.2457093
8	0.1754204	0.2010417	0.2223176	0.2400999	0.2550015
9	0.1747682	0.2035915	0.2275261	0.2475287	0.2642911
10	0.1741143	0.2061396	0.2327328	0.2549558	0.2735789

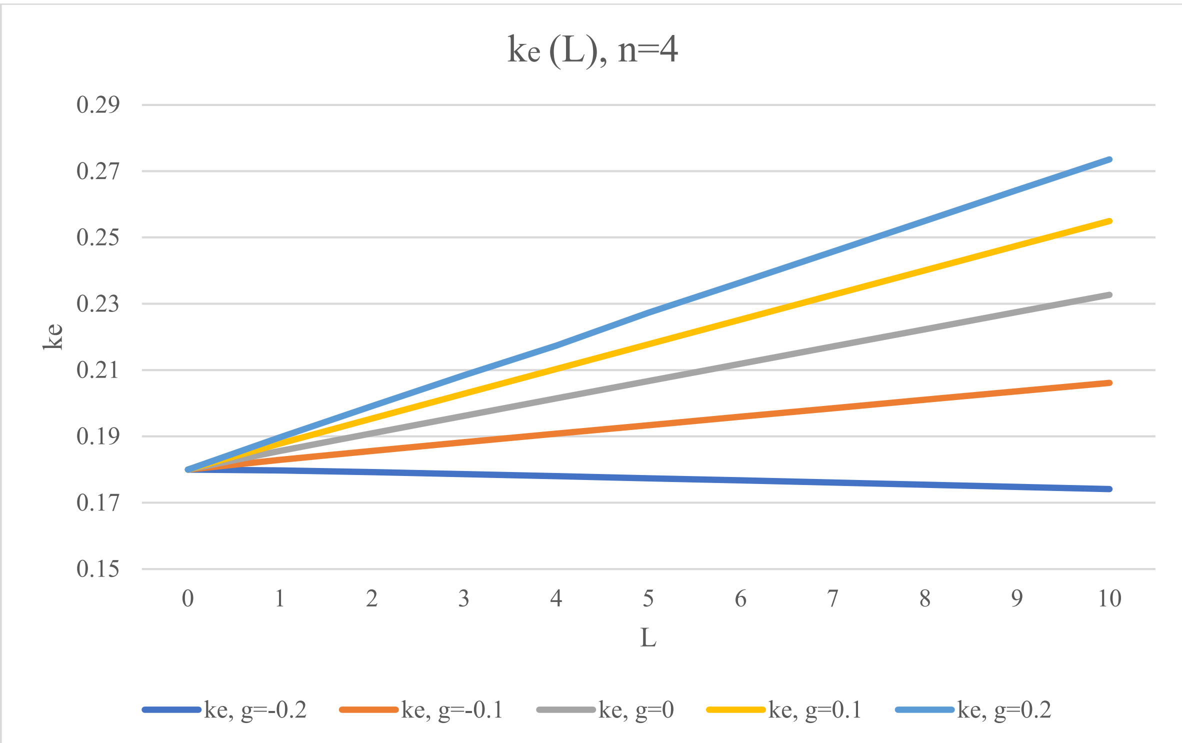

Figure 8. The equity cost, k_e, depending on the level of leverage L at different growth rates g in Generalized Brusov–Filatova–Orekhova theory (GBFO theory).

However, the biggest change in the company's dividend policy is related to the discovery of a qualitatively new effect in corporate finance: at a rate $g < g^*$, the slope of the $k_e(L)$ curve turns out to be negative (one can observe this effect here for $g = -0.2$ where a decrease in k_e with leverage level L takes place). This effect, which is absent in the classical Modigliani–Miller theory and the classical Brusov–Filatova–Orekhova theory with constant income, exists in the Modigliani–Miller theory with variable income and in the Brusov–Filatova–Orekhova theory with variable income at a certain age of the company, n, which exceeds some cutoff age value, n^*.

The latter effect is similar to a qualitatively new effect in corporate finance, discovered by Brusov–Filatova–Orekhova within the framework of the BFO theory [7,8]: anomalous dependences of the cost of equity k_e on the leverage level L when income tax T exceeds a certain value T^*. This discovery also significantly changes the principles of the company's dividend policy.

3.3. Comparison with the Theory of Modigliani and Miller with Variable Income

The main difference between the Modigliani–Miller (MM) theory and the Brusov–Filatova–Orekhova (BFO) theory is that the latter describes companies of an arbitrary age, whereas the former represents the eternal limit of the BFO theory and is valid only for perpetual companies (with an infinite lifetime). If there is no time factor in the MM theory, then within the framework of the modern BFO theory, it is possible to analyze the financial condition of a company of any age; in this paper, this is done for two company ages—two and four years.

Since the MM theory is the eternal BFO limit, it is important to note that some of the results, such as the change in the discount rate from $WACC$ to $WACC–g$, etc., are general, and this emphasizes the correctness of both theories and the connection between them as a connection between a general theory and its limiting case.

Along with the fundamental differences between the results of the two theories indicated above, there are also qualitative and quantitative differences. One of them is the next. The BFO results for a four-year company, as it was seen for a two-year company as well, differ from the results for the perpetual limit—the theory of Modigliani and Miller [1], where the $WACC(L)$ curves decrease with increasing leverage L for all values of the growth rate g. As is known from [1], in the case of Modigliani and Miller, the $WACC(L)$ curves decrease with the level of leverage L for $g < k_0$ and increase for $g > k_0$.Therefore, k_0 is the threshold value g separating the increasing $WACC(L)$ curves from the decreasing ones, and for $g = k_0$ $WACC = \text{const} = k_0$ (see Figure 9 below).

We would like to emphasize an important observation. If in the classical versions of the Brusov–Filatova–Orekhova (BFO) theory and its perpetual limit, the theory of Nobel laureates Modigliani and Miller, where the case of constant income was considered, and where the gap between these two theories is huge (many qualitative effects that take place in the first theory, missing in the second), when taking into account the variable income, some effects of the BFO theory also take place in the Modigliani–Miller theory. This means that taking into account some effects that are present in economic practice (for example, variable income) brings both theories closer, and even the Modigliani–Miller theory, with all its many limitations, becomes more applicable in economic practice. However, it should be remembered that the Modigliani–Miller theory is only true for perpetual companies, whereas the BFO theory is valid for companies of any age, and from this point of view, they never coincide.

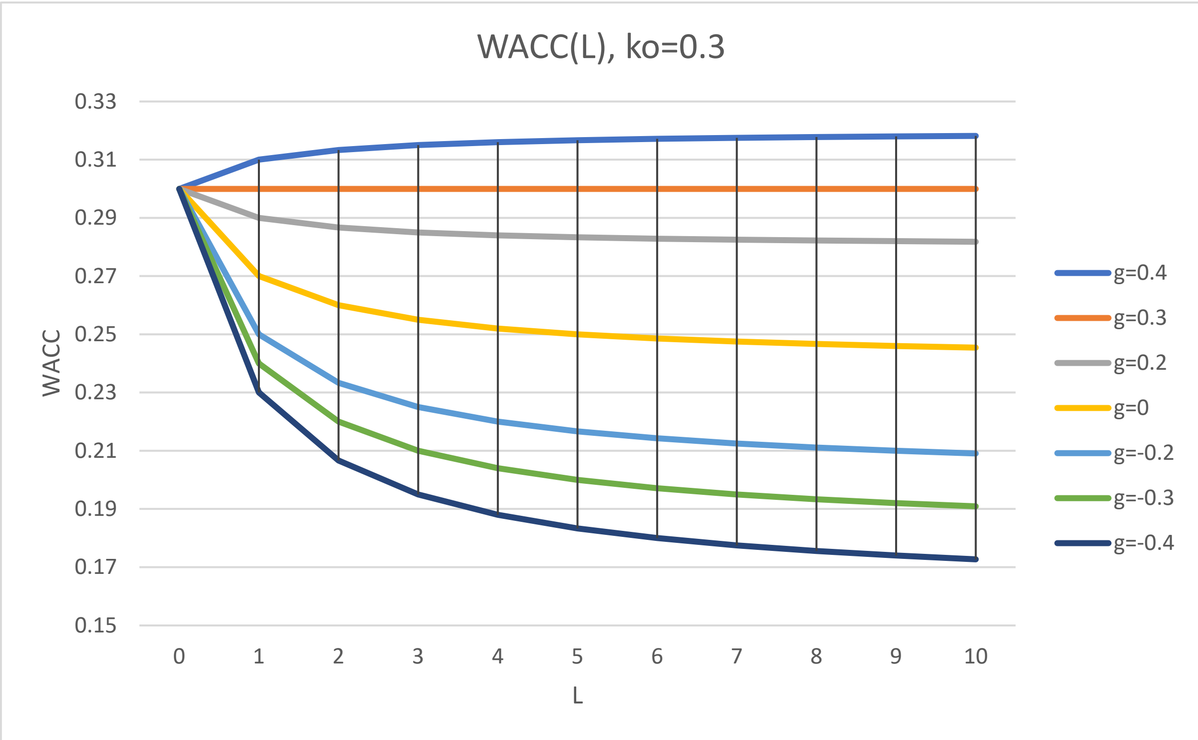

Figure 9. WACC depending on leverage level L in Generalized Modigliani–Miller theory (GMM theory) at k_0 = 0.3 and g = 0; ±0.2; ±0.3; ±0.4 (from [1]).

4. Conclusions

The Brusov–Filatova–Orekhova (BFO) theory of capital cost and capital structure as well as the theory by Nobel Prize winners Modigliani and Miller (perpetuity limit of BFO theory) consider the case of constant income, whereas in practice, the income of a company is, of course, variable. Recently, we have generalized the latter for the case of variable income, and here we have generalized for the first time the Brusov–Filatova–Orekhova theory for the case of variable income.

This generalization significantly expands the applicability of this modern capital structure theory, which is valid for companies of any age, and in practice for corporate finance, business valuation, investments, banking, ratings, etc.

We have derived the generalized BFO formula for *WACC* and this consists of a main theoretical result of a current paper.

From this formula and as well from using this formula in MS Excel, we show that the role of the discount rate shifts from *WACC* to *WACC*–g (where g is the growth rate) for financially dependent companies and from k_0 to k_0–g (for financially independent companies). Whereas the *WACC* increases with g, the actual discount rates *WACC*–g and k_0–g decrease with g and, accordingly, the company value, V, increases with g. For the cost of equity k_e, the slope of the curve $k_e(L)$ increases with g. Since the cost of equity determines the economically justified amount of dividends, this should change the company's dividend policy. It turns out that at the rate $g < g^*$, the slope of the curve $k_e(L)$ becomes negative, which can significantly change the company's dividend policy principles. This means a qualitatively new effect on discoveries in corporate finance.

The novelty of the work is the generalization of the theory of Brusov–Filatov–Orekhova to the case of variable income, the derivation of generalized BFO formulas for the weighted average cost of capital, *WACC*, cost of equity, k_e, company value, V, and the use of these formulas to study the influence of the growth rate g on the dependence of the main financial performance of the company on debt financing.

The importance of the current consideration is due to a couple of points:

- gives an idea of the behavior of the main financial indicators of the company with a change in the growth rate g for both cases—an increase in g and a decrease in g;
- creates a developed methodology that allows the researcher to analyze the main financial indicators of the company (capital costs, company value, etc.) for the actual conditions of the company's functioning.

Limitations of the study: a generalization of the BFO theory was carried out for the case of paying income tax at the end of reporting periods. However, in practice, these payments may also be made in advance. This determines the further direction of the study: consideration of the case of variable income when income tax is paid in advance.

Author Contributions: Conceptualization, P.B. and T.F.; methodology, T.F.; software, P.B. and T.F.; validation, P.B.; formal analysis, P.B. and T.F.; investigation, P.B. and T.F.; writing—original draft preparation, P.B. and T.F.; numerical calculations, P.B. All authors have read and agreed to the published version of the manuscript.

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