The Golden Age of the Company: (Three Colors of Company's Time)

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Abstract: In this paper we investigate the dependence of attracting capital cost on the time of life of company n at various leverage levels, at various values of capital costs with the aim of define of minimum cost of attracting capital. All calculations have been done within modern theory of capital cost and capital structure by Brusov–Filatova–Orekhova (Brusov *et al.* 2011a,b,c,d,e; 2012 a,b; 2013 a,b,c; 2014 a,b; Filatova *et al.* 2008).

It is shown for the first time that valuation of WACC in the Modigliani – Miller theory (Modigliani *et al.* 1958; 1963; 1966) is not minimal and valuation of the company capitalization is not maximal, as all financiers supposed up to now: at some age of the company its WACC value turns out to be lower, than in Modigliani – Miller theory and company capitalization V turns out to be greater, than V in Modigliani – Miller theory.

It is shown that, from the point of view of cost of attracting capital there are two types of dependences of weighted average cost of capital, WACC, on the time of life of company n: monotonic descending with n and descending with passage through minimum, followed by a limited growth. The first type takes place for the companies with low capital costs of the company, characteristic for the western companies. The second type takes place for higher capital costs of the company, characteristic for the Russian companies as well as for companies from other developing countries. This means that latter companies, in contrast to the western ones, can take advantage of the benefits, given at a certain stage of development of company by discovered effect. Moreover, since the "golden age" of company depends on the company's capital costs, by controlling them (for example, by modifying the value of dividend payments, that reflect the equity cost), company may extend the "golden age" of the company, when the cost to attract capital becomes a minimal (less than perpetuity limit), and capitalization of companies becomes maximal (above than perpetuity assessment) up to a specified time interval.

Concluded that existed up to the present conclusions of the results of the theory of Modigliani-Miller (Modigliani *et al.* 1958; 1963; 1966) in these aspects are incorrect. We discuss the use of opened effects in developing economics (Brusov *et al.* 2015).

Keywords: Brusov–Filatova–Orekhova theory, Modigliani – Miller theory, minimal capital cost of company.

INTRODUCTION

It is well-known, that the company goes through several stages in its development process: adolescence, maturity and old age. Within the modern theory of capital cost and capital structure by Brusov-Filatova-Orekhova (BFO theory) (Brusov *et al.* 2011a,b,c,d,e; 2012 a,b; 2013 a,b,c; 2014 a,b; Filatova *et al.* 2008) it is shown that the problem of the company development has an interpretation, which is absolutely different from generally accepted one.

One of the most important problem in corporate finance is the problem of capital cost and capital structure. Before 2008 there were just two kind of valuations of cost of capital: one of them was the first quantitative theory by Nobel Prize winners Modigliani and Miller (Modigliani *et al.* 1958; 1963; 1966), applicable to perpetuity (with infinite life-time)companies, and the second one was the valuation applicable to one-year companies by Steve Myers (Myers 1984).

So, before 2008, when the modern theory of capital cost and capital structure by Brusov-Filatova-Orekhova (BFO theory) has been created (Brusov *et al.* 2011a,b,c,d,e; 2012 a,b; 2013 a,b,c; 2014 a,b; Filatova *et al.* 2008), only two points in time interval has been known: one-year and infinity. That time Steve Myers (Myers 1984) has supposed that the Modigliani – Miller (MM) theorem (Modigliani *et al.* 1958; 1963; 1966) gives the lowest assessment for weighted average cost of capital, WACC, and consequently, the highest assessment for company capitalization. This mean that the weighted average cost of capital, WACC, monotonically descends with time of life of company, n, approaching to its perpetuity limit (Figure **1**), and, consequently, company capitalization monotonically increases approaching to its perpetuity limit (Figure **3**).

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Created in 2008 the modern theory of capital cost and capital structure by Brusov-Filatova-Orekhova (BFO theory) (Brusov *et al.* 2011a,b,c,d,e; 2012 a,b; 2013 a,b,c; 2014 a,b; Filatova *et al.* 2008) is turned out to be able to make valuation of capital cost and company capitalization for companies with arbitrary life-time: this completes the whole time interval from n=1 up to $n=\infty$. A lot of qualitatively new effects in corporate finance, investments, taxations etc has been made within BFO theory.

In this Paper within BFO theory it is shown, that Steve Myers suggestion (Myers 1984) turns out to be wrong.

Choosing of optimal capital structure of the company, i.e., proportion of debt and equity, which minimizes weighted average cost of capital and maximizes the company capitalization, is one of the most important tasks of financial manager and the management of a company. The search for an optimal capital structure attracts attention of economists and financiers during many tens of years. And it is clear why: one can, nothing making, but only by changing the proportion between the values of equity capital and debt one of the company, significantly enhance the company capitalization, by other words to fulfill the primary task, to reach critical goal of the business management. Spend a little less of your own, loan slightly more (or vice versa), and company capitalization reaches a maximum.

Before now the search for an optimal capital structure was made by study of the dependence of weighted average cost of capital, WACC, on leverage level in order to determine the optimal leverage level L_0, at which WACC is minimal and capitalization V is maximal. Here we apply absolutely different method, studying the dependence of weighted average cost of capital, WACC, on the time of life of company n. Note, that before appearance of BFO theory study of such kind of dependences was impossible via the absence of "time" parameter in perpetuity Modigliani – Miller theory (Modigliani *et al.* 1958; 1963; 1966).

As it is shown in this Paper, from the point of view of cost of capital there are two types of dependences of weighted average cost of capital, WACC, on the time of life of company n: monotonic descending of WACC with n and descending of WACC with passage through minimum, followed by a limited growth (Figures **1** and **2**).

The first type of behavior is linked with the comment by Myers (Myers 1984), that the Modigliani – Miller (MM) theorem (Modigliani *et al.* 1958; 1963; 1966) gives the lowest assessment for weighted average cost of capital, WACC, that, as shown by us within the BFO theory, is, generally speaking, incorrect. In many cases, there is a second type of behavior of dependence of weighted average cost of capital, WACC, on the time of life of company n: descending with passage through minimum, followed by a limited growth.

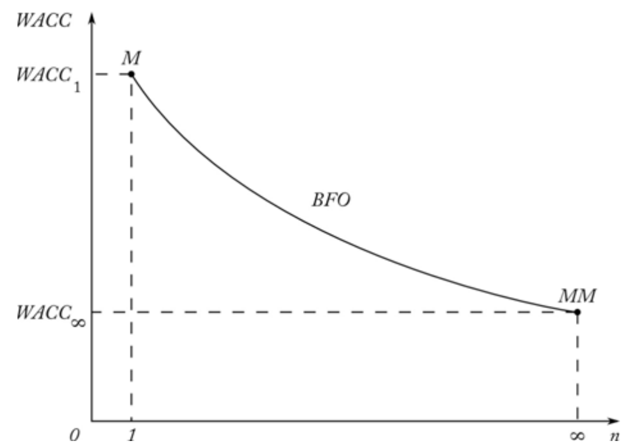

Figure 1: Monotonic dependence of weighted average cost of capital, WACC, on life-time of the company *n*.

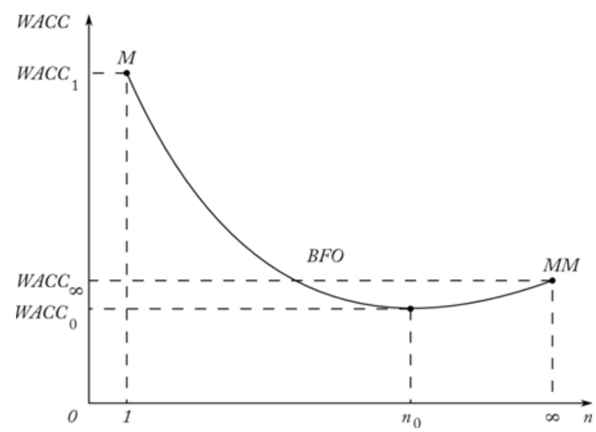

Figure 2: Dependence of weighted average cost of capital, WACC, on life-time of the company *n*, showing descending with n, and with the passage through a minimum and then a limited growth.

Thus, in the general case, the comment by Myers (Myers 1984) turns out to be wrong, and in the life of company there is a "golden age", or "the golden century", when the cost of attracting of the capital becomes a minimal, and capitalization companies - maximal (Figures **2** and **3**). In the life of company the same number of stages as usually can be allocated: youth, maturity and old age. In youth weighted average cost of capital, WACC, decreases with n, in the maturity value of attracting capital cost becomes minimal, and in the old-age this cost growth, approaching its perpetuity limit.

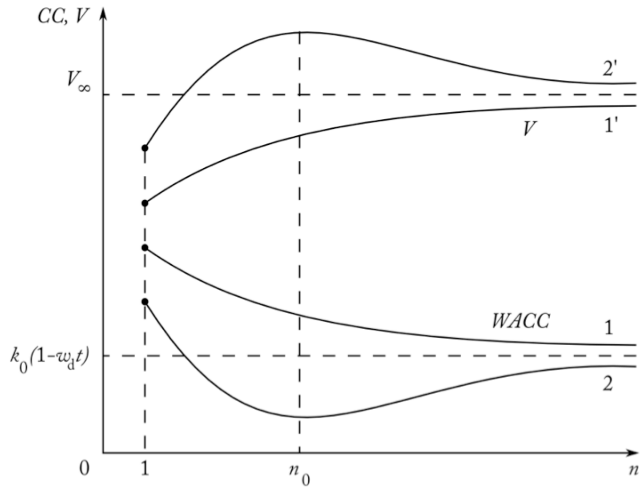

Figure 3: Two kind of dependences of weighted average cost of capital, WACC, and company capitalization, V, on life-time of the company *n*:

1-1' - monotonic dependence of weighted average cost of capital, WACC, and company capitalization, V, on life-time of the company *n*;

2-2' - showing descending of WACC with n, and with the passage through a minimum and then a limited growth and increase of V with the passage through a maximum (at n_0) and then a limited descending.

So, figuratively speaking, a current investigation transforms "black and white business world" (with monotonic descending of WACC with time of life of company, n) into "color business world" (with descending of WACC with n with passage through minimum, followed by a limited growth): really there are three colors of company's time.

The conclusion made in this Paper for the first time, that the assessment of weighted average cost of capital of the company, WACC, in the theory of Modigliani and Miller (MM) (Modigliani *et al.* 1958; 1963; 1966) is not the minimal, and capitalization is not maximal, seems to be very significant and important.

1. Dependence of Weighted Average Cost of Capital, WACC, on Life-Time of the Company *n* at Different Leverage Levels

In this paragraph we study the dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different leverage levels

For L=1 one has

Table 1:

L	WACC	ko	kd	Wd	t	n	ke
1	0.1843	0.2	0.15	0.5	0.2	1	0.2487
1	0.1798	0.2	0.15	0.5	0.2	2	0.2397
1	0.1780	0.2	0.15	0.5	0.2	3	0.2360
1	0.1772	0.2	0.15	0.5	0.2	4	0.2345
1	0.1769	0.2	0.15	0.5	0.2	5	0.2339
1	0.1769	0.2	0.15	0.5	0.2	6	0.2338
1	0.1770	0.2	0.15	0.5	0.2	7	0.2340
1	0.1771	0.2	0.15	0.5	0.2	8	0.2343
1	0.1773	0.2	0.15	0.5	0.2	9	0.2346
1	0.1775	0.2	0.15	0.5	0.2	10	0.2351

For L=2 we have

Table 2:

L	WACC	ko	kd	Wd	t	n	ke
2	0.1791	0.2	0.15	0.66667	0.2	1	0.2974
2	0.1731	0.2	0.15	0.66667	0.2	2	0.2793
2	0.1706	0.2	0.15	0.66667	0.2	3	0.2719
2	0.1696	0.2	0.15	0.66667	0.2	4	0.2687
2	0.1692	0.2	0.15	0.66667	0.2	5	0.2675
2	0.1691	0.2	0.15	0.66667	0.2	6	0.2672
2	0.1692	0.2	0.15	0.66667	0.2	7	0.2675
2	0.1694	0.2	0.15	0.66667	0.2	8	0.2681
2	0.1696	0.2	0.15	0.66667	0.2	9	0.2689
2	0.1699	0.2	0.15	0.66667	0.2	10	0.2697

For L=3 one has

Table 3:

L	WACC	ko	kd	Wd	t	n	ke
3	0.1765	0.2	0.15	0.75	0.2	1	0.3461
3	0.1697	0.2	0.15	0.75	0.2	2	0.3189
3	0.1669	0.2	0.15	0.75	0.2	3	0.3078
3	0.1657	0.2	0.15	0.75	0.2	4	0.3029
3	0.1653	0.2	0.15	0.75	0.2	5	0.3010
3	0.1651	0.2	0.15	0.75	0.2	6	0.3006
3	0.1653	0.2	0.15	0.75	0.2	7	0.3010
3	0.1655	0.2	0.15	0.75	0.2	8	0.3019
3	0.1658	0.2	0.15	0.75	0.2	9	0.3030
3	0.1661	0.2	0.15	0.75	0.2	10	0.3042

For L=5 one has

Table 4:

L	WACC	ko	kd	Wd	t	n	ke
5	0.1739	0.2	0.15	0.83333	0.2	1	0.4435
5	0.1663	0.2	0.15	0.83333	0.2	2	0.3980
5	0.1632	0.2	0.15	0.83333	0.2	3	0.3795
5	0.1619	0.2	0.15	0.83333	0.2	4	0.3713
5	0.1613	0.2	0.15	0.83333	0.2	5	0.3680
5	0.1612	0.2	0.15	0.83333	0.2	6	0.3672
5	0.1613	0.2	0.15	0.83333	0.2	7	0.3679
5	0.1615	0.2	0.15	0.83333	0.2	8	0.3693
5	0.1619	0.2	0.15	0.83333	0.2	9	0.3711
5	0.1622	0.2	0.15	0.83333	0.2	10	0.3732

For L=7 one has

Table 5:

L	WACC	ko	kd	Wd	t	n	ke
7	0.1726	0.2	0.15	0.875	0.2	1	0.5409
7	0.1646	0.2	0.15	0.875	0.2	2	0.4771
7	0.1614	0.2	0.15	0.875	0.2	3	0.4511
7	0.1599	0.2	0.15	0.875	0.2	4	0.4396
7	0.1594	0.2	0.15	0.875	0.2	5	0.4349
7	0.1592	0.2	0.15	0.875	0.2	6	0.4338
7	0.1593	0.2	0.15	0.875	0.2	7	0.4347
7	0.1596	0.2	0.15	0.875	0.2	8	0.4366
7	0.1599	0.2	0.15	0.875	0.2	9	0.4392
7	0.1603	0.2	0.15	0.875	0.2	10	0.4421

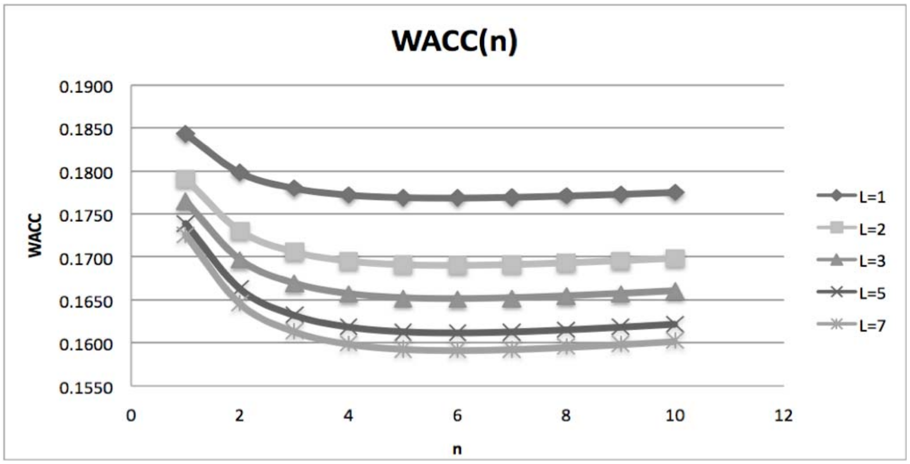

Figure 4: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different leverage levels.

The analysis of the Tables **1-5**, and Figure **4** allows us to make the following conclusions:

1. In all examined cases, (at all leverage levels) at current values of capital costs (equity, k_0, and debt, k_d) the second type of behavior of dependence of weighted average cost of capital, WACC, on the life time of company, n, takes place, namely, descending of WACC with n with the passage through the minimum with subsequent limited growth.

2. The minimum of cost of attracting capital (weighted average cost of capital of the company, WACC) is achieved at all leverage levels at the same company's age at n=6 (only when L=1 minimum is spread for two years (n=5 and n= 6).

3. The value of WACC minimum significantly depends on the level of leverage, L, and, of course, decreases with increasing L, because weighted average cost of capital, WACC, at a fixed n decreases with leverage.

2. Dependence of Weighted Average Cost of Capital, WACC, on Life-Time of the Company *n* at Different Values of Capital Costs (Equity, k_0, and Debt, k_d) and Fixed Leverage Levels

The analysis of the Tables **6-9**, and Figures **5-6** allows us to make the following conclusions:

Table 6:

L	WACC	ko	kd	Wd	t	n	ke
1	0.0758	0.08	0.04	0.5	0.2	1	0.1197
1	0.0745	0.08	0.04	0.5	0.2	2	0.1170
1	0.0738	0.08	0.04	0.5	0.2	3	0.1157
1	0.0735	0.08	0.04	0.5	0.2	4	0.1149
1	0.0732	0.08	0.04	0.5	0.2	5	0.1144
1	0.0731	0.08	0.04	0.5	0.2	6	0.1141
1	0.0729	0.08	0.04	0.5	0.2	7	0.1139
1	0.0729	0.08	0.04	0.5	0.2	8	0.1137
1	0.0728	0.08	0.04	0.5	0.2	9	0.1136
1	0.0728	0.08	0.04	0.5	0.2	10	0.1135

Table 7:

L	WACC	ko	kd	Wd	t	n	ke
1	0.1843	0.2	0.15	0.5	0.2	1	0.2487
1	0.1798	0.2	0.15	0.5	0.2	2	0.2397
1	0.1780	0.2	0.15	0.5	0.2	3	0.2360
1	0.1772	0.2	0.15	0.5	0.2	4	0.2345
1	0.1769	0.2	0.15	0.5	0.2	5	0.2339
1	0.1769	0.2	0.15	0.5	0.2	6	0.2338
1	0.1770	0.2	0.15	0.5	0.2	7	0.2340
1	0.1771	0.2	0.15	0.5	0.2	8	0.2343
1	0.1773	0.2	0.15	0.5	0.2	9	0.2346
1	0.1775	0.2	0.15	0.5	0.2	10	0.2351

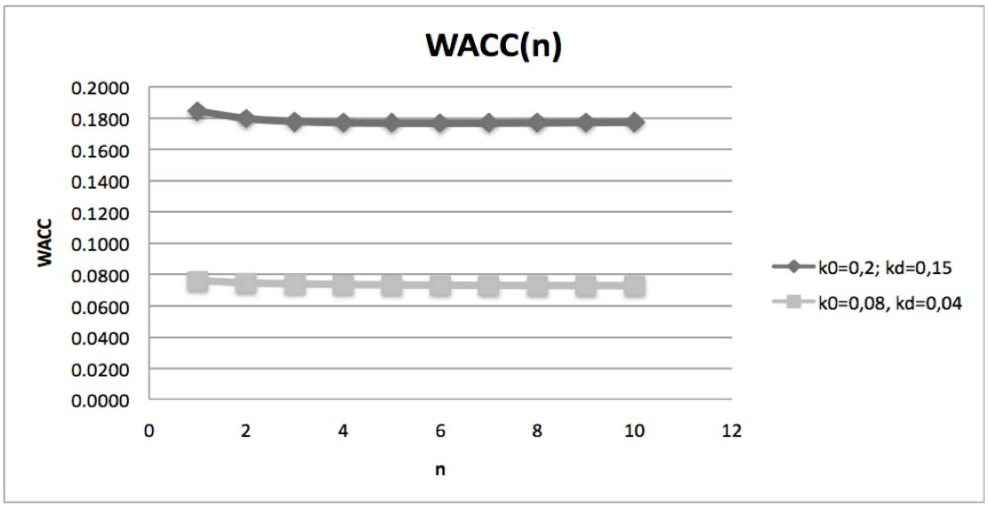

Figure 5: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different values of capital costs (equity, k_0, and debt, k_d) and fixed leverage level L=1.

L=3

Table 8:

L	WACC	Ko	Kd	Wd	t	n	Ke
3	0.1765	0.2	0.15	0.75	0.2	1	0.3461
3	0.1697	0.2	0.15	0.75	0.2	2	0.3189
3	0.1669	0.2	0.15	0.75	0.2	3	0.3078
3	0.1657	0.2	0.15	0.75	0.2	4	0.3029
3	0.1653	0.2	0.15	0.75	0.2	5	0.3010
3	0.1651	0.2	0.15	0.75	0.2	6	0.3006
3	0.1653	0.2	0.15	0.75	0.2	7	0.3010
3	0.1655	0.2	0.15	0.75	0.2	8	0.3019
3	0.1658	0.2	0.15	0.75	0.2	9	0.3030
3	0.1661	0.2	0.15	0.75	0.2	10	0.3042

Table 9:

L	WACC	ko	kd	Wd	t	n	ke
3	0.0738	0.08	0.04	0.75	0.2	1	0.1991
3	0.0717	0.08	0.04	0.75	0.2	2	0.1909
3	0.0707	0.08	0.04	0.75	0.2	3	0.1870
3	0.0702	0.08	0.04	0.75	0.2	4	0.1847
3	0.0698	0.08	0.04	0.75	0.2	5	0.1832
3	0.0696	0.08	0.04	0.75	0.2	6	0.1822
3	0.0694	0.08	0.04	0.75	0.2	7	0.1815
3	0.0693	0.08	0.04	0.75	0.2	8	0.1810
3	0.0692	0.08	0.04	0.75	0.2	9	0.1806
3	0.0691	0.08	0.04	0.75	0.2	10	0.1803

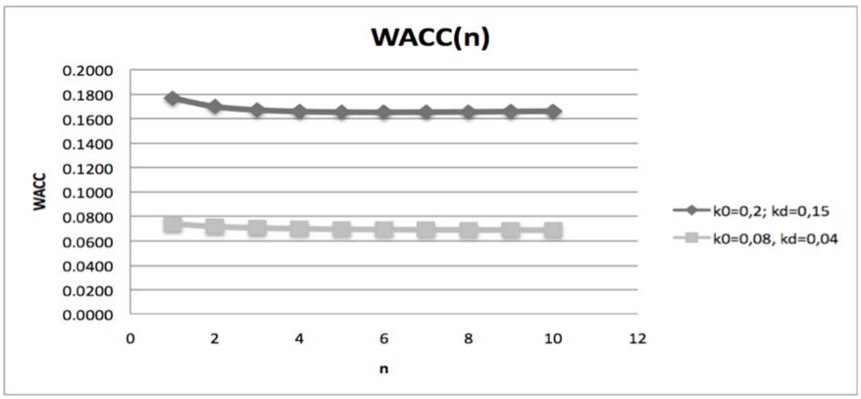

Figure 6: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different values of capital costs (equity, k_0, and debt, k_d) and fixed leverage level L=3.

1. The type of behavior of dependence of weighted average cost of capital, WACC, on the life time of company, n, at fixed leverage level significantly depends on values of capital costs (equity, k_0, and debt, k_d). At the values of capital costs that are specific to Russia (k_0 = 20 %, k_d =15 %) there is a second type of dependence of WACC on the life time of company, n, namely, descending of WACC with n with the passage through the minimum with subsequent limited growth. And at the capital cost values, characteristic to the West (k_0 = 8 %, k_d = 4 %) there is a first type of dependence of WACC on the time of life of company n, namely, the descending of WACC with n.

2. The same features is observed in both considering cases: at the leverage values L=1 and L=3.

Put first L=1.

Table 10:

L	WACC	ko	kd	Wd	t	n	ke
1	0.1843	0.2	0.15	0.5	0.2	1	0.2487
1	0.1798	0.2	0.15	0.5	0.2	2	0.2397
1	0.1780	0.2	0.15	0.5	0.2	3	0.2360
1	0.1772	0.2	0.15	0.5	0.2	4	0.2345
1	0.1769	0.2	0.15	0.5	0.2	5	0.2339
1	0.1769	0.2	0.15	0.5	0.2	6	0.2338
1	0.1770	0.2	0.15	0.5	0.2	7	0.2340
1	0.1771	0.2	0.15	0.5	0.2	8	0.2343
1	0.1773	0.2	0.15	0.5	0.2	9	0.2346
1	0.1775	0.2	0.15	0.5	0.2	10	0.2351

Table 11:

L	WACC	ko	kd	Wd	t	n	ke
1	0.1871	0.2	0.12	0.5	0.2	1	0.2783
1	0.1832	0.2	0.12	0.5	0.2	2	0.2705
1	0.1815	0.2	0.12	0.5	0.2	3	0.2670
1	0.1807	0.2	0.12	0.5	0.2	4	0.2653
1	0.1802	0.2	0.12	0.5	0.2	5	0.2644
1	0.1799	0.2	0.12	0.5	0.2	6	0.2639
1	0.1798	0.2	0.12	0.5	0.2	7	0.2636
1	0.1798	0.2	0.12	0.5	0.2	8	0.2636
1	0.1798	0.2	0.12	0.5	0.2	9	0.2635
1	0.1798	0.2	0.12	0.5	0.2	10	0.2636

Table 12:

L	WACC	ko	kd	Wd	t	n	ke
1	0.1826	0.2	0.17	0.5	0.2	1	0.2291
1	0.1777	0.2	0.17	0.5	0.2	2	0.2194
1	0.1759	0.2	0.17	0.5	0.2	3	0.2158
1	0.1752	0.2	0.17	0.5	0.2	4	0.2144
1	0.1750	0.2	0.17	0.5	0.2	5	0.2141
1	0.1751	0.2	0.17	0.5	0.2	6	0.2143
1	0.1754	0.2	0.17	0.5	0.2	7	0.2148
1	0.1757	0.2	0.17	0.5	0.2	8	0.2154
1	0.1760	0.2	0.17	0.5	0.2	9	0.2160
1	0.1763	0.2	0.17	0.5	0.2	10	0.2167

Table 13:

L	WACC	ko	kd	Wd	t	n	ke
1	0.1891	0.2	0.1	0.5	0.2	1	0.2982
1	0.1857	0.2	0.1	0.5	0.2	2	0.2913
1	0.1841	0.2	0.1	0.5	0.2	3	0.2881
1	0.1832	0.2	0.1	0.5	0.2	4	0.2864
1	0.1827	0.2	0.1	0.5	0.2	5	0.2853
1	0.1823	0.2	0.1	0.5	0.2	6	0.2846
1	0.1821	0.2	0.1	0.5	0.2	7	0.2842
1	0.1819	0.2	0.1	0.5	0.2	8	0.2838
1	0.1818	0.2	0.1	0.5	0.2	9	0.2836
1	0.1817	0.2	0.1	0.5	0.2	10	0.2834

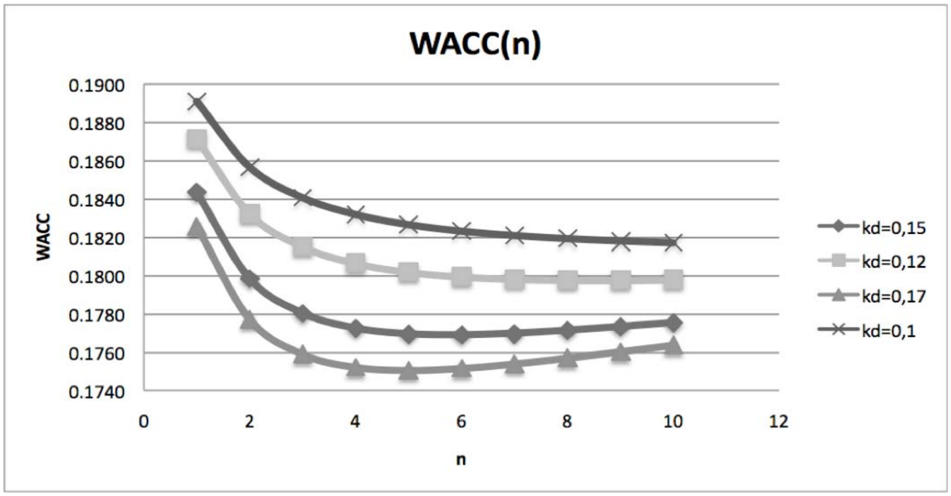

Figure 7: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different values of debt capital cost, k_d , and fixed equity cost, k_0 , and fixed leverage level L=1.

Put than L=3.

Table 14:

L	WACC	ko	kd	Wd	t	n	ke
3	0.1765	0.2	0.15	0.75	0.2	1	0.3461
3	0.1697	0.2	0.15	0.75	0.2	2	0.3189
3	0.1669	0.2	0.15	0.75	0.2	3	0.3078
3	0.1657	0.2	0.15	0.75	0.2	4	0.3029
3	0.1653	0.2	0.15	0.75	0.2	5	0.3010
3	0.1651	0.2	0.15	0.75	0.2	6	0.3006
3	0.1653	0.2	0.15	0.75	0.2	7	0.3010
3	0.1655	0.2	0.15	0.75	0.2	8	0.3019
3	0.1658	0.2	0.15	0.75	0.2	9	0.3030
3	0.1661	0.2	0.15	0.75	0.2	10	0.3042

Table 15:

L	WACC	ko	kd	Wd	t	n	ke
3	0.1807	0.2	0.12	0.75	0.2	1	0.4349
3	0.1748	0.2	0.12	0.75	0.2	2	0.4113
3	0.1722	0.2	0.12	0.75	0.2	3	0.4009
3	0.1709	0.2	0.12	0.75	0.2	4	0.3955
3	0.1702	0.2	0.12	0.75	0.2	5	0.3927
3	0.1698	0.2	0.12	0.75	0.2	6	0.3911
3	0.1696	0.2	0.12	0.75	0.2	7	0.3903
3	0.1695	0.2	0.12	0.75	0.2	8	0.3900
3	0.1695	0.2	0.12	0.75	0.2	9	0.3899
3	0.1695	0.2	0.12	0.75	0.2	10	0.3900

Table 16:

L	WACC	ko	kd	Wd	t	n	ke
3	0.1738	0.2	0.17	0.75	0.2	1	0.2874
3	0.1665	0.2	0.17	0.75	0.2	2	0.2581
3	0.1637	0.2	0.17	0.75	0.2	3	0.2469
3	0.1626	0.2	0.17	0.75	0.2	4	0.2426
3	0.1624	0.2	0.17	0.75	0.2	5	0.2415
3	0.1625	0.2	0.17	0.75	0.2	6	0.2420
3	0.1628	0.2	0.17	0.75	0.2	7	0.2433
3	0.1633	0.2	0.17	0.75	0.2	8	0.2451
3	0.1638	0.2	0.17	0.75	0.2	9	0.2470
3	0.1643	0.2	0.17	0.75	0.2	10	0.2490

Table 17:

L	WACC	ko	kd	Wd	t	n	ke
3	0.1836	0.2	0.1	0.75	0.2	1	0.4945
3	0.1785	0.2	0.1	0.75	0.2	2	0.4739
3	0.1761	0.2	0.1	0.75	0.2	3	0.4642
3	0.1747	0.2	0.1	0.75	0.2	4	0.4588
3	0.1739	0.2	0.1	0.75	0.2	5	0.4556
3	0.1734	0.2	0.1	0.75	0.2	6	0.4535
3	0.1730	0.2	0.1	0.75	0.2	7	0.4520
3	0.1727	0.2	0.1	0.75	0.2	8	0.4510
3	0.1726	0.2	0.1	0.75	0.2	9	0.4502
3	0.1724	0.2	0.1	0.75	0.2	10	0.4496

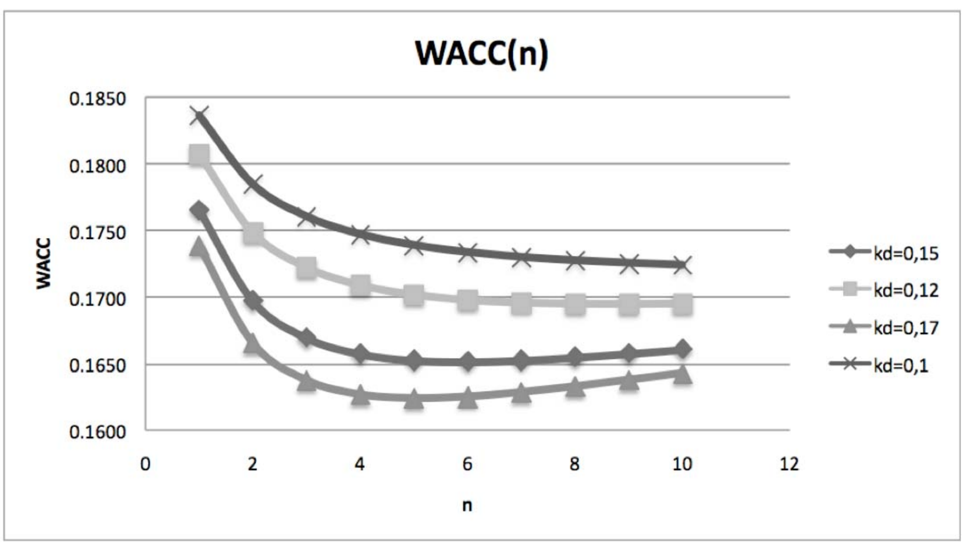

Figure 8: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different values of debt capital cost, k_d , and fixed equity cost, k_0 , and fixed leverage level L=3.

3. Dependence of Weighted Average Cost of Capital, WACC, on Life-Time of the Company *n* at Different Values of Debt Capital Cost, k_d, and Fixed Equity Cost, k_0, and Fixed Leverage Levels

In this paragraph we study the dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different values of debt capital cost, k_d, and fixed equity cost, k_0, and fixed leverage levels

The analysis of the Tables **10-17**, and Figures **7-8:** allows us to make the following conclusions:

1. At fixed equity cost, k_0, and at fixed leverage level the type of behavior of dependence of weighted average cost of capital, WACC, on the life time of company, n, significantly depends on value of debt capital cost, k_d: with growth of k_d it is changing from monotonic descending of WACC with n to descending of WACC with n with the passage through the minimum with subsequent limited growth.

2. At k_d=10% and k_d=12% (k_0=20%) the monotonic descending of WACC with n is observed, while at higher debt costs, k_d=15% and k_d=17% (k_0=20%) descending of WACC with n with the passage through the minimum with subsequent limited growth takes place. The optimum age of the company is growing with k_d decreasing: it is equal to 5 years at k_d = 17% and 6 years at k_d = 15 %.

3. The conclusions are saved at both considered values of leverage level: L=1 and L=3.

4. Dependence of Weighted Average Cost of Capital, WACC, on Life-Time of the Company *n* at Different Values of Equity Cost, k_0, and Fixed Debt Capital Cost, k_d, and Fixed Leverage Levels

In this paragraph we study the dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different values of equity cost, k_0, and fixed debt capital cost, k_d, and fixed leverage levels.

The analysis of the Tables **18-23**, and Figures **9-10:** allows us to make the following conclusions:

Table 18:

L	WACC	ko	kd	Wd	t	n	ke
1	0.1646	0.18	0.15	0.5	0.2	1	0.2092
1	0.1602	0.18	0.15	0.5	0.2	2	0.2005
1	0.1585	0.18	0.15	0.5	0.2	3	0.1970
1	0.1578	0.18	0.15	0.5	0.2	4	0.1956
1	0.1576	0.18	0.15	0.5	0.2	5	0.1952
1	0.1576	0.18	0.15	0.5	0.2	6	0.1952
1	0.1578	0.18	0.15	0.5	0.2	7	0.1955
1	0.1580	0.18	0.15	0.5	0.2	8	0.1960
1	0.1583	0.18	0.15	0.5	0.2	9	0.1965
1	0.1585	0.18	0.15	0.5	0.2	10	0.1970

Table 19:

L	WACC	ko	kd	Wd	t	n	ke
1	0.1843	0.2	0.15	0.5	0.2	1	0.2487
1	0.1798	0.2	0.15	0.5	0.2	2	0.2397
1	0.1780	0.2	0.15	0.5	0.2	3	0.2360
1	0.1772	0.2	0.15	0.5	0.2	4	0.2345
1	0.1769	0.2	0.15	0.5	0.2	5	0.2339
1	0.1769	0.2	0.15	0.5	0.2	6	0.2338
1	0.1770	0.2	0.15	0.5	0.2	7	0.2340
1	0.1771	0.2	0.15	0.5	0.2	8	0.2343
1	0.1773	0.2	0.15	0.5	0.2	9	0.2346
1	0.1775	0.2	0.15	0.5	0.2	10	0.2351

Table 20:

L	WACC	ko	kd	Wd	t	n	ke
1	0.2041	0.22	0.15	0.5	0.2	1	0.2882
1	0.1994	0.22	0.15	0.5	0.2	2	0.2789
1	0.1975	0.22	0.15	0.5	0.2	3	0.2751
1	0.1967	0.22	0.15	0.5	0.2	4	0.2733
1	0.1963	0.22	0.15	0.5	0.2	5	0.2726
1	0.1962	0.22	0.15	0.5	0.2	6	0.2723
1	0.1962	0.22	0.15	0.5	0.2	7	0.2723
1	0.1962	0.22	0.15	0.5	0.2	8	0.2725
1	0.1964	0.22	0.15	0.5	0.2	9	0.2727
1	0.1965	0.22	0.15	0.5	0.2	10	0.2730

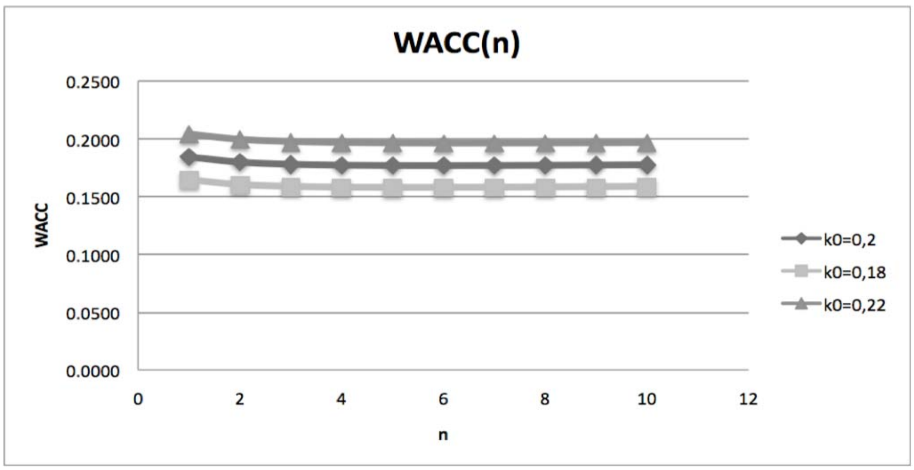

Figure 9: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different values of equity cost, k_0, and fixed debt capital cost, k_d, and fixed leverage level L=1.

L=3

Table 21:

L	WACC	ko	kd	Wd	t	n	ke
3	0.1569	0.18	0.15	0.75	0.2	1	0.2677
3	0.1503	0.18	0.15	0.75	0.2	2	0.2412
3	0.1477	0.18	0.15	0.75	0.2	3	0.2307
3	0.1466	0.18	0.15	0.75	0.2	4	0.2264
3	0.1462	0.18	0.15	0.75	0.2	5	0.2249
3	0.1462	0.18	0.15	0.75	0.2	6	0.2250
3	0.1464	0.18	0.15	0.75	0.2	7	0.2258
3	0.1468	0.18	0.15	0.75	0.2	8	0.2271
3	0.1471	0.18	0.15	0.75	0.2	9	0.2286
3	0.1475	0.18	0.15	0.75	0.2	10	0.2302

Table 22:

L	WACC	ko	kd	Wd	t	n	ke
3	0.1765	0.2	0.15	0.75	0.2	1	0.3461
3	0.1697	0.2	0.15	0.75	0.2	2	0.3189
3	0.1669	0.2	0.15	0.75	0.2	3	0.3078
3	0.1657	0.2	0.15	0.75	0.2	4	0.3029
3	0.1653	0.2	0.15	0.75	0.2	5	0.3010
3	0.1651	0.2	0.15	0.75	0.2	6	0.3006
3	0.1653	0.2	0.15	0.75	0.2	7	0.3010
3	0.1655	0.2	0.15	0.75	0.2	8	0.3019
3	0.1658	0.2	0.15	0.75	0.2	9	0.3030
3	0.1661	0.2	0.15	0.75	0.2	10	0.3042

Table 23:

L	WACC	ko	kd	Wd	t	n	ke
3	0.1961	0.22	0.15	0.75	0.2	1	0.4245
3	0.1891	0.22	0.15	0.75	0.2	2	0.3965
3	0.1862	0.22	0.15	0.75	0.2	3	0.3848
3	0.1849	0.22	0.15	0.75	0.2	4	0.3795
3	0.1843	0.22	0.15	0.75	0.2	5	0.3770
3	0.1840	0.22	0.15	0.75	0.2	6	0.3762
3	0.1840	0.22	0.15	0.75	0.2	7	0.3761
3	0.1841	0.22	0.15	0.75	0.2	8	0.3766
3	0.1843	0.22	0.15	0.75	0.2	9	0.3773
3	0.1845	0.22	0.15	0.75	0.2	10	0.3781

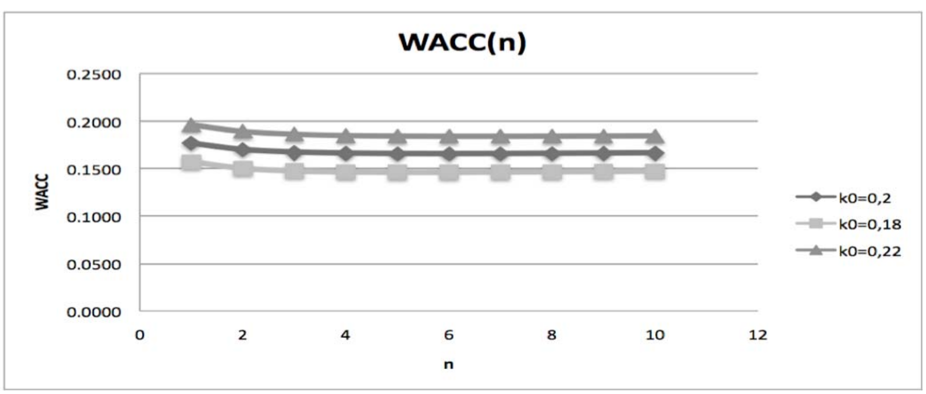

Figure 10: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at different values of equity cost, k_0, and fixed debt capital cost, k_d, and fixed leverage level L=3.

1. At fixed debt capital cost, k_d, and at fixed leverage level at all considered cases (at all equity costs k_0 and all leverage levels L) the second type of dependence of weighted average cost of capital, WACC, on the life time of company, n, namely, descending of WACC with n with the passage through the minimum with subsequent limited growth takes place.

"The Golden Age" of the company slightly fluctuates under change of the equity value k_0, these fluctuations are described in Tables **24** (age is in years).

Table 24:

L\ k_0	18%	20%	22%
1	5–6	5–6	6–8
3	5–6	6	6–7

5. Dependence of Weighted Average Cost of Capital, WACC, on Life-Time of the Company *n* at High Values of Capital Cost (Equity, k_0, and Debt, k_d) and High Life-Time of the Company

Let us study the dependence of weighted average cost of capital, WACC, on life-time of the company *n* at high values of capital cost (equity, k_0, and debt, k_d) and high life-time of the company.

1. At Fixed Leverage Level

From Figure **11** it follows, that:

1. In all considered cases (at all leverage levels L) at high values of capital cost (equity, k_0 =40%, and debt, k_d =35%) the second type of dependence of weighted average cost of capital, WACC, on the life time of company, n, namely, descending of WACC with n with the passage through the minimum with subsequent limited growth up to perpetuity limit takes place.

2. A minimum value of attracting capital cost (weighted average cost of capital, WACC) is achieved at all leverage levels in the same age when n=4. This means that, at high-value of capital costs, company age, at which minimal value of attracting capital cost is achieved is shifted forward lower (younger) values. We just remind, that at k_0 = 20 %, and k_d = 15% (see above) the golden age was 6 years.

3. Shift of curves to lower values of WACC with increase of leverage level L is associated with decrease of WACC with leverage.

4. An interesting thing is analysis of the value of detected effect, i.e., how much is the difference between the minimum of the attracting capital, found in the BFO theory, and its perpetuity limit value, which has been considered as minimal value up to now. In Table **25** a dependence of the difference between the minimum of the attracting capital and its perpetuity limit value on leverage level L is shown.

Perpetuity limit value of WACC is calculated by using Modigliani – Miller formula (Modigliani *et al.* 1958; 1963; 1966) with accounting of corporate taxes:

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

From Figure **11:** it is seen that at high values of time of life of company ($n \geq 30$) weighted average cost of capital, WACC, practically does not differ from its perpetuity limit.

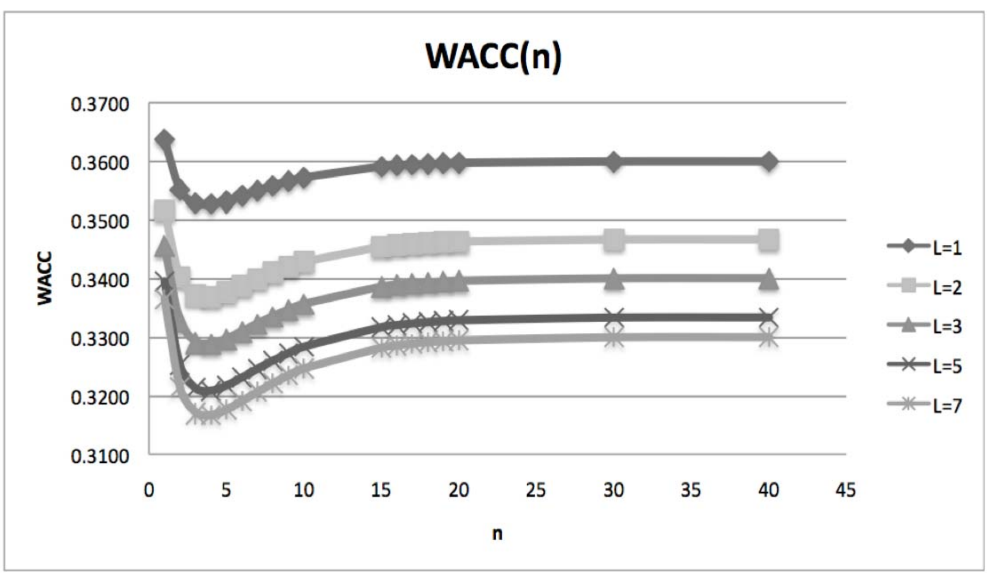

Figure 11: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at high values of capital cost (equity, k_0 =40%, and debt, k_d =35%) at different leverage levels L (up to high values of life-time of the company).

Table 25: The Difference between the Optimal (Minimal) Value of Weighted Average Cost of Capital, WACC, and its Perpetuity Limit

L	1	2	3	5	7
$\Delta WACC$, %	–0.72	–0.99	–1.12	–1.25	–1.33

From Table **25** it is seen that the gain value is from 0.7 per cent up to 1.5 per cent, and grows with the increase in the leverage level of company, L.

2. Under Change of the Debt Capital Cost, k_d.

Under change of the debt capital cost, k_d, a depth of pit in dependence of weighted average cost of capital, WACC, on the time of life of the company, n, is changed as well: from Figure **12** it is seen that pit (accounted from perpetuity value) is changed from 0.49% (at k_d =0.3) up to 0.72% (at k_d =0.35).

Note, that as it is seen from Figure **12**, a perpetuity limit of WACC does not depends on debt cost, k_d, that is in accordance with the Modigliani - Miller formula (1) for WACC, which does not contain a debt capital cost, k_d, that means independence of perpetuity limit of WACC values from k_d, while the intermediate WACC values (for finite life time of company, n) depend on the debt capital cost, k_d (see BFO theory (Brusov *et al.* 2011a,b,c,d,e; 2012 a,b; 2013 a,b,c; 2014 a,b; Filatova *et al.* 2008)).

From Figure **13** it is seen, that with increase of debt cost, k_d, the character of dependence of weighted average cost of capital, WACC, on life-time of the company *n* is changed from monotonic descending of WACC with n to descending of WACC with n with passage through minimum, followed by a limited growth.

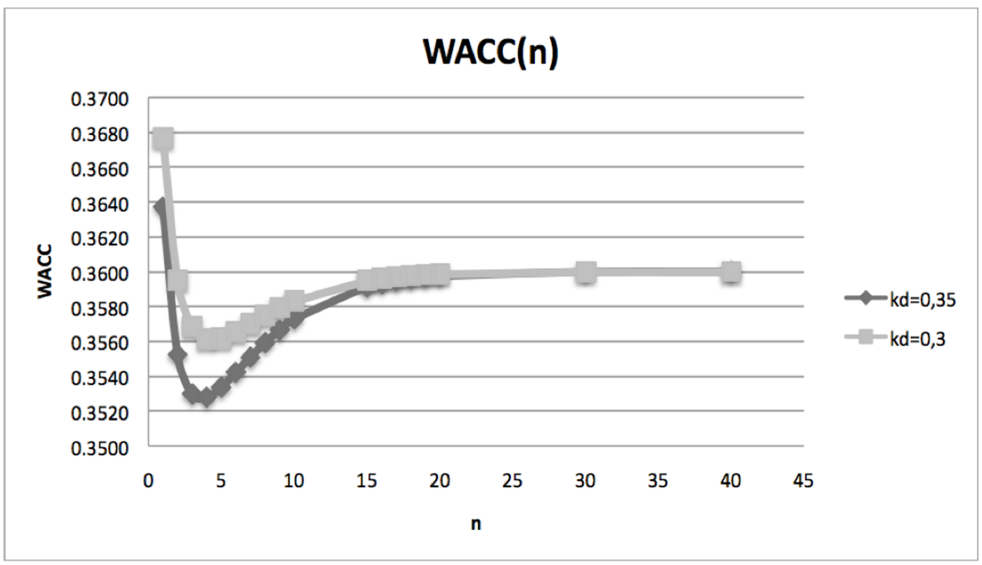

Figure 12: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at fixed high value of equity cost, k_0 =40%, and two values of debt cost, k_d =30% and 35% at leverage level L=1.

Table 26:

WACC	ko	kd	L	n	t
18.2889%	0.2	0.18	1	1	0.2
17.4859%	0.2	0.18	1	3	0.2
17.4155%	0.2	0.18	1	5	0.2
17.4654%	0.2	0.18	1	7	0.2
17.5833%	0.2	0.18	1	10	0.2
17.8641%	0.2	0.18	1	20	0.2
17.9629%	0.2	0.18	1	30	0.2
17.9909%	0.2	0.18	1	40	0.2

Table 27:

WACC	ko	kd	L	n	t
18.4736%	0.2	0.15	1	1	0.2
17.8200%	0.2	0.15	1	3	0.2
17.6936%	0.2	0.15	1	5	0.2
17.6967%	0.2	0.15	1	7	0.2
17.7528%	0.2	0.15	1	10	0.2
17.9192%	0.2	0.15	1	20	0.2
17.9797%	0.2	0.15	1	30	0.2
17.9957%	0.2	0.15	1	40	0.2

Table 28:

WACC	ko	kd	L	n	t
18.6583%	0.2	0.12	1	1	0.2
18.1511%	0.2	0.12	1	3	0.2
18.0181%	0.2	0.12	1	5	0.2
17.9817%	0.2	0.12	1	7	0.2
17.9789%	0.2	0.12	1	10	0.2
18.0145%	0.2	0.12	1	20	0.2
18.0175%	0.2	0.12	1	30	0.2
18.0099%	0.2	0.12	1	40	0.2

Table 29:

WACC	ko	kd	L	n	t
18.9082%	0.2	0.1	1	1	0.2
18.4030%	0.2	0.1	1	3	0.2
18.2615%	0.2	0.1	1	5	0.2
18.2045%	0.2	0.1	1	7	0.2
18.1678%	0.2	0.1	1	10	0.2
18.1146%	0.2	0.1	1	20	0.2
18.0669%	0.2	0.1	1	30	0.2
18.0330%	0.2	0.1	1	40	0.2

Table 30:

WACC	ko	kd	L	n	t
19.1087%	0.2	0.08	1	1	0.2
18.6716%	0.2	0.08	1	3	0.2
18.5297%	0.2	0.08	1	5	0.2
18.4692%	0.2	0.08	1	7	0.2
18.4040%	0.2	0.08	1	10	0.2
18.2594%	0.2	0.08	1	20	0.2
18.1532%	0.2	0.08	1	30	0.2
18.0813%	0.2	0.08	1	40	0.2

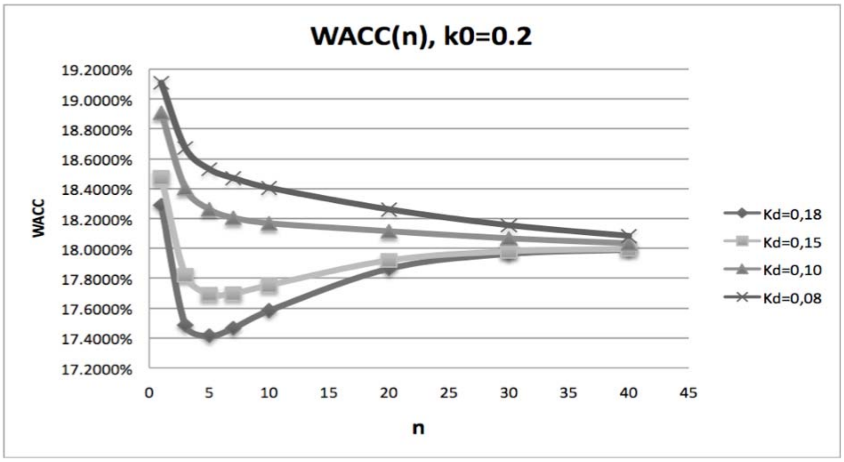

Figure 13: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at fixed value of equity cost, k_0 =20%, and at four values of debt cost, k_d =8%; 10%; 15% and 18% at leverage level L=1**.**

3. Under Change of the Equity Capital Cost, k_0 .

Table 31:

WACC	ko	kd	L	n	t
23.2477%	0.25	0.15	1	1	0.2
22.6690%	0.25	0.15	1	3	0.2
22.5117%	0.25	0.15	1	5	0.2
22.4913%	0.25	0.15	1	7	0.2
22.4933%	0.25	0.15	1	10	0.2
22.5219%	0.25	0.15	1	20	0.2
22.5136%	0.25	0.15	1	30	0.2
22.5045%	0.25	0.15	1	40	0.2

Table 32:

WACC	ko	kd	L	n	t
20.3006%	0.22	0.15	1	1	0.2
19.7431%	0.22	0.15	1	3	0.2
19.6171%	0.22	0.15	1	5	0.2
19.6163%	0.22	0.15	1	7	0.2
19.6514%	0.22	0.15	1	10	0.2
19.7639%	0.22	0.15	1	20	0.2
19.7960%	0.22	0.15	1	30	0.2
19.8007%	0.22	0.15	1	40	0.2

Table 33:

WACC	ko	kd	L	n	t
18.4717%	0.2	0.15	1	1	0.2
17.8015%	0.2	0.15	1	3	0.2
17.6938%	0.2	0.15	1	5	0.2
17.6972%	0.2	0.15	1	7	0.2
17.7592%	0.2	0.15	1	10	0.2
17.9192%	0.2	0.15	1	20	0.2
17.9797%	0.2	0.15	1	30	0.2
17.9957%	0.2	0.15	1	40	0.2

Table 34:

WACC	ko	kd	L	n	t
16.4350%	0.18	0.15	1	1	0.2
15.8519%	0.18	0.15	1	3	0.2
15.7610%	0.18	0.15	1	5	0.2
15.7793%	0.18	0.15	1	7	0.2
15.8561%	0.18	0.15	1	10	0.2
16.0683%	0.18	0.15	1	20	0.2
16.1586%	0.18	0.15	1	30	0.2
16.1884%	0.18	0.15	1	40	0.2

Table 35:

WACC	ko	kd	L	n	t
14.4304%	0.16	0.15	1	1	0.2
13.9019%	0.16	0.15	1	3	0.2
13.8278%	0.16	0.15	1	5	0.2
13.8610%	0.16	0.15	1	7	0.2
13.9481%	0.16	0.15	1	10	0.2
14.2119%	0.16	0.15	1	20	0.2
14.3324%	0.16	0.15	1	30	0.2
14.3781%	0.16	0.15	1	40	0.2

Table 36:

k_0	0.16	0.18	0.20	0.22	0.25
$\Delta WACC$, %	0.55	0.43	0.30	0.18	0.03

Depth of gap, $\Delta WACC$, is decreased with equity cost, k_0 .

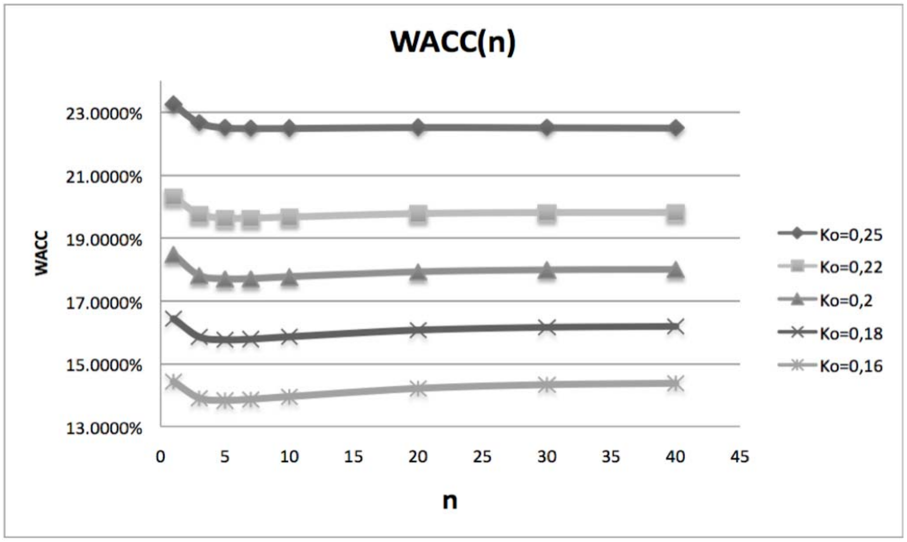

Figure 14: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at fixed value of debt cost, k_d =15%, and five values of equity cost, k_0 =16%; 18%; 20%; 22% and 25% at leverage level L=1.

4. Under Change of the Tax on Profit Rate, t.

The depth of gap in dependence of WACC on n, which is equal to 0.41% at t=0.2 is increased in 2.2 times and becomes equal to 0.92% at t=0.4, i.e. it is increased in 2.2 times when tax on profit rate is increased in 2 times.

We see from Figure **16**, that at fixed capital costs, k_0 =30%; k_d =15%, and different values of tax on profit rates, t, there is no minimum in WACC at finite life-time of the company: minimal value of WACC is reached at $n = \infty$. Note, that this is a feature of these particular values of capital costs (probably, too big difference between k_0 and k_d).

Table 37:

L	WACC	ko	kd	t	n
2	17.84%	0.2	0.15	0.2	1
2	17.07%	0.2	0.15	0.2	3
2	16.92%	0.2	0.15	0.2	5
2	16.92%	0.2	0.15	0.2	7
2	16.99%	0.2	0.15	0.2	10
2	17.12%	0.2	0.15	0.2	15
2	17.30%	0.2	0.15	0.2	30
2	17.33%	0.2	0.15	0.2	45

Table 38:

L	WACC	ko	kd	t	n
2	15.72%	0.2	0.15	0.4	1
2	14.09%	0.2	0.15	0.4	3
2	13.76%	0.2	0.15	0.4	5
2	13.73%	0.2	0.15	0.4	7
2	13.86%	0.2	0.15	0.4	10
2	14.13%	0.2	0.15	0.4	15
2	14.56%	0.2	0.15	0.4	30
2	14.65%	0.2	0.15	0.4	45

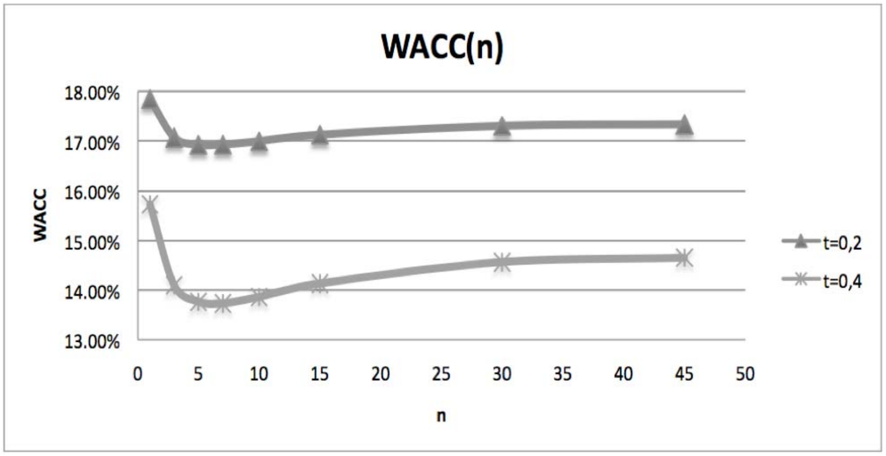

Figure 15: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at fixed capital costs, k_0 =20%; k_d =15%, and two values of tax on profit rates t=0.2 and 0.4 and at leverage level L=2.

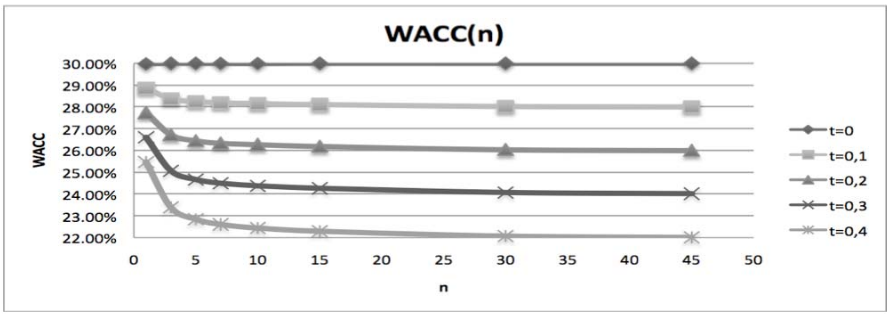

Figure 16: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at fixed capital costs, k_0 =30%; k_d =15%, and different values of tax on profit rates t=0; 0.1; 0.2; 0.3 and 0.4 and at leverage level L=2**.**

6. Further Investigation of Effect

During further investigation of effect we have discovered one more interesting feature of dependence of WACC on n, WACC(n): we have called this effect "Kulik effect" (Figure **20**).

It turns out that at particular values of capital costs, for example, at k_0 =25%; k_d =15%, a third modification of dependences of weighted average cost of capital, WACC, on the time of life of company n takes place: descending of WACC with passage through minimum, followed by a growth with passage through maximum and finally with trend to perpetuity limit from bigger values (remind, that at second type of WACC(n) behavior, the curve WACC(n) tends to perpetuity limit from lower values). We have called this effect "Kulik effect".

Table 39:

L	t	ko	kd	n	Wd	WACC
1	0.2	0.25	0.15	1	0.5	23.2270%
1	0.2	0.25	0.15	3	0.5	22.6725%
1	0.2	0.25	0.15	5	0.5	22.5184%
1	0.2	0.25	0.15	7	0.5	22.4914%
1	0.2	0.25	0.15	10	0.5	22.4934%
1	0.2	0.25	0.15	20	0.5	22.5220%
1	0.2	0.25	0.15	30	0.5	22.5137%
1	0.2	0.25	0.15	40	0.5	22.5045%
1	0.2	0.25	0.15	∞	0.5	21.50%

Table 40:

L	t	ko	kd	n	Wd	WACC
2	0.2	0.25	0.15	1	0.6667	22.8255%
2	0.2	0.25	0.15	3	0.6667	21.8935%
2	0.2	0.25	0.15	5	0.6667	21.6843%
2	0.2	0.25	0.15	7	0.6667	21.6431%
2	0.2	0.25	0.15	10	0.6667	21.6448%
2	0.2	0.25	0.15	20	0.6667	21.6895%
2	0.2	0.25	0.15	30	0.6667	21.6842%
2	0.2	0.25	0.15	40	0.6667	21.6742%
2	0.2	0.25	0.15	∞	0.6667	21.6665%

Note, that perpetuity limits for WACC(n), calculated by the Modigliani – Miller formula (1) (Modigliani *et al.* 1958; 1963; 1966) are equals to:
for L=1 $WACC(\infty)$ =22,5%;
for L=2 $WACC(\infty)$ =21,6665%.

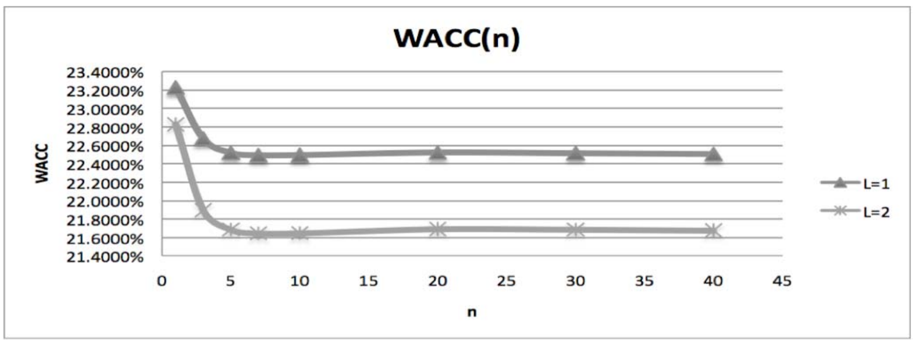

Figure 17: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at fixed capital costs, k_0 =25%; k_d =15%, and different values of leverage level L=1 and L=2.

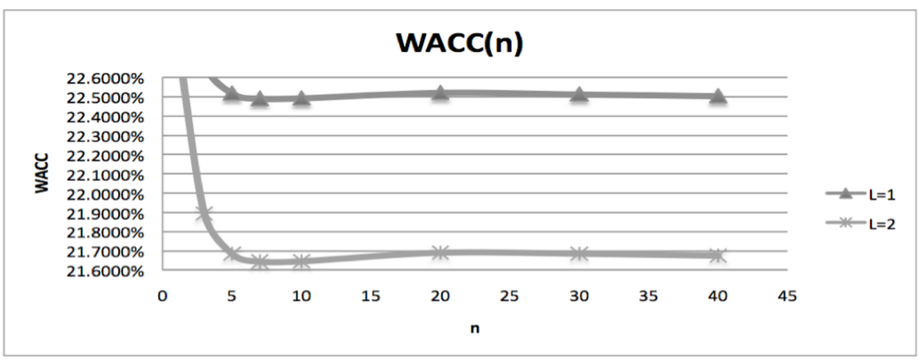

Figure 18: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at fixed capital costs, k_0 =25%; k_d =15%, and different values of leverage level L=1 and L=2 (lager scale).

CONCLUSIONS

In this paper it is shown for the first time within BFO theory (Brusov *et al.* 2011a,b,c,d,e; 2012 a,b; 2013 a,b,c; 2014 a,b; Filatova *et al.* 2008), that valuation of WACC in the Modigliani – Miller theory (Modigliani *et al.* 1958; 1963; 1966) is not minimal and valuation of the company capitalization is not maximal, as all financiers supposed up to now: at some age of the company its WACC value turns out to be lower, than in Modigliani – Miller theory and company capitalization V turns out to be greater, than V in Modigliani – Miller theory (Modigliani *et al.* 1958; 1963; 1966). Thus, existing up to the present presentations concerning the results of the Modigliani-Miller theory in this aspect (Myers 1984) turn out to be incorrect.

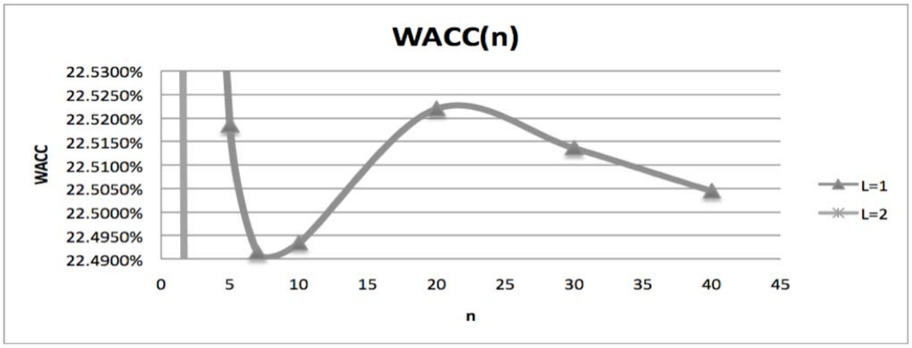

Figure 19: Dependence of weighted average cost of capital, WACC, on life-time of the company *n* at fixed capital costs, k_0 =25%; k_d =15%, and different values of leverage level L=1 and L=2 (the largest scale).

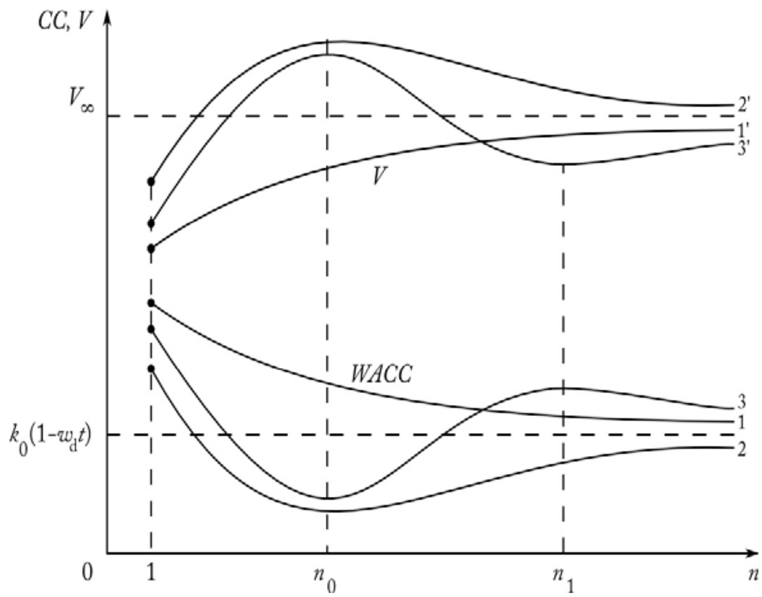

Figure 20: Kulik effect for WACC (3) and for V (3').

It is shown that, from the point of view of cost of attracting capital there are two types of dependences of weighted average cost of capital, WACC, on the time of life of company n: monotonic descending with n and descending with passage through minimum, followed by a limited growth (there is a third modification of dependences WACC(n), which leaves all conclusions valid). The first type takes place for the companies with low cost capital, characteristic for the western companies. The second type takes place for higher costs capital costs of the company, characteristic for the Russian companies as well as for companies from other developing countries. This means that latter companies, in contrast to the western ones, can take advantage of the benefits, given at a certain stage of development of company by discovered effect**.** (For example, the capitalization of Russian oil company "Rosneft' ", which has been valued in 2014 by Modigliani – Miller method, could be higher, accounting the discovered effect and BFO theory). Moreover, since the "golden age" of company depends on the company's capital costs, by controlling them (for example, by modifying the value of dividend payments, that reflect the equity cost), company may extend the "golden age" of the company, when the cost to attract capital becomes a minimal (less than perpetuity limit), and capitalization of companies becomes maximal (above than perpetuity assessment) up to a specified time interval.

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