Inflation in Brusov–Filatova–Orekhova Theory and in its Perpetuity Limit – Modigliani – Miller Theory

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Abstract: In this paper the influence of inflation on capital cost and capitalization of the company within modern theory of capital cost and capital structure – Brusov–Filatova–Orekhova theory (BFO theory) (Brusov *et al*. 2011, 2013; Filatova *et al*., 2008) and within its perpetuity limit – Modigliani – Miller theory is investigated. By direct incorporation of inflation into both theories, it is shown for the first time that inflation not only increases the equity cost and the weighted average cost of capital, but as well it changes their dependence on leverage. In particular, it increases growing rate of equity cost with leverage. Capitalization of the company is decreased under accounting of inflation.

Keywords: Brusov–Filatova–Orekhova theory, Modigliani – Miller theory, inflation.

INTRODUCTION

Created more than half a century ago by Nobel Prize winners Modigliani and Miller theory of capital cost and capital structure (Modigliani F., Miller M., 1958, 1963, 1966) did not account a lot of factors of a real economy, such as taxing, bankruptcy, unperfected capital markets, inflation and many others. But while taxing has been included into consideration by authors themselves and some other limitations have been taken off by their followers, direct incorporation of inflation to Modigliani – Miller theory is absent still now.

The influence of inflation on valuation of capital cost of company and its capitalization is investigated within Modigliani – Miller theory (MM) (Modigliani F., Miller M., 1958, 1963, 1966), which is now outdate, but still widely used at the West, as well as within modern theory of capital cost and capital structure– Brusov–Filatova–Orekhova theory (BFO theory) (Brusov *et al*. 2011,2013; Filatova *et al*., 2008), which should replaced Modigliani – Miller theory (Modigliani F., Miller M., 1958, 1963, 1966). It is shown, that inflation not only increases the equity cost and the weighted average cost of capital, but as well it changes their dependence on leverage. In particular, it increases growing rate of equity cost with leverage. Capitalization of the company is decreased under accounting of inflation.

We start from the study of inflation within Modigliani – Miller theory without taxing (Modigliani F., Miller M., 1958), than with taxing (Modigliani F., Miller M., 1963) and finally within modern theory of capital cost and capital structure– Brusov–Filatova–Orekhova theory (BFO theory) (Brusov *et al*. 2011, 2013; Filatova *et al*., 2008).

1. ACCOUNTING OF INFLATION IN MODIGLIANI – MILLER THEORY WITHOUT TAXES

Note, that any modification of Modigliani–Miller theory, as well as of any other one, requires going behind the frame of modified theory. Thus, in current case we should go behind the frame of perpetuity of the company (remind to reader, that Modigliani–Miller theory describes only perpetuity companies – companies with infinite lifetime), come to the companies with finite lifetime, make necessary calculations and then use the perpetuity limit.

As known, in profit approach capitalization of the company is equal to discounted sum of profits of the company. Suppose that profit is constant for all periods and equal to *CF*, one gets for capitalization of the financially independent company V_0 , existing n years at market

$$V_0=\frac{CF}{1+k_0}+\frac{CF}{(1+k_0)^2}+...+\frac{CF}{(1+k_0)^n}. \qquad (1)$$

Here k_0 capital cost of the financially independent company.

Under inflation with rate α the capitalization of the financially independent company V_0^* becomes equal to

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$$V_0^* = \frac{CF}{(1+k_0)(1+\alpha)} + \frac{CF}{\left[(1+k_0)(1+\alpha)\right]^2} + \ldots + \frac{CF}{\left[(1+k_0)(1+\alpha)\right]^n}. \quad (2)$$

Using the formula for sum of the terms of indefinitely diminishing geometrical progression with the first term

$$a_1 = \frac{CF}{(1+k_0)(1+\alpha)}$$

and denominator

$$q = \frac{1}{(1+k_0)(1+\alpha)}$$

one gets for capitalization of the financially independent company V_0^* the following expression

$$V_0^* = \frac{a_1}{1-q} = \frac{CF}{(1+k_0)(1+\alpha)\left[1-\left((1+k_0)(1+\alpha)\right)^{-1}\right]} = \frac{CF}{(1+k_0)(1+\alpha)-1} = \frac{CF}{k_0(1+\alpha)+\alpha}.$$

$$V_0^* = \frac{CF}{k_0(1+\alpha)+\alpha}. \quad (3)$$

It is seen, that under accounting of inflation the capitalization of the company decreases.

At discount rate $k_0 = 10\%$ and inflation rate α =3% the decrease is equal to 5,7%, and at discount rate $k_0 = 15\%$ and inflation rate α =7% the decrease is equal to 35%. One can see that influence of inflation on the company capitalization could be significant enough and negative.

For leverage company, using debt capital one has without inflation $V_L = \frac{CF}{1+WACC} + \frac{CF}{(1+WACC)^2} + \ldots + \frac{CF}{(1+WACC)^n}$.

Under accounting of inflation the capitalization of the company is equal to $V_L^* = \frac{CF}{(1+WACC)(1+\alpha)} + \frac{CF}{\left[(1+WACC)(1+\alpha)\right]^2} + \ldots + \frac{CF}{\left[(1+WACC)(1+\alpha)\right]^n}$.

Summing the ifinite set, we get for leverage company capitalization under accounting of inflation in Modigliani–Miller limit

$$V_L^* = \frac{a_1}{1-q} = \frac{CF}{(1+WACC)(1+\alpha)\left[1-\left((1+WACC)(1+\alpha)\right)^{-1}\right]} = \frac{CF}{(1+WACC)(1+\alpha)-1} = \frac{CF}{WACC(1+\alpha)+\alpha}$$

$$V_L^* = \frac{CF}{WACC(1+\alpha)+\alpha}. \quad (4)$$

It is seen, that similar to the case of the financially independent company inflation decreases the company capitalization and the decrease could be significant. From the formulas (3) and (4) it follows that effective values of capital costs (equity and WACC) are equal to

$$k_0^* = k_0(1+\alpha)+\alpha \quad (5)$$

$$WACC^* = WACC \cdot (1+\alpha)+\alpha \quad (6)$$

Note, that both capital costs increases under inflation.

We can compare obtained results with Fisher formula for inflation.

$$i^* = \frac{i-\alpha}{1+\alpha}.$$

Solving this equation with respect to nominal rate i, one gets equation, similar (5) and (6).

$$i = i^* \cdot (1+\alpha)+\alpha.$$

Thus, effective capital costs in our case have meaning of nominal ones, accounting inflation.

From the Modigliani–Miller theorem, that the weighted average cost of capital WACC does not depends on leverage level (without taxing), formulating under accounting of inflation, it is easy to get expression for the equity cost:

$$WACC^* = k_0^* = k_e^* w_e + k_d^* w_d.$$

Here k_e^* and k_d^* are equity cost and debt cost consequently under accounting of inflation

Finding from here k_e^*, one gets:

$$k_e^* = \frac{k_0^*}{w_e} - k_d^* \frac{w_d}{w_e} = \frac{k_0^*(S+D)}{S} - k_d^* \frac{D}{S} = k_0^* + (k_0^* - k_d^*)\frac{D}{S} = k_0^* + (k_0^* - k_d^*)L.$$

Putting instead of k_0^*, k_d^* their expressions, one gets finally

$$k_e^* = k_0^* + (k_0^* - k_d^*)L = k_0(1+\alpha) + \alpha + L(k_0 - k_d)(1+\alpha) = (1+\alpha)\left[k_0 + \alpha + L(k_0 - k_d)\right]$$

$$k_e^* = k_0(1+\alpha) + \alpha + L(k_0 - k_d)(1+\alpha). \quad (7)$$

It is seen, that inflation not only increases the equity cost, but as well it changes its dependence on leverage. In particular, it increases growing rate of equity cost with leverage by multiplier (1+α). The growing rate of equity cost with leverage, which is equal to $(k_0 - k_d)$ without inflation becomes equal to $(k_0 - k_d)(1+\alpha)$ under accounting of inflation.

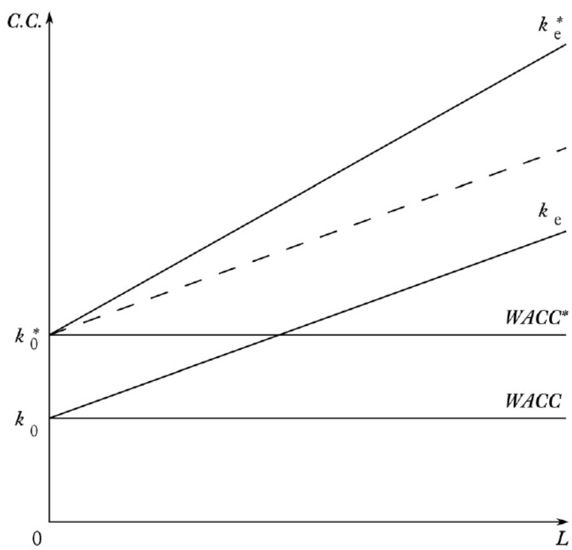

Figure 1: Dependence of the equity cost and the weighted average cost of capital on leverage in the Modigliani–Miller theory without taxing under accounting of inflation. It is seen, that growing rate of equity cost increases with leverage. Axis y means capital costs –C.C.

Thus, we come to conclusion, that it is necessary to modify the second statement of the Modigliani–Miller theory (Modigliani F., Miller M., 1958) concerning the equity cost of leverage company.

2-nd Original MM Statement

Equity cost of leverage company k_e could be found as equity cost of financially independent company k_0 of the same group of risk, plus premium for risk, which value is equal to production of difference $(k_0 - k_d)$ on leverage level *L*.

2-nd Modified MM-BFO Statement

Under existing of inflation with rate α equity cost of leverage company k_e could be found as equity cost of financially independent company k_0 of the same group of risk, multiplied by (1+α), plus inflation rate α and plus premium for risk, which value is equal to production of difference $(k_0 - k_d)$ on leverage level *L* and on multiplier $(1+\alpha)$.

2. ACCOUNTING OF INFLATION IN MODIGLIANI – MILLER THEORY WITH CORPORATE TAXES

2.1. Accounting of Inflation

Let us calculate first the tax shield for perpetuity company under accounting of inflation

$$(PV)_{TS} = k_d^* DT \sum_{t=1}^{\infty} (1+k_d^*)^{-t} = DT \quad (8)$$

Here T- tax on profit rate; D-debt capital value.

It is interesting to note, that inspite of dependence of each term of set on effective credit rate

k_d^* tax shield turns out to be independent of it and equal to "inflationless" value *DT* and Modigliani–Miller theorem under accounting of inflation takes the form (Modigliani F., Miller M., 1963)

$$V_L^* = V_0^* + DT. \quad (9)$$

Substituting $D = w_d V_L^*$,

one gets

$$V_L^* = CF / k_0^* + w_d V_L^* T \quad (10)$$

or

$$V_L^*(1 - w_d T) = CF / k_0^*. \quad (11)$$

Because leverage company capitalization is equal to

$V_L^* = CF / WACC^*$ for the weighted average cost of capital one has

$$WACC^* = k_0^*(1 - w_d T). \quad (12)$$

From (12) we get the dependence of $WACC^*$ on leverage level $L = D/S$:

$$WACC^* = k_0^*(1 - LT/(1+L)).$$

$$WACC^* = \left[k_0(1+\alpha) + \alpha\right] \cdot (1 - w_d T) \quad (13)$$

On definition of the weighted average cost of capital with accounting of the tax shield one has

$$WACC^* = k_0^* w_e + k_d^* w_d (1-T). \quad (14)$$

Equating right hand parts of expressions (12) and (14), we get

$$k_0^*(1-w_d T) = k_0^* w_e + k_d^* w_d (1-T),$$

from where one obtains the following expression for equity cost:

$$k_e^* = k_0^* \frac{(1-w_d T)}{w_e} - k_d^* \frac{w_d}{w_e}(1-T) =$$
$$k_e^* \frac{1}{w_e} - k_0^* \frac{w_d}{w_e} T - k_d^* \frac{D}{S}(1-T) =$$
$$= k_0^* \frac{D+S}{S} - k_0^* \frac{D}{S} T - k_d^* \frac{D}{S}(1-T) = k_0^* + L(1-T)(k_0^* - k_d^*).$$

$$k_e^* = k_0^* + L(1-T)(k_0^* - k_d^*) =$$
$$\left[k_0(1+\alpha)+\alpha\right] + L(1-T)(k_0 - k_d)(1+\alpha) \quad (15)$$

It is seen, that similar to the case without taxes inflation not only increases the equity cost, but as well it changes its dependence on leverage (Figure **2**). In particular, it increases growing rate of equity cost with leverage by multiplier (1+α). The growing rate of equity cost with leverage, which is equal to $(k_0 - k_d)(1-T)$ without inflation becomes equal to $(k_0 - k_d)(1+\alpha)(1-T)$ under accounting of inflation.

We can now reformulate the fourth statement of the Modigliani–Miller theory (Modigliani F., Miller M., 1963) concerning the equity cost of Leverage Company for case of accounting of inflation.

4-th Original MM Statement

Equity cost of leverage company k_e paying tax on profit could be found as equity cost of financially independent company k_0 of the same group of risk, plus premium for risk, which value is equal to production of difference $(k_0 - k_d)$ on leverage level *L* and on tax shield (*1-T*).

4-th Modified MM-BFO Statement

Equity cost of leverage company k_e paying tax on profit under existing of inflation with rate α could be found as equity cost of financially independent company k_0 of the same group of risk, multiplied by (1+α), plus inflation rate α and plus premium for risk, which value is equal to production of difference $(k_0 - k_d)$ on leverage level *L*, on tax shield (*1-T*) and on multiplier $(1+\alpha)$.

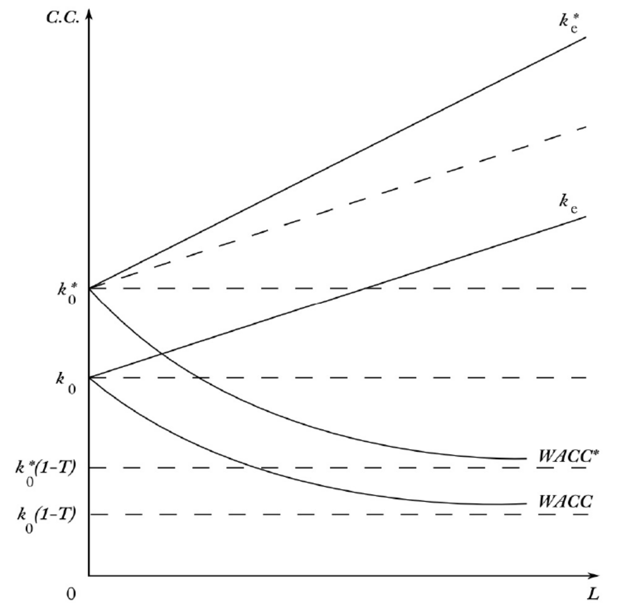

Figure 2: Dependence of the equity cost and the weighted average cost of capital on leverage in the Modigliani–Miller theory with taxing under accounting of inflation. It is seen, that growing rate of equity cost increases with leverage. Axis y means capital costs –C.C.

3. ACCOUNTING OF INFLATION IN BRUSOV–FILATOVA–OREKHOVA THEORY WITH CORPORATE TAXES

3.1. Generalized Brusov–Filatova–Orekhova theorem

Brusov–Filatova–Orekhova, generalized the Modigliani–Miller theory for the case of the companies with arbitrary lifetime (Brusov *et al*. 2011, 2013; Filatova *et al*., 2008), have proved the following important theorem in case of absence of corporate taxing:

Without corporate taxing the equity cost k_0, as well as the weighted average cost of capital WACC do not depend on company lifetime and are equal to

$$k_e = k_0 + L(k_0 - k_d) \text{ and } WACC = k_0. \quad (16)$$

consequently.

Thus, the theorem has proved, that without corporate taxes (say, in offshore zones) the Modigliani–Miller results for capital costs, in spite of the fact, that they have been obtained in perpetuity limit, remain in force for companies with arbitrary lifetime, describing by Brusov–Filatova–Orekhova theory (BFO theory). To prove this theorem Brusov–Filatova–Orekhova, of course, had to go behind Modigliani–Miller approximation.

Under accounting of inflation we can generalize this theorem (Brusov *et al*. 2011, 2013; Filatova *et al*., 2008):

3.1. Generalized Brusov−Filatova−Orekhova theorem

Under accounting of inflation without corporate taxing the equity cost k_0^*, as well as the weighted average cost of capital $WACC^*$ do not depend on company lifetime and are equal to

$$k_e^* = k_0^* + L\left(k_0^* - k_d^*\right) = k_0\left(1+\alpha\right) + \alpha + L\left(k_0 - k_d\right)\left(1+\alpha\right)$$

and $WACC^* = k_0^* = k_0\left(1+\alpha\right) + \alpha$ (17)

consequently.

3.2. Arbitrary Lifetime Companies with Account of Corporate Taxing

Following to Brusov–Filatova–Orekhova (Brusov *et al*. 2011, 2013; Filatova *et al.*, 2008), let us consider the situation for arbitrary lifetime companies with account of corporate taxing. They have derived the famous formula for weighted average cost of capital of companies with arbitrary lifetime

$$\frac{\left[1-\left(1+WACC\right)^{-n}\right]}{WACC} = \frac{\left[1-\left(1+k_0\right)^{-n}\right]}{k_0\left[1-\omega_d T\left(1-\left(1+k_d\right)^{-n}\right)\right]} \quad (18)$$

The application of BFO formula (18) is very wide: authors have applied it in corporate finance, in investments, in taxing, in business valuation, in banking and some other areas (Brusov et al., 2013b, 2011a,b). Using this formula (18), one can study the dependence of the weighted average cost of capital, WACC, as well as the equity cost k_e on leverage level L, on tax on profit rate t, on lifetime of the company n and on relation between equity and debt cost. The qualitatively new effect in corporate finance has been discovered: decrease of the equity cost k_e on leverage level L, which is quite important for corporate finance in general and, in particular, for creating the adequate dividend policy.

Below we generalize formula (18) under existing of inflation.

4. GENERALIZED BRUSOV–FILATOVA–OREKHOVA FORMULA UNDER EXISTING OF INFLATION

Under existing of inflation it is necessary to replace all capital costs: the equity, the debt and the weighted average cost of capital $k_0, k_d, WACC$ by effective ones $k_0^*, k_d^*, WACC^*$,

where

$$k_0^* = k_0\left(1+\alpha\right) + \alpha$$

$$k_d^* = k_d\left(1+\alpha\right) + \alpha$$

$$WACC^* = WACC \cdot \left(1+\alpha\right) + \alpha$$

Rewriting the equation (8) and others for the case of existing of inflation, one gets

$$\left(PV\right)_{TS} = k_d^* DT \sum_{t=1}^{n} (1+k_d^*)^{-t} = DT\left[1-\left(1+k_d^*\right)^{-n}\right] \quad (19)$$

$$V_0^* = CF \sum_{t=1}^{n} (1+k_0^*)^{-t} = CF\left[1-\left(1+k_0^*\right)^{-n}\right] \Big/ k_0^* \quad (20)$$

$$V_L^* = CF \sum_{t=1}^{n} (1+WACC^*)^{-t} = CF\left[1-\left(1+WACC^*\right)^{-n}\right] \Big/ WACC^* \quad (21)$$

$$V_L^* = V_0^* + \left(TS\right)_n, \quad (22)$$

After substitution $D = w_d V_L^*$ we have

$$V_L^* = CF / k_0^* + w_d V_L^* T \quad (23)$$

From here after some transformations we get generalized Brusov-Filatova-Orekhova (18) formula under existing of inflation

$$\frac{\left[1-\left(1+WACC^*\right)^{-n}\right]}{WACC^*} = \frac{\left[1-\left(1+k_0^*\right)^{-n}\right]}{k_0^*\left[1-\omega_d T\left(1-\left(1+k_d^*\right)^{-n}\right)\right]}, \quad (24)$$

or after substitutions

$$k_0^* = k_0\left(1+\alpha\right) + \alpha; \quad k_d^* = k_d\left(1+\alpha\right) + \alpha$$

one gets finally

$$\frac{1-\left(1+WACC^*\right)^{-n}}{WACC^*} = \frac{1-\left[\left(1+k_0\right)\left(1+\alpha\right)\right]^{-n}}{\left(k_0\left(1+\alpha\right)+\alpha\right)\cdot\left[1-\omega_d T\left(1-\left(\left(1+k_d\right)\left(1+\alpha\right)\right)^{-n}\right)\right]} \quad (25)$$

Formula (25) is the generalized Brusov-Filatova-Orekhova formula under existing of inflation.

Let us show some figures, illustrating obtained results.

At Figures **3** and **4** the dependence of the weighted average cost of capital WACC on debt ratio w_d at different inflation rate α (1 - α = 3%; 2 - α=5%; 3 -

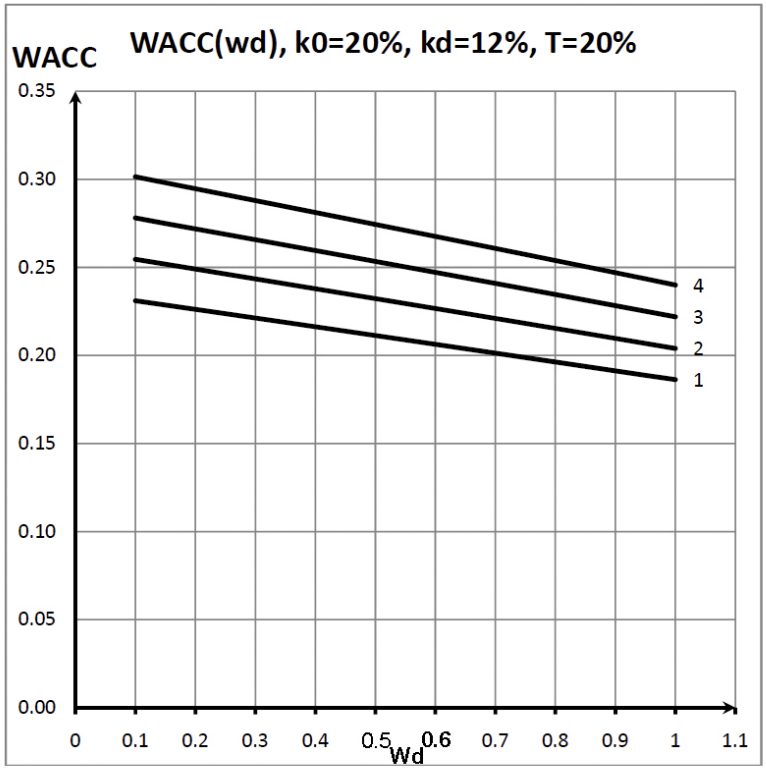

Figure 3: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different inflation rate $\alpha(1-\alpha=3\%;2-\alpha=5\%;3-\alpha=7\%;4-\alpha=9\%)$ for five –year company.

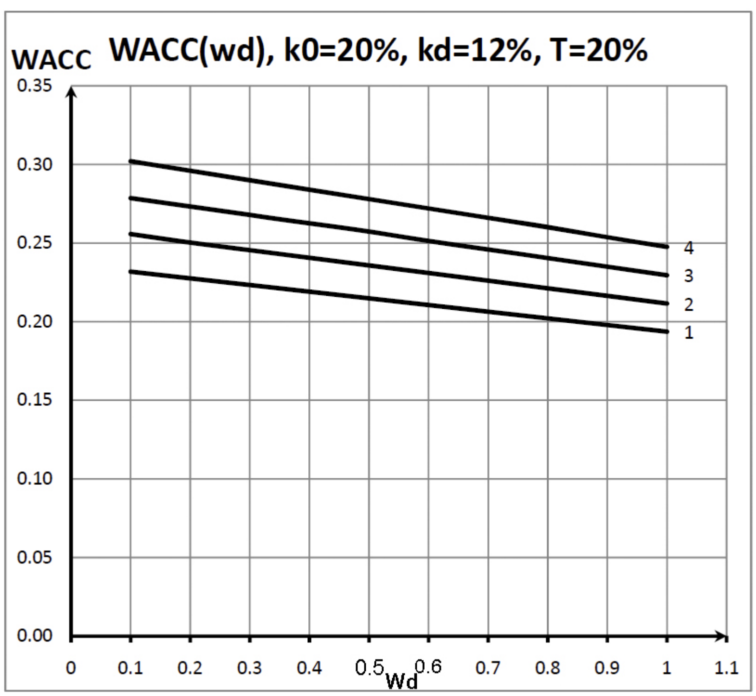

Figure 4: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different inflation rate $\alpha(1-\alpha=3\%;2-\alpha=5\%;3-\alpha=7\%;4-\alpha=9\%)$ for two –year company.

Table 1: Dependence of the Weighted Average Cost of Capital WACC on Debt Ratio w_d at Different Inflation Rate α=3%; 5%; 7%; 9% for Two – Year Company

α\wd	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
0,03	0,2318	0,2276	0,2233	0,2191	0,2149	0,2106	0,2064	0,2021	0,1979	0,1937
0,05	0,2557	0,2503	0,2455	0,2406	0,2358	0,2309	0,2261	0,2212	0,2164	0,2115
0,07	0,2786	0,2733	0,2679	0,2626	0,2573	0,2514	0,2459	0,2404	0,2350	0,2295
0,09	0,3020	0,2960	0,2900	0,2839	0,2779	0,2720	0,2661	0,2602	0,2537	0,2476

Table 2: Dependence of the Weighted Average Cost of Capital WACC on Debt Ratio w_d at Different Inflation Rate α=3%; 5%; 7%; 9% for Five – Year Company

α\wd	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
0,03	0,2311	0,2262	0,2213	0,2163	0,2113	0,2064	0,2013	0,1963	0,1912	0,1863
0,05	0,2546	0,2491	0,2434	0,2379	0,2323	0,2267	0,2210	0,2154	0,2097	0,2040
0,07	0,2781	0,2718	0,2657	0,2595	0,2534	0,2472	0,2408	0,2346	0,2283	0,2219
0,09	0,3015	0,2947	0,2879	0,2812	0,2744	0,2676	0,2608	0,2539	0,2471	0,2400

α=7%; 4 - α=9%) for five –year company as well as for two–year company. It is seen that with increase of inflation rate lines, showing the dependence WACC (w_d) shift practically homogeneously to higher values.

It is seen, that difference in results for two –year company and five –year company is very small. More obviously it could be observed from below tables.

Below we show the dependences of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate from *T*=10% up to *T*=100% at different inflation rate α=3%,5%,7%,9% for five –year company (Figures **5-8**) as well as for two –year company (Figures **9-12**). Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with the step 0,1.

The analysis of Figures **5-12** show, that the weighted average cost of capital WACC decreases with debt ratio w_d faster with increase of tax on profit rate. The space between lines, corresponding to different tax on profit rates, increases with inflation rate. The

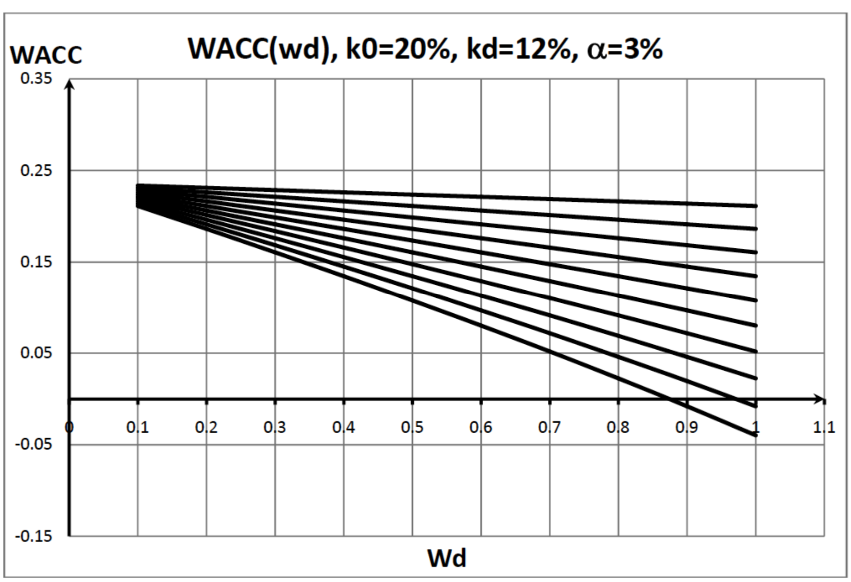

Figure 5: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate at inflation rate α=3% for five –year company. Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with step 0,1.

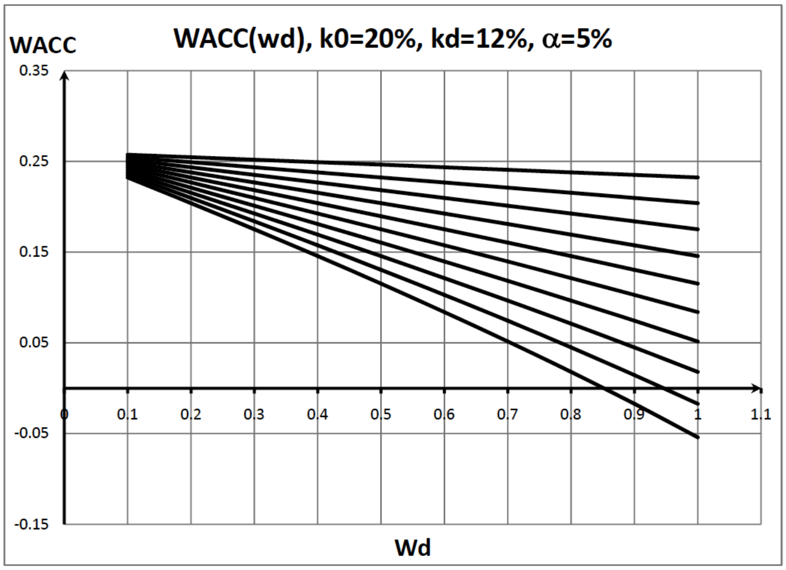

Figure 6: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate at inflation rate α=5% for five – year company. Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with step 0,1.

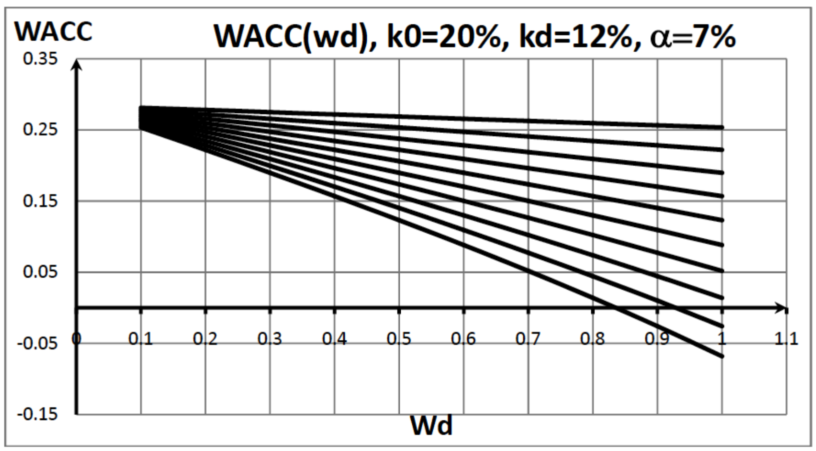

Figure 7: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate at inflation rate α=7% for five – year company. Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with step 0,1.

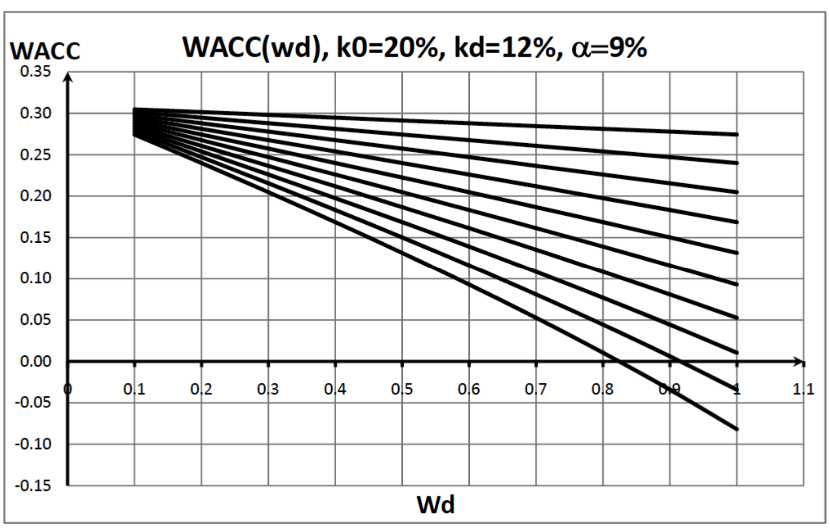

Figure 8: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate at inflation rate α=9% for five – year company. Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with step 0,1.

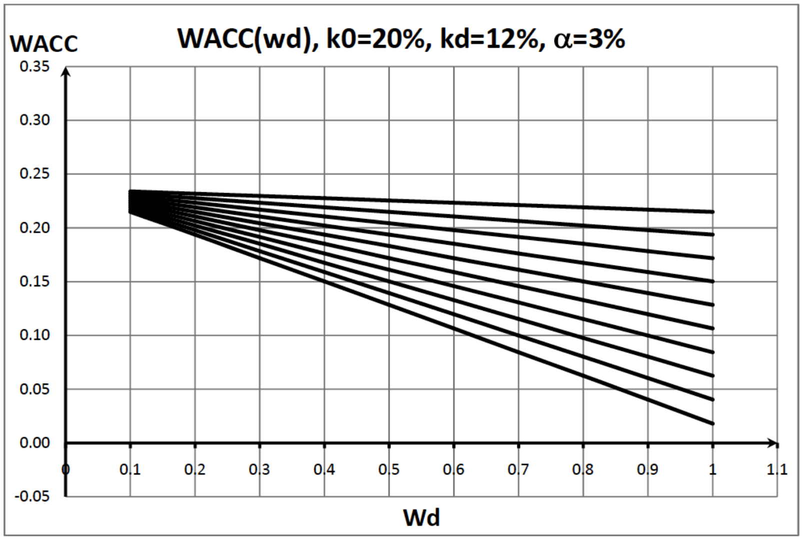

Figure 9: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate at inflation rate α=3% for two – year company. Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with step 0,1.

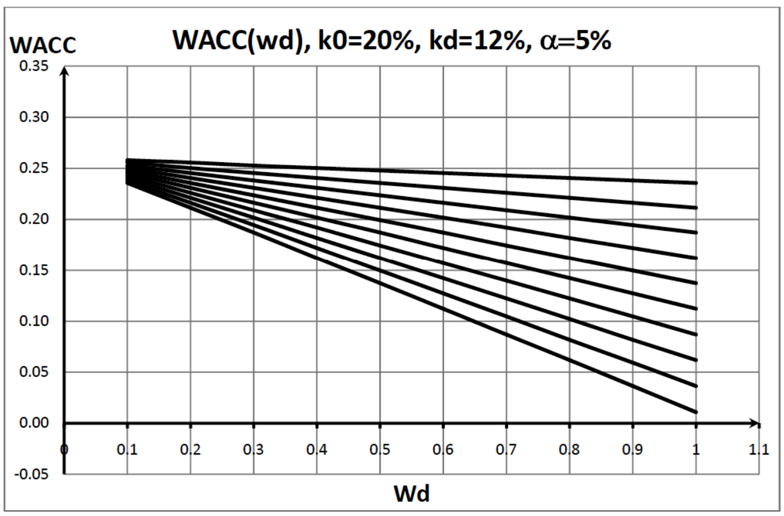

Figure 10: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate at inflation rate α=5% for two – year company. Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with step 0,1.

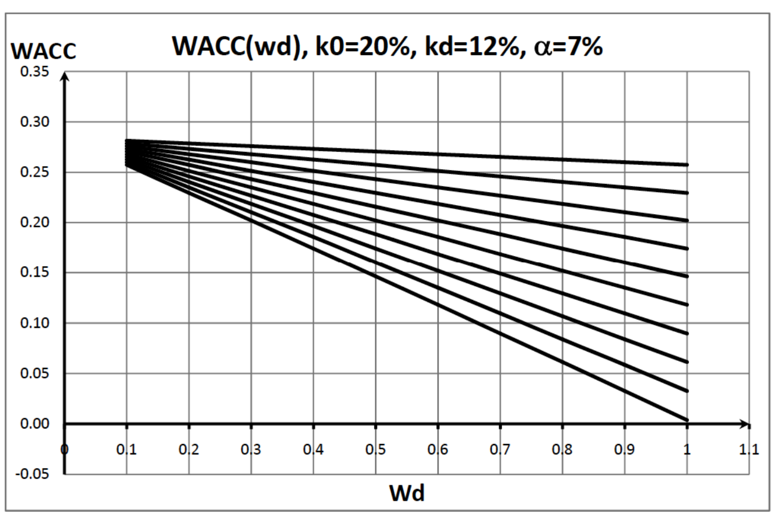

Figure 11: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate at inflation rate α=7% for two – year company. Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with step 0,1.

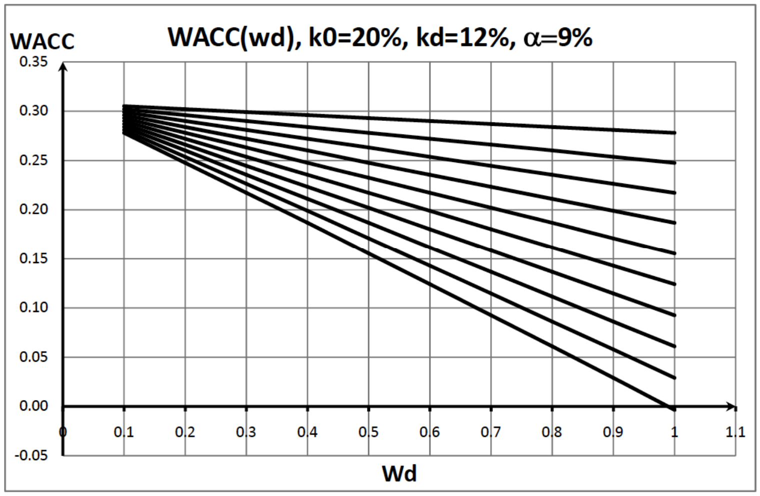

Figure 12: Dependence of the weighted average cost of capital WACC on debt ratio w_d at different tax on profit rate at inflation rate α=9% for two – year company. Tax on profit rate increases from *T*=0,1 (upper line) up to *T*=1 (lowest line) with step 0,1.

variation range of WACC increases with inflation rate as well as with lifetime of the company

5. IRREGULAR INFLATION

Above we considered inflation rate as constant. Really, as a rule, the inflation rate is a variable. It is possible to generalize all above consideration for the case of nonhomogeneous inflation, introducing effective inflation for a few periods.

The effective inflation rate for a few periods $t = t_1 + t_2 + ... + t_n$ is equal to

$$\alpha = (1+\alpha_1)(1+\alpha_2)\cdot ...\cdot(1+\alpha_n) - 1 , \quad (30)$$

where $\alpha_1, \alpha_2, ..., \alpha_n$ are inflation rates for periods $t_1, t_2, ..., t_n$.

The proof of the formula (30) will be done below in Appendix I.

In the case of nonhomogeneous inflation it could be accounted in both theories: Modigliani – Miller and Brusov–Filatova–Orekhova theory (BFO theory) either through effective inflation rate, or directly upon discounting of financial flow.

CONCLUSIONS

In this paper the influence of inflation on capital cost and capitalization of the company within modern theory of capital cost and capital structure – Brusov–Filatova–Orekhova theory (BFO theory) (Brusov *et al*. 2011, 2013; Filatova *et al.*, 2008) and in its perpetuity limit – Modigliani – Miller theory, which is now outdate, but still widely used at the West, is investigated. All basic results of Modigliani – Miller theory were modified. It is shown, that inflation not only increases the equity cost and the weighted average cost of capital, but as well it changes their dependence on leverage. In particular, it increases growing rate of equity cost with leverage. Capitalization of the company is decreased under accounting of inflation.

Within modern theory of capital cost and capital structure – Brusov–Filatova–Orekhova theory (BFO theory) the modified equation for the weighted average cost of capital, WACC, applicable to companies with arbitrary lifetime under accounting of inflation has been derived. Modified BFO equation allow to investigate the dependence of the weighted average cost of capital, WACC, and equity cost, k_e, on leverage level *L*, on tax on profit rate *t*, on lifetime of the company *n*, on equity cost of financially independent company, k_0, and debt cost, k_d, as well as on inflation rate α.

Using modified BFO equation the analysis of the dependence of the weighted average cost of capital, WACC, on debt ratio, w_d, at different tax on profit rate *t*, as well as inflation rate α has been done.

It has been shown, that WACC decreases with debt ratio, w_d, faster at bigger tax on profit rate *t*. The space between lines, corresponding to different values of tax on profit rate at the same step (10%), increases with inflation rate α. The variation region (with change of tax on profit rate *t*) of the weighted average cost of capital, WACC, increases with inflation rate α, as well as with lifetime of the company *n*.

APPENDIX I

Inflation Rate for a Few Periods

Suppose that the inflation rates for the consistent time periods $t_1, t_2, ..., t_n$ are equal to $\alpha_1, \alpha_2, ..., \alpha_n$

consequently. Let us find the inflation rate α for total time period $t = t_1 + t_2 + ... + t_n$.

Common sense dictates that inflation rate is an additive value, so that α, at least approximately, is equal to the sum of the inflation rates $\alpha_1, \alpha_2, ..., \alpha_n$

$$\alpha \approx \alpha_1 + \alpha_2 + ... + \alpha_n . \quad \text{(A1)}$$

Below we will get an exact expression for inflation rate for the total period of time *t*, and will see how it is different from an intuitive result (A1).

At the end of the first commitment period the gained sum will be equal to the amount $S_1 = S_0(1+i)$, and with the account of inflation $S_{1\alpha} = S_0(1+i)^{t_1}/(1+\alpha_1)$. At the end of the second commitment period the gained sum will be equal to the amount $S_2 = S_0(1+i)^{t_1+t_2}$, and with the account of inflation $S_{2\alpha} = S_0(1+i)^{t_1+t_2}/(1+\alpha_1)(1+\alpha_2)$. At the end of the *n*–th commitment period the gained sum will be equal to the amount $S_n = S_0(1+i)^{t_1+t_2+...+t_n}$, and with the account of inflation

$$S_{n\alpha} = S_0(1+i)^{t_1+t_2+...+t_n}/(1+\alpha_1)(1+\alpha_2)\cdot ...\cdot(1+\alpha_n) . \quad \text{(A2)}$$

On the other hand, at inflation rate α for the total period at $t = t_1 + t_2 + ... + t_n$ at the end of this period *t* gained sum will be equal to

$$S_{n\alpha} = S_0(1+i)^t/(1+\alpha) . \quad \text{(A3)}$$

Equating the right-hand part of (A2) and (A3), we get

$$(1+\alpha_1)(1+\alpha_2)\cdot ...\cdot(1+\alpha_n) = 1+\alpha . \quad \text{(A4)}$$

From where

$$\alpha = (1+\alpha_1)(1+\alpha_2)\cdot ...\cdot(1+\alpha_n) - 1 . \quad \text{(A5)}$$

It is easy to get a strict proof of this formula by the method of mathematical induction. Note that inflation rate for the *n*–periods do not depend on both of the length on constituting periods and of the period *t*.

For equal inflation rates $\alpha_1 = \alpha_2 = ... = \alpha_n$ (it is interesting to note, that herewith the time intervals $t_1, t_2, ..., t_n$ can be arbitrary and do not equal each other) one has

$$\alpha = (1+\alpha_1)^n - 1 . \quad \text{(A6)}$$

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