A Qualitatively New Effect in Corporative Finance: Abnormal Dependence of Cost of Equity of Company on Leverage

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Abstract: Qualitatively new effect in corporative finance is discovered: decreasing of cost of equity k_e with leverage L. This effect, which is absent in perpetuity Modigliani–Miller limit, takes place under account of finite lifetime of the company at profit tax rate, which exceeds some value T*.

At some ratios between cost of debt and cost of equity the discovered effect takes place at profit tax rate, existing in western countries and Russia. This provides the practical meaning of discussed effect. Its accounting is important at modification of tax low and can change the dividend policy of the company.

In paper the complete and detailed investigation of discussed effect, discovered within Brusov – Filatova – Orekhova theory (BFO theory), has been done. It has been shown, that the absence of the effect at some particular set of parameters is connected to the fact, that in these cases T* exceeds 100% (profit tax rate is situated in "non– financial" region).

Keywords: Taxes, company capital cost and capital structure, leverage, Modigliani–Miller theory, Brusov – Filatova – Orekhova theory.

INTRODUCTION

The structure of article is as follows: first, we consider the value of the cost of equity k_e in the theory of Modigliani and Miller, its dependence on leverage L and profit tax rate T to show that, in this perpetuity limit the cost of equity k_e is always growing with leverage (for any profit tax rate T).

Then we consider the cost of equity k_e within the modern Brusov – Filatova – Orekhova theory and show that, for companies with finite lifetime a qualitatively new effect takes place: decreasing of the cost of equity with the leverage. The effect takes place at profit tax rate T, exceeding a value T*.

Next, we make a complete study of the discovered effect: we investigate the dependence of T* on company lifetime *n*, on cost of equity of financially independent company k_0 and on debt rate k_d as well as on ratio of these parameters.

We separately consider a one– year company and analyze their special feature in connection with the discussed effect. An explanation of the absence of this effect for such companies will be given. In the conclusion the importance of the discovered effect in various areas, including improving of tax legislation and dividend policies of companies, as well as the practical value of the effect is discusses.

1. COST OF EQUITY IN THE MODIGLIANI–MILLER THEORY

For weighted average cost of capital $WACC$ in the Modigliani–Miller theory the following expression has been obtained (Modigliani, Miller 1958, 1963, 1966)

$$WACC = k_0(1 - w_d T) \quad (1)$$

Dependence of $WACC$ on financial leverage $L = D/S$ is described by the formula

$$WACC = k_0(1 - LT/(1+L)) \quad (2)$$

In accordance to definition of the weighted average cost of capital accounting the tax shield one has

$$WACC = k_e w_e + k_d w_d (1-T). \quad (3)$$

Equating (1) to (3), we get

$$k_0(1 - w_d T) = k_e w_e + k_d w_d (1-T), \quad (4)$$

From where for cost of equity one has

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$$k_e = k_0 + L(1-T)(k_0 - k_d). \quad (5)$$

Note that the formula (5) is different from the corresponding formula without tax only by multiplier (1–T) in the term, indicating premium for risk. As the multiplier is less than unit, the appearance of corporate tax on profits leads to the fact that cost of equity increases with leverage more slowly comparing to the case without taxes.

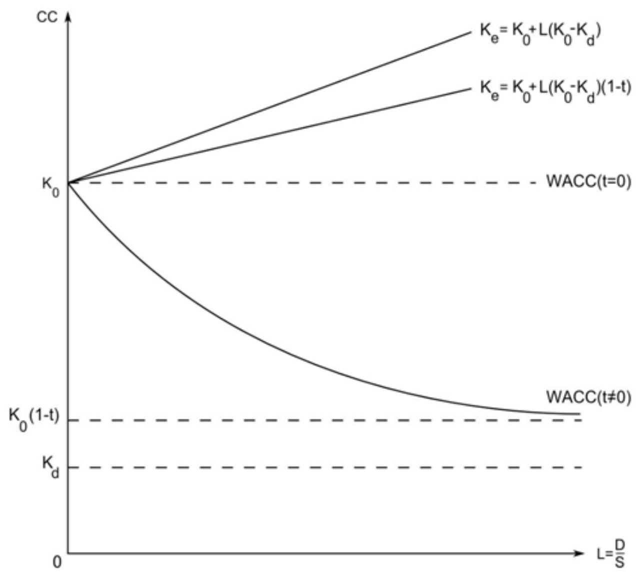

Figure 1: Dependence of cost of equity, cost of debt and WACC on leverage without taxes ($t=0$) and with taxes ($t \neq 0$).

Analysis of formulas (1) and (5) leads to the following conclusions.

With the Increasing of Financial Leverage:

1) Value of the company increases,

2) weighted average cost of capital decreases from k_0 (at $L=0$) up to $k_0(1-T)$ (at $L=\infty$, when the company is funded solely by borrowing, or its own capital is negligible,

3) Cost of equity increases linearly from k_0 (at $L=0$) up to ∞ (at $L=\infty$).

Let us analyze now the influence of taxes on cost of equity in Modigliani–Miller theory by study of the dependence of cost of equity on profit tax rate.

For this we will analyze the formula

$$k_e = k_0 + L(1-T)(k_0 - k_d).$$

It is seen that dependence is linear: cost of equity decreases linearly with profit tax rate. The module of negative tilt angle tangent $tg\gamma = -L(k_0 - k_d)$ increases with leverage, and besides all dependences at different leverage level L_i, coming from different points $k_e = k_0 + L_i(k_0 - k_d)$ at T=0, at T=1 converge at the point k_0 (Figure **2**).

This means that the difference in cost of equity at different leverage level L_i decreases with profit tax rate T, disappearing at T=1.

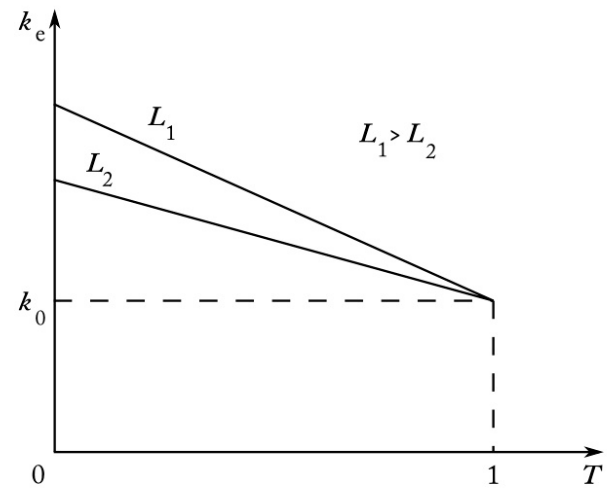

Figure 2: Dependence of cost of equity on profit tax rate T at different leverage level L_i.

Let us illustrate these general considerations by the example $k_0 = 10\%;\ k_d = 8\%$ (see Figures **3-5**).

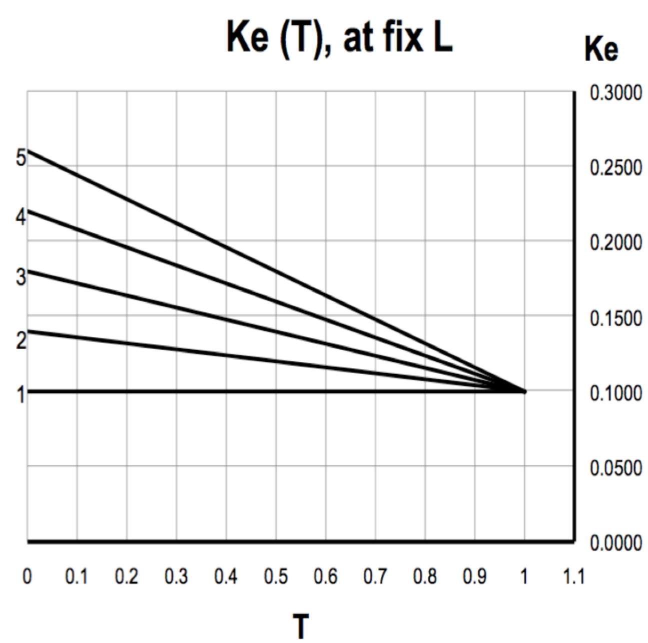

Figure 3: Dependence of cost of equity on profit tax rate T at different leverage level L_i for the case $k_0 = 10\%;\ k_d = 8\%$. (1– $L=0$; 2– $L=2$; 3– $L=4$; 4– $L=6$; 5– $L=8$).

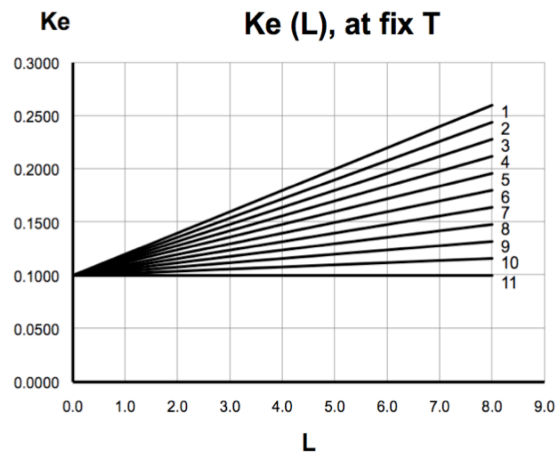

Figure 4: Dependence of cost of equity on leverage *L* at different profit tax rates *T* for the case $k_0 = 10\%;\ k_d = 8\%$.

(1– $T = 0$; 2– $T = 0{,}1$; 3– $T = 0{,}2$; 4– $T = 0{,}3$; 5– $T = 0{,}4$; 6 – $T = 0{,}5$; 7– $T = 0{,}6$; 8– $T = 0{,}7$; 9– $T = 0{,}8$; 10 – $T = 0{,}9$; 11 – $T = 1$).

From Figure **4** it is seen that cost of equity increases linearly from k_0 (at $L = 0$) up to ∞ (at $L = \infty$), and besides tilt angle tangent decreases with profit tax rate *T*, becoming zero at *T*=100%.

By other words, with increase of profit tax rate *T*, dependence of cost of equity on leverage *L* becomes smaller, disappearing at *T*=100%, i.e. within perpetuity Modigliani–Miller theory there is no any anomaly – effect, announced in the title of paper, is absent.

In conclusion, here is a three– dimensional graph of dependence of cost of equity on leverage *L* and on profit tax rate *T* for the case $k_0 = 10\%;\ k_d = 8\%$.

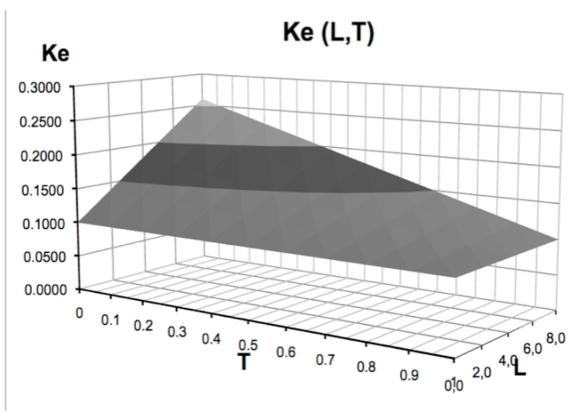

Figure 5: Dependence of cost of equity on leverage *L* and on profit tax rate *T* for the case $k_0 = 10\%;\ k_d = 8\%$.

2. COST OF EQUITY IN BRUSOV – FILATOVA – OREKHOVA THEORY (BFO THEORY)

The general solution of the problem of weighted average cost of capital and the cost of equity for the company with finite lifetime has been received for the first time by Brusov – Filatova – Orekhova with coauthors (Brusov *et al.* 2011a, 2011b, 2011c, 2011d, 2011e, 2012; Brusov, Filatova 2011a, 2011b, 2011c; Filatova, Orekhova, Brusova 2008; Brusov, Filatova, Orekhova 2013a, 2013b).

They have gotten (now already famous) formula for *WACC*

$$\frac{\left[1-(1+WACC)^{-n}\right]}{WACC} = \frac{\left[1-(1+k_0)^{-n}\right]}{k_0\left[1-\omega_d T\left(1-(1+k_d)^{-n}\right)\right]}. \qquad (6)$$

At *n*=1 one gets Myers formula (Myers 2001) for one– year company which is particular case of Brusov – Filatova – Orekhova formula (6)

$$WACC = k_0 - \frac{1+k_0}{1+k_d} k_d w_d T$$

Algorithm for Finding of WACC and Cost of Equity in Case of Arbitrary Life–Time of the Company

Let us return back to *n*–year company. We have the following equation for WACC in *n*–year case

$$\frac{\left[1-(1+WACC)^{-n}\right]}{WACC} - A(n) = 0, \qquad (7)$$

where

$$A(n) = \frac{\left[1-(1+k_0)^{-n}\right]}{k_0\left[1-\omega_d T\left(1-(1+k_d)^{-n}\right)\right]}. \qquad (8)$$

The algorithm of the solving of the equation (7) should be as following:

1) Putting the values of parameters k_0, ω_d, T and given *n* into (8), we calculate $A(n)$;

2) We determine two WACC values, for which the left part of the equation (7) has opposite signs. It is obviously that as these two values we can use $WACC_1$ and $WACC_\infty$, because $WACC_1 > WACC_n > WACC_\infty$ for finite $n \geq 2$.

3) Using, for example, the bisection method, we can solve the equation (7) numerically.

4) In Excel for solutions of the equation (7) one can use the function "matching the parameter".

5) After calculating the value $WACC$, using the formula

$WACC = k_e w_e + k_d w_d (1-T)$

we find $k_e = \frac{WACC}{w_e} - \frac{k_d w_d (1-T)}{w_e}$

In accordance with this procedure we will study the dependence of cost of equity k_e on profit tax rate *T* and leverage level *L* by three methods:

1) we will study the dependence of cost of equity k_e on profit tax rate *T* at fix leverage level *L* for different lifetime *n* of the company;

2) we will study the dependence of cost of equity k_e on leverage level *L* at fix profit tax rate *T* for different lifetime *n* of the company;

3) we will explore the influence of simultaneous change of leverage level *L* and profit tax rate *T* on cost of equity k_e for different lifetime *n* of the company. In this case the results will be presented as 3D graphs.

In these studies a qualitatively new effect has been discovered, and it is visible in each of the applicable types of studies (1– 3).

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

1) Dependence of Cost of Equity k_e on Profit Tax Rate T at Fix Leverage Level L

Below we show three figures of the dependence of cost of equity k_e on profit tax rate *T* at different fix leverage L for different sets of parameters n, k_0, k_d.

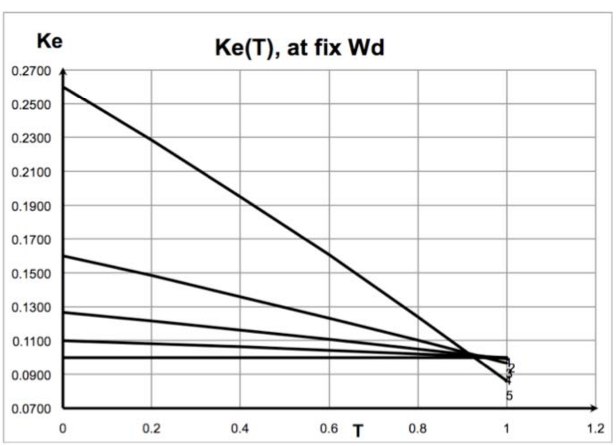

Figure 6: Dependence of cost of equity k_e on profit tax rate *T* at different fix leverage level *L* ($n = 5, k_0 = 10\%, k_d = 6\%$).

(1– $w_d = 0$; 2– $w_d = 0,2$; 3– $w_d = 0,4$; 4– $w_d = 0,6$; 5– $w_d = 0,8$).

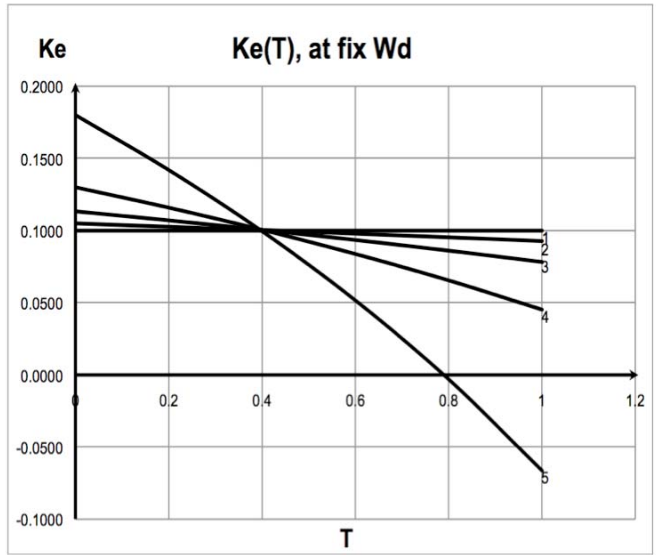

Figure 7: Dependence of cost of equity k_e on profit tax rate *T* at different fix leverage level *L* ($n = 10, k_0 = 10\%, k_d = 8\%$).

(1– $w_d = 0$; 2– $w_d = 0,2$; 3– $w_d = 0,4$; 4– $w_d = 0,6$; 5– $w_d = 0,8$).

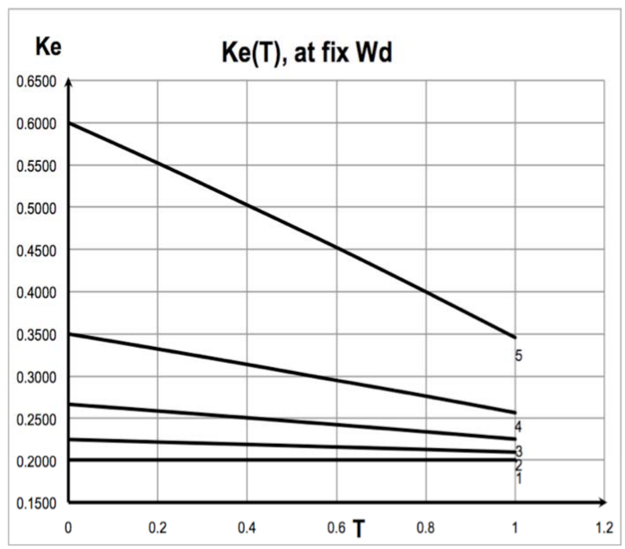

Figure 8: Dependence of cost of equity k_e on profit tax rate *T* at different fix leverage level *L* ($n = 3, k_0 = 20\%, k_d = 10\%$).

(1– $w_d = 0$; 2– $w_d = 0,2$; 3– $w_d = 0,4$; 4– $w_d = 0,6$; 5– $w_d = 0,8$).

On the basis of the analysis of the three graphs, and other data we come to the following conclusions:

1. All dependences are linear: cost of equity decreases linearly with profit tax rate.

2. The initial values of k_e grow significantly with the level of leverage (the share of debt capital w_d) and exceed k_0.

Table 1: Dependence of Cost of Equity k_e on Leverage Level L at Different Fix Profit Tax Rates *T* for the Case $n=7, k_0=20\%, k_d=10\%$

T\L	0,0	1,0	2,0	3,0	4,0	5,0	6,0	7,0	8,0	9,0	10
0	0,2000	0,3000	0,4000	0,5000	0,6000	0,7000	0,8000	0,9000	1,0000	1,1000	1,2000
0,2	0,2000	0,2842	0,3682	0,4522	0,5362	0,6202	0,7042	0,7874	0,8713	0,9551	1,0389
0,4	0,2000	0,2677	0,3344	0,4008	0,4672	0,5335	0,5998	0,6661	0,7323	0,7986	0,8649
0,6	0,2000	0,2504	0,2984	0,3457	0,3928	0,4397	0,4865	0,5334	0,5802	0,6265	0,6731
0,8	0,2000	0,2323	0,2601	0,2861	0,3117	0,3369	0,3619	0,3867	0,4116	0,4364	0,4612
1	0,2000	0,2132	0,2185	0,2210	0,2223	0,2229	0,2231	0,2233	0,2231	0,2228	0,2224

3. Lines, corresponding to the different values of leverage level (the share of debt capital w_d) intersect at one point (at some value of profit tax rate T^*), depending on parameters n, k_0, k_d (Figures **7**, **8**).

At fix profit tax rate $T > T^*$ increasing of leverage level corresponds to moving from line 1 to 2,3, 4, 5, i.e decreasing k_e, this means the discovery of qualitatively new effect in corporative finance: decreasing of equity cost k_e with leverage***.*** In a more obvious form, it will manifest itself in studies depending on cost of equity of the company on the leverage level, carried out by us below.

At some values of parameters n, k_0, k_d the intersection of all lines at one point could not happened at any profit tax rate $0 < T \le 100\%$. From the Figure **9** it is seen, that with a large gap between k_0 and k_d the intersection of the lines lies in the non– existent ("non–financial") region $T^* > 100\%$. (for data of Figure **9** $T^* \approx 162\%$).

2.2. Dependence of Cost of Equity k_e on Leverage Level L (the Share of Debt Capital w_d) at Different Fix Profit Tax Rate T

Below we show the results on calculation of dependence of cost of equity k_e on leverage level L (the share of debt capital w_d) in Excel at different fix profit tax rate *T* in the form of a table, and in the form of a graph for the case $n=7, k_0=20\%, k_d=10\%$, as well as in the form of a graph for the case $n=5, k_0=10\%, k_d=8\%$.

From Figure **9** it is seen, that dependence of cost of equity k_e on leverage level *L* with a good accuracy is linear. The tilt angle decreases with profit tax rate like the perpetuity case.

However for the finite lifetime of companies along with the behavior $k_e(L)$, similar to the perpetuity behavior of the Modigliani–Miller case (Figure **9**), for some sets of parameters n, k_0, k_d there is an other behavior $k_e(L)$ (Figure **10**).

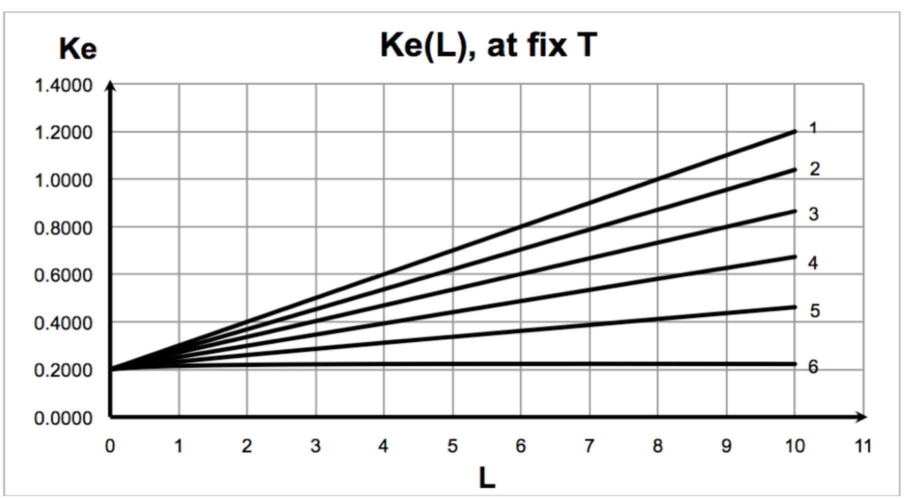

Figure 9: Dependence of cost of equity k_e on leverage level *L* at different profit tax rate *T* ($n=7, k_0=20\%, k_d=10\%$).
(1– $T=0$; 2– $T=0,2$; 3– $T=0,4$; 4– $T=0,6$; 5– $T=0,8$; 6 – $T=1$).

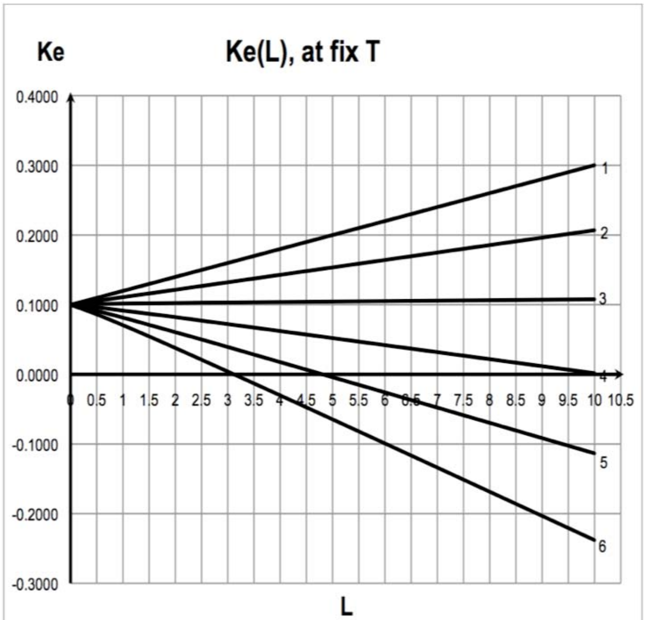

Figure 10: Dependence of cost of equity k_e on leverage level *L* at different profit tax rate *T* ($n=5, k_0=10\%, k_d=8\%$). (1– $T=0$; 2– $T=0,2$; 3– $T=0,4$; 4– $T=0,6$; 5– $T=0,8$; 6 – $T=1$).

From the Figure **10** it is seen that starting from some values of profit tax rate T^* (in this case from $T^*=40\%$, although at other sets of parameters n, k_0, k_d critical values of profit tax rate T^* could be lower) there is not the rise in the cost of equity of the company with leverage, but descending. Once again, the presence or the absence of such an effect depends on a set of parameters k_0, k_d, n .

This effect has been observed above in the dependence of cost of equity k_e on profit tax rate *T* at fixed leverage level, but it is more clearly visible on the dependence of cost of equity of the company on the leverage $k_e(L)$ for various fixed values of profit tax rate *T*.

Note that this is a new effect, which may take place only for the finite lifetime company and which is not observed in perpetuity Modigliani–Miller limit.

It is easy to see from the Modigliani–Miller formula (8)

$$k_e = k_0 + L(1-T)(k_0 - k_d),$$

that at $T=1$ (100%) cost of equity k_e does not change with leverage: $k_e = k_0$, i.e there is no decreasing of k_e with leverage at any profit tax rate *T*.

3. DEPENDENCE OF THE CRITICAL VALUE OF PROFIT TAX RATE T^* ON PARAMETERS n, k_0, k_d OF THE COMPANY

In this section we study the dependence of the critical value of profit tax rate T^* on parameters n, k_0, k_d of the company.

I. First we study the dependence of the critical value of profit tax rate T^* on the lifetime of the company under variation of the difference between k_0 and k_d .

The results of calculations are shown in Table **2**, empty cells means, that the critical value of profit tax rate T^*>100%, i.e. we are in "non– financial" region.

The conclusions from Figure **11** are as follows:

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

2. The critical value of profit tax rate T^* decreases monotonically with the lifetime of the company

Table 2: The Dependence of the Critical Value of Profit Tax Rate T^* on the Lifetime of the Company Under Variation of the Difference Between k_0 и k_d

Ke(t)\n	2	3	5	7	10	15	20	25
kd=6%,k0=8%	0,9575	0,6600	0,5200	0,4800	0,4640	0,4710	0,4903	0,5121
kd=6%,k0=10%			0,9110	0,8225	0,7650	0,7332	0,7249	0,7260
kd=6%,k0=12%					0,9800	0,9040	0,8693	0,8504
kd=6%,k0=14%							0,9671	0,9324
kd=6%,k0=16%								
kd=6%,k0=20%								
kd=6%,k0=24%								

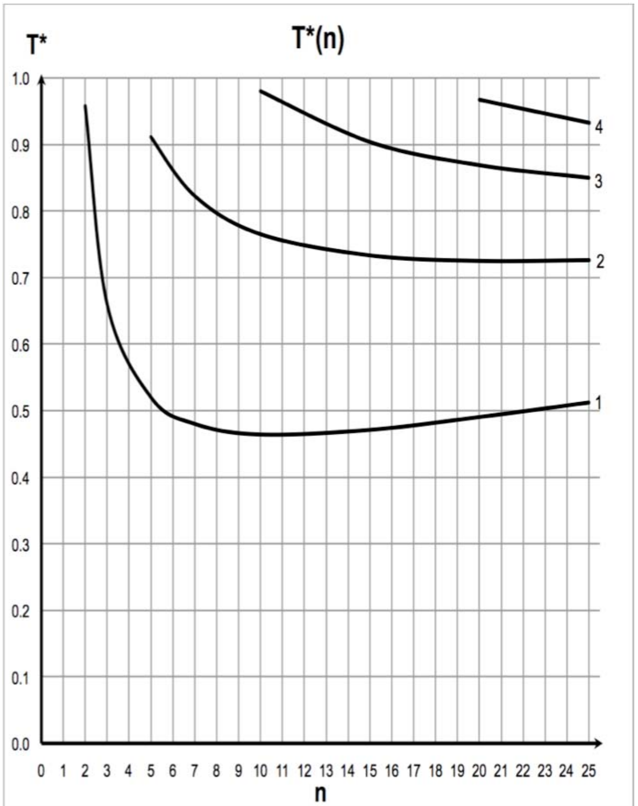

Figure 11: The dependence of the critical value of profit tax rate $T*$ on the lifetime of the company under variation of the difference between k_0 и k_d ($\Delta k = k_0 - k_d = 2\%; 4\%; 6\%; 8\%$) (1 – kd=6%,k0=8%;2 – kd=6%,k0=10%; 3– kd=6%,k0=12%; 4– kd=6%,k0=14%).

(only for the case of $\Delta k = k_0 - k_d = 2\%$ it has a minimum for 10 – years company). Therefore the probability of the anomaly effect is higher for "adult" companies.

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

We calculated as well $T*$ at different values of k_0 and k_d at constant difference between them $\Delta k = k_0 - k_d = 2\%$. The data are shown in Table **3**.

The conclusions in current case are as follows:

1. All curves are convex and the critical value of profit tax rate T* reaches minimum, which value decreases with k_0. Min T*=22.2% at $k_0 = 24\%$, min T*=24.35% at $k_0 = 20\%$, min T*=28.1% at $k_0 = 16\%$, min T*=30.43% at $k_0 = 14\%$, min T*=33.92% at $k_0 = 12\%$, min T*=38.92% at $k_0 = 10\%$, min T*=46.4% at $k_0 = 8\%$. Therefore the higher value of k_0 and the higher value of k_d at constant difference between them $\Delta k = k_0 - k_d = const$ favor for existence of a new effect.

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

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

III. Now let us investigate the dependence of critical value of profit tax rate $T*$ on k_0 for the second considerable case (at constant difference between k_0 and k_d $\Delta k = k_0 - k_d = 2\%$).

For this we consider Figure **13**.

For companies with lifetime up to 10– 15 years the decreasing of critical value of profit tax rate $T*$ with k_0 is observed. At further increase of company lifetime

Table 3: The Dependence of the Critical Value of Profit Tax Rate $T*$ on the Lifetime of the Company Under Different Values of k_0 и k_d at Constant Difference Between them $\Delta k = k_0 - k_d = 2\%$

Ke(t)\n	2	3	5	7	10	15	20	25
kd=6%,k0=8%	0,9575	0,6600	0,5200	0,4800	0,4640	0,4710	0,4903	0,5121
kd=8%,k0=10%	0,7313	0,5125	0,4140	0,3905	0,3892	0,4138	0,4453	0,4803
kd=10%,k0=12%	0,6000	0,4280	0,3510	0,3392	0,3467	0,3840	0,4285	0,4733
kd=12%,k0=14%	0,5125	0,3687	0,3110	0,3043	0,3218	0,3697	0,4239	0,4788
kd=14%,k0=16%	0,4437	0,3266	0,2810	0,2821	0,3043	0,3636	0,4277	0,4904
kd=18%,k0=20%	0,3625	0,2710	0,2435	0,2549	0,2895	0,3677	0,4468	0,5221
kd=22%,k0=24%	0,3100	0,2370	0,2220	0,2400	0,2875	0,3818	0,4759	0,5588

one observes in dependence of T^* on k_0 a smooth transition to a low growing function T^* on k_0.

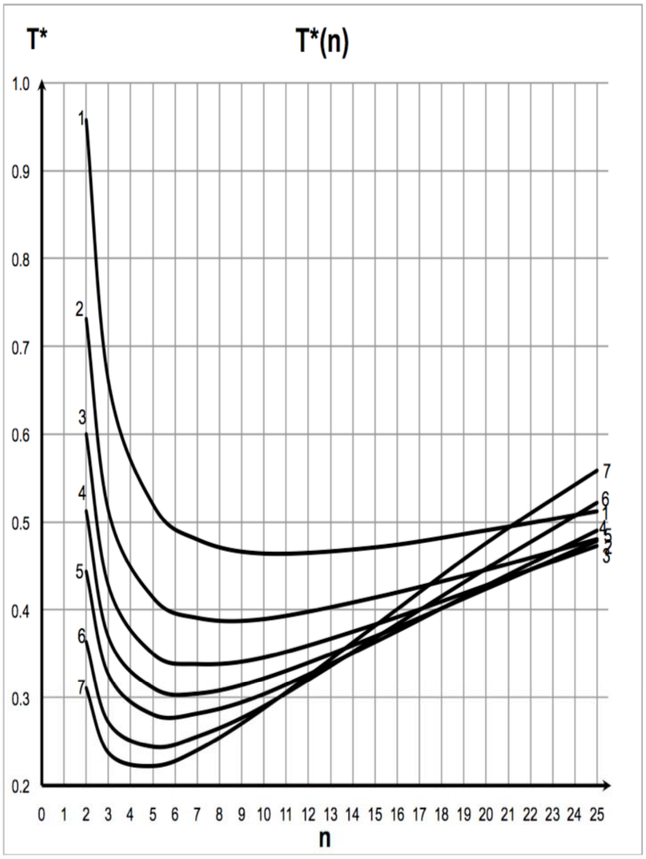

Figure 12: The dependence of the critical value of profit tax rate T^* on the lifetime of the company under different values of k_0 и k_d at constant difference between them $\Delta k = k_0 - k_d = 2\%$ (1– $k_0 = 8\%$; 2– $k_0 = 10\%$; 3– $k_0 = 12\%$; 4– $k_0 = 14\%$; 5– $k_0 = 16\%$; 6– $k_0 = 20\%$; 7– $k_0 = 24\%$).

So, for companies with lifetime up to 10– 15 years monotonic growing of k_0 favors to new effect, while for companies with longer lifetime rates of order $k_0 \approx 12\% - 15\%$ favors to new effect.

4. PRACTICAL VALUE OF EFFECT

What is the practical value of effect? Does it exists in real life or its discovery has a purely theoretical interest?

Because a new effect takes place at profit tax rate, which is bigger some value T*, it is necessary to compare this value with real profit tax rates established in the different countries.

The biggest tax on profits of corporation rate is in USA – 39,2 %. In Japan it exceeds a little bit 38 %. In France tax on profits of corporation rate varies from 33.3 % for small and medium– sized companies, up to 36% for the major. In England tax on profits of corporation rate is in the range of 21% to 28 %. In the Russian Federation tax on profits of corporation rate is installed in the amount of 20 %.

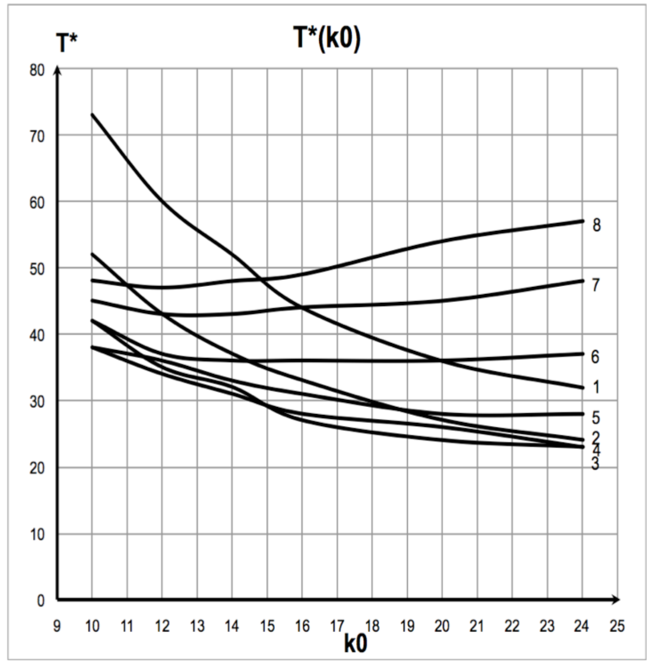

Figure 13: The dependence of the critical value of profit tax rate T^* on k_0 at constant difference between them $\Delta k = k_0 - k_d = 2\%$.

(1– $n = 2$; 2– $n = 3$; 3– $n = 5$; 4– $n = 7$; 5– $n = 10$; 6– $n = 15$; 7– $n = 20$; 8– $n = 25$).

In considered by us examples the value T* strongly depends on the ratio between k_0, k_d, n and reaches a minimal value of 22,2%, and it is quite likely even lower values of T* with other ratios between k_0, k_d, n.

In this way, we come to the conclusion, that at some ratios between equity cost, debt cost and company lifetime k_0, k_d, n discovered by us effect takes place at tax on profits of corporation rate established in most developed countries, that provides the practical value of effect.

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

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

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

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

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

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

It turns out that the rule taken by the shareholders since immemorial time to require higher rate of return on the share with an increase in the share of debt capital now does not always work. This will allow to company management to hold a more realistic dividend policy, limiting appetites of shareholders by economically founded value of dividends.

5. COST OF EQUITY OF ONE – YEAR COMPANY

The dependence of the cost of equity on profit tax rate *T* for one – year company has some features considered below. Interest in the one– year companies is associated also with the fact that a great number of companies, both in developed countries as well as in developing ones go bankrupt or no longer exist in the first year or two after the creation.

For one – year company the Brusov – Filatova – Orekhova equation (BFO) for weighted average cost of capital is simplified and can be expressed in apparent form (Brusov *et al.* 2011a, 2011b, 2011c, 2011d, 2011e, 2012; Brusov, Filatova 2011a, 2011b, 2011c; Filatova, Orekhova, Brusova 2008; Brusov, Filatova, Orekhova 2013a,2013b)

$$WACC = k_0 - \frac{1+k_0}{1+k_d} k_d w_d T \ . \quad (9)$$

This formula has been obtained for the first time by Meyers (Myers 2001) and is the particular case of the Brusov – Filatova – Orekhova (BFO) equation.

By definition for weighted average cost of capital with accounting "the tax shield" one has

$$WACC = k_e w_e + k_d w_d (1-T) \, . \quad (10)$$

Substituting here the expression for $WACC$ of one–year company, let us find the expression for cost of equity k_e of the company

$$k_e = \frac{WACC - w_d k_d (1-T)}{w_e} = k_0 + L(k_0 - k_d)\left(1 - T\frac{k_d}{1+k_d}\right). \quad (11)$$

It is seen that cost of equity k_e decreases linearly with profit tax rate. The module of negative tilt angle tangent is equal to

$$tg\alpha = L(k_0 - k_d)\frac{k_d}{1+k_d} .$$

However, the calculation for the case $k_0 = 10\%,\ k_d = 8\%$ gives practically independence of cost of equity k_e of the company profit tax rate *T* at fix leverage level (Figure **14**).

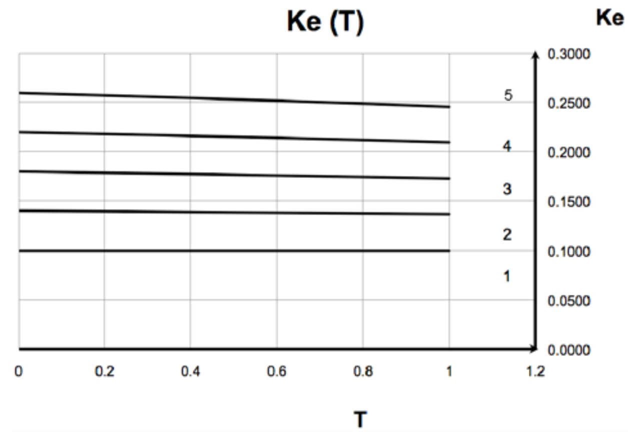

Figure 14: Dependence of cost of equity k_e of the company on profit tax rate *T* at fix leverage level for one– year company ($n = 1, k_0 = 10\%, k_d = 8\%$).

This is due to the low value of coefficient

$$(k_0 - k_d)\frac{k_d}{1+k_d} \ ,$$

which in our case is equal to $0{,}00148$. Therefore, descending becomes visible only at significant higher leverage (see Figure **14**).

Note that such a weak dependence (virtually independence) of cost of equity k_e of the company on profit tax rate *T* at fix leverage level takes place for one– year company only.

Already for two– year company with the same parameters dependence of cost of equity k_e of the company on profit tax rate *T* at fix leverage level becomes significant.

Below we give an example for two–year company with other parameters $n = 2, k_0 = 24\%, k_d = 22\%$ (see Figure **15**).

Finding a Formula for *T*.*

In case of one– year company it is easy to find a formula for *T**.

Putting in (11) $k_e = k_0$, one gets

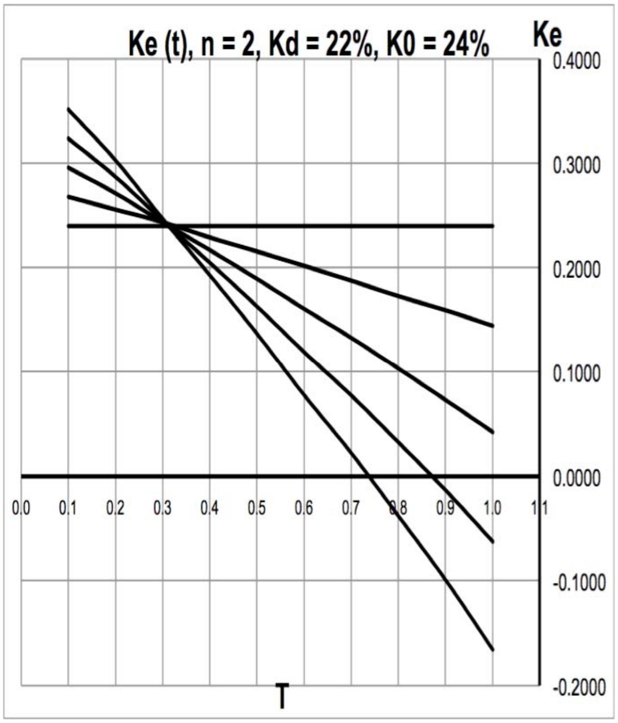

Figure 15: Dependence of cost of equity k_e of the company on profit tax rate *T* at fix leverage level for two– year company ($n = 2, k_0 = 24\%, k_d = 22\%$).

$$k_0 = k_0 + L(k_0 - k_d)\left(1 - T\frac{k_d}{1+k_d}\right) \qquad (12)$$

From where

$$T^* = \frac{1+k_d}{k_d} \qquad (13)$$

It is seen, that T^* does not depends of *L*, i.e. all the direct lines, corresponding to different L, intersect at a single point. From the data for the older companies (n >1 year) it follows that similar situation takes place for them as well, however to prove this fact becomes more difficult and in case $n > 3$ practically impossible.

Note, that equation (13) allows to evaluate the value T^*, which depends now on credit rate only and is equal to:

for $k_d = 8\%$ $T^* = 13{,}5$

for $k_d = 10\%$ $T^* = 11$

for $k_d = 15\%$ $T^* = 7{,}7$

for $k_d = 25\%$ $T^* = 5$

for $k_d = 100\%$ $T^* = 2$

It is clear that for all (reasonable and unreasonable) credit rate values tax rate on profits *T** is situated in “nonfinancial” region (exceeds 1 (100%)), that is the cause of the absence of effect.

Analysis of the formula (13) shows that, at very large credit rate k_d values T* tend to 1(100%), always remaining greater than 1. This means, that found by us effect is absent for one– year company.

Let us show the 3D picture for dependence of cost of equity k_e of the company on profit tax rate *T* and leverage level L for one– year company.

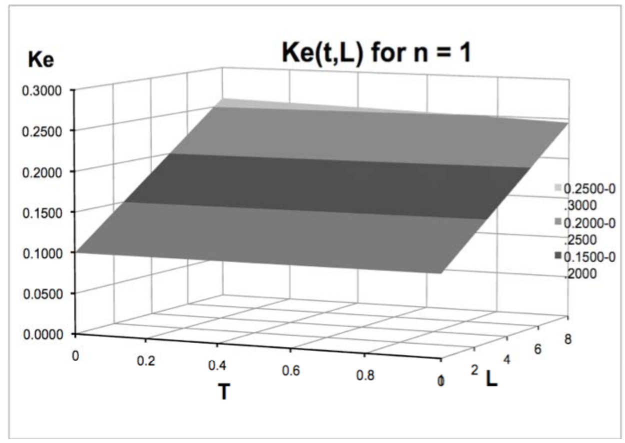

Figure 16: Dependence of cost of equity k_e of the company on profit tax rate *T* and leverage level L ($n = 1, k_0 = 10\%, k_d = 8\%$).

It is seen, that all dependences of cost of equity k_e of the company on profit tax rate *T* and leverage level L are linear, and abnormal effect for one– year company (as well as for perpetuity one) is absent.

CONCLUSIONS

Qualitatively new effect in corporative finance is discovered: decreasing of cost of equity k_e with leverage *L*. This effect, which is absent in perpetuity Modigliani–Miller limit, takes place under account of finite lifetime of the company at profit tax rates, which exceed some value T*.

At some ratios between debt cost and cost of equity the discovered effect takes place at profit tax rate, existing in western countries and Russia. This provides the practical meaning of discussed effect. Its accounting is important at modification of tax low and can change the dividend policy of the company.

In paper the complete and detailed investigation of discussed effect, discovered within Brusov – Filatova – Orekhova (BFO) theory, has been done. It has been shown, that the absence of the effect at some particular set of parameters is connected to the fact, that in these cases T* exceeds 100% (profit tax rate is situated in a ”non– financial” region).

In future, the papers and monographs will be devoted to discussion of discovered abnormal effect, but it is already now clear, that we will have to abandon of some established views in corporative finance. We thank D.Dolgov for help with numerical calculations.

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