
Hochschule Kaiserslautern | University of Applied Sciences

# CAPITAL STRUCTURE THEORY

## UNIVERSIDAD NACIONAL DEL LITORAL – HOCHSCHULE KAISERSLAUTERN

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# LEARNING TARGETS

**Modigliani-Miller whithout taxes (1958)**

- Proposition I
- Proposition II
- Proposition III

**Modigliani-Miller with taxes (1963)**

- Tax shield and WACC

# THE DEBATE AT THE END OF THE 50'S

- Does capital structure matter?
- Is there an optimal capital structure?
- How can we explain the different capital structures?

# MM ASSUMPTIONS (1958)

- Capital markets are ***perfect.*** There are neither taxes nor transaction costs
- Firms can be divided in "***equivalent return" classes***
- Investors are **rational** and agree with respect to the expected return
- There are **neither corporate taxes nor personal taxes**
- There are no bankruptcy costs
- Investors can borrow at the same interest rate charged to firms

# PROPOSITION I

*The market value of any firm is independent of its capital structure and is given by capitalizing its expected operative income at the cost of capital $\rho_k$, appropriate to its class:*

$$V_j = \frac{X_j}{\rho_k}$$

*$X_j$=expected operative income of the firm j*
*$\rho_k$=cost of capital for any firm firm j in class k*

*In equivalent form, the cost of capital is*

$$\rho_k = \frac{X_j}{V_j}$$

*The cost of capital is absolutely independent of its capital structure and is equal to the cost of capital for a full equity firm (unlevered firm) of its class*

# PROPOSITION I: IMPLICATIONS

1. The market value of a firm is given by its assets, since the assets have the capacity to generate profits.

2. If 1. is true, the financial decisions are irrelevant; thus, anyone could take them…

| Assets | Debt (D) |
| --- | --- |
| | Equity (E) |
| V | V =D+E |

# FIRM VALUE BEFORE THE ARBITRAGE PROCESS

| | Firm A | Firm B |
|---|---|---|
| EBIT | **20** | **20** |
| Interest | 0 | (5) |
| EBT | 20 | 15 |
| Income taxes | 0 | 0 |
| *ke* | 20% | 24 % |
| Equity market value (E) | 100 | 62.5 |
| Debt market value (D) | 0 | 50 |
| **Firm market value (V)** | **100** | **112.5** |
| **WACC before taxes** | 20 % | 17.7 % |
| **D/E (leverage)** | **0 %** | **80 % (50/62.5)** |

**20/112.5**

# MM AND THE ARBITRAGE

MM demonstrated impecably that the Proposition I holds due in perfect capital markets…because the arbitrage would correct any difference…

Remember: in the MM theorem there is too much things playing that seem at the first view. In a first explanation, we can explain only the movement of the hands of the complex, splendid Swiss watch that the MM theorem really is. It can be expanded in a numerous ways.

It supports different contexts of analysis and can be taught in different formats, in more abstraction for the school of economics and in less abstraction for the school of business, without loss of precision. And it can be perfectly integrated with the CAPM and the option theory.

# MM AND THE ARBITRAGE

The return of an investor who has a percentage α in B is

$$Y_B = \alpha(X - k_d D_B)$$

Now suppose the investor sold his worth of firm B ($\alpha E_B$) borrowing an addittional amount $\alpha D_B$ on his own credit (to replicate the leverage of firm B), pledging his new holding in A as a collateral.

Then she acquired an amount $\alpha(E_B+D_B)$ of the shares of firm A. The return of the new portfolio, $Y_A$, after paying the interest over his personal debt, is given by

$$Y_A = \frac{\alpha(E_B + D_B)}{E_A} X - k_d \alpha D_B = \alpha \frac{V_B}{V_A} X - k_d \alpha D_B$$

As long as $V_B > V_A$ we must have $Y_A > Y_B$, so investors in B will sell their shares to acquire shares of A, thereby depressing $E_B$ and $V_B$, and raising $E_A$ and $V_A$

# ARBITRAGE STRATEGY: BORROWING AND INVESTING IN A

1) Selling the shares of B for $10

2) Borrowing $8, equaling the leverage ratio of firm B

3) Investing $ 18 in A:

| | |
|---|---|
| Investment in A : 18 x 0.20 = | 3.6 |
| Interest : 8 x 0.10 = | (0.80) |
| **Return:** | **2.80** |

# PROPOSITION II

The cost of capital for a levered firm, ke, is equal to the cost of capital for an unlevered firm, ku, plus a premium related to financial risk equal to the debt-to-equity ratio times the spread between ku and kd:

$$ke = ku + (ku-kd)D/E$$

Proposition II is not really a new proposition; in fact, it is derived from the fundamental Proposition I…

# PROPOSITION II

Proposition I stated: $$V_j = \frac{X_j}{\rho_k}$$

Since $\rho_k$ represents an unlevered cost of capital, we call it "ku"

$$ke = \frac{Xj - kdD}{E} = \frac{Vku - kdD}{E}$$

$$ke = \frac{ku(E + D) - kdD}{E}$$

$$ke = ku\frac{E}{E} + ku\frac{D}{E} - kd\frac{D}{E}$$

$$ke = ku + (ku - kd)\frac{D}{E}$$

# Firm value after the arbitrage

| | Firm A | Firm B |
|---|---|---|
| EBIT | 20 | 20 |
| Interest | 0 | (5) |
| EBT | 20 | 15 |
| Income taxes | 0 | 0 |
| *ke= ku + (ku-kd)D/E* | 20 % | 30% |
| Equity market value (E) | 100 | 50 |
| Debt market value (D) | 0 | 50 |
| Firm market value (V) | 100 | 100 |
| WACC *before* taxes | 20 % | 20% |
| D/E | 0 % | 100 % (50/50) |

# WACC BEFORE TAXES

Taking into account that the cost of equity capital for a levered company rises when the leverage increases, and *assuming the cost of debt kd remains constant*, the total cost of capital does not change and is equal to the unlevered cost of capital of 20%, after the arbitrage process.

$$WACC' = ke \frac{E}{E+D} + kd \frac{D}{E+D}$$

$$WACC' = 30\% \frac{50}{100} + 10\% \frac{50}{100}$$

Note: The WACC is always expressed ajusted by tax effects. Here, the WACC represents the weighted average cost of capital in a world whithout taxes…

# LEVERAGE: MORE RETURN DOES NOT MEAN MORE VALUE

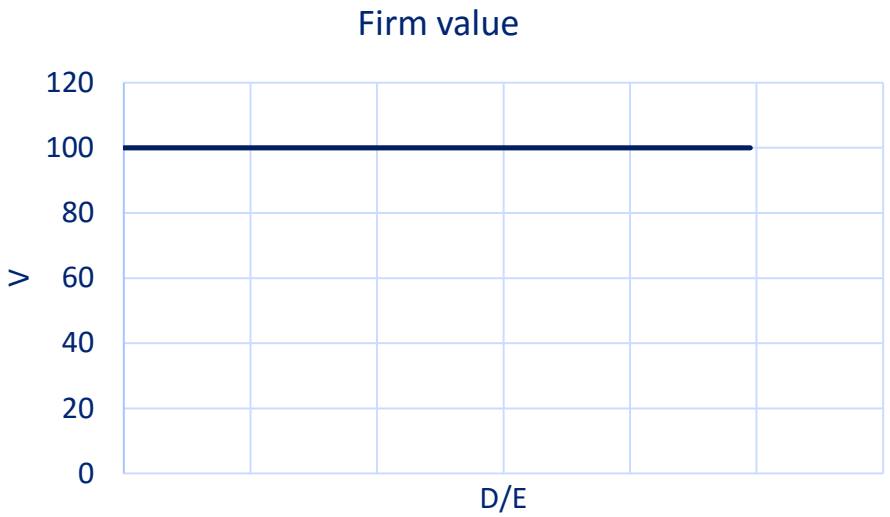
- The leverage increases the stockholder's return, but this does not necessarily mean more value. More return does not create value per se.
- Remember that debt must be paid first (interest and capital).
- The common stockholders receive a residual claim on the company's results.

# EXERCISES

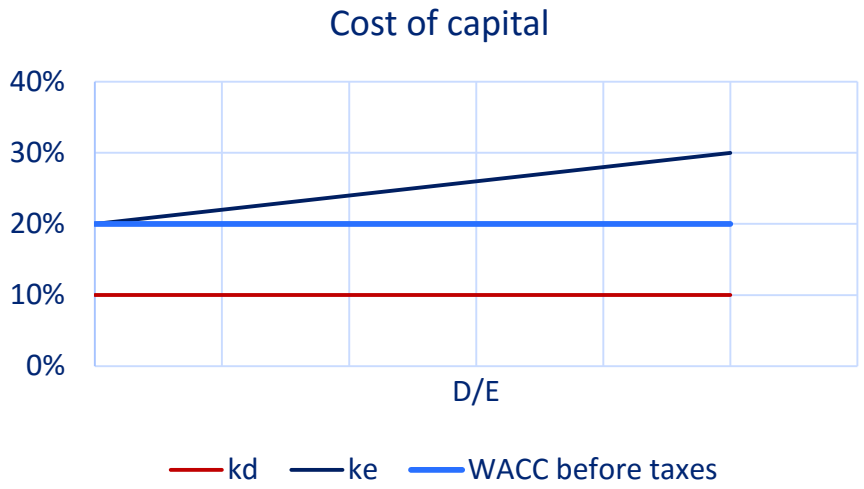
Complete the following table, explain a possible arbitrage strategy, and demonstrate that the WACC before taxes is of 20% after the arbitrage process. Hint: remember "the pizza story" when calculating ke using the Proposition II.

| | Firm A | Firm B |
|---|---|---|
| EBIT | 20 | 20 |
| Interest | 0 | (4) |
| EBT | 20 | 16 |
| Income taxes | 0 | 0 |
| ke= ku + (ku-kd)D/E | 20 % | |
| Equity market value (E) | 100 | 70 |
| Debt market value (D) | 0 | 40 |
| Firm market value (V) | 100 | 110 |
| WACC before taxes | 20 % | |
| D/E | 0 % | |

# FIRM VALUE AND COST OF CAPITAL




Proposition I: the firm market value remains constant for any level of leverage

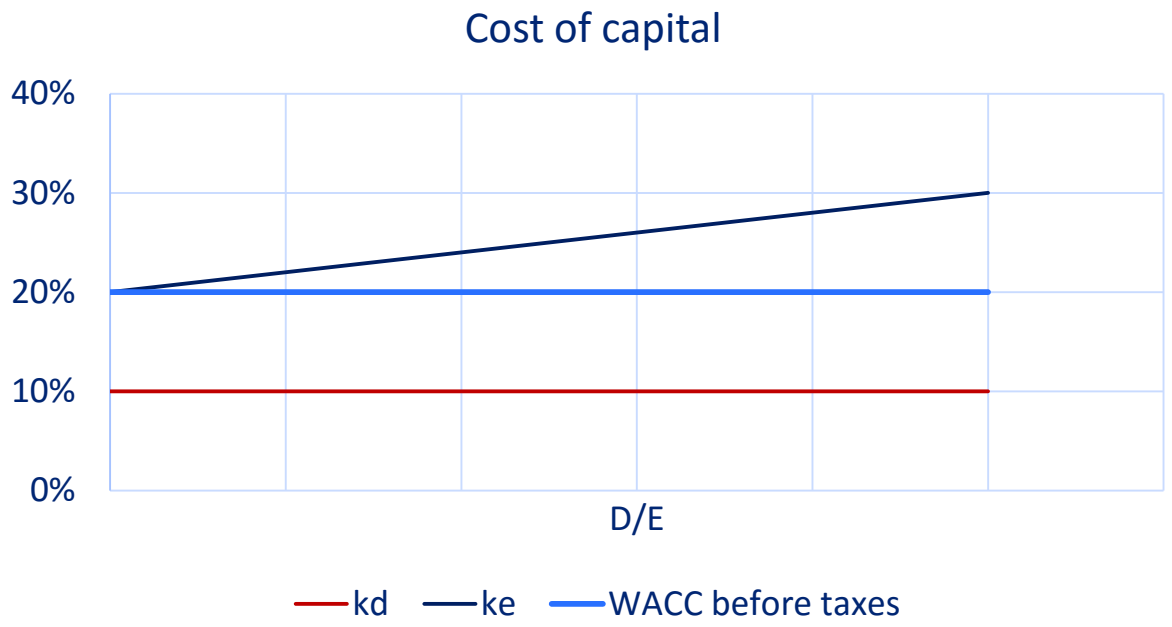



Proposition II: ke increases as the leverage increases and the WACC before taxes remains constant independently of the leverage

# EXERCISES

Mark a point on the ke function for the following ratios (the first is done for you):

a) D/E=50% answer: (ke=20%+(20%-10%)0,5=25%)
b) D/E=100%
c) D/E=120%



# EXERCISES

Which are the equivalent D/E ratios for the following D/V ratios (the first was done for you):

a) D/V=20% answer: (20%/80%=25%)
b) D/V=50%
c) D/V=60%
d) D/V=90%

# MERTON MILLER ON HIS OWN WORDS

*"I have a simple explanation (for the first Modigliani – Miller proposition). It´s after the ball game, and the pizza man comes up to Yogi Berra and he says, `Yogi, how do you want me to cut this pizza, into quarters? ´Yogi says, ´No cut it into eight pieces, I´m feeling hungry tonight´. Now when I tell that story the usual reaction is, ´And you mean to say that they gave you a (Nobel) prize for that?´".*

Merton H. Miller, from his testimony in Glendale Federal Bank´s lawsuit against the U.S. government, December 1997.

# PROPOSITION III – DEBT FINANCING

*If a firm in class k is acting in the best interest of the stockholders at the time of the decision, it will exploit an investment opportunity if and only if the rate of return on the investment, is as large as or larger than its cost of capital.*

It seems that there isn't something new in this assertion, but behind this there is a powerful advice to avoid confusing the relevant cost of capital…

# PROPOSITION III – DEBT FINANCING

The value of an unlevered company, which has an operative income X=100 and a cost of capital $\rho$=*10%* is:

$$V = \frac{100}{0.10} = 1{,}000$$

Since the firm is full equity financed, the assets market value V is equal to the equity market value Eo:

$$V_0 = E_0 = 1{,}000$$

Now suppose the firm has an "opportunity" to invest $100 in a new Project which its expected return is of 8% and can be financed with debt at an interest rate of 4%). The new assets market value is:

$$V_1 = \frac{100 + 100 \times 8\%}{0.10} = 1{,}080$$

After to invest in the Project, the market value of equity decreases and the stockholders become more poor!

$$S_1 = 1{,}080 - 100 = 980$$

# PROPOSITION III – DEBT FINANCING

The new ke, according to Proposition II is:

$$ke = ku + / ku - kd) \frac{D}{D} = 0.10 + (0.10 - 0.04) \frac{100}{980} = 0.1061$$

If earnings before taxes ($ 108 - $ 4 = $ 104) is discounted using the new ke of 10,61% the equity market value is obtained (observe that it is equal to the value obtained applying Proposition I):

$$E = \frac{EBT}{ke} = \frac{104}{0.106} = 980$$

# PROPOSICIÓN III – DEBT FINANCING

MM proposition III implies that *the cost of debt does not have any effect on the firm value.*

Remember that MM propositions are conditionals propositions, and they are true in the sense that they follow logically from the assumptions previously stated.

Notice that if kd had an increase, ke would be reduced but the WACC before taxes would remain constant.

# THE ANECDOTES

Excerpt from the conference of Prof. Merton Miller "Modigliani-Miller Propositions after forty years" during the European Financial Management meeting, Estambul, 1998:

Some months ago I was being deposed as an 'expert economic witness' in a law suit where our side was advancing, among other things, the view that a firm, not actually run by known thieves ready to abscond, could always raise additional equity capital. The firm might not *want* to raise more equity capital, but, in principle, it could. That's basically just a straightforward, implication of the M&M perfect capital market assumption, I noted.

As I was trying to explain that point in the course of my deposition, the attorney for the other side suddenly cut in and asked: 'Professor. Do you or do you not believe the M&M Propositions are true?'

Fortunately, you cannot really be held to simple yes or no answers in a deposition. And I hope my inevitably longer answer to the opposing attorney can serve at least as a useful takeoff for my remarks today on the M&M Propositions and where they appear to stand.

# THE ANECDOTES

After describing the Propositions under discussion, I went on to point out immediately to the opposing lawyer that those Propositions were *conditional* propositions. They say that if you accept the specific assumptions we made about the nature of the capital markets, and about what we would call today the nature of the information structure, then you must accept the conclusions. The M&M Propositions follow logically from the assumptions and in that sense they are certainly true.

# THE ANECDOTES

At that point the opposing lawyer got a gleam in his eye and asked: but what if the assumptions underlying the derivatives are false? Doesn't that mean that the M&M Propositions are false?

No, I said, with mock sadness. You still do not seem to understand the principles of scientific inquiry. The minute you start questioning the assumptions underlying a model you leave the world of pure logic behind. You have gone from deduction to induction, from an ideal world to the empirical world where terms like true and false no longer apply. On empirical matters, you cannot speak of anything as simple as right or wrong, but only of the degree of accuracy of the predictions of the model. And for judging the accuracy of the *predictions*, the literal accuracy of the assumptions is beside the point.

For the M&M Propositions, then, as for any other scientific theory, it all comes down to the question of 'goodness of fit', and that alas cannot be given any simple, one word or even one line answer. How good a fit is depends on the

# Modigliani-Miller in practice: Sofora's case

In 2008, we were hired to determine the fair value of Sofora (the controller of Telecom Argentina).

| **Valuation of Sofora (in U.S.$ millions)** | |
|---|---|
| Telecom Argentina fair value | **4.502,1** |
| Nortel Inversora particip. (54,74%) | 2.464,5 |
| Control Premium | 492,9 |
| Preferred shareholders class A fair value | 282,0 |
| Preferred shareholders class B fair value | 1.047,8 |
| **Sofora's shareholders fair value** | **1.627,6** |

Fair value estimated by discounted dividends

In the meeting, someone asked:

*"If the Sofora fair value is estimated discounting the forecasted dividends available to Sofora's shareholders plus the control Premium, a similar value is obtained, right?"*

# BACK TO THE BASICS: MODIGLIANI & MILLER

*"I have a simple explanation…("the pizza story")*

After revising the analysis, we noticed that to calculate the fair value of the preferred shareholders portion we considered the historical payout of Telecom, and therefore, implying that all free cash flow would not be distributed as dividends as in the case of Telecom fair value.

# SOFORA FAIR VALUE – DOUBLE CHECK

Therefore, we made a second analysis adding the present value of marketable securities to the Sofora DCF. When the securities that Telecom had at this moment were added, both approaches matched and all of us became satisfied with the double check.

| **Valuation of Sofora (in U.S.$ millions)** | |
|---|---|
| Telecom Argentina fair value | **4.502,1** |
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| Preferred shareholders class A fair value | 282,0 |
| Preferred shareholders class B fair value | 1.047,8 |
| **Sofora's shareholders fair value** | **1.627,6** |

| **Valuation of Sofora (in U.S.$ millions)** | |
|---|---|
| Sofora DCF | 841 |
| PV marketable securities | 217 |
| Marketable securities at Dec 2007 | 83,47 |
| Control Premium | 492,9 |
| **Sofora's shareholders fair value** | **1.635,26** |

(*) A minimum difference persist due to the different dates for the dividend distribution.

# QUESTIONS

Mark TRUE or FALSE:

1. Only accounting values of debt and equity must be considered in the capital structure instead of market values.

2. The accounting values are historical and do not reflect the marginal cost of capital.

3. The cost of capital is always marginal.

# QUESTIONS

1. Comment on this phrase: “in the world of Modigliani-Miller without taxes, debt financing reduces the weighted average cost of capital”

2. Comment on this phrase: “MM ignore the fact that when the leverage increases, the interest rate on debt increases”

# QUESTIONS

Mark TRUE or FALSE:

a) The expected return on equity increases as the firm leverages, since the probability of bankruptcy rises.

b) For an unlevered firm which doesn't pay income taxes and does not grow, the EBIT=EBT=Net income=Dividends

c) MM Proposition I implies that if the firm leverages, the earnings per share (EPS) increases while the Price earning decreases.

# Firm Value with corporate taxes

| | Firm A | Firm B |
|---|---|---|
| EBIT | **20** | **20** |
| Interest | 0 | (5) |
| EBT | 20 | 15 |
| **Income taxes (40%)** | **8** | **6** |
| Net income = Dividends | 12 | 9 |
| Interest + Dividends | 12 | 14 |
| ke= ku + (ku-kd)D/E (1-t) | 20% | 30% |
| Equity market value (E) | 60 | 30 |
| Debt market value (D) | 0 | 50 |
| **Firm market value (V)** | **60** | **80** |

**Interest (5) + dividends (9)**

9/0.30

# PRESENT VALUE OF TAX SHIELD

$$\frac{D.kd.t}{kd} = D.t = 50 \times 0{,}40 = 20$$

The present value of tax shield will be equal to D.t if three conditions hold:

1. Debt is renewed permanently
2. The firm has profits every year
3. The tax rate *t* remains constant

# EXERCISES

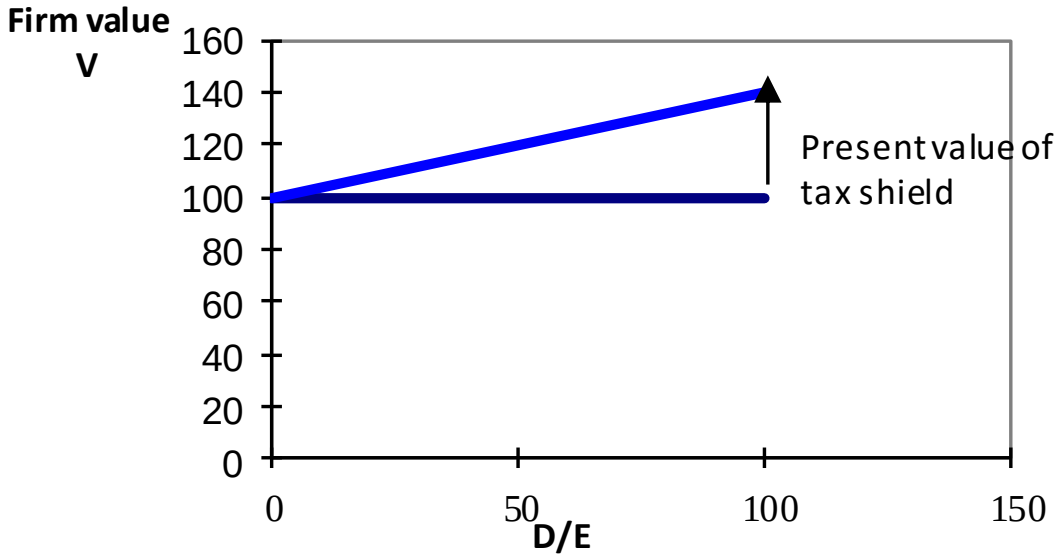
1. The firm market value of an unlevered firm A is V=60 million. Assume now Firm A decides to issue bonds for $59 million, modifying its capital structure.

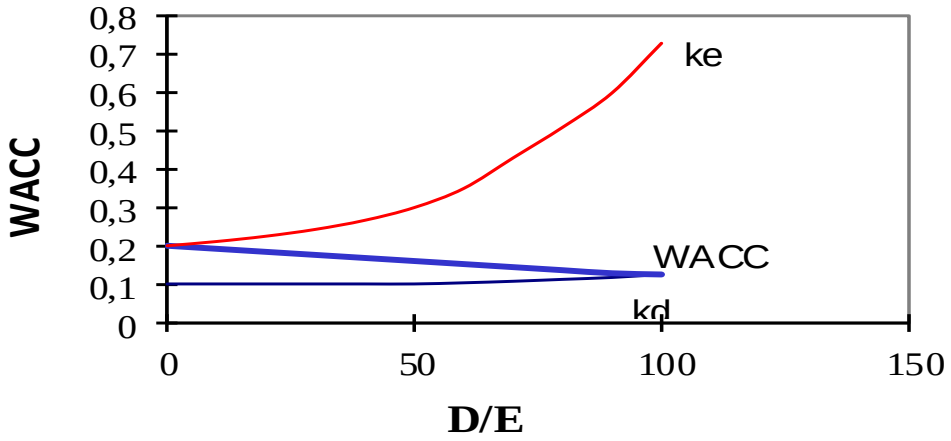
   a) Which is the new firm value and its WACC

   b) Which is the present value of tax shield?

   c) Now that the bondholders have the control, they are the new stockholders. Do you think that this situation would affect the cost of capital? (remember that while they were bondholders, kd was assumed to be kd=10%).

# MM PROPOSITIONS WITH TAXES



# MM WITH CORPORATE TAXES: BOTTOM LINE

- More debt means more value
- At 99.99% of leverage, the firm would go bankrupt and then the property would pass to the bondholders. Why would the bondholders accept a return lower than what the original stockholders had?
- It seems that with a high leverage the probability of financial distress increases and tax shield could be lost

# EXERCISES

1. The operative income (EBIT) of company Z is of 3 million. The expected return for an unlevered firm is *ku*=15% . Z has a financial debt D=10 million and *kd is of* 10%. Calculate $V_U$ *and* $V_L$, supposing that the world of MM whithout taxes holds. Then calculate the WACC before taxes verfying that this is of 15%.

2. Now resolve the previous exercise but assuming MM with taxes (1963) assuming a tax rate t=40% and show how propositions I and II are modified.