Capital structure I: Basic Concepts

What is a capital structure?

The big question:

How should the firm finance its investments?

The methods the firm uses to finance its investments is called its capital structure.

Equity

-**Stock**s

-**Warrants**: another security, the firm gives you the option to buy a stock at a specified price. If you exercise the warrant you dilute the stocks value. Not the same as an option. We can trade an option on the firms stock. An option is outside the firm. A warrant is an option which the firm issues. This means that if you hold the warrant and you decide to exercise the warrant, you are going to dilute the value of the other stock holders. (We will discuss options in a later class. Warrants are not options. It sounds like a warrant is an issue of NEW stock). Example, if you have a warrant worth $100 it means that you can convert it to stock worth &$100.

DEBT

-**Bank loans**

-**Corporate bonds**: bond holders become the creditors.

A **CAPITAL STRUCTURE** describes the **mix of the firm's financing sources** (i.e., equity and debt)

Say the firm has many projects to finance. It has two choices on how to do so, Equity or Debt. The firm will usually use a mix of equity and debt, this mix is called the firm's capital structure.

If we know one proportion of the capital structure we can calculate the other.
The ratio is also called the **LEVERAGE** of the firm, the proportion financed by debt.

Measures of Leverage

BOOK LEVERAGE = $\dfrac{\text{Book value of debt}}{\text{Book value of debt} + \text{Book value of equity}}$

The book ratio is the ratio of the book value of the debt divided by the book value of the total assets (which is the book value of the debt divided by the book value of the equity). We extract this ratio from the balance sheet.

Example:

Balance Sheet

Assets	D & E
10 Mil	D = 3 Mil
	E = 7 Mil

book leverage = 3/(3+7) = .3

MARKET LEVERAGE = $\dfrac{\text{Book value of debt}}{\text{Book value of debt} + \text{Market value of equity}}$

Here we replace the book value of the equity with the market value of the equity. The market value is the real value of the equity, it's not based on historical value or "cost based value" (?). It is a more realistic value so we prefer to use it. So we would like to know what is the ratio of the assets that are financed by debt when taking into account the real market value assets.

Now we want to try to answer why we do not take the market value of the debt. We take the market value of the equity but why not also take the market value of the debt to make the equation entirely market based leverage?

What is the market value of the debt? The book value of the debt is some face or historical value. The market value of the debt is the current market value. Will it be close to the face value? Probably it will be very close to the face value. So we know the market value of the equity is not surprising larger than the book value.

This is the first reason, it is a good measure of the book value. Another reason is that the market value of the debt is not readily available. It is very hard to get the market value of the debt. There would in most cases be many bonds, many stock issues, we would have to take representative averages and such. Not easy. This is a good approximation.

Capital structure represents the proportion of the firms assets which are represented by debt and the proportion which are financed by equity. Since these proportions are related one to the other it is enough to know one and solve for the other.

Usually the one specific proportion that we look at is the debt proportion. The debt to asset ratio. When speaking of the capital structure of a firm we will usually say "the debt to asset ratio is" some percentage. This ratio is also called the leverage of the firm.

The **LEVERAGE** represents the proportion of the firm which is financed by **debt**.

Empirical Evidence

The 7 big industrial countries.

Country	Average Book Leverage
US	0.27
Japan	0.27
Germany	0.05
France	0.26
Italy	0.18
UK	0.15
Canada	0.30

(Difference with Germany because loans are expensive due to regulation)

With the exception of Germany the average book leverage is about 20 to 25% (say between 15 and 30%). Most of the assets are financed by equity and about 25% financed by debt (with the exception of Germany).

So how should the firm choose it's capital structure? Why will it's capital structure make a difference? This is a non-intuitive question. Why will the capital structure effect the value of the firm? All we are considering is the way we finance the projects. Both debt and equity cost money. Why does the way we finance the investment effect the value of the investment? We will see the answer ahead. But we must be clear of the question. The firm has many projects (assets), now the firm wants to finance the assets. It can issue stocks and it can issue bonds. So the question is, What is the optimal financing structure? What is the optimal proportion?

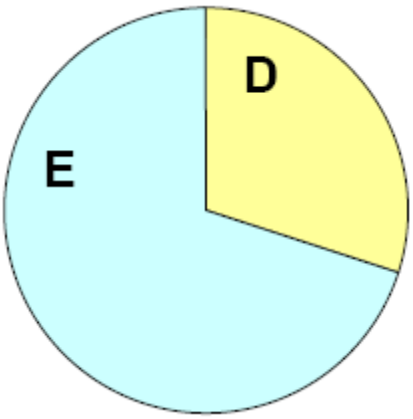
First we must realize that the value of the assets of the firm is the sum of the value of the equity and the value of the debt.

The Pie Theory

-The value of a firm is defined to be the sum of the value of the firm's equity and the firm's debt. The goal is to increase the value of the firm as much as possible.

Value = Equity + Debt

V = E + D



How should the firm select the capital structure? With many projects to finance what is the best proportion?

Goal is to increase the size of the firm as much as possible.

Shareholders (equity) want to increase the size of the entire pie. Related to efficiency, maximize the value of the firm not only the size of the equity.

Important questions:

1. Why should the stockholders care about maximizing firm value? Perhaps they should be interested in strategies that maximize the equity value

2. What is the ratio of debt-to-assets that maximizes the equity value?

As it turns out, **CHANGES IN CAPITAL STRUCTURE BENEFIT THE STOCKHOLDERS IF AND ONLY IF THE VALUE OF THE FIRM INCREASES**

-If the goal of the management of the firm is to make the firm as valuable as possible, then the firm should pick the debt-to-assets ratio that makes the pie as big as possible

We will see that maximizing the equity will **MAXIMIZE THE VALUE OF THE ENTIRE FIRM (PIE)**. So for now we assume that the share holder want to increase the size of the entire pie.

Modigliani-Miller (1958) Theory

Assumptions

- No transaction costs
- Competitive markets --both individuals and firms are price takers (no monopolies, no single market movers)
- Equal access to relevant information
- Firms and investors can borrow/lend at the same rate

If

- There are no taxes
- There are no bankruptcy costs
- The firm's investment policy is fixed (capital structure will not change according to which projects are taken).

Then

- The value of the firm is independent of its capital structure. The capital structure has no effect on the value of the firm. The capital structure is irrelevant.

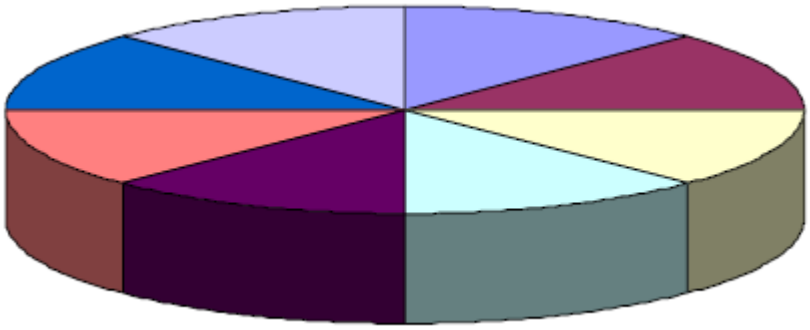
IF WE FIND THAT CAPITAL STRUCTURE IS IMPORTANT THEN AT LEAST ONE OF THE 3 CONDITIONS IS NOT VALID (RELEVANT).

We will see that the capital structure becomes relevant when we consider taxes, bankruptcy, and investment policy. If at least one is important then all 3 are important.

NOW WE WILL PROVE THE MM1 THEOREM…

Simple Proof of the Theorem

-The size of the pie does not depend on how it is sliced!



More Elaborate Proof of the Theorem

An **ARBITRAGE OPPORTUNITY** is an opportunity to generate a riskless positive cash flow with no cost!

Arbitrage opportunities cannot exist for long in the market; they quickly get traded away.

We will show that if MM1 does not hold, there is an arbitrage opportunity. That is, IF two firms are identical except for their capital structure and their total market value is not the same, THEN there is an opportunity for arbitrage.

You construct a portfolio at zero cost and sell it in the future for a positive amount. This would be an arbitrage and quickly priced out of the market.
Postulate a logical argument:

If MM1 does NOT hold then there is an arbitrage opportunity.

We know arbitrage opportunities cannot exist, thus MM1 must hold.

MM1 says capital structure is not relevant. If MM1 is not true then capital structure is relevant.

More Elaborate Proof of the Theorem

Proof by Example:

• 2 Firms (U and L)

• Each Exist for 1 year

• Have identical cash flows (X) and liquidate at end of the year

• Have different capital structure: firm **U has no debt**, while firm **L has debt equal to D**

	UNLEVERAGED		LEVERAGED	
	Firm U		Firm L	
	CF	Value	CF	Value
Debt	0	0	$(1+R_D)D$	D
Equity	X	V_U	$X-(1+R_D)D$	E_L
Total	X	V_U	X	$V_L = D + E_L$

The two firms generate identical cash flows, X, hence must have the same total (market) value (in this proof the 3 conditions hold).

Values of the firms are V_U (value unleveraged firm) and V_L (value leveraged firm).

MM1 implies $V_U = V_L$ (most). If it does not then there is an arbitrage opportunity.

More Elaborate Proof of the Theorem

-Suppose they don't. Assume:

$$V_U = \$100 \text{ million} > V_L = \$90 \text{ million}$$

$$D = \$30 \text{ million} ; E_L = \$60 \text{ million}$$

-How can you earn arbitrage profits?
-At time 0 (selling short at time 0):

- Sell 20% of shares of U → yields $20 million
- Simultaneously, buy 20% of L's securities (equity and debt) → costs $18 million

-Profit at time 0:
$20 million -$18 million = $2 million

Basically this is saying we buy 20% of each firm and since one firm is valued greater than the other we make a $2 million arbitrage.

Value of Debt = $(1 + R_D)D$
X is the value of the firm liquidated and distributed to the shareholders.

-At time 1:

- You pay dividends: 0.2 * X
- You receive dividends: 0.2 * [X - (1+ RD)D]
- You receive interest payments: 0.2 * (1+ RD)D

-Profit at time 1:
- 0.2* X + 0.2 * [X - (1+ RD)D] + 0.2 * (1+ RD)D = 0

-Thus, this strategy yields a positive cash at time 0 and zero cash at time 1
i.e., an arbitrage!

-Since arbitrage opportunities cannot exist, the total market value of firms U and L must be the same, regardless of their capital structure

Time	0	1
selling 20% of U equity	+ 20	-.2X
buying 20% of L debt	- 6 (D)	.2[(1+R_D)D]
buying 20% of L equity	- 12 (E)	.2[X-(1+R_D)D]
	+ 2	0

At time 0 we have made $2 million and buy back at time 1 for no cost. This is a valid arbitrage strategy but arbitrage cannot exist. But we only have the arbitrage opportunity because the values of the firms are different. This is a money machine, all investors will pursue this portfolio until it is priced out of the market. Price of firm L will increase and price of firm U will decrease until the arbitrage opportunity disappears. (END OF PROOF)

MM World with Taxes

If leverage affects the value of the firm, it must be via:

- Taxes
- bankruptcy costs
- or change in the firm's investment policy

Interest payments to bondholders are tax deductible,
while payments to equity holders are not tax deductible

so for more debt In the capital structure more payment will be tax deductible so we can save some money due to the tax shield.

Hence, issuing debt has a tax-advantage

Tax can make capital structure relevant because payments to bondholders are tax deductible and equity holders payments are not.

Example

All Equity, Unlevered

Has Debt, Levered

-Consider the following income statement:

	Firm U	Firm L
EBIT	$1,000	$1,000
Interest payment at 8%	$0	$80
Pre-tax income	$1,000	$920
Taxes at 34%	$340	$312.8
Net stockholders income	$660	$607.2
Total net income	$660	$687.2

Coupon Payment, Tax Free

Value = Equity + Debt

In this case total income to the bond holders and the equity holders is 607.2 + 80 = 687.20 (greater than the 660)

Here we have higher income because we paid less tax due to the tax free interest payment. **We are asking: Where can we use the tax exempt status of bonds to save money?**

Firm U has only stock holders so no debt means no coupon payments so 0% interest. Firm U has only stockholders.

Firm L: Total income to bond and stock holders is 607.20 + 80 = $687.20 due to bond payment. But the firm paid less tax which is also due to the bond payment. The interest payment is tax deductible.

Note … 687.20 – 660 = 27.2 = 80 * .34 = Interest Payment * Tax Rate

We are getting back 34% from the IRS on the interest! This is called the **TAX SHIELD**.

TAX SHIELD = INTEREST PAYMENT * TAX RATE

MM World with Taxes

T_C = Tax Rate D = Face Value R_D = Coupon Rate

Coupon Payment = Coupon Rate * Face Value

General form of tax shield

-The tax bill of firm L is $\$T_C R_D D$ less than that of firm U

-If the debt (level) is perpetual, the value of this tax shield is:

$$PV(\text{tax shield}) = \frac{T_C \times R_D \times D}{R_D} = T_C \times D$$

-We thus have:

$$V_L = V_U + T_C D$$

or,

V(levered firm) = V(unlevered firm) + PV(tax shields)

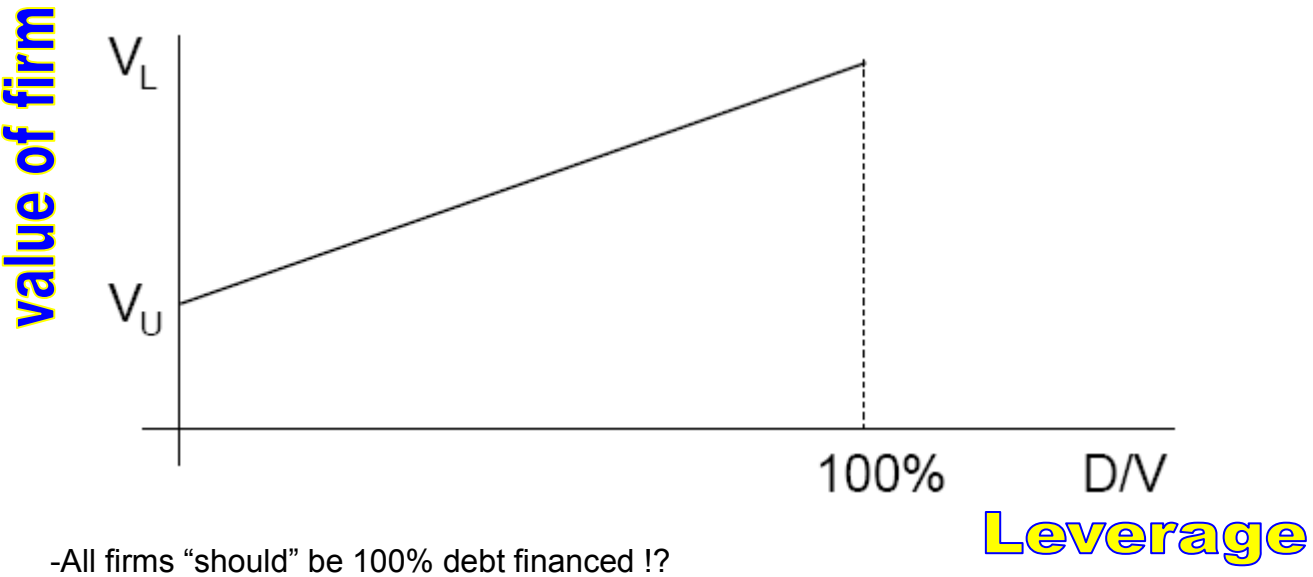
What is the difference between the value of the leveraged firm and the unleveraged firm? The tax shield is an annual yield, so we must look out from next year to forever when making this calculation. The income of the levered firm will be higher than that of the unlevered firm.

We are using $PV = \frac{C}{R}$ but substituting $D*R_D$ for C.

Higher debt implies higher firm value.
This suggest that if we only take into account taxes, the value of the firm will increase with it's leverage. The implication would be that 100% debt increases the firms value to the max. But we know no firm exist on 100% debt so there must be other factors which are influencing the value of the firm. There may be disadvantages to financing with debt.

MM World with Taxes

-But, what does this imply..?



-All firms "should" be 100% debt financed !?
Note $V_U = V_L$ where L = 0.

If only taxes then 100% debt would be good. But this would not be practical. Implies there are other factors at play, disadvantages. The disadvantages would be the MM1 factors, but which are relevant?

-The fact that we don't see firms financed with 100% debt (no equity) tells us that our theory is missing something

-We need to account for other factors associated with debt financing

- Bankruptcy costs
- Change in the firm's investment policy

(Taxes have been factored in, that is what we are considering!)

MM World with Taxes and Bankruptcy Costs

Firm cannot pay what it owes to bondholders and creditors so it files for bankruptcy. Firm is in default.

US BANKRUPTCY CODE

• Chapter 7

- Liquidation
- Proceeds are distributed to the firm's claimants according to their priority

All assets of the firm are sold, proceeds go to the claimants according to their priority (bond holders are first, equity holders second). The firm ceases operations immediately.

• Chapter 11

- Reorganization plan
- Debt holders and equity holders get new claims instead of the old ones

There are negotiations, most likely new owners. New owners will have plan to recover firm, or at least keep it going through the proceedings. Bondholders get a new contract, probably less money.

MM World with Taxes and Bankruptcy Costs

BANKRUPTCY COSTS

- **Direct:**
  - -Lawyers', accountants', and other professionals' fees
  - -Court fees
  - -Managerial time spent on bankruptcy administration

Many activities not related to the normal course of the business.

- **Indirect:**
  - -Loss of reputation (risk of losing clients, employees, suppliers, etc.)
  - -Loss of potential business deals, partners

MM World with Taxes and Bankruptcy Costs

The probability of entering bankruptcy, and thus incurring these costs, is an increasing function of the firm's debt-to-assets ratio, more debt reduces the value of the firm!

Increasing leverage increases the PV of debt tax shields, but also increases the probability of bankruptcy and, thus, the PV of expected bankruptcy costs

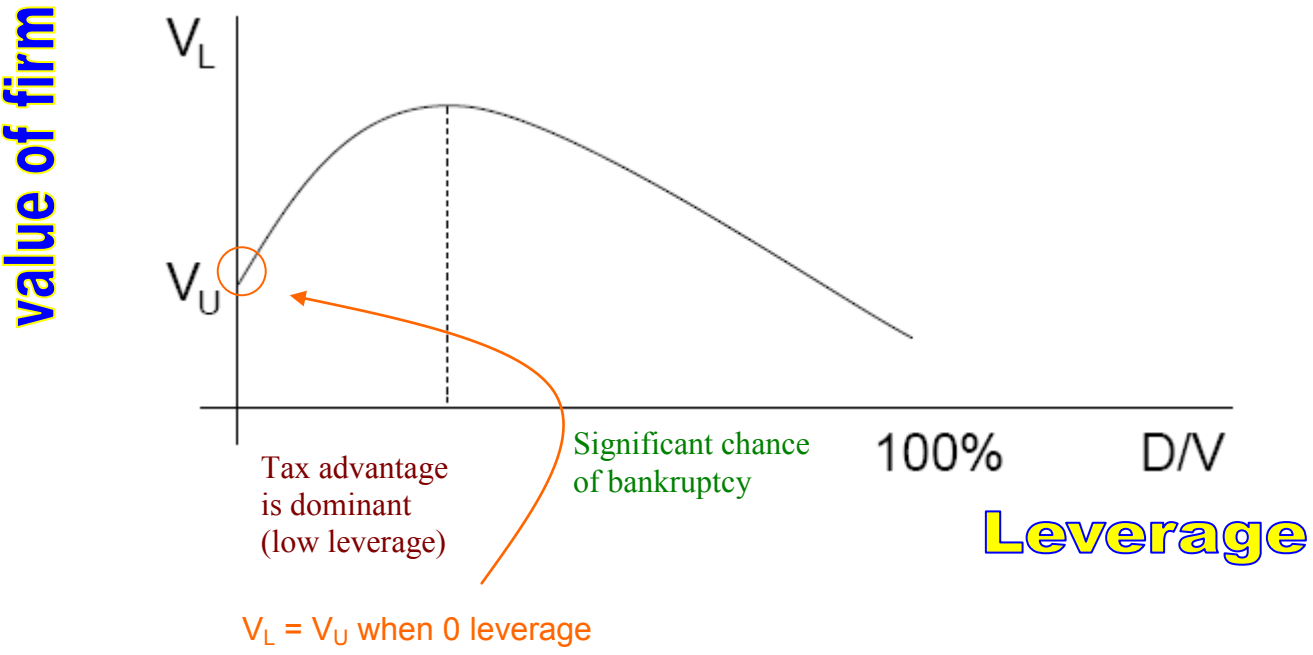
Hence,

Value of levered firm = Value of unlevered firm + PV of tax shields - PV of bankruptcy costs

High debt increases probability of bankruptcy. Very high coupon payments, may no be able to meet them. This lowers the value of the firm.

When the expected bankruptcy costs (and likelihood) increase the value of the firm decreases.

Optimal capital structure trades off the gains from increased tax shields against the increased expected costs of bankruptcy



Goal is to find the capital structure which maximizes the value of the firm.

How Big are Direct Bankruptcy Costs?

-Empirical evidence shows that direct bankruptcy costs account for 1.5% to 5% of total firm value. This range is too small to explain the firms choice of capital structure.

-Bankruptcy costs may be too small to generate observed financing choices by corporations

-We need to account for another factors associated with debt financing

- **Change in the firm's investment policy**

This is the only MM1 factor left to explain which is relevant. The factor that the level of debt explains which projects are taken.

Practice questions

15.2 **15.6** **15.9**