# Debt Overhang and Free Cash Flow Problems
# Implications for capital structure

## Overview of the lecture:

- Debt Overhang and Underinvestment (Myers (1977))
- Benefits of Renegotiation with Existing Investors
- New Claims as Renegotiation
- Free cash flow problem (Jensen (1986))
- Free cash flow problem vs. debt overhang: implications for debt structure (Hart-Moore (1995))

## Indirect Costs of Financial Distress

- Some evidence: firms in Financial Distress
  - Are constrained in their investment strategies, i.e., they have to pass up positive NPV investments
  - Follow short-sighted strategies to meet repayments
  - Need to sell assets below their value under best use
  - Are weakened in the product market competition (especially if competitors are financially strong)
  - Lose the confidence of stakeholders such as customers, key employees, suppliers.

# THE DEBT OVERHANG PROBLEM

Myers (1977) shows how such indirect costs of financial distress can prevent a firm from exploiting valuable investment opportunities.

**Main idea:**

**(1) Risky debt makes equityholders reluctant to finance some NPV$>$0 projects because they would have to share the returns with the existing creditors.**

**(2) Particularly so in financial distress, i.e., when a default is very likely.**

**(3) In principle, the claimholders could renegotiate to avoid inefficiency. Thus, the problem arises when renegotiation is imperfect.**

## Model

Two dates $(t = 1, 2)$, no discounting.

At $t = 1$, an entrepreneur is running a firm with:

- **Assets in place:**
  - Generate $X \in \{X^F, X^S\}$ at $t = 2$
  - with $\Delta X := X^S - X^F > 0$ and $p := \Pr\left[X = X^S\right]$

- **Existing investors:**
  - Hold debt with face value $K$ so that

$$R^F = \min\{K; X^F\} \quad \text{and} \quad R^S = \min\{K; X^S\}$$

- **Investment opportunity:**
  - At $t = 1$, the entrepreneur considers undertaking a project
  - Investing $I$ increases $p$ to $p + \Delta p$
  - This investment has a positive NPV, i.e.,

$$\Delta p \Delta X - I > 0$$

  - We assume that the entrepreneur has at least $I$ available. You can think of $I$ as either his own funds or the firm's free cash that he can either pay as dividend to himself of invest in the new opportunity.

At $t = 2$ – repayment

**Assumption**: The cash flow of the new investment cannot be contracted upon separately from that of the assets in place

## Underinvestment

The existing debtholders' payoff is

$$R^F + \Pr\left[X = X^S\right] \Delta R$$

$\Rightarrow$ if $I$ is invested, their payoff increases by

$$\Delta p \Delta R$$

$\Rightarrow$ the entrepreneur's payoff increases by

$$\underbrace{(\Delta p \Delta X - I)}_{\text{project's NPV}} \quad - \quad \underbrace{\Delta p \Delta R}_{\substack{\text{part accruing to} \\ \text{existing debtholders}}}$$

That is, the existing debt acts as a "**tax" on investment**.

$\Rightarrow$ the entrepreneur invests iff

$$\Delta p \Delta X - I > \Delta p \Delta R$$

With risky debt ($\Delta R > 0$), the investment policy is distorted towards **underinvestment**. Indeed, projects such that

$$\Delta p \Delta R > \Delta p \Delta X - I > 0$$

should be undertaken, but are rejected.

**Intuition:**

- The entrepreneur would incur the investment's entire cost, but gets only part of its return.
- Holders of existing risky claim do not contribute to funding, but get additional $\Delta p \Delta R$.
- This transfer may prevent optimal investment policy.
- **NOTE:** With risk-free debt ($\Delta R = 0$), there is no distortion in the investment decision. Hence, to have the debt overhang problem we need $K > X^F$.

## CAN RENEGOTIATION HELP?

Consider a project such that

$$\Delta p \Delta R > \Delta p \Delta X - I > 0$$

Since $K > X^F$, if $X = X^F$ the entrepreneur gets 0 and the debtholders get $R^F = X^F$

If the entrepreneur does not invest, his payoff is

$$p\left(X^S - R^S\right)$$

and the debtholders' payoff is

$$X^F + p\left(R^S - X^F\right)$$

**Debt forgiveness can be Pareto improving.**

Conditionally on the investment being made, the debtholders accept to reduce the face value of the debt from $R^S$ to $\hat{R}$ such that

$$X^F + (p + \Delta p)\left(\hat{R} - X^F\right) = X^F + p\left(R^S - X^F\right)$$

that is,

$$\hat{R} = \frac{pR^S + \Delta p X^F}{p + \Delta p}$$

If the entrepreneur has full bargaining power, the debtholders' payoff is unchanged but now the entrepreneur invests because he receives the project's entire NPV:

$$\begin{aligned}
&= (p + \Delta p)(X^S - \hat{R}) - I \\
&= (p + \Delta p)X^S - \big(pR^S + \Delta p X^F\big) - I \\
&= \underbrace{p(X^S - R^S)}_{\substack{\text{entrepreneur's payoff} \\ \text{absent investment}}} + \underbrace{\Delta p \Delta X - I}_{\substack{\text{new investment's} \\ \text{NPV}>0}}
\end{aligned}$$

**Note:**

- If the entrepreneur did not have full bargaining power the result would not change

- Renegotiation (debt reduction) always restores the first best incentives (all NPV $>0$ undertaken) only if the investment decision at $t=1$ is verifiable
- When investment choice is not verifiable, a stronger condition than $\Delta p \Delta X - I > 0$ is needed to make sure that renegotiation leads to investment.

That is, unconditional debt forgiveness (without the entrepreneur's commitment to invest) might not restore efficiency. Indeed, to satisfy the entrepreneur's $IC$ constraint, it must be that

$$\Delta p \Delta X - I > \Delta p \Delta \hat{R}$$

where $\Delta \hat{R} = \hat{R} - X^F$

Though $\Delta \hat{R} < \Delta R$, this condition may not hold even though $\Delta p \Delta X - I > 0$ holds.

## Essence of the overhang problem:

Existing risky claims reduces the incentives to invest.

Crucial assumptions

- Claims cannot be (perfectly) renegotiated
- Cash flow from new investment cannot be separated from cash flow of assets in place
- All the above reasoning is not specific to the debt-like contracts. Underinvestment arises as soon as existing claims are risky (i.e., $\Delta R \neq 0$). The crucial implicit assumption is that the existing investors' claims **cannot be diluted**, i.e. **senior** to any new claims (see below). This is a typical feature of debt contracts.

# NEW CLAIMS AS RENEGOTIATION

- **Can issuing new equity help if the existing claims are debt? No**

With competitive capital markets, the entrepreneur needs to promise new investors a repayment with PV$= I$.

$\Rightarrow$ Nothing changes, $\Delta p \Delta R$ still goes to the existing investors. Hence, the maximum you can promice to the new investors is $\Delta p \Delta X - \Delta p \Delta R$, meaning no investment iff

$$\Delta p \Delta X - \Delta p \Delta R < I$$

- 
  - The face value of debt is unchanged by the new issue
  - Debt is senior to equity $\Longrightarrow$ the new issue does not modify the existing debtholders' claim
  - The overhang problem is unchanged.

- **Can issuing new equity help if the existing claims are equity and existing investors are passive? Yes**
  - Investment financed with new shares $\beta$. New investors break even

$$\frac{\beta}{1+\beta}[(p + \Delta p)\Delta X + X^F] = I$$

  - Existing shareholders (including entrepreneur) share the positive NPV.

Entrepreneur with fraction $\alpha$ gets

$$\begin{aligned} & \frac{\alpha}{(1+\beta)}[(p+\Delta p)\Delta X + X^F] \\ = \; & \alpha(1-\frac{\beta}{1+\beta})[(p+\Delta p)\Delta X + X^F] \\ = \; & \alpha[(p+\Delta p)\Delta X + X^F] - \alpha I \\ > \; & \alpha[p\Delta X + X^F] \end{aligned}$$

and old shareholders get

$$(1-\alpha)[(p+\Delta p)\Delta X + X^F] - (1-\alpha)I > (1-\alpha)[p\Delta X + X^F]$$

**Intuition**: the new issue modifies the existing shareholders' claim. That is, old shareholders' claim gets diluted from $1$ to $\frac{1}{1+\beta}$. The new equity can be viewed as "forcing" forgiveness.

## Implications

### Main insights:

- Debt Overhang is a renegotiation problem
- Firms in financial distress find it hard to raise new funds, even for positive NPV investments (Note: Similar problem for countries)

### Ex-Post Way to Mitigate Overhang Problem:

- Issue more senior claims
  - Avoids the “tax”. But it may not be feasible (covenants).
  - If new senior claims can be issued,
    * existing debtholders may lose
    * even negative NPV projects might be undertaken (will be discussed in sections)

## Ex-Ante Ways to Mitigate Overhang Problem:

- Less debt
- Issue shorter maturity claims: If debt matures prior to investment decision, problem disappears.
  - If firm value + investment option exceeds debt claim, pay off debtors and invest, if positive NPV (in this case you can always raise money in the market to pay off debtors).
  - If reverse holds, debtors take control and invest if positive NPV.
- Separate project financing: No tax on new project by existing investors
- Debt structure which is more easily renegotiated
  - Bank rather than public debt
  - Fewer rather than many banks

# FREE CASH FLOW PROBLEM VS. DEBT OVERHANG: IMPLICATIONS FOR DEBT STRUCTURE

- We just saw that too much long-term debt can lead to under-investment
- We will see now that if manager has too much cash and too *little* debt he may *over*invest (Jensen (1986), Hart-Moore (1995))
- A combination of short-term debt and long-term debt can optimally mitigate the combination of the two problems

## Managers as empire builders

How can investors design the capital structure to limit the manager's ability to do inefficient investment?

**Assumptions:**

- We will look at the optimal capital structure decisions from the investors' viewpoint.
  - Thus, manager's private benefits are excluded from efficiency considerations.
  - Implicitely: manager's individual rationality constraint does not bind.

- The manager's utility is strictly increasing in the assets under his control (level of investment he makes).
  - Thus, the agency problem cannot be solved by putting manager on incentive scheme, either because he does not respond to monetary incentive or because such a scheme is too costly.
- The manager cannot divert resources for his own use.
  - Given the manager's preferences, agency problem reduces to inefficient expansion (or continuation).
- Contractual incompleteness
  - The efficient investment decision to be taken at some later date is not contractible at the initial date.
- No renegotiation is possible between the manager and the investors (e.g. because there are many small dispersed investors)

We will consider two models of how debt can constrain the manager's empire-building tendencies.

## FREE CASH FLOW THEORY OF DEBT (Jensen (1986))

Jensen (1986)

**Main Ideas:**

**(1) Managers control resources inside the firm.**

**(2) They might misallocate some, especially Free Cash Flow (cash remaining after all NPV>0 projects).**

**(3) Debt payments reduce the resources under manager control by pumping them out of the firm.**

### Model

- At $t = 0$, assets are put in place and the entrepreneur designs the firm's capital structure:
  - Short-term debt $K_1$ due at $t = 1$
  - Long-term debt $K_2$ due at $t = 2$ (will play no role in *this* model)
- At $t = 1$, the firm is run by a manager.
  - A cash flow $X_1$ is generated
  - The manager can decide the investment level $I_1$
- At $t = 2$,
  - A cash flow $X_2 \in \{0, X_2^S\}$ is generated
  - with $\Pr\left[X_2 = X_2^S\right] \equiv p + \Delta(I_1)$
  - $\Delta' > 0$, $\Delta'' < 0$, $\Delta'(0) > \frac{1}{X_2^S}$, $\Delta'(X_1) < \frac{1}{X_2^S}$

## First Best:

$$I_1^* \equiv \arg\max \ (p + \Delta(I_1))X_2^S - I_1 \Longrightarrow \Delta'(I_1^*) = \frac{1}{X_2^S}$$

## Restraining Overinvestment:

**Assumption:** The manager invests as much as he can and does not respond to monetary incentives.

Or formally, he gets private benefits $Z(I_1)$ with $Z' > 0$

Not responding to monetary incentives means that there is no incentive scheme, e.g. no share $\alpha$, such that

- the investors can afford to give it to the manager and

- it induces the manager to lower $I_1$, i.e. the solution of

$$\max_{I_!} \alpha[(p + \Delta(I_1))X_2^S - I_1] + Z(I_1)$$

is equivalent to the solution of

$$\max_{I_!} Z(I_1)$$

**Note:**

- If private benefits were included in efficiency calculations, first best would solve

$$\arg\max(p + \Delta(I_1))X_2^S - I_1 + Z(I_1)$$

- will not change the essense of the story unless $Z(I_1)$ grows too fast (otherwise indeed it would be optimal to have as big $I_1$ as possible).

**Problem:** Allocate control over $X_1$ such that optimal reinvestment decision (non-contractible) is chosen.

**Assumption:** The manager "controls" funds inside the firm.

**Assumption:** "Free Cash Flow" $\equiv (X_1 - I_1^*) > 0$.

At $t = 1$, the manager reinvests all the available funds, as he bears none of the costs:

$$I_1 = X_1 - K_1$$

Hence, he overinvests unless

$$K_1 \geq X_1 - I_1^*$$

and it is optimal to set:

$$K_1^* = X_1 - I_1^*$$

- Thus, optimal short-term debt (repayment obligation) implements
  - Investor control over the Free Cash Flow
  - Manager control over the remaining funds
- Debt is a commitment to payout

**Note:** If renegotiation of $K_1$ is costless, there is no efficiency loss associated with $K_1 > X_1 - I_1^*$, as $K_1$ will always be renegotiated to its efficient level $K_1^*$.

# Comments

## Implications:

- The Free Cash Flow problem is particularly severe for "cash cows", i.e., firms which are cash rich but have poor investment opportunities.
- Debt should be negatively correlated with measures of growth potential such as Tobin's $q$.
- Jensen interprets (some) LBOs as a means to increase the leverage of firms with too much Free Cash Flow.

## Debt?

- More a theory of financial contract maturity
  - Any security implementing a payout $X_1 - I_1^*$ prevents over-investment.
  - Thus, debt reasoning implicitly relies on assumption that other securities entail less credible penalty for defaulting on payout $X_1 - I_1^*$.

## Outside Finance?

- Implicitly, the model so far assumes
  - either that the shareholders control the firm's access to outside finance at $t = 1$
  - or that this is contractible at $t = 0$
- Otherwise, the manager could try to raise debt at $t = 1$ due at $t = 2$
- Even if the manager controls access to outside finance, raising funds at $t = 1$ can be prevented via using long-term debt (see next model)

# LONG-TERM DEBT AS A RESTRAINT TO OVERINVESTMENT

Hart and Moore (1995)

**Main Ideas:**

**(1) Managers control the firm's access to outside finance**

**(2) They might raise excessive funds for empire building.**

**(3) Long-term debt reduces the firm's access to outside finance (by using up the firm's debt capacity).**

Same model as before except:

**Assumption:** $X_1 = 0$ and $K_1 = 0$.

$X_1 = 0$ for simplicity, $X_1 < I_1^*$ would suffice.

**Assumption:** At $t = 1$, the manager can raise new debt due at $t = 2$, senior to equity but junior to the existing long-term debt $K_2$.

At $t = 1$, the manager can raise funds by issuing claims against $[p + \Delta(I_1)](X_2^S - K_2)$

As he wants to invest as much as possible, the manager always exhausts the firm's remaining debt capacity:

$$I_1 = [p + \Delta(I_1)](X_2^S - K_2)$$

$$\Rightarrow I_1(K_2)$$

Choice of $K_2$ at $t = 0$ involves following trade-off:

- Benefit of high levels of $K_2$: This reduces the income that can be pledged to new investors. Hence it reduces manager's ability to overinvest thorugh the reduction in the amount of funds that can be raised.

- Cost of high levels of $K_2$: Given new investors at date $t = 1$ are junior, debt overhang may occur: the firm may be unable to raise enough funds for efficient investment level, i.e.,

  $$[p + \Delta(I_1^*)](X_2^S - K_2) < I_1^*.$$

Optimal level of $K_2$ strikes balance between these two conflicting objectives.

In this simple model, there exists a unique $K_2^*$ that implements first best

$$I_1(K_2^*) = I_1^*$$

Notice that $\dfrac{dK_2^*}{dI_1^*} < 0$, $\dfrac{dK_2^*}{dp} > 0$ (Note: $p$ has no effect on $I_1^*$)

In the original model of Hart and Moore (1995), returns from assets in place $X_1$, $X_2$, investment cost and project return are uncertain at date $0$, while their realizations are known at date $t = 1$, prior to the investment decision.

- As a result, there is generally over- or underinvestment depending on the realizations of $X_1$, $X_2$ and the project's NPV.

In addition, Hart and Moore assume that $X_1 < I_1^*$, and liquidation at $t = 1$ is inefficient $(E[X_2] > L)$.

- Hence, $K_1 = 0$ is optimal (we just assumed $K_1 = 0$)
  - Inefficient liquidation is avoided.
  - Since the manager needs to raise additional funds to (over-)invest, only the sum of $X_1 + X_2$ matters for the investment decision.
  - See Hart's book (1995) and Hart and Moore (1995) for details

## SUMMARY OF THE TWO MODELS:

- To curb the manager's empire-building tendencies, long-term debt is of primary importance: It is a means of regulating inflow of new capital and thereby limiting the level of investment that the manager can undertake.
  - For $X_1 < I_1^*$, overinvestment can be avoided by long-term debt.
    * Even in the absence of short-term debt, i.e., $K_1 = 0$, the manager has to raise additional funds to overinvest $I > I_1^*$. Hence, there is no need to have $K_1 > 0$.
  - For $X_1 \geq I_1^*$, Free Cash Flow problem is added to manager's empire-building tendencies. Overinvestment can be avoided only with combination of both short-term and long-term debt.
  - With risky date $1$ cash flow, say $X_1^S > I_1^* > X_1^F$, the choice of debt is determined by following consideration:
    * To avoid overinvestment, $K_1$ and $K_2$ should be set high, while preventing inefficient liquidation requires to set $K_1$ and $K_2$ low.

## Comments

Hart and Moore (1995) and Jensen (1986) provide argument why public companies issue senior non-postponable debt. Hard debt has an important role when managers are (assumed to be) self-interested.

Non-postponable short-term debt forces managers to disgorge funds, rather than to invest in unprofitable projects and triggers liquidation when assets are more valuable elsewhere.

Senior long-term debt prevents manager from financing unprofitable investments by borrowing against future earnings.

**Implications:**

- Profitability of investment project and leverage are inversely related (as $\Delta(I_1)$ becomes steeper, $I_1^*$ increases, since $\Delta'(I_1^*) = \frac{1}{X_2^S}$)

  $$-\frac{dK_2^*}{dI_1^*} < 0$$

- Profitability of assets in place and leverage are positively related

  $$-\frac{dK_2^*}{dp} > 0$$

- Recall that the manager controls financing at $t = 1$ but not $t = 0$. Is it plausible?
- If he controls financing also at $t = 0$, why would he self-restrain?

– Potential answer: under takeover pressure (see next lecture, Zwiebel (1996))