# NOTES ON CAPITAL STRUCTURE: ADVERSE SELECTION AND THE PECKING ORDER THEORY

Professor B. Espen Eckbo
Corporate Finance (15.441J)
MIT, Fall 2001

SESSION 4A

Contents

# 1 INTRODUCTION

Myers and Majluf (1984): Pecking Order Theory
*Main ideas:*

(1) *Good types prefer to issue securities whose value is not very sensitive to information. Securities may be ranked in terms of their information. Securities may be ranked in terms of their information sensitivity.*

(2) *Under certain conditions, the ordering is:*

1. *Internal funds (retained earnings)*
2. *Risk-free debt*
3. *Risky debt*
4. *Hybrid securities (convertible debt)*
5. *Equity*

Following analysis decomposes the Myers and Majluf problem into
(ii) project funding under asymmetric information
(iii) impact of assets in place on cost of funding under asymmetric information.

Debt as relatively information insensitive claim

Entrepreneur with same project as usual
- two dates ($t = 0, 1$), no discounting
- $t = 1: \; X \in \{\underline{X}, \overline{X}\}$ with $0 \leq \underline{X} \leq \overline{X}$
- $p = Pr(X = \overline{X})$
- two types of firms $p \in \{p_B, p_G\}$ with $p_B < p_G$
- for investors, $q = Pr(p = p_G)$
- both types are positive NPV projects, i.e.

$$p_G\overline{X} + (1 - p_G)\underline{X} > p_B\overline{X} + (1 - p_B)\underline{X} > F$$

- entrepreneur is risk-neutral

$\Longrightarrow$ Leland-Pyle does not apply. Good type cannot reveal his type. Since risk-neutrality means

$$pU(\overline{X}) + (1 - p)U(\underline{X}) = U(p\overline{X} + (1 - p)\underline{X})$$

bad types are not deterred from mimicking good types (i.e. accept risk exposure in return for higher price on smaller fraction of shares sold)

$\Longrightarrow$ to motivate outside financing, one needs penniless entrepreneur (wealth-constraint).

**Case 1**: $\underline{X} > F$

<u>Good type issues risk-free debt:</u>

- Given no discounting, investors require

$$p_G \overline{R} + (1 - p_G)\underline{R} = F$$

  as $F < \underline{X}$, you can set $\overline{R} = \underline{R} = F$.

- I.e., risk-free claim (debt) sells at fair price.
- Since $\underline{X} > F$, this holds also for bad types: they can issue risk-free claim at fair prie
- *Thus, there is pooling, but it is irrelevant. Investors are not fooled, there is no subsidizing across types.*

<u>Good type issues risky claim, e.g., equity:</u>

- If issuing firm is known to be good, investors require a fraction $\beta$ of the firm such that

$$F = \beta[p_G \overline{X} + (1 - p_G)\underline{X}]$$

$$\Rightarrow \beta_G = \frac{F}{\underline{X} + p_G(\overline{X} - \underline{X})}$$

- However, bad types have incentive to mimic good types. That is, at that price, they would switch from issuing riskless debt to equity and retain:

$$(1-\beta)[\underline{X} + p_B(\overline{X} - \underline{X})]$$
$$= \frac{\underline{X} + p_G(\overline{X} - \underline{X}) - F}{\underline{X} + p_G(\overline{X} - \underline{X}}[\underline{X} + p_G(\overline{X} - \underline{X})]$$
$$> \underline{X} + p_B(\overline{X} - \underline{X}) - F$$

- Anticipating this, rational investors require

$$F = \beta[\underline{X} = p_B(\overline{X}-\underline{X})+q(p_B-p_B)(\overline{X}-\underline{X})]$$

$$\Rightarrow \beta = \frac{F}{\underline{X} + p_B(\overline{X} - \underline{X}) + q(p_G - p_B)(\overline{X} - \underline{X})}$$
$$> \frac{F}{\underline{X} + p_G(\overline{X} - \underline{X})} = \beta_G$$

- $\Rightarrow$ If good types issue risky claims (equity), bad guys mimic them. Hence, good types' claims would be sold at discount, subsidizing bad types. So, good types issue risk-free claim

- Bad types may issue either risk-free debt or equity. Choice is irrelevant:

<u>Bad type issues risk-free debt</u>:

- Since $\underline{X} > F$ bad types can also issue risk-free claim where $\overline{R} = \underline{R} = F$:

$$\begin{aligned} F &= p_B(\overline{X} - \overline{R}) + (1 - p_B)(\underline{X} - \underline{R}) \\ &= \underline{X} + p_B(\overline{X} - \underline{X}) - F \end{aligned}$$

. <u>Bad type issues risky claim (equity)</u>:

- Investors require a fraction $\beta$ such that

$$F = \beta[p_B\overline{X} + (1 - p_B)\underline{X}]$$

$$\Rightarrow \beta_B = \frac{F}{\underline{X} + p_B(\overline{X} - \underline{X})}$$

- Bad types indifferent between risk-free debt and equity:

$$(1 - \beta_B)[\underline{X} + p_B(\overline{X} - \underline{X})]$$

$$= \frac{\underline{X} + p_B(\overline{X} - \underline{X}) - F}{\underline{X} + p_B(\overline{X} - \underline{X})}[\underline{X} + p_B(\overline{X} - \underline{X})]$$

$$= \underline{X} + p_B(\overline{X} - \underline{X}) - F$$

- Outcomes:

  (i) Both types issue risk-free claim (pooling but not fooling)

  (ii) Otherwise, separating where good types issue risk-fee debt, bad types issue risky claim

  (iii) In either cases, both types sell fairly price claims. $\Rightarrow$ given risk-neutrality, first-best obtains

Intuition:

- *Risk-free claims are insensitive to hidden information* $\Longrightarrow$ *saves on costs of asymmetric information*

- Note: Risk-free means *recognized* as risk-fee by investors, despite asymmetric information about firm type.

**Case 2**: $\underline{X} < F$

Risk-free claims insufficient to fund project. Can good firm signal its type?

- *(i) Separating Equilibrium where good firms only invest?* $\rightarrow$ *NO*
- Bad types refraining from investing requires that they would sell claims at a discount. That is

$$p_G\overline{R} + (1 - p_G)\underline{R} \leq p_B\overline{R} + (1 - p_B)\underline{R}$$
$$(p_G - p_B)(\overline{R} - \underline{R}) \leq 0$$
$$\overline{R} \leq \underline{R}$$

- However, this violates investors' participation constraint. Indeed, by assumption (case 2) and by limited liability.

$$\overline{R} \leq \underline{R} \leq \underline{X} < F$$

$\Longrightarrow$ investors' PC is violated

$$p\overline{R} + (1 - p)\underline{R} < F$$

Hence, no such equilibrium exists

- *(ii) Separating Equilibrium where bad firms only invest?* $\rightarrow$ *NO*
- Given that

$$p_B \overline{X} + (1 - p_B)\underline{X} > F$$

by assumption, bad types are viable without subsidies from good types

- Given bad projects have positive NPV, this is also true for "average" type ($p = qp_H + (1 - q)p_B$)

$$p\overline{X} + (1 - p)\underline{X} > F$$

- Hence, even if good type has to pool with bad types, i.e. subsidize them, it is still worthwhile to undertake project.
- <u>Recall</u>: Necessary condition for market breakdown is that bad types have negative NPV project

- Proof by example: Suppose that

$$p\overline{R} + (1-p)\underline{R} = F \text{ and } \underline{R} = \underline{X}$$

$$\Rightarrow \overline{R} = \frac{F-(1-p)\underline{X}}{p}$$

Then, expected return of good type is

$$= p_G(\overline{X} - \overline{R}) + (1-p_G)(\underline{X} - \underline{R})$$

$$= p_G(\frac{p\overline{X} - (F-(1-p)\underline{X})}{p})$$

$$p_G[p(\overline{X} - \underline{X}) + \underline{X} - F] > 0$$

Good type makes positive expected profit, despite subsidizing bad types

- Hence, no separating equilibrium where good types do not invest

- *(iii) Pooling equilibrium?* $\rightarrow$ *YES*
  *Is type of issued claim irrelevant?* $\rightarrow$ *NO*
- The good type's program is

$$\max_{\overline{R},\underline{R}} \; p_G(\overline{X} - \overline{R}) + (1 - p_G)(\underline{X} - \underline{R})$$
$$+(p\overline{R} + (1 - p)(\underline{R} - F)$$

s.t.

$$p\overline{R} + (1 - p)\underline{R} \geq F$$
$$\underline{R} \leq \underline{X} \;\text{ and }\; \overline{R} \leq \overline{X}$$

Objective function can be rewritten as

$$-p_G(\overline{R} - \underline{R}) - \underline{R} + p(\overline{R} - \underline{R}) + \underline{R}$$
$$+p_G(\overline{X} - \underline{X}) + \underline{X} - F$$
$$= -(p_G - p)(\overline{R} - \underline{R}) + p_G(\overline{X} - \underline{X}) + \underline{X} - F$$

Hence, good types' optimization problem can be reduced to

$$\max_{\overline{R},\underline{R}} \; -(p_G - p)(\overline{R} - \underline{R})$$

s.t

$$\underline{R} + p(\overline{R} - \underline{R}) \geq F$$
$$\underline{R} \leq \underline{X} \;\text{ and }\; \overline{R} \leq \overline{X}$$

- Since objective function is increasing in $\underline{R}$, limited liability constraint ($\underline{R} \leq \underline{X}$) determines $\underline{R}$.
- Since objective function is decreasing in $\overline{R}$, funding constraint ($\underline{R} + p(\overline{R} - \underline{R}) \geq F$ determines $\overline{R}$. Thus,

$$\underline{R}^* = \underline{X} \text{ and } \overline{R}^* = \frac{F - (1-p)\underline{X}}{p}$$

- Good or bad types issues the same contract: $R \in \{\underline{R}^*, \overline{R}^*\}$
- Contract looks like debt; face value $K = \overline{R}^*$
  - repay all you have in the low state
  - repay some fixed amount in the high state
- *Debt-like contract is optimal because it minimizes underpricing of good type's claim*
  Good type's objective function

$$\max_{\overline{R},\underline{R}} \; -(p_G - p)(\overline{R} - \underline{R})$$

  is equivalent to minimizing underpricing:

$$\min_{\overline{R},\underline{R}} (p_H - p)(\overline{R} - \underline{R}) = (1-q)(p_H - p_B)(\overline{R} - \underline{R})$$

- Two-state model predicts
  - debt-like contract is optimal as it minimizes under-pricing for the good type.
  - sell risk-free cash flows first at fair price and then sell some more at discount until F is raised.
- This intuition is, however, specific to the two-state model. Result is also due to:
  - $(\overline{X} > F > \underline{X})$, hence repayment $\overline{R}$ needs to be positive and larger than $\underline{X} = \underline{R}$.
  - $\underline{X} > 0$, there is risk-fee claim to be sold
- The intuition for the more general case:
  - overall, good type's claim is underpriced
  - claim $\overline{R}$ is under-priced for good firm
  - claim $\underline{R}$ is over-priced for good firm! Good type reaches state $\underline{X}$ less often than "average" type.

  $\Longrightarrow$ *underpricing is increasing in* $X$, first negative, then positive.

- Does this intuition generalize? That is, are repayments in lower states more favorable to good type?
- <u>A More General Model</u> (Innes (1990))
- Consider same problem with $X \in [0, +\infty)$ generated by density $h \in \{h_G, h_B\}$.
- For debt to be optimal, it is not sufficient to assume

$$\int_0^{+\infty} X h_G(X) dX > \int_0^{+\infty} X h_B(X) dX$$

- Instead, assume that a higher realization X is more likely to be generated by a good type.

$$Pr(good \mid X) = \frac{Pr(good \text{ and } X)}{Pr(good)}$$

$$= \frac{q h_G(X)}{q h_G(X) + (1-q) h_B(X)}$$

$$= \frac{1}{1 + (\frac{1-q}{q}) \frac{h_B(X)}{h_G(X)}}$$

- Technically, the distributions are assumed to satisfy the Monotone Likelihood Ratio Property (MLRP):

$$\frac{\partial}{\partial X}\left(\frac{h_G(X)}{h_B(X)}\right) > 0$$

- Remark: This condition is obviously satisfied in the two-state model:

$$\frac{1 - p_G}{1 - p_B} < \frac{p_G}{p_B}$$

- Given $X \in [0, \infty)$, there are no risk-fee claims (risk-free claims are not sufficient to fund $F$)
  $\Longrightarrow$ risky claims have to be issued
  $\Longrightarrow$ bad type mimics
  $\Longrightarrow$ good type minimizes discount (=under-pricing)

- Thus, good type has same program as in the two state model:

$$\max_{R(X)} \int_0^\infty h_G(X)[X - R(X)]dX - F$$

$$+ \int_0^\infty [qh_G(X) + (1-q)h_B(X)]R(X)dX$$

subject to

$$\int_0^\infty [qh_G(X) + (1-q)h_B(X)]R(X)dX \geq F$$

$$0 \leq R(X) \leq X$$

Collecting $R(X)$ terms shows that the problem is equivalent to minimizing underpricing:

$$\max_{R(X)} -(1-q)\int_0^\infty [h_G(X) - h_B(X)]R(X)dX$$

subject to

$$\int_0^\infty [gh_G(X) + (1-q)h_B(X)]R(X)dX \geq F$$

$$0 \leq R(X) \leq X$$

The Lagrangian (ignoring the second constraint):

$$\max_{R(X)} \; -(1-q)\int_0^{\infty}[h_G(X)-h_B(X)]R(X)dX$$

$$+\lambda[\int_0^{+\infty}[gh_G(X)+(1-q)h_B(X)]R(X)dX-F]$$

which can be rewritten as

$$\max_{R(X)} \int_0 R(X)[\lambda(qh_G(X)+1-q)h_B(X))-Q]d(X)$$

$$\text{where} \;\; Q \equiv (1-q)[h_G(X)-h_B(X)]$$

By inspection, the solution is to maximize $R(X)$ when term inside square brackets is positive, and to minimize $R(X)$ when it is negative. Or equivalently, $R(X)$ has to be maximized when the ratio

$$A \equiv \frac{h_G(X)-h_B(X)}{qh_G(X)+(1-q)h_B(X)}$$

is smallest, and minimized for other values of $A$

Under MLRP, the ratio $A$ is increasing in $X$

$$A = \frac{1}{q + \frac{h_B(X)}{h_G(X) - h_B(X)}} = \frac{1}{q + \frac{1}{\frac{h_G(X)}{h_B(X)} - 1}}$$

$$= \left[q + \left(\frac{h_G(X)}{h_B(X)} - 1\right)^{-1}\right]^{-1}$$

Hence, there exists a level $K$ such that

$$R^*(X) = \{X \text{ if } X < K;\ 0 \text{ if } X > K\}$$

*This does not yet look like debt* $\longrightarrow$ Additional assumption required

Monotonic reimbursement: If repayments have to be non-decreasing in the cash flow, i.e. if $dR(X)/dX \geq 0$, then optimal contract is standard debt contract.

Why? Otherwise, entrepreneur could secretly borrow and report a high cash flow $\longrightarrow$ reduced repayment (and then repay side loan). This new constraint is binding and so a standard debt contract obtains:

$$R^*(X) = \{X \text{ if } X \leq K;\ K \text{ if } X > K\}$$

## 3 FUNDING WITH ASSETS IN PLACE

- Back to the two-state model
  Consider a firm with:
  - retained earnings (financial slack) $S$
  - assets in place: two-state two-type project with $X \in \{\underline{X}, \overline{X}\}$ and $p \in \{p_B, p_G\}$
  - new investment opportunity: invest $F$ to increase $p$ to $p + \Delta$ (with $p_G + \Delta < 1$)
  - new project has a positive NPV and should thus be undertaken:

$$\Delta(\overline{X} - \underline{X}) - F > 0$$

- Crucial assumption: new project's income cannot be contracted upon separately from that of the assets in place

**Case 1**: $S + \underline{X} > F$

- Equivalent to funding problem without assets in place where $\underline{X} > F$
- Good firm can finance new project with internal funds and risk-free claim $F - S < \underline{X}$ Risk-free claim sells at fair price.
- Suppose good types issue risky claim, e.g. equity. Given issuing firm is known to be good, investors require

$$\beta_G = \frac{F - S}{\underline{X} + (p_G - \Delta)(\overline{X} - \underline{X})}$$

At that price bad types have incentive to mimic god types:

$$(1 - \beta)[\underline{X} + p_B + \Delta(\overline{X} - \underline{X}]$$

$$= \frac{\underline{X} + (p_G + \Delta)(\overline{X} - \underline{X}) - (F - S)}{\underline{X} + (p_G + \Delta)(\overline{X} - \underline{X})}$$

$$\times[\underline{X} + (p_B + \Delta)(\overline{X} - \underline{X})]$$

$$> \underline{X} + (p_B + \Delta)(\overline{X} - \underline{X}) - (F - S)$$

Hence, rational investors require

$$\beta = \frac{F - S}{\underline{X} + (\overline{X} - \underline{X})[(p_B + \Delta) + q(p_G - p_B)]}$$

$$> \frac{F - S}{\underline{X} + (p_G + \Delta)(\overline{X} - \underline{X})} = \beta_G$$

$\Rightarrow$ If good types issue risky claims (equity), bad guys mimic them

- Hence good types' risky claims would be sold at discount, subsidizing bad types
  $\Rightarrow$ good firm issues risk-fee claim
  $\Rightarrow$ no cost of information asymmetry
  $\Rightarrow$ risk-fee claim insensitive to hidden information

- What about bad firm? Bad type may issue either risk-fee claim or risky claim. Indifferent because claims are fairly priced
  If risk-fee claim, pooling but not fooling
  Otherwise, separating

**Case 2**: $S + \underline{X} < F$

- To finance the project, good firm has to issue risky claims.

  Can good firm signal its type?

  Formally, analysis is unchanged

(i) *Separating Equilibrium: Good firms only invest?* $\rightarrow$ *NO*

Bad types refraining from investing requires that they would sell claims at a discount. That is

$$(p_G+\Delta)\overline{R}+(1-p_G-\Delta)\underline{R} \leq (p_B+\Delta)\overline{R}+(1-p_B-\Delta)\underline{R}$$
$$(p_G - p_B)(\overline{R} - \underline{R}) \leq 0$$
$$\overline{R} \leq \underline{R}$$

However, this violates investors' participation constraint. By assumption (case 2) and by limited liability

$$\overline{R} \leq \underline{R} \leq \underline{X} < F - S$$

$\Rightarrow$ investors' PC is violated

$$p\overline{R} + (1-p)\underline{R} < F - S$$

Hence, no such equilibrium exists

(ii) *Pooling equilibrium?* $\rightarrow$ *MAYBE*

If yes, good type will want to raise as little as needed, since bad type is mimicking. Hence, good type raises $F - S$ and his program is

$$\max_{\overline{R},\underline{R}} \ (p_G+\Delta))(\overline{X}-\overline{R})+(1-p_G-\Delta)(\underline{X}-\underline{R})$$
$$+(p+\Delta)\overline{R}+(1-p-\Delta)\underline{R}-(F-S)$$

s.t.

$$(p+\Delta)\overline{R}+(1-p-\Delta)\underline{R} \geq F-S$$
$$\underline{R} \leq \underline{X} \ \text{ and } \ \overline{R} \leq \overline{X}$$

Objective function can be rewritten as

$$= -(p_G-p)(\overline{R}-\underline{R})+(p_G+\Delta)(\overline{X}-\underline{X})$$
$$+\underline{X}-(F-S)$$

Hence, good types' optimization problem can be reduce to

$$\max_{\overline{R},\underline{R}} \ -(p_G-p)(\overline{R}-\underline{R})$$
$$\text{s.t.} \ \ \underline{R}+(p+\Delta)(\overline{R}-\underline{R}) \geq F-S$$
$$\underline{R} \leq \underline{X} \ \text{ and } \ \overline{R} \leq \overline{X}$$

- Since objective function is increasing in $\underline{R}$, limited liability constraint ($\underline{R} \leq \underline{X}$) determines $\underline{R}$

- Since objective function is decreasing in $\overline{R}$, funding constraint ($\underline{R} + p(\overline{R} - \underline{R}) \geq F$) determines $\overline{R}$.

- Good or bad types issue the same contract:

$$\underline{R}^* = \underline{X} \text{ and } \overline{R}^* = \frac{F - S - (1 - p - \Delta)\underline{X}}{p + \Delta}$$

- Contract looks like debt with face value $K = \overline{R}^*$

  - repay all you have in the low state
  - repay some fixed amount in the high state

  $\Rightarrow$ debt-like contract is optimal because it minimizes underpricing of good types' claim.

- Note: Assets in place of good type are underpriced even though THEY need not be financed.

(iii) *Separating Equilibrium : Bad firms only invests?* $\rightarrow$ *MAYBE*

For the new project to be worthwhile under pooling, NPV has to be larger than the discount

$$\Delta(\overline{X}-\underline{X})-F \geq [(p_G+\Delta)-(p+\Delta)](\overline{R}^*-\underline{R})$$

which can be rewritten as

$$\Delta(\overline{X}-\underline{X})-F$$

$$\geq (1-q)(p_G-p_B)\left(\frac{F-S-(1-p-\Delta)\underline{X}}{p+\Delta}-\underline{X}\right)$$

$$\geq (1-q)(p_G-p_B)\frac{F-S-\underline{X}}{p+\Delta}$$

$$\geq (1-q)[F-S-\underline{X}]\frac{p_G-p_B}{qp_G-(1-q)p_B+\Delta}$$

If inequality is not satisfied:

- good firm prefers not to undertake new project
- bad firm does undertake it
- claims it issues are irrelevant (in more general model, it issues debt)

## Summary of Project Funding

- *Good types issue claims which minimize the cost of asymmetric information*
  I.e. they opt for the least information sensitive claim (debt), provided investment is undertaken

- *Asymmetric information and no assets in place*
  Results in pooling equilibrium and all projects get funded (they were assumed to have NPV $> 0$). Good types subsidize bad types since alternative is not to invest (zero return)

- *Asymmetric information about asset in place*
  Leads to either pooling or separating. Issuing underpriced claims dilutes good type. Pooling if this loss exceeds NPV of additional investment. Otherwise separating where only bad types undertake positive NPV project

Note: Project funding with assets in place more likely to result in separating equilibrium (i.e. good types do not invest) if:

- $F$ increases or $S$ decreases: more funds need to be raised. Hence, claims against a larger part of the assets in place have to be issued at a discount, $\rightarrow$ a greater overall discount
- $q$ decreases: increases discount that the good firm would have to incur when selling claims against assets in place, hence a greater overall discount
- If for some (exogenous) reason, firm has to finance project with claims other than the optimal debt contract: departure from the optimal (debt) contract increases the overall discount incurred by the good firm

## 4 Myers and Majluf (1984)

- They examine impact of a manager's private information about assets in place and investment opportunities on investment behavior
- Assume
  - poorly-informed existing claimholders and well-informed manager who is in charge of the financing decisions.
  - manager acts in the interests of the existing old share- holders
  - manager considers issuing equity only
  - existing old shareholders remain passive, i.e. do not adjust their portfolio in response to firm's issue-invest decision

These assumptions make financing matter for the investment decision, as cost to old shareholders of undervalued firms in terms of diluting their claims on assets in place may outweigh gains from undertaking positive NPV project

- Given issue and invest is profitable for all overpriced firms, but not for some underpriced firm, issue and invest is (on average) a bad signal
- Given that issue and invest is a bad signal, claims of good types are underpriced which may prevent them from undertaking positive NPV.
- The underinvestment reduces ex-ante value of good firms
- Inefficiency more likely (or larger) when return prospects of asset in place are higher and those of new investment are lower
- Sub optimal outcome could be avoided by issuing to old shareholders (right offer) or issuing risk-free debt (requires financial slack)
- If firm can choose between equity and risky debt, it never issues equity. Equity issue is preferred only if firm is overvalued $\rightarrow$ it is always a bad signal.

Numerical example: Myers and Majluf (1984)

$t_{-1}$: Symmetric info about assets in place $\tilde{a} \geq 0$, and NPV of investment project $\tilde{b} \geq 0$

$t_0$: Managers learn $a, b$:

| | State 1 | State 2 |
|---|---|---|
| $\tilde{a}$ | 150 | 50 |
| $\tilde{b}$ | 20 | 10 |

- Investing requires issuing E=100 dollars worth of equity to *outside* investors. Project is lost if not taken now
- Common knowledge that managers maximize $V_0^{old} = V(a, b, E)$, and that old shareholders are passive

$t_{t+1}$: Again symmetric info betwen firm and market

P'= market value of old shares at time 0 if issue
P = market value of old shares at time 0 if no issue

*What if managers issue regardless of state?*
$\Rightarrow P' = E(\tilde{a}) + E(\tilde{b}) = 100 + 15 = 115$

- **State 1**:
  *True value* $V \equiv V^{old} + V^{new} = 150 + 20 + E = 270$
  *Market value* at $t_0$ = P' + E
  $V^{old} = \frac{P'}{P'+E}V = \frac{115}{215}270 = 144.42$
  $V^{new} = \frac{E}{P'+E}V = \frac{100}{215}270 = 125.58$

- **State 2**:
  *True value* $V \equiv V^{old} + V^{new} = 50 + 10 + E = 160$
  $V^{old} = \frac{P'}{P'+E}V = \frac{115}{215}160 = 85.58$
  $V^{new} = \frac{E}{P'+E}V = \frac{100}{215}160 = 74.42$

- With equally probable states:
  $P' = \frac{1}{2}(144.42 + 85.58) = 115$
  $E = \frac{1}{2}(125.58 + 74.42) = 100$
  $\Rightarrow$ correct pricing.

- *However, not an equilibrium*

| Payoff | Issue-Invest | Do nothing |
|---|---|---|
| $V^{old}$ state 1 | $\frac{P'}{P'+E}V$=144.42 | a=150 |
| $V^{old}$ state 2 | $\frac{P'}{P'+E}V$=85.58 | a=50 |

- Equilibrium:
  - Issue and invest in state 2 only
  - Issuing stock signals state 2 and P' drops to 50+10=60
  - Firm passes up a good investment opportunity in state 1
    $\Rightarrow$ firm's market value At time $t_0$ is P'=(.5)60 + (.5)150 = 105
  - There is an ex ante loss of 115-105=10
  - Issue-invest decision depends on distribution of $\tilde{a}, \tilde{b}$ in the two states
  - There is value to building up financial slack

Pecking order behavior Myers (1984):

- Issue least information-sensitive securities first
- Implies debt-equity ratio is not stable over time, but function of past profitability
- Provides motive for building financial slack through retained earnings

Robustness issues:

- The asset substitution argument of Jensen and Meckling (1976) implies that equity can be less information sensitive that debt. So, the Pecking Order Theory is a response to a particular type of info asymmetry
- Will shareholders agree to a low dividend policy? Depends on beliefs about the value future investment opportunities and agency costs of free cash flow (Jensen (1986)). Internal finance is not free of information problems; it merely shifts the focus to existing shareholders

- The theory is less relevant for small entrepreneurial firms, where issuing shares for risk-sharing purposes is more important, and where shareholders may participate in new issue
- Managerial contract is assumed, not derived. Dybvig and Zender (1991): There exists a managerial incentive contract that will induce optimal investment policy even for the Myers-Majluf manager. This contract compensates managers on total firm value rather than on value of old equity stake. For instance, manager gets paid a constant plus fraction of initial stock value and is rewarded with participation in new issue. Then, if stock is currently underpriced, loss on holdings is offset by gain on stake in new issue. $\Rightarrow$ manager does not only care about value of existing claims, but also about terminal firm value.

## Pecking Order vs. Static Trade-off Theory

- Pecking Order Theory is concerned with optimal financing decision *at the margin*, i.e. how to fund next investment, rather than overall optimal debt-equity ratio
- Thus, firms' observed capital structure are the result of history, i.e previous (path dependent) decisions on the margin.
- In contrast, the Static Trade-off Theory holds that firms follow a target capital structure which they strive to approach. The observed capital structures should be close to the target
- Firms probably do prefer internal funds over external sources of finance, and debt over equity. Asymmetric information likely part of the story
- The pecking order does not preclude firms from having a target debt-equity ratio

- The PO may induce firms to deviate from the target for a relatively long period of time:
  - After sustained periods of low cash flow (PO implies debt raises), firms may find debt to be too high (Static TO: e.g. bankruptcy costs, debt-overhang...) and will thus issue equity to approach their target
  - Conversely, after long periods of high cash flow (PO implies that debt falls) firms may find debt to be too low (Static TO: e.g. tax shield) and thus will raise debt so as to approach their target
- There are benefits from reducing adverse selection. Some mechanisms:
  - managerial compensation contracts
  - communication via financial intermediaries
  - private placements/equity-carve-outs
  - callable convertible debt
  - rights offer

**References**


Dybvig, Philip H., and Jamie F. Zender, 1991, Capital structure and dividend irrelevance with asymmetric information, *Review of Financial Studies* 4, 201–219.

Innes, 1990, Limited liability and incentive contracting with ex-ante action choices, *Journal of Economic Theory* 52, 45–67.

Jensen, Michael C., 1986, Agency costs of free cash flow, corporate finance, and takeovers, *American Economic Review* 76, 323–329.

———, and William Meckling, 1976, Theory of the firm: Managerial behavior, agency costs, and capital structure, *Journal of Financial Economics* 3, 305–360.

Myers, Stewart C., 1984, The capital structure puzzle, *Journal of Finance* 39, 575–592.

———, and Nicholas S. Majluf, 1984, Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics* 13, 187–221.