Incentives and Information in Finance

Prof. Dr. Felix Noth

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Halle Institute for Economic Research (IWH) and Otto-von-Guericke University (OVGU)

Agenda

Introduction

Administration

The team

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Schedule day 1: Feb 04, 2026

Place	Time	Subject
103	08.00–10.00h	**Basics of Corporate Governance and Corporate Financing**
	10.00–12.00h	**A Basic Model for Analyzing Incentives in Corporate Finance** and **Asymmetric Information**
	12.00-13.00h	**Lunch break**
103	13.00-14.00h	**Asymmetric Information** cont'd
	14.00-15.00h	**A Short Introduction to Regressions using Investment-Cashflow Sensitivity**
	15.00-16.00h	**Event studies**

Schedule day 2: Feb 05, 2026

Place	Time	Subject
103	8.00–10.00h	**Overborrowing and Debt Overhang**
	10.00–12.00h	**Diversification** and **Collateral**
	12.00-13.00h	**Lunch break**
103	13.00-14.30h	**Collateral** cont'd
	14.30-16.00h	**Monitoring**

Main Lecture

Basics of Corporate Governance

Starting point

The theorem of Modigliani and Miller (1958, 1963). `In a world with perfect capital markets, firms' financial structure and dividend policy are irrelevant to firm value.` But:

- Moral hazard at various stages of the corporate decision process gives rise to agency conflicts.
- Agency conflicts between managers and owners.
- Agency conflicts between different corporate claimholders.
- The ability to contain agency conflicts affects firms' returns and value.

Separation of ownership and control

- Due to the high capital intensity of modern production processes, the need to diversify investments, and efficiency gains from the division of labor, managing owners have become rare.
- Owners typically delegate daily corporate decision-making to managers.
- Owners do not possess all information relevant for decision-making.
- Managers must receive discretion.
- Managers can use discretion to follow their own agendas and act in their own interests rather than the owners' interests.

Corporate governance (CG)

`[CG relates to the] ways in which the suppliers of finance to corporations assure themselves of getting a return on their investment.`

- Dominant view following Shleifer and Vishny (1997).
- This narrow definition excludes other stakeholders (employees, suppliers, communities, or customers).
- The content of this course builds on the agenda implied by this view.

Dysfunctional CG

Focus on the institutional response in terms of CG to, for example, managerial misbehavior.

- Forms of dysfunctional CG:
  - Lack of transparency.
  - Perks.
  - Leverage.
  - A tenuous link between performance and compensation.
  - Accounting manipulations.

Forms of moral hazard (MH)

Moral hazard either reduces firms' expected profits or inefficiently increases profit risk

- Insufficient effort.
  - Reluctance to make unpleasant decisions (e.g., cutting costs via tough wage negotiations, switching suppliers, or reducing the workforce, ...).
  - Insufficient effort in overseeing subordinates.
  - Managers spend insufficient time on the tasks they were hired for (and engage too much in competing activities, e.g., board mandates or political engagements, ...).
- Extravagant investments.
  - Investing in pet projects and empire-building.
- Entrenchment strategies.
  - Choosing opaque investments with high demands on managers' specific human capital.
  - Creative accounting to cover poor performance.
  - Gambling for resurrection in the case of deteriorating performance.
- Self-dealing.
  - Consuming perks.
  - Choosing costly suppliers from private networks.
  - Engaging in insider trading.

How to mitigate or prevent MH

- Takeover threats (along with the threat of replacing the manager) provide incentives for managers to act in owners' interests.
- Owners provide compensation schemes to align managers' incentives with owners' interests.
  - The performance measure must correct for exogenous factors.
  - Compensation should be based on performance corrected for general industry and market trends.
  - Otherwise, managers bear large risks and require a risk premium.
  - In practice, compensation is rarely based on *relative* performance.
- Owners can invest in monitoring to overcome informational asymmetries and prevent moral hazard.

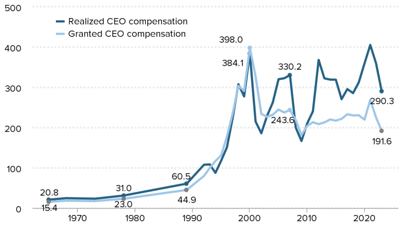
Monetary incentives: bonuses, stock options, and stocks

- Bonuses as an accounting-data-based performance measure.
  - Accounting leaves discretion to intertemporally shift profits; bonuses generate incentives for manipulation and short-termism.
  - The incentive effect is undermined, and the transparency of accounting data is corrupted.
- Stock-based incentive schemes: stocks and stock options.
  - These align interests only if managers cannot undo incentives by selling these securities (e.g., via minimum holding periods).
  - Stock prices are volatile due to exogenous factors, which impairs incentive effects.
- Bonuses and stock-based compensation tend to be complements: an increase in bonuses (short-term incentives) should go hand in hand with a rise in stock-based rewards (long-term incentives) to keep firm objectives in balance.

Monetary incentives: CEO vs. worker

CEOs make 290 times as much as typical workers

CEO-to-worker compensation ratio, 1965–2023



Notes: Average annual compensation for CEOs is for CEOs at the top 350 U.S. firms ranked by sales. Typical worker compensation is the average annual compensation (wages and benefits of a full-time, full-year worker) of production/nonsupervisory workers in the industries that the top 350 firms operate in.

Source: Authors' analysis of data from Compustat's ExecuComp database, the Bureau of Labor Statistics' Current Employment Statistics data series, and the Bureau of Economic Analysis NIPA tables.

Economic Policy Institute

Source: Economic Policy Institute

Straight shares vs. stock options

- Stocks require a substantial investment of managers' personal wealth, which is often unavailable and usually inefficient from a risk-sharing perspective.
- Stock options do not require private wealth.
- However, stock options can provide incentives for excessive risk-taking if they are significantly out of the money.

Straight shares vs. stock options cont'd

a) The managerial reward for the option is $\max(0, P - P^S)$, where the strike price is P^S at the exercise date.
   For a straight share, it would be P.
b) When the likelihood that the price will exceed the strike price decreases, managers have incentives to take substantial risks.

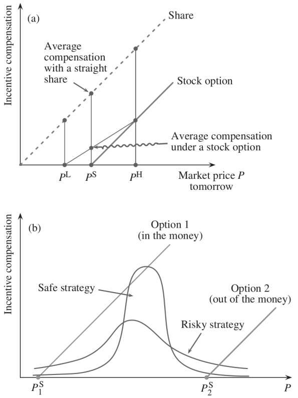


Figure 1.1 Straight shares and stock options. (a) Expected rents (P^L: low price (option "out of the money"); P^S: strike price; P^H: high price (option "in the money")). (b) Risk preferences under a stock option.

Source: Tirole (2006)

Implicit and explicit incentives

Implicit incentives.

- Managers want to secure their jobs.
- Poor performance can lead to bankruptcy and job loss.
  - Product market competition reduces monopoly rents and increases bankruptcy risk.
  - Boards may fire managers in the case of poor performance or interfere with managers' strategies.
  - Poorly performing firms may be taken over, and management may be dismissed.
  - Passive monitoring (analysts' valuations) disciplines management because it affects stock prices and takeover risk.

Implicit and explicit incentives cont'd

Explicit incentives.

- Stock options, shares, and bonuses.

Interactions.

- Implicit and explicit incentives are substitutes.
- For example, if implicit incentives are high, there is less need to increase incentives via costly bonuses or stock options.

Pay mix and levels, UK, US, Germany, and France

2019 numbers (Edmans et al., 2023)

	Median CEO pay % of total ($m)			
	UK	US	Germany	France
Salary	24% (1.30)	10% (1.28)	25% (1.68)	28% (1.35)
Bonus	29% (1.58)	19% (2.54)	41% (2.77)	36% (1.74)
Long-term incentives	48% (2.64)	71% (9.54)	34% (2.28)	35% (1.69)
Total	100% (5.52)	100% (13.36)	100% (6.73)	100% (4.78)

Source: CEO Pay Landscape in Japan, US, and Europe – 2019 Analysis, WillisTowersWatson. Firms with >$10bn sales.

Monitoring

- Monitoring is performed by different parties.
  - Boards of directors.
  - Auditors.
  - Large shareholders and creditors (banks).
  - Rating agencies.
- Active monitoring requires information and the power to interfere with management (i.e., the exercise of control rights).
- Active monitoring is forward-looking.
- Speculative monitoring aims to "take a picture of the firm".
  - It is backward-looking.
  - It does not aim to increase firm value.
  - It serves to decide whether to increase or decrease investment in the firm.
  - A typical player is a market analyst.
  - It helps to keep managers on their toes.

Board of directors

- The idea of the board is to monitor important strategic management decisions and intervene if necessary in the interest of owners.
- A key problem is the trade-off between competence and independence.
  - Competent board decisions require specific knowledge that only insiders might have.
  - Insiders may lack independence from (former) colleagues and may be forced to assess the results of their own (former) decisions.
- Board members should receive performance-dependent compensation (which they usually do not receive in practice) to align incentives with shareholders.

Investor activism

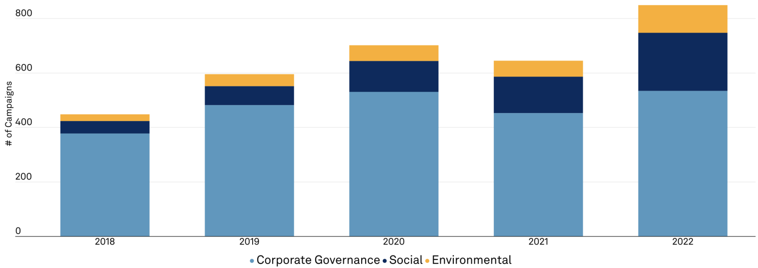
- Investors can invest in monitoring and intervene in strategic decisions, the design of takeover defenses, and the composition of the board.
- Monitoring prevents moral hazard only if it is connected with control rights.
- Large shareholders owning a majority of voting rights can exert control and mitigate moral hazard.

Investor activism cont'd

- In proxy fights, minority shareholders build coalitions to gain a majority of voting rights and exert control.
- However, the efficiency of proxy fights is impaired by communication costs, minority shareholders' own agendas, and related frictions.
- Ownership concentration is important for efficient control.
- Financial institutions are important in concentrating funds and ownership.

Investor activism

Number of campaigns

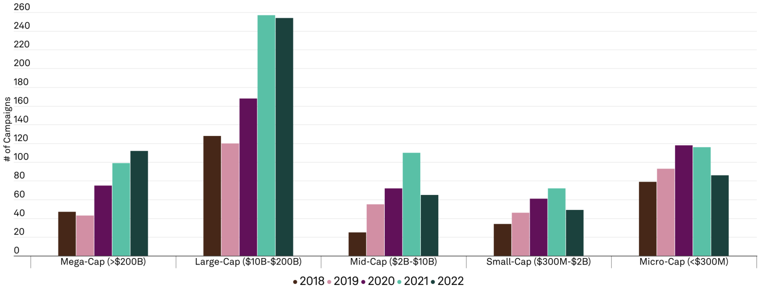


Source: S&P Capital IQ data as of January 1, 2023. Investor Activist campaigns can have multiple objectives tagged.

Source: S&P Global Market Intelligence

Investor activism

Number of campaigns by size



Source: S&P Global Market Intelligence

Investor activism

Activist fund assets under management (Economist, 2015)

Economist.com

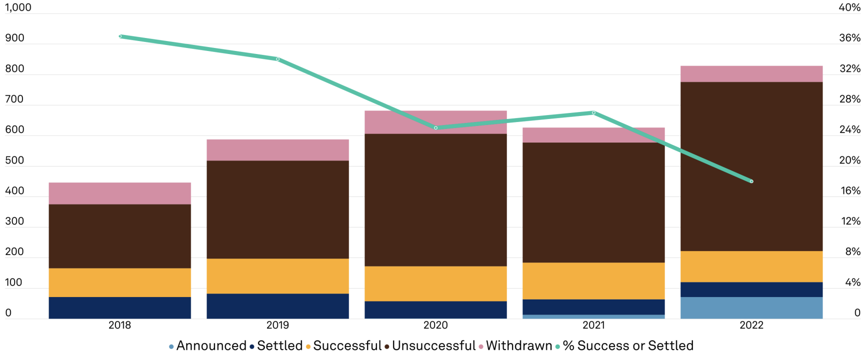
Investor activism

Improvements (Economist, 2015)

Economist.com

Investor activism

Success rate



Source: S&P Capital IQ data as of January 1, 2023.

Source: S&P Global Market Intelligence

Monitoring costs

- Monitoring and exerting control are costly.
- Active monitoring by one owner has positive externalities for other owners.
- Monitoring has the character of a public good, which creates a free-rider problem.
- Ownership concentration mitigates free-rider problems.
- Financial institutions as major shareholders can economize on monitoring costs.
- Higher product market competition makes it easier to judge managers' performance.

Monitoring the monitor

- Having financial institutions (or other firms) as major shareholders only shifts the problem.
- An agency problem arises between owners and managers of the financial institution.
- Given that financial institutions are opaque and, by construction, have dispersed ownership, the problem is even more severe for managers of financial institutions.
- In general, a blockholder might have different interests than minority shareholders and use informational advantages in their own interest.

Takeovers and takeover defenses

Takeover threats keep managers on their toes. However, managers and boards may install effective obstacles and defense measures:

1. Staggered boards allow potential acquirers to replace only a few directors at a time.
2. Supermajority rules for mergers require acquirers to obtain more than 50% of voting rights.
3. Employee stock option plans give voting power to employees, who typically vote with management.
4. Differential voting rights grant additional voting rights to long-term owners.
5. Poison pills allow existing shareholders, in the event of a takeover, to buy additional shares at a discount.
6. Sales of assets that are particularly attractive to acquirers (scorched-earth policy).
7. Management uses corporate funds to buy back raiders' stock blocks at a premium (greenmailing).

Leveraged buyouts (LBO)

- In an LBO, a firm is taken private by allocating its shares to concentrated ownership financed with large amounts of debt.
- This leaves the firm highly leveraged.
- An LBO together with incumbent management is an MBO.
- Advantages:
  - Stronger monetary incentives for management.
  - Stronger incentives for active monitoring by owners.
  - High debt makes managers focus on cost reductions and efficiency improvements to ensure future financing.

Debt as a governance mechanism

- A higher debt-to-equity ratio increases bankruptcy risk and keeps managers on their toes.
- Cash flow is absorbed to repay debt; free cash flow cannot be misused for pet projects and managerial consumption.
- However, (short-term) debt also puts firms' liquidity and ability to finance ongoing projects at risk.
- Bankruptcy generates costs.
  - Direct legal and other expenses.
  - Bankruptcy threats can induce gambling for resurrection.
  - Excessively conservative strategies may arise while debtholders are in control.

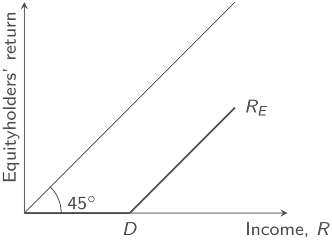
Corporate Financing

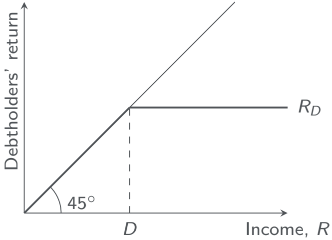
Basic distinction between different claims

Important aspects in corporate finance

1. What are the claims on a firm's future cash flows assigned to (potential) financiers?
2. What are the cash-flow rights associated with the different claims issued?
3. How many different claims should a firm issue to finance its investment?

Basic difference between debt and equity

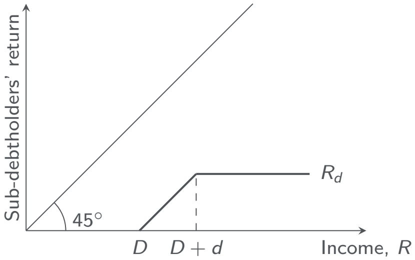




- Equityholders are residual claimants (returns increase 1:1 with performance after debt claims are paid).
- In undercapitalized firms (with a high D), debt can resemble equity.
- Returns on a claim (particularly equity) depend on the holder's information access and ability to exert control.
- Debt claims can be secured or unsecured.
- The dichotomy is oversimplifying; there is a range of in-between claims.

Mezzanine finance

- Subordinated (junior) debt is served only after senior debtholders are repaid.
- Preferred stock pays a fixed dividend before common stockholders receive dividends.



Multiple layers in claims' priority structure (from left to right).

Convertible debt

Convertibles are particularly important for heavily indebted firms

- The holder has the option to convert the debt claim into stock at a predetermined rate.
- The holder will do so if it is beneficial.
- Convertibles protect debtholders against excessive risk-taking by the firm.
  - Holders participate in upside gains from risky investments.
  - However, they do not participate in downside risk as much as stockholders.
  - Stockholders have fewer incentives for excessive risk-taking and gambling for resurrection.

Characteristics of debt instruments

Debt contracts typically specify:

1. Amount lent, interest rate, and repayment schedule.
2. Information provision.
3. Covenants:
   - Affirmative covenants force borrowers to take some actions.
     - Pursue certain investments with the loan.
     - Hedge key risks (exchange rates, . . .).
   - Negative covenants prohibit certain actions by the borrower.
     - Prohibit large payments to shareholders and overly generous transfer pricing.
     - Prohibit the issuance of further debt claims.
     - Prohibit entering new business lines.
4. Default: circumstances under which the lender can terminate lending, ...

Characteristics of debt instruments cont'd

- Liquidity and tradability of debt contracts.
  - Securitized debt claims are tradable in a secondary market.
  - A debt claim is tradable and liquid if informational asymmetries are sufficiently contained.
  - If potential buyers are too concerned about adverse selection, the secondary market fails.
- Debt contracts differ in their maturity, i.e., the time to the final repayment.
  - Short-term debt: short-term credit, loan commitments and lines of credit, commercial paper, and trade credit.
  - Long-term debt: bank loans, corporate bonds, and privately placed debt.
  - Short-term debt forces firms to continuously seek new funds.

Sum-up.

- The corporate bond market exists only for sufficiently transparent firms.
- Opaque firms are financed by bank loans or privately placed debt; here, financiers must invest in information, which makes claims less liquid.

Dichotomy of debtholders

Two structures on the lending side

1. Concentration of debt claims among a few well-informed creditors.
   - Typically, bank loans or privately placed debt.
   - More intensive screening.
   - Relationship lenders monitor covenants.
   - Concentration facilitates renegotiation in default.
2. Dispersed ownership of debt claims.
   - Typically securitized debt, such as commercial paper and bonds.
   - Tradable debt claims usually involve only a few covenants.
   - Coordination problems arise if debt restructuring becomes necessary.

Equity financing

Venture capital financing

- Financing of start-ups.
- Venture capitalists invest heavily in information gathering (screening and monitoring).
- Venture capitalists obtain extensive control rights.

Initial public offerings

- Shares of a privately held company are offered for the first time.
- Benefits (diversifying equity, reducing the hold-up problem, etc.) trade off against costs (transaction costs, information provision, loss of control rights, etc.).

Seasoned public offerings

- Publicly traded companies issue new shares.
- Announcements of new share issuance are associated with negative abnormal returns.
- In contrast, bank loan announcements are associated with positive abnormal returns.

Payout policy

- Dividend payouts attract capital.
- Issuing new claims to new investors is costly (transaction costs and information frictions).
- Trade-off: retain earnings within the firm to support continuation and growth vs. pleasing investors with dividend payouts.
- Some empirical observations:
  - Growth opportunities are correlated with lower payout ratios.
  - Due to serial correlation in profits and their signaling of future profitability, medium-term payout ratios are lower.
  - Financially constrained firms must try harder to attract funds and therefore have higher payout ratios.

Financing structures

- Bank finance is countercyclical: large firms use bond financing in booms and have to turn to bank loans in downturns.
- Strong firms provide trade credit in recessions to weaker firms.
- Financing of small and medium-sized firms and firms with higher leverage is more severely affected by downturns and banking crises.
- Equity issuance is more frequent in upswings and stock market booms.

Reasons:

- Marginal product of capital is high in upswings, ...
- . . . making new investment more attractive and more often financed with new equity.
- Adverse selection is lower in upswings, ...
- . . . because in booms funding demand is driven by new profitable investment opportunities.
- Managers take advantage of irrational exuberance in booms.

$\Rightarrow$ Leverage decreases in upswings.

$\Rightarrow$ Negative announcement effects are smaller in upswings.

A Basic Model for Analyzing Incentives in Corporate Finance

Goal of the lecture

- To introduce the basic corporate finance model used in this class.
- To understand the modeling approach and some basic terminology.
- To highlight why moral hazard (this section) and asymmetric information (next section) matter for corporate finance.

What is a model?

`Economic models are conceptual frameworks that aid in understanding, describing, and/or predicting human behavior [and economic systems].`

Gabaix and Laibson (2008)

- A model is a description of the world.
- Most models rely on assumptions that are only approximately true (and exactly false).
  - For example, the most commonly used models of the earth (maps) are flat and do not account for bumps and grooves.
  - Tourists who use a flat subway map do not need all the details.

What properties should a good model have?

The seven properties of good models (**Gabaix and Laibson, 2008**)

1. Parsimony: simple, with relatively few special assumptions.
2. Tractability: easy to analyze.
3. Conceptual insightfulness: reveals fundamental properties of behavior or systems.
4. Generalizability: applies to many situations.
5. Falsifiability: makes nontrivial predictions that can, in principle, be empirically falsified.
6. Empirical consistency: broadly consistent with the empirical data.
7. Predictive precision: precise, strong predictions.

$\Rightarrow$ Successful economic models satisfy most of these properties, although almost none satisfy all of them.

Readings

- Gabaix and Laibson (2008).
- Tirole (2006), Sections 3.1–3.2.4 (pp. 113–121).
- Check the book website's "Errata" for pp. 120–121.

First considerations

`A would-be borrower is said to be rationed if he cannot obtain the loan that he wants even though he is willing to pay the interest that the lenders are asking, perhaps even a higher interest.` (Bester and Hellwig, 1987).

- Principal–agent problem: the borrower* can take a hidden action $\rightarrow$ moral hazard.
  - The borrower can reduce effort and thereby increase private benefits.
  - Low effort increases failure risk and reduces the expected profitability of the investment project.
- If the borrower receives a too-low fraction of the project's return, she cares more about private benefits than about project success.
- This trade-off depends on the size of private benefits and on the consequences of high vs. low effort.

* The terms "entrepreneur", "managing owner", "borrower", "he", and "she" are used interchangeably.

Assumptions

Project

- Two-period economy: investment at $t = 0$ with returns at $t = 1$.
- The entrepreneur has a risky investment project with fixed scale I at $t = 0$.
- The entrepreneur has assets (cash/net worth) A with $A < I$.
  - To finance the project, the entrepreneur must borrow $I - A$.
- If the project succeeds, the verifiable return is R; otherwise, it is 0.
- Effort is non-verifiable.
  - With high effort, success probability is p_H.
  - With low effort, success probability is p_L, where $\Delta p = p_H - p_L > 0$.
  - Low effort yields a private benefit B (moral hazard).
- The project is only viable (positive NPV) under high effort.
  - $p_H R - I > 0$.
  - $p_L R - I + B < 0$.

Assumptions cont'd

Preferences

- The entrepreneur and potential lenders are risk-neutral.
- The risk-free rate is zero (no time preference).

Loan agreement

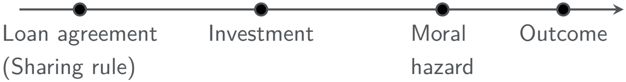
- The loan agreement specifies how returns are shared between borrower and lender.
- $R = R_b + R_l$.
- Limited liability implies $R_b \geq 0$ and $R_l \geq 0$.
- Lenders are competitive: expected profit is zero if the contract induces high effort.

$$p_H R_l = I - A.$$

- The implied default premium (interest factor) is $R_l = (1 + \iota)(I - A)$, so $1 + \iota = 1/p_H$.

Timing

Timeline



Problem

- Under which conditions will the project be financed and implemented?

Approach

- The borrower must refrain from moral hazard $\rightarrow$ incentive compatibility constraint.
- Lenders must be willing to fund the project $\rightarrow$ participation constraint.

Incentive compatibility constraint

Incentive compatibility constraint (IC_b)

The borrower "behaves" (chooses high effort) if:

$$\begin{aligned} p_H R_b &\geq p_L R_b + B, \\ \Delta p \, R_b &\geq B. \end{aligned}$$

Thus, the *pledgeable income* (the amount that can be promised to lenders without breaking incentives) satisfies:

$$\begin{aligned} \Delta p(R - R_l) &\geq B, \\ R_l &\leq R - \frac{B}{\Delta p}. \end{aligned}$$

Lenders' individual rationality constraint

Lenders' individual rationality constraint (IR_l)*

The lender breaks even if:

$$p_H R_l \geq I - A.$$

Using the maximum pledgeable income $R_l = R - \frac{B}{\Delta p}$ yields:

$$p_H \left(R - \frac{B}{\Delta p} \right) \geq I - A.$$

Equivalently:

$$A \geq \overline{A} = p_H \frac{B}{\Delta p} - (p_H R - I).$$

* Also called the "break-even constraint" or "participation constraint".

Interpretation

$$A \geq \overline{A} = p_H \frac{B}{\Delta p} - (p_H R - I).$$

Credit rationing

- The borrower must have sufficient assets to obtain a loan, as determined by the threshold $\overline{A}$.
- If the borrower lacks sufficient assets (cash/net worth), the project is not financed.
- The borrower cannot promise lenders a higher success-state return because lenders then anticipate shirking (low effort).
- Therefore, if $A < \overline{A}$, the borrower is credit-rationed.

Interpretation cont'd

$$A \geq \overline{A} = p_H \frac{B}{\Delta p} - (p_H R - I).$$

Determinants of credit rationing

- What is the impact of B?
- What is the impact of p_H and p_L?
- What is the impact of the project's NPV?

Agency rent

- $p_H \frac{B}{\Delta p}$ is the *agency rent*: the minimum expected return left to the borrower to preserve incentives.
- Thus, $\overline{A} = \textit{agency rent} - \textit{NPV}$.

Interpretation cont'd

$$A \geq \overline{A} = p_H \frac{B}{\Delta p} - (p_H R - I).$$

Borrower's payoffs

- Because lenders break even, the borrower receives the full NPV if the project is financed, and zero otherwise.

$$U_b = \begin{cases} 0, & \text{if } A < \overline{A}, \\ p_H R - I, & \text{if } A \geq \overline{A}. \end{cases}$$

- This implies that one unit of assets can be worth more than one unit to the borrower if it helps overcome credit rationing.

Conclusion

- If the entrepreneur's own stake (A) is small, she may value private benefits (B) more than the project's expected return ($p_H R$).
- Anticipating moral hazard, lenders may refuse financing unless incentives are strong enough.

Check up

Quizzes:

- Basic Model I
- Basic Model II
- Basic Model III

Asymmetric Information

Goal of the lecture

- To understand basic corporate financing problems arising from asymmetric information.
- How can asymmetric information lead to market breakdown and cross-subsidization?

Readings

- Tirole (2006), Sections 6.1–6.2 (pp. 237–249).

Agency problems

Moral hazard and asymmetric information

- So far, we focused on moral hazard problems.
  - For example, the borrower can take actions that yield private benefits but reduce the expected value of the project.
- Several empirical findings are hard to explain with moral hazard alone.
  - For example, announcements of secondary equity offerings typically lead to negative stock price reactions.
  - Firms seem to prefer "internal finance" (retained earnings) and low information-sensitive claims (debt) to finance new projects, as stated by the pecking-order hypothesis.
- Such findings can often be better explained by asymmetric information between insiders and investors.
  - Investors have imperfect knowledge of the firm's prospects, the value of assets, or other firm characteristics affecting investment profitability.
  - Investors therefore worry about buying overvalued claims.

Assumptions

- Entrepreneurs have no funds ($A = 0$) to finance a project costing I.
- The project yields R if it succeeds and 0 if it fails.
- Entrepreneurs and investors are risk-neutral, and the interest rate is zero.
- Investors require only that they can expect to recoup their funds.
- Entrepreneurs can be one of two types: good or bad.
  - A fraction α are good: high expected return, $pR > I$.
  - A fraction $(1 - \alpha)$ are bad: lower expected return, $qR < pR$.
- Two subcases:
  - $pR > qR > I$ (both types are creditworthy).
  - $pR > I > qR$ (only the good type is creditworthy).
- Each entrepreneur's type is private information (not observable to investors).
  - Let $m \equiv \alpha p + (1 - \alpha)q$ denote investors' prior probability of success.

Symmetric information (benchmark)

To set a benchmark, consider financing when investors know the project's prospects.

Good borrower

- The good borrower obtains financing from investors who break even on average:

$$p\left(R - R_b^G\right) = I.$$

- R_b^G is the good borrower's payoff in the success state.

Bad borrower

- If $qR < I$, the bad borrower does not invest because she would receive negative NPV.
- If $qR > I$, the bad borrower obtains financing and receives positive NPV (and typically $R_b^B < R_b^G$).

Asymmetric information

- Under asymmetric information, the bad borrower can mimic the good borrower.
- For simplicity, consider contracts with $R_b \geq 0$ in success and 0 in failure (limited liability).
- Investors' expected profit is:

$$[\alpha p + (1-\alpha)q](R - R_b) - I = m(R - R_b) - I.$$

Market breakdown / no lending: $mR < I$

- Limited liability implies $R_b \geq 0$.
- Threshold for financing solves:

$$[\alpha^* p + (1-\alpha^*)q](R - R_b) - I = 0.$$

- If $\alpha < \alpha^*$, no financing occurs: the market breaks down.
- Good borrowers are harmed by bad borrowers because quality cannot be credibly demonstrated.

$\Rightarrow$ Positive-NPV projects may not be realized: underinvestment.

Asymmetric information cont'd

Cross-subsidization / lending: $mR \geq I$

- If $mR \geq I$, investors fund the project and break even on average:

$$
\begin{aligned}
[\alpha p + (1-\alpha)q](R - R_b) &= I, \\
m(R - R_b) &= I, \\
R_b &= R - \frac{I}{m}.
\end{aligned}
$$

- Ex post, investors gain on the good type and lose on the bad type: cross-subsidization.

Asymmetric information cont'd

- The good borrower receives lower compensation in success than under symmetric information:

$$p\left(R - R_b^G\right) = I,$$
$$R_b^G = R - \frac{I}{p}.$$

  - Compare $R_b = R - \frac{I}{m}$ with $p > m$.
- The bad borrower receives higher compensation in success than under symmetric information:

$$q\left(R - R_b^B\right) = I,$$
$$R_b^B = R - \frac{I}{q}.$$

  - Compare $R_b = R - \frac{I}{m}$ with $q < m$.
- If $mR \geq I$ but $qR < I$ (bad type is not creditworthy), pooling and cross-subsidization can lead to overinvestment.

A measure of adverse selection

Pledgeable income

- The condition $mR \geq I$ can be rewritten as:
$$\left[1 - (1-\alpha)\left(\frac{p-q}{p}\right)\right] pR \geq I.$$
- Define a measure of adverse selection:
$$\chi \equiv (1-\alpha)\left(\frac{p-q}{p}\right).$$
- The good borrower's pledgeable income pR is discounted by the presence of bad borrowers.
- This discount mirrors the agency rent under moral hazard:
$$p_H \frac{B}{p_H - p_L}.$$

A measure of adverse selection cont'd

NPV of good borrowers

- The measure χ can represent the cost borne by the good borrower under asymmetric information.
- Instead of receiving the full NPV, $pR - I$, the good borrower receives:

$$\begin{aligned} pR_b &= p\left(R - \frac{I}{m}\right) \\ &= pR - \frac{p}{m}I \\ &= (pR - I) - \frac{\chi}{1-\chi}I. \end{aligned}$$

Check up

Quizzes:

- Asymmetric Information I
- Asymmetric Information II
- Asymmetric Information III

A Short Introduction to Regressions using Investment-Cashflow Sensitivity

Readings

- Section 3.2.7 in Tirole (2006).
- Fazzari et al. (1988, 2000) and Kaplan and Zingales (1997, 2000) on investment–cash-flow sensitivities.
- Huntington-Klein (2021) for an introduction to microeconometrics (especially Chapters 4 and 13).
  - No need to buy the book. It is available here: https://theeffectbook.net.

Regression and ordinary least squares (OLS)

A regression can be written as

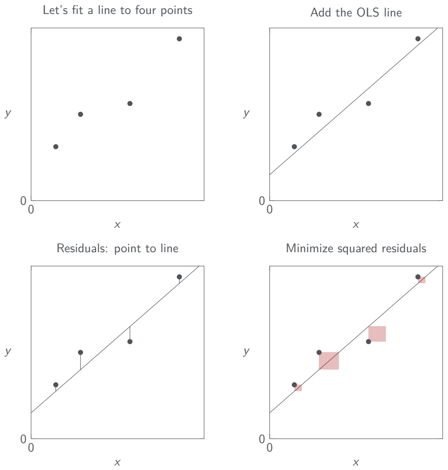
$$y_i = \beta_0 + \beta_1 x_{1,i} + \sum_{k=2}^{K} \beta_k x_{k,i} + \epsilon_i.$$

- y_i is the dependent variable: the variation across individuals $i = 1, \ldots, N$ we want to explain.
- $x_{1,i}$ is the main explanatory variable: we want to estimate the empirical relationship between x_1 and y.
- β_1 is the estimated strength of this relationship.
- $x_{k,i}$ (for $k \geq 2$) are control variables that may also affect y and/or be related to x_1.
- ϵ_i is the error term: the part of the variation in y not explained by the regressors.

Regression OLS cont'd

- A regression fits a shape—often a line—to summarize relationships between variables.
- OLS is the most common line-fitting method.
  - OLS chooses the line that minimizes the sum of squared residuals.

Visualizing line-fitting with OLS



Source: Huntington-Klein (2021)

What is OLS doing to get the slope?

- Use the covariance:

$$\begin{aligned}\mathrm{Cov}(y, x) &= \frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})(x_i - \bar{x}) \\ &= \frac{1}{n^2}\sum_{i=1}^{n}\sum_{j>i}^{n}(y_i - y_j)(x_i - x_j).\end{aligned}$$

- Scale by the variance of x:

$$\text{Slope} = \frac{\mathrm{Cov}(y, x)}{\mathrm{Var}(x)}.$$

- Interpretation: the slope measures how much of the variation in x co-moves with y.
- The intercept is chosen so that the mean residual is zero.

OLS and non-linear relationships

- OLS does not have to fit a straight line in x.
- It needs a model that is linear in the slope parameters (the coefficients).
  - That is, each coefficient multiplies a regressor.
- Examples:
  - $y = \beta_0 + \beta_1 x + \beta_2 x^2$,
  - $y = \beta_0 + \beta_1 \ln(x)$,

  are not straight lines in x, but they are linear in the coefficients.

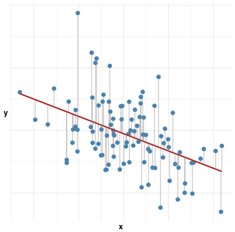
Non-linear regressions

- Sometimes we model

$$y = F(\beta_0 + \beta_1 x),$$

  where $F(\cdot)$ is a (non-linear) link function.
- This is common when y is bounded (e.g., binary outcomes).
- OLS can produce predictions outside feasible ranges (e.g., negative probabilities).
- Logit and probit models address this by mapping $\mathbb{R}$ into $[0, 1]$.

Conditional means



Source: Huntington-Klein (2021)

- A residual is the difference between the observed value and the predicted value (on the fitted line).
- Equivalently: the residual is the part of the variation in y that is unrelated to x (in the fitted linear sense).
- Other variables may explain this remaining variation.

Conditional means cont'd

Consider another variable z. We can isolate the part of the relationship between y and x not explained by z:

1. Estimate $E[y \mid z]$ (run a regression of y on z).
2. Take the residual y^r from this regression.
3. Estimate $E[x \mid z]$ (run a regression of x on z).
4. Take the residual x^r from this regression.
5. Regress y^r on x^r.

This recovers the relationship between y and x holding z fixed (i.e., controlling for z).

Multivariate regression is doing the trick

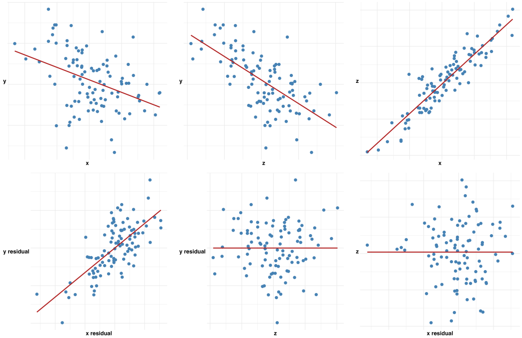
The Frisch–Waugh–Lovell (FWL) theorem says that β_1 from

$$y = \beta_0 + \beta_1 x + \beta_2 z$$

equals the slope from regressing the residualized outcome on the residualized regressor:

$$\begin{aligned} x &= \gamma_0 + \gamma_1 z, \\ \tilde{x} &= x - (\hat{\gamma}_0 + \hat{\gamma}_1 z), \\ y &= \beta_0 + \beta_1 \tilde{x}. \end{aligned}$$

The regression anatomy in a graph



Source: Huntington-Klein (2021)

- The scatterplot "y residual" vs. "x residual" reflects the relationship between y and x after removing the variation explained by z.

p-values

- A common (two-sided) test uses a 5% significance level ($\alpha = 0.05$) for the null hypothesis $\beta = 0$.
- If the probability of observing an estimate at least as extreme as $\hat{\beta}$ under the null is below 5%, we call it statistically significant.
- This probability is the p-value, computed from the sampling distribution of $\hat{\beta}$ (often approximated as normal in large samples).

t-test

- The t-statistic is a convenient significance test:

$$t = \frac{\hat{\beta}}{\mathrm{se}(\hat{\beta})}.$$

- Under large-sample normal approximations, $|t| \geq 1.96$ corresponds roughly to 5% significance (two-sided).

Goodness-of-fit

The R-squared (R^2)

- For each observation: $y_i = \hat{y}_i + \hat{u}_i$.

$$\mathrm{SST} = \sum_{i=1}^{n}(y_i - \bar{y})^2, \qquad \mathrm{SSE} = \sum_{i=1}^{n}(\hat{y}_i - \bar{y})^2, \qquad \mathrm{SSR} = \sum_{i=1}^{n}\hat{u}_i^2.$$

- We have $\mathrm{SST} = \mathrm{SSE} + \mathrm{SSR}$ and define

$$R^2 = \frac{\mathrm{SSE}}{\mathrm{SST}} = 1 - \frac{\mathrm{SSR}}{\mathrm{SST}}.$$

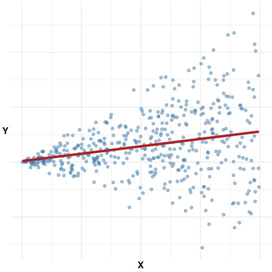
- R^2 lies between 0 and 1 and equals the squared correlation between y_i and $\hat{y}_i$.
- R^2 mechanically weakly increases when adding regressors; adjusted R^2 corrects for this.

Assumptions about standard errors

- A common benchmark assumes the error term is normally distributed.
- Often we also assume errors are independent and identically distributed (i.i.d.).
- These assumptions can fail due to:
  - Autocorrelation (mostly a time-series issue): errors are correlated across observations (e.g., over time).
  - Heteroskedasticity (mostly a cross-sectional issue): the variance of the error term depends on regressors.

Heteroskedasticity

Problem: the variance of the error term changes with values of x. Unadjusted OLS pools variance across the sample (homoskedasticity), which can understate uncertainty.



Source: Huntington-Klein (2021)

- With microdata, heteroskedasticity is often the default case.

Fixing heteroskedasticity

- A common solution uses "sandwich" estimators for standard errors.
- The most prominent is the Huber–White (robust) estimator, which uses squared residuals as observation-specific weights in the variance estimate.
- Practical fix: most software provides robust standard errors (e.g., `robust` in Stata, `HC1` in R).

Consistency

Revisiting important OLS assumptions

To obtain consistent coefficients (converging to the population value as n grows), a regression typically needs:

- $E(u) = 0$.
- $E(u_i \mid x_{1i}, \ldots, x_{Ki}) = 0$ for all regressors $k = 1, \ldots, K$ (equivalently, $\mathrm{Corr}(x_{ki}, u_i) = 0$).
- The sample is drawn randomly from the population.
- No perfect multicollinearity among regressors.
- No (severe) outliers that dominate estimates.

Establishing causality

- The key condition implies:

$$E\left(x_i\left(y_i - x_i'\beta\right)\right) = 0.$$

- That is, the residual $u_i = y_i - x_i'\beta$ is orthogonal to x_i (equivalently $\mathrm{Corr}(x_i, u_i) = 0$).
- OLS chooses β so that sample analogues of these orthogonality conditions hold.
- This is central for interpreting β causally (exogeneity).

The breakdown of the exogeneity assumption

- Our interpretation relies on:

$$E(x_i(y_i - x_i'\beta)) = 0,$$

  which assumes regressors are uncorrelated with the residual.
- OLS enforces orthogonality mechanically in the sample.
- If the population condition fails, i.e.,

$$E(x_i(y_i - x_i'\beta)) \neq 0,$$

  then OLS coefficients are biased (and inconsistent).
- In econometric terms: we have an endogeneity problem.

Biased estimates

- The following simulation illustrates how correlation between x and ϵ biases estimates:
  1. Generate normally distributed x and ϵ for 1,000 observations with different correlations between them.
  2. Construct y as $y = 5 + 2x + \epsilon$ for each sample.
  3. Run $y = \beta_0 + \beta_1 x + \epsilon$ 100 times and summarize estimates.

Cov(x,ϵ)	0		0.1		0.5	
	β_1	β_0	β_1	β_0	β_1	β_0
Mean	2.0033	4.9971	2.1059	5.0018	2.4984	5.0032
se	0.0033	0.0031	0.0029	0.0029	0.0026	0.0027
CI95 up	2.0099	5.0031	2.1117	5.0075	2.5034	5.0085
CI95 low	1.9968	4.9911	2.1002	4.9962	2.4933	4.9978

- Even a 10% correlation between x and ϵ can make $\hat{\beta}_1$ significantly different from the true value 2.

Causes for concerns

- Endogeneity can arise due to:
  - omitted variables,
  - simultaneity,
  - sample selection,
  - measurement error (and functional-form mistakes).
- These mechanisms violate $\mathrm{Corr}(x_k, \epsilon) = 0$.

$\Rightarrow$ Endogeneity implies coefficients do **not** reflect the “true” relationship in the population (i.e., they are inconsistent).

Estimating investment–cash-flow sensitivities

- Firms respond to signals from centralized securities markets.
- Tobin's q-theory suggests that investment is driven by prospects (captured by q).
- In perfect markets, investment should be independent of financing sources.
  - With imperfect markets, internal and external finance are not interchangeable.
  - Investment may depend on internal cash flow (and average tax burdens).

Theoretical framework

- Two types of firms:
  1. Firms with no significant cost disadvantage for external finance.
  2. Firms facing high external financing costs due to asymmetric information (e.g., small or high-tech firms).
- Implications:
  - Internal finance is prioritized, yielding a "financing hierarchy" (pecking order).
  - Taxes can affect marginal and average investment costs differently across firms.

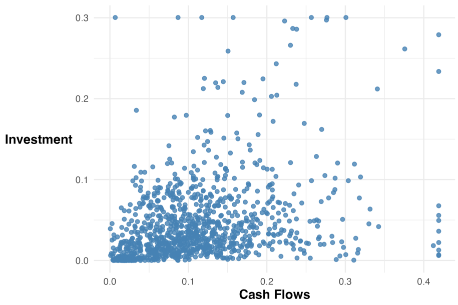
The supply of finance and investment

- **Perfect markets**
  - Firms finance any positive-NPV project, regardless of cash flow.
  - Dividend policy and investment are independent.
- **Imperfect markets**
  - Internal funds can be cheaper due to asymmetric information.
  - External finance may carry a "lemons premium," increasing financing costs.
  - Firms may reject positive-NPV projects to avoid costly equity or debt issuance.
- **Resulting hierarchy**
  - Internal finance $\rightarrow$ Debt $\rightarrow$ Equity.
  - For some firms, investment is constrained by internal finance availability.
  - Constrained firms may exhibit higher investment–cash-flow sensitivity.

Using U.S. corporate finance data

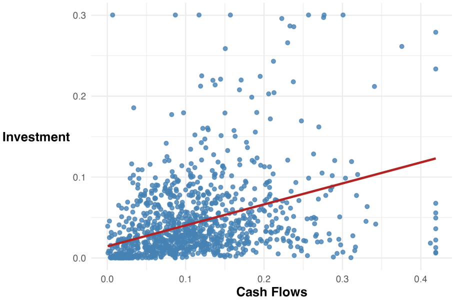
- Tidy Finance provides code to download security and accounting data in R.
  - Caveat: You need access to WRDS.
  - Alternatively, there is code to download data via Yahoo Finance.

Cash flows and investment



- Firm-level means over 2010–2023.
- Random 5% subsample to improve readability.

Cash flows and investment



- The regression line indicates a positive correlation.

The regression equation

$$\text{Investment}_{i,t} = \beta_0 + \beta_1 \text{Cash-Flow}_{i,t} + \beta_2 \text{Tobin's } q_{i,t} + \epsilon_{i,t}.$$

- i indexes firms and t indexes years.
- Sample: about 5,800 firms over 2010–2023; the average firm is observed for 6.4 years.
- Investment: capital expenditures scaled by (lagged) total assets.
- Cash flow: operating cash flow scaled by (lagged) total assets.
- Tobin's q: market-to-book value of equity.
- Under q-theory, Tobin's q should be the key predictor of investment.

The regression equation cont'd

$$\text{Investment}_{i,t} = \beta_0 + \beta_1 \text{Cash-Flow}_{i,t} + \beta_2 \text{Tobin's } q_{i,t} + \epsilon_{i,t}.$$

- β_0 is the intercept (the predicted investment when all regressors equal zero).
- β_1 measures how Investment changes when Cash-Flow increases by one unit, holding Tobin's q fixed.
- β_2 measures how Investment changes when Tobin's q increases by one unit, holding Cash-Flow fixed.
- $\epsilon_{i,t}$ captures variation in Investment not explained by the regressors.

Descriptive statistics

				Percentiles			
Variable	Mean	SD	Min	5th	50th	95th	Max
Investment	0.03	0.05	0.00	0.00	0.02	0.14	0.30
Cash-Flow	-0.02	0.31	-1.78	-0.59	0.05	0.24	0.42
Tobin's q	2.01	1.63	0.56	0.83	1.41	5.39	10.00
37,138 observations							

- A one-unit change is large for Cash-Flow; a one-standard-deviation change (0.31) is often more interpretable.

Investment seems to depend on internal finance

	(1)	(2)	(3)
Dependent variable:	Investment	Cash-Flow	Investment
Intercept	0.030***	0.048***	0.036***
	(0.000)	(0.003)	(0.000)
Cash-Flow	0.032***		
	(0.001)		
Tobin's q	0.003***	-0.032***	
	(0.000)	(0.002)	
Cash-Flow (residual)			0.032***
			(0.001)
Observations	37,138	37,138	37,138
Adj. R^2	0.040	0.029	0.036

- Comparing firms with low vs. high Cash-Flow, firms with more cash flow invest more on average, controlling for prospects (Tobin's q).
- Economic magnitude: a 1 SD increase in Cash-Flow (0.31) implies $0.31 \times 0.032 \approx 0.010$ higher investment.
- Relative to mean investment 0.03, this is about a 33% increase.

Firm prospects correlate with higher investment too

	(1)	(2)	(3)
Dependent variable:	Investment	Cash-Flow	Investment
Intercept	0.030***	0.048***	0.036***
	(0.000)	(0.003)	(0.000)
Cash-Flow	0.032***		
	(0.001)		
Tobin's q	0.003***	-0.032***	
	(0.000)	(0.002)	
Cash-Flow (residual)			0.032***
			(0.001)
Observations	37,138	37,138	37,138
Adj. R^2	0.040	0.029	0.036

- Firms with higher Tobin's q (better prospects) invest more, controlling for cash flow.
- A 1 SD increase in Tobin's q (1.63) implies $1.63 \times 0.003 \approx 0.0049$ higher investment.
- Relative to mean investment 0.03, this is about a 17% increase.

Regression anatomy revisited

	(1)	(2)	(3)
Dependent variable:	Investment	Cash-Flow	Investment
Intercept	0.030***	0.048***	0.036***
	(0.000)	(0.003)	(0.000)
Cash-Flow	0.032***		
	(0.001)		
Tobin's q	0.003***	-0.032***	
	(0.000)	(0.002)	
Cash-Flow (residual)			0.032***
			(0.001)
Observations	37,138	37,138	37,138
Adj. R^2	0.040	0.029	0.036

- Column (2) shows a significant negative correlation between Tobin's q and Cash-Flow.
- Residualizing Cash-Flow with respect to Tobin's q isolates the variation in Cash-Flow not explained by q.
- Column (3) shows the coefficient on Cash-Flow (residual) matches Column (1), as implied by FWL.

⇒ Adding controls removes shared variation; coefficients reflect the relationship net of other regressors.

Do cash-flow sensitivities indicate financial constraints?

- Fazzari et al. (1987); Fazzari and Athey (1987); Fazzari et al. (1988) argue “yes”: firms with lower dividend payouts (a proxy for constraints) show higher investment–cash-flow sensitivities.
- Kaplan and Zingales (1997) finds non-monotonic patterns across groups labeled “financially constrained”.
- In some samples, non-constrained firms show higher sensitivities, suggesting sensitivities are not a clean proxy for constraints.
- The debate in Fazzari et al. (2000) and Kaplan and Zingales (2000) did not settle the issue.
- For example, Chen and Chen (2012) document a decline in sensitivities from about 0.3 (1970s) to about 0.03 (2010s), and that sensitivities were absent during the 2007–09 credit crunch.

The basic model as a guide

- Firms whose investment rises strongly with a small increase in cash flow are the marginal firms: those with A just below $\bar{A} = I - \rho_0$ (where ρ_0 is pledgeable income).
- Firms with more cash or lower agency costs may already be unconstrained and thus adjust investment little.
- Suppose firms are heterogeneous in two dimensions: A and ρ_0.
- Let $G(A)$ be the cumulative distribution of cash, with density $g(A)$.
- Since firms receive financing when $\rho_0 \geq I - A$, aggregate investment among firms with pledgeable income ρ_0 is:

$$P(\rho_0) \equiv [1 - G(I - \rho_0)]\, I.$$

The basic model as a guide cont'd

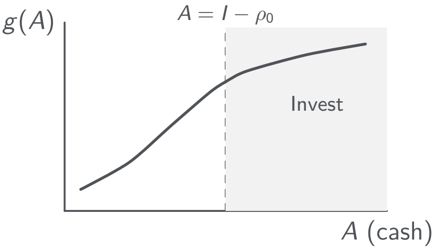
$$P(\rho_0) \equiv [1 - G(I - \rho_0)]\, I.$$

- Consider a small uniform increase in cash, ∂A, for all firms. Investment among firms with pledgeable income ρ_0 rises by:

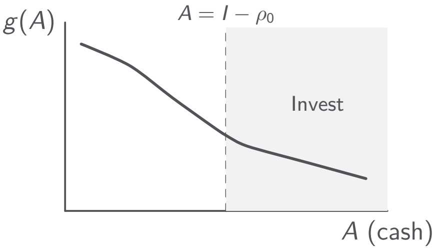
$$\partial P(\rho_0) = g(I - \rho_0)\, I\, \partial A, \qquad \frac{\partial}{\partial \rho_0}(\partial P(\rho_0)) = -g'(I - \rho_0)\, I\, \partial A.$$

- If the density is decreasing ($g' < 0$), sensitivity is higher for firms with low agency costs (high ρ_0), as in Kaplan and Zingales (1997).
- If the density is increasing ($g' > 0$), sensitivity is higher for firms with high agency costs (low ρ_0), as in Fazzari and Athey (1987); Fazzari et al. (1987).

Cash-flow sensitivity: what happens at the cutoff?



$g'(A) > 0$ **near cutoff**



$g'(A) < 0$ **near cutoff**

- A small cash-flow increase shifts firms right by ΔA.
- Investment rises more when many firms are close to the cutoff.

$$P(\rho_0) = [1 - G(I - \rho_0)]\, I \qquad \Rightarrow \qquad \partial P(\rho_0) = g(I - \rho_0)\, I\, \partial A.$$

Conclusion of the mechanics

- **Consider a small, uniform increase in cash flow for all firms** — think of an unexpected earnings shock $\Delta A > 0$.
- **Which firms start investing because of that shock?**
- **Only firms right at the margin:** those clustered around the financing cutoff

$$A = I - \rho_0,$$

where ρ_0 is pledgeable income.
- **Aggregate investment responds more** when *many firms* are located near that margin.
- This is captured by the **density at the cutoff**:

$$\partial P(\rho_0) = g(I - \rho_0)\, I\, \partial A.$$

Key insight (two cases):

- If $g'(A) < 0$ near the cutoff (many firms already have high cash), investment sensitivity is higher for **low agency-cost** firms (high ρ_0). *Kaplan–Zingales case.*
- If $g'(A) > 0$ near the cutoff (many firms bunched at low cash), investment sensitivity is higher for **high agency-cost** firms (low ρ_0). *Fazzari–Hubbard–Petersen case.*

Conclusion: The same positive investment–cash-flow sensitivity can reflect very different underlying structures; without knowledge of the joint distribution of cash and agency costs, sensitivities alone do *not* cleanly identify financial constraints.

Event studies

Readings

- MacKinlay (1997) for starters.
- See also Chapter 17 of Huntington-Klein (2021).

Event studies in stock markets

In (semi-strong form) efficient markets, stock prices reflect publicly available information; therefore, prices should react when economically relevant news arrives.

- **Key idea:** compare observed returns to a counterfactual "normal" return model.
- **Steps.**
  1. Choose an estimation window (well before the event) and estimate a model for normal returns.
  2. Use that model to predict normal returns in the event window.
  3. Compute abnormal returns as the difference between realized and predicted returns.

Models for "normal" returns

Let the simple return be

$$r_{it} = \frac{p_{it} - p_{i,t-1}}{p_{i,t-1}}$$

for firm i on day t. Common choices for predicted (normal) returns $\hat{r}_{it}$ are:

- **Mean-adjusted returns:** $\hat{r}_{it} = \bar{r}_i$ (average return in the estimation window).
- **Market-adjusted returns:** $\hat{r}_{it} = r_{mt}$.
- **Risk-adjusted (market) model:**

$$\begin{aligned} r_{it} - r_{ft} &= \alpha_i + \beta_i \left(r_{mt} - r_{ft} \right) + \varepsilon_{it}, \\ \Rightarrow \quad \hat{r}_{it} &= r_{ft} + \hat{\alpha}_i + \hat{\beta}_i \left(r_{mt} - r_{ft} \right). \end{aligned}$$

Abnormal returns

- **Abnormal return (AR):**

$$AR_{it} = r_{it} - \hat{r}_{it}.$$

- **Cumulative abnormal return (CAR)** over an event window $t \in [\tau_1, \tau_2]$:

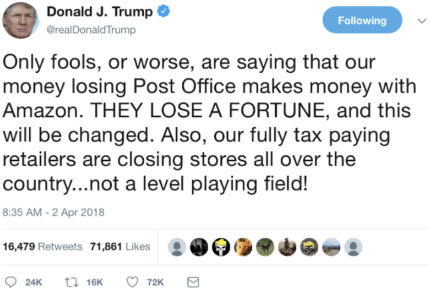
$$CAR_i(\tau_1, \tau_2) = \sum_{t=\tau_1}^{\tau_2} AR_{it}.$$

- Interpretation: AR_{it} isolates the part of the return attributable to the event, relative to the chosen counterfactual model.

Example events in corporate finance

- Mergers and acquisitions: Mulherin et al. (2017).
- Earnings announcements: Savor and Wilson (2016).
- IPOs: Ritter (1991); Ritter and Welch (2002).
- Seasoned equity offerings: Carlson et al. (2006).

Trump attacks on corporate America



- For more details, see: ashgreat.github.io.

Trump attacks on corporate America cont'd

Company	Symbol	Date attacked
Amazon	AMZN	2018-04-02
Boeing	BA	2016-12-06
Delta	DAL	2017-01-30
General Motors	GM	2017-01-03
Lockheed Martin	LMT	2016-12-22
Merck	MKGAF	2017-08-14
New York Times	NYT	2017-02-17
New York Times	NYT	2017-01-28
Nordstrom	JWN	2017-02-08
Toyota	TM	2017-01-05

Using the market model to predict daily returns

A standard specification is the CAPM-style market model:

$$r_{it} - r_{ft} = \alpha_i + \beta_i \left(r_{mt} - r_{ft}\right) + \varepsilon_{it}.$$

- r_{it}: daily return of firm i.
- r_{mt}: daily market return (e.g., S&P 500).
- r_{ft}: daily risk-free rate.
- Estimating the model for each firm yields:
  - firm-specific (idiosyncratic) component α_i,
  - market sensitivity β_i.

More sophisticated: three-factor model

Fama and French (1993) proposed:

$$r_{it} - r_{ft} = \alpha_i + \beta_i \left(r_{mt} - r_{ft}\right) + \lambda_i \, SMB_t + \gamma_i \, HML_t + \varepsilon_{it}.$$

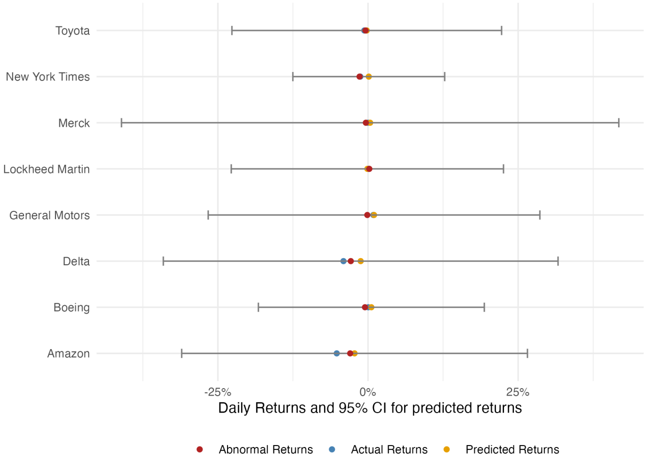
- SMB_t: excess return of small versus big firms.
- HML_t: excess return of high book-to-market ("value") versus low book-to-market ("growth") firms.

Procedure

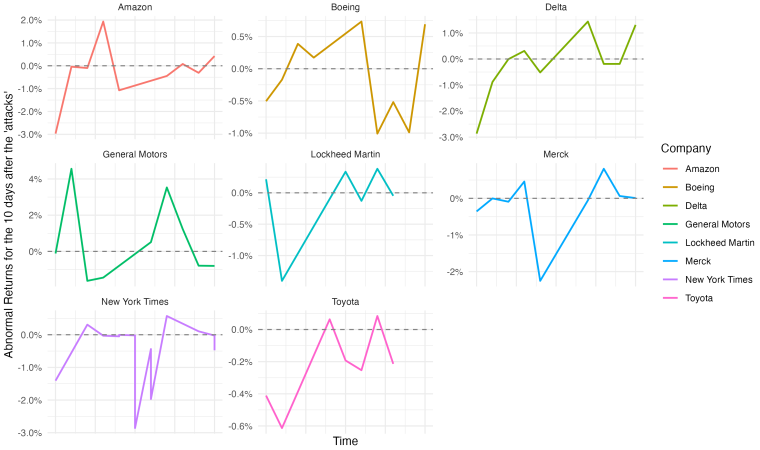
1. Estimate a return model for each firm using a sufficiently long estimation window.
   - The event day(s) should not be included.
2. Predict normal returns for the event window (event day and surrounding days).
3. Compute abnormal returns in the event window:

   $\Rightarrow$ $AR_{it} = r_{it} - \hat{r}_{it}$.
   - The model-based prediction provides the counterfactual: what returns would have been without the event.

Returns around the "Trump attacks"



Abnormal returns for a 10-day period



Overborrowing and Debt Overhang

Readings

- Tirole (2006), Sections 6.1–6.2 (pp. 119–126).
- Wittry (2021).

Dilution and overborrowing

It can be observed in practice that loan contracts sometimes include negative covenants that prohibit the issuance of new securities (loans).

- Why is this the case?

Two potential reasons

1. If new debt is not junior, it reduces the recovery ratio in the case of default.
2. The issuance of new securities may change borrower incentives and thereby reduce the size of the pie.

$\Rightarrow$ The following example addresses the second reason.

Assumptions

Initial loan contract between borrower and initial lender

New loan contract

- An additional (deepening) investment opportunity becomes available.
- If an additional amount J is invested, the success probability of the project increases by τ (independent of effort).
- Deepening investment has negative NPV (direct costs):

$$C_1 \equiv J - \tau R > 0.$$

- Deepening investment becomes available before the entrepreneur chooses effort.
- Deepening investment increases private benefits from shirking to $B' > B$, but shirking remains inefficient.
- If the investment induces shirking, incentive costs arise:

$$C_2 \equiv \Delta p R - B'.$$

- The initial lender is not formally diluted (R_l unchanged). Borrower reallocates R_b between herself ($\hat{R}_b$) and new lenders ($\hat{R}_l$).

Timing

Borrower has wealth A and borrows $I - A$ from initial lenders.

Contract allocates return R between borrower (R_b) and lenders (R_l).

Borrower can contract with new lenders to finance deepening investment J.

Borrower allocates R_b between herself ($\hat{R}_b$) and new lenders ($\hat{R}_l$).

Moral hazard: Entrepreneur behaves ($p = p_H$, no private benefit) or misbehaves ($p = p_L$, private benefit B).

Outcome: success with probability p (or $p + \tau$) or failure with probability $1 - p$ (or $1 - (p + \tau)$).

Problem

- Under which conditions will the borrower undertake the additional (inefficient) investment?

Approach

- The borrower must profit from the additional investment.
- New lenders must be willing to fund the additional investment.

Analysis

Entrepreneur's incentives

- Since the entrepreneur pays the cost of the inefficient investment out of her own repayment $\hat{R}_b$, she will only undertake it if it becomes beneficial for her to save on effort after pursuing the deepening investment, i.e., if

$$(p_L + \tau)\hat{R}_b + B' > p_H R_b.$$

Break-even condition for new investors

- Given competition among lenders, the repayment for financing the deepening investment must satisfy

$$(p_L + \tau)\hat{R}_l = J.$$

Analysis cont'd

- Using the payoff distribution,

$$\hat{R}_l + \hat{R}_b = R_b,$$

  and the lenders' break-even condition,

$$(p_L + \tau)\hat{R}_l = J,$$

  the condition for the deepening investment to be financed and undertaken,

$$(p_L + \tau)\hat{R}_b + B' > p_H R_b,$$

  becomes

$$(p_H - (p_L + \tau))R_l > J - \tau R + (p_H - p_L)R - B'.$$

Interpretation

$$\underbrace{(p_H - (p_L + \tau))R_I}_{\text{negative externality}} > \underbrace{J - \tau R}_{C_1 = \text{negative NPV}} + \underbrace{(p_H - p_L)R - B'}_{C_2 = \text{incentive costs}}.$$

- The loss of value for initial investors (left-hand side) must exceed the total costs of refinancing (right-hand side).
- The larger R_I for a given R, the larger is the fraction of extra returns from behaving that goes to the lender.
  - Incentives to behave are weaker at the margin.
  - The borrower benefits more from the new investment.
- The smaller the entrepreneur's stake A in the firm, the larger R_I, and thus the stronger the incentive to *overborrow*.

Debt overhang

- Starting with Myers (1977), many contributions study situations in which a borrower is debt-ridden and cannot raise funds for an otherwise profitable project.
- The borrower is then said to suffer from debt overhang.
- Our framework suggests two interpretations:
  1. Decrease in net worth.
  2. Lack of renegotiation.

Decrease in net worth

- The borrower may have a positive-NPV project that would be financed absent previous debt, but is denied financing due to such an obligation.
- Suppose that:
  1. The entrepreneur has A in cash or collateral but owes D from previous borrowing to initial investors.
  2. Initial investors imposed a covenant specifying that the borrower cannot raise more funds without their consent.
  3. The borrower's assets A are pledged to initial investors as collateral in the case of default.

Decrease in net worth cont'd

- If $A > \bar{A} > (A - D) \geq 0$, the project is not undertaken, since initial and new investors cannot recoup the investment cost $(I - A)$ plus the previous debt obligation D, while initial investors can receive D by seizing the collateral.
- Suppose initial and new investors enter an agreement to finance the project.
  - Since initial investors can secure D by seizing collateral, they must receive expected payment at least D under any agreement.
- Pledgeable income is

$$p_H\left(R - \frac{B}{\Delta p}\right) - I.$$

- New investors obtain at most

$$p_H\left(R - \frac{B}{\Delta p}\right) - I - D + A = A - D - \bar{A} < 0,$$

which contradicts that rational investors must at least break even.

Lack of renegotiation

Suppose that:

1. The project is sufficiently profitable to attract funds even if the borrower has zero net worth: $\bar{A} < 0$.
2. The borrower has a long-term loan and must reimburse D "at the end," when the project's outcome occurs.
3. This long-term debt is contractually senior to any new claim.
4. The borrower has no cash: $A = 0$.
5. Debt overhang is sufficiently serious that it cannot be overcome by expected profitability:

$$\bar{A} + p_H D > 0.$$

Lack of renegotiation cont'd

- Because the borrower has no cash, initial investors receive nothing if the project is not financed.
- They are willing to participate as long as they break even on the new investment.
- They can forgive existing debt, finance I, and demand the entire external cash-flow rights $R - \frac{B}{\Delta p}$ in the case of success:

$$p_H\left(R - \frac{B}{\Delta p}\right) - I = -\bar{A} > 0.$$

- The borrower is willing to accept, obtaining rent $p_H \frac{B}{\Delta p}$ in expectation rather than 0 if the project is not financed.

Lack of renegotiation cont'd

- Initial investors have no cash and cannot directly finance I.
- Are new investors willing to finance the project?
- Since the initial debt is senior and the borrower must keep a minimum stake to commit to behave, the maximal pledgeable income in the case of success is
$$R - \frac{B}{\Delta p} - D.$$
- New investors finance the project if and only if
$$p_H\left(R - \frac{B}{\Delta p} - D\right) \geq I,$$
or equivalently,
$$\bar{A} + p_H D \leq 0,$$
which contradicts assumption 5.

Lack of renegotiation cont'd

Conclusion so far

- The borrower cannot raise funds from new investors unless she renegotiates some debt forgiveness from initial investors.
- If renegotiation is infeasible, gains from trade between the borrower and the investor community may not be realized.
- A renegotiation breakdown creates debt overhang.

Lack of renegotiation cont'd

- Debt overhang is often invoked when initial investors represent corporate bondholders.
- Because bondholders are dispersed, and despite coordination mechanisms (e.g., trustees, exchange offers), renegotiating debt in distress can be difficult.

Lack of renegotiation cont'd

Assume initial investors can act collectively and renegotiate their initial claims.

- Since $\bar{A} < 0$, there exists a renegotiated arrangement agreeable to all parties (borrower, initial investors, new investors), who would all get nothing if no agreement is reached.
- Suppose initial investors reduce face value from D to $d < D$ such that

$$\bar{A} + p_H d = 0.$$

Lack of renegotiation cont'd

- New investors receive
$$R - \frac{B}{\Delta p} - d$$
in the case of success and are willing to invest since
$$p_H\left(R - \frac{B}{\Delta p} - d\right) = I,$$
which is equivalent to their break-even constraint
$$p_H\left(R - \frac{B}{\Delta p}\right) = I - \bar{A}.$$
- Initial investors benefit from forgiving part of their claim, since they now get
$$p_H d = -\bar{A} > 0.$$
- The borrower undertakes the project and obtains rent $p_H \frac{B}{\Delta p} > 0$.

Lack of renegotiation: conclusion

- Debt renegotiation allows the project to be undertaken and all parties to share the gains from trade.
- How gains are shared depends on bargaining power between borrower and initial investors (new investors are competitive and break even).
- The arrangement above is most favorable to initial investors.
- Varying bargaining power generates any level of debt forgiveness from $D - d$ (most favorable to initial investors) to D (least favorable).

Debt overhang: evidence from resource extraction

- Wittry (2021) studies the empirical importance of debt overhang in corporate finance.
- Focus: resource extraction firms and their investment decisions.
- Key idea: compare traditional debt versus mine reclamation liabilities and their effects on investment.

Key feature #1: ex ante NPVs

- Canadian resource extraction firms provide ex ante NPV estimates for new mining projects.
- In 2000, the Ontario Securities Commission increased disclosure requirements for publicly listed mining firms.
  - Firms must file technical reports including project NPV estimates.
- This allows differentiation between positive-NPV project take-up versus delay/forgiveness.

Key feature #2: two types of liabilities

Traditional debt

- Overhang distortions from traditional debt can often be mitigated at relatively low cost:
  - Avoiding debt altogether.
  - Issuing short-maturity debt.
  - Renegotiating ex post Myers (1977).
  - Securing debt issuances Stulz and Johnson (1985).

Key feature #2: two types of liabilities cont'd

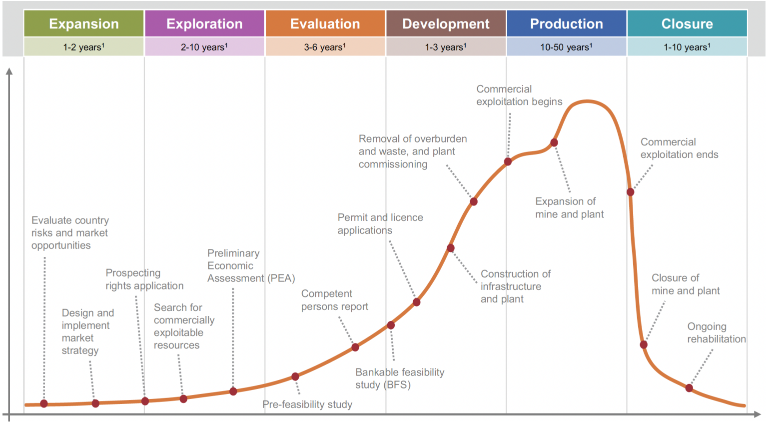
Mine reclamation liabilities

- Standard overhang "solutions" are much more costly for mine reclamation liabilities.
- In particular, projects cannot be financed solely through equity.
  - Extraction mechanically creates reclamation liabilities.
  - It is difficult to shorten maturity or renegotiate these obligations ex post.

Key feature #3: regulation to guarantee reclamation liabilities

- Accepted forms of guarantees vary across jurisdictions.
- Jurisdictions differ in requiring explicit collateral (externally bonded) versus not (self-bonded).
- The paper uses these regulatory differences to separate liabilities into:
  - Treatment group: self-bonded (similar to unsecured debt).
  - Control group: externally bonded (similar to secured debt).

The mining asset life cycle



Source: Wittry (2021)

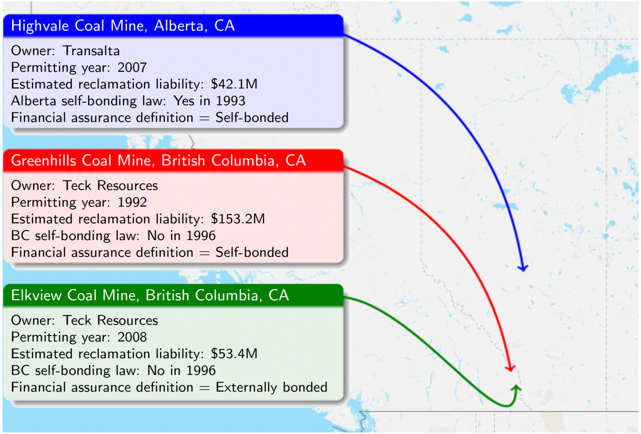
Empirical measures

The ideal setting to test debt overhang uses exogenous variation in the value of a firm's option to default (Merton, 1974).

- Two empirical measures (positively correlated with default option value):
  1. Leverage ratio (debt / market value of assets):
     - Traditional debt.
     - Reclamation liabilities: self-bonded (SB) vs. externally bonded (EB).
  2. Indicator for liabilities exceeding new-project value:

$$\mathbb{1}_{SB \geq NPV} = 1.$$

Identification



Source: Wittry (2021)

Regression and sample

$$Y_{it} = \beta \cdot \text{Leverage Ratio}_{it} + \text{Controls} + \text{Firm and Year FE} + \epsilon_{it}.$$

- Dependent variables:
  - $\mathbb{1}_{\text{firm acquires new mining rights}}$.
  - $\mathbb{1}_{\text{firm starts construction of NPV+}}$.
  - Time between NPV+ report and construction start.
- Sample: Canadian firms listed on TSX/TSXV, 1990–2016.
- Standard errors clustered at the firm level.

Self-bonded liabilities reduce acquisition of mining rights

	$\mathbb{P}$(acquiring new mining rights)	
	All	NPV+
SB/MV	-0.035**	-0.024***
EB/MV	0.003	0.001
Market leverage	-0.057*	-0.026
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	6,747	6,747
Firms	775	775
Adjusted R^2	0.30	0.15

- The SB coefficient is significant and more than ten times larger than EB.

Self-bonded liabilities reduce likelihood of construction start

	$\mathbb{P}$(beginning construction of NPV+ project) (1)	(2)
Debt ratios:		
SB/MV	-0.054***	-0.046**
EB/MV	0.003	0.004
Market leverage	-0.007	-0.041
Overhang indicators:		
$\mathbb{1}_{SB \geq NPV} = 1$	-0.264**	-0.248**
$\mathbb{1}_{EB \geq NPV} = 1$	-0.019	0.008
$\mathbb{1}_{TD \geq NPV} = 1$	-0.034	-0.032
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Primary mineral FE	No	Yes

- ∘ If self-bonded liabilities exceed NPV, construction starts with significantly lower probability.

$\Rightarrow$ Self-bonded reclamation liabilities significantly affect investment decisions.

Self-bonded liabilities increase time to construction start

	Time to construction start	
	(1)	(2)
Debt ratios:		
SB/MV	0.378*	0.670
EB/MV	0.523	0.152
Market leverage	0.934	0.908
Overhang indicators:		
$\mathbb{1}_{SB \geq NPV} = 1$	0.338***	0.467**
$\mathbb{1}_{EB \geq NPV} = 1$	0.759	0.629
$\mathbb{1}_{TD \geq NPV} = 1$	0.978	0.858
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Primary mineral FE	Yes	Yes
Time-varying coefficients	No	Yes

- Reported coefficients are hazard ratios.
- The significant 0.467 suggests that projects with $SB \geq NPV$ begin construction less than half as often at any point in time.
- A linear leverage measure struggles to identify when firms are truly exposed to overhang.

Back-of-the-envelope: delay from Self-bonded liabilities

- Compute the difference in the survival function between $\mathbb{1}_{SB \geq NPV} = 1$ and $\mathbb{1}_{SB \geq NPV} = 0$ at each percentile of construction starts.
- Projects with $SB \geq NPV$ begin construction, on average, 1.9 years later than otherwise similar projects.

Back-of-the-envelope cont'd

- For the median project, constructing nearly two years later, the new NPV is

$$\frac{172}{1.075^{1.9}} = \$149.9 \text{ million.}$$

- Time-value-of-money loss: \$22.1 million.
- Baseline probability of starting construction on a positive-NPV project is 5.01%. Firms with large self-bond liabilities face an expected loss each year of \$1.1 million.
- Present value over 20 years: \$11.28 million (4.11% of market value) for the median-producing firm.

Summary

- Investment is significantly affected by overhang imposed by unsecured (self-bonded) mine reclamation liabilities.
- Traditional debt is largely unrelated to investment in positive-NPV projects in this setting.
- Traditional debt alone imposes few overhang-related investment distortions.
- Resolving debt overhang is critical: the implied shadow costs of ex ante solutions for traditional debt could be as large as 6.34% of firm value.

Check up

Quizzes:

- Debt Overhang and Overborrowing I
- Debt Overhang and Overborrowing II
- Debt Overhang and Overborrowing III

Diversification

Goal of the lecture

- To further explore the basic model based on extensions related to borrowing capacity.
- How does diversification increase borrowing capacity?

Readings

- Tirole (2006), Sections 4.1–4.3.4 (pp. 157–171).
- Hann et al. (2013).

Benefits of diversification

Intuition

- ∘ If projects are less than perfectly correlated, with positive probability some projects succeed while others fail.
- ∘ A borrower running two (or more) projects can cross-pledge project returns: borrow to pursue one project while pledging the managerial rent of the other. If he fails on one project, he also loses his stake in the other.

$\Rightarrow$ Cross-pledging serves as collateral: it strengthens incentives to exert effort and increases financiers' pledgeable return.

$\Rightarrow$ Diversification (if observable by the lender) mitigates agency conflicts and credit rationing.

Assumptions

Basic model

- As described (see Tirole, Section 3.2).
- Project requires fixed investment I and yields return R.
- If the borrower exerts effort in one project, success probability is p_H, otherwise p_L.
- Effort in one project reduces the borrower's payoff by B.
- Required net worth is

$$\begin{aligned}\overline{A} &= p_H \frac{B}{\Delta p} - (p_H R - I) \\ &= I - p_H \left(R - \frac{B}{\Delta p} \right).\end{aligned}$$

Assumptions

New assumptions

- Borrower has two projects.
- Returns are stochastically independent.
- Borrower cross-pledges entire project returns.

First considerations

- Borrower receives residual return R_b only if both projects succeed.
- This ensures maximal incentives for a given expected reward.

Borrower's incentive constraint

- Borrower prefers to invest effort in both projects instead of no project if

$$p_H^2 R_b - 2B \geq p_L^2 R_b,$$
$$R_b \geq \frac{2}{p_H + p_L} \frac{B}{\Delta p}.$$

- Borrower prefers to invest effort in both projects instead of one project if

$$p_H^2 R_b - 2B \geq p_H p_L R_b - B,$$
$$R_b \geq \frac{1}{p_H} \frac{B}{\Delta p}.$$

- The second constraint is automatically satisfied if the first is, since $p_H > \frac{1}{2}(p_H + p_L)$ and therefore

$$\frac{2}{p_H + p_L} \frac{B}{\Delta p} > \frac{1}{p_H} \frac{B}{\Delta p}.$$

Lenders' individual rationality constraint

- Lenders break even if expected repayment is at least the initial outlay:

$$2p_H R - p_H^2 R_b \geq 2(I - A).$$

- From the borrower's incentive constraint, the minimum payoff left to the borrower is

$$R_b = \frac{2B}{(p_H + p_L)\Delta p}.$$

- Substituting:

$$2p_H R - p_H^2 \frac{2B}{(p_H + p_L)\Delta p} \geq 2(I - A),$$

$$p_H \left(R - \left(1 - \frac{p_L}{p_L + p_H} \right) \frac{B}{\Delta p} \right) \geq I - A.$$

- Equivalently,

$$A \geq \overline{\overline{A}} = I - p_H \left(R - \left(1 - \frac{p_L}{p_L + p_H} \right) \frac{B}{\Delta p} \right).$$

Interpretation

$$A \geq \overline{\overline{A}} = I - p_H \left(R - \left(1 - \frac{p_L}{p_L + p_H} \right) \frac{B}{\Delta p} \right)$$

- For $p_L > 0$, it holds that $\overline{\overline{A}} < \overline{A}$, where

$$\overline{A} = I - p_H \left(R - \frac{B}{\Delta p} \right).$$

- Thus, cross-pledging facilitates financing.
- The term $\frac{p_L}{p_L + p_H} \in \left(0, \frac{1}{2}\right)$ is an agency-based measure of economies of diversification across two independent projects.
- Diversification corresponds to a reduction of the private benefit from B to

$$\left(1 - \frac{p_L}{p_L + p_H} \right) B.$$

- Project finance (separate, unrelated claims on individual projects) is suboptimal unless projects are perfectly correlated or $p_L = 0$.

Limits to diversification

What could limit the effect of diversification in practice?

- Core business competency.
- Limited attention.
- Endogenous correlation.

Diversification and cost of capital

Hann et al. (2013) ask:

- Does corporate diversification lower the cost of capital?
- What role does cash flow correlation play in this relationship?
- Are coinsurance effects stronger for financially constrained firms?

Conceptual framework

- Diversification and coinsurance:
  - Diversified firms transfer resources across business units.
  - This can mitigate countercyclical costs (e.g., financial distress, transaction costs).
- Empirical approach:
  - Compare cost of capital between diversified and stand-alone firms.
  - Analyze cash-flow correlations across business segments.

Cost of capital lower for Multi-segment firms

					Quartile	
	Obs.	Mean	STD	Lower	Median	Upper
Single-segment	21,969	-0.038***	0.281	-0.127	-0.002***	0.093
Multi-segment	8,585	-0.048***	0.270	-0.153	-0.027***	0.090
MS–SS		-0.010***			-0.025***	

Cost of capital lower if correlations are lower

	Obs.	Sort Variable	Cost of Capital
Firms Sorted by Cash Flow Correlations			
Multi-segment Firms			
Q1 (Lowest correlation)	1,495	0.414	-0.059
Q2	1,496	0.734	-0.054
Q3	1,496	0.911	-0.050
Q4	1,496	0.998	-0.046
Q5 (Highest correlation)	2,602	1.000	-0.038
Single-segment firms	21,969	1.000	-0.038
Q1–Q5			-0.022***
Q1–SS			-0.022***
Firms Sorted by Investment Correlations			
Multi-segment Firms			
Q1 (Lowest correlation)	1,495	0.430	-0.072
Q2	1,496	0.760	-0.056
Q3	1,496	0.929	-0.042
Q4	1,496	0.999	-0.039
Q5 (Highest correlation)	2,602	1.000	-0.038
Single-segment firms	21,969	1.000	-0.038
Q1–Q5			-0.034***
Q1–SS			-0.034***

Effects stronger for financially constrained firms

	CF Correlation				Investment Correlation			
	Obs.	Low FC	Obs.	High FC	Obs.	Low FC	Obs.	High FC
Multi-segment Firms								
Q1 (Lowest correlation)	293	-0.024	674	-0.072	293	-0.031	674	-0.087
Q2	294	-0.026	674	-0.064	294	-0.011	674	-0.079
Q3	294	0.018	674	-0.075	294	0.003	674	-0.055
Q4	294	-0.011	674	-0.045	294	-0.005	674	-0.035
Q5 (Highest correlation)	536	-0.010	984	-0.040	536	-0.010	984	-0.040
Single-segment firms	8,634	-0.025	6,665	-0.035	8,634	-0.025	6,665	-0.035
Q1–Q5		-0.014		-0.033***		-0.021		-0.047***
Q1–SS		0.001		-0.037***		-0.006		-0.052***

Regressions explaining cost of capital

	(1)	(2)	(3)	(4)
Full sample				
Cash flow correlations	0.068***		-0.028***	
	(0.012)		(0.008)	
Investment correlations		0.088***		-0.014
		(0.015)		(0.011)
Cash flow correlations × FC-rank			0.038***	
			(0.003)	
Investment correlations × FC-rank				0.038***
				(0.003)
Controls	yes	yes	yes	yes
R^2	0.121	0.122	0.198	0.199
Multi-segment firms				
Cash flow correlations	0.052***		-0.029***	
	(0.011)		(0.010)	
Investment correlations		0.072***		-0.020
		(0.016)		(0.012)
Cash flow correlations × FC-rank			0.041***	
			(0.007)	
Investment correlations × FC-rank				0.043***
				(0.007)
Controls	yes	yes	yes	yes
R^2	0.111	0.112	0.209	0.211

Conclusion

- Costs of capital are higher when firms are less diversified (in cash flows and investment).
- Effects are more pronounced for financially constrained firms.

Check up

Quizzes:

- Diversification I
- Diversification II
- Diversification III

Collateral

Readings

- Tirole (2006), Sections 4.1–4.3.4 (pp. 157–171).
- Chaney et al. (2012).

The costs and benefits of collateralization

So far, net worth has been considered a cash endowment of the borrower.

- But as we have seen, (expected) return from other projects due in $t = 1$ can be pledged and serves as collateral, reducing agency conflict.

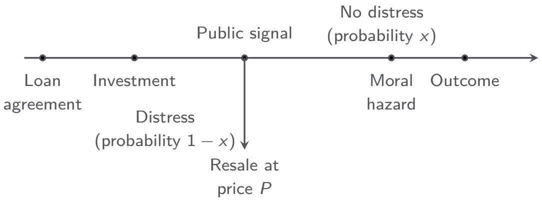
Productive assets

- Pledging productive assets can mitigate agency problems: if the initial investment involves buying machinery or real estate, the resale price can be pledged as collateral to an outside financier.
- More generally, the ability to pledge productive assets may help raise external finance.

Assumptions

Redeployability and timing

- Productive asset can be sold in the case of project failure.
- After the investment, a public signal indicates whether the project is viable:
  - with probability x, the project is viable; characteristics as in the basic model,
  - with probability $1-x$, the parties learn that the project fails.
- If financiers learn that the project fails ("distress"), they can force the borrower to sell off the assets. Resale price $P \leq I$ is exogenous.



Assumptions

- Assume that $x < 1$ and $P < I$ (assets are specialized), but still the project has positive NPV:

$$xp_H R + (1 - x)P > I.$$

Interpretation

- The higher the resale price P, the higher the NPV of the project.
- Positive NPV implies expected profits overcompensate expected capital losses:

$$x(p_H R - I) > (1 - x)(I - P).$$

Pledgeable income

Similar to the base case, the borrower's incentives to exert effort must only be preserved in the no-distress state.

- Resale price in distress can be fully pledged to financiers.
- Conditional on no distress, the borrower must keep a sufficient stake:

$$R_b = \frac{B}{\Delta p}.$$

Condition for financing

- Expected pledgeable income must cover lenders' initial outlay:

$$x p_H \left(R - \frac{B}{\Delta p} \right) + (1 - x) P \geq I - A.$$

Interpretation

$$\underbrace{xp_H\left(R-\frac{B}{\Delta p}\right)+(1-x)P}_{\text{expected pledgeable income}} \geq \underbrace{I-A}_{\text{initial outlay}} .$$

- Expected pledgeable income increases in redeployability, as captured by P.
- The required cash endowment $\overline{A}$ declines in P.
- Thus, redeployability of assets helps a firm to borrow.

Equilibrium determination of asset values

- So far, the resale price P was taken as given.
- With downward-sloping demand for assets, P depends on correlation of distress across firms.
- Fire sales generate negative externalities: they reduce asset prices and thus reduce pledgeable income.
- This aggravates credit rationing and reduces investment, lowering welfare.
- Firms could mitigate this by coordinating on not selling all assets.
- This cartelization can raise resale revenues and thus pledgeable income.

- Cartelization can be welfare-enhancing:
  - If it raises pledgeable income, it increases investment in positive NPV projects and thus social surplus.
- However, other ways to boost investment (e.g., subsidies that raise net worth) avoid the costs of leaving assets undeployed.
- If buyers are credit rationed, cartelization can also reduce buyers' positive-NPV investment.

Costs of collateralization

So far, collateralization, asset transfer, and redeployment only increased pledgeable income and improved efficiency.

- However, asset redeployment involves costs:
  1. Transaction costs (broker fees, taxes, legal/judicial costs).
  2. The initial owner may derive highest value from ownership (family house; superior know-how to use equipment).
  3. Intangible assets are hard to sell (once know-how is transferred, buyer may no longer pay).
  4. If the borrower is likely to be credit rationed again, assets may be more valuable to him than to the lender.
  5. If the borrower is risk-averse, collateralization (e.g., a house) involves high risks that require compensation.
  6. High probability of asset transfer weakens incentives to maintain the asset ($\rightarrow$ moral hazard).
  7. Lender needs a manager to use seized assets and must pay an agency rent to the new manager.

Costly collateral and contingent pledges

First considerations

- When transferring pledged assets is costly, borrowers prefer pledging future returns over assets.
- If pledgeable returns are too low, borrower may be forced to pledge collateral.
- If forced to pledge collateral, borrower prefers to pledge it contingent on project cash flow.
- Pledging collateral in failure increases pledgeable return and has a positive incentive effect.
- Thus, costly asset transfers should occur . . .
  1. for weak firms (low pledgeable return) and low net worth,
  2. in the case of project failure.

Assumptions

- Borrower has no initial cash.
- Investment I is (partially) used to acquire assets.
  - If no funding is available, borrower also has no assets.
- After the project is finished, the asset has value A for the borrower and $A' < A$ for the lender.
  - Asset transfer generates deadweight loss (allocative inefficiency) of $A - A'$.
- Loan contract specifies division of cash flow in success: $R = R_b + R_l$.
- Loan contract specifies probabilities y_S and y_F that assets are kept by the borrower in success and failure.
  - y_S and y_F can be interpreted as the borrower's share of the asset in success or failure.

Optimization problem

The optimal loan agreement maximizes the borrower's payoff subject to borrower incentives and lender break-even.

Borrower's payoff (utility) if borrower behaves

$$U_b = p_H(R_b + y_S A) + (1 - p_H)y_F A.$$

- Using $R = R_l + R_b$ and the lender's zero-profit condition (next slide), this can be written as

$$U_b = \underbrace{p_H R - I + A}_{\text{expected monetary profit}} - \underbrace{\left[p_H(1 - y_S) + (1 - p_H)(1 - y_F)\right](A - A')}_{\text{expected deadweight loss}}.$$

Constraints

Borrower's incentive constraint

$$
\begin{aligned}
p_H(R_b + y_S A) + (1 - p_H) y_F A &\geq p_L(R_b + y_S A) + (1 - p_L) y_F A + B, \\
\Delta p \big(R_b + (y_S - y_F) A \big) &\geq B, \\
R_b &\geq \frac{B}{\Delta p} - (y_S - y_F) A.
\end{aligned}
$$

Lenders' individual rationality constraint

$$
p_H \big(R_l + (1 - y_S) A' \big) + (1 - p_H)(1 - y_F) A' \geq I.
$$

Regimes: first considerations

$$U_b = \underbrace{p_H R - I + A}_{\text{expected monetary profit}} - \underbrace{\left[p_H(1-y_S) + (1-p_H)(1-y_F)\right](A-A')}_{\text{expected deadweight loss}}.$$

- Borrower prefers pledging as little collateral as possible since collateral pledging causes deadweight costs, while pledging income does not.
- For a given level of agency costs, the optimal agreement depends on balance-sheet strength.
  - E.g., if borrower had initial cash $\tilde{A}$, this could reduce required investment I.
- The prevailing regime is the contract that minimizes expected collateral transfer while satisfying incentive and break-even constraints.

Regimes: comparison

(i) Strong balance sheet

- Optimal to pledge money (income) first.
- No collateral: $y_S = y_F = 1$, $R_b > 0$.

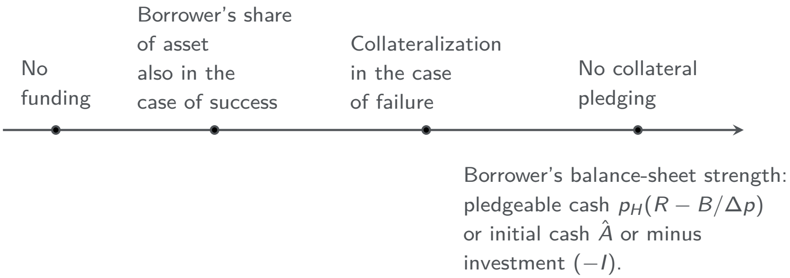
(ii) Intermediate balance sheet

- If the asset must be pledged, it is better to pledge it in failure.
- Collateral in failure: $y_S = 1$, $y_F \leq 1$, $R_b \geq 0$.

(iii) Weak balance sheet

- Borrower is compensated only via a share of the asset in success.
- Collateral in failure and success: $y_S \leq 1$, $y_F = 0$, $R_b = 0$.

Only weak borrowers pledge collateral



The role of contingent pledging

Pledging collateral is costly while pledging future returns is not.

- Efficiency is enhanced if the probability of asset transfer is limited.

Contingent pledging of collateral minimizes the probability of transfer.

- Efficiency gains add to borrower rent.
- Incentivizing the borrower requires a smaller share in project cash flow.

The case of uncontingent asset transfer

- Borrower's incentive constraint:

$$p_H R_b \geq p_L R_b + B,$$
$$R_b \geq \frac{B}{\Delta p}.$$

- Expected pledgeable income with uncontingent asset transfer ($y_S = y_F = 0$):

$$p_H \left(R - \frac{B}{\Delta p} \right) + A'.$$

Collateral and corporate investment

Chaney et al. (2012): *How Real Estate Shocks Affect Corporate Investment*

- Firms use pledgeable assets as collateral to finance new projects.
- Real estate shocks impact corporate investment through the collateral channel.
- This channel helps explain:
  - Amplified downturns (e.g., Great Depression; Japanese crisis).
  - Investment behavior during recent real estate price declines in the United States.

Research objectives

This paper aims to

- quantify sensitivity of corporate investment to changes in real estate collateral values,
- use local real estate price variation as shocks to collateral value,
- provide micro evidence for the collateral channel in aggregate investment.

Main Result: An increase in collateral value leads to an increase in corporate investment.

Accounting and real estate data

- Accounting data
  - Active Compustat firms, 1993–2007.
  - Excludes finance, insurance, real estate, construction, and mining.
  - Sample: 5,584 firms, 50,858 firm-year observations.
  - Key variables:
    - Investment rate (CAPEX / lagged PPE),
    - Real estate value / lagged PPE,
    - Market-to-book, debt issuance.
- Real estate data
  - Residential prices: OFHEO/FHFA Home Price Index (HPI), state and MSA.
  - Commercial prices: Global Real Analytics (office/industrial properties).
  - Prices indexed/normalized for comparison over time.

Measurement

- Measurement issues
  - Real estate assets valued at historical cost (inflation-adjusted).
  - Geographic location of real estate proxied by firm headquarters.
- Manual data collection
  - HQ ownership manually coded from 10-K forms (1997).
  - SEC EDGAR used for supplemental ownership info.
  - Residential vs. commercial index correlations:
    - 0.57 at the state level,
    - 0.42 at the MSA level.

Real estate value and firm investment

$$\text{INV}_{it} = \alpha_i + \delta_t + \beta \cdot \text{RE Value}_{it} + \gamma \cdot P' + \text{controls}_{it} + \epsilon_{it}$$

- INV_{it}: Investment rate (CAPEX / lagged PPE).
- RE Value_{it}: Real estate value normalized by lagged PPE.
- P': Controls for local price levels (state/MSA).
- α_i: Firm fixed effects.
- δ_t: Year fixed effects.
- Controls include cash flows / PPE and lagged market-to-book.
- Errors clustered at the state/MSA-year level.

Real estate value drives corporate investment

	(1) Res. Prices	(2) Off. Prices
RE Value	0.05***	0.06***
MSA Prices	-0.58	0.25
Cash	0.03***	0.03***
Market/Book	0.07***	0.07***
Year FE	Yes	Yes
Firm FE	Yes	Yes
Further Controls	Yes	Yes
Observations	22,894	17,805
Adjusted R^2	0.33	0.33

- A one s.d. increase in office RE value (1.27) implies $0.06 \times 1.27 = 0.076$ higher investment (CAPEX/K), about 21% relative to mean investment of 0.35.

Exogenous variation to explain real estate prices

$$P' = \alpha + \delta_t + \gamma \cdot (\text{Elasticity}_i \times \text{IR}_t) + \epsilon_i$$

- P': Predicted real estate price at the MSA level.
- Elasticity_i: Local housing supply elasticity in MSA i (Saiz, 2010).
- IR_t: Nationwide real interest rate.
- Interaction captures amplification via local supply constraints (Himmelberg et al., 2005).
- MSA FE and year FE control for local and aggregate shocks.

Land supply and cost of credit

	(1) Res. Prices	(2) Off. Prices
Elasticity × IR	0.028***	0.036***
Year dummies	Yes	Yes
MSA FE	Yes	Yes
Controls	Yes	Yes
Observations	1,358	804
Adjusted R^2	0.94	0.84

- Constrained land and more expensive credit drive up real estate prices.

Real estate value drives corporate investment (cont'd)

	(1)	(2)
RE Value (MSA Off. Prices)	0.06***	
RE Owner × MSA Off. Prices		0.44***
MSA Off. Prices	0.22	0.20
Year FE	Yes	Yes
Firm FE	Yes	Yes
Controls	Yes	Yes
Observations	17,586	17,731
Adjusted R^2	0.33	0.33

- Tighter identification corroborates results.
- Prices increase investment when firms own real estate.

Constrained vs. unconstrained firms

	Payout Policy		Firm Size		Bond Ratings	
	C	U	C	U	C	U
RE Value (MSA Off. Prices)	0.08***	0.04***	0.09***	0.04***	0.07***	0.03***
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,879	6,090	5,846	4,535	10,409	3,208
Adjusted R^2	0.29	0.48	0.18	0.66	0.32	0.60

- Collateral effects are more pronounced for constrained firms.

Debt issues

	Debt issues	Debt repayments
RE Value (MSA Off. Prices)	0.095***	0.050***
Year FE	Yes	Yes
Firm FE	Yes	Yes
Controls	Yes	Yes
Observations	19,375	19,691
Adjusted R^2	0.30	0.36

- Higher real estate values ($\rightarrow$ more collateral) $\rightarrow$ higher debt capacity.

Conclusion

- We analyzed the role of diversification and collateralization for borrowing capacity.
- Both diversification and the ability to pledge relatively safe collateral (e.g., commercial real estate) increase borrowing capacity.

- More determinants of borrowing capacity:
  - Diamond (1984) on diversification with many projects.
  - Hart and Moore (1994) on borrower–lender renegotiation.

Check up

Quizzes:

- Diversification I
- Diversification II
- Diversification III

Monitoring

Goal of the lecture

- Introducing the instrument of monitoring.
- Early signals of a manager's performance reduce agency costs and thus increase pledgeable income.
- A delegated monitor can be incentivized by stock options to acquire information.
- But the value of monitoring may be mitigated if the monitor collects too much information.

Readings

- Tirole (2006), Sections 8.1–8.2 (pp. 334–345).

General topic

- So far, informational asymmetries were taken as given.
- Financial contracts were designed to contain detrimental effects of hidden actions and hidden information.
- Financial contracts can eliminate hidden information:
  - Requiring sufficient collateral investors can identify good borrowers.
  - Transfer of collateral, though, generates a deadweight loss.
- Incentive-compatible contracts can eliminate hidden action:
  - Investors know that entrepreneur behaves.
  - However, incentive compatibility generates costs.

$\Rightarrow$ Monitoring allows investors to assess the behavior of the manager.

$\Rightarrow$ Information reveals opportunistic behavior, and investors can intervene.

Early performance monitoring

Intuition

- Consider a biotech company developing a molecule that may cure diseases.
- Basic research, testing, approval, and marketing may take years.
- Final profit is highly uncertain and is a poor (garbled) indicator of the value created early on.
- It is therefore desirable to measure performance early:
  - The manager needs money long before final profit is realized.
  - Even if the manager can wait, better incentive schemes are possible if an advanced measure of assets in place can be obtained.

$\Rightarrow$ Many investments bear fruits late; compensation should rely on early performance measures beyond accounting/income recognition.

The assumptions of the basic model apply

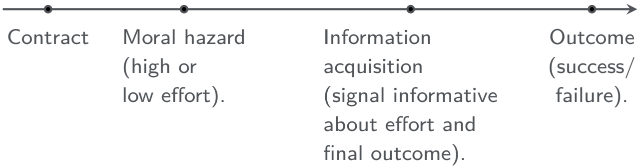
- An entrepreneur undertakes a project of size I that she cannot finance with own resources A, so she borrows $I - A$.
- The project produces R in the case of success and zero otherwise.
- Success probability is p_H if the manager behaves and $p_L = p_H - \Delta p$ if she shirks and gets private benefit B.
- Effort can be high (H) or low (L).
- Manager and investors are risk-neutral; managers have limited liability.

The new ingredient

$$
\begin{tikzcd}
\text{Effort } i \in \{H, L\} \arrow[r, "\sigma_{ij} = \Pr(\text{signal } j \mid \text{effort } i)"'] & \text{Signal } j \in \{H, L\} \arrow[d, "v_j = \Pr(\text{success} \mid \text{signal } j)"'] \\
& \text{Outcome(success, failure)}
\end{tikzcd}
$$

- After effort is chosen and before project ends, information can be acquired about the final outcome.
- Signals: $j \in \{H, L\}$.
- Efforts: $i \in \{H, L\}$.
- σ_{ij} is the probability of signal j conditional on effort i, with $\sigma_{iH} + \sigma_{iL} = 1$ for all i.
- v_j is the probability of success given signal j (assume v_j independent of effort).

Timing



- For *ex ante* probabilities to match p_H and p_L under high and low effort, require

$$p_H = \sigma_{HH} v_H + \sigma_{HL} v_L,$$
$$p_L = \sigma_{LH} v_H + \sigma_{LL} v_L.$$

- Assumption: the high signal raises confidence in success: $v_H > p_H$ (equivalently, $v_L < p_L$).

The benchmark of free performance monitoring

- Assume the signal is observed and verified at no cost.
- The incentive-compatible contract can be based solely on the realized signal.
- Manager receives R_b in the case of a high signal and zero otherwise.
- This gives incentives for high effort (and not to enjoy private benefit B).
- High effort increases Pr(high signal) from σ_{LH} to σ_{HH}.

The benchmark of free performance monitoring (cont'd)

- Incentive constraint (pay R_b if signal is high):

$$\sigma_{HH} R_b \geq B + \sigma_{LH} R_b,$$
$$(\sigma_{HH} - \sigma_{LH}) R_b \geq B.$$

- Incompressible share (expected value) left to the manager:

$$\sigma_{HH} R_b = \frac{\sigma_{HH}}{\sigma_{HH} - \sigma_{LH}} B.$$

The benchmark of free performance monitoring (cont'd)

- Sufficient condition for financing:

$$p_H R - \frac{\sigma_{HH}}{\sigma_{HH} - \sigma_{LH}} B \geq I - A.$$

- I.e., NPV net of the manager's share must cover the funding gap.
- Without any signal (basic model):

$$p_H R - \frac{p_H}{p_H - p_L} B \geq I - A.$$

The benchmark of free performance monitoring (cont'd)

- Comparing with and without a signal:

$$\frac{p_H}{p_H - p_L} = \frac{\sigma_{HH}(v_H - v_L) + v_L}{(\sigma_{HH} - \sigma_{LH})(v_H - v_L)} > \frac{\sigma_{HH}}{\sigma_{HH} - \sigma_{LH}}.$$

- Conclusion: the signal increases pledgeable income and thus funding.
- Early signals provide information about future performance and thus about moral hazard.
- Early signals are relatively free of noise from future environments.

A designated monitor

- A designated monitor collects information on behalf of investors.
- Collecting the signal costs c.
- The information is private (soft information), i.e., not publicly available.
- Collecting information can entail moral hazard.
- Contract must induce the monitor to
  1. collect information and
  2. report it truthfully.

The optimal contract for the monitor

- Optimal contract ensures truthful reporting and leaves no rent to the monitor.
- Implemented by stock options with strike equal to the stock price at grant date.
- Monitor can purchase s^* shares at the *ex ante* par value (no insider trading): $p_H R$ per share.
- The number of options s^* is pinned down by:

$$s^* \sigma_{HH}(v_H R - p_H R) = c.$$

The optimal contract for the monitor (cont'd)

$$s^* \sigma_{HH}(v_H R - p_H R) = c.$$

- ◦ If the monitor does not monitor: $c = 0$ and shares are worth $p_H R$ (equal to exercise price) $\Rightarrow$ zero profit.
- ◦ If the monitor monitors: signal is high with probability σ_{HH}.
- ◦ If signal is high, shares are worth $v_H R$, giving capital gain $v_H R - p_H R$ per share.
- ◦ If signal is low, shares are worth $v_L R < p_H R$ and the option is not exercised.

$\Rightarrow$ The contract equates expected benefit of monitoring to its cost.

$\Rightarrow$ Manager receives R_b^* when the monitor exercises the option, and zero otherwise.

Too much monitoring

- Monitors should only "take a picture" of performance before further noise dilutes it.
- If they obtain information mapping the signal to the final outcome, stock price reaction reflects noisy projections of the final outcome rather than managerial performance.
- Speculative information is useless for entrepreneurial compensation.

$\Rightarrow$ By collecting too much information, the monitor reduces the quality of performance measurement.

Too much monitoring (cont'd)

Illustration

- Monitor can obtain information mapping the signal to the final outcome at cost $c + \epsilon$ with $\epsilon \geq 0$ (very small).
- Under the same option scheme, the monitor exercises based on the final outcome and prefers:

$$s^* p_H(R - p_H R) - (c + \epsilon) > s^* \sigma_{HH}(v_H R - p_H R) - c.$$

- With probability p_H the project succeeds.
- Knowing the final outcome, monitor exercises and earns $R - p_H R$ on s^* shares.
- The option is exercised with *ex ante* probability p_H.

Too much monitoring (cont'd)

Illustration cont'd

- If the monitor learns the final outcome, monitoring brings no new information; pledgeable income is lower than without monitoring:

$$p_H R - \frac{p_H B}{\Delta p} - (c + \epsilon) < p_H \left(R - \frac{B}{\Delta p} \right).$$

- Final outcome depends on effort and an uncontrollable shock.
- Ideally, monitoring should reveal effort, not the shock.
- But the monitor will not spend resources to learn effort: effort can be inferred from the incentive scheme (entrepreneur works if she expects monitoring).
- Incentive to monitor stems from learning about the uncontrollable shock (to profit from options).

$\Rightarrow$ Monitoring intensity and precision covary negatively.

Conclusion

- Early signals provide an ungarbled assessment of effort and increase pledgeable income.
- Monitors can be incentivized to provide such signals with stock options.
- But monitors may prefer to learn the final outcome rather than effort (to raise option gains).
- Trade-off: easier access to information about the uncontrollable shock strengthens monitoring incentives but adds unwanted noise to performance measurement.

Check up

Quizzes:

- Monitoring I
- Monitoring II
- Monitoring III

the End.

Bonus material

Liquidity

Goal of the lecture

- Implementing a liquidity shock at an intermediate stage into the basic model.
- At this stage, there will be a need for a reinvestment.
- Borrowers should anticipate reinvestment needs and hoard liquidity in the form of credit lines or liquid securities.
- Empirical associations with this lecture:
  - Highly indebted firms borrow on a short-term basis.
  - Growth firms tend to have long-term maturities.

Readings

- Tirole (2006), Sections 5.1–5.2 (pages 199–207).

General topic

- Firms are ongoing entities and thereby concerned with future liquidity shortages.
- Liquidity shortages reflect an inadequacy between sources available to the firm and refinancing needs.
- Financing resources depend on the difference between income and payments to investors, i.e., payouts and debt repayments.
- Short-term liabilities (as opposed to long-term debt or equity) force the firm to disgorge cash and thereby induce liquidity problems.
- Income must be available at the refinancing stage (e.g., start-ups do not generate income in the first years).
- Liquidity management is important!

What's new to the basic model 1/3

So far, firm investment and financing have had the same maturity

- We introduce an intermediate stage.
- At this stage, the borrower faces a liquidity shock (e.g., reinvestment, a shortfall in earnings).
- This liquidity shock has to be withstood to continue, so extra cash has to be thrown in.
- Two possibilities to face liquidity needs:
  - Secure some cash or liquid assets (treasury bonds) before the shock emerges.
  - Secure a line of credit (i.e., to start raising funds when the shock occurs).

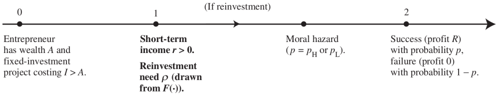


Figure 5.1

Source: Tirole (2006)

What's new to the basic model 2/3

- At the intermediate stage (date 1), the initial investment yields deterministic and verifiable income $r \geq 0$.
- To continue the amount ρ has to be reinvested.
- ρ is *ex ante* unknown and has a cumulative distribution function $F(\rho)$ with density $f(\rho)$ on $[0, \infty)$.
- The realization of ρ is learned at date 1 and has to be undertaken; otherwise, the firm is liquidated (with a liquidation value of 0).
- If ρ is reinvested the firm yields R at date 2 with probability p and 0 with probability $1 - p$.

What's new to the basic model 3/3

- The other assumptions from the basic model apply.
  - $p = p_H$ if borrower behaves; $p = p_L = p_H - \Delta p$ if borrower does not behave.
  - The entrepreneur and investors are risk neutral.
  - Entrepreneur is protected by limited liability.
  - Competition among investors deprives them of any surplus.
- Additionally, there is a storage technology that yields an interest of 0 (i.e., 1 unit invested at date 0 delivers 1 unit at date 1).

Inefficiency of wait-and-see 1/2

- Assume that the entrepreneur does not preserve any funds at date 0 for reinvestments at date 1 and that she does not prearrange any access to liquidity at date 1.
- Assume that she invested all her funds A at date 0 in the project to get it started and that she pledged maximum future income including r to outside investors to attract funding.
- Now, in date 1, she faces a reinvestment need of ρ.
- By providing the additional liquidity ρ, investors can secure their expected contractual repayment.
- Consequently, outside financiers are willing to provide additional liquidity up to

$$\rho_0 = p_H \left(R - \frac{B}{\Delta p} \right).$$

- At date 1, the initial outside investment $(I - A)$ is sunk.

Inefficiency of wait-and-see 2/2

- From the perspective of the entrepreneur, continuation is beneficial as long as the expected return exceeds the additional costs.
- Thus, the entrepreneur would reinvest up to

$$p_H R - \rho_1 = 0 \Rightarrow \rho_0 \leq \rho_1 = p_H R.$$

- Moral hazard problem reduces pledgeability of future income (as in the basic model).
- Positive NPV projects are credit (liquidity) rationed and have to be terminated.

$\Rightarrow$ There might be situations in which the firm would continue under an optimal contract, but with the wait-and-see approach, lenders (initial and new) do not want to engage in a rescue.

$\Rightarrow$ The entrepreneur has incentives to withhold some liquidity at date 0 to ensure continuation in the case of a liquidity shortage.

Optimal continuation threshold

- If the initial contract can specify for which values of ρ the firm continues or liquidates (requires investors to reinvest ρ), then the firm continues with

$$\rho \leq \rho^*.$$

- ρ^* is a cutoff.
- The firm continues whenever it is cheap to do so.

The borrower's utility

- Without the intermediate stage, the utility for the borrower is

$$U_b = p_H R - I.$$

- The net utility is equal to the NPV of the project assuming that the contract induces high effort ($A \geq \bar{A}$).
- In the case with an intermediate stage and with the probability of continuation $Pr(\rho \leq \rho^*) = F(\rho^*)$, the borrower's net utility is:

$$U_b = [r + F(\rho^*) p_H R] - \left[I + \int_0^{\rho^*} \rho f(\rho) d\rho \right].$$

- The first bracket is the expected revenue.
- The second bracket is the sum of initial investment and expected reinvestment.

Intermediate vs. final compensation

- To ensure good behavior, the entrepreneur receives R_b (at date 2) in the case of good behavior and 0 otherwise with

$$(\Delta p)R_b \geq B.$$

- Suppose the entrepreneur receives $r_b > 0$ at date 1.
- This may induce moral hazard in the case of continuation.
- The contract can eliminate the short-term compensation by increasing R_b by σR_b.
- The expected total reward

$$F(\rho^*)p_H\sigma R_b = r_b.$$

  remains constant.
- The substitution alleviates moral hazard in the case of continuation.
- The suppression of date-1 compensation leaves the date-1 income unchanged (because it is exogenous given).

Pledgeable income

- In the base case, the pledgeable income is

$$P = p_H \left(R - \frac{B}{\Delta p} \right).$$

- In the case with an intermediate stage and deflated by the investor's initial outlay ($I - A$, i.e., while the entrepreneur has no longer cash available, the reinvestment must be financed from the investor or from date-1 revenue), it is:

$$\begin{aligned} P(\rho^*) - (I - A) = & \left[r + F(\rho^*) \left[p_H \left(R - \frac{B}{\Delta p} \right) \right] \right] \\ & - \left[I + \int_0^{\rho^*} \rho f(\rho) d\rho - A \right]. \end{aligned}$$

Comparative statics 1/2

- What happens to U_b with respect to ρ^* (taking first derivatives)?
- The NPV is increasing in the cutoff value ρ^* as long as $\rho^* < p_H R$ (decreasing afterwards).

$$\frac{\partial U_b}{\partial \rho^*} = f(\rho^*) p_H R - \rho^* f(\rho^*).$$

- One would salvage the investment whenever the costs are lower than the expected payoff of continuing.
- The entrepreneur achieves maximum payoff for $U(\rho^*) = p_H R$.

Comparative statics 2/2

- What happens to P with respect to ρ^* (taking first derivatives)?
- The pledgeable income increases in ρ^* for $\rho^* < p_H(R - B/\Delta p)$ and decreases afterwards.

$$\frac{\partial P}{\partial \rho^*} = f(\rho^*)p_H\left(R - \frac{B}{\Delta p}\right) - \rho^* f(\rho^*).$$

- Because investors bear the costs of salvaging the project, they only reinvest if their maximum stake $p_H(R - B/\Delta p)$ (to ensure incentive compatibility for the borrower) is greater than the costs.
- The maximum pledgeable income is at $P(\rho^*) = p_H(R - B/\Delta p)$.

Three cases

Depending on the strength of the balance sheet, there are three cases to consider:

1. An efficient amount of liquidation.
2. An over-optimal amount of liquidation (depicted in Figure 5.2).
3. No funding at all.

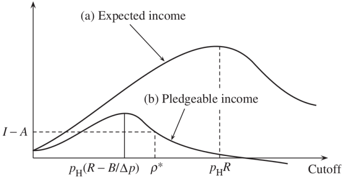


Figure 5.2 Optimal continuation policy:
(a) $U_b + I = r + F(\rho^*)[p_H R] - \int_0^{\rho^*} \rho f(\rho)\,d\rho$;
(b) $\mathcal{P}(\rho^*) = r + F(\rho^*)[p_H(R - B/\Delta p)] - \int_0^{\rho^*} \rho f(\rho)\,d\rho$.

Source: Tirole (2006)

Case one

$$P(p_H R) \geq I - A.$$

- If the pledgeable income exceeds the funding gap, even for a reinvestment policy that ensures the continuation of all positive NPV projects ($\rho^* = p_H R$), then the first-best cutoff can be achieved.
- The contract is written in such a way that it leaves no intermediate income for the entrepreneur (to mitigate moral hazard) and pays $R_b \geq B/\Delta p$ at date 2 in the case of success.

Case two 1/2

$$P(p_H R) < I - A \leq P\left(p_H\left(R - \frac{B}{\Delta p}\right)\right).$$

- The entrepreneur receives the lowest compensation $R_b = B/\Delta p$ that is incentive-compatible.
- Not all positive NPV projects can be continued.
- To be able to invest more ex-ante (higher I), the borrower accepts a level of reinvestment that is below the efficient level $p_H R$.
- The entrepreneur has to reduce the maximum liquidity injections and terminate those projects with the smallest positive NPV, i.e., with the highest reinvestment needs.
- Intuition: to preserve incentives, the borrower cannot pledge the entire benefit of the reinvestment decision to lenders (because her stake would decrease, which induces moral hazard).

Case two 2/2

In this case the cutoff $\rho^* \in [p_H(R - B/\Delta p), p_H R]$ is determined by

$$r + F(\rho^*)\left[p_H\left(R - \frac{B}{\Delta p}\right)\right] = I + \int_0^{\rho^*} \rho f(\rho) d\rho - A.$$

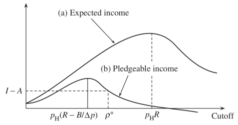


Figure 5.2 Optimal continuation policy:
(a) $U_b + I = r + F(\rho^*)[p_H R] - \int_0^{\rho^*} \rho f(\rho)\, d\rho$;
(b) $\mathcal{P}(\rho^*) = r + F(\rho^*)[p_H(R - B/\Delta p)] - \int_0^{\rho^*} \rho f(\rho)\, d\rho$.

Source: Tirole (2006)

- ρ^* from $P(\rho^*)$ exceeds ρ that maximizes P because a small increase in ρ^* at $p_H(R - B/\Delta p)$ induces only a second-order decrease in debt capacity, but has a first-order gain in expected income (efficiency).

Case three

- However, reducing the liquidity injections and discontinuing projects only increase the pledgeable income for

$$\rho \geq \left(p_H \left(R - \frac{B}{\Delta p}\right)\right).$$

- Reducing the liquidity injection even further and discontinuing projects with $\rho < p_H(R - B/\Delta p)$ would reduce the overall pledgeable income since also projects would be terminated whose preserved pledgeable income exceeds the reinvestment costs.
- So, for

$$P\left(p_H \left(R - \frac{B}{\Delta p}\right)\right) < I - A.$$

  the project would not be financed at date 0.

Term structure of cash-rich firms

- A cash-rich firm can throw in money (generate sufficient cash-flows) at the intermediate stage, i.e., $r \geq p_H R$.
- The optimal contract could be implemented through a combination of
  ... short-term debt $d = r - \rho^*$, and.
  ... long-term debt $D = R - B/\Delta p$.
- If the entrepreneur can use liquidity at her discretion, she reinvests up to $r = \rho = p_H R$.
- This reduces pledgeable income and might make ex-ante funding impossible.
- To prevent this, excess liquidity has to be repaid to investors.

Short-term and long-term debt

- Short-term debt drains liquidity from the firm by $d = r - \rho^*$.
- Long-term debt payments are given by $D = R - B/\Delta p$, the maximum pledgeable income.
- Firms with a high funding gap $(I - A)$ require high pledgeable income and thus can afford only a low ρ^*.
- Thus, cash-rich firms with a high initial funding gap (weak initial balance sheet) must drain more liquidity and need to refinance more with short-term debt, i.e., have a shorter maturity debt structure.

$\Rightarrow$ Highly indebted firms are more likely to borrow short term.

Liquidity drain by dividends

- In principle, the liquidity drain could also be achieved by dividend payments.
- It must be ensured (covenant) that investors cannot push for higher dividends than optimal.
- Investors would push for a higher dividend because

$$\bar{d} = r - p_H \left(R - \frac{B}{\Delta p} \right) > d.$$

  to prevent the entrepreneur from reinvesting whenever the liquidity shock exceeds date-1 pledgeable income ρ_0.
- Thereby, covenants serve to protect the entrepreneur against excessive liquidation.

Term structure of cash-poor firms

- Investments may take a long time to produce income (in the extreme, there is no short-term income r).
- The entrepreneur could choose to wait and see and borrow at date 1 what is needed.
- In this case, the entrepreneur had to issue new shares at date 1 and thereby dilute initial investors.

Dilution

- The date-1 pledgeable income is $\rho_0 = p_H(R - B/\Delta p)$, i.e., the value of external shares held by initial investors.
- Entrepreneur faces liquidity shock $\rho = \frac{1}{2}\rho_0$, i.e., that as many shares are sold to new investors as already exist.
- The firm raises $\rho = \frac{1}{2}\rho_0$ in cash and can withstand the shock.
- Will the initial investors let themselves be diluted?
  - Which means that their share is reduced to $\frac{1}{2}\rho_0$.
- Yes, because the alternative solution is to liquidate the firm – in this case, investors receive nothing.

The upper limit of dilution

- Dilution can go quite far, but not unlimited.
- Investors will never pay more than the firm is worth.
  - Even in a frictionless market, the firm cannot raise more than ρ_0.
- The maximum the firm can raise in capital markets at date 1 is:

$$\rho \leq \rho_0 = p_H \left(R - \frac{B}{\Delta p} \right).$$

- Because the optimal financing arrangement specifies

$$p_H \left(R - \frac{B}{\Delta p} \right) < \rho^* \leq p_H R.$$

  the entrepreneur must secure a line of credit or hoard liquidity to face potential date-1 liquidity shocks.

Two types of securing liquidity

There are two alternatives to secure liquidity for date 1.

1. The firm secures a line of credit ρ^* at date 0, stating that initial investors will not be diluted.
   - The entrepreneur borrows $I + \rho^*$ at date 0.
2. The entrepreneur borrows $\rho^* - p_H(R - B/\Delta p)$ with a right to dilute initial claim holders as needed to continue business at date 1.

- The optimal contract can be implemented by an irrevocable line of credit.
- If this credit line is revocable then lenders have incentives to shut down business whenever $\rho > \rho_0$, i.e., the liquidity shock is greater than date-1 pledgeable income.

A reinterpretation of liquidity shocks

- Think of the liquidity shock as a growth opportunity not available to the firm (because there is not enough cash).
- At date 1, the firm receives a deterministic income r, forgoes the growth opportunity, and succeeds in date 2 with either p_H or p_L (depending on whether the entrepreneur behaves at date 1).
- The growth opportunity (reinvesting) at date 1 increases expected profits for the firm at date 2.
- To formalize that, reinvesting leaves income in date 2 unchanged (R or 0) but changes the success probability by $\tau > 0$.

IC and utility in the case of a growth opportunity

- The entrepreneur's incentive compatibility constraint is unchanged by the growth opportunity.

$$(p_H + \tau)R_b \geq (p_L + \tau)R_b + B \iff (\Delta p)R_b \geq B.$$

- Again, the reinvestment cost ρ is drawn from $F(\rho)$ with $f(\rho)$ on $[0, \infty)$.
- It is optimal to reinvest only when $\rho \leq \rho^*$.
- The entrepreneur's utility is:

$$U_b(\rho^*) = [r + [p_H + F(\rho^*)\tau]R] - \left[I + \int_0^{\rho^*} \rho f(\rho) d\rho \right].$$

The case of constrained firms

The firms are cash-constrained but can raise funds (see case two in the former section).

- The cutoff is given by:

$$r + [p_H + F(\rho^*)\tau]\left(R - \frac{B}{\Delta p}\right) = [I - A] + \int_0^{\rho^*} \rho f(\rho) d\rho.$$

and

$$\tau\left(R - \frac{B}{\Delta p}\right) \leq \rho^* < \tau R.$$

$\Rightarrow$ Reinvestment occurs whenever it boosts pledgeable income $\rho^* \geq \tau\,(R - B/\Delta p)$.

The term structure of growth firms

- The impact of growth opportunities τ on a firm's maturity structure $d = r - \rho^*$.

$$\frac{\partial(r-\rho^*)}{\partial\tau} = -\frac{F(\rho^*)}{f(\rho^*)}\frac{R - B/\Delta p}{\rho^* - \tau(R - B/\Delta p)} < 0.$$

- Firms with better growth opportunities should go for longer maturities.
- There is support that firms with growth opportunities have lower leverage ratios (when equity is seen as long-term debt).

Accounting Manipulation

Goal of the lecture

- Implementing an intermediate signal about the quality of the manager.
- Accounting manipulation makes initial contracts less efficient.
- Golden parachutes are efficient in preventing accounting manipulation when prospects in the case of continuation are low.

Readings

- Tirole (2006), Section 7.2 (pages 299–305).

General topic

- Accounting manipulation is a “hot topic”, foremost in the public debate.
- “High-powered” incentive schemes may induce accounting manipulations.
- Accounting manipulation comes in many ways (e.g., managers move income in time, forgo investments that at a later date would be beneficial).
- Any move towards high-powered incentive schemes must take care of the manipulation cost.

The Enron scandal

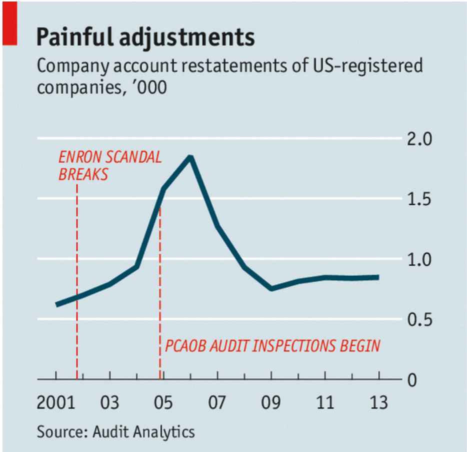
- From 1997 on, Enron's accounting practices were primarily focused on keeping income and cash flows up.
- Assets were inflated (book costs of canceled projects as assets), and liabilities were recorded off the balance sheet.
- Between 1996–2000, revenues increased by more than 750% (average industry growth was about 2–3%).
- Accounting manipulation was approved by executives (and was not detected by Enron's auditor firm, Arthur Andersen – even on February 12, 2001, there were no concerns).
- Enron used mark-to-market accounting and special-purpose vehicles (to buy Enron's worst assets) to undertake misleading accounting (techniques coming from banking – Jeff Skilling, Chief Executive Officer since 1990, led First City Bank of Houston into insolvency before).

The Enron scandal cont'd

- In combination with a dysfunctional corporate culture that solely focuses on short-term earnings to maximize bonuses, this accounting scandal was detected in October 2001, and on December 2, 2001, Enron filed for bankruptcy under Chapter 11.
- On February 5, 2001, Enron executives got bonus checks for millions of dollars.
- A consequence of the scandal was that new regulations and legislation were enacted to expand the accuracy of financial reporting for public companies.
- E.g., the Sarbanes-Oxley Act expanded repercussions for destroying, altering, or fabricating records in federal investigations or for attempting to defraud shareholders.
- This act also increased the accountability of auditing firms to remain unbiased and independent of their clients.

Restatements since Enron

(Economist, 2014a)



Downside of “high-powered incentive schemes”

- So far, we have been concerned with contracts that induce a high level of managerial performance.
- Such “high-powered” incentive schemes come with the risk that the interests of managers and investors are no longer aligned on other dimensions of managerial activities.
- Incentives schemes may create moral hazard in two ways:
  - Timing of income recognition (managers have the discretion to move income/losses in time).
  - Change in risk management.

$\Rightarrow$ “High-powered” incentive schemes are costly (e.g., garble performance measurement, which makes an assessment of project/management quality much harder) and thereby must be accompanied by direct controls for the side effects.

Accounting methods ("cooking the books")

- Even without resorting to fraud, managers have a lot of discretion in P&L and balance sheet statements.
- E.g., a shift in loss provisions can make the firm look much better today.
- Sales or expenses can be recorded at different times (e.g., manipulation of the firm's situation during the year).
- Firms can transfer poor investments or associated debts to non-consolidated subsidiaries.
- Direct cost associated with such behavior:
  - Managers may focus more on these actions than providing high effort to their core task.
  - Corporate resources may be involved in these actions.

Operating methods

- The firm can deviate from its strategy to alter the external assessment of the firm.
- E.g., to increase current profits, the firm delays maintenance and reduces investments.
- Firms can also time their sale periods: to increase end-of-period sales in December, firms lower prices at the end of the year (in the high-priced Christmas time) rather than in January (end of holidays).
- Firms may also manage late/early payment terms with customers to shift profits.
- Direct cost associated with such behavior:
  - Bad timing, overtime pay, production disturbances,...

Managerial myopia

- Investors are often provided with several options to keep managers “on a tight leash” (e.g., fire managers, downsize firm).
- Such behavior increases efficiency and raises pledgeable income.
  - *Ex post* sanctions may act as a signal and reduce moral hazard *ex ante* (generally reduce adverse selection problems (see next lecture)).
  - Sanctions may be forward-looking: weak past performance may signal weak future performance.
- Power through strong boards or potential raiders.

⇒ The threat of firing increases incentives for managers to manipulate short-term earnings: managerial myopia.
  - Myopia refers to the perception of an outside observer who fails to internalize long-term agency considerations.
  - Solving one agency problem (implying incentives and decreasing moral hazard) induces another one (accounting manipulation).

Introduction of an intermediate stage in which we learn about the quality of the manager.

- Choice of continuing or terminating the project.

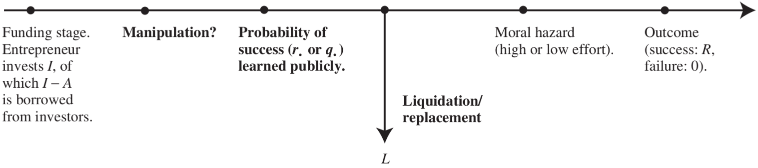


Figure 7.7

Source: Tirole (2006)

New ingredients

- At the intermediate stage, players receive a signal (e.g., a quarterly report) that tells the type of the manager.
- The manager's type is either:
  - $r.$, which means high ability.
  - $q.$, which means low ability.
- The dot refers to the fact that the probability of success is determined by the manager's ability and later effort, i.e., $r. = (r_H, r_L)$ or $q. = (q_H, q_L)$ with $r_H > q_H$ and $r_L > q_L$.

New ingredients cont'd

- At the funding stage the *a priori* probabilities are α and $1-\alpha$ for both abilities, respectively.
- So the probabilities of success in the case of continuation are:

$$\pi_{\cdot} = \begin{cases} r_{\cdot} & \text{with probability} \quad \alpha \\ q_{\cdot} & \text{with probability} \quad 1-\alpha \end{cases}.$$

- Assume that the manager's type is orthogonal (not related) to later moral hazard, i.e.,
  $r_H - r_L = q_H - q_L = p_H - p_L = \Delta p$.
- $p_H = \alpha r_H + (1-\alpha) q_H$ and $p_L = \alpha r_L + (1-\alpha) q_L$.
- Regardless of the type, shirking reduces the probability of success by Δp.

Example without manipulation

- The signal is publicly available and verifiable.
- The initial contract specifies whether the manager continues or not.
- As an example: if the replacement for the old manager is a similar manager with an unknown type, then the liquidation value (expected profit, the value investors receive) is

$$L = p_H \left(R - \frac{B}{\Delta p} \right).$$

- In the case of termination, L is an expected profit at this stage.
- To make it *ex ante* efficient for the manager to keep her job, we assume

$$q_H R > L.$$

Example without manipulation cont'd

- We rule out that a contract that guarantees either tenure or termination creates sufficient pledgeable income.

$$I - A > \max\left[p_H\left(R - \frac{B}{\Delta p}\right), L\right]$$

i.e.,

$$\begin{aligned} I - A >& L \\ I - A >& \alpha r_H\left(R - \frac{B}{\Delta p}\right) + (1-\alpha) q_H\left(R - \frac{B}{\Delta p}\right). \end{aligned}$$

- The incentive problem is independent of the manager's type, so the minimum reward $B/\Delta p$ that keeps the manager on her toes is insufficient to cover the investor's outlay in the case of a job guarantee.

Example without manipulation cont'd

- We assume that there is sufficient pledgeable income when termination is possible in the case of bad ability (investors then receive L).

$$I - A < \alpha r_H \left(R - \frac{B}{\Delta p} \right) + (1 - \alpha) L$$

with

$$q_H \left(R - \frac{B}{\Delta p} \right) < L < r_H \left(R - \frac{B}{\Delta p} \right).$$

Example without manipulation cont'd

- As usual, the borrower's utility equals the NPV of the project.

$$\begin{aligned} U_b(z^r, z^q) =& \alpha[z^r(r_H R) + (1 - z^r)L] \\ & + (1-\alpha)[z^q(q_H R) + (1 - z^q)L] - I. \end{aligned}$$

- z^r and z^q are the contracted-for probabilities of continuation for high and low-ability managers.
- The utility is maximized by a guaranteed tenure $z^r = z^q = 1$ (because we assume $q_H R > L$).

Example without manipulation cont'd

- But, guaranteed tenure $z^r = z^q = 1$ does not provide sufficient funds.
- Some contingent termination must be conceded that satisfied investors' break-even condition:

$$\begin{aligned}
&\alpha\left[z^r r_H\left(R-\frac{B}{\Delta p}\right)+(1-z^r)L_l^r\right] \\
&+(1-\alpha)\left[z^q q_H\left(R-\frac{B}{\Delta p}\right)+(1-z^q)L_l^q\right] \\
&\geq I-A.
\end{aligned}$$

- L_l^r and L_l^q ($\leq L$) are the lenders' return in the case of termination for managers with high and low abilities.
- Setting $L_l^r = L_l^q = L$ is optimal since it leaves the NPV unchanged but relaxes the investors' break-even constraint.

Example without manipulation cont'd

- To maximize both – NPV and pledgeable income – it is more efficient to retain a high-ability manager, therefore $z^r = 1$.
- If we define $z^q = z^*$, $z^* \in (0, 1)$ is the smallest possible value to satisfy the investors' break-even constraint:

$$\alpha r_H \left(R - \frac{B}{\Delta p} \right) + (1-\alpha) \left[z^* q_H \left(R - \frac{B}{\Delta p} \right) + (1 - z^*) L \right] = I - A.$$

$\Rightarrow$ Some termination in the case of low ability is the concession made by the manager to raise sufficient funds.

$\Rightarrow$ As usual: the manager sacrifices NPV to boost pledgeable income.

Manipulation

- In the example, we assumed that the signal is outside the control of the manager.
- Now: the manager can influence this signal at a cost.
- In detail: the manager can generate (secretly, by manipulating the relevant data) the high signal r. at a cost: the probability of success is uniformly reduced by $\tau > 0$.
- The entrepreneur may know her type when choosing whether or not to manipulate the information, i.e., informed manipulation.
- The entrepreneur manipulates the information without knowing her type and learns her type at the same time as the investors, i.e., uninformed manipulation.

Setup of the contract

The contract specifies:

a The probabilities of continuation z^r and z^q for signals r. and q..

b The reward $R_b \geq B/\Delta p$ in the case for continuation and success (and 0 otherwise).

Uninformed manipulation

- The manager decides about the signal r. for certain before she learns her type.
- We assume that it is optimal to induce the manager not to manipulate the information.
- Given uninformed managers, the no-manipulation constraint is:

$$z^r[(p_H - \tau)R_b] \leq [\alpha z^r r_H + (1-\alpha)z^q q_H]R_b.$$

Left: the expected reward in the case of manipulation.

- In that case, the manager sends the signal r. yielding continuation probability z^r.
- The average success probability is $p_H - \tau$.

Right: the expected reward when the manager does not manipulate and does not know her type.

Uninformed manipulation cont'd

- We can rewrite the constraint as:

$$\frac{z^r}{z^q} \leq \frac{1}{1 - \frac{\tau}{(1-\alpha)q_H}}.$$

- We need to fulfill this condition to have no manipulation.
- We see that z^r cannot be much greater than z^q (the decision to continue is made less signal dependent).
- Even for a meager cost of manipulation, the constraint would hold.
- Given that continuation for a good signal is otherwise more appealing, i.e., $z^r \geq z^q$.
- The greater the difference between z^r and z^q, the higher the likelihood of manipulation.

Informed manipulation 1/2

- The manager will only manipulate the information if she learns that she is inefficient.
- Again, it is optimal to induce the manager not to manipulate the information.
- Given informed managers, the no-manipulation constraint is:

$$z^r[(q_H - \tau)R_b] \leq z^q[q_H R_b].$$

Left: the expected reward in the case of manipulation.

Right: the expected reward when the manager does know that she is inefficient.

Informed manipulation

- We can rewrite the constraint as:

$$\frac{z^r}{z^q} \leq \frac{1}{1 - \frac{\tau}{q_H}}.$$

- It is harder to satisfy the no-manipulation constraint in the case of informed managers than for uninformed managers.
- The decision to continue must be made even less signal-dependent (z^r/z^q is close to one) compared to the case of *Uninformed Manipulation*.
- The manager has more incentives to look good when she knows that she is inefficient.
- In the case of uninformed manipulation, the cost τ is potentially wasteful when the manager learns that she is efficient.

The impact of manipulation on the initial contract 1/2

- We assume that $z^r = 1$ and $z^q = z^*$ (continuation is guaranteed by high ability).
- We also assume that the no-manipulation constraints are not satisfied:

$$
\begin{aligned}
\frac{1}{z^*} &> \frac{1}{1-\tau/(1-\alpha)q_H} \\
\frac{1}{z^*} &> \frac{1}{1-\tau/q_H}.
\end{aligned}
$$

- If we kept $z^r = 1$, we have to increase z^q above z^* in order to guarantee no manipulation.
- But, we cannot increase z^q above z^* because it would reduce pledgeable income, i.e., it is not possible for a lender to cover $I - A$.

The impact of manipulation on the initial contract 2/2

- Because raising z^q above z^* is not feasible, the job guarantee for high-ability managers has to be offset.
- The reduction in z^r reduces pledgeable income due to $r_H(R - B/\Delta p) > L$.
- Therefore, z^q must also decrease to compensate for the shortfall in pledgeable income.

$\Rightarrow$ The manager's ability to "cook the books" *ex post* may jeopardize funding *ex ante*.

$\Rightarrow$ Even if funding is feasible, potential accounting manipulations reduce the NPV.

Golden parachutes

- "Golden parachutes" are compensations that managers receive when employment is terminated (for questions of a better design, see Economist (2014b)).
- This seems suspicious because termination is mostly due to bad performance.
- On the one hand, golden parachutes are due to boards that do not want conflicts with the management.
- But, there is another rationale.

$\Rightarrow$ Golden parachutes can reduce the incentive for managers to engage in behavior such as accounting manipulations.

Golden parachutes

Big CEO payouts (Economist, 2010)

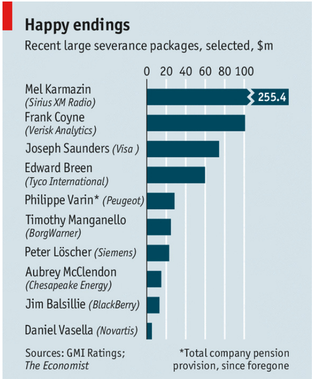
Big CEO payouts

Name	Company	Year	Payout package	Comments
Michael Ovitz	Walt Disney Company	1995	$140m	Costly falling out with boss and friend, Michael Eisner, after 14 months in the job
Percy Barnevik	Asea Brown Boveri	1996	SFr148m ($88m) pension, (SFr90m returned)	Payout disclosed in 2002 on same day company announced 2001 losses of $691m
Jack Welch	General Electric	2001	$9m a year pension and perks worth some $2m a year	Twenty years of successful leadership, significantly increased company's value
James Kilts	Gillette	2005	$165m	Doubled share price in five-year term, revived flagging Duracell battery business
Lee Raymond	Exxon Mobil	2005	$400m, including $98m lump-sum pension, use of company jet	Rode soaring oil prices to record profits
Henry McKinnell	Pfizer	2006	$99m and $82m pension	Share price sank by 40% during his five-year reign
Robert Nardelli	Home Depot	2007	$210m, incl. $84m shares	Company performed poorly under his leadership. Share price plunged but pay agreed during boom
Edward Whitacre	AT&T	2007	$158m including use of company jets for ten hours a month	Transformed smallest "Baby Bell" into world's largest communications company
Stan O'Neal	Merrill Lynch	2007	$161.5m	Left bank after huge write-downs, sold to BofA in 2008
Charles Prince	Citigroup	2007	$42m	Huge write-downs from subprime mortgages on his watch
Fred Goodwin	RBS	2008	£16.6m ($24m) pension (later reduced by a third)	Oversaw heavy subprime exposure, bailed out by government
John Thain	Merrill Lynch	2009	$11m shares	Spent $1.2m decorating his office, rushed out $3bn in bonuses before seeing through merger with BofA
Wendelin Wiedeking	Porsche	2009	€50m ($71m)	Made Porsche the most profitable car-maker in the world; left heavily indebted company over VW merger
Tony Hayward	**BP**	**2010**	**£1m ($1.6m, one year's salary) and £11m pension**	**Presided over record company losses because of Gulf of Mexico oil spill**

Sources: Company reports; press reports; *The Economist*

Golden parachutes

Severance packages (Economist, 2013)



Are golden parachutes beneficial?

- Golden parachutes are clearly costly because they reduce pledgeable income.
- But, golden parachutes help to relax the no-manipulation constraints because they increase the payoff for the manager in the case of liquidation (lower incentives to manipulate information about bad ability).
- The question is whether it is cheaper to prevent manipulation by making tenure relatively insensitive to new information (z^r is close to z^q) or by granting a golden parachute.

The case of informed managers

- We assume that the manager knows her type.
- The manager receives some amount $T \geq 0$ (the golden parachute) in the case of liquidation when she admits that prospects are poor (i.e., she is inefficient with q.).
- In this case the no-manipulation constraint is:

$$z^r[(q_H - \tau)R_b] \leq z^q[q_H R_b] + T.$$

- Again, $R_b = B/\Delta p$ to maximize pledgeable income.

NPV and pledgeable income

- The NPV is independent of T:

$$\begin{aligned} U_b(z^r, z^q, T) =& \alpha[z^r(r_H R) + (1 - z^r)L] \\ &+ (1-\alpha)[z^q(q_H R) + (1 - z^q)L] - I. \end{aligned}$$

- The pledgeable income is:

$$\begin{aligned} P(z^r, z^q, T) &= \alpha[L + z^r[r_H(R - R_b) - L]] \\ &+ (1-\alpha)[L + z^q[q_H(R - R_b) - L] - T] \\ &= I - A. \end{aligned}$$

- Obviously, the golden parachute is a cash transfer to the manager that does not change NPV.
- Continuation (no parachute) affects NPV.
- A golden parachute is used whenever continuation is inefficient, i.e., continuation with low ability reduces the NPV.

The trade-off between continuation and golden parachutes

- Assume $T > 0$, and that continuation under poor prospects yields a higher NPV than termination ($q_H R > L$).
- A unit increase in z^q decreases pledgeable income.

$$\frac{\partial P}{\partial z^q} = (1 - \alpha)[q_H(R - R_b) - L] < 0.$$

- So, the golden parachute must be reduced by

$$\left| \frac{dT}{dz^q} \right| = L - q_H(R - R_b).$$

The trade-off between continuation and golden parachutes cont'd

- This change leaves investors' income constant (cash transfer) but changes the *no-manipulation* constraint.

$$\begin{aligned} dz^q[q_H R_b] + dT &= dz^q[q_H R_b] + dz^q(q_H(R - R_b) - L) \\ &= dz^q[q_H R_b - L + q_H(R - R_b)] \\ &= (q_H R - L)dz^q > 0. \end{aligned}$$

- Thereby, the optimal golden parachute policy in the case of poor prospects that do not decrease NPV is to have $T^* = 0$.

The trade-off between continuation and golden parachutes cont'd

- If poor prospects reduce the NPV, i.e., $q_H R < L$, the *no-manipulation* constraint is reduced.

$$\begin{aligned} dz^q[q_H R_b] + dT &= dz^q[q_H R_b] + dT \\ &= dz^q[q_H R_b - L + q_H(R - R_b)] \\ &= (q_H R - L)dz^q < 0. \end{aligned}$$

- Therefore, it is cheaper to use the golden parachute policy than an insensitive tenure policy to keep the manager from manipulating information.
- When it is optimal to fire the manager under bad prospects, she is paid

$$T^* = z^r(q_H - \tau)R_b > 0 \quad \text{with} \quad z^{q*} = 0.$$

Conclusion

- "High-powered" incentive schemes increase incentives for managers to manipulate information about their quality.
- The threat of accounting manipulation creates inefficiencies and may lead to credit rationing.
- Manager must sacrifice NPV to get finance.
- The use of golden parachutes can reduce incentives for accounting manipulation.

Credit Rationing and Economic Activity

Goal of the lecture

- Macroeconomic implications of financial frictions.
- Different channels.

Readings

- Tirole (2006, Sections 13.1–13.3).

Introduction

- Financial constraints may impact the business cycle and monetary policy transmission.
  - Balance-sheet channel: in a recession, the collateral value decreases, leverage increases, and investment falls (i.e., through the balance sheets of firms).
  - Lending channel: impact of the health of financial intermediaries on firms' balance sheets.
- Theoretical framework to analyze the two channels.

Balance-sheet channel

- Study impact of changes in interest rates in the presence of financial constraints.
- Extend the basic model by endogenizing the interest rate to investigate the macroeconomic implications.
  - Special case: perfectly elastic savings function at a specific level of r.
- Real rate of interest: $r > 0$.

Savings

Investors

- Two-period economy: lending at $t = 0$, claims on firms pay off at $t = 1$.
- Associated consumptions: c_0, c_1.
- Investors' preferences: $U(c_0, c_1) = u(c_0) + c_1$.
  - $u(\cdot)$ increasing and concave.
  - Savings function imperfectly elastic and risk neutrality w.r.t. returns at $t = 1$.

Savings cont'd

Optimal consumption

- The problem:

$$\max_{\{c_0, c_1\}} \{u(c_0) + c_1\}$$

s.t.

$$c_0 + \frac{c_1}{1+r} = y,$$

where y is the investors' income.

- Equivalent to:

$$\max_{\{c_0\}} \{u(c_0) + (1+r)(y - c_0)\}.$$

- Hence:

$$u'(c_0(r)) = 1 + r,$$

with $c_0(r)$ decreasing in r because $u'' < 0$.

Savings cont'd

Savings function

- Given the optimal consumption above:

$$S(r) = y - c_0(r).$$

- Savings increase in r.
- Higher r affects investment negatively $\rightarrow$ exacerbated by financial constraints: let's see how.

Corporate investment

Basic fixed-investment model

- Continuum of mass 1 of risk-neutral entrepreneurs, each with:
  - Investment opportunity requiring an outlay of I.
  - Own wealth A.
  - Utility function: $U(c_0, c_1) = c_0 + c_1$ (more impatient than investors).
  - Limited liability: $c_1 \geq 0$.
  - Need to borrow $I - A$ to finance the project.

Moral hazard

- If the project succeeds, the verifiable return is R, otherwise 0.
- Entrepreneur's effort is non-verifiable.
  - With high effort, the success probability is p_H.
  - With low effort, success probability is p_L, where $\Delta p = p_H - p_L > 0$.
  - Low effort gives the entrepreneur a private benefit B (part of c_1).
- Same timing as in the single-firm model, but now we allow $r > 0$.
- Positive NPV only under high effort: $p_H R > (1 + r)I > p_L R + B$.

Corporate investment cont'd

Heterogeneity

- Heterogeneous initial wealth A across entrepreneurs.
- Distributed following c.d.f. $G(A)$, p.d.f. $g(A)$, with support $[A, \bar{A}]$.
- Assume $\bar{A} < I$ to focus on entrepreneurs that need external finance.

Loan agreement

- The loan agreement specifies how the return is shared between the borrower and the lender.
- $R = R_b + R_l$.
- Limited liability implies that $R_b \geq 0$ and $R_l \geq 0$.

Corporate investment cont'd

Incentive compatibility

- $\Delta p R_b \geq B$.
- Thus, pledgeable income is $p_H\left(R - \frac{B}{\Delta p}\right)$.
- Lowest cash on hand A allowing funding: $A^*(r)$, increasing in r.
- Necessary and sufficient condition to receive funding:

$$p_H\left(R - \frac{B}{\Delta p}\right) \geq (1+r)(I - A^*(r)).$$

Macroeconomic equilibrium

Financial market clearing

- Net corporate investment equals investors' savings: $\mathcal{I}(r) = \mathcal{S}(r)$.
- Net corporate investment:

$$\begin{aligned}\mathcal{I}(r) &\equiv \int_{A^*(r)}^{\bar{A}} (I - A)\, g(A)\, dA - \int_{\underline{A}}^{A^*(r)} A\, g(A)\, dA \\ &= (1 - G(A^*(r)))I - A^e,\end{aligned}$$

where $A^e \equiv \int_{\underline{A}}^{\bar{A}} A\, g(A)\, dA$.

Macroeconomic equilibrium cont'd

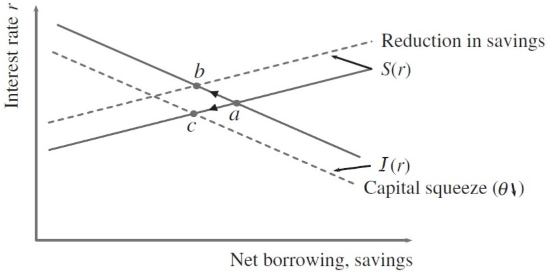


Figure 13.2

Source: Tirole (2006)

- Equilibrium in point a.
- Let's look at some comparative statics.

Savings reductions

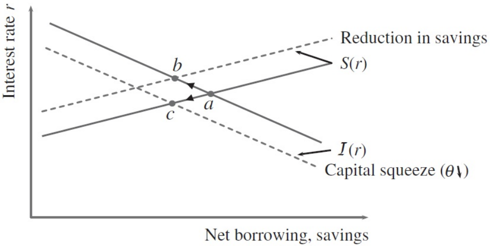


Figure 13.2

Source: Tirole (2006)

- Exogenous reduction of $\mathcal{S}(r)$ (curve moves up).
- Equilibrium goes from a to b.
  - $\mathcal{I}(r)\downarrow$.
  - $r\uparrow$.

Balance-sheet deterioration (capital squeeze)

- Distribution of the balance sheet of firms deteriorates.
  - Modeled through parameter θ of the distribution of A.
  - Based on first-order stochastic dominance, $\theta \uparrow$ improves the distribution: $G_\theta(A \mid \theta) \equiv \frac{\partial G}{\partial \theta} < 0$ where $A < A < \bar{A}$.
  - $r \uparrow$.
- Two effects on net corporate investment $\mathcal{I}(r, \theta)$:

$$\mathcal{I}_\theta = -G_\theta(A^*(r))I - \frac{dA^e}{d\theta}.$$

- Balance-sheet deterioration: $\theta \downarrow \Rightarrow$ two opposing forces.
  - Indirect effect (eviction).
  - Direct effect (greater needs).

Balance-sheet deterioration (capital squeeze) cont'd

Eviction

- Corresponds to the first term in $\mathcal{I}_\theta$: $-G_\theta(A^*(r))I$.
- Marginal firms exit the pool of borrowers because their balance sheets are too weak.
- $\theta \downarrow \Rightarrow G_\theta(A^*(r))I \uparrow \Rightarrow$ demand for funds $\downarrow$.

Greater needs

- Corresponds to the second term in $\mathcal{I}_\theta$: $-\frac{dA^e}{d\theta}$.
- Integrating by parts:

$$A^e \equiv \int_A^{\bar{A}} A\, g(A)\, dA = \int_A^{\bar{A}} A\, dG(A) = \bar{A} - \int_A^{\bar{A}} G(A \mid \theta)\, dA.$$

- Then: $\frac{dA^e(\theta)}{d\theta} > 0$.
- Therefore: $\theta \downarrow \Rightarrow$ demand for funds $\uparrow$ because of the reduction of entrepreneurs' average wealth A^e.

Balance-sheet deterioration (capital squeeze) cont'd

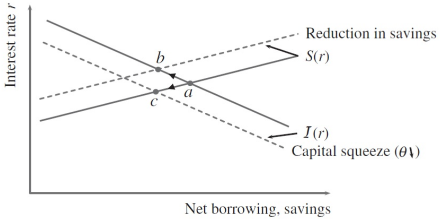


Figure 13.2

Source: Tirole (2006)

- Equilibrium goes from *a* to *c*.
  - In the figure, the eviction effect dominates the increase in entrepreneurs' needs.
  - Net borrowing declines.
- What happens to total investment $((1 - G(A^*(r)))I)$?
  - Only the eviction effect is present in this case.
  - Decreases unambiguously.

Adverse selection

- Introduce adverse selection (Stiglitz and Weiss, 1981; Mankiw, 1986) in the initial phase to the model.
- Study effect of interest rates on macroeconomic activity in two cases.
  - Effect on behavior.
  - Effect on the pool of firms.

Effect on behavior

Assumptions

- No heterogeneity in A.
- Private benefits B are heterogeneous.
- Distributed following c.d.f. $H(B)$, with support $[0, \bar{B}]$.
- Asymmetric information on B.
- Investors contribute $I - A$ to the "representative" entrepreneur.
  - All entrepreneurs look the same to investors.
  - Investors cannot screen out "bad" firms because these have a surplus from borrowing at least as large as "good" type firms.
- Loan agreement: $R = R_b + R_l$.

Effect on behavior cont'd

Loan agreement

- Entrepreneur exerts high effort if $B < B^*(R_b)$ and low effort if $B > B^*(R_b)$, where $B^*(R_b) = \Delta p R_b$.
- Investors' break-even condition:

$$\hat{p}(R_b)(R - R_b) = (1 + r)(I - A),$$

  where $\hat{p}(R_b) \equiv p_H H(B^*(R_b)) + p_L(1 - H(B^*(R_b)))$ (expected probability of success).
- $\hat{p}(R_b)$ is increasing in R_b.
  - $R_b \uparrow \Rightarrow$ entrepreneur has more skin in the game (debt $\downarrow$).
  - $r \uparrow \Rightarrow$ debt $\uparrow$ for a certain $\hat{p}(R_b) \Rightarrow R_b \downarrow \Rightarrow$ entrepreneur has less skin in the game, etc.
  - This may lead to a lending breakdown.

Example

Setting

- $p_L = 0$, $\bar{B} = 1$, B follows uniform distribution on $[0, 1]$.
- Hence, $H(B^*) = B^* = \Delta p R_b = p_H R_b$.
- Expected probability of success: $\hat{p}(R_b) = p_H B^* + p_L(1 - B^*) = p_H^2 R_b$.
- Investors' break-even condition: $p_H^2 R_b(R - R_b) = (1 + r)(I - A)$.

Example cont'd

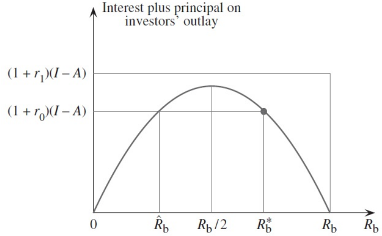


Figure 13.3

Source: Tirole (2006)

- Interest rate at r_0: two equilibria satisfying break-even.
  - At $\hat{R}_b$.
  - At R_b^* (socially optimal and stable).
- Interest rate at r_1: lending breakdown from a tiny increase in r.

Effect on the pool of firms

Assumptions

- No heterogeneity in A or B, with $A = 0$.
- Now heterogeneity in probability of success of the project (i.e., profitability): $p + \tau$.
  - $p_H + \tau$ if high effort.
  - $p_L + \tau$ if low effort.
- Distributed following c.d.f. $H(\tau)$, with support $[\underline{\tau}, \bar{\tau}]$.
- Asymmetric information on τ.
- Truncated means:
  - $\tau^+(\tau) \equiv E(\tilde{\tau} \mid \tilde{\tau} \geq \tau) = \frac{\int_{\tau}^{\bar{\tau}} \tilde{\tau} h(\tilde{\tau}) d\tilde{\tau}}{1 - H(\tau)}$.
  - $\tau^-(\tau) \equiv E(\tilde{\tau} \mid \tilde{\tau} < \tau) = \frac{\int_{\underline{\tau}}^{\tau} \tilde{\tau} h(\tilde{\tau}) d\tilde{\tau}}{H(\tau)}$.
- Incentive compatibility constraint:

$$((p_H + \tau) - (p_L + \tau))R_b \geq B.$$

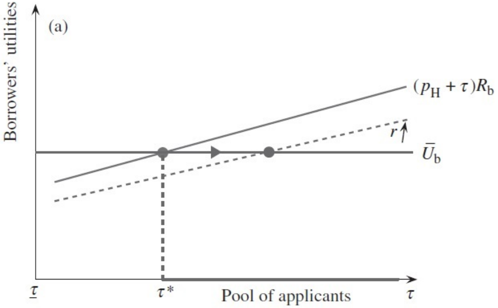
  - Benefit of τ specification: separate analysis of incentive and adverse selection problem.

Case 1: good types applying for loans

- Type-independent entrepreneurs' reservation utility: $\bar{U}_b$.
- For a certain R_b, only firms such that $\tau > \tau^*(R_b)$ apply for a loan, with $\tau^*(R_b)$ such that $(p_H + \tau^*(R_b))R_b = \bar{U}_b$.
- Investors' expected payoff: $(p_H + \tau^+(\tau^*(R_b)))(R - R_b)$.
- Hence, for a certain r, the investors' break-even condition is:

$$\underbrace{(p_H + \tau^+(\tau^*(R_b)))(R - R_b)}_{\text{decreasing in } R_b} = (1 + r)(I - A).$$

Case 1: good types applying for loans cont'd



Source: Tirole (2006)

- Ceteris paribus, $r \uparrow \Rightarrow R_b \downarrow \Rightarrow \tau^* \uparrow$ (i.e., better applicant pool).

Case 2: bad types applying for loans

- Type-dependent entrepreneurs' reservation utility: $\bar{U}_b(\tau)$.
- Assuming that $\bar{U}_b(\tau)$ grows more quickly than the expected payoff from getting the loan and undertaking the project ($(p_H + \tau^*(R_b))R_b$), only firms such that $\tau \leq \tau^*(R_b)$ apply for a loan.
- $\tau^*(R_b)$ is now obtained from: $(p_H + \tau^*(R_b))R_b = \bar{U}_b(\tau^*(R_b))$.
- Hence, for a certain r, the investors' break-even condition is:

$$(p_H + \tau^-(\tau^*(R_b)))(R - R_b) = (1 + r)(I - A).$$

Case 2: bad types applying for loans cont'd

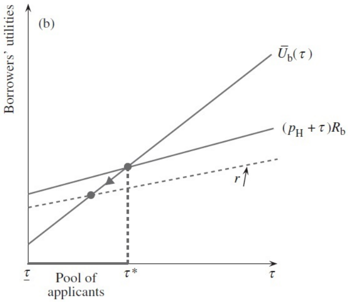


Figure 13.4 (a) Case 1; (b) case 2.

Source: Tirole (2006)

- $r \uparrow \Rightarrow R - R_b$ (debt burden) $\uparrow$, but $\tau^* \downarrow$ and $\tau^- \downarrow \Rightarrow$ further $R - R_b \uparrow$, etc.
- Potential lending breakdown.

Lending channel

Intuition

- So far, we looked at the weakness of the nonfinancial corporate sector (balance-sheet channel).
- But also the weakness of lending institutions can impact macroeconomic conditions (lending channel).
- Credit crunch: erosion of banking sector capitalization $\Rightarrow$ not able to finance all profitable projects available.
- Similar idea applies to other financiers providing "informed capital", like a venture capitalist.
- Credit rationing can arise both from the nonfinancial and the financial sector (Holmstrom and Tirole, 1997).

The setting

Assumptions

- Three sectors:
  - Borrowing firms.
  - Monitoring banks.
  - Investors (uninformed).
- Each sector comprises a continuum of risk-neutral agents (no market power).
- Two (gross) rates of return in equilibrium:
  - To investors: γ.
  - To monitors: χ.
  - Monitoring is remunerated: $\chi > \gamma$.
- Usual fixed-investment framework.

The players

Borrowing firms

- Continuum of firms of mass 1.
- Each faces the usual fixed-investment (I) problem.
- Three possible levels of probability of success/private benefits:
  - Good: p_H, 0.
  - Bad: p_L, b.
  - BAD: p_L, B.
  - With $p_H > p_L$, $B > b > 0$.
- Positive NPV only in the first case:

$$p_H R - \gamma I > 0 > (p_L R - \gamma I) + B.$$

- Heterogeneity in own wealth A, distributed following $G(A)$ on the support $[0, \infty]$.

The players cont'd

Monitoring banks

- Continuum of banks of mass 1 with capital K_m.
- Each asks a return χ.
- Each can rule out the BAD project by paying monitoring cost c.

Uninformed investors

- As each of them is small, they stay uninformed and free-ride the monitoring performed by banks.
- Each asks a return γ.

Market equilibrium

Market equilibrium

- With an exogenous interest rate:
  - Storage technology provides γ to uninformed investors.
  - Perfect elasticity of savings at $r = \gamma - 1$.
- With an endogenous interest rate:
  - Aggregate savings by uninformed investors: $\mathcal{S}(\gamma)$.
  - Increasing in γ.
- Intermediation vs. certification.

Exogenous interest rate

Only direct finance by uninformed investors

- Conditional on getting the loan, the entrepreneur's NPV is $U_b^* \equiv \frac{p_H R}{\gamma} - I$.
- Uninformed investors provide funding only if pledgeable income is high enough.
- Sharing rule of R: R_b to the entrepreneur, R_u to uninformed investors.
- Investors' break-even: $p_H R_u \geq \gamma(I - A)$.
- Incentive compatibility: $\Delta p R_b \geq B$.
- Then:

$$A \geq \bar{A}(\gamma) \equiv I - \frac{p_H}{\gamma}\left(R - \frac{B}{\Delta p}\right).$$

- In the absence of banks, no funding if $A < \bar{A}(\gamma)$, with $\bar{A}(\gamma)$ increasing in γ.

Exogenous interest rate cont'd

Adding monitored finance

- Certification role of banks.
- Sharing rule of R: R_b to the entrepreneur, R_u to uninformed investors, R_m to banks.
- The initial outlay is covered by the entrepreneur's initial wealth A, the monitor's loan I_m, and uninformed investors' funding $I_u = I - A - I_m$.
- Returns: $p_H R_m = \chi I_m$ and $p_H R_u = \gamma I_u$.
- The storage technology providing a return γ is also available to the entrepreneur, so her net utility is:

$$U_b = \frac{p_H(R - R_m - R_u)}{\gamma} - A = \frac{p_H R - (\chi - \gamma) I_m}{\gamma} - I.$$

Exogenous interest rate cont'd

Adding monitored finance cont'd

- $\chi > \gamma$ to remunerate the bank for paying c instead of staying uninformed: $\chi I_m - c \geq \gamma I_m$.
- Then, the entrepreneur prefers not to resort to a bank if $A \geq \bar{A}(\gamma)$.
- If $A < \bar{A}(\gamma)$, the entrepreneur will still seek to minimize reliance on monitored finance I_m.
- Assume that $\Delta p R_b < B$ and $\Delta p R_b \geq b$.
  - Need for monitoring.
  - High effort if monitored.
- Monitoring bank's incentive compatibility: $\Delta p R_m \geq c$.
- Monitoring bank's minimum investment:

$$I_m \geq I_m(\chi) \equiv \frac{p_H c}{\Delta p \chi}.$$

Exogenous interest rate cont'd

Adding monitored finance cont'd

- The entrepreneur gets funding from uninformed investors in the presence of a monitor iff:

$$\frac{p_H(R - (b + c)/\Delta p)}{\gamma} \geq I - A - I_m(\chi).$$

- Or $A \geq A(\gamma, \chi)$, which increases in γ and χ.
- As $\chi > \gamma$: $A(\gamma, \chi) < \bar{A}(\gamma)$ iff $c < \bar{c}$, with $\bar{c} > 0$.
- The entrepreneur is better off obtaining monitored funding if her net utility:

$$U_b = \frac{p_H R - (\chi - \gamma) p_H c/(\Delta p \chi)}{\gamma} - I \geq 0.$$

- Monitoring rent vs. no monitoring rent.

Exogenous interest rate cont'd

Macroeconomic equilibrium

- Clearing of demand and supply of monitored finance:

$$K_m \geq (G(\bar{A}(\gamma)) - G(A(\gamma, \chi)))I_m(\chi).$$

- Inequality in the absence of monitoring rents $((\chi - \gamma)I_m(\chi) = c)$.

Endogenous interest rate

Macroeconomic equilibrium

- Need to impose clearing of savings market as well in this case.
- χ and γ must be such that:

$$\mathcal{S}(\gamma) = \int_{\bar{A}(\gamma)}^{\infty} (I - A)\, dG(A) + \int_{A(\gamma,\chi)}^{\bar{A}(\gamma)} (I - A - I_m(\chi))\, dG(A) - \int_0^{A(\gamma,\chi)} A\, dG(A).$$

  - Firms with $A > I$ save the excess cash in other firms.
- Combining the two market clearing conditions, we obtain the equilibrium rates χ and γ.
- Let's look at some comparative statics.

Different types of recessions

Types

- Industrial recession.
  - Balance-sheet channel: a decrease of θ leads to a deterioration of the distribution $G(A)$.
- Credit crunch.
  - Lending channel: reduction of K_m.
- Lack of savings.
  - Reduction of $\mathcal{S}$.

Consequences

- Decline in aggregate investment $\mathcal{I}$.
- Increase of $A(\gamma, \chi)$.

Effects of a credit crunch

Weak firms ($A < A < \bar{A}$)

- Firms that can get funding only in the presence of a monitor are worse off.
- $K_m \downarrow \Rightarrow \chi \uparrow \Rightarrow$ marginal firms exit the pool of borrowers, the others pay higher funding costs.

Strong firms

- No direct effect on them because they rely on direct (uninformed) finance.
- Possibly even better off as weak firms may demand less direct finance driving down its cost, i.e., it is possible that $\chi \uparrow$ and $\gamma \downarrow$.

Monitoring banks

- They get a rent only if K_m is low enough.

Conclusion

- We analyzed the role of financial frictions in a simple macroeconomic framework.
- Both the financial health of borrowers and lenders matter for aggregate outcomes.

Credits

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