Econ 234C – Corporate Finance

Lecture 13: Initial Public Offerings (IPOs), Corporate Governance

Ulrike Malmendier
UC Berkeley

April 30, 2008

IPOs: The Initial Underpricing Puzzle

Model 1: (Rock 1986)
Asymmetric Information between Informed Investors and Uninformed Investors (Firm is uninformed.)

- Models underpricing as a rational equilibrium in the presence of (potential) 'winner's curse.'

- Intuition:

  - If some investors have better information about company prospects than others, they will buy fewer shares when prospects are low.
  - In order to attract less informed invesetors, shares are sold at a discount.

Model 2:
Asymmetric Information between Informed Firm and Uninformed Investors

- Models underpricing as a signal of quality ('burning money').

VERSION 1: **Rock Model** (*improved lecture notes*)

Model Set-Up

- Two kinds of potential investors in IPO
  - Informed (I)
    - Perfect information about the value of the firm (realization v of random value $\tilde{v}$ per share).
  - Uninformed investors (N)
    - Only know the probability distribution over values.
  - Investors risk-neutral.
  - Investors have wealth $= 1$.

- Firm
  - Firm is uninformed.
  - Sets price per share (p) and quantity of shares (Z).
  - Need participation of uninformed agent to clear market.
- Safe asset, with return of 1.
- No short-sales.
- Investors cannot bid/borrow more than their wealth.

Key Steps

- Informed investors have 0/1 demand.
  - If $p < v$, then demand all, I.
  - If $p > v$, then demand is 0.
- Uninformed investors' demand is some fraction T of their wealth.
- Total demand is therefore:
  - $NT + I$ if $p < v$
  - NT if $p > v$

- Who's order will be filled if oversubscribed?
  - **Assumption**: orders are picked randomly ('are assigned a lottery number'), and conditional on being chosen, an order is filled in entirety.
    - Ignore rounding error.
    - Denote with $\tilde{n}_u$ the number of uninformed orders filled and with $\tilde{n}_i$ the number of informed orders being filled. Then we have

$$\tilde{n}_u T + \tilde{n}_i \mathbf{1} = pZ \text{ if } b < 1 \text{ and } p < v$$

and

$$\tilde{n}_u T = pZ \text{ if } b < 1 \text{ and } p > v$$

    - Taking expectations, we obtain

$$bNT + bI = pZ \text{ if } b < 1 \text{ and } p < v$$

and

$$b'NT + b'I = pZ \text{ if } b < 1 \text{ and } p > v.$$

– Probability of receiving shares (i.e., probability of 'order being filled') if issue price is less than value, $p < v$:

$$b = \min\{pZ/(NT + I), 1\}$$

– Probability of receiving shares (of order being filled) if issue price is greater than value, $p > v$:

$$b' = \min\{pZ/NT, 1\}$$

- **Insight**: $b < b'$, i.e. probability of receiving shares higher if overpriced
$\Longrightarrow$ Uninformed agent is more likely to receive shares if issue overpriced.
$\Longrightarrow$ Uninformed agent revises valuation downwards.
$\Longrightarrow$ Issuer must price at discount = compensation for receiving disproportionate number of shares if overpriced.

Terminal Wealth of Uninformed Agent

	$p < v$ (underpriced)		$p \geq v$ (overpriced)	
Allocation	Yes	No	Yes	No
Wealth	(v/p)*T + (1-T)	1	(v/p)*T + (1-T)	1
Probability	b•Pr$\{p < v\}$	(1-b)•Pr$\{p < v\}$	(b')•Pr$\{p \geq v\}$	(1-b') •Pr$\{p \geq v\}$

Expected Terminal Wealth of Uninformed Agent

$$
\begin{aligned}
& b \cdot \mathsf{Pr}\left\{p < \tilde{v}\right\} \cdot E\left[U\left(\mathsf{1} + T\left(\frac{\tilde{v}}{p} - \mathsf{1}\right)\right)|p < \tilde{v}\right] \\
& + b' \cdot \mathsf{Pr}\left\{p \geq \tilde{v}\right\} \cdot E\left[U\left(\mathsf{1} + T\left(\frac{\tilde{v}}{p} - \mathsf{1}\right)\right)|p \geq \tilde{v}\right] \\
& + \left[\left(\mathsf{1} - b\right) \cdot \mathsf{Pr}\left\{p < \tilde{v}\right\} - b' \cdot \mathsf{Pr}\left\{p \geq \tilde{v}\right\}\right)\right] U(\mathsf{1})
\end{aligned}
$$

First order condition for optimal bid of uninformed agent:

$$
\begin{aligned}
\partial(\cdot)/\partial T \;\; = \;\; & b \cdot \mathsf{Pr}\left\{p < \tilde{v}\right\} \cdot E\left[U'\left(1 + T\left(\frac{\tilde{v}}{p} - 1\right)\right)\left(\frac{\tilde{v}}{p} - 1\right)|p < \tilde{v}\right] \\
& + b' \cdot \mathsf{Pr}\left\{p \geq \tilde{v}\right\} \cdot E\left[U'\left(1 + T\left(\frac{\tilde{v}}{p} - 1\right)\right)\left(\frac{\tilde{v}}{p} - 1\right)|p \geq \tilde{v}\right] \\
& \overset{!}{=} 0
\end{aligned}
$$

Insight:

Choice of T determined by relative probability of being rationed if the issue is underpriced vs. overpriced, b/b'.

Theorem 2

For large markets and any price below $E[\tilde{v}]$, $d[T(b(p,N),p)]/dp < 0$.

In words:

- If price is below mean value, then as the price of the offering falls, uninformed investors demand more.

- *Intuition*:

  - Suppose price equals mean value of shares, $p = E[\tilde{v}]$.

    * Informed investors may or may not submit orders (in either case insufficient to buy entire issue); uninformed investors earn expected return $=$ return of safe asset $==>$ don't submit bids.

- Now suppose price is lowered below mean value.
  - Uninformed start submitting orders.
  - At some low enough price, demand of informed + uninformed investors exactly equals supply in the good state (but not in the bad state).
  - As price further falls, uninformed demand grows further; uninformed start dominating the market and the probability of receiving shares in the good and the bad state become more and more similar.

- *Summary*: As price declines, increases in demand of uninformed investors increase the ratio b/b', i.e., rationing still exists, but relative rationing is much lower (i.e. also rationing in the 'bad state') and therefore the uninformed investor is willing to buy.

Model Implications

- Informed investors make money.
- Uninformed investors break even (participation constraint).
- PC determines price.
- To attract uninformed investors ("dogs"), must underprice on average, so that they are still willing to participate.

VERSION 2:

Model assumptions: usual asymmetric information assumptions

- Manager / entrepreneur has investment project costing I, no cash on hand $C = 0$.

- Project is of good quality or of bad quality:
  - Returns: $\begin{cases} \text{good} \quad \Longrightarrow & \text{return } R \text{ w/prob. } p, \\ & \text{else return } 0; \\ \text{bad} \quad \Longrightarrow & \text{return } R \text{ w/pr. } q < p, \\ & \text{else return } 0. \end{cases}$
  - Two cases: $\begin{cases} \text{only good project creditworthy:} & pR > I > qR \\ \text{both projects creditworthy} & pR > qR > I \end{cases}$

- Entrereneur, investors risk neutral.

- Entrepreneur protected by LL.

- Interest rate normalized to 0.

- Competitive capital markets.

- *Key assumption*: project quality = private information of firm.

- Investors' prior on success probability:

$$m \equiv \alpha p + (1-\alpha)q$$

- Firms have assets $A > 0$.

- Assets can be pledged to investors, but would also be of full value to firm.

- We consider contracts $\{R_m, 0\}$ **plus** A goes to ('is pledged to') investors.

- **Intuition of what follows:**

  - By pledging all of A to the lender, good firms increase the cost to bad firms of accepting any given offer. (So, they want to pledge as much as possible! And both in the case of success and in the case of failure.)

  - Good firms / investors want to drive out bad firms; hence make contract that would set their expected profits to 0. (Or, more generally, to the minimum profit so that the bad firms do not enter).

- Further assumptions:
  - Denote with R_m^g the rent paid to a good firm under symmetric information:
  $$p(R - R_m^g) + A = I \Longleftrightarrow R_m^g = R - \frac{1}{p}(I - A)$$
  - Assume $I > qR + A$, but $I \leq pR + A$
    - Interpretation?

      Answer: Only good firm creditworthy / has enough pledgeable income!
  - Also assume: $A < qR_m^g$.
    - Interpretation?

      Answer: Bad firm happy to enter contract / to pledge her entire wealth / mimics good firm.

      $\Longrightarrow$ Utility of good firms reduced due to presence of bad types.

- **Question**: Can we find a contract that is unappealing to the bad type, still let the investor break even, and make the good type better off?

- Consider a contract that sets the *change* in expected utility for the bad firm from entering the contract equal to 0: $qR_m - A = 0$, so $R_m = \frac{A}{q}$.

  - *Note:* expected utility of bad firm from **not** entering the contract is A, total expected utility of bad firm from entering the contract is $qR_m = A$.

  - *Note (2):* Implicit assumption that bad entrepreneur does not enter if indifferent.

- (Change in) expected utility of good firm?

  Answer: $pR_m - A > 0$, i.e., good firm make money in expectations.

- Expected profit of investors?

  Answer: Knowing that facing a good firm: $p(R - R_m) + A - I$

$$\begin{aligned} & p(R - R_m) + A - I \\ = \ & p(R_m^g - R_m) \end{aligned}$$

  and $R_m^g > \frac{A}{q} = R_m$, hence positive.

- Interpretation:
  - Good firms raise equity funds at a price lower than investors' participation constraint requires = give out a higher fraction of total shares (for a given amount of cash inflow) than the PC requires.
  - For bad firms, keeping all shares + receiving no cash + not being able to invest is better than issuing the high number of shares + receiving cash + investing the cash.

- Implication:

  1. Investors make profit and the "new shares" are underpriced.

  2. Rationing at issuance. (Excess demand!)

  3. Once issued the price should adjust immediately upward.

- Limitations of the analysis:

  – It is possible to find better contracts: could "bribe" bad investors to go away by letting them take a lump sum payment out of the financing instead of investing. Pareto dominates because no negative NPV investment occurs.

  – Also ignores possibility of random financing or screening fees.

- ‘Burning-Money’ model:
  - Good firm “burns money” (leaves money on the table) in order to signal to investors that they are good firms.
  - Idea of one possible cause of the underpricing-it is a signal to the market that this firm has good prospects.
  - No evidence to support “burning money” models (good firms underprice more than bad firms as a signal to the market $->$ can afford to waste money).

IPOs: The Long-Run Underperformance Puzzle

$\longrightarrow$ Jay Ritter (1991), "The long-run performance of initial public offerings," *Journal of Finance* 42, pp.365-394:

- Computes three-year performance of issuing firms. (Sample period: 1975-1984)
- Computes returns using equally weighted portfolio. (Overweights small-cap firms from a portfolio perspective!)
- Finds that IPOs are poor investment relative to all benchmarks:
  - NASDAQ
  - Index of AMEX/NYSE
  - Matched firms (for each firm: similar firm not going through IPO)
  - Small stocks

$\longrightarrow$ Similar results in Tim Loughran and Jay Ritter (1995), "The New Issues Puzzle," *Journal of Finance* 50, pp.23-51:

- Five year returns are 50% less than size-matched firms
- Average wealth relatives are
  - 0.70 vs. size-matched firms;
  - 0.84 vs. S&P 500.
- But again ... returns are equal weighted.

- Explanation: 'Market-timing' type of explanation
  - Investors are periodically overoptimistic about earnings potential of young growth companies.
  - Firms take advantage of these "windows of opportunities."
- **But**: Has Ritter adjusted enough?
  - Fama-French adjustment for book-market ratio (investment opportunities; profitability; agency costs?)

LR Underperformance puzzle challenged in (among other papers):

- Alon Brav and Paul Gompers, "Myth or Reality? The Long-Run Underperformance of Initial Public Offerings: Evidence from Venture and Nonventure-backed Companies"

- Matching methodology:
  - Create 5x5 size and book-to-market portfolios that exclude IPO (and SEO) firms
  - Match IPO firms to size and book-to-market portfolios
  - Compute five year buy-and-hold excess returns

- Finding: No strong pattern of underperformance!
  - Venture-backed: small-size, low B/M outperform small, low benchmark by 42%.
  - Non-venture-backed: small-size, low B/M outperform small, low benchmark by 12%
  - *Conclusion:* IPO underperformance is not an issuing firm effect, but a small low book-to-market effect.

Corporate Governance

THEORY: Optimal monitoring / auditing contract

- Seminal paper: Townsend (1979) Costly State-Verification (CSV) Model
- (Original) context: Derive optimal mix of securities / capital structure *given misaligned incentives of managers*.
- Link to Corporate Governance:
  - Explicit assumption about 'hiding income (accounting fraud, perks, option timing ...)
  - Explicit derivation of optimal contractual/monitoring response.

- Assumption 1: Managers prefer to hide (steal) income.
  - *Side note*: later capital-structure literature moved instead to 'private benefits of control' or 'shirking' as the source of the basic conflict of interests. But 'stealing' assumption useful, too. (Esp. in light of recent accounting issues!)
- Assumption 2: Lenders can verify income at cost K (e.g. auditing cost).

- Set up:
  - firm, investors risk-neutral
  - (non-cash) assets A, for simplicity $A = 0$;
  - cash C,

- cost of investment I,
- return to investment $R \in [0, \infty)$,
  - stochastic (density $f(R)$)
  - observable but not verifiable

- Timeline

- Question: Optimal contract design?

Proposition: *For any contract satisfying (PC) with equality and satisfying the (IC) constraint of the firm ("no lying") with expected payoff E[w] for the firm, there is a standard debt contract resulting in a (weakly) higher expected payoff.*

Proof:

STEP 1: Show that for any contract, there is a debt contract with weakly higher repayment to the investors and lower auditing costs than the the original contract.

STEP 2: For any such debt contract (derived in STEP 1), there is another debt contract with equal repayment to the investors as in the original contract and lower auditing costs than in the original contract and in the first debt contract.

STEP 1: Consider an arbitrary contract satisfying (PC) and (IC) with auditing region $\Re_0$, no-audit region $\Re_1$, and constant repayment D for all $\hat{R} \in \Re_1$.

Now consider a debt contract with auditing region $\Re_0^D = [0, D)$, no-audit region $\Re_1^D = [D, \infty)$, and constant repayment D for all $\hat{R} \in \Re_1^D$.

The expected audit cost under the debt contract is weakly smaller than under the original contract since $\Re_1 \subseteq \Re_1^D$

The expected repayment to investors under the debt contract is weakly smaller than under the original contract since (i) the repayment is identical $\forall R \in \Re_1$ (namely D), (ii) the repayment is weakly smaller under the original contract than under the debt contract $\forall R \in \Re_0 \cap \Re_1^D$ (since it is D under the debt contract but weakly less under the orignal contract by Lemma 3), and (iii) the repayment is weakly smaller under the original contract than under the debt contract $\forall R \in \Re_0 \cap \Re_0^D$ (since it is $R - K$ is the maximum available).

STEP 2: Suppose investors obtain strictly positive surplus (rather than exactly their reservation repayment) under the debt contract in STEP 1. Then $\exists D' < D$ s.t. $[1 - F(D')]D' + \int_0^{D'} Rf(R)dR - F(D')K = I - C$ (i.e. a D'such that the participation constraint is binding). Under this new debt contract, audit costs are lower since $\Re_1^D \subset \Re_1^{D'}$ and the expected repayment to the investors is lower (equal to reservation repayment) by construction.

Remarks:

- Paper starts the 'security design' literature: endogenous derivation of contract design of financial securities.
- *Note*: the classic debt-contract result is not robust to random auditing.
- *Note*: the result is also not robust to renegotiation (i.e. if parties cannot commit not to renegotiate auditing, see Gale and Hellwig (1989))

Relevance for Corporate Governance

- Model assumption: 'borrower cannot consume any portion of R before audit but can withdraw the entire residual after audit.'
- Interpretation 1: manager steals, but can be forced to repay (and is liquid enough to repay) in case of audit.
- Interpretation 2: manager can transform hidden income over time into private benefits (only if firm is not shut down).

EMPIRICS: Exogenous variation in monitoring / auditing / entrenchment

Starting point: **CEO pay**

- Some facts
  - CEO pay has increased $\sim$ **600%** over last 20 years; average worker's pay by $\sim$ **15%**
  - Median CEO pay in 2000: 60% equity-based (valued at grant date); in 1990 only 8%.
- Question: appropriate pay-for-performance sensitivity?
  - Jensen and Murphy (1990): "Are CEOs paid like Bureaucrats?"
    - Compensation data 1974-1986
    - \$1,000 increase in firm value increases CEO wealth (due to pay, options, stocks) by only \$3.25. $\Longrightarrow$ 'too low'

  - Hall and Liebman (1998)
    * Compensation data 1980-1994
    * \$1,000 increase in firm value increases CEO wealth by \$6.00
    * Sensitivity larger when scaled by managers' wealth instead of firm value. E.g. in 1994, median CEO at 10th percentile of performance loses \$436k, at 90th percentile makes \$8.6m.
  - 1990s: Dramatic increase of CEO pay and stock option grants
  - CEOs not bureaucrats, but what are they?

- Problems:
  - If company does badly, options are repriced –> lose incentives
  - Bertrand-Mullainathan (2004): Rent seeking by CEO to get higher pay
  - Bertrand-Mullainathan (2002): CEOs rewarded for luck
  - Why do rank-and-file wokers get options?

Example 1: Bertrand-Mullainathan (2001)

- Topic: CEO pay ("Are CEOs rewarded for luck?")
- Data on CEO pay (salaries + stock options) + company performance (accounting / stock returns) from ExecuComp, CRSP, Compustat
- w_t = pay at time t
- y_t = performance at time t
- X_t = set of controls
- L_t = luck variables measured at time t

Empirical specification:

- First stage: $$y_t = \alpha + \beta_0 X_t + \beta_1 L_t + \varepsilon_t$$
  - Obtain predicted performance based on luck: $\hat{y}_t$
- Second stage: $$w_t = \gamma + \delta X_t + \lambda \hat{y}_t + \varepsilon_t$$
  - Coeffcient on λ should be zero according to standard principal/agent model
- Measures for L :
  1. price of oil on pay in 51 US oil companies: 1977-1994
  2. industry-specific exchange rate: 792 corporations (Yermack and Shleifer data)
  3. mean accounting return in 2-digit industry (excluding same company)

- Why is there pay for luck?
  - CEOs stealing.
  - Inability of board (monitors): mis-take luck for ability.
  - Collusion / preference of board for high pay + justifiability of pay (tangible measures) towards shareholders. (Similar to 'outcry constraint' of Bebchuck and Friedman.)

- Does this result partly go away in better-managed firms?
  - Proxy: number of large shareholder in board
  - Check on actions of CEO
  - New second stage:

$$w_t = \gamma + \delta X_t + \lambda \hat{y}_t + \lambda GOV * \hat{y}_t + \varepsilon_t$$

Example 2: Bertrand and Mullainathan (2004, JPE): Enjoying the Quiet Life

- *Anti-takeover laws.*

- Business combination laws that make takeovers more difficult: most stringent; moratorium (3-5 yrs) on assets sales, mergers.

- Exploit variation in implementation across states

- Diff-in-Diff – outcome y

$$y_{i,t} = \alpha + \beta d_{i,t} + \eta_i + \varphi_t + \varepsilon_{i,t}$$

  where i is state, t is year and $d_{i,t} = 1$ if antitakeover law is in place in state i in year t

Effects of anti-takeover laws

- Blue-collar wages rise by 1%
- White-collar wages rise by 4%
- Rate of plant destruction falls.
- Rate of plant creation falls!
- Total factor productivity decreases by 1%
- Return on capital decreases by 1%

Open Questions

- Boards
  - Optimal composition of boards
  - Optimal decision-making mechanism on boards. (What should be approved by board, what not?)
  - Optimal compensation structure for board members.
  - Key: instrument (regulation)
- Fraud detection

- Appropriate (shareholder-value maximizing) CEO compensation and monitoring
  - CEO selection
  - CEO incentives
- For all of the above:
  - careful modelling!
  - data from other countries (different reforms, different institutions, ..)

Readings for next week:

* Malmendier, Ulrike and Geoffrey Tate (2005), "CEO Superstars," Working Paper.

* Ariely, Dan; Gneezy, Uri; Loewenstein, George; and Nina Mazar (2005). "Large Stakes and Big Mistakes," Working Paper.