INVESTMENTS FINANCE ECF5103

LECTURE 7

R P Beatty and J R Ritter, "Investment banking, regulation and the underpricing of initial public offerings", *JFE* (1986)

In their paper, they argue that there is an equilibrium relation between the expected underpricing of an initial public offering and the ex-ante uncertainty about its value.

They suggest that an issuing firm, which will go public only once, cannot make a credible commitment by itself that the offering price is below the expected market price once it starts trading. Instead, an issuing firm must hire an investment broker to take the firm public. An investment broker is in a position to enforce the underpricing equilibrium because it will be involved in many IPOs and has reputational capital at stake.

The relation between ex-ante uncertainty and expected initial return

Ritter (1984) reports that for the approximately 5,000 firms that went public in the US between 1960-1980, the average initial public offering was trading at a price 18.8% higher than its offering price shortly after public trading started.

This does not imply that an investor can expect to realise excess returns because of institutional features of the market.

Once the offering price is set, any excess demand for the issue creates a situation of quantity rationing rather than further adjustment of the offering price. A representative investor will find he is allocated shares in offering that go up in price less frequently in offerings that decline in price.

- an investor faces a 'winner's curse'.

Faced with this winner's curve problem, a representative investor will only submit orders if, on average, IPOs are underpriced - the degree of underpricing is directly related to the ex-ante uncertainty about the value of an issue.

Proposition 1

The greater the ex-ante uncertainty about the value of an issue, the greater the expected underpricing.

There is not a 'lemons' problem because the investment broker underwrites many offerings over time - it can develop a reputation and earn a return on this reputation.

Suggest 3 conditions:

1. Investment banker is uncertain about the initial trading price.
2. Investment banker has reputational capital at stake.
3. This reputational capital drops if he cheats by underpricing too much or too little.

Proposition 2

Underwriters whose offerings have average initial returns that are not commensurate with their ex-ante uncertainty lose subsequent market share.

Data

They test ex-ante uncertainty by two proxy measures:

1. The log of one plus the number of uses of proceeds tested in the prospectus.
2. The inverse of the gross proceeds.

1. The first measure is adopted because the SEC requires more speculative issues to give more details of the uses of the proceeds.

2. Small offerings are more speculative, on average, than larger offerings.

   Use SEC registered IPOs from 1977-1982 - a total of 1028 firms.

   Split the sample into two sub-periods:

   1977-1981 - first quarter

   1981-1982 end - second quarter

Empirical evidence

To test proposition 1, they regress initial returns on two proxies for ex-ante uncertainty, using the 545 firms in the second sub-period.

They suspect the presence of heteroscedasticity - since high ex-ante uncertainty should be reflected in a greater dispersion of initial returns. They use weighted least squares and multiply both left and RUS variables by log (1000+ sales).

Table (2) reports the results, using initial return as the dependent variable.

The results seem consistent with proposition 1. There is a positive relationship between ex-ante uncertainty and underpricing. They also interpret the low R^2 as consistent with proposition 1. (weak proxies - size effect anyway!).

Table 2

Weighted least squares regression results with initial return as the dependent variable.[a]

Constant	Log (1 + number of uses of proceeds)	Reciprocal of gross proceeds	R^2
-0.0268	0.0691	83,578	0.07
(0.0360)	(0.0209)	(18,561)	

[a] Standard errors in parentheses. The sample is comprised of all 545 underwritten SEC-registered initial public offerings from April 1981 to December 1982. The weighting factor is log [1000 + sales], where sales is the most recent 12-month revenues for the issuing firm expressed in terms of 1982 purchasing power. The means of the variables are: 13.24 for the weighting factor, 1.74 for the log of one plus the number of uses of proceeds and 0.000000423 for the reciprocal of gross proceeds. Gross proceeds is measured in dollars of 1982 purchasing power. The average initial return is 0.141, or 14.1 percent.

To test proposition 2, they compute the market shares of all underwriters involved in 4+ IPOs in the first sub-period.

They plot the actual and predicted average return in the first period, using the second period regression.

For each IPO they compute a predicted initial return and calculate the difference between the actual and this to obtain a residual

$$r_{ij} = P_{ij} - E(p_{ij})$$

For each underwriter, they then compute the average residual

$$\bar{r}i = \frac{1}{Ni} \sum_{j=1}^{Ni} rij$$

They divide $\bar{r}i$ by $\sigma i / \sqrt{Ni}$, the standard deviation of the mean initial return, to get a standardized average residual. σi is the standard deviation of the residuals of underwriter i.

In Table 1, they rank underwriters in terms of their absolute standardized residuals - the 24 underwriters with the largest standardized absolute residuals are referred to as pricing off the line.

In Table 3A, they report that the 24 underwriters off the line saw their market share fall from 46.6% to 24.5% in the second sub-period - a 45% decrease. The 25 firms pricing on the line saw their share fall by only 23% - (were they both writing the same type of business in the periods - was demand the same in both periods?)

Table 3b shows the result of regressing percentage charge in market share on absolute standardized average residuals. The reported regression supports this proposition.

They interpret their findings as supporting their proposition that investment bankers enforce the underpricing equilibrium.

K Rock, Why new issues are underpriced", *Journal of Financial Economics* (1986)

Grossman (1976) showed that if one class of investors has superior information about the terminal value of an asset, the information can be read by anyone from the equilibrium price. This result produces a paradox. If anyone can infer private information from the equilibrium price, no-one pays to collect information. Yet if no-one collects information, the price reveals none, and an incentive emerges to collect it.

The key to the paradox is the assumption of a noiseless environment. If noise is present in the equilibrium price, privileged information is secure.

Rock takes another approach. If price, which is observable, does not correspond to a unique level of demand, which is unobservable, then the main channel by which inside information is communicated to the market is destroyed. Until the channel is re-established, the informed investor has an opportunity to profit from his knowledge by bidding for 'mispriced' securities. In this way, the investor is compensated for this costly investigations into the asset's value.

The setting for Rock's model is the new issue market. In particular, the market for 'firm commitment offerings. In a firm commitment offering, the firm and its investment bank agree on a price and quantity for the firm's first issuance of equity. Once the price is set, typically on the morning of the offer, no further adjustments are allowed. If there is excess demand, the underwriter rations the shares. If there is excess supply, the offer concludes with unsold shares.

The new issue market resembles an auction, but the resemblance is not exact. The issuing firm is both a bidder, who submits a price in consultation with the underwriting investment bank, and a seller who exchanges an asset for cash.

The model is directed towards an explanation of an anomaly in the new issue market. New shares appear to be issued at a discount. Ibbotson (1975) found an average discount of 11.4%.

The model

Consider a market in which there are two assets available for investment. One is a safe asset, whose return is normalised to 1. The other is an asset whose value per share $\tilde{v}$, is uncertain.

The issuer preselects an offer price p and an offer quantity of shares z.

In the new issue market, the probability that an order is filled can be less than one (the issue is over-subscribed) - shares are rationed.

This is likely to occur from large numbers of informed investors demanding shares - all other investors are regarded as being uninformed - including the 'issuer'.

The firm gives up its informational advantage by revealing its proprietary knowledge to the market, i.e., through information disclosed in the prospectus.

The firm and the underwriter disclose their assessment of the firm's financial future by how aggressively they price the issue, relative to 'comparable' offerings.

Even though the firm and its agent know more than any single individual in the market, they know less than all the individuals in the market combined.

Rock assumes

A1 The informed investors have perfect information about the realised value of the new issue.

A2 Informed investors cannot borrow securities or short-sell.

A3 Informed demand I, is no greater than the mean value of the shared offered $\bar{v}Z$.

A4 Uninformed investors have homogenous expectations about the distribution of $\tilde{v}$.

A5 All investors have the same wealth (equal to 1) and the same utility.

In addition to these five assumptions, the investment bank is implicitly regarded as an invisible intermediary. The firm is assumed to dictate the price of the offering, not the underwriter. In addition, the firm rather than the investment bank bears the risk of having the issue under subscribed.

By A1, the informed submit orders for the new shares whenever the realised value per share $\bar{v}$ exceeds the other price P.

By A2, the informed order to the full extent of their wealth (equal to 1).

By A3, when the informed order, they order a constant dollar amount.
1 if $p < \tilde{v}$

0 if $p > \tilde{v}$

Unlike the informed, the uninformed, who are N in number, cannot predicate the size of their order upon the realisation of $\tilde{v}$.

By A4 and A5, each uninformed investor wants to submit the same fraction of his wealth T for the new issue. Each investor submits the positive share T* = max (0,T).

The combined dollar demand of the informed and the uninformed is

$\mathrm{NT}* + \mathrm{I}$ if $p < \tilde{v}$

$\mathrm{NT}*$ if $p > \tilde{v}$

Since the demand fluctuates according to whether $\tilde{v}$ is above or below $\tilde{p}$, the issue must experience either excess demand or supply in one of the two states.

In the state that $\tilde{v} > p$, let the probability that an order be filled be denoted b.

If $\tilde{v} < p$ designate the probability b'.

To relate b and b' to fundamental magnitudes, a particular mechanism for allocating rationed shares must be devised.

If rationing occurs, the value of the issue equals the value of the orders filled, plus some small excess - if the last order cannot be totally filled. Ignoring this, we have

$\tilde{N}u T* + \tilde{N}i = PZ$ if $b < 1$

where

$\tilde{N}u$ is the number of uninformed orders.

$\tilde{N}i$ is the number of informed orders.

Taking expectations

$$BNT* + B1 = pZ \text{ if } b < 1 \qquad (1)$$

$$\text{or } b = \min\left(\frac{\mathrm{PZ}}{\mathrm{NT}* + 1}, 1\right)$$

Similarly,

$$b' = \min\left(\frac{PZ}{NT*}, 1\right) \tag{2}$$

Observe that b<b' which says directly that the probability of receiving an allocation of an underpriced issue ($\tilde{v} > p$) is less than or equal to the probability of receiving an overpriced issue ($\tilde{v} < p$). This bias in allocation causes the uninformed investors to revise down their valuation of the new shares.

Therefore, to attract uninformed investors to the offering, the issuer must price the shares at a discount, which can be interpreted as compensation for receiving a number of overpriced stocks.

When uninformed investors decide on the fraction of their wealth to be placed in the new issue, they base the decision upon their prior beliefs regarding b and b' - we denote this by subscript e.

Table 1

Terminal wealth of investor as a function of the after market value of the new issue and the probability of obtaining an allocation

	After market value[a]			
	$\tilde{v} > p$ (underpriced)		$\tilde{v} < p$ (overpriced)	
Allocation	yes	no	yes	no
Wealth	$p^{-1}\tilde{v}T + (1-T)$	1	$p^{-1}\tilde{v}T + (1-T)$	1
Probability	$b_e\, p(\tilde{v} > p)$	$(1-b_e)p(\hat{v} > p)$	$b_e^{'}\, p(\tilde{v} < p)$	$(1-b_e^{'})p(\tilde{v} < p)$

a After market value is the price, v, realised on the first trade; the after market price differs from the offering price, p, according to whether the issue is underpriced (v>p) or overpriced (v<p). The probabilities of these two events from the viewpoint of the uninformed investor are denoted p(v>p) and p(v<p), respectively. Given the issue is underpriced, the probability of an allocation is b_e; given the issue is overpriced, the probability of an allocation is b_e. The uninformed investor has unit wealth initially, and chooses a fraction, T, to invest in the new issue.

From the table, the uninformed investor has the expected terminal utility

$$b_e p(\tilde{v} > p)E\left[u\left(1+T\left(p^{-1}\tilde{v}-1\right)\right)\middle|\tilde{v} > p\right]$$

$$+b_e^{'} p(\tilde{v} \le p)E\left[u\left(1+T\left(p^{-1}\tilde{v}-1\right)\right)\middle|\tilde{v} \le p\right] \tag{3}$$

$$+\left[1-b_e p(\tilde{v} > p)-b_e^{'} p(\tilde{v} \le p)\right]u(1)$$

Therefore, the optimal T satisfies the first order condition

$$\left(b_e \big/ b_e^{'} \right) p(\tilde{v} > p)E\left[u'\left(1+T\left(p^{-1}\tilde{v}-1\right)\right)\left(p^{-1}\tilde{v}-1\right)\middle|\tilde{v} > p\right]$$

$$+\, p(\tilde{v} \le p)E\left[u'\left(1+T\left(p^{-1}-\tilde{v}-1\right)\right)\left(p^{-1}\tilde{v}-1\right)\middle|\tilde{v} \le p\right]=0$$

It is not rationing per se which lowers his estimate of the value of an offering when he obtains an allocation, rather it is bias in rationing good issues relative to bad - the bias being measured by the ratio $\left(b_e \big/ b_e^{'} \right)$ in the optimality condition.

Upon equating investors' beliefs to actual outcomes given by Equations (1) and (2), the complete equilibrium is

$$b = \min\left(\frac{pz}{NT*\left(b \big/ b', p\right)+I}, 1\right) \tag{4}$$

$$b' = \min\left(\frac{pz}{NT*\left(b \big/ b', p\right)}, 1\right) \tag{5}$$

$$0 = \left(b/b'\right) p\left(\tilde{v} > p\right) E\left[u'\left(1 + T\left(p^{-1}\tilde{v} - 1\right)\right)\left(p^{-1}\tilde{v} - 1\right) \middle| \tilde{v} > p\right]$$

$$+ p\left(\tilde{v} \le p\right) E\left[u^{1}\left(1 + T\left(p^{-1}\tilde{v} - 1\right)\right)\left(p^{-1}\tilde{v} - 1\right) \middle| \tilde{v} \le p\right] \tag{6}$$

$$T^*\left(b/b', p\right) = Max\left(0, T\left(b/b', p\right)\right)$$

The major issue is whether uninformed investment increases as the offer price is reduced.

The opportunity set facing the issue

What happens when the number of investors is very large? In this case, the risky asset represents a small fraction of each investor's total wealth. Since individuals are approximately risk-neutral with respect to small gambles, any uninformed investor who buys the initial public offering expects a return which is close to the risk-free rate.

If an uninformed investor submits a bid, his expected profit is

$$bp\left(\tilde{v} > p\right) E\left(\tilde{v} - p \middle| \tilde{v} > p\right) + p\left(\tilde{v} < p\right) E\left(\tilde{v} - p \middle| \tilde{v} < p\right)$$

Upon requiring zero abnormal profits, we have

$$b \equiv bo\left(p\right) = \frac{p\left(\tilde{v} > p\right) E\left(\tilde{v} - p \middle| \tilde{v} > p\right)}{p\left(\tilde{v} < p\right) E\left(p - \tilde{v} \middle| \tilde{v} < p\right)}$$

This is the smallest probability an uninformed investor will tolerate of obtaining rational shares before withdrawing from the new issue market, given the offering price is p.

Then proceeds to the proof that uninformed demand will increase with a drop in the price.

Suppose the market price is initially set equal to the mean value of the shares. $\tilde{v}$ and the informed are not numerous enough to buy the entire issue. As the price is lowered, the uninformed become more interested. At some critical price, the issue is fully subscribed in the state of the world where the informed know the issue is worth purchasing.

Curious result, the more nearly equal the chances are of receiving an allocation in the good and the bad states, the larger is the demand of the uninformed, who care only about the bias in the rationing.

Rock provides a proof that the full subscription price always exists.

Table (2) calculates the uninformed demand and the probability of receiving an allocation under two sets of assumptions about the parameters. In each case, the uninformed have the expectation that overpriced shares are not rational, an expectation which is analytically equivalent to $b'=1$.

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