IPOs and Long Term Relationships: An Advantage of Book Building

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There is a global trend in initial public offerings towards the increased use of book building, the primary US method. A key difference between book building and other methods such as auctions is that, with book building, the underwriter has total discretion in allocating shares, allowing allocations to be based on a long term relationship between the underwriter and investors. This paper extends the work of Benveniste and Spindt on the importance of a multi-period setting when analyzing book building. In a multi-period model with endogenous (and costly) information acquisition, I show that the investment bank's ability to lower underpricing depends largely on its ability to favor regular uninformed investors. Among other things, this implies that the hybrid book building/open offer IPO method which is becoming increasingly popular internationally will lead to higher underpricing than straight book building.

There is an international trend towards increased use of the US book building (firm commitment) method for initial public offerings (IPOs)[1]. Book building has been added to the allowed methods in many countries that limit the choice of issuers, and it is being chosen more frequently in countries that do not restrict the choice of issuers. The two main alternative IPO methods are auctions and the open offer or "fixed price" method. It is particularly surprising that auctions have not been more popular, since it would seem that the auction method would be the best way to maximize the seller's proceeds.

The key difference between book building and other IPO methods is that the book building method gives underwriters total discretion in the allocation of shares.[2] In contrast, auctions require the allocation of shares to be based on the bids, without regard to any past relationship between certain bidders and the auctioneer. Similarly, the open offer method normally includes "fairness rules" which allow discrimination only on the basis of order size. It is the ability to allocate shares freely that makes "book building" (the advance gathering of indications of interest) possible. Under auctions or the open offer system, underwriters are free to do road shows and to ask for indications of interest. However, without the ability to make allocations dependent on the information reported, there is no way for underwriters to give investors the incentive to report their information accurately, as was first discussed in Benveniste and Spindt (1989).

The allocational discretion given to underwriters in the book building method is also what makes it possible for underwriters to have long term relationships with regular investors. This paper extends the work of Benveniste and Spindt in illustrating the importance of long term relationships to book building IPOs. In an infinite-period setting with endowed information, Benveniste and Spindt showed

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1 The book building method has traditionally been used primarily in the US and Canada. It is now often used in Argentina, Brazil, Finland, France, Germany, Japan, New Zealand (with some variations) and Poland. It is allowed and is used at least occasionally (for instance for large issues, privatizations or international IPOs), in Australia, Austria, Hong Kong, India, Ireland, Thailand, Sri Lanka and Switzerland. The most distinctive aspects of a US firm commitment offering ("book building") are that the underwriter does pre-selling and gathers information in advance through a road show to a regular group of investors, and that it then allocates the shares to that group.

2 This discretion is of course limited in the obvious ways, forbidding the underwriter from allocating shares to its own employees or their close relatives and from keeping shares to be sold at a higher price on the aftermarket. Cornelli and Goldreich (1999) offer evidence that underwriters use their discretion to favor investors that provide information.

that the underwriter could use the promise of future participation to reduce the excess return of informed investors. With costly information, however, informed investors do not earn excess returns except in special cases (see Sherman and Titman (1999)). Thus, when the information purchase decision is endogenous, a multi-period setting may not allow the underwriter to reduce the returns of the informed.

I show that, with costly information, a repeated setting allows the underwriter to lower the excess returns of *un*informed investors, thus lowering the required level of underpricing. To reduce the level of underpricing, however, the underwriter must be able to discriminate in favor of a particular group of regular investors who still receive abnormally large returns. These results are consistent with the popular sentiment that allocating shares only to regular investors prevents the general population from sharing in high returns.[3] Uninformed investors in this model are indeed receiving unearned excess returns, but the reason that access is limited to regulars is to limit the losses of the issuer and underwriter.

One implication of these results is that the role of the underwriter is substantially reduced in the auction and open offer systems, where the underwriter cannot give preference to a group of regular investors. This is true even for hybrid offerings, where book building is used to gather information from institutional investors but open offer is used for retail investors. This model implies that hybrid issues will lead to more underpricing than straight book building.

This paper builds on past work on how the investment bank allocates and prices shares in the US book building system. Benveniste and Spindt (1989) began this approach by modeling the book building process in detail. Benveniste and Wilhelm (1990) demonstrate how a uniform price restriction increases underpricing, while Sherman and Titman (1999) endogenize investors' information sets and explore how the underwriter selects the pool of regular informed investors. This model endogenizes the information purchase decision of investors, the choice by the underwriter of the optimal number of both informed and uninformed regular investors, and the preference of the underwriter for greater price accuracy. Results are obtained for both finite and infinite multi-period settings.

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[3] See, for instance, "Block That Sale! War on IPO Flippers Hurts Little Guy", by Anthony J. Correra, *Barron's* v72 n22, June 1, 1992, p.34; "IPO's: Don't Get Dunked in '97" by Duff McDonald, *Money* v25n13 (1997 Forecast Supplement), pp. 116-120;, or "Group Urges Wall Street to Give Small Investors a Piece of New Stock Deals", http://www.sddt.com/files/librarywire/96w...lines/08_96/DN96_08_28_fg.html, The San Diego Source, Aug. 28, 1996.

In addition to the general work on the pricing of new issues, a more recent trend in IPO research is to explore the effects of various regulatory features[4]. Benveniste and Busaba (1997) compare book building with a fixed price system where investors have correlated information and may observe each other's orders. Benveniste and Wilhelm examine a simplified (pro rata) version of the allocation restrictions used in the open offer method. Chowdhry and Sherman (1996a) model the open offer method more specifically, demonstrating that the pay in advance feature, as well as restrictions that force the price to be set far in advance, lead to higher levels of underpricing.

In a subsequent paper, Chowdhry and Sherman (1996b) point out that the higher level of underpricing with open offer may be partially offset by the practice of favoring small over large investors, which reduces the winner's curse problem. Brennan and Franks (1997) use corporate control issues to explain the common practice of favoring small over large investors, while Stoughton and Zechner (1998) and Mello and Parsons (1998) predict that, in certain cases, large investors should be favored over small investors. Maksimovic and Pichler (1997) compare book building IPOs to private placements.

The rest of the paper is organized as follows. Section 1 describes the model, while section 2 gives the final or only period solution. Section 3 describes how the outcome changes for earlier periods, when the same underwriter handles multiple issues sequentially. Section 4 discusses implications for countries that are in the process of adopting the book building method, and section 5 is the conclusion.

1. The Model

The basic environment of this section is similar to that in Benveniste and Wilhelm. Therefore, their notation is used as much as possible. Benveniste and Spindt also considered multiple periods in

[4] For general work on IPO underpricing, see Rock (1986), Allen and Faulhaber (1989), Grinblatt and Hwang (1989), Welch (1989), Titman and Trueman (1986), Chemmanur (1993) and Chemmanur and Fulghieri (1994). One aspect that has been examined is aftermarket price stabilization, which is illegal in many countries but is becoming more common internationally (often accompanying the spread of book building). Chowdhry and Nanda (1996) and Benveniste, Busaba and Wilhelm (1996) explore the effects of this regulatory feature. Another IPO mechanism that has been analysed is that for best efforts offerings in the US. Sherman (1992) showed that the maximum and minimum sales levels for best efforts, plus the possibility that an issue might fail, allows issuers to gather information from investors and use it to avoid investment in negative net present value projects.

their model of book building. I extend their work by assuming a cost to information, endogenizing the number of informed and uninformed investors and solving a finite as well as an infinite multi-period model.

There are two kinds of investors: risk neutral investors who have access to a costly information-gathering technology (informed investors); and risk averse investors who do not have access to private information (uninformed investors). The risk aversion of the uninformed plays an important role in this model, since it endogenizes the desire of the underwriter for information on the value of the issue[5]. The risk neutrality of the informed investors is a simplifying assumption. The key features of informed investors are that they are strictly less risk averse (perhaps because they are better diversified) than uninformed investors and that they are able to purchase information which may reduce uncertainty for all investors. There are three possible values for IPO shares, good (g), bad (b) or neutral (u). The true state will be discovered and signaled through the aftermarket price in time two.

1.1 Informed investors

There are H informed investors, where H is chosen by the investment bank. They are risk neutral but face a binding wealth constraint of Q*. For the cost c > 0, informed investors may choose to purchase a signal that may be good, bad or uninformative (neutral). All investors who receive an informative signal (i.e. good or bad) receive the same signal.

1.2 Uninformed investors

There are K risk averse uninformed investors, where K is chosen by the investment bank. The one period utility function of the uninformed investors is U(x), which is strictly increasing in x, strictly concave and twice continuously differentiable. The investor can always invest her endowment, Q, or any portion of it at the riskless intra-period rate of return, r, which for simplicity is set to zero. Therefore, the uninformed investor will only invest in an IPO if the expected utility of investing in the IPO exceeds U(Q).

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[5] Other reasons why the investment bank would value pricing accuracy include: that better quality firms tend to prefer underwriters with better reputations for accurate pricing; that avoiding mispricing reduces the chance of costly lawsuits in the future; and that accurate pricing reduces the chance that the issue will fail.

Uninformed investors maximize E $\{\Sigma^{T}_{t=1} (1+k)^{-t} U(x_t)\}$, where E is the expectations operator, k > 0 is the time discount factor between periods and $x_t \geq 0$ is consumption at time t.

1.3 The issuer and underwriter

I assume that there are no conflicts of interest between the issuer and the underwriter. The value per share given signal i is s^i, i ∈ {g,b}, while the value per share if there is no undiscovered information is s^u. The value of the additional information is such that $s^g = s^u + \alpha$ and $s^b = s^u - \alpha$, where $\alpha > 0$.[6]

The issuer sells a fixed number of shares, N. I assume that the current owners absorb any excess proceeds, over and above the amount needed to accept whatever new investment the firm plans to make. This holds the dilution per share constant and simplifies the model considerably, since otherwise the value of each share depends on the issue price (because a higher issue price means that the firm will have more funds after the IPO).

Once g or b has been revealed, the issue is riskless and needs to return only the risk-free rate. This is a simplifying assumption - all that is necessary is that receiving an informative signal leads to some reduction in uncertainty, which seems like a reasonable way to think of information.

1.4 The timing

Below is a summary of the timing within each period. IB stands for investment bank.

[6] I have tried to avoid adding notation to differentiate between the true state u, when there is no information that could be discovered, and the case where no informative signal is received, which may or may not mean that information exists. The expected value per share is the same either way, and it is usually clear from the context how "state u" should be interpreted. The only time it makes a significant difference is in calculating the required return to uninformed investors, because they are risk averse.

IB selects investors, announces price & allocation schedule	Investors decide whether to purchase signals	Investors report signals to IB	IB sets price & allocates shares (based on announced schedule)	Shares pay off and investors consume

1.5 Prices, allocations and probabilities

Consistent with US law, all investors pay the same price in this model (the one price rule). The price and allocation notation is:

s_i = the stock's issue price when signal i is reported, $i \in \{g,b,u\}$;

q_i = the allocation of an informed investor when signal i is reported, $i \in \{g,b,u\}$;

$q_{R,i}$ = the allocation of an uninformed (retail) investor when signal i is reported, $i \in \{g,b,u\}$.

Let π be the probability that the true state is either g or b. The two states are equally likely, so $\pi/2$ is the probability of state g. The probability that state u has occurred is $(1-\pi)$.

Let π_i be the conditional probability that investor i receives an informative signal, either good or bad (conditional on the occurrence of an informative state). The unconditional probability that investor i will receive a good signal is $\pi_i\pi/2$. The unconditional probability of state g occurring and of h of the H informed investors receiving the signal g is:

$$P(g,h) \quad = \quad \frac{\pi}{2} \binom{H}{h} \pi_i^{h} (1 - \pi_i)^{H - h}$$

Since the probabilities are symmetric, P(b,h) = P(g,h). The unconditional probability that none of the H investors receive informative signals is $P(\cdot,0) = P(g,0) + P(b,0) + (1 - \pi)$. The probability that h of H-1 other investors will receive a good signal, given that one investor observes g, is

$$P'(g,h) \quad = \quad \binom{H-1}{h} \pi_i^{h} (1 - \pi_i)^{H - h - 1}$$

And again, P'(b,h) = P'(g,h). Finally, given that one investor fails to receive an informative signal, the conditional probability that no other investor will receive an informative signal is $P'(u,0) = (\pi/2)[P'(g,0) + P'(b,0)] + (1-\pi)$.

1.6 Information reporting constraints

In order to guarantee that investors accurately report their information, the investment bank must set the prices and allocations so that it is optimal for them to do so. Thus, we have a set of information reporting or "truth-telling" constraints. It is assumed that the underwriter is able to commit to these schedules in advance, as a function of reported information. This is crucial, since the underwriter would otherwise pretend that all issues were type g and would overprice all u and b issues[7].

If conflicting informative signals are reported to the underwriter, the underwriter knows that at least one of the investors has lied. In this case, I assume that the investment bank allocates zero shares to all informed investors and sells the shares at price s_u to the uninformed investors. This is an off-equilibrium path assumption that is needed to specify the equilibrium.

The information reporting constraints are given in Appendix A. R(j,k) is the notation for the expected profit or excess consumption of an informed investor who receives signal j and reports k. There will be six information reporting constraints, since there are three possible signals and thus six possible ways to lie (two per signal).

1.7 Information purchase constraint

An information gathering constraint is also needed[8]. This condition is:

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[7] If the underwriter did not follow these schedules, investors would find out later when the issue began trading, or when investors got together to compare notes. Thus, this implicitly assumes that the underwriter has some sort of reputation at stake and will lose future business if investors discover that the underwriter has been lying to them. Note that investors have no reason to hide their information after the issue is completed, but they do have an incentive to keep their information secret at first, to keep it from potential free-riders. This free rider problem is sufficiently large to prevent collusion among investors. In addition to reputation effects, the underwriter's incentive to overstate the amount of interest in the issue is limited by its commitment to aftermarket price stabilization, as Benveniste, Busaba and Wilhelm (1996) have pointed out.

[8] There are actually several information gathering constraints that must be satisfied - buying information, investing and reporting truthfully must be better than investing without buying the information, better than buying the information, investing and lying and better than not investing in IPOs at all. However, equation (1) will always be the binding constraint in equilibrium.

$$(\pi_i\pi/2)\ \{R(g,g) + R(b,b)\} + (1-\pi_i\pi)\ R(u,u) \ \geq\ R'(u,u) + c\ . \qquad (1)$$

where R'(u,u) is the expected return to reporting u without evaluating. This constraint guarantees that the expected return to buying and reporting a signal is greater than the return to pretending to buy a signal, keeping the cost c and simply reporting u. It can be seen from the above equation that underpricing in state u will increase the total required underpricing (if informed investors are allocated shares in state u). Because an informed investor can always receive R'(u,u) "for free" by simply reporting u without evaluating, satisfying equation (1) is easiest when underpricing is concentrated in states g or b, with the return in state u kept as low as possible.

1.8 Participation conditions for uninformed investors

For the uninformed to be willing to buy shares, there are three participation constraints that must be satisfied, one for each possible state. I have assumed that the underwriter can make a binding commitment to follow a certain price and allocation schedule, based on reported information. Therefore, even uninformed investors will know what state has been reported once they observe the issue price. In practice, underwriters announce an initial size and price range for the issue (say, between 4.0 and 4.5 million shares at between $12 and $14 per share) before the road show. When investors learn the final price and number of shares to be sold, they can compare it to the initial range and get a fairly good idea of the level of demand expressed by informed investors.

Because indications of interest are not legally binding in the US until the final price is set, investors are able to back out and refuse to buy shares once they learn the actual issue price. Therefore, in this model, uninformed investors will only purchase shares if their expected return is sufficient given the reported state. There can be no averaging across states, with excess returns in one state compensating for insufficient returns in another. This gives us separate participation constraints for each possible state. The constraints are:

$$s_g \leq s^g \qquad (2)$$

$$E\ \{U((s^b - s_b)\ q_{R,b} + Q) + z_t\} \ \geq\ U(Q) \qquad (3)$$

$$E\{U((s^u - s_u)\, q_{R,u} + Q) + z_t\} \geq U(Q) \qquad (4)$$

where z_t is the "bribe" that the investment bank can offer to uninformed investors participating in the period (T - t) IPO. The bribe is based on the promise of participation in the remaining future issues, and may be used to convince uninformed investors to accept a lower return on the current issue. Because it is based on how many future offerings the investor might potentially participate in, an IPO three periods before the last period (t = 3) is the same regardless of T.[9] The bribe is credible, since the underwriter will be forced by the one price rule to offer excess returns to some uninformed investors in the future. The investment bank is indifferent as to which uninformed investors receive future excess returns, and therefore it has no incentive to violate participation promises made to specific uninformed investors today.

The first participation constraint requires only that g shares are not overpriced. The second and third constraints leave open the possibility that the underwriter will convince uninformed investors to accept overpriced state u or b shares in exchange for access to future IPO shares, some of which may be underpriced state g shares. If the bribe $z_t = 0$, then equation (3) reduces down to $s_b \leq s^b$ (i.e. state b shares cannot be overpriced). The last constraint is further complicated by the fact that "state u" shares are risky - they might actually be b or g shares that have not yet been detected. Thus equation (4) says that the expected utility of an investment with an excess return of s^u-s_u per share for $q_{R,u}$ shares (and with an expected bribe of z_t) must be at least as great as the utility that the investor would get from receiving zero excess returns (i.e. of consuming only Q) with probability one.

2. The Final (or Only) Period Solution

In this model, there are no mechanisms for underwriters or investors to make binding commitments regarding offerings that may arise in the future[10]. Therefore, the final period in a multi-

[9] The bribe to the uninformed, z_t, may be positive for every period except the final period. If investors back out of the current issue, they are cut out of the pool and they lose $E(z_t)$. In the final or only period, $z_0 = 0$.

[10] Although underwriters and investors cannot make credible commitments to act against their own best interests in the future, it is assumed that promises to take a future action are credible as long as there is no incentive to break the promise. The underwriter's promise to favor regular informed and uninformed investors in the future is therefore

period setting is the same as the one period solution. With only one issue, there is no possibility of averaging investor returns over time by keeping the same group of investors for every issue. In other words, there are no "regulars".

Below is the maximization problem of the investment bank. The underwriter is maximizing the expected price per share subject to the information reporting, information purchase and participation constraints, and to the requirement that exactly N shares are sold.

$$\max_{\substack{q_u,\, q_b,\, q_g,\\ q_{R,u},\, q_{R,b},\, q_{R,g},\\ s_u,\, s_b,\, s_g,\, H,\, K}} \left\{ [(\pi/2)-P(g,0)]\, s_g + [(\pi/2)-P(b,0)]\, s_b + P(\cdot, 0)\, s_u \right\}$$

Subject to constraints (A1) - (A6), (1) - (4) and

$$Hq_i + Kq_{R,i} = N, \quad \text{for } i \in \{g, b, u\}.$$

There are multiple solutions to this model that have only slight variations in the allocations for, say, five good signals reported vs. only four good signals reported. These extra equilibria can be eliminated without loss of generality, as shown in the following lemma which is proved in Appendix B.

Lemma 1: For every price and allocation schedule that satisfies the issuer's maximization problem, there is an equivalent schedule such that, for all $h \geq 1$

a) the issue price does not depend on h; and

b) the informed and uninformed investors' allocations do not depend on either h or the individual report of the investor.

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credible, since the underwriter is indifferent between investors and thus has no reason to violate the agreement. Regarding the price and allocation schedules that the underwriter will use for future offerings, the investors conjecture that the underwriter will act optimally in the future, and this conjecture will be correct in equilibrium.

The optimal number of informed investors, H, is determined by the following first order condition:

$$\frac{\partial L}{\partial H} = -\frac{\partial P(g,0)}{\partial H} s_g - \frac{\partial P(b,0)}{\partial H} s_b + \left\{ \frac{\partial P(g,0)}{\partial H} + \frac{\partial P(b,0)}{\partial H} \right\} s_u = 0 \qquad (5)$$

Recall that P(g,0) = P(b,0) and therefore that $\partial P(g,0)/\partial H = \partial P(b,0)/\partial H$. $\partial L/\partial H$ starts out positive for low H but turns negative for high H (since s_u increases and s_g decreases as H increases, and $\partial P(g,0)/\partial H < 0$). Therefore, there will be an optimal H > 0[11], meaning that the above equation can be written as an equality.

The single-period solution is described in more detail in Appendix B. Regarding pricing, all state g ("hot") issues will be underpriced. These issues must be underpriced to give informed investors an incentive to purchase and report information. Because of the one price rule, the same low price must be charged to uninformed investors, giving them excess returns. State b ("cold") issues will be fairly priced, while state u issues will be underpriced sufficiently to convince the risk-averse uninformed investors to purchase them.

Regarding allocations, uninformed investors as a group will get all of the shares for u and b issues, and they will get whatever shares are left over for g issues after informed investors have taken as many as they will take. Informed investors receive their entire order for hot issues, and take zero shares in other issues.

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[11] It is not surprising that there is an optimal number of informed investors. Adding one more member to the pool means that underpricing in state g must be increased to overcome the free rider problem. The reason an investor is willing to buy a signal even assuming that all of the other investors will buy signals and report them accurately is because there is a chance that the "last" investor's signal will uncover a good issue that all of the other investors missed. Since informed investors get more shares in g than in u issues and since g issues are underpriced, the informed investor wants all g issues to be detected.

However, as the buying syndicate gets larger, the chance that only one signal will be informative gets smaller. Therefore, underpricing must increase to make the expected return large enough to justify the cost of a signal. Since underpricing is increased for all investors, the cost to the underwriter of an additional signal is substantial, while the marginal benefit of an increased signal decreases as the size of the informed investor pool increases. Therefore, there will be an interior optimum (assuming the signals are cheap enough and strong enough to make at least one signal worthwhile).

3. Earlier periods

An unfortunate feature (from the investment bank's standpoint) of the final period solution is that the uninformed are getting excess returns. This comes from two institutional features of US IPOs. First, investors can always back out of the issue after observing the price (since no orders are legally binding until the final price has been set). Second, all shares must be sold at the same price. Thus, in order to underprice to the informed to get them to buy shares, the investment bank must also underprice hot issues to the uninformed. However, the fact that the uninformed get a free ride in state g does not change the required returns in states u and b, because investors can back out of buying shares once the final price reveals the state, if the returns in that state are insufficient. Thus, the uninformed investors get their required return in states u and b, and they get an excess return in state g.

The situation changes in a multi-period setting. The promise of future offerings allows the investment bank to impose a "penalty" on uninformed investors who back out of state u or b issues, meaning that investors might buy such shares even if they are overpriced. Therefore, rather than giving the uninformed investors enough in states u and b and too much in state g, the investment bank can give them less in states u or b but promise them shares in future issues, some of which will be g's, if they continue to invest. The expected return to uninformed investors will still be above the minimum required return but will be lower than in the one period solution, since the lower returns in states u or b are offset by excess returns in state g that would have occurred anyway. This will not allow the underwriter to recapture all of the excess, but it can at least recover part of the surplus this way.

The solution for earlier periods in a multi-period setting is given in Appendix C, which also gives the formula for z_t, the bribe to uninformed investors to convince them to accept a lower return today in exchange for shares in future issues. Holding everything else constant, the potential bribe is larger and thus underpricing will be lower when there are more remaining periods in the future. Of course, the bribe for the final period, $z_{0,}$ must equal zero[12].

[12] It is important to note, however, that there is no unraveling in this model. Even if everyone knows that the investment bank will handle only one issue in the future, the underwriter will still have to give excess returns to some uninformed investors in that future period (if state g occurs) because of the one price rule.

State g issues will still be underpriced in a multi-period setting, while b issues will now be overpriced. State u issues will be less underpriced than in the single period case, and may even be overpriced. This matches the findings of Hanley (1993) that those issues with the greatest upward price revision relative to the initial price range are also the most underpriced (the partial adjustment phenomenon), while cold issues, where the issue price is below the initial price range, have the lowest level of underpricing (or, after adjusting for risk, possible overpricing).[13]

Another way of modeling this would be to have an infinite (or large) number of possible future issues, but with some probability each period of the failure of the investment bank. Over time and across underwriters, the size of z_t would vary with the underwriter's probability of survival. Qualitatively, however, all of these solutions are the same. As long as there is some positive probability that the underwriter will handle at least one future issue, then $z_t > 0$ and the underwriter can lower the required amount of underpricing by promising to favor regular investors. The key result of this section is summarized in the following proposition, which is proved in Appendix C.

> Proposition 1: If the underwriter is expected to handle at least one future issue, it can reduce but not eliminate expected underpricing for the current issue by forming a group of regular uninformed investors to participate in all offerings.

A clear empirical implication of this model is that underwriters that are expected to handle a greater number of book building IPOs in the future are able to achieve lower levels of average underpricing. This explains why investment banks tend to specialize in a certain issue method in countries (such as France) that allow several different issue methods. It may also form a barrier to entry

[13] There is empirical evidence to support the idea that cold issues may be overpriced. Moreover, there is recent empirical evidence that institutional investors receive disproportionate benefits from underwriter price stabilization, since institutional investors are more likely to "flip" or "stag" (i.e. sell quickly) cold issues whose prices are being supported by the underwriter. See Benveniste, Erdal and Wilhelm (1998) and Krigman, Shaw and Womack (1999). This suggests a model where the underwriter is forced to allocate some overpriced state b shares to informed investors, perhaps because of a shortage of regular uninformed investors, but the informed investors are allowed to sell back their shares to the underwriter at the issue price, while uninformed investors are expected to keep the overpriced cold issues as the price they pay for access to future hot issues.

to new investment banks, helping to explain how implicit price collusion may be maintained (see Chen and Ritter (1999)). This result is formalized in Proposition 2, which is also proved in Appendix C.

Proposition 2: Underwriters that handle book building IPOs more frequently will be able to offer greater reductions in underpricing.

4. The Transition to Book Building

Benveniste and Spindt (1989) point out that a key role of the underwriter is to lower the average level of IPO underpricing by giving priority to regular investors. Since some issues will have to be underpriced in the future, offering investors access to those issues may convince them to lower their required return on the current issue. In Benveniste and Spindt's model, this is done with informed investors. However, Sherman and Titman (1999) show, in an environment similar to this one, that informed investors usually do not receive excess returns when information is costly, because the information purchase rather than the information reporting constraint will be binding.

In this model, informed investors receive just enough to compensate them for the cost of information. Therefore, the returns of the informed investors cannot be reduced in a repeated setting, because of the need to induce those investors to purchase new information every period. This paper indicates that giving priority to regulars may be more important with uninformed than with informed investors. This distinction may seem minor, but it has implications for the many countries that have used open offer in the past but have recently begun to allow hybrid book building/open offer issues[14].

For instance, in Hong Kong the traditional IPO method is open offer, but the government began allowing book building (and auctions) in 1994 because of problems with excessive oversubscription

[14] Countries where the open offer method is the only or at least has traditionally been the primary method include Australia, Barbados, Finland, Germany, Hong Kong, India, Indonesia, Jordan, Malaysia, Singapore, South Korea, Sri Lanka, Taiwan, Thailand and the United Kingdom. Many of these countries now allow book building. Hybrid offerings have been used by France, Hong Kong, Hungary, Indonesia, Malaysia and the Philippines, among others. See Loughran, Ritter and Rydqvist (1994) and Sherman (1999) for descriptions of IPO methods in various countries, Chowdhry and Sherman (1996a, 1996b) for more information on the open offer method, and Derrien and Womack (1999) for a description of IPO methods in France. However, Derrien and Womack do not separate out hybrids from pure book building, in spite of their differences as pointed out in Chowdhry and Sherman (1996a) and this paper.

levels. Since the open offer method is very popular among retail investors in Hong Kong[15], total elimination of this method might have brought protest. Therefore, book building so far has only been used in hybrid issues, where book building is used for the institutional ("international placing") tranche and open offer is used for retail investors. This continued use of open offer for retail investors is significant if the underwriter's ability to reduce excess underpricing depends largely on its ability to give priority to regular uninformed investors, since open offer does not allow the underwriter to favor regular investors.

Relative to a pure open offer system, hybrid offerings at least allow underwriters to gather information through road shows before setting the issue price, a key advantage of the book building method. Nevertheless, this research indicates that the desire to "give everyone a chance" by continuing to allocate retail shares through the open offer method may lead to higher underpricing and thus higher issue costs for firms.

5. The Conclusion

In this model, IPOs are underpriced to compensate investors for the cost of evaluating issues. Because of the one price rule, uninformed investors (who have no evaluation costs) receive excess returns. However, in a repeated setting, the underwriter reduces these excess returns by requiring uninformed investors to accept overpricing of cold issues in order to remain in the regular investor group that purchases future issues. The underwriter forms regular groups of both informed and uninformed investors. The more IPOs that an underwriter is expected to handle in the future, the more it can reduce underpricing of the current offering.

This paper extends the work of Benveniste and Spindt on the importance of a repeated setting in analyzing book building IPOs. The discretion given to underwriters in the book building method allows them to form regular investor groups that participate in every offering. These long term relationships allow the underwriter to lower average underpricing while still giving investors the incentive

[15] Retail investors tend to like the open offer method in spite of the fact that research suggests that small investors do not make excess profits on average, after adjusting for their costs and their probability of actually receiving shares. See Chowdhry and Sherman (1996a).

to gather and report the optimal level of information. Other issue methods such as auctions do not allow long term relationships between the underwriter and investors.

The model offers an explanation for why investment banks restrict the access of small, uninformed investors to book building IPOs. The open offer method used by much of the world is popular with the general public because there is a subscription period that is open to everyone. Similarly, auctions are particularly popular for privatizations partly because the method is transparent and does not allow specific bidders to be favored. On the other hand, book building is often criticized in the US because the restrictions on investor access are seen as a way of giving special favors to an exclusive few at the expense of everyone else. This paper formalizes the explanation suggested by Benveniste and Wilhelm that the restriction even of the uninformed to only a small pool of regular investors may be an attempt not to *give* benefits to only select investors but to *reclaim* at least part of the benefits from those investors.

In many countries that are moving towards the use of book building, the method being adopted is a hybrid offering, with book building for institutional investors and open offer for local retail investors. This paper indicates that underwriters need to be able to give priority to certain regular uninformed investors in order to minimize underpricing. Therefore, the open offer system, by limiting the underwriter’s ability to discriminate between retail investors, may increase the cost of financing for issuers. Similarly, complaints from small investors in the US about the "unfairness" of the book building method should be balanced against the general societal gain from lowering underpricing.

Appendices

Appendix A: Truth-telling or information reporting constraints

$R(g,g) \geq R(g,u)$:

$$P'(g,0)\{ (s^g - s_g)(q_g) - (s^g - s_u)(q_u) \} \geq 0 \qquad \text{(A1)}$$

$R(u,u) > R(u,g)$:

$$(\pi/2)(1 - P'(b,0))\{ (s^b - s_b) q_b\} + P'(u,0)\{ (s^u - s_u) q_u - (s^u - s_g) q_g) \} \geq 0 \qquad \text{(A2)}$$

$R(b,b) > R(b,u)$:

$$P'(b,0)\{ (s^b - s_b) q_{b,1} - (s^b - s_u) q_u) \} \geq 0 \qquad \text{(A3)}$$

$R(u,u) > R(u,b)$:

$$(\pi/2)(1 - P'(g,0))\{ (s^g - s_g) q_g\} + P'(u,0)\{ (s^u - s_u) q_u - (s^u - s_b) q_{b,1}) \} \geq 0 \qquad \text{(A4)}$$

$R(g,g) > R(g,b)$:

$$P'(g,0)\{ (s^g - s_g) q_g - (s^g - s_b) q_{b,1}) \} + (1 - P'(g,0))\{ (s^g - s_g) q_g\} \geq 0 \qquad \text{(A5)}$$

$R(b,b) > R(b,g)$:

$$P'(b,0)\{ (s^b - s_b) q_{b,1} - (s^b - s_g)) q_g) \} + (1 - P'(b,0))\{ (s^b - s_b) q_b\} \geq 0 \qquad \text{(A6)}$$

Note that $q_{b,1}$ is the allocation of an investor who is the only one to report a bad signal.

Appendix B: Solution for the final or only period and proof of Lemma 1

Proof of Lemma 1: Suppose we have a price and allocation schedule with varying issue prices and allocations for good and bad issues based on h. Since investor decisions are made ex-ante (before h is revealed), those decisions are based on only the expected returns. Therefore we can replace the prices and allocations in the original scheme with the ex ante expected prices and allocations, which do not depend on h. This new scheme still satisfies the constraints of the issuer's maximization problem and offers the issuer the same expected utility.

Since uninformed investors do not make individual reports, all that remains is to show that, for every optimal schedule, there is always an equivalent schedule in which the allocations of informed investors do not depend on their individual reports. First, any allocation scheme that differentiated between investors that had all made the same report would still need to have average allocations that satisfied the information reporting constraints. Once again, an allocation scheme that replaced the various actual allocations with the expected allocation levels would give the same incentives and expected returns to investors and the same expected utility to the issuer.

Next, when state g is reported, a scheme that allocated more shares to investors that reported u than to investors that reported g would not give investors the incentive to report good signals. On the other hand, a scheme that gave more shares to investors that reported g than to those that reported u would increase the required amount of underpricing. The cost of information is fixed in this model, and the total expected return to informed investors must cover this fixed cost. Also, this model has a binding upper limit on investment by each informed investor. If informed investors got smaller allocations when they reported u, the extra shares would go to uninformed investors because the informed that reported g would already have their maximum allocation. Therefore, any optimal allocation schedule will involve giving informed investors their maximum allocation whenever state g is reported, regardless of the reports of each individual informed investor.

Last, when state b is reported, the cheapest way to satisfy truth-telling constraints (A3)-(A6) is to set $q_{b,1} = 0$. In other words, if only one investor reports a bad signal, that investor gets zero shares. In equilibrium, state b shares will be fairly priced ($s_b = s^b$) in the final or only period, and so investors will be indifferent about how many shares they receive. Thus, for any optimal allocation scheme that sets $q_b > 0$ for h > 1, there is an equivalent scheme with $q_b = 0$ for all h. In a multi-period setting with at least one remaining future period, state b shares will be overpriced, and informed investors will refuse to purchase them. Thus, $q_b = 0$ for all h.

Description of one-period solution: Using equations (A1)-(A6) and (1) (the information reporting and information gathering constraints), it can be seen that the cheapest way, in terms of underpricing, to satisfy all of the constraints is to have $q_{b,1} = 0$ (which prevents (A3)-(A6) from binding) and $q_u = 0$.

Underpricing in state g is being used to offset the fixed cost of information for the informed investors. Thus, the level of underpricing is minimized by giving the informed their full allocation, $(Q^* - c)/s_g$, in state g, with the uninformed buying any remaining g shares.

The optimal solution, then, will be to set $q_u = q_b = 0$ and $q_g = (Q^* - c)/s_g$. Equation (3) determines s_b, equation (4) determines s_u, equation (5) determines s_g and equation (1) determines H. The optimal K will be such that $Kq_{R,u} = N$, where $q_{R,u} = Q/s_u$. Uninformed investor allocations in states b and g will be $q_{R,b} = N/K$ and $q_{R,g} = (N - Hq_g)/K$.

Appendix C: Solution for the multi-period case and proofs of Propositions 1 and 2

Multi-period solution: As in the single-period case, the price in the good state, s_g, will be determined by equation (5), while H will be determined by equation (1). The optimal K will be such that $Kq_{R,u} = N$, where $q_{R,u} = Q/s_u$. Uninformed investor allocations in states b and g will be $q_{R,b} = N/K$ and $q_{R,g} = (N - Hq_g)/K$, where $q_g = (Q^* - c)/s_g$. The primary change is that the prices in states b and u (given by equations (3) and (4)) will be higher, because $z_t > 0$ for $t > 0$. The bribe, z_t, will depend on how many periods remain. The formula is:

$$z_t \;=\; \{U[(s^g - s_g)q_{R,g} + Q] \;-\; U(Q)\} \;\; \Sigma_{j=1}^{t} \{[(\pi/2)\text{-}P(g,0)]/(1+k)\}^{j}$$

Recall that the "discount rate", k, is the time value of money for the length of time between periods (whereas r, which was set equal to zero, is the alternate riskless return on investments within each period). Consider first the problem in the second-to-last period. If states u or b occur in period T – 1, the uninformed will be asked to trade a guaranteed loss today for a possible expected profit in the future. Because of both time discounting and the risk aversion of the uninformed, the overpricing that they will accept today will be strictly less than the expected future underpricing. Of course, when there are many future periods, the acceptable overpricing today will increase.

However, z_t will converge to an upper limit as t goes to infinity, since additional future periods are far enough away that the present value gets smaller and smaller. The potential bribe converges to an upper limit for another reason, also. There is always a possibility that there will be many, many state g issues in a row, in which case the investors earn very large excess returns. However, once state u or b occurs, the utility of any expected excess earnings after that period will be offset by overpricing in that period, meaning that the present value in that period of the expected excess utility for that period plus all subsequent periods is zero.

Thus, when looking ahead today at possible future paths, all paths that include a state u or b issue will have an expected excess return of zero from that first state u or b issue onwards. The probability of getting a string of only g issues naturally goes down as the number of future periods increases. Thus, each additional future period increases the potential bribe today, but the amount by which the potential bribe increases gets smaller as the additional period is farther into the future. For an infinite period model, the bribe would be the limit of z_t as $t \to \infty$.

Proof of Proposition 1: It is clear that a bribe to the uninformed, z_t, does not change the required return to the informed. The informed are getting high returns as compensation for the costs of evaluating, and their returns cannot be reduced without eliminating their incentive to purchase and report information. Therefore, all underpricing cannot be eliminated.

The next question is whether the excess returns of the uninformed can be eliminated. The uninformed will still receive expected excess returns if, as $t \to \infty$, z_t converges to something less than the excess returns of the uninformed if state g occurs today. For every additional future period (i.e. as t increases), z_t increases by the change in utility from the excess return to a future state g issue, multiplied by $\{[(\pi/2)-P(g,0)]/(1+k)\}^t$. Thus, each term will be multiplied by something less than $(1/2)^t$, since $[(\pi/2)-P(g,0)]/(1+k) < (\pi/2)-P(g,0) < \pi/2 < 1/2$. And, since $\lim_{t\to\infty} \Sigma^t_{j=1}(1/2)^j = 1$, it is clear that $\lim_{t\to\infty} \Sigma^t_{j=1}\{[(\pi/2)-P(g,0)]/(1+k)\}^j < 1$. Therefore, no matter how many periods remain in the future, the expected present value of the excess returns to the uninformed in the future (and thus the potential overpricing today) can never be greater than the value of the excess returns if state g occurs today.[16]

Proof of Proposition 2: It has already been shown that an underwriter that is expected to handle, say, 10 issues per year over the next 5 years would have a higher z_t and therefore lower underpricing than an underwriter expected to handle only 5 issues per year for the next 5 years, since t would be larger for

[16] This analysis is all ex ante. Ex post, the uniformed will do extremely well if it happens that state g occurs over and over, while they will get a relatively low return if states u or b occur over and over, with few or no state g issues.

the first underwriter (50 vs. 25). If the number of issues is held constant (which would include the case of an infinite number of future issues), increasing the frequency of issues, or lowering the time between each future issues, would essentially lower k, the time value of money for the length of time between periods (assuming the same effective annual discount rate for all issues). Since $\partial z_t/\partial k < 0$, lowering k increases z_t, which decreases required underpricing.

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