

Stabilization, Syndication, and Pricing of IPOs

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Abstract

We argue that in the after-market trading of an IPO, the underwriting syndicate, by standing ready to buy back shares at the offer price ("price stabilization"), compensates uninformed investors ex post for the adverse selection cost they face in bidding for IPOs. This dominates ex ante compensation by underpricing. The reason is that stabilization exploits ex post information about investor demand whereas underpricing must be based on ex ante information. However, liquidity and syndication costs constrain the use of stabilization which, in equilibrium, generates some underpricing as well. We develop a model that formalizes this intuition and generates several empirical implications.

I. Introduction

It is well known (see Hanley, Kumar, and Seguin (1993)) that underwriters typically stand by and intervene, if necessary, by buying back shares in after-market trading so as to "stabilize" the stock price.¹ This is evidently an important part of underwriters' strategy for marketing Initial Public Offerings (IPOs). While a significant amount of theoretical literature in finance focuses on one element of underwriters' marketing strategy, the underpricing of IPOs, little attention is devoted to understanding stabilization. In this paper, we provide a rationale for the after-market stabilization of IPOs by underwriting syndicates.

A well-known argument for IPO underpricing goes as follows. In an IPO, relatively uninformed bidders face an adverse selection problem. Relatively better informed investors do not bid if, based on their superior information, they consider the offering to be overpriced. Hence, if shares are allocated pro rata, based on the amount bid by each investor, uninformed investors receive a larger allocation of "lemons" and a smaller allocation of "peaches" (see Rock (1986)). Rock (1986) argues that this is the reason why IPOs are underpriced.² Underpricing the issue

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¹Some indirect evidence is also provided in Miller and Reilly (1987).

²As we shall discuss later, the Rock (1986) model does not capture the process of "book-building" employed by underwriters in the United States (see Benveniste and Spindt (1989)). It does, however,

serves to compensate uninformed investors ex ante for the “adverse selection” cost faced by them. However, underpricing has a major drawback—it is an expensive way to keep uninformed investors in the market because it rewards the informed as well as the uninformed investors. This suggests that there may be more efficient ways in which the uninformed investors could be compensated.

Our argument is that uninformed investors can be compensated ex post by underwriters buying back shares at the offer price in after-market trading. By this stage, some of the information possessed by informed investors becomes public through the level of subscription of the issue and after-market trading (see Barry and Jennings (1993)). The advantage of such ex post compensation over the ex ante compensation through underpricing is that with ex post compensation, it is mainly the uninformed investors who benefit. With ex ante compensation (underpricing), however, all investors, including the informed, receive benefits in the form of a lower offer price. An offer to buy back shares at the issue price is equivalent to giving a put option to investors. The put option is valuable to the uninformed investors. It is less valuable to informed investors, because the informed bid only when they expect the true share price to be larger than the offer price.³

The idea that the adverse selection problem faced by uninformed investors can be mitigated has been discussed in the literature in the context of over-allotment options (see Smith (1986), Ritter (1987), Benveniste and Spindt (1989), and Schultz and Zaman (1994)). The contribution this paper makes is that it not only formalizes this tradeoff between underpricing and after-market price stabilization, but also shows that stabilization *dominates* underpricing as a means of compensating uninformed investors for the adverse selection problem they face.

An alternative explanation for stabilization is developed in Benveniste, Busaba, and Wilhelm (1994) (BBW, henceforth). They build on the insight in Benveniste and Spindt (1989) that information asymmetries among investors can be resolved by rewarding investors providing strong indications of interest during the “book-building” (used extensively in the U.S.) phase with relatively large allocations of underpriced shares. However, the resolution of information asymmetry among investors by building the “book” creates an information asymmetry between the underwriter and the investors because of information contained in the “book.” Underwriters, therefore, may have an incentive to overstate overall investor interest prior to pricing and allocation of the issue. BBW argues that this incentive problem is mitigated if underwriters commit to stabilize the price in after-market trading. Further efficiency gains are realized because underwriters can make the stabilization commitment selectively after observing the demand *state*. To the extent that stabilization exploits ex post information about investor demand, it is somewhat similar to the main insight of our model.

well describe the British Fixed Price method, which is also used in a number of countries such as Hong Kong, Singapore, and Thailand. Koh and Walter (1989) finds empirical support for this model using data from IPOs in Singapore.

³Our arguments regarding the benefits of providing investors with an implicit put option do not depend upon investment banks possessing superior information about the firm. Our analysis assumes that investment banks have the same information as the relatively uninformed investors in the offering. Alternative explanations for the benefits of offering put options to investors have relied on the notion that the put option signals superior information possessed by the underwriter (see Smith (1993)).

Regardless of the underlying reasons for stabilization, we argue that since the compensation to investors by stabilization activity is provided ex post, only reputable investment banks may be in a position to convince investors that they would carry out such a promise in after-market trading. "Major bracket" investment banks, therefore, are more likely to be involved in the underwriting and management of firm commitment offerings rather than best efforts type offerings (consistent with the evidence in Ritter (1987)), since they can put their reputation capital on the line. Also, larger underwriters may be able to withstand losses better than smaller underwriters, lowering their cost of providing loss capacity. This suggests that, independent of reputation effects, we expect to find larger investment banks associated with firm commitment offerings, as compared to best efforts offerings, for which loss capacity is less important.

While the lead underwriters may need to have a well established reputation, they may be able to include less established investment banks in the syndicate and draw on them for risk bearing and loss capacity, as well as for other underwriting services. In the event that the syndicate suffers losses, the lead underwriters will be able to force less established syndicate members to share in the losses by the threat of future exclusion from syndicates unless they comply.⁴ If syndication were costless, a sufficiently large syndicate would be formed and the issue need not be underpriced at all. However, if syndication is costly, an optimal loss capacity is determined by equating the marginal cost and benefit of increasing such loss capacity. We show that larger issues are associated with smaller offer prices (more underpricing) and with syndicates that have a larger loss capacity.

It has been documented in the literature that there are certain periods in which the volume of IPOs is dramatically higher than in other periods (see Ritter (1984) and Ibbotson, Sindelar, and Ritter (1993)). The average underpricing of IPOs in these "hot issue" periods also tends to be higher. In terms of our model, if there is a large increase in the demand for underwriting services, this may increase the cost of providing a given level of loss capacity in such periods. We show that these "hot issue" periods would be expected to be associated with greater average underpricing and with syndicates that have a smaller loss capacity. There would also tend to be reduced after-market support for offerings in such periods.

We develop a model in the next section that formalizes our arguments. Section III discusses the implications of the model.

II. The Model

Let N denote the number of shares to be issued in the IPO and let V denote the true value per share. While the value of V is only revealed later, at the time of the offering it is common knowledge among market participants that V is drawn from a prior distribution over $[0, \infty)$ with a density function denoted $f(V)$. Let N_I be the number of informed investors and N_U be the number of uninformed investors in the market. We assume that each investor bids for either zero or exactly one share and that $N_I < N$, i.e., there are not enough informed investors to buy all the N

⁴Though, according to rule 10b7, only the lead underwriter is permitted to place a limit order in support of the issue, members of the underwriting syndicate are obligated to share the costs of price stabilization; see Teweles, Bradley, and Teweles (1992), p. 292.

shares offered for sale. However, the number of uninformed investors is assumed to be sufficient to absorb the entire offering, i.e., $N_U > N$. This ensures that participation by at least some uninformed bidders is required to make the offering successful. All investors are assumed to be risk neutral.

The only source of heterogeneity between the investors is that at the time of bidding in the IPO, informed investors have more precise information about the realization of V than the other uninformed participants. Prior to the offering, each informed investor receives a qualitative signal, “good” or “bad,” about the value of the firm. Let $\theta(V)$ denote the fraction of the informed investors who receive the “good” signal as a function of the true value of the firm. For the signals to be informative, the signals must be correlated with the true value of the shares. We capture this by assuming that the fraction of informed investors who receive the “good” signal is strictly increasing in V , i.e., $\theta'(V) > 0$.

We will assume that if the initial offer price is such that the uninformed investors’ expected profits from bidding are nonnegative, they will all bid for one share each. The informed investors bid for one share each if and only if their signal is “good.”⁵ So, if the uninformed investors are induced to bid, the offer will be oversubscribed since the total number of shares bid, $N_U + \theta(V)N_I$, exceeds the number of shares offered, N . Each investor is allocated shares on a pro rata basis and receives

$$a(V) \equiv \frac{N}{N_U + \theta(V)N_I}$$

shares in the offering. Since the allocation $a(V)$ is strictly decreasing in V , the value of each share of the firm is perfectly revealed when the shares are allocated. Hence, the bidding process serves to aggregate the signals received by informed investors and to publicly reveal the true value of the stock.

Let P_O denote the price at which shares are offered for sale in the initial public offering. A successful public offering (i.e., an offer that is fully subscribed) thus raises a total of NP_O dollars. The underwriter promises to engage in price stabilization in the after-market, i.e., it promises to buy back shares at the issue price P_O . Let α denote the fraction of the total number of shares sold in the offering that the underwriter commits to buying back at the initial offer price P_O to stabilize the price in the after-market. The choice of α and its effect on issuer revenue is discussed below. We will assume that the underwriters have sufficient reputation capital at stake that their assurances are credible to investors. This issue is discussed more fully in Section III.C.

Under the assumption that the market for underwriting services is perfectly competitive, the expected profits of the underwriter will be driven to zero. Hence, the issuing firm would expect to receive the total revenues NP_O , reduced by the expected cost of the after-market stabilization activity and the cost of assembling a syndicate that undertakes this stabilization activity. For simplicity of exposition, all other costs associated with the underwriting process are assumed to be zero.

⁵If the informed investors’ expected profits from bidding, conditional on receiving even a “bad” signal, are nonnegative, then they will always choose to bid for the shares of the company. In such a case, the uninformed do not face any adverse selection costs and, therefore, need not be compensated in any way (underpricing or price stabilization) to ensure their participation in the bidding.

Let R denote the revenues thus raised by the firm going public. Because of the uncertainty in the after-market price, the *actual* cost of buying back αN shares may exceed the *expected* cost. Hence, this promise to buy back part of the offering exposes the underwriter to risk, while reducing the risk to investors. The issuing firm, however, receives a fixed amount R .

The underwriter cannot, however, spend an unlimited amount of resources on the stabilization activity. It is costly for any given investment bank to set aside funds, in addition to what it receives from the issuing firm, for the stabilization activity. The more funds it commits for the stabilization activity, the costlier it is to do so. This could be because a large loss may result in severe liquidity problems and may expose the investment bank to potential bankruptcy and financial distress. One way to increase the loss capacity associated with the stabilization activity is to spread the risk among a number of investment banks by forming an underwriting syndicate.⁶ Increasing the number of banks in the syndicate will increase its loss capacity. The cost of forming the syndicate will likewise depend on the number of banks in the syndicate, since the cost of managing the syndicate and coordinating and contracting between the several banks is expected to increase in the number of banks in the syndicate. Let L denote the total amount of funds committed for the stabilization activity by the members of the syndicate in addition to the compensation received from the issuing firm. Let $C(L)$ denote the least cost of achieving a loss capacity of L , by allocating this loss capacity optimally among syndicate members.

$(NP_0 - R)$ represents the total amount of funds retained by the syndicate from the revenues raised in a fully subscribed offering. Of this amount, $C(L)$ is spent in providing a loss capacity of L . Thus, the total amount of funding available for stabilization activity, denoted by S , is equal to $\{NP_0 - R - C(L) + L\}$. Under the zero expected profit condition, the expected cost of the stabilization activity must be equal to $\{NP_0 - R - C(L)\}$. We thus have,

$$(1) \quad \alpha N \int_{P_0 - \frac{S}{\alpha N}}^{P_0} (P_0 - V)f(V)dV + S \int_0^{P_0 - \frac{S}{\alpha N}} f(V)dV = NP_0 - R - C(L).$$

The expression on the LHS has been derived on the basis that the syndicate needs to engage in stabilization only if it is revealed that the value of each share, V , is smaller than the issue price, P_0 . The syndicate loses an amount $(P_0 - V)$ for each share that it reacquires at a price P_0 . The total loss when it repurchases αN shares is thus $\alpha N(P_0 - V)$. If this amount $\alpha N(P_0 - V)$ is less than or equal to S , the total amount available for stabilization activity, the syndicate will repurchase αN shares at the issue price. If, however, $\alpha N(P_0 - V)$ exceeds S (which is equivalent

⁶Note that we are implicitly assuming that increasing fund capacity through syndication is more efficient than alternative sources of funds, for example, through the formation of a market for stabilization insurance. The rationale is that, given the large asymmetries of information present in the valuation and pricing of new securities, moral hazard problems associated with providing third party insurance may make such insurance relatively inefficient. Syndication may be an effective way to deal with potential moral hazard problems, since the parties providing the funding are also privy to the information and decision making process.

to $V < P_0 - (S/\alpha N)$, the syndicate will conduct its stabilization activity by repurchasing shares at the issue price P_0 until the losses reach S .

To ensure the participation of uninformed investors, it is necessary that these investors not expect to lose as a result of bidding in the IPO. The incentive compatibility condition for the uninformed to be induced to bid in the IPO can be expressed as follows

$$(2) \int_{P_0}^{\infty} a(V)(V - P_0)f(V)dV - \left[(1 - \alpha) \int_{P_0 - \frac{S}{\alpha N}}^{P_0} a(V)(P_0 - V)f(V)dV + \int_0^{P_0 - \frac{S}{\alpha N}} a(V) \left(P_0 - V - \frac{S}{N} \right) f(V)dV \right] = 0.$$

The first term represents the expected profit if the offer is underpriced. The second expression (in square brackets) represents the expected loss if the issue is overpriced, taking into account the ex post compensation associated with the stabilization activity. If the after-market price is not too low (if $V > P_0 - (S/\alpha N)$), the underwriter buys back a fraction α of all shares. The investors are thus left with only $(1 - \alpha)$ of shares allocated to them: the first term in the square brackets represents the expected loss in this case. If the after market price is low enough (if $V < P_0 - (S/\alpha N)$), the underwriter spends a total of S dollars in buying back shares. Therefore, on average, the investors expect to receive S/N for each share that is allocated to them: the second term in the square brackets represents the expected loss in this case.

Note that $\alpha = 0$ would imply that the syndicate did not engage in any stabilization activity and we would essentially get the model in Rock (1986). The results in the next section demonstrate that $\alpha = 0$, however, cannot be the revenue maximizing choice for the firm going public.

III. Implications

A. Optimality of After-Market Stabilization

Proposition 1.

The revenue raised by the firm R is increasing in the fraction of shares α the underwriting syndicate promises to buy back at the issue price P_0 .

Proof. See the Appendix.

The intuition for this result is that subject to the maximum amount set aside for stabilization, the underwriter should be willing to commit to buying back any and all shares at the offer price since this reduces the ex ante adverse selection cost faced by uninformed investors. The underpricing is reduced and, consequently, the expected profits captured by informed investors are smaller.

The above proposition implies that if the syndicate faces no costs in subsequently reselling the shares (at the publicly revealed true value V) it buys back (at

the initial offer price P_0) during the stabilization activity, the revenue maximizing solution is to promise to buy back all shares ($\alpha^* = 1$) in the after-market. (Note, however, that if there are costs associated with the reselling of shares, we may get an interior optimum with $\alpha^* < 1$.) The extent to which the syndicate fulfills this promise is, however, limited to the amount that it has committed to the stabilization activity.⁷

B. Why Firms Use Underwriters

We now examine how the optimal loss capacity L^* is determined and discuss the role of underwriters in providing this capacity. The loss capacity L^* will be chosen so as to maximize the revenue R raised by the firm subject to i) the zero profit constraint for the syndicate, and ii) the incentive compatibility condition, which guarantees that the uninformed investors make nonnegative profits. The first order condition for the maximum is thus obtained by differentiating both equations (1) and (2) with respect to L . This gives two linear equations in two unknowns, dR/dL and dP_0/dL . We solve for dR/dL and set that equal to zero to obtain the first order condition for the optimal loss capacity L^* . If there were no costs to increasing the loss capacity, it would be optimal to form a syndicate with unlimited loss capacity. However, in the presence of costs that are increasing and convex, the following proposition holds.

Proposition 2.

If the cost $C(L)$ of providing a loss capacity of L is increasing and convex in L and if the marginal cost at $L = 0$, $C'(0)$ equals zero, then the optimal loss capacity L^* is strictly greater than zero and is finite.

Proof. See the Appendix.

The intuition for an interior solution for the optimal loss capacity is straightforward. The marginal benefit of additional support, starting from no additional support ($L = 0$), is positive whereas the marginal cost is assumed to be zero. So, it makes sense to choose $L > 0$. Since the marginal benefit is bounded but the marginal cost is increasing, an unlimited amount of support cannot be optimal either.

For the rest of our analysis, we will assume that $C(L)$ is increasing and convex in L and that $C'(0) = 0$.

The interpretation of $L = 0$ is not that there is no capital set aside for stabilization activity, but rather that there is no capital set aside in addition to the *expected* cost of stabilization activity ($NP_0 - R$). This strategy ($L = 0$), however, does not maximize expected revenues for the firm. The proposition shows that it is indeed optimal for the firm to employ an outside agent who is willing to provide additional support ($L > 0$) for the stabilization activity. Our argument thus provides a positive role for the underwriter even in the absence of skills normally attributed to underwriters, such as the ability to assess market conditions or estimate firm value (see Booth and Smith (1986)).

⁷Notice that if one were to compute the average return to the uninformed investors, ignoring the effects of stabilization, this would turn out to be negative.

C. Underwriter Reputation and After-Market Stabilization

We have alluded above to the fact that underwriters may need to have a sufficient reputation capital in order to convince investors of their intention to provide after-market price support. This suggests that banks with well established reputations would most likely be the ones to be involved in firm commitment type contracts. Other investment banks, if they did underwrite firm commitment offerings, may find it difficult to convince the investors of their intention to provide after-market support. Therefore, we expect to find less established investment banks to be primarily associated with best efforts types of offerings. Indeed, Ritter (1987), finds that only "one of the 364 best efforts offers in 1977–1982 was conducted by a 'major bracket' investment banker."⁸

One way of building up reputation may, of course, be through long association with other reputable underwriters. In most IPOs, the lead underwriters and co-managers are a small number, but a large number of other underwriters are involved as well. It is possible that by serving as lead underwriters, the reputable banks provide the guarantee that the after-market intervention will take place—while the other, less reputable banks, are included as syndicate members to provide risk sharing and loss capacity, in addition to other underwriting services.

It has been observed (about the underwriting industry) that underwriting syndicate groups seem to persist through time (see Hayes, Spence, and Marks (1983)). There could be different reasons for this. One, of course, is that if the same banks associate together often in syndicates, this presumably lowers coordination and other costs between these banks. Another reason is that it may make it easier for the lead banker (whose reputation could be on the line) to compel other banks in the syndicate to share losses if these banks are likely to be involved with the same lead banker in future syndicates. The threat of exclusion from future deals could be strong enough to induce compliance by less established syndicate members.

D. Effects of Issue Size on Pricing and Syndication

We now examine how the optimal loss capacity L^* and the optimal offer price P_0^* vary as N , the size of the offering, varies. To keep the degree of informational heterogeneity constant, we assume that the ratio of informed to uninformed bidders does not change.

Proposition 3.

The optimal loss capacity L^* is larger, the larger is the total quantity of shares N offered in the issue.

Proof. See the Appendix.

The intuition for this result is as follows. The marginal benefit of having a larger loss capacity is higher, the larger is the size of the issue. The marginal cost, however, is independent of the size of the issue. As a result, it pays to have a larger

⁸Notice that our explanation for the use of reputable underwriters in firm commitment offerings is different, though not mutually exclusive, from that in Ritter (1987). Ritter argues that reputable underwriters play an important role in certifying firm commitment offerings. Also, see Carter and Manaster (1990).

loss capacity for bigger offerings. A larger loss capacity, in general, would also imply a larger number of investment banks in the syndicate. Therefore, it follows that larger issues should be associated with larger syndicates.

Proposition 4.

The optimal offer price P_O^* is smaller, the larger is the total quantity of shares N offered in the issue.

Proof. See the Appendix.

The intuition for this result is as follows. The offer price would be the same for larger issues if proportionately larger loss capacity were associated with these offerings. However, since the cost of increasing loss capacity (through syndication) gets steeper, larger issues are not associated with proportionately larger loss capacity. Consequently, in order to induce uninformed investors to participate in the bidding process, the offer price must be lowered (since the price support in after-market trading will not be as extensive).⁹

E. "Hot Issue" Markets and the Pricing of IPOs

We now examine how the optimal loss capacity L^* and the optimal offer price P_O^* vary as the cost of providing a given size of loss capacity varies with the demand for underwriting services. For instance, in response to changes in the economic climate, there may be periods in which large numbers of firms decide to go public over a relatively short time span (see Ritter (1984)). In such "hot issue" markets with great demand for underwriting services, the cost of putting together a syndicate with a given size of loss capacity might increase since the size of the investment banking industry cannot immediately increase to satisfy the increased demand. We analyze this by positing the cost function for providing loss capacity to be of the following form,

$$C(L) = Dc(L),$$

where the parameter D measures the extent of the demand; the higher the value of D , the greater is the industry wide demand for underwriting services and, consequently, the higher is the cost of assembling a syndicate that has a given loss capacity.

Proposition 5.

The optimal loss capacity L^* is smaller, the larger is the demand for syndication services (i.e., the larger is the value of D).

Proof. See the Appendix.

The intuition for this proposition is straightforward. Even though the marginal benefit of additional support in the after-market is the same, if the marginal cost is higher in the high demand periods, the optimal loss capacity will be lower in

⁹This result is not inconsistent with the empirical evidence in Ritter (1987) in which he finds that larger offers are typically associated with smaller underpricing. The reason is that the smaller offers also tend to be associated with firms whose value is highly uncertain. Our result examines the effect of issue size on underpricing, holding uncertainty in firm value fixed.

these periods. Hence, we would expect to find reduced support in the after-market in such high issue periods.¹⁰

Smaller loss capacity in this case, however, does not necessarily imply fewer investment banks in the syndicate. The reason is that diversification benefits from syndication may be most relevant when there are several offerings to be handled at the same time. Syndication not only provides a greater loss capacity overall, but it also allows for a more efficient use of that capacity, since, if the risks of the offerings are unrelated, this allows the allocation of the loss capacity to the offerings that need it. This can have overall cost efficiency benefits.

Proposition 6.

The optimal offer price P_O^* is smaller, the larger is the demand for syndication services (i.e., the larger is the value of D).

Proof. See the Appendix.

The intuition here is that since periods with larger demand for IPOs are associated with syndicates that have smaller loss capacity and, therefore, reduced support for after-market stabilization activity, a “sweetener” in the form of lower offer prices must be offered to the uninformed investors in order to induce them to participate in the bidding. This is generally consistent with the empirical evidence in Ritter (1984) and Ibbotson, Sindelar, and Ritter (1993).

F. Effect of Ex Ante Uncertainty in IPO Value

It has been argued that the greater the uncertainty associated with the true value of the shares being offered, the greater should be the underpricing (see Beatty and Ritter (1986)). The intuition is that the extent of the adverse selection problem faced by uninformed investors is increasing in the ex ante uncertainty in firm value. Since underpricing is the only mechanism by which uninformed investors are compensated, in their model, this implies that underpricing should unambiguously increase with an increase in the ex ante uncertainty in firm value.

In our model, however, uninformed investors are compensated both through after-market stabilization as well as through underpricing the offer. In our model, the loss capacity (and, therefore, the extent of after-market support) varies endogenously and the relationship between the optimal loss capacity as well as the optimal offer price and the ex ante uncertainty in firm value becomes ambiguous. The intuition for this is as follows.

First, consider pricing. A higher uncertainty about V , on the one hand, must exacerbate the adverse selection problem faced by the uninformed investors; the syndicate, as a result, must lower the price to induce them to participate in the bidding. On the other hand, the promise to buy back shares at the offer price provides a put option to the investors whose value is higher when the volatility of V is higher. The overall effect of increasing ex ante uncertainty will, therefore, be ambiguous in general.

¹⁰An implication of this may be that in such high issue periods, if the relative cost of using a firm commitment contract compared to a best efforts contract rises, we may expect to observe a relatively greater reliance on best efforts contracts in such periods.

Now, consider the issue of optimal loss capacity. On the one hand, the higher the uncertainty, the higher is the marginal benefit of providing incremental support for price stabilization in terms of higher L . But, on the other hand, the higher uncertainty may also mean that the value of the put option for the uninformed is higher. As a result, the offer price required to induce the uninformed to participate may be larger. This reduces the marginal benefit of increasing L . The overall effect on the marginal benefit, thus, is ambiguous. Since the optimal choice equates marginal benefit to marginal cost, the effect on the choice of optimal L is ambiguous.

G. Effect of Ex Post Uncertainty in IPO Value

In the model, V represents the true value per share, which is perfectly revealed once shares are allocated and investors observe share allocations. Suppose now that there is an additional source of uncertainty so that $V + \delta$ represents the true share value with $E[\delta|V] = 0$. The innovation δ is observed by all market participants (including informed investors) only after shares are initially allocated but before any stabilization activity commences.

It is easy to see that this extra element of uncertainty will reduce the effectiveness of stabilization as a way of compensating the uninformed investors relative to the informed investors in our model. Consider the case in which $V > P_0$ and δ is sufficiently negative such that $V + \delta < P_0$. Underwriters attempting to stabilize at the offer price P_0 , in this case, will not be effective in targeting the benefits to uninformed investors. This suggests that stabilization may not be carried out in instances in which subscription levels are high, though the price falls in after-market trading. Now consider the case in which $V < P_0$ and δ is sufficiently positive such that $V + \delta > P_0$. In this case, despite the relatively low subscription level, underwriters will not be able to provide stabilization benefits to uninformed investors.

The above discussion implies that higher after-market volatility, because it diminishes the efficacy of stabilization in mitigating the winner's curse problem, will be associated with larger underpricing in general. It also implies that in periods of higher stock price volatility, underwriters will be less likely to engage in stabilization activity.

H. Scale and Scope Economies in Investment Banking Services

An investment bank with a larger scale and scope of operations would, in general, have a greater capacity to weather losses and, therefore, may be able to provide a given level of loss capacity at a lower cost. In a firm commitment type contract, because of the possibility of after-market stabilization activity, an increased loss capacity is of value. In best efforts type of contracts, in contrast, there is no benefit to having a loss capacity. An implication, therefore, is that different types of investment banks may specialize in different types of offerings. Large investment banks with a larger loss capacity would be more likely to engage in the underwriting of firm commitment contracts. Best efforts types of offerings, on the other hand, would likely be undertaken by smaller investment banks. This could be independent of reputation effects.

IV. Conclusion

It is well known that underwriters typically stand by and intervene, if necessary, by buying shares in the after-market trading so as to “stabilize” the stock price. We have argued that price stabilization by the underwriting syndicate of investment banks in the after-market trading of an IPO is a mechanism by which the uninformed investors are compensated ex post for the adverse selection cost they face. Since the syndicate abandons the stabilization activity after suffering a given amount of losses, the issue may have to be underpriced as well. We show that this dominates ex ante compensation by underpricing alone since with ex post compensation only the uninformed investors need be compensated, whereas with ex ante compensation (underpricing), even the informed investors receive the benefits in the form of a lower offer price.

In the argument we make, the underwriter need not possess any superior information about the firm. The role of the underwriter in our model is to commit some funds to support the price stabilization, if required. Our argument thus provides a positive role for the underwriter even in the absence of any informational advantage possessed by the underwriter.

Since compensation to investors is provided ex post through stabilization, this commitment may be credible only when it is given by a reputable investment banking syndicate. This is consistent with the finding that “major bracket” investment banks engage almost exclusively in firm commitment offerings. The model also predicts that, keeping other things fixed, larger offerings would tend to be associated with smaller offer prices (larger underpricing) and with syndicates that have a larger loss capacity. Further, “hot issue” periods of high demand for IPOs are predicted to be associated with smaller offer prices (larger underpricing) and with syndicates that have a smaller loss capacity. We hope that future empirical studies of the relation between syndicate size, IPO underpricing, and price stabilization will provide tests of these predictions.

As discussed, underwriter reputation may play a critical role in assuring investors that after-market price support would be provided. This suggests that a fruitful area for future research may be to investigate the relation between measures of underwriter reputation and extent of price stabilization provided. Particularly interesting in this regard is the issue of market penalties for underwriters that breach implicit stabilization guarantees. Such an underwriter may lose market share; there may also be an increase in the underpricing of offerings done by the underwriter, reflecting the drop in investor confidence.

Appendix

The following notation and definitions will be useful in proving the propositions.

We first define three regions as follows,

$$\begin{aligned}
 X &\equiv \{V : P_0 \leq V \leq \infty\}, \\
 Y &\equiv \left\{ V : P_0 - \frac{S}{\alpha N} \leq V \leq P_0 \right\},
 \end{aligned}$$

$$\text{and } Z \equiv \left\{ V : 0 \leq V \leq P_0 - \frac{S}{\alpha N} \right\}.$$

Let

$$\Pi_A \equiv \int_A f(V) dV, \quad A \in \{X, Y, Z\}.$$

Also, for any function $g(V)$, let

$$E_A g(V) \equiv E [g(V) | V \in A] = \frac{\int_A g(V) f(V) dV}{\Pi_A}, \quad A \in \{X, Y, Z\}.$$

Equations (1) and (2) can now be rewritten as follows:

$$(3) \quad R = NP_0 - [\alpha N \Pi_Y E_Y [P_0 - V] + \Pi_Z \{NP_0 - R - C(L) + L\}] - C(L),$$

$$(4) \quad \begin{aligned} & \Pi_X E_X [a(V)(V - P_0)] - \left[(1 - \alpha) \Pi_Y E_Y [a(V)(P_0 - V)] \right. \\ & \left. + \Pi_Z E_Z \left[a(V) \left(\frac{R + C(L) - L}{N} - V \right) \right] \right] = 0. \end{aligned}$$

Proof of Proposition 1.

Differentiating (3) with respect to α and simplifying, we get

$$(5) \quad \frac{dR}{d\alpha} (1 - \Pi_Z) = N \frac{dP_0}{d\alpha} [\Pi_X + (1 - \alpha) \Pi_Y] - N \Pi_Y E_Y [P_0 - V].$$

Similarly, differentiating (4) with respect to α and simplifying, we get

$$(6) \quad N \frac{dP_0}{d\alpha} = \frac{N \Pi_Y E_Y [a(V)(P_0 - V)] - \frac{dR}{d\alpha} \Pi_Z E_Z a(V)}{\Pi_X E_X a(V) + (1 - \alpha) \Pi_Y E_Y a(V)}.$$

Eliminating $dP_0/d\alpha$ from (5) and (6) and simplifying, we get

$$(7) \quad \begin{aligned} & \frac{dR}{d\alpha} \left[1 + \Pi_Z \left(\frac{\Pi_X + (1 - \alpha) \Pi_Y}{\Pi_X \frac{E_X a(V)}{E_Z a(V)} + (1 - \alpha) \Pi_Y \frac{E_Y a(V)}{E_Z a(V)}} - 1 \right) \right] \\ & = N \Pi_Y \left[E_Y [P_0 - V] \left(\frac{\Pi_X + (1 - \alpha) \Pi_Y}{\Pi_X \frac{E_X a(V)}{E_Y a(V)} + (1 - \alpha) \Pi_Y} - 1 \right) \right. \\ & \quad \left. + \text{Cov} [a(V), (P_0 - V)] \frac{\Pi_X + (1 - \alpha) \Pi_Y}{\Pi_X E_X a(V) + (1 - \alpha) \Pi_Y E_Y a(V)} \right]. \end{aligned}$$

Now, since, $E_X a(V) < E_Y a(V) < E_Z a(V)$, the terms in large parentheses in (7) are positive. Also, since $\text{Cov}[a(V), (P_O - V)] > 0$, and $E_Y[P_O - V] > 0$, it follows that $dR/d\alpha > 0$. \square

Proof of Proposition 2.

Substituting $\alpha = 1$ in (3) and (4), differentiating with respect to L , and rearranging, we get the following,

$$(8) \quad \frac{dR}{dL} (1 - \Pi_Z) = N \frac{dP_O}{dL} \Pi_X - \Pi_Z - (1 - \Pi_Z) C'(L),$$

$$(9) \quad N \frac{dP_O}{dL} = \left[1 - \frac{dR}{dL} - C'(L) \right] \frac{\Pi_Z E_Z a(V)}{\Pi_X E_X a(V)}.$$

Eliminating dP_O/dL from (8) and (9) and simplifying, we get

$$(10) \quad \frac{dR}{dL} = \frac{Q}{1 + Q} - C'(L),$$

where

$$(11) \quad Q \equiv \Pi_Z \left[\frac{E_Z a(V)}{E_X a(V)} - 1 \right] > 0.$$

The first order condition, therefore, is as follows,

$$(12) \quad \left[\frac{Q(L^*)}{1 + Q(L^*)} \right] = C'(L^*).$$

Clearly, then, $C'(L^*) > 0$, from which it follows that $L^* > 0$. \square

Proof of Proposition 3.

Differentiating the first order condition (12) with respect to N , we get

$$\frac{\partial}{\partial L^*} \left[\frac{Q(L^*, N)}{1 + Q(L^*, N)} - C'(L^*) \right] \frac{dL^*}{dN} + \frac{\partial}{\partial N} \left[\frac{Q(L^*, N)}{1 + Q(L^*, N)} - C'(L^*) \right] = 0.$$

From the second order condition, the first term multiplying dL^*/dN is negative. Therefore, it follows that

$$\text{Sign} \left[\frac{dL^*}{dN} \right] = \text{Sign} \left[\frac{\partial}{\partial N} \left[\frac{Q(L^*, N)}{1 + Q(L^*, N)} - C'(L^*) \right] \right] = \text{Sign} \left[\frac{\partial}{\partial N} Q(L^*, N) \right].$$

Substituting the optimal values for the endogenous variables and partially differentiating (3) and (4) with respect to N , keeping L^* fixed, we get

$$(13) \quad \frac{\partial R^*}{\partial N} = P_O^* - \frac{\Pi_Y}{1 - \Pi_Z} E_Y [P_O^* - V] + \frac{\Pi_X}{1 - \Pi_Z} N \frac{\partial P_O^*}{\partial N}.$$

$$(14) \quad -\frac{\partial P_O^*}{\partial N} [\Pi_X E_X a(V)] = \Pi_Z E_Z a(V) \left[\frac{1}{N} \frac{\partial R^*}{\partial N} - \frac{R^* + C(L^*) - L^*}{N^2} \right].$$

Eliminating $\partial R^*/\partial N$ from (13) and (14) and simplifying, we get

$$(15) \quad -\frac{\partial P_O^*}{\partial N} \left[\Pi_X \left\{ E_X a(V) + \frac{\Pi_Z}{1 - \Pi_Z} E_Z a(V) \right\} \right] = \frac{L^*}{N^2 (1 - \Pi_Z)} > 0.$$

Therefore,

$$(16) \quad \frac{\partial P_o^*}{\partial N} < 0.$$

From (16) and (14), it follows that

$$(17) \quad \frac{\partial}{\partial N} \left[\frac{R^* + C(L^*) - L^*}{N} \right] = \left[\frac{1}{N} \frac{\partial R^*}{\partial N} - \frac{R^* + C(L^*) - L^*}{N^2} \right] > 0.$$

Therefore,

$$(18) \quad \frac{\partial \Pi_Z}{\partial N} > 0,$$

$$(19) \quad \frac{\partial E_Z a(V)}{\partial N} > 0,$$

$$(20) \quad \frac{\partial E_X a(V)}{\partial N} < 0.$$

From (18), (19), (20), and (11), it follows that $(\partial/\partial N)Q(L^*, N) > 0$. Therefore $\partial L^*/\partial N > 0$. \square

Proof of Proposition 4.

The first order condition could be rewritten as follows,

$$(21) \quad \left[\frac{Q(P_o^*, N)}{1 + Q(P_o^*, N)} \right] - C'(L(P_o^*, N)) = 0.$$

Differentiating the first order condition (22) with respect to N , we get

$$\begin{aligned} \frac{\partial}{\partial P_o^*} \left[\frac{Q(P_o^*, N)}{1 + Q(P_o^*, N)} - C'(L(P_o^*, N)) \right] \frac{dP_o^*}{dN} \\ + \frac{\partial}{\partial N} \left[\frac{Q(P_o^*, N)}{1 + Q(P_o^*, N)} - C'(L(P_o^*, N)) \right] = 0. \end{aligned}$$

From the second order condition, the first term multiplying dP_o^*/dN is negative. Therefore, it follows that

$$\text{Sign} \left[\frac{dP_o^*}{dN} \right] = \text{Sign} \left[\frac{\partial}{\partial N} \left[\frac{Q(P_o^*, N)}{1 + Q(P_o^*, N)} \right] - C''(L(P_o^*, N)) \frac{\partial L^*}{\partial N} \right].$$

Substituting the optimal values for the endogenous variables and partially differentiating (3) and (4) with respect to N , keeping P_o^* fixed, and rearranging, we get

$$(22) \quad \frac{\partial}{\partial N} \left[\frac{R^* + C(L(P_o^*, N)) - L(P_o^*, N)}{N} \right] = 0.$$

$$(23) \quad \frac{\partial R^*}{\partial N} = P_O^* - \frac{\Pi_X}{1 - \Pi_Z} E_Y [P_O^* - V] - \left[\frac{\Pi_Z}{1 - \Pi_Z} + C'(L(P_O^*, N)) \right] \frac{\partial L^*}{\partial N}.$$

Simplifying (22), eliminating $\partial R^*/\partial N$ from (22) and (23), and simplifying, we get

$$(24) \quad \frac{\partial L^*}{\partial N} = \frac{L^*}{N} > 0.$$

From (22), $(\partial/\partial N)Q(P_O^*, N) = 0$. Therefore, from (24) $dP_O^*/dN < 0$. \square

Proof of Proposition 5.

Differentiating the first order condition (12) with respect to D , we get

$$\frac{\partial}{\partial L^*} \left[\frac{Q(L^*, D)}{1 + Q(L^*, D)} - C'(L^*) \right] \frac{dL^*}{dD} + \frac{\partial}{\partial D} \left[\frac{Q(L^*, D)}{1 + Q(L^*, D)} - Dc'(L^*) \right] = 0.$$

From the second order condition, the first term multiplying dL^*/dD is negative. Therefore, it follows that

$$\text{Sign} \left[\frac{dL^*}{dD} \right] = \text{Sign} \left[\frac{\partial}{\partial D} \left[\frac{Q(L^*, D)}{1 + Q(L^*, D)} \right] - c'(L^*) \right].$$

Substituting the optimal values for the endogenous variables and partially differentiating (3) and (4) with respect to D , keeping L^* fixed, we get:

$$(25) \quad \frac{\partial R^*}{\partial D} = N \frac{\Pi_X}{1 - \Pi_Z} \frac{\partial P_O^*}{\partial D} - c(L^*);$$

$$(26) \quad \frac{\partial P_O^*}{\partial D} \Pi_X E_X a(V) + \frac{\Pi_Z E_Z a(V)}{N} \left[\frac{\partial R^*}{\partial D} + c(L^*) \right] = 0.$$

From (25) and (26), we get

$$(27) \quad \frac{\partial P_O^*}{\partial D} = 0,$$

$$(28) \quad \frac{\partial R^*}{\partial D} = -c(L^*) < 0.$$

From (27) and (28), it follows that $(\partial/\partial D)Q(L^*, D) < 0$. Therefore, $dL^*/dD < 0$. \square

Proof of Proposition 6.

The first order condition could be rewritten as follows,

$$(29) \quad \left[\frac{Q(P_O^*, D)}{1 + Q(P_O^*, D)} \right] - Dc'(L(P_O^*, D)) = 0.$$

Differentiating the first order condition (29) with respect to D , we get

$$\begin{aligned} \frac{\partial}{\partial P_O^*} \left[\frac{Q(P_O^*, D)}{1 + Q(P_O^*, D)} - Dc'(L(P_O^*, D)) \right] \frac{dP_O^*}{dD} \\ + \frac{\partial}{\partial D} \left[\frac{Q(P_O^*, D)}{1 + Q(P_O^*, D)} - Dc'(L(P_O^*, D)) \right] = 0. \end{aligned}$$

From the second order condition, the first term multiplying dP_O^*/dD is negative. Therefore, it follows that

$$\text{Sign} \left[\frac{dP_O^*}{dD} \right] = \text{Sign} \left[\frac{\partial}{\partial D} \left[\frac{Q(P_O^*, D)}{1 + Q(P_O^*, D)} \right] - Dc''(L(P_O^*, N)) \frac{\partial L^*}{\partial D} - c'(L(P_O^*, D)) \right].$$

Substituting the optimal values for the endogenous variables and partially differentiating (3) and (4) with respect to D , keeping P_O^* fixed, and rearranging, we get

$$(30) \quad \frac{\partial R^*}{\partial D} = - \left[c(L(P_O^*, D)) + Dc'(L(P_O^*, D)) \frac{\partial L^*}{\partial D} \right] - \frac{\Pi_Z}{1 - \Pi_Z} \frac{\partial L^*}{\partial D},$$

$$(31) \quad \frac{\partial R^*}{\partial D} + c(L(P_O^*, D)) + Dc'(L(P_O^*)) \frac{\partial L^*}{\partial D} - \frac{\partial L^*}{\partial D} = 0.$$

From (30) and (31),

$$(32) \quad \frac{\partial L^*}{\partial D} = 0.$$

Since from (31), $(\partial/\partial D)Q(P_O^*, D) = 0$, and using (32), it follows that $dP_O^*/dD < 0$. \square

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