Specialized Valuation and the Economic Organization of Investment Banking Syndicates

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\. . . you simply had to have a stabilization clause in order to make this business function in putting the securities on the market [because] there were many ways that shrewd people could beat the game and spoil the putting of any security on the market unless you did this."[1]

1. Introduction

What is the economic function of investment banking syndicates? Until 1953, when Judge Medina rendered his forceful opinion exonerating the syndicate system as a horizontal restraint of trade in U.S. v. Morgan,[2] this was a question that had long preoccupied antitrust authorities. There is little doubt that the syndicate system involves horizontal arrangements between ¯rms that might otherwise act as rivals in the initial public sale of corporate equities. Yet, as the Morgan court found, the investment banking syndicate appears to be \a reasonable business combination having the purpose and e®ect of e±ciently promoting, rather than restraining, trade."[3]

In this paper, we analyze the modern syndicate system in an attempt to discover its underlying purpose and its e®ects. We hypothesize that a major function of the investment banking syndicate is to economize on the costs of valuing and pricing the initial public sale of corporate equities. Following Hirshleifer (1971), we focus on the social losses arising from excess search in the pursuit of \private foreknowledge." In the absence of syndicate restrictions, market participants will spend resources to produce this information. Although this search activity can be privately pro¯table, it has no social value because its sole function is to transfer wealth from the uninformed to the informed, with no e®ect on resource allocation.

[1] Testimony of Mr. Harold L. Stuart of Halsey, Stuart & Co., regarding stabilization by the managing underwriter and the related use of \repurchase penalties," now referred to as \penalty bids." U.S. v. Morgan Stanley, et al., 118 F. Supp. 621, 643 (1953).

[2] 118 F. Supp. 621 (1953).

[3] Id. at 622.

As Barzel (1977) has emphasized, the parties will devise institutions to minimize the social losses from excess search subject to the cost of transacting. We argue that the syndicate system is just such an arrangement.

Coase (1937) offers an early insight that firms exist to economize on the costs of forming market prices. We suggest that an investment banking syndicate is an ad hoc firm designed to suppress excessive valuation. As with any economic activity, optimal valuation does not require perfect valuation. Past some point, errors in pricing are efficient and should be tolerated, because the social benefit of improved valuation does not warrant its cost. But errors in pricing provide those who are in a position to refine the price forecast with an opportunity to capture a share of the wealth generated by the transaction. For example, if an investor can privately determine whether a new issue is overpriced or underpriced, he can profit by subscribing only to underpriced issues (Rock, 1986). Further, he can use his private foreknowledge to speculate by going either long or short in the aftermarket in anticipation of the inevitable price adjustment. Under certain circumstances, he might even be able to profit by selling the information to other market participants. To the extent that such speculative activity is costly and unavoidable, over the long run it will reduce the total returns to investment banking and raise the cost of capital to issuing firms. This activity is costly to the speculator and wasteful for society, among other reasons because it is likely to require the speculator to duplicate the information contained in the initial price forecast and then to spend additional resources to refine it. To avoid systematically losing wealth to speculators, an underwriter will be compelled to spend excessive resources valuing the issue in an effort to reduce the likelihood of pricing errors that create the opportunity for profitable speculation. This itself is costly.

The parties can enhance their wealth by entering into enforceable restrictions that reduce their incentive to engage in costly wealth transfers. We believe this is much of what the syndicate system is designed to achieve. By turning the would-be speculator into a syndicate member who is in effect required to participate in all issues according to the established rules of the game, the managing underwriter denies him the opportunity to profit from acquiring private information, thereby curtailing his incentive to acquire such information. Just as importantly, by effectively committing to offer syndicate members participation in all issues, the managing underwriter denies himself the opportunity to profit from acquiring private information, thereby curtailing his own incentive to acquire this information.[4]

[4] The requirement that syndicate members are required to participate in all issues, and that

An implication of this analysis is that the banks invited to participate in a given syndicate by the managing underwriter will be those with specialized expertise in gathering information about the particular issue in question. One bene¯t is that these banks can use their distribution networks to provide expert assistance in gathering the information properly to value the issue (Pichler and Wilhelm, 1998). Another bene¯t to the managing underwriter, which is the focus of this paper, comes in avoiding the threat these ¯rms would pose as speculators if left out of the syndicate. In this sense, the syndicate is a mechanism for de¯ning and enforcing property rights to the information imbedded in the price forecast, and to any subsequent price revisions, by paying o® would-be speculators.[5]

The syndicate has historically been described as a risk-sharing mechanism and has recently been argued to serve to increase the loss capacity of underwriters who engage in post-issue stabilization for the purpose of remedying the problem of adverse selection introduced by the presence of informed traders (Rock, 1986; Chowdhry and Nanda, 1996). Like Pichler and Wilhelm (1998), we believe that the economic function of syndicates can no longer be motivated by risk sharing considerations. In fact, we remain agnostic that risk sharing, as traditionally conceived, has ever been the underlying motivation for syndicates. Like Chowdhry and Nanda (1996), we view the syndicate as motivated by the problem of adverse selection. In contrast to them, we view the syndicate as serving to prevent the problem of adverse selection rather than remedying it.

The syndicate involves would-be speculators as co-sellers of an issue. It therefore serves to prevent the problem of adverse selection that would arise in the presence of informed sellers. The counterpart to the syndicate is the group of regular investors. These investors are required to subscribe to all issues. As for syndicate members, the requirement to participate in all issues denies regular investors the opportunity to pro¯t from acquiring private information, thereby

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the managing underwriter commits to o®er syndicate members participation in all issues, are admittedly extreme. All that is required for our purpose is that no party can inde¯nitely engage in picking and choosing among issues.

[5]Our view of the underwriting syndicate recalls Barzel's (1977) view of the `sights' organized by De Beers for its `approved' dealers. Sights are boxes of diamonds which are o®ered ony to approved dealers. Dealers can accept or reject the sights they have been o®ered, but they cannot negotiate their price, nor can they choose amongst the diamonds in a sight. Rejection usually leads to the loss of approved dealer status. Barzel has hypothesized that the sights are intended to prevent dealers from acquiring information about the quality of the diamonds. Diamond dealers covet the status of approved dealer, revealing the diamonds in the sights to be underpriced. See Barzel (1977) and Kenney and Klein (1983) for further details.

curtailing their incentive to acquire such information. The presence of regulars therefore serves to prevent the problem of adverse selection that would arise in the presence of informed buyers.

The paper proceeds as follows. Section 2 provides a detailed institutional description of the syndicate system and the underwriting process. Section 3 develops our model and analysis and presents our main results. Finally, Section 4 discusses our results and concludes.

2. Syndicate Organization and Underwriter Contracts

There is surprisingly little material documenting the organizational details of investment banking syndicates. This may be due, in part, to their ever changing structure in response to evolving regulatory and market in°uences. For example, it seems clear that passage of the Securities Act (1933) and the Securities Exchange Act (1934) had a substantial in°uence on syndicate structure. Prior to the Act, syndicates appear to have involved a larger number of transactions between separate groups of ¯rms in the vertical chain of distribution. Following passage of the Act, these groups appear to have been vertically integrated into a single group of syndicate ¯rms. Since then, there have no doubt been a substantial number of organizational changes to the syndicate system that have occurred to meet market in°uences arising from changes in industrial structure and the proliferation of ¯nancial instruments.

The dearth of descriptive material on syndicates may also be due to their °eeting character and the common use of repeated and reciprocal participations. Syndicates are formed for the speci¯c purpose of marketing an issuer's securities. This takes about two weeks. Once the task has been completed, there is little need for participating ¯rms to associate with each other as to that issue.[6] Curiously, however, there is a striking tendency for syndicate participants to work together in subsequent o®erings and to engage in reciprocal business relations. Managing underwriters expect subunderwriters to be members of the managing underwriters' successive syndicates; and they expect subunderwriters to invite them to become members of the syndicates the subunderwriters, now managing underwriters, will manage. Subunderwriters expect to be invited to become members of managing underwriters' successive syndicates; and they expect managing underwriters, now subunderwriters, to become members of the syndicates the subunderwriters, now

[6] Check to see if syndicate members engage in the concerted exercise of warrants somewhere down the road.

managing underwriters, will manage. The repeated failure to make or to accept such invitations eventually excludes the contravening party from participation in underwriting syndicates. Under these circumstances { short-lived organization with repeated and reciprocal business { there is little reason to reduce the terms of syndicate deals to writing. Instead, customary practice seems to prevail, and this is much more di±cult to document in any detailed way by outside observers.

The public sale of securities begins with the issuing ¯rm's decision to raise capital. The issuer may be an existing publicly-traded corporation hoping to issue new classes of securities or additional units of existing or \seasoned" classes in what is known as a secondary o®ering. It may also be a private ¯rm hoping to go public in an initial public o®ering (IPO), in which case the investment project at hand involves no less than the reorganization of the ¯rm into a publicly-traded corporation. The number of possibilities is large, both in terms of the variety and the complexity of ¯nancial instruments to be used to package the sale and in terms of the circumstances facing the issuing ¯rm. For our purposes, the IPO provides the prototype because this is where we expect the excess search problem to be most pronounced due to the novelty of the shares being sold.

Having determined to raise capital, the ¯rm has a choice of selling the issue itself or hiring an underwriter, pursuant to an underwriting contract, to form a syndicate to market the issue. In the case of an initial public o®ering of corporate equities, the issuer seldom sells the issue itself, although it is fairly common for a ¯rm that has already gone public to issue additional shares of an existing class of stock to current shareholders in a so-called \rights o®ering." An issuer can use one of two methods to hire an underwriter: a negotiated or a competitive underwriting. In a negotiated underwriting, the issuer hires a lead, or managing, underwriter and the parties establish the discount from the retail o®ering price, or \spread," that the underwriter(s) will pay for the issue, as well as the number of shares to be issued. The managing underwriter then forms the syndicate (consisting of other investment banks) and establishes the per share issue price and other terms of the o®ering including the number of shares to be allocated to each participant. In a competitive underwriting, the issuer puts the underwriting out for competitive bid, often hiring an investment bank up front for an hourly wage to \shape up" the issue by establishing the basic parameters that will allow a meaningful auction. The winner of the auction then takes on the role of managing underwriter.[7] Competitive underwritings are especially common in municipal

[7] Are competitive underwritings done on both a ¯rm commitment and a best e®orts basis? Do competitive underwritings always, sometimes, or never involve the use of a syndicate? In

bond issues, where they are often mandated by law. The spread on competitive underwritings is generally thought to be lower than on otherwise similar negotiated underwritings, and it is thus puzzling why issuers generally choose the latter over the former. Our proposed answer is that competitive underwriting is subject to an indirect compensating di®erential.

Negotiated underwritings can be performed according to one of three contractual forms, the ¯rm commitment contract, the best e®orts contract, and the stand-by contract. The ¯rm commitment contract amounts to a lump sum transfer of the entire issue to the syndicate at the discount price negotiated between the issuer and the managing underwriter, which is announced to syndicate participants at the last minute. Once the retail price has been set, the syndicate commits to paying the issuer the retail price less the spread times the number of shares. The syndicate bears any losses arising from the failure to sell the entire issue at the retail price and therefore becomes the residual claimant to its success at selling the issue at the established price. The sole exception to this occurs when the issuer provides the managing underwriter with a so-called \over-allotment" option consisting of warrants to purchase up to an additional 15% of the shares to be issued.

The best e®orts contract is essentially a commission agency arrangement between the managing underwriter and the issuer. The managing underwriter agrees to use its best e®orts to market the issue and receives a per share commission on all sales. Presumably, the managing underwriter takes a speci¯c share of each commission and distributes the remainder among the syndicate participants in proportion to their respective sales.[8] Relative to the ¯rm commitment contract, the best e®orts contract makes the issuer bear much of the variability in the success of the o®ering, with the residual borne by the syndicate being proportionate to the per unit commission on unsold shares.

The stand-by contract is now rarely used and represents a hybrid between the ¯rm commitment and the best e®orts contracts. In a standby contract, the issuer self-sells the issue but arranges for the syndicate to buy any shares that remain unsold at an established price °oor in the event the o®ering is poorly subscribed. This arrangement appears to put the syndicate in a position similar to that of a debtholder.

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our view, it would make little sense to auction o® the right to sell as an agent an unspeci¯ed number of shares.

[8] Is the commission per unit or ad velorem. Either way, it should dovetail with Yoram's tax article.

The syndicate system exhibits a number of remarkable institutional features and empirical artifacts. One of the most notable institutional features is post-o®ering \stabilization" by the syndicate to control the market price, an activity that is prescribed under Rules 10(b)(6), (7), and (8) of the Securities Exchange Act (1934).[9] For oversubscribed issues, the managing underwriter may exercise its over-allotment option to expand the number of shares to keep the secondary market price from rising too far, and for undersubscribed issues the managing underwriter might purchase shares in the market to establish a price °oor. The terms of the o®er often prohibit the immediate aftermarket resale of the purchased securities, or \°ipping." Press reports indicate that syndicate managers threaten and impose penalties on syndicate members whose customers engage in °ipping.. Pooling arrangements; the last-minute pricing and prohibition on preselling of the issue; repeated and reciprocal relations with required participation; and the manager's unilateral allocation of participation shares to syndicate members and discretion over the moment the syndicate disbands, or \breaks;" are added institutional features of the syndicate system. Perhaps the most remarkable empirical artifact, which is common to all IPOs, is that new issues are routinely underpriced; that is, initial buyers enjoy systematic positive abnormal returns on the day of the sale.

Many of the institutional features of syndicates appear to be a consequence of the need to elicit the production of what Hirshleifer describes as \discovery" information and its truthful revelation. Unlike \foreknowledge," discovery information occurs before resource allocation has been set and can therefore have positive social value. In the context of book-building, institutional investors must be o®ered a discount from the retail price to induce them to truthfully reveal to underwriters their knowledge of the likely demand for a new issue (Benveniste and Spindt, 1989; Benveniste and Wilhelm, 1990; Cornelli and Goldreich, 1998; Weiss Hanley, 1993; Weiss Hanley and Wilhelm, 1995); a commitment on the part of the syndicate to stabilize the market combines with the imposition of penalties on °ipping to deter syndicate members from misreporting the information communicated by institutions (Benveniste, Busaba, and Wilhelm, 1997; Benveniste, Erdal, and Wilhelm, 1998); and the visibility of the position of lead underwriter (Nanda and Yun, 1997) induces syndicate members who might be called on to assume that position to incur the cost of maintaining ongoing contacts with institutions (Pichler and Wilhelm, 1998).[10]

[9] Cite US Code.

[10] See Jenkinson and Ljungqvist (1996) for an extensive review of the literature on IPOs.

Some characteristics of the syndicate appear to have remained unexplained, however. We believe our analysis provides an explanation for several such characteristics. These are repeated relations between managing underwriters and sub-underwriters, required participation on the part of the former and the latter, and over-allotment options. Our analysis further suggests an explanation for the prevalence of negotiated underwritings in spite of their higher spreads. Finally, its implications are consistent with many of the aforementioned characteristics, such as stabilization, the prohibition on °ipping, and underpricing.

3. The Model

Consider an entrepreneur who will invest in a number of identical assets. For reasons left unmodelled, the entrepreneur chooses to obtain the necessary funding through an initial public o®ering. Assume for simplicity that each share issued by the entrepreneur in the IPO constitutes a claim on a single asset of the ¯rm. Both the asset and the share have value $\tilde{v}$, $\tilde{v} \sim N(\bar{x}; \frac{1}{h})$. The entrepreneur wishes to determine the number, q, of assets in which he will invest and of shares he will issue, at a cost $\frac{1}{2}kq^2$.[11] The problem faced by the entrepreneur is therefore:

$$\max_q \; qE[\tilde{v}] - \frac{1}{2}kq^2$$

The preceding problem has solution $q = \frac{E[\tilde{v}]}{k}$. The entrepreneur's expected payo® is therefore $\Pi = \frac{\bar{x}^2}{2k}$. The corresponding expected value of the ¯rm is $V = \frac{\bar{x}^2}{k} = 2\Pi$.

3.1. Social Information and Underwriting

Suppose that information $\tilde{v}_1 = \tilde{v} + \tilde{e}_1$, $\tilde{e}_1 \sim N(0; \frac{1}{h_1})$, about the value of a single asset and share is available at a cost c_1. Such information serves to guide the entrepreneur's investment decision, thereby increasing his expected payo®, gross of the cost of acquiring the information. To see this, note that the scale chosen by the ¯rm in the presence of the information i_1 is $q(i_1) = \frac{E[\tilde{v}|i_1]}{k}$. The entrepreneur's expected payo®, gross of the cost of the information is therefore:

$$E\left[\Pi - c_1\right] = E\left[\frac{E[\tilde{v}|i_1]^2}{2k}\right]$$

[11] The formulation of the problem follows that of Leland (1993).

$$= \frac{1}{2k} E\left[\left(\frac{h\bar{x} + h_1 i_1}{h + h_1}\right)^2\right]$$
$$= \frac{1}{2k}\left(\bar{x}^2 + \frac{h_1}{h(h + h_1)}\right)$$
$$> \frac{\bar{x}^2}{2k}$$
$$= \text{¦}$$

The corresponding expected value of the ¯rm is $E[V(\tilde{r}_1)] = E\left[\frac{E[\tilde{x}|i_1]^2}{k}\right] = 2E[\text{¦}(\tilde{r}_1)]$. The acquisition of the information i_1 is desirable if $E[\text{¦}(\tilde{r}_1)] - \text{¦} = \frac{1}{2k}\frac{h_1}{h(h+h_1)} > c_1$. We assume this to be true. The information i_1 therefore has social value and should be acquired.

The entrepreneur is assumed to be unable to acquire the information i_1, perhaps because such information pertains to demand conditions about which the entrepreneur knows relatively little. The same is assumed to be true of retail investors. In contrast, investment banks and institutional investors are assumed to be able to acquire the information i_1 at the cost c_1.[12] They are also assumed to be able to communicate information credibly, if they so choose.[13]

We can now prove our ¯rst result:

Proposition 3.1. The entrepreneur can obtain his maximum expected payo® $E[\text{¦}(\tilde{r}_1)] - c_1$ by entering into an agreement with an investment bank whereby the bank, now an underwriter, buys the entire issue for $E[V(\tilde{r}_1)] - c_1$ in return for a commitment on the part of the entrepreneur to issue $q(P(i_1)) = \frac{P(i_1)}{k}$ shares and to use an amount $\frac{1}{2}kq(P(i_1))^2$ of his proceeds to invest in $q(P(i_1))$ assets. $P(i_1)$ denotes the price at which the underwriter sells the shares after having acquired the information i_1. $P(i_1) = E[\tilde{x}|i_1]$ and $q(P(i_1)) = q(i_1)$. c_1 is the underwriter's spread.

Proof: The agreement between the entrepreneur and the underwriter is entered into before information is acquired, for doing so avoids the need for the ¯rm to

[12] The assumption that the entrepreneur and retail investors cannot acquire the information is without loss of generality. It is su±cient that their cost of acquiring information be greater than that of investment banks and institutional investors.

[13] This last assumption is without loss of generality, given the prior assumption that both investment banks and institutional investors are able to acquire the information i_1.

grant an informational rent to the underwriter.[14] The underwriter is willing to enter into the agreement because his expected payo® is:

$$E\left[V \mid \tilde{e}_1\right] - E\left[V \mid \tilde{e}_1\right] - c_1 - c_1 = 0$$

Having entered into the agreement, the underwriter communicates any information he acquires. Institutional investors and investment banks, fearing a lemon problem (Akerlof, 1970), otherwise acquire the information themselves and correspondingly decrease the price they are willing to pay for the shares by the cost of the information. Institutional investors and investment banks expect the underwriter to acquire the information: his expected payo® if he does, zero, is greater than his expected payo® if he does not:

$$\begin{aligned} V - E\left[V \mid \tilde{e}_1\right] - c_1 &= 2\left(-2E\left[\tilde{e}_1\right] + c_1\right) \\ &< -2c_1 + c_1 \\ &= -c_1 \\ &< 0. \end{aligned}$$

Note the importance of the assumption that both the underwriter and institutional investors and investment banks can acquire the information to the achievement of e±ciency.[15] Assuming that only the underwriter or only institutional investors and investment banks can acquire the information would require signalling or screening, respectively, on the part of the underwriter, thereby resulting in well-known distortions.[16] Note also that the communication of information economizes on the costly production of information. Finally, note that retail investors bene¯t from the presence of institutional investors and investment banks, for it is their presence that induces the underwriter to communicate his information, thereby preventing him from exploiting such information.[17]

[14] The choice of investment bank is indeterminate in this case, as the cost of acquiring information is identical for all investment banks. In case this cost were to di®er across investment banks, the investment bank with the lowest cost would become the underwriter. It would earn economic rents by virtue of having the lowest cost.

[15] The participation of investment banks in the o®ering is assumed to be made necessary by the need to access these banks' distribution networks.

[16] See for example Allen and Faulhaber (1989), Chemmanur (1993), Grinblatt and Hwang (1989), and Welch (1989, 1992) for signalling models of IPOs; and Baron (1982), Baron and Holmstrom (1980), Benveniste and Spindt (1989), and Benveniste and Wilhelm (1990) for screening models.

[17] This is in contrast to Rock (1986). The relation of our work to Rock's is further discussed in Section 3.2.

Proposition 3.1 suggests an explanation for the prevalence of negotiated underwritings in spite of their higher spreads.[18] The \shaping up" that precedes the auction in a competitive underwriting establishes only the basic parameters of the issue. In contrast, as noted by Smith (1986), an issuer will negotiate detailed o®ering terms with the underwriter in a negotiated underwriting. The o®ering will be for $q = \frac{E[\tilde{v}]}{k}$ shares at a price $E[\tilde{v}]$ per share in the case of competitive underwriting, whereas it will be for $q(i_1) = \frac{E[\tilde{v}|i_1]}{k}$ shares at a price $E[\tilde{v}|i_1]$ per share in the case of negotiated underwriting. The social value of the information i_1 implies that the issuer's expected payo® will be greater in the latter case, in spite of his payment of the spread c_1 in that case. Negotiated underwritings will be chosen where there is information to be acquired. In contrast, competitive underwritings will be chosen where there is no information to be acquired, or where information can be acquired by the issuer. Debt issues and seasoned equity o®erings can arguably be viewed as instances of the latter case.

Proposition 3.1 also suggests an explanation for the choice between best efforts and ¯rm commitment underwriting. Assume that the precision h_1 of the information i_1 can be chosen by the underwriter at a cost $c_1(h_1)$.[19] It is then immediate that the ¯rst-best precision will be chosen by the underwriter only under ¯rm commitment underwriting. Best e®orts underwriting may instead be chosen where the precision of the information is e®ectively constant.[20]

This section has examined the acquisition of social information. However, the ability to acquire social information is also the ability to acquire private information, and whilst the former is desirable, the latter is not.

3.2. Private Information and the Problem of Excess Search

Suppose that additional information $\tilde{v}_2 = \tilde{v} + \tilde{\varepsilon}_2$, $\tilde{\varepsilon}_2 \sim N(0; \frac{1}{h_2})$, $cov(\tilde{\varepsilon}_1; \tilde{\varepsilon}_2) = 0$, can be acquired by the underwriter, institutional investors, and investment banks at a cost c_2. The information i_2 is assumed to have no social value, in the sense that $E\left[\tilde{v} \mid \tilde{v}_2\right] - c_2 < E[\tilde{v}]$. Equivalently, $\frac{1}{2k}\frac{h_2}{h(h+h_2)} < c_2$. It is then immediate

[18] See Heinkel and Schwartz (1986) for an alternative explanation based upon the monitoring role of underwriters.

[19] Note that higher precision is desirable as $\frac{h_1}{h(h+h_1)}$ is increasing in h_1.

[20] In the case where the issuer too can acquire information, best e®orts underwriting may serve to provide him with the incentive to do so.

that:

$$E\left[\tilde{\pi}\left(\tilde{\theta}_1,\tilde{\theta}_2\right) - c_1 - c_2\right] = \frac{1}{2k}\left(\bar{x}^2 + \frac{h_1+h_2}{h\left(h+h_1+h_2\right)}\right) - c_1 - c_2$$

$$= \frac{1}{2k}\left(\bar{x}^2 + \frac{h_1}{h\left(h+h_1+h_2\right)}\right) - c_1 + \frac{1}{2k}\frac{h_2}{h\left(h+h_1+h_2\right)} - c_2$$

$$< \frac{1}{2k}\left(\bar{x}^2 + \frac{h_1}{h\left(h+h_1\right)}\right) - c_1$$

$$= E\left[\tilde{\pi}\left(\tilde{\theta}_1\right)\right] - c_1$$

It is also the case that:

$$E\left[\tilde{\pi}\left(i_1,\tilde{\theta}_2\right) \mid i_1\right] - c_2 = \pi\left(i_1\right) + \frac{1}{2k}\frac{h_2}{\left(h+h_1\right)\left(h+h_1+h_2\right)} - c_2$$

$$< \pi\left(i_1\right)$$

The information i_2 clearly has no social value: neither in isolation, nor concurrently with i_1, nor following the acquisition of i_1.[21]

But the information i_2 may have private value. A prospective buyer such as an institutional investor or an investment bank may have an incentive to acquire the information i_2 prior to deciding whether to buy the shares, for there is of course the possibility that the realization of $\tilde{\theta}$ is lower than the price paid per share, $P\left(i_1\right)$. Acquiring the information i_2 helps guard against that possibility. Formally, a prospective buyer who has been offered to buy $q \geq q\left(i_1\right)$ shares will acquire the information i_2 if:

$$qE\left[\max\left\{E\left[\tilde{\theta} \mid i_1,\tilde{\theta}_2\right] - P\left(i_1\right), 0\right\} \mid i_1\right] - c_2 > q\left(E\left[\tilde{\theta} \mid i_1\right] - P\left(i_1\right)\right)$$

The prospective buyer's gain is however the underwriter's loss, as the latter's payoff per share is then $E\left[\min\left\{E\left[\tilde{\theta} \mid i_1,\tilde{\theta}_2\right], P\left(i_1\right)\right\} \mid i_1\right] < P\left(i_1\right)$. Furthermore, in the case where the $q\left(i_1\right)$ shares that are issued are to be shared among institutional investors, investment banks, and retail investors, the ability of institutional

[21] The assumption that the information i_2 has no social value is made in order to simplify the analysis. It is stronger than needed. Our results would remain unchanged if the information i_2 were a refinement of the information i_1 whose marginal benefit in guiding investment decisions were lower than its marginal cost.

investors and investment banks to acquire the information i_2 introduces the adverse selection problem noted by Rock (1986).[22] Retail investors are allocated a fraction of the offering when it is underpriced ($E[\tilde{v}|i_1; i_2] > P(i_1)$), but they are allocated the offering in full when it is overpriced ($E[\tilde{v}|i_1; i_2] \leq P(i_1)$). They are therefore unwilling to pay the price $P(i_1)$, resulting in a second source of loss to the underwriter.

Such losses are of course reflected in the price paid by the underwriter to the entrepreneur for the firm. The acquisition of the information i_2 thus results in a transfer between the entrepreneur and informed investors, thereby indicating that the information i_2 has private but not social value. Indeed, it decreases total social surplus by the cost c_2 of acquiring the information i_2.

3.3. Two Responses to the Problem of Excess Search

The underwriter will naturally react to the ability of a prospective buyer to acquire the information i_2. He can do so in two ways: either by acquiring the information i_2 at a cost c_2 himself, and communicating the information to the prospective buyer; or by selling the shares at a price which is such as to eliminate the prospective buyer's incentive to acquire the information. In the case where all $q(i_1)$ shares are sold to a single buyer, this price satisfies the inequality:

$$\begin{aligned} & q(i_1)(E[\tilde{v}|i_1] - P(i_1)) \\ > \; & q(i_1) E\left[\max\left(E\left[\tilde{v}|i_1; \tilde{i}_2\right] - P(i_1); 0\right)|i_1\right] - c_2 \\ , \; & P(i_1) \leq E\left[E\left[\tilde{v}|i_1; \tilde{i}_2\right] - E\left[\tilde{v}|i_1; \tilde{i}_2\right] \leq P(i_1)\right]; i_1 \\ & + \frac{c_2}{q(i_1) f_{2|1}(i_2^{\alpha}(P(i_1))|i_1)} \end{aligned} \tag{3.1}$$

where $i_2^{\alpha}(P(i_1))$ is such that $E[\tilde{v}|i_1; i_2^{\alpha}(P(i_1))] = P(i_1)$ and $F_{2|1}(\cdot|\cdot)$ denotes the conditional distribution function of i_2 given i_1. $f_{2|1}(\cdot|\cdot)$ denotes the corresponding density function. Inequality 3.1 implies that the shares must be sold at a discount: $P(i_1) < E[\tilde{v}|i_1]$. Assuming $P(i_1) = E[\tilde{v}|i_1]$ would imply:

$$q(i_1)(E[\tilde{v}|i_1] - P(i_1)) = 0 < q(i_1) E\left[\max\left(E\left[\tilde{v}|i_1; \tilde{i}_2\right] - P(i_1); 0\right)|i_1\right] - c_2$$

[22] See also Barzel (1998).

which would contradict inequality 3.1.[23] A surplus must be offered to the prospective buyer to deter him from acquiring the information i_2. There is therefore underpricing. We show such underpricing to be increasing in uncertainty, where we use $\text{var}\left[E\left[\tilde{x}|\tilde{i}_1,\tilde{i}_2\right]|i_1\right]$ as a measure of uncertainty. This is the uncertainty that would be dispelled by the acquisition of the information i_2, but is not when such acquisition is precluded.

For the purpose of establishing the desired relation, we define $P^{\alpha}(i_1)$ to be the maximum price that precludes the acquisition of information by the prospective buyer. $P^{\alpha}(i_1)$ is such that:

$$P^{\alpha}(i_1) = E\left[E\left[\tilde{x}|\tilde{i}_1,\tilde{i}_2\right]|\tilde{i}_1,\tilde{i}_2 \geq i_2^{\alpha}(P^{\alpha}(i_1))\right] - E\left[\tilde{x}|\tilde{i}_1,\tilde{i}_2 < i_2^{\alpha}(P^{\alpha}(i_1))\right]|i_1 + \frac{c_2}{q(i_1)\,F_{2|1}(i_2^{\alpha}(P^{\alpha}(i_1))|i_1)} \tag{3.2}$$

Proposition 3.2. Underpricing is increasing in uncertainty. Formally:

$$\frac{\partial UP}{\partial \text{var}\left[E\left[\tilde{x}|\tilde{i}_1,\tilde{i}_2\right]|i_1\right]}\Bigg|_{E[\tilde{x}|i_1]} > 0$$

where $UP = \frac{E[\tilde{x}|i_1] - P^{\alpha}(i_1)}{P^{\alpha}(i_1)}$.

Proof: It is sufficient to show that $\frac{\partial P^{\alpha}(i_1)}{\partial \text{var}\left[E\left[\tilde{x}|\tilde{i}_1,\tilde{i}_2\right]|i_1\right]}\Big|_{E[\tilde{x}|i_1]} < 0$. Rewrite equation 3.2 as:

$$H = E[\tilde{x}|i_1] - P^{\alpha}(i_1) - E\left[\max\left[E\left[\tilde{x}|\tilde{i}_1,\tilde{i}_2\right] - P^{\alpha}(i_1), 0\right]|i_1\right] + c_2 \tag{3.3}$$

$$= \int_{i_2^{\alpha}(P^{\alpha}(i_1))}^{1} \left[E[\tilde{x}|i_1,i_2] - P^{\alpha}(i_1)\right] f_{2|1}(i_2|i_1)\,di_2 + c_2 \tag{3.4}$$

$$= 0$$

where $i_2^{\alpha}(P^{\alpha}(i_1))$ is such that $E[\tilde{x}|i_1,i_2^{\alpha}(P^{\alpha}(i_1))] = P^{\alpha}(i_1)$. Now note that $\frac{\partial H}{\partial P^{\alpha}(i_1)} < 0$ and $\frac{\partial H}{\partial \text{var}\left[E\left[\tilde{x}|\tilde{i}_1,\tilde{i}_2\right]|i_1\right]}\Big|_{E[\tilde{x}|i_1]} < 0$. The first inequality is immediate

[23] Note that there is no problem of excess search if:

$$c_2 > q(i_1)\,E\left[\max\left[E\left[\tilde{x}|\tilde{i}_1,\tilde{i}_2\right] - E[\tilde{x}|i_1], 0\right]|i_1\right]$$

$E[\tilde{x}|i_1]$ is the maximum price per share paid by a buyer who has only the information i_1:

from expression 3.4. The second inequality is a consequence of the convexity of $\max[:]$ combined with the observation that $E\left[\tilde{x}\,|\,i_1;\tilde{\varepsilon}_2\right]$ is a mean-preserving spread of the degenerate distribution $E[\tilde{x}\,|\,i_1]$. Indeed, we can write:

$$E\left[\tilde{x}\,|\,i_1;\tilde{\varepsilon}_2\right] = E[\tilde{x}\,|\,i_1] + \tilde{\eta}$$

where:

$$\tilde{\eta} \equiv \frac{h\bar{x} + h_1 i_1 + h_2\tilde{\varepsilon}_2}{h + h_1 + h_2} - \frac{h\bar{x} + h_1 i_1}{h + h_1}$$

with $E\left[\tilde{\eta}\,|\,i_1\right] = 0$ and $\mathrm{var}\left[\tilde{\eta}\,|\,i_1\right] = \mathrm{var}\left[E\left[\tilde{x}\,|\,i_1;\tilde{\varepsilon}_2\right]\,|\,i_1\right]$. The term:

$$E\left[\max\left[E\left[\tilde{x}\,|\,i_1;\tilde{\varepsilon}_2\right] - P^{\alpha}(i_1);0\right]\,|\,i_1\right]$$

in expression 3.3 therefore increases in $\mathrm{var}\left[E\left[\tilde{x}\,|\,i_1;\tilde{\varepsilon}_2\right]\,|\,i_1\right]$ for constant $E[\tilde{x}\,|\,i_1]$.[24] We can then conclude that:

$$\frac{\partial P^{\alpha}(i_1)}{\partial \mathrm{var}\left[E\left[\tilde{x}\,|\,i_1;\tilde{\varepsilon}_2\right]\,|\,i_1\right]}_{E[\tilde{x}|i_1]} = -\frac{\frac{\partial H}{\partial \mathrm{var}\left[E\left[\tilde{x}|i_1,\tilde{\varepsilon}_2\right]|i_1\right]}}{\frac{\partial H}{\partial P^{\alpha}(i_1)}}_{E[\tilde{x}|i_1]} < 0$$

The result of Proposition 3.2 is quite intuitive. The greater the uncertainty that can be dispelled by the acquisition of the information i_2, the greater the private gain to acquiring that information, the greater therefore the discount at which shares must be sold to preclude its acquisition. This result recalls that of Rock (1986), in which greater uncertainty increases the losses retail investors sustain to informed investors. A greater discount must therefore be offered to retail investors to ensure their participation in the offering.

We conclude this section by noting that the underwriter chooses to acquire the information i_2 if the net proceeds, $E\left[q\,|\,i_1;\tilde{\varepsilon}_2\right] - E\left[\tilde{x}\,|\,i_1;\tilde{\varepsilon}_2\right]\,|\,i_1\right] - c_2$, when acquiring the information i_2 are greater than the proceeds, $q(i_1)P^{\alpha}(i_1)$, from selling at the price $P^{\alpha}(i_1)$.

[24] $E[\tilde{x}\,|\,i_1]$ is assumed to remain constant for we wish to examine the variation of underpricing in uncertainty alone.

3.4. Arrangements and Institutions: Regulars, Stabilization, and Over-Allotment Options

However, the total social surplus is undoubtedly larger when the acquisition of the information i_2 is precluded. There is therefore an incentive for the underwriter to devise arrangements that increase the maximum price $P^{\natural}(i_1)$ which precludes the acquisition of information by the prospective buyer. We argue that repeated relations with a set of institutions that are expected to take part and expect to be invited to take part in all IPOs (the "regulars," in Benveniste and Spindt (1989) and Benveniste and Wilhelm's (1990) terminology), syndicates, stabilization, and over-allotment options are such arrangements.[25] We discuss regulars, stabilization, and over-allotment options in the present section and leave the discussion of syndicates to Section 3.5.

Consider first the decision to sell to a set of buyers rather than a single buyer. Assume these are unable to collude. Denote the number of buyers by N_b and assume that each buyer receives $\frac{q(i_1)}{N_b}$ shares. The price $P^{\natural}_{N_b}(i_1)$ that precludes the production of information is such that:

$$P^{\natural}_{N_b}(i_1) = E\left[E\left[\tilde{v}\,|\,i_1,\tilde{i}_2\right]\,|\,i_1,\tilde{i}_2 \geq P^{\natural}_{N_b}(i_1)\right] + \frac{N_b c_2}{q(i_1)\left[1-F_{2|1}\left(i^{\natural}_2\,|\,i_1\right)\right]} \tag{3.5}$$

We can now prove:

Proposition 3.3. *The price $P^{\natural}_{N_b}(i_1)$ that precludes the production of information increases in the number of buyers N_b.*

Proof: Rewrite equation 3.5 as:

$$q(i_1)\int_{i_2^{\natural}\left(P^{\natural}_{N_b}(i_1)\right)}^{1}\left[P^{\natural}_{N_b}(i_1) - E\left[\tilde{v}\,|\,i_1,i_2\right]\right]^{\natural} f_{2|1}(i_2\,|\,i_1)\,di_2 - N_b c_2 = 0$$

where $i_2^{\natural}\left(P^{\natural}_{N_b}(i_1)\right)$ is such that $E\left[\tilde{v}\,|\,i_1,i_2^{\natural}\left(P^{\natural}_{N_b}(i_1)\right)\right] = P^{\natural}_{N_b}(i_1)$. Use the Implicit Function Theorem to obtain:

$$\frac{\partial P^{\natural}_{N_b}(i_1)}{\partial N_b} = \frac{c_2}{q(i_1)\left[1-F_{2|1}\left(i^{\natural}_2\,|\,i_1\right)\right]} > 0$$

[25] Note the correspondance between these arrangements and those discussed by Barzel (1982) in the context of product markets, specifically share contracts, brand names, and warranties.

Proposition 3.3 suggests an explanation for the prohibition on °ipping imposed on retail investors. A prospective buyer that is to be precluded from acquiring information by a limitation on his share of the o®ering may be able to overcome such limitation by trading with retail investors in the aftermarket, thereby increasing his share of the o®ering and possibly defeating the arrangement designed to deny him the incentive to acquire private information.[26] A prohibition on °ipping by retail investors may be intended to preclude such a development.

Now consider the case of repeated relations over an in¯nity of periods between the underwriter and a single buyer. Let r denote the per-period discount rate. Assume that if the buyer were to acquire the information i_2 in a single period, he would be identi¯ed as having done so at the end of the period, regardless of whether he had actually bought the shares or not. In such a case, the underwriter can increase the price at which he sells the shares by threatening to cease selling to a buyer who has acquired information. To see this, note that the price that precludes the acquisition of information is now such that:

$$\begin{aligned} & q(i_1)\left(E[v|i_1] - P(i_1)\right) + \frac{E\left(q(i_1)\left(E[v|i_1] - P(i_1)\right)\right)}{1+r} \\ > \; & q(i_1)\, E\left[\max\left\{E\left[v|i_1, i_2\right] - P(i_1), 0\right\} \middle| i_1\right] - c_2 \end{aligned}$$

Let $P^{*}_{rep}(i_1)$ denote the price for which the equality is true. This is the maximum price the underwriter can obtain whilst still precluding the acquisition of information. We can now prove:

Proposition 3.4. Repeated relations between the underwriter and the buyer increase the price that precludes the acquisition of information above that prevailing in the case of a single interaction: $P^{*}_{rep}(i_1) > P^{*}(i_1)$.

Proof: The proof is by contradiction. Recall that $P^{*}(i_1)$ and $P^{*}_{rep}(i_1)$ are such that:

$$q(i_1)\left(E[v|i_1] - P^{*}(i_1)\right) = q(i_1)\, E\left[\max\left\{E\left[v|i_1, i_2\right] - P^{*}(i_1), 0\right\} \middle| i_1\right] - c_2$$

and:

$$\begin{aligned} & q(i_1)\left[E[v|i_1] - P^{*}_{rep}(i_1)\right] + \frac{E\left[q(i_1)\left[E[v|i_1] - P^{*}_{rep}(i_1)\right]\right]}{1+r} \\ = \; & q(i_1)\, E\left[\max\left\{E\left[v|i_1, i_2\right] - P^{*}_{rep}(i_1), 0\right\} \middle| i_1\right] - c_2 \end{aligned}$$

[26] This requires that retail investors be willing to sell their shares at less than their full value $E[v|i_1, i_2]$. Retail investors must therefore be, in a sense, noise traders.

respectively. Assume that $P^{\alpha}_{rep}(i_1) < P^{\alpha}(i_1)$. We have:

$$\begin{aligned}
0 &= q(i_1)\left(E[\tilde{v}|i_1] - P^{\alpha}(i_1)\right) \\
&\quad - q(i_1)\, E\left[\max\left(E[\tilde{v}|i_1,\tilde{i}_2] - P^{\alpha}(i_1), 0\right)|i_1\right] + c_2 \\
&< q(i_1)\left[E[\tilde{v}|i_1] - P^{\alpha}_{rep}(i_1)\right] \\
&\quad - q(i_1)\, E\left[\max\left(E[\tilde{v}|i_1,\tilde{i}_2] - P^{\alpha}_{rep}(i_1), 0\right)|i_1\right] + c_2 \\
&= -\frac{E\left[q(i_1)\left[E[\tilde{v}|i_1] - P^{\alpha}_{rep}(i_1)\right]\right]}{r} \\
&\leq 0
\end{aligned}$$

which is clearly a contradiction. The first inequality is true by noting that:

$$\begin{aligned}
&E[\tilde{v}|i_1] - P(i_1) - E\left[\max\left(E[\tilde{v}|i_1,\tilde{i}_2] - P(i_1), 0\right)|i_1\right] \\
&= \int_{-1}^{i^{\alpha}_2(P(i_1))} \left[E[\tilde{v}|i_1,i_2] - P(i_1)\right] f_{2|1}(i_2|i_1)\, di_2
\end{aligned}$$

is decreasing in $P(i_1)$. Recall that $i^{\alpha}_2(P(i_1))$ is such that $E[\tilde{v}|i_1, i^{\alpha}_2(P(i_1))] = P(i_1)$. The second inequality is true by noting that a buyer who has only the information i_1 will pay a maximum price of $E[\tilde{v}|i_1]$ per share.¥

Of course, the underwriter can obtain yet a higher share price by combining the sale of the shares to a set of buyers with repeated relations with these buyers, resulting in the first arrangement we have described, specifically regulars.

Now turning to stabilization, we note that it is similar to a warranty. In a sale subject to a warranty, the seller commits to compensating the buyer for the difference, if any, between the value of a good unit and that of the unit the buyer has purchased. The buyer therefore has no incentive to acquire information about the quality of that unit. Under stabilization, the underwriter commits to buying back the shares at their issue price if their post-issue value, $E[\tilde{v}|i_1, i_2]$, is revealed to be lower than the issue price. There is clearly no incentive for the buyer to acquire any information in that case, and the issue price per share, $P^{\alpha}_{stab}(i_1)$, is such that:

$$\begin{aligned}
P^{\alpha}_{stab}(i_1) = \Pr\left[E\left[E[\tilde{v}|i_1,\tilde{i}_2] > P^{\alpha}_{stab}(i_1)\right]|i_1\right] \cdot \\
\left[E\left[E[\tilde{v}|i_1,\tilde{i}_2]|E[\tilde{v}|i_1,\tilde{i}_2] > P^{\alpha}_{stab}(i_1), i_1\right]\right.
\end{aligned}$$

$$+ \Pr\left[E\left[\tilde{v}\mid i_1,\tilde{\varepsilon}_2\right] \le P^{\alpha}_{stab}(i_1)\mid i_1\right] \le \Pi^{\alpha}_{stab}(i_1)$$

$$\Leftrightarrow \quad P^{\alpha}_{stab}(i_1) = E\left[E\left[\tilde{v}\mid i_1,\tilde{\varepsilon}_2\right]\mid E\left[\tilde{v}\mid i_1,\tilde{\varepsilon}_2\right] > P^{\alpha}_{stab}(i_1), i_1\right]$$

which has solution $P^{\alpha}_{stab}(i_1) = \underset{i_2}{\text{Max}}\, E[\tilde{v}\mid i_1, i_2]$.[27] The underwriter's proceeds per share equal $E\left[P^{\alpha}_{stab}(i_1) - P^{\alpha}_{stab}(i_1) - E\left[\tilde{v}\mid i_1,\tilde{\varepsilon}_2\right]\mid i_1\right] = E[\tilde{v}\mid i_1]$, which is the expected value of a share and represents the maximum issue price that can be achieved. In practice, of course, the information i_2 is only one of many determinants of the post-issue price, which may explain why there is only limited stabilization. The multiple determinants of the post-issue price may also explain the last-minute pricing of the issue, which may be intended to ensure that the holding of inequality 3.1 is not compromised by extraneous developments between the setting of the issue price and the offering.

Stabilization may be viewed as serving to deny the incentive to acquire information that would reveal the issue to be overpriced. An over-allotment option, on the other hand, may be viewed as serving to deny the incentive to acquire information that would reveal the issue to be underpriced. This is because the exercise of the option by the underwriter in that case would dilute the gains from having acquired that information.[28]

To see this formally, assume that the underwriter exercises the over-allotment option when he identifies the buyer as having acquired the information i_2 and when the post-issue value of a share is greater than its issue price: $E[\tilde{v}\mid i_1, i_2] > P^{\alpha}_{OAO}(i_1)$.[29] $P^{\alpha}_{OAO}(i_1)$ denotes the issue price that is intended to preclude the acquisition of the information i_2 in the presence of the over-allotment option. The underwriter issues $(1+\alpha)\,q(i_1)$ in place of $q(i_1)$ shares. This dilutes the value of the shares as these now have value per share:

$$\frac{q(i_1)\,E[\tilde{v}\mid i_1, i_2] + \alpha q(i_1)\,P^{\alpha}_{OAO}(i_1)}{(1+\alpha)\,q(i_1)} < E[\tilde{v}\mid i_1, i_2]$$

We can show:

[27] This assumes the existence of a maximum.

[28] This recalls Cornelli and Yosha's (1997) rationale for the use of convertible debt in venture capital.

[29] The underwriter clearly has no incentive to exercise the over-allotment option when $E[\tilde{v}\mid i_1, i_2] < P^{\alpha}_{OAO}(i_1)$, for he would then sell the shares at a loss. He is indifferent when $E[\tilde{v}\mid i_1, i_2] = P^{\alpha}_{OAO}(i_1)$.

Proposition 3.5. The issue price that precludes the acquisition of the information i_2 in the presence of an over-allotment option, $P^{\alpha}_{OAO}(i_1)$, is increasing in the percentage of the option, α.

Proof: $P^{\alpha}_{OAO}(i_1)$ is such that:

$$q(i_1)\left(E[v|i_1] - P^{\alpha}_{OAO}(i_1)\right) - q(i_1)E\left[\max\left[\frac{E[v|i_1,i_2] + \alpha P^{\alpha}_{OAO}(i_1)}{1+\alpha} - P^{\alpha}_{OAO}(i_1), 0\right]\middle| i_1\right] + c_2 = 0$$

$$\Leftrightarrow \quad q(i_1)\left(E[v|i_1] - P^{\alpha}_{OAO}(i_1)\right) - \frac{q(i_1)}{1+\alpha}E\left[\max\left[E[v|i_1,i_2] - P^{\alpha}_{OAO}(i_1), 0\right]\middle| i_1\right] + c_2 = 0$$

Use the Implicit Function Theorem to obtain $\frac{\partial P^{\alpha}_{OAO}(i_1)}{\partial \alpha} > 0$. ¥

3.5. Arrangements and Institutions: Syndicates

The syndicate is very similar to the first arrangement described in Section 3.4, specifically repeated interactions with a set of buyers. It differs from that arrangement in that those invited to take part in the arrangement with the underwriter are invited to do so as co-sellers rather than buyers. They are subunderwriters in a syndicate managed by the original underwriter, now the managing underwriter. We argue that this is intended to preclude the acquisition of information by the underwriter, a problem hitherto ignored and to which we now turn.

Consider the case where not only the buyer but also the underwriter can acquire information. The underwriter too may have an incentive to acquire information, for doing so provides him with the opportunity to communicate a high realization of the information i_2 and sell a share at a price $E[v|i_1,i_2] > P(i_1)$. Should that be the case, the social surplus would again be lowered by the cost of acquiring the information. There is therefore an incentive to preclude the acquisition of information by the underwriter, just as there was an incentive to preclude the acquisition of information by the buyer. The former can be achieved by setting a price $P(i_1)$ such that:

$$q(i_1)P(i_1) > q(i_1)E\left[\max\left[E[v|i_1,i_2], P(i_1)\right]\middle| i_1\right] + c_2$$

$$, \quad P(i_1) > E\left[E\left[\tilde{x}\,|\,i_1,\tilde{i}_2\right]\,|\,i_1,P(i_1)\right] - E\left[E\left[\tilde{x}\,|\,i_1,\tilde{i}_2\right]\,|\,i_1,P(i_1)\right] - \frac{c_2}{q(i_1)\left[1 - F_{2|1}(i_2^{*}(P(i_1))\,|\,i_1)\right]}$$

The minimum price $P^{**}(i_1)$ that precludes the acquisition of information by the underwriter is such that:

$$P^{**}(i_1) = E\left[E\left[\tilde{x}\,|\,i_1,\tilde{i}_2\right]\,|\,i_1,P^{**}(i_1)\right] - E\left[E\left[\tilde{x}\,|\,i_1,\tilde{i}_2\right]\,|\,i_1,P^{**}(i_1)\right] - \frac{c_2}{q(i_1)\left[1 - F_{2|1}(i_2^{*}(P^{**}(i_1))\,|\,i_1)\right]}$$

Precluding the acquisition of information by both the underwriter and the buyer then requires that $P^{**}(i_1) \geq P(i_1) \geq P^{*}(i_1)$, which imposes the necessary condition that $P^{**}(i_1) \geq P^{*}(i_1)$. But this need not always be true. To take an admittedly extreme example, it will not be true when $c_2 = 0$, for it is then the case that $P^{**}(i_1) = \underset{i_2}{Max}\, E[\tilde{x}\,|\,i_1,i_2]$ and $P^{*}(i_1) = \underset{i_2}{Min}\, E[\tilde{x}\,|\,i_1,i_2]$.[30]

It is clear that an increase in $P^{*}(i_1)$ is desirable regardless of whether $P^{**}(i_1) \geq P^{*}(i_1)$ or $P^{**}(i_1) > P^{*}(i_1)$, for such an increase increases the proceeds from the issue. In contrast, a decrease in $P^{**}(i_1)$ is desired only to the extent that it is necessary to reduce $P^{**}(i_1)$ to $P^{*}(i_1)$, thereby precluding the acquisition of the information i_2 by the underwriter. This can be achieved by the same means and for the same reasons as used in Section 3.4 to increase $P^{*}(i_1)$. Specifically, it is easy to show that $P^{**}(i_1)$ decreases in the number of sellers of the issue, or underwriters. It can also be shown that $P^{**}(i_1)$ decreases in the context of repeated relations among the underwriters. But the sale of an issue by a number of sellers defines a syndicate, and the use of repeated relations describes the tendency of syndicate participants to work together in successive offerings. In our view, then, a syndicate is an arrangement that is intended to preclude the acquisition of private information by underwriters.

We conclude the present section with two remarks. The ability of underwriters to acquire private information about a given issue need not coincide with their ability to distribute that issue. This suggests that the fraction of the issue distributed by each underwriter should not be the same as the fraction he underwrites. This is indeed the case.[31] The requirement that underwriters earn excess profits, over and above the spread c_1 which is intended to compensate them for gathering the social information i_1, for the promise of repeated relations to

[30] This assumes the existence of the extrema. Note that there is no need to preclude the acquisition of information in the case where $c_2 = 0$, for there are only benefits and no costs to acquiring information in that case.

[31] This may also explain the separation of underwriting and selling syndicates prior to the passage of the Securities Act (1933) and the Securities Exchange Act (1934).

deter them from acquiring the private information i_2 suggests an explanation for these excess pro¯ts that does not posit cartel-like behavior on the part of the underwriters.[32]

4. Discussion and Conclusion

We have argued in this paper that the problem of socially ine±cient excess search in IPOs is very real, but that the parties will adopt institutional arrangements to minimize the problem, thereby increasing their joint wealth. This allows us to model and explain several institutional features and empirical artifacts of the syndicate system that have thus far de¯ed explanation. Our theory of excess search does not preclude earlier explanations for the syndicate, or for the underwriting process more generally; it simply provides an added dimension for further analysis. We should note, however, that our theory takes a novel view of information asymmetries. In our view, information asymmetries are endogenous. All parties have the opportunity to become fully informed to reduce the problems of trading under asymmetrical information. But this would lead to the ine±cient duplication of information, which the syndicate is designed to avoid.

The syndicate system's use of repeat reciprocal relations to preclude the acquisition of information re°ects a \specialized stock of knowledge" that allows various specialized parties to cooperate without the need to learn one another's specialty. Demsetz (1988) has argued that this stock of knowledge is one of the unique characteristics that di®erentiates the ¯rm from market exchange. Viewing the syndicate as an ad hoc ¯rm of repeat players is consistent with this notion, where the group's stock of specialized knowledge consists, at least in part, of a common set of rules, including norms of behavior, to suppress excess search. Barzel (1982) has shown that organization within the ¯rm reduces the incentives for workers to \pick-and-choose" between sequential inputs and outputs in the production process. Intelligent picking and choosing, of course, must rely on some underlying valuation, and this measurement cost argument therefore appears ultimately to rely on the suppression of excessive valuation for the bene¯t of the group as a whole.

[32] See Klein and Le²er (1981) for a formal proof of the need for excess pro¯ts in the context of repeated relations. See Marsh (1980) and Chen and Ritter (1998) for evidence suggestive of cartel-like behavior on the part of underwriters. See Booth and Smith (1986) for an alternative explanation based upon the role of excess pro¯t in certifying the quality of the information acquired by underwriters

Although we show how the syndicate system's reliance on repeat business relations can e®ectively reduce the parties' incentives for excess search, we have yet to focus on the reciprocal nature of these relations. It is one thing for A to buy repeatedly from B, but it is quite another thing for A to buy from B and then for B to turn around and buy from A, and for this process to repeat. Consistent with our view of the syndicate system as a mechanism for enforcing property rights to price information, others have noted the use of reciprocity relations as a property rights enforcement mechanism where third-party enforcement is either unavailable or inadequate (Ho®man, McCabe, and Smith, 1998).[33] Among other things, established reciprocity relations moderate each party's reaction to idiosyncratic exogenous shocks, somewhat akin to diversi¯cation.

The syndicate bears striking resemblance to another property rights institution that arose in a radically di®erent setting where third-party enforcement was absent. Prior to European contact in the late eighteenth century, the Northwest Coast Indian tribes developed an institution known as \potlatching," which involved repeat reciprocal transfers of wealth between tribes. These transfers appear to have been designed to enforce private property rights to salmon streams by paying o® other tribes in the locality whose salmon ¯shing productivity was temporarily low and who therefore would have had an incentive to encroach on other tribes' salmon ¯shing streams (Johnsen, 1986, 1998). For the Northwest Coast tribes, as in the syndicate system, there was no \state" to enforce property rights in salmon streams, and the potlatch system apparently provided a satisfactory substitute. With the syndicate system, as with the potlatch system, the motivation for inviting participation by outsiders appears to be, at least in part, the threat they posed to private property rights if excluded.

One important question remaining about the syndicate system concerns industrial structure. Why do investment banks who routinely participate together in syndicates remain under separate ownership? Why not simply merge? One explanation, of course, is the threat of antitrust enforcement. But aside from that, it seems plausible that each bank under the current, relatively unconcentrated industrial structure, remains independent because that re°ects its optimal scale and scope in its core operations of establishing client relations, gathering (discovery) information about the demand for new issues, and selling and distributing

[33] It is unclear whether the syndicate avoids legal enforcement of its prescriptions for antitrust reasons or whether, even in the absence of antitrust threats, the use of legal sanctions would simply be ine®ective. It seems likely that many of the syndicate's rules and understandings are simply noncontractible.

new issues. According to the excess search hypothesis, banks join together in a syndicate speci¯cally to price a new issue, not because doing so is necessary to e±ciently arrive at the proper issue price but because it is necessary to suppress the opportunities for wealth transfer that the pricing of a novel product would entail. This reason is independent of e±ciencies from merging.

One point on the certi¯cation function performed by underwriters in the context of the overall syndicate is worth noting. The standard view is that the cost to a reputable managing underwriter of certifying the quality of a high-quality issue is lower than for less reputable underwriters (Carter and Manaster, 1990), and that an issuer's selection of a reputable underwriter thereby serves as a signal of issue quality. Ritter (1984) and others have argued that ex ante uncertainty forms the underlying basis for issue quality, with greater uncertainty being associated with lower quality.[34] Empirically, this suggests that issues subject to greater ex ante uncertainty will be subject to a larger IPO discount and greater post-o®ering abnormal returns. The excess search hypothesis allows us to identify the source of underwriter reputations and to re¯ne the nature of the certi¯cation function. There is no doubt that issues subject to greater ex ante uncertainty provide the basis for greater gains from speculation, all else equal. In our view, an underwriter's reputation should be associated with the expectation that it can have a relatively large e®ect in reducing the losses arising from ex ante uncertainty by way of its success at limiting the opportunities for wealth transfers from excess search. Reputation arises from the value-added an underwriter is expected to provide in constraining market participants' opportunities for excess search.

This leads to a fairly straightforward assessment of IPO underpricing, which is intended to preclude the acquisition of information by buyers. As with any good whose price is held below that which would clear the market in the short run, the IPO's \price ceiling" establishes excess demand. Competition for the resulting rents between all who would like to participate must manifest itself in a rationing method other than price. The rules of the syndicate as established by the managing underwriter provide the basis for such competition and presumably channel participants' competitive behavior in a way that increases social wealth rather than reducing it. As with college degrees and sporting contests, the prize goes to those willing to compete most ¯ercely according to the \rules of the game" rather than to those willing to pay the highest price to attain the prize. Where property rights are imperfectly de¯ned, nonprice competition can create value, and it is the managing underwriter who controls the means of competition. Over

[34] See Jenkinson and Ljungqvist (1998), p. 48.

the course of time, the better he performs this role by establishing rules to limit excess search, and the better he is at selecting participating banks who obey the rules, the better his reputation. In our view, this is the source of the reputation that allows the managing underwriter to \certify" the quality of a new issue and to reduce the cost of capital to issuing ¯rms. Presumably, for issues of given ex ante uncertainty, underwriters who are better at performing this function will engage in less IPO underpricing.

For example, we doubt that stabilization by the managing underwriter can have any direct e®ect on underwriter pro¯ts or the issuer's cost of capital. For issues that turn out to be overpriced, the manager's purchase of shares in the market will have no e®ect on the total number of outstanding shares, although it may succeed in temporarily supporting the market price. Sooner or later, the managing underwriter will want to sell the shares. At this time, prices will decline, relative to what they would otherwise be, by exactly the same amount as they were \supported" by the managing underwriter's original purchase. For underpriced issues, the managing underwriter may exercise the over-allotment option to suppress an inordinate price increase. This expands the number of shares available in the market. But those who purchase shares in the IPO will reduce the price they are willing to pay ex ante by an amount re°ecting the expected dilution e®ect of the over-allotment option. On the other hand, the managing underwriter (and perhaps the syndicate as a whole) will increase the price it is willing to pay the issuer (by reducing the spread) ex ante by an amount re°ecting the expected proceeds from the sale of additional shares. Even if transaction costs are zero, the immediate net e®ect on the parties' wealth will be zero. Once we recognize that stable prices reduce the opportunities for excess search and socially ine±cient speculation, however, positive long-run wealth e®ects in excess of the transaction costs of stabilization appear plausible. Beyond providing stable prices, the managing underwriter's commitment to engage in stabilization appears to be a threat to syndicate members and market participants that there will be little pro¯t in speculative activity.

We have attempted to show that the excess search hypothesis provides a plausible explanation for many of the institutional features and empirical artifacts associated with the syndicate system. Indeed, it appears to explain several observations that are otherwise di±cult to explain.

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