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THE INVESTMENT BANKING CONTRACT FOR NEW ISSUES UNDER ASYMMETRIC INFORMATION: DELEGATION AND THE INCENTIVE PROBLEM

by

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THE INVESTMENT BANKING CONTRACT FOR NEW ISSUES UNDER ASYMMETRIC INFORMATION: DELEGATION AND THE INCENTIVE PROBLEM

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David P. Baron and Bengt Holmström*

Most new security issues are managed and distributed by investment banking syndicates that perform three basic services for the issuer of the securities. First, investment bankers provide advice and counsel regarding the type of securities to be issued, coupon rates, maturity, timing, offer price, etc. Second, the banking syndicate serves an underwriting function by bearing some or all of the risk associated with the proceeds of the issue. Third, the syndicate performs a distribution function by selling the securities to investors. The underwriting or risk-sharing function has been analyzed by Mandelker and Raviv (1977) who determined conditions under which firm commitment, best efforts, and standby arrangements are optimal when the issuer and the banker have symmetric information regarding the proceeds from a new issue. Also under the assumption of symmetric information, Baron (1979) investigated the pricing and distribution of new issues and the incentive problem resulting from the inability of the issuer to observe the effort expended by the banker in distributing the securities. To mitigate the incentive problem, the issuer must sacrifice some gains from optimal risk sharing in order to induce the banker, through the design of the commission payment, to expend more effort in selling the issue than it would otherwise expend.

When the issuer and the banker have symmetric information regarding the demand for the issue, the advisement function of an investment banker plays no role, but a principal reason for utilizing the services of an investment banker is that the banker may have better information than does the issuer regarding the demand for the issue. This informational asymmetry may arise because the banker has expertise not possessed by the issuer or because the investment banker obtains private information about the demand for the securities through its preselling contacts with potential purchasers. In this case the potential incentive problems are aggravated because the banker has the opportunity through its advisement function to recommend an offer price that is contrary to the issuer's interests, and the issuer is unable because of his limited information to determine if the recommended price is appropriate.

The incentive problems created by asymmetric information have two important dimensions. First, if the banker has better information than does the issuer regarding the demand for the issue, the issuer may find it preferrable to delegate the offer price decision to the banker so that the banker can use its superior information to make a more informed decision than the issuer could make based on his limited information. Such delegation may be preferrable even though the banker may not set the same offer price that the issuer would set if the issuer had the same information as the banker. Delegation is likely to be the most common arrangement for pricing new issues, and to implement such a scheme, the issuer wishes to bring the banker's interests more in line with his own through the design of the compensation schedule for the banker.

The second dimension of the incentive problem centers on the tradeoff between the offer price decision and the distribution effort made to place the issue. Distribution involves substantial costs and thus a banker would be expected to attempt to limit those costs to the extent that is feasible.

As an indication of the magnitude of the distribution effort, "Dean Witter Reynold's...has 3,700 securities salesmen available to push offerings (a crew that ranks it second only to Merrill Lynch, which with White, Weld in hand has about 7,000)." (Fortune, May 22, 1978, pages 62-3.) The resulting incentive problem is described by Van Horne (1977, p. 535) as: "the underwriter wants a price that is high enough to satisfy the issuer but low enough to make the probability of successful sale to investors reasonably high." Stoll (1978, p. 101) elaborates: "A second strategy would set the offering price too low, thereby bringing about quick sale of the issue. ...the underwriter would experience lower costs and might be able to benefit favored customers in this way..." While the success of such behavior may be greater for unseasoned than for seasoned issues, the opportunity seems to be present with any issue.

The seriousness of these incentive problems is an empirical question that has received only limited attention. Smith (1977) studied underwritten equity issues for the January 1971-December 1975 period and concluded that "underwriters appear to set the offer price below the market value of the stock by at least 0.5 percent (p. 274)."[1] As Smith indicates this underpricing cannot be explained as a payment for consulting or advisement services, since the cost of underpricing is not tax deductible while payments for services are. "Furthermore, estimates of expenses from reports filed with the Securities and Exchange Commission indicate that rights offerings involve lower out-of-pocket costs than underwritten offerings. (p. 29)"[2] Ibottson (1975) studied unseasoned new issues and based on the performance of the securities in the aftermarket concluded that the offer price is set approximately 11.4 percent below the market value of the securities. In his study of competitive bidding for corporate securities Christenson (1965) tentatively concluded that not only do investment bankers underprice relative to the interests of issuers but even underprice relative to their own best interests.

> "In the case of pricing policies, there is reason to believe, as noted earlier, that investment bankers are overly reluctant to carry inventories of unsold bonds. While this conclusion is still tentative and further research is suggested, if the conclusion is supported it will mean that bankers can improve their overall profitability by pricing somewhat higher even at the expense of carrying higher average inventories. (p. 5)"

There are two principal forces that can work to mitigate the incentives to underprice. First, the investment banking industry is to some extent competitive, and a banker that continually prices new issues "lower" than the industry norm is likely to eventually lose some market share.[3] The threat of such losses may restrict deviations from the norm, but this does not imply that the incentive problem is eliminated by competitive pressures but rather that divergence from the norm would not be anticipated. In an industry in which tradition plays an important role (see Hayes (1971)), one might wonder if the norm does not incorporate the results of the incentive problem. The studies by Smith and Ibottson are supportive of this view. Furthermore, for firm commitment offerings of common stock between July 1, 1967 and June 30, 1970, Stoll (1975) found a positive relationship between the dollar value of equity offerings managed by an underwriting house and the spread (the difference between offer price and the price paid for the issue). He interprets this result as an indication that the quality of the underwriter leads to a higher spread, and if the securities market is competitive, the greater spread would be due to a lower price to the issuer indicating that bankers have some market power vis à vis issuers or are able to use their advisement role to their own advantage.[4]

One test of the strength of competition in investment banking would involve examining the rates of return earned by investment banking houses.[5] Such a test is difficult at best because many houses are organized as partnerships, while others consolidate their underwriting profits with profits from brokerage activities and from fee-based advisory services. Casual empiricism, however, would suggest that returns may be above competitive levels. For example, a recent Fortune article (February 1978) reported that in 1976 Morgan Stanley earned 40 percent on "average capital employed," while Merrill Lynch and First Boston earned 18 and 23 percent, respectively. As further evidence that returns may not be competitive, Ederington (1975) concluded that the spread on issues sold through competitive bidding decreases as the number of bidders increases.

The second force that could act to mitigate the incentive problems is the sophistication of the issuer. As Weston and Brigham (p. 467) state, "If the issuer is financially sophisticated and makes comparisons with similar security issues, the investment banker is forced to price close to the market."[6] There is recent evidence however that some issuers are dissatisfied with investment banking pricing and commission practices. The Fortune article reports that

> Since the beginning of the Seventies a few of Morgan Stanley's clients have, for example, arranged their own private placements without using the firm as intermediary. They include Texaco, Mobil, and just last month, International Harvester, which directly placed $150 million of bonds. Other companies are raising very large amounts of capital through such channels as dividend reinvestment plans and employee stock purchase plans. ...Exxon has been especially ambitious at do-it-yourself financing. For two bond issues totalling $305 million, Exxon's chief financial officer, Jack Bennett, has conducted "Dutch auctions" in a widely publicized departure from conventional underwriting practices. ...Bennett...figures it saved Exxon about $1.9 million compared with what it would have spent on a conventional underwriting. (pages 88 and 90).

These indications of client dissatisfaction with traditional investment banking practices suggest that the incentive problems may be present and may have significant costs to issuers.[7]

I. The Issue Process and Asymmetric Information

The model to be analyzed involves an issuer who plans to sell a fixed number of securities and has decided to utilize the services of an investment banking house for their sale rather than using a rights offering, for example. The analysis focuses on a "negotiated sale" in which an agreement or contract is to be concluded between the investment banker and the issuer for the sale of the securities.[8] When the issuer has decided to raise capital by selling new securities, he is assumed to meet with the banker at which time they share their information, decide on the specifics of the issue, agree to the terms of the contract, and register the issue with the SEC. At this time the issuer and the banker will be assumed to have symmetric information regarding the demand for the issue.[9]

At the time of registration a preliminary prospectus, the "red herring," is issued, and a registration period of at least twenty days follows. During the registration period, the banker conducts preselling activities.

> During the waiting period between the filing and the offer date, no written sales literature other than the so-called 'red herring' prospectus and 'tombstone' advertisements are permitted by the SEC. However, oral selling efforts are permitted, and the underwriters can and do note interest from their clients to buy at various prices. These do not represent legal commitment, but are used to help the underwriter decide on the offer price for the issue. (Smith (1977) pp. 298-9)

Ibottson (p. 263) is more specific:

> Underwriters typically ask the purchasers to 'circle' (pledge to subscribe to) the issues at a certain price. Even though this pledge is not legally binding, no purchaser could disguise his demand curves for the issues over a reasonable period of time without giving up his access to the new issue market.

This information is not perfect, of course, because of limited contacts with potential purchasers and because the state of the capital market can change between the registration period and the offer date. The concern addressed here is not with the accuracy of the information received but instead with the informational asymmetry created by the banker's access to information not directly available to the issuer.

Before formalizing this informational asymmetry, it is necessary to specify the demand for the securities. The issuer is assumed to offer a fixed quantity B of securities the demand for which depends on an uncertain state $\theta \in [\underline{\theta}, \overline{\theta}] \subset \mathbb{R}$ of the market reflecting how the market perceives the quality of the issue. To simplify the analysis, the offer period will be assumed to be of fixed duration with the demand $Q(p,a,\theta)$ for the securities during the offer period a function of θ, the offer price p, and the distribution effort a. The latter may be thought of as the time of the salesmen allocated to this issue.[10] The states will be ordered such that Q is an increasing function of θ. During the offer period the banker is assumed to conduct stabilizing activities by placing simultaneous buy and sell orders at p so that (hopefully) the remaining securities can be sold at p.[11] If stabilization is unsuccessful because of low demand and selling pressure, the unsold securities are assumed to be sold in the resale market at an uncertain price $p(\theta,a)$ which depends on the distribution effort as well as the state.[12] The price $p(\theta,a)$ in the resale market is assumed to be such that $p(\theta,a) = p$

if and only if $Q(p,a,\theta) = B$ and $p(\theta,a) < p$ if and only if $Q(p,a,\theta) < B$. The resale price will naturally be assumed to be increasing in θ and in a. The proceeds $x^*(p,a,\theta)$ from the sale thus are

$$x^*(p,a,\theta) = \begin{cases} pQ(p,a,\theta) + p(\theta,a)(B - Q(p,a,\theta)) & \text{if} \quad Q(p,a,\theta) \leq B \\ pB & \text{if} \quad Q(p,a,\theta) \geq B . \end{cases}$$

The net proceeds $x(p,a,\theta)$ are defined by

$$x(p,a,\theta) = x^*(p,a,\theta) - c,$$

where c represents the cost of registration, legal and auditing fees, printing costs, etc.

Given the assumptions on Q and $p(\theta,a)$, the function x is increasing in θ when $Q < B$ and will be assumed to be differentiable and concave in p and a and to be increasing in a when $Q < B$. It will further be assumed that

A. $x_{p\theta} \geq 0$ and $x_{p\theta} > 0$ when $Q < B$

B. $x_{ap} \geq 0$ and $x_{ap} > 0$ when $Q < B$.

Assumption A implies that the marginal return from an increase in the offer price is greater for higher values of θ, which corresponds to the parameterization of θ such that higher values of θ are associated with a more favorable reception for the securities in the capital market. Assumption B implies that a higher price yields higher returns to increased effort, which is a property that reasonably could be expected to be satisfied.[13]

The informational asymmetry between the banker and the issuer will be represented by assuming that the banker receives through its preselling activities a signal or information in the form of the realization of $\omega \in \Omega$ of a random variable that is not observable by the issuer.[14] At the end of the registration period the investment banker then has a conditional distribution $f(\theta|\omega)$ on the state. The issuer and the banker are assumed to hold identical prior beliefs about the distribution of θ and about the signal ω, and thus the informational asymmetry arises only because the issuer is unable to observe ω. The distribution of the signal ω will be assumed to be absolutely continuous with a differentiable density function $f(\omega)$.

The signal ω will be interpreted as information regarding the perceived quality of the issue with higher values of ω corresponding to "more favorable" information in the sense that a higher value of ω results in a distribution $f(\theta|\omega)$ that is stochastically dominant in the first degree or

$$\int_{\underline{\theta}}^{\theta} f_{\omega}(\theta^{+}|\omega)\,d\theta^{+} \leq 0 \quad \text{for all } \theta \tag{1}$$

with a strict inequality holding for some θ^{o} and where the subscript denotes partial derivative. Since x is increasing in θ for $Q < B$, an increase in ω results in a stochastically dominant distribution of the net proceeds. Letting $\theta^{o}(p,a,x)$ be defined by

$$x = x(p,a,\theta^{o}) \ ,$$

the probability that net proceeds will be less than or equal to x is

$$G(x|p,a,\omega) = \int_{\underline{\theta}}^{\theta^{o}} f(\theta|\omega)\,d\theta \ .$$

It will further be assumed that

$$G_{p\omega} \leq 0 \quad \text{for all} \quad x \geq 0, \tag{2}$$

with the strict inequality holding for some x^{+}. This condition states that if more favorable information is obtained a small increase in price can be made and results in a more favorable distribution of the proceeds. This assumption will be utilized only to establish Proposition 2 below.

II. The Model and the Commission Function

The payment received by the banker will be represented by a "commission function" S^* that may be a function of any variable that is observable by both the issuer and the banker.[15] The net proceeds to the issuer are thus $(x - S^*)$, and the preferences of the issuer will be represented by an increasing, strictly concave von Neumann-Morgenstern utility function U. The issuer's preferences are thus represented by[16]

$$\int \int U(x - S^*) f(\theta \mid \omega) f(\omega) d\theta d\omega.$$

The observation that most new issues involve firm commitment arrangements suggests that issuers are risk averse, and the analysis will focus on that case.

The "banker" may be thought of as the managing house representing the syndicate, and the banker's preferences will be assumed to depend on both its compensation S^* and on the effort it expends in distributing the issue. Preferences are represented by a utility function $V(S^*,a)$, where $V_1 > 0$ and V_{11} is nonpositive reflecting risk aversion or risk neutrality. The utility function is assumed to be strictly decreasing in effort, reflecting both a preference for the expenditure of less to more effort and a desire not to use "muscle" on customers by "persuading" them to buy securities that they otherwise would not wish to purchase.

The use of firm commitment contracts is not consistent with risk-averse behavior of investment bankers, but the formation of syndicates is inconsistent with risk neutrality unless there are real costs of bankruptcy or decreasing returns to the distribution effort.[17] Another possible explanation of the use of firm commitment contracts is that they arise because of tradition and that while investment bankers would prefer to bear less risk they receive sufficient commissions to compensate for the additional risk. For example, Conrad and Frankena (1969) argue that investment bankers have risk averse preferences and compensate for greater risks by lowering the offer price so that there is less chance of an unsuccessful issue.

The design of the commission payment to the banker is to be determined by the issuer who is assumed to have some market power relative to the banker. The level of compensation of the banker however is assumed to be determined through a negotiation process that will be taken here to pertain to a reservation level $\overline{V}$ of expected utility of the banker. The issuer must then design a commission schedule S* such that[18]

$$\iint V(S^*,a)f(\theta|\omega)f(\omega)d\theta d\omega \geq \overline{V} .$$

The reservation level $\overline{V}$ may be affected by competitive pressures as well as by the "reputation" of the investment banking house.

The only variables observable by both the issuer and the banker in this model are the proceeds x from the issue and the offer price p, so the commission function $S^*(x,p)$ can depend only on those two variables. The analysis is concerned with the design of the function S* in order to induce the banker under delegation to utilize the information ω in the issuer's interests and to expend more effort in distributing the issue than it would otherwise expend. The general design problem is quite complex, and hence, S* will initially be specified as

$$S^*(x,p) = S(x) + T(p) ,$$

where $S(x)$ is an increasing, differentiable function representing a payment based on the net proceeds from the issue and $T(p)$ is a payment based on the offer price set by the banker. In the next section $S(x)$ and the distribution effort are assumed to be predetermined, and the design of $T(p)$ is considered in conjunction with the delegation of the offer price decision. In Section

IV the design of the function $S(x)$ and the distribution effort incentive problem are considered.

III. Delegation of the Offer Price Decision

If the offer price decision is delegated to the banker, the banker will set the price in response to the information ω obtained during the registration period. The price response function $p(\omega)$ used by the banker satisfies

$$p(\omega) = \underset{p}{\text{argmax}}\ EV(\omega) = \int V(S(x) + T(p),a)f(\theta|\omega)d\theta \ , \tag{3}$$

where argmax denotes the argument that maximizes the conditional expected utility $EV(\omega)$. Assuming that T is differentiable, the first-order condition corresponding to (3) will be written as[19]

$$v_T T' + v_p = 0 \ , \tag{4}$$

where

$$v_T = v_T(p(\omega),T(p(\omega)),\omega) \equiv \int V_1 f(\theta|\omega)d\theta$$

$$v_p = v_p(p(\omega),T(p(\omega)),\omega) \equiv \int V_1 S' x_p f(\theta|\omega)d\theta \quad ,$$

and $x_p = \partial x/\partial p$. The condition in (4) indicates the problem caused by the asymmetric information and how the commission function can be used to mitigate that problem. When the issuer cannot observe ω, such a commission function cannot be used. If a commission payment $T(p)$ were not used in conjunction with delegation, the banker would choose an offer price $p(\omega)$ satisfying $v_p = 0$. An increasing (decreasing) commission function $T(p)$ however will cause the banker to price such that $v_p > (<) \ 0$, so a commission based on the offer price is effective in inducing the banker to price higher (lower) than it otherwise would.

The issuer's problem is thus to choose $T(p)$ in order to influence the response function $p(\omega)$ so that the banker uses the signal ω to further the interests of the issuer. In doing so, the issuer must take into account the response function $p(\omega)$ satisfying (4) and thus chooses $T(p)$ according to the program

$$\max_{T(p)} \iint U(x - S(x) - T(p))f(\theta|\omega)f(\omega)d\theta d\omega \tag{5}$$

$$\text{S.T.} \quad \iint V(S(x) + T(p),a)f(\theta|\omega)f(\omega)d\theta d\omega \geq \overline{V} \tag{6}$$

$$v_T T'(p) + v_p = 0 \qquad \text{for all } \omega \in \Omega \quad . \tag{7}$$

The solution to this program will be characterized in two steps. First, the class of attainable response functions that the issuer can induce the banker to choose will be characterized, and second, first-order conditions for the program will be stated and analyzed.

To characterize the class of attainable response functions, note that $p(\omega)$ satisfying (4) will be at least a local optimum if the second-order condition is satisfied at that ω. To investigate the second-order condition, suppose that $p(\omega)$ is a strictly increasing, differentiable function so that $p'(\omega) > 0$. Then, differentiating (4) with respect to ω and rearranging yields

$$\frac{\partial}{\partial p}(v_T T' + v_p) = - \frac{1}{p'(\omega)}\left(\frac{\partial}{\partial \omega}(v_T T' + v_p)\right) .$$

Since

$$\frac{\partial}{\partial \omega}(v_T T' + v_p) = v_T \frac{\partial}{\partial \omega}\left(\frac{v_p}{v_T}\right) ,$$

if $\frac{\partial}{\partial \omega}\left(\frac{v_p}{v_T}\right) > 0$ at $p(\omega)$, the optimal response function is at least a local optimum. The condition $\frac{\partial}{\partial \omega}\left(\frac{v_p}{v_T}\right) > 0$ states that more favorable information increases the ratio of the marginal utility v_p resulting from the effect of a price increase on $S(x)$ to the marginal utility v_T of total compensation. This property seems intuitively reasonable given the interpretation of information in Section I and will be assumed here. To investigate the plausibility of this assumption, evaluate the derivative to obtain

$$v_T \frac{\partial}{\partial\omega}\left(\frac{v_p}{v_T} \right) = v_{p\omega} - v_p v_{T\omega}/v_T = v_{p\omega} + T' v_{T\omega} \quad . \tag{8}$$

Since an increase in ω results in a stochastically dominant distribution of x from (1),

$$v_{T\omega} = \frac{\partial}{\partial\omega} \int V_1 f(\theta|\omega)d\theta = \int V_1 f_\omega(\theta|\omega)d\theta < (= 0) \ ,$$

if $S(x)$ is increasing and $V_{11} < (=) \ 0$. The term $v_{p\omega}$ is given by

$$v_{p\omega} = \frac{\partial}{\partial\omega} \int V_1 S' x_p f(\theta|\omega)d\theta = \int V_1 S' x_p f_\omega(\theta|\omega)d\theta \ ,$$

which is positive from (2), since $S(x)$ is an increasing function. In this case a sufficient but not necessary condition for $\frac{\partial}{\partial\omega}\left(\frac{v_p}{v_T} \right) > 0$ when (2) is satisfied is $v_p \geq 0$ or equivalently $T' \geq 0$ at $p(\omega)$. If the expression in (8) is positive, the following proposition establishes that any nondecreasing response function $p(\omega)$ is attainable through the choice of a payment $T(p)$ and is a global optimum to the banker's choice problem. Furthermore, any attainable response function is a nondecreasing function. This result is a direct consequence of Holmström's (1977) Theorem 2.15, and its proof is presented here for completeness.

Proposition 1: If $\frac{\partial}{\partial \omega}\left(\frac{v_p}{v_T}\right) > 0$ for all (ω, p), any nondecreasing differentiable price response function $p(\omega)$ can be generated by some commission function $T(p)$. Conversely, any price function $p(\omega)$ that can be generated by a commission function is nondecreasing.

Proof: Assume that $p'(\omega) > 0$. Then ω can be expressed as a function $\omega(p)$ of p, and the first-order condition in (4) can be written as a function of p as

$$v_T(p,T(p),\omega(p))T'(p) + v_p(p,T(p),\omega(p)) = 0$$

for all p such that $p = p(\omega)$ for $\omega \in \Omega$. This is a differential equation in $T(p)$ and under the assumptions on V and g, a solution $T(p)$ exists. Consequently, for any $p(\omega)$ such that $p'(\omega) > 0$ there exists a $T(p)$ such that $p(\omega)$ satisfies the first-order condition and hence is at least a local maximum. To show that the local maximum is also a global maximum, assume the contrary. This implies that for $p(\omega)$ satisfying the first-order condition at some ω_1, the banker's indifference curve in the (p,T)-plane given by

$$v(p,T,\omega_1) \equiv \int V(S(x) + T,a)g(x|\omega_1;p,a)dx = \bar{v}$$

is tangent to $T(p)$ at $p(\omega_1)$.[20] That is, the slope $(-v_p(p,T,\omega_1)/v_T(p,T,\omega_1))$ of the indifference curve equals the slope of $T(p)$ at $p(\omega_1)$ as in Figure 1. If $p(\omega_1)$ is not a global optimum, however, the indifference curve must intersect $T(p)$ at some other point $p_2 = p(\omega_2)$. Assume $p_2 > p_1$. At $p(\omega_2)$ there is an indifference curve with slope $(-v_p(p,T,\omega_2)/v_T(p,T,\omega_2))$ that is tangent to $T(p)$ at $p(\omega_2)$, since at $p(\omega_2)$ the first-order condition in (4) is satisfied. This implies, since $p_2 > p_1$, that

$$T'(p(\omega_2)) = -\frac{v_p(p(\omega_2),T(p(\omega_2)),\omega_2)}{v_T(p(\omega_2),T(p(\omega_2)),\omega_2)} > -\frac{v_p(p(\omega_2),T(p(\omega_2)),\omega_1)}{v_T(p(\omega_2),T(p(\omega_2)),\omega_1)}, \quad (9)$$

as is apparent in Figure 1. Because p is increasing, $p_2 > p_1$ implies $\omega_2 > \omega_1$. Thus, (9) contradicts the assumption that $\frac{\partial}{\partial \omega}\left(\frac{v_p}{v_T}\right) > 0$, so a response function $p(\omega)$ satisfying (4) and such that $p'(\omega) > 0$ is a global optimum. (If $p_2 < p_1$, the same conclusion follows). An analogous argument can be given for the case in which $p'(\omega) = 0$.

It remains to show that any function $p(\omega)$ that satisfies (4) is nondecreasing. This follows again from the argument above. That is, if v_p/v_T is increasing in ω, the slope of the indifference curve for ω_2 $(\omega_2 > \omega_1)$ evaluated at $p(\omega_1)$ is more negative than for ω_1. Consequently, the price must be increased from $p(\omega_1)$. If $T(p)$ is sufficiently steeply sloped at $p(\omega_1)$, then $p(\omega_2)$ can equal $p(\omega_1)$, so a constant function $p(\omega)$ is also possible.

$\blacksquare$

Proposition 1 indicates that the issuer, through the payment function $T(p)$, can induce the banker to choose a higher price the more favorable is the information received during the registration period. The next step in the characterization of the solution to the issuer's design problem is to determine the first-best or Pareto optimal response function $p^*(\omega)$ that the issuer would choose if he were able to observe ω. That response function maximizes (5) subject to (6), without $T(p)$, and hence satisfies the first-order condition

$$\frac{d(EU + \lambda^* EV)}{dp} = \int [U'(1-S') + \lambda^* V_1 S'] x_p f(\theta|\omega) d\theta = 0 \ , \qquad (10)$$

where λ^* is the multiplier associated with the constraint in (6) and E denotes expectation with respect to θ. If $p^*(\omega)$ satisfying (10) is a nondecreasing function of ω, Proposition 1 indicates that a payment function $T^*(p)$ exists such that the banker will choose $p^*(\omega)$ when the price decision is delegated to the banker. To investigate $p^*(\omega)$, differentiate (10) with respect to ω to obtain

$$\frac{d^2(EU + \lambda^* EV)}{dp2}\, p^{*\prime}(\omega) + \int [U'(1-S') + \lambda^* V_1 S'] x_p f_\omega(\theta|\omega) d\theta = 0. \qquad (11)$$

Assuming that $EU + \lambda^* EV$ is strictly concave in p at $p^*(\omega)$, the sign of $p^{*\prime}(\omega)$ is the same as that of the last term in (11). If the sign of that term is nonnegative, the first-best price response function $p^*(\omega)$ is attainable. The following proposition gives conditions sufficient for this result.

Proposition 2: If $S(x)$ and $x - S(x)$ are nondecreasing in x, (2) is satisfied and the hypothesis of Proposition 1 is satisfied, $p^*(\omega)$ is attainable.

Proof: The condition in (2) corresponds to a stochastically dominant distribution resulting from an increase in ω and p, and if $S(x)$ and $x - S(x)$ are nondecreasing

$$\int U'(1-S') x_p f_\omega(\theta|\omega) d\theta + \lambda^* \int V_1 S' x_p f_\omega(\theta|\omega) d\theta > 0.$$

Hence, $p^*(\omega)$ is increasing in ω. Given the hypothesis of Proposition 1, there exists a function $T^o(p)$ such that $p^*(\omega)$ is chosen by the banker and is a global optimum to the banker's problem in (3). ■

If the first-best price function is not nondecreasing in ω and the hypothesis of Proposition 1 is satisfied, that Proposition implies that $p^*(\omega)$ is not attainable.

Although the first-best response function $p^*(\omega)$ can be attained under the conditions of Proposition 2, the first-best solution to the issuer's program is not attainable because the payment $T^0(p^*(\omega))$ adds uncertainty and reduces the expected utility of a risk averse issuer or banker. The second-best design involves taking into account both the response function induced by the payment and the direct effect of the payment on the expected utilities in (5) and (6) and will be characterized using the calculus of variations. Since the constraint in (7) involves a control T that is an indirect function of ω, that constraint must be reformulated in order to view the program as a control problem. To do this, let $q(\omega) \equiv T(p(\omega))$, so $q'(\omega) = T'p'(\omega)$. If $p'(\omega) \neq 0$, then substituting into (5) yields

$$v_T q' + v_p p' = 0 \quad \text{for all } \omega \in \Omega, \tag{12}$$

which replaces (7). In the reformulated program, the issuer chooses $q(\omega)$ and $p(\omega)$, and given Proposition 1, the second-best payment function $\hat{T}(p)$ can be recovered from $q(\omega)$ and $p(\omega)$, since $p(\omega)$ is nondecreasing. The Euler conditions for the second-best $\hat{q}(\omega)$ and $\hat{p}(\omega)$, respectively, are

$$-u_T + \lambda v_T - \Psi'(\omega)v_T - \Psi(\omega)\left(v_{T\omega} + \frac{\partial}{\partial\omega}\log[f(\theta|\omega)f(\omega)]\right) = 0 \tag{13}$$

$$u_p + \lambda v_p - \Psi'(\omega)v_p - \Psi(\omega)\left(v_{p\omega} + v_p\frac{\partial}{\partial\omega}\log[f(\theta|\omega)f(\omega)]\right) = 0 \tag{14}$$

where $u_T = \int U' g dx$, $v_{T\omega} = \partial v_T/\partial\omega$, $u_p = \int U g_p dx$, $v_{p\omega} = \partial v_p/\partial\omega$, and $\Psi(\omega)$ is the multiplier associated with the constraint in (10).[21] The multiplier $\Psi(\omega)$ has the interpretation as the marginal cost to the issuer resulting from the banker's opportunity to choose the response function. If $\Psi(\omega) = 0$ for all ω, the condition in (13) simply characterizes the first-best solution in (10).

One case in which the first-best solution is attained is when the banker is risk neutral, since in that case a firm commitment contract is optimal under which the banker pays the issuer a fixed price p^o for the securities and assumes all the risk. To prove that a firm commitment contract is optimal, it is necessary to demonstrate that the net payment $(x - S(x) - T(p))$ is a constant in the optimal contract. For any response function $p(\omega)$ define the expected net proceeds μ to the issuer by

$$\mu = \iint \big(x - S(x) - T(p(\omega))\big) f(\theta|\omega)f(\omega)d\theta d\omega \equiv p^o B.$$

By Jensen's inequality a risk averse issuer is strictly better off with μ

than with $x - S(x) + T(p(\omega))$, and a risk neutral banker is indifferent between $(x - \mu)$ and $S(x) + T(p(\omega))$. A firm commitment contract is thus optimal, and the banker bears the full consequences of his pricing decision. This implies that $\Psi(\omega) = 0$ for all ω and from (4) that $v_p = 0$. These results are summarized as

Proposition 3: If the banker is risk neutral, a firm commitment contract is optimal and the optimal response function satisfies $v_p = 0$. Also, $\Psi(\omega) = 0$ for all ω.

For a risk-averse banker $\Psi(\omega)$ will not equal zero for all ω because it will be optimal for the issuer to bear some of the risk. To characterize the solution in this case, solve (13) for $(\lambda - \Psi'(\omega) - \Psi(\omega) \frac{\partial}{\partial\omega} \log[f(\theta|\omega)f(\omega)]$ and substitute into (14) to obtain

$$\Psi(\omega)[v_p v_{T\omega} - v_{p\omega} v_T]/v_T + u_T\left(\frac{u_p}{u_T} + \frac{v_p}{v_T}\right) = 0. \tag{15}$$

Since $v_T \frac{\partial}{\partial\omega}\left(\frac{v_p}{v_T}\right) = (v_{p\omega} v_T - v_p v_{T\omega})/v_T$, the sign of $\Psi(\omega)$ is the same as that of $\left(\frac{u_p}{u_T} + \frac{v_p}{v_T}\right)$ if $\frac{\partial}{\partial\omega}\left(\frac{v_p}{v_T}\right) > 0$. To sign this term, consider Figure 2. If the indifference curve

$$u(p,-T(p),\omega) \equiv \int U(x - S(x) - T(p))f(\theta|\omega)d\theta = \bar{u}$$

at $p(\omega_1)$ cuts $\hat{T}(p)$ from below, then the slope $\frac{u_p}{u_T}$ is greater than the slope $-\frac{v_p}{v_T}$. Thus, $u_p/u_T > -v_p/v_T$ implies $v_p/v_T + u_p/u_T > 0$, and (15) implies that $\Psi(\omega) > 0$. If the issuer's indifference curve cuts $\hat{T}(p)$ from above, then $\Psi(\omega) < 0$. Consequently, $\Psi(\omega) > (=)(<) \; 0$ implies that the issuer prefers a greater (the same)(a lower) price than that preferred by the banker given the optimal payment function $\hat{T}(p)$. This analysis is summarized as Proposition 4.

Proposition 4: If $\frac{\partial}{\partial\omega}(\frac{v_p}{v_T}) > 0$ and $\frac{u_p}{u_T} > (=)(<) - \frac{v_p}{v_T}$, then $\Psi(\omega) > (=)(<) 0$, and the issuer prefers a price greater than (equal to)(less than) $\hat{p}(\omega)$ given $\hat{T}(p)$.

Proposition 4 thus demonstrates that the cost, as represented by $\Psi(\omega)$, of using the payment function to affect the banker's pricing decision is positive (negative) when the issuer prefers a higher (lower) offer price than does the banker. The most likely case is that the issuer prefers a higher offer price than does the banker, so $\Psi(\omega) > 0$ indicates that the issuer incurs losses relative to the first-best response function because of the need to influence the banker's decision.

Throughout the analysis in this section the distribution effort and the commission payment S(x) have been assumed to be predetermined. In the next section the effort incentive problem and the design of S(x) are considered.

IV. Delegation and the Distribution Effort Incentive Problem

Characterization of the optimal contract to deal with the incentive problems resulting from both the unobservability of ω and of the distribution effort is quite difficult in general, so attention will be restricted to the case of linear commission functions of the form

$$S^*(x,p) = \alpha(p)x + \beta(p).$$

This class of commission functions includes the cases of firm commitment contracts ($\alpha(p) = 1$, $\beta(p) < 0$), standby contracts ($0 < \alpha(p) < 1$), and best efforts contracts ($\alpha(p) = 0$, $\beta(p) > 0$) and thus encompasses the most frequently used issuer-investment banker arrangements.

In addition to imposing the additional structure on the commission function, the preferences of the banker will be assumed to be separable in profit and effort of the form

$$V(S,a) = V_{\star}(S) - W(a),$$

where $V_{\star}$ represents the utility of money and $(-W(a))$ represents the disutility of effort. The function W is assumed to be increasing and convex. Given a commission function, the banker under a delegation scheme is able to choose the offer price and the distribution effort conditionally on ω. In designing the commission function, the issuer must take into account these responses and thus has the program

$$\max_{\alpha(p),\beta(p)} \iint U((1-\alpha(p(\omega)))x - \beta(p(\omega)))f(\theta|\omega)f(\omega)d\theta d\omega \tag{16}$$

$$\text{s.t.} \quad \iint V_{\star}(\alpha(p(\omega))x + \beta(p(\omega)))f(\theta|\omega)f(\omega)d\theta d\omega - \int W(a(\omega))f(\omega)d\omega \geq \overline{V} \tag{17}$$

$$(a(\omega),p(\omega)) = \operatorname*{argmax}_{(a,p)} \int V_{\star}(\alpha(p)x + \beta(p))f(\theta|\omega)d\theta - W(a), \ \forall\, \omega, \tag{18}$$

where the explicit dependence of x on (a,p,θ) has been suppressed for notational simplicity.

As in the previous section where the distribution effort was fixed, if the banker is risk neutral, a firm commitment contract is optimal and the banker bears the full consequences of its decisions.[22] For the case in which both parties are risk averse a standby arrangement under which both bear some portion of the risk is optimal. To characterize the optimal contract in this case, the distribution effort decision problem will first be dealt with in isolation from the delegation of the offer price decision. If the offer price decision were not to be delegated but instead were to be determined prior to the registration period, the contract design problem reduces to determining an optimal commission function with parameters $\alpha(p) = \alpha$ and $\beta(p) = \beta$ independent of p. The effort response function $a(\omega,p)$ corresponding to an offer price p thus satisfies

$$\int V_*' \alpha x_a f(\theta|\omega)d\theta - W'(a(\omega,p)) = 0 \tag{19}$$

and is unique since x is strictly concave in a and V_* is concave. Since the constraint in (17) is binding in any optimal contract, differentiation with respect to α yields

$$\frac{d\beta}{d\alpha} = -\iint V_*' \, x f(\theta|\omega)f(\omega)d\theta d\omega / \iint V_*' f(\theta|\omega)f(\omega)d\theta d\omega \; .$$

Consequently, an increase in α requires a reduction in β.

The effort response to a change in α, and the corresponding adjustment in β, is determined by differentiating (19) to obtain

$$\frac{da(\omega,p)}{d\alpha} = -\left(\int V_*'' \alpha x_a \left(x + \frac{d\beta}{d\alpha}\right) f(\theta|\omega)d\theta + \int V_*' x_a f(\theta|\omega)d\theta\right) \Big/ \frac{\partial^2 EV(\omega)}{\partial a^2} \; . \tag{20}$$

The denominator is negative, since $EV(\omega)$ is concave in a by assumption, so the distribution effort increases with α if the numerator is positive. The second term represents the incentive effect on effort of an increased share of the net proceeds and is unambiguously positive. The first term represents the income effect of an increase in α and the corresponding decrease in β. Since the constraint in (17) remains binding, the income effect would be expected to be small and hence that the sign of (20) would be determined by the incentive effect. Consequently, $a(\omega,p)$ will be taken to be increasing in α.

To characterize the issuer's response to the effort incentive problem, let α^*, β^*, and $a^*(\omega,p)$ denote the solution to (16), (17), and (19). Also, let $(\bar{\alpha},\bar{\beta})$ denote the parameters of the Pareto optimal risk sharing contract that the issuer would employ if he were able to observe ω and implement the response function $a^*(\omega,p)$. The contract parameters $(\bar{\alpha},\bar{\beta})$ are determined by maximizing (16) with respect to (α,β) subject only to (17) and $a(\omega,p) = a^*(\omega,p)$.

The following proposition then characterizes the issuer's response to the effort incentive problem.

Proposition 5: If the offer price is determined prior to the registration period and if an increase in α leads to a greater distribution effort, the optimal commission function (α^*,β^*) in (16), (17), and (19) is such that $\alpha^* \geq \bar{\alpha}$ and $\beta^* \leq \bar{\beta}$, where $(\bar{\alpha},\bar{\beta})$ corresponds to the Pareto optimal risk sharing arrangement given $a^*(\omega,p)$.[23]

Proof: Suppose $\bar{\alpha} > \alpha^*$ and hence $\bar{\beta} < \beta^*$. Evaluated at $a^*(\omega,p)$, a change from (α^*,β^*) to $(\bar{\alpha},\bar{\beta})$ will be Pareto improving by definition of $\bar{\alpha}$ and $\bar{\beta}$. The banker will respond by choosing a higher level of effort at $(\bar{\alpha},\bar{\beta})$ improving further its welfare. The issuer will be better off as well, since he always prefers higher effort because $x_a \geq 0$. Thus, $(\bar{\alpha},\bar{\beta})$ is better than (α^*,β^*) even under the restriction (19). This contradicts the optimality of (α^*,β^*) in (16), (17), and (19), so $\bar{\alpha} \leq \alpha^*$ and $\bar{\beta} \geq \beta^*$. ∎

It is not necessarily true that $\bar{\alpha} < \alpha^*$ and $\bar{\beta} > \beta^*$, since if for example $U(z) = V_*(z) = \log(z)$, β must equal zero to ensure that $x - S(x,p) > 0$ and $S(x,p) \geq 0$.[24] If such cases can be ruled out because, for example, the initial wealth of both parties is sufficient to cover any losses on the issue, then $\bar{\alpha} < \alpha^*$ and $\bar{\beta} > \beta^*$ obtains. Under the hypotheses of Proposition 1 the issuer deals with the distribution effort incentive problem by increasing the percentage of the proceeds paid to the banker and correspondingly reducing the fixed payment compared to the Pareto optimal risk-sharing contract corresponding to $a^*(\omega,p)$. The response to the effort incentive problem is thus to let the banker bear a greater share of the consequences of his efforts. Since the net proceeds are an increasing function of the distribution effort and the banker has disutility from effort, the issuer prefers a greater distribution effort than does the banker.

The offer price response function $p_B(\omega)$ of the banker specifies the price that would be set when ω is observed and is defined by

$$p_B(\omega) = \underset{p}{\text{argmax}} \int V_*(\alpha x(p,a(\omega,p),\theta) + \beta)f(\theta|\omega)d\theta - W(a(\omega,p)).$$

If x is jointly concave in (a,p), $p_B(\omega)$ will be unique and using (19) satisfies the first-order condition

$$\int V_*' x_p f(\theta|\omega)d\theta = 0. \tag{21}$$

The offer price preferred by the issuer, if he were able to observe ω, is defined by

$$p_I(\omega) = \underset{p}{\text{argmax}} \int U((1-\alpha)x(p,a(\omega,p),\theta) - \beta)f(\theta|\omega)d\theta,$$

and satisfies the first-order condition

$$\int U'(1-\alpha)(x_p + x_a a_p)f(\theta|\omega)d\theta = 0. \tag{22}$$

This condition takes into account the effects of the offer price directly on the proceeds x and indirectly through the distribution effort expended by the banker, since even if ω is observable, the distribution effort is not.

To compare $p_I(\omega)$ and $p_B(\omega)$, add (19) and (21) to obtain

$$\int V_*'\alpha(x_p + x_a)f(\theta|\omega)d\theta - W' = 0. \tag{23}$$

Comparing (22) and (23) suggests that the banker would prefer a lower offer price than would the issuer, ceteris paribus, because of the disutility of effort represented by $(-W')$ and because a higher offer price would be expected to require a greater distribution effort. The comparison between $p_I(\omega)$ and $p_B(\omega)$ however is ambiguous in general, so a special case will be considered. A characterization of a_p is required first.

For a given ω the effort response function $a(\omega,p)$ will be an increasing function of p if and only if from (19)

$$\frac{\partial EV(\omega)}{\partial a \partial p} = \int \left(V_*'\alpha x_{ap} + V_*'' \alpha^2 x_a x_p \right) f(\theta|\omega)d\theta$$

$$= \int \alpha V_*' \left(x_{ap} - \alpha x_a x_p r \right) \quad f(\theta|\omega)d\theta > 0, \qquad (24)$$

where r is the Arrow-Pratt index of absolute risk aversion. Since x_{ap} is nonnegative and is positive when the issue is not sold out, the first term in (24) is positive. From (21) and the concavity of expected utility in p

$$\int \alpha V_*' x_p \; f(\theta|\omega)d\theta \le 0, \qquad \text{for } p \ge p_B(\omega).$$

Since $x_a r > 0$, it seems likely that the expression in (24) is positive. This motivates the assumption that greater effort is expended when the offer price is increased.

The following proposition uses this condition in analyzing the case in which the issuer and the banker have HARA utility functions with the same risk cautiousness. That is, the functions U and V_* are such that

$$-\frac{U'(z)}{U''(z)} = bz + c \qquad \text{and} \qquad -\frac{V_*'(z)}{V_*''(z)} = bz + d.$$

For this class of utility functions Wilson (1968) has shown that the Pareto optimal risk-sharing contract function S is linear in x. The following result then obtains.

Proposition 6: Let U and V belong to the class of HARA - utility functions, and assume they have identical risk cautiousness. Let (α^*,β^*), $p_B^*(\omega)$, and $\hat{a}(\omega) = a(\omega, p_B^*(\omega))$ denote the optimal solution to the program (16), (17), (19), and (21), and assume that a higher price, <u>ceteris paribus</u>, leads to a greater effort. Then, $p_B^*(\omega) < p_I^*(\omega)$, where $P_I^*(\omega)$ is defined in (23) given (α^*,β^*).

Proof: As above let $(\bar{\alpha},\bar{\beta})$ denote the parameters of the Pareto optimal risk-sharing rule given $(\hat{a}(\omega), p_B^*(\omega))$. Since U and V have identical risk cautiousness,

$$\frac{U'((1-\bar{\alpha})x-\bar{\beta})}{V_*'(\bar{\alpha}x+\bar{\beta})} = \eta, \qquad \forall x,$$

for some $\eta > 0$. From Proposition 5 $\alpha^* \geq \bar{\alpha}$ and $\beta^* \leq \bar{\beta}$, and direct calculation shows that the function $\eta(x)$ defined by

$$\eta(x) \equiv \frac{U'((1-\alpha^*)x-\beta^*)}{V_*'(\alpha^* x+\beta^*)},$$

is such that

$$\eta'(x) \geq 0. \tag{25}$$

Given $\hat{a}(\omega)$ and $p_B^*(\omega)$, (25) implies that

$$\int_{\underline{\theta}}^{\theta^o} V_*'\eta(x(p_B^*,\hat{a},\theta))x_p f(\theta|\omega)d\theta + \int_{\theta^o}^{\bar{\theta}} V_*'\eta(x(p_B^*,\hat{a},\theta))x_p f(\theta|\omega)d\theta$$

$$\geq \int_{\underline{\theta}}^{\theta^o} V_*'\eta^o x_p f(\theta|\omega)d\theta + \int_{\theta^o}^{\bar{\theta}} V_*'\eta^o x_p f(\theta|\omega)d\theta, \tag{26}$$

where $\eta^o \equiv \eta(x(p_B^*,\hat{a},\theta^o))$, θ^o is defined such that $x_p(p_B^*(\omega),\hat{a},\theta^o) = 0$, and $\theta \in [\underline{\theta},\bar{\theta}]$. The inequality in (26) follows, since on $[\underline{\theta},\theta^o)$, $\eta^o > \eta(x(p_B^*,\hat{a},\theta))$ and on $(\theta^o,\bar{\theta}]$, $\eta^o < \eta(x(p_B^*,\hat{a},\theta))$ because $x_{p\theta} > 0$ and $x_\theta > 0$. Then, (21), (26), and the definition of $\eta(x)$ imply that

$$\int U' x_p f(\theta|\omega)d\theta = \int V_*' \eta(x(p_B^*, \hat{a}, \theta))\, x_p f(\theta|\omega)d\theta \geq \int V_*' \eta^o x_p\, f(\theta|\omega)d\theta = 0 \ .$$

Consequently, the issuer prefers at least as high a price as the banker, when only the choice of price at the fixed effort level $\hat{a}(\omega)$ is considered. By assumption a higher price induces greater effort, and since $(1 - \alpha^*) > 0$ and $x_a > 0$, the issuer's utility increases strictly with effort. Thus, the effect of price on effort will strictly increase the issuer's choice of price from what it would be when effort is ignored. Hence, $p_I^*(\omega) > p_B^*(\omega)$. ∎

The intuition behind this result is based on two observations. First, by Proposition 5 the banker is induced, due to the effort incentive problem, to take on more risk than is Pareto optimal. This increases the risk to the banker in comparison to the issuer's risk, and whereas in the Pareto optimal risk-sharing case they would choose the same price (see Wilson (1968)), the banker now prefers a lower price than does the issuer. Second, a higher price induces greater effort, which benefits the issuer. Thus, aspects of risk and effort both indicate that the issuer would choose a price above that which the banker would choose. Intuition suggests that this may be the case for more general utility function specifications, but such a demonstration does not suggest itself.[25]

If $p_I(\omega)>p_B(\omega)$ and both response functions are increasing in ω, then it can be shown that some delegation of the offer price decision is optimal. To demonstrate this, let $\hat{p}$ be the offer price that the issuer would set when the price is not delegated. If ω has sufficiently wide range that for some ω the price that the banker would set under delegation is above $\hat{p}$, delegation is preferred by the issuer. Delegation is restricted however by not permitting the banker to set a price below the level $\hat{p}$.

Proposition 7: Consider a commission function $S(x) = \alpha x + \beta$, and assume that $p_I(\omega) > p_B(\omega)$ for all ω and that for some ω, $p_B(\omega) > \hat{p}$, where $\hat{p}$ is a price fixed before ω is revealed. Then, both parties can be made better off than at $\hat{p}$ by delegating the pricing decision to the banker under a contract of the form

$$S^*(x,p) = \begin{cases} \alpha x + \beta & \text{if } p \in [\hat{p},\infty) \\ 0 & \text{otherwise} \end{cases} \qquad (27)$$

Proof: It is necessary to show that for states ω for which $p_B(\omega) > \hat{p}$, the issuer prefers $p_B(\omega)$ to $\hat{p}$. Disregarding effort, the issuer's preference over p is concave. Since a lower price reduces effort, it follows that the issuer's preferences over p, including the effect on effort, is quasi-concave in the region $p \leq p_I(\omega)$. Thus, the issuer prefers $p_B(\omega)$ to $\hat{p}$, since $\hat{p} < p_B(\omega) < p_I(\omega)$. The banker is better off as well, since it can always choose $\hat{p}$ if it wants to. $\blacksquare$

This result demonstrates that the issuer can use the banker's superior information to the benefit of both parties by letting the banker determine the offer price. However, the banker is not given complete freedom, since a minimum price is set in order to guarantee a sufficiently high price. A contract of the form (27), is generally not optimal, however, since improvements could be achieved by considering more complex contracts such as $\alpha x + \beta(p)$, for example. It is clear that if such a contract were to improve on (27) the reward for an increase in ω would have to be positive, since otherwise the banker would have an incentive to choose an even lower price than before with the issuer paying for it. In other words, with a contract of the form $\alpha x + \beta p + \gamma$, β must be positive to provide the proper incentives. From a normative point of view this kind of a contract does not appear unrealistic to implement and is strongly reminiscent of the Soviet incentive scheme discussed by Weitzman (1976). With a contract of the general form $\alpha x + \beta(p)$, if more favorable information reduces the marginal cost of an increase in the offer price, then any increasing price response function is attainable as in Proposition 1.[26]

V. Conclusions

The process through which new issues are sold in a negotiated offering gives the investment banker an opportunity to learn about the demand for the issue by conducting preselling activities during the registration period. Recognizing that the banker has superior information, the issuer may delegate the offer price decision to the banker so that the banker can use its superior information. When effort is held constant, more favorable information would be expected to lead to a price response function chosen by the banker that results in a higher offer price the more favorable is the information. Furthermore, a payment function based on the offer price set by the banker is sufficient to induce any increasing response function. If the banker is risk neutral, a firm commitment contract is optimal, and the issuer not only prefers to delegate the pricing decision to the banker but finds it optimal to let the banker bear the full consequences of its decision. When the banker is not risk neutral, a commission payment based in part on the offer price can be effective in inducing the banker to set a price more in the issuer's interests than would otherwise result.

When both delegation and the distribution effort incentive problem are considered in the context of a linear commission function, a firm commitment contract is optimal if the banker is risk neutral. For a risk averse banker it is optimal for both the issuer and the banker to bear some of risk, and to induce greater distribution effort, the issuer lets the banker bear a larger share of the risk. With asymmetric information some delegation of the offer price decision is desirable when the issuer prefers a higher offer price than does the banker and both prefer a higher offer price the more favorable is the information.

Although delegation is preferred, the issuer incurs losses because of his inability to observe ω and the distribution effort. This suggests that there may be gains to basing the commission payment on observable variables in addition to x and p. Information that correlates with ω would, in principle, enable the issuer to better assess the appropriateness of the distribution effort and the offer price under delegation. Holmström (1979) has given necessary and sufficient conditions for such information to be informative in the sense that a commission function based on that information exists that is Pareto superior to any commission function not based on that signal. One variable that might plausibly be used is the total demand Q for the securities. The issuer can presumably ask to see the banker's subscription books and could base the commission on the difference between the subscription Q and B. To discourage underpricing and oversubscription, for example, a penalty $R(Q - B)$, with R an increasing function, could be deducted from S and the banker would be induced to price higher for a given level of effort. For a given price, however, this penalty encourages the banker to expend less effort placing the issue. Such a penalty would obviously have to be carefully designed in order to obtain an increase in price that yields benefits that exceed the losses from the induced decrease in effort.

Figure 1

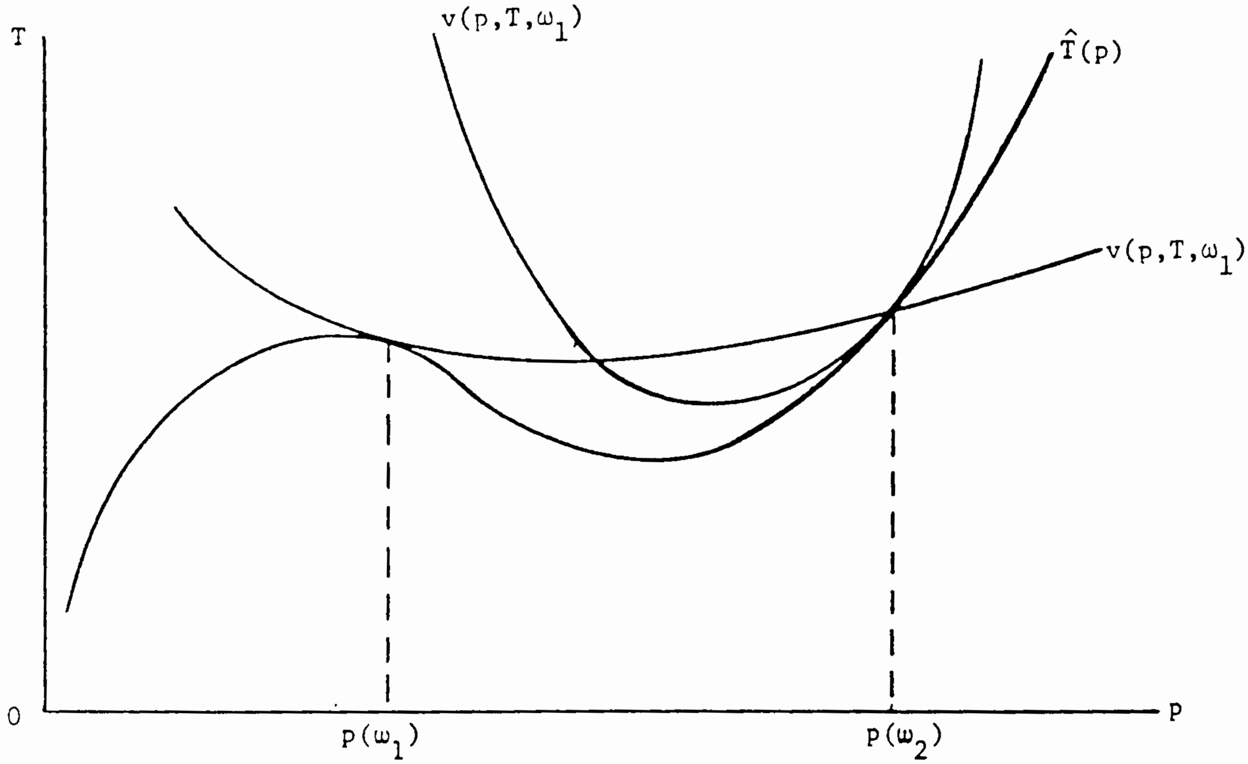
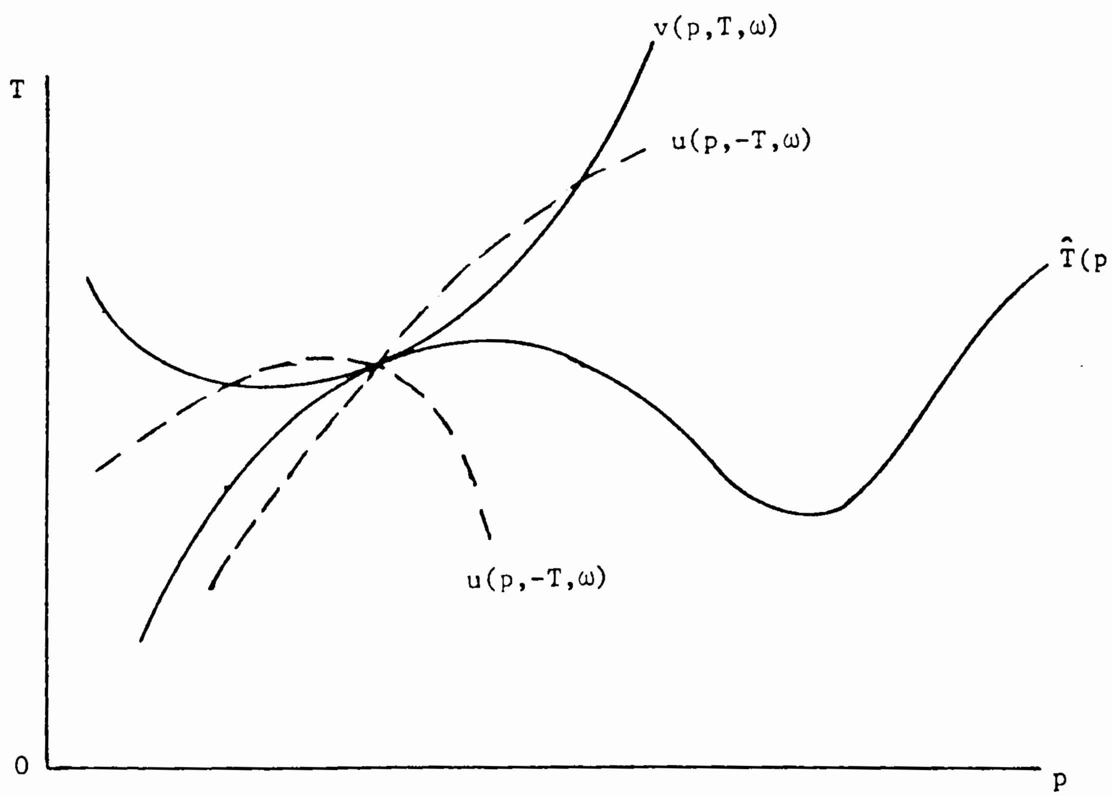


Figure 2



Footnotes

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1. Stoll (1975, p. 102) tentatively draws the opposite conclusion.

   > The fact that on average there is no postoffering price recovery in the short run suggests that the offering price was not set below the market's judgment of the equilibrium price. This conclusion should be tempered by the fact that some negative correlation between pre and postoffering price changes exists particularly in the case of primary and combination issues and by the relatively short period of time (nine trading days) for which postoffering prices were observed. Certainly, more investigation of this point is warranted.

2. Friend (1965) has presented an earlier study on investment banking compensation for new issues.

3. A competitive model involving principal-agent contracting is not yet available, although Ross (1978) has provided some initial results on the choice of an agent by a principal.

4. A study by Davey (1976) of 100 companies sheds some light on the competitiveness issue by indicating the extent to which issuers choose among investment bankers.

   > Sixty-three companies, or almost two-thirds of those polled, maintain multiple investment banking relationships. The range of such associations extends from a low of two to a high of eighteen: the median is three. ...Two-thirds (67) of participating companies have maintained current investment banking connections for at least the past five years (many of these associations date back a score of years or more); the remaining one-third (33) have either changed investment banking affiliations, added to the number of investment bankers used, or abstained from forming any investment banking association during the period. (pages 7-8).

   This survey suggests that many negotiated offerings do not involve direct competition among bankers but instead are determined by continuing associations.

5. An indication that the investment banking industry may not be competitive is the legislation which requires that public utilities receive competitive bids for new security issues.

6. Dynamic factors and the market power of an issuer may lead the banker to set the offer price too high.

> "An even higher return of about 9.2% widely had been anticipated, as indicated by a paucity of purchase orders for the Michigan Bell securities. "Underwriters are setting aggressive terms on Bell System issues in an attempt to curry favor with AT&T, which is expected to need a huge amount of high-priced financial services in the months ahead," one specialist noted." (Wall Street Journal, 11/29/78)

> "Michigan Bell Telephone Co.'s new 9 1/8% debentures were marked down drastically only a day after being poorly received by investors in the $100 million offering, dealers said.
>
> The American Telephone & Telegraph Co. subsidiary's triple-A rated, 40-year obligations plunged to about 98 3/8, where their yield soared to 9.28%, upon being released into the resale market early yesterday. They initially had been priced at 99.628, to yield 9.16%, the most for any comparable Bell System issue in three years.
>
> That sharp markdown reduced a buyer's cost by the equivalent of $12.53 for every $1,000 face amount. It also resulted in a loss of about $6.84 for each $1,000 face amount to the underwriters, who originally envisioned a profit of about $5.69." (Wall Street Journal, 11/30/78)

7. Not only is there increasing pressure from clients to modify traditional practices, but there is the possibility that the industry custom of fixed commissions may be under pressure. In response to a suit brought by an investor, named Papilsky, in a mutual fund, "a federal judge ruled that 'recapture of underwriting fees was available and legal.'" (Fortune (February 1978), p. 90). The Fortune article expresses the industry concern over moves to recover underwriting fees.

> The securities industry is mainly concerned because the case has turned an unwelcome spotlight on the only place where commissions remained fixed--in issues of new securities. This vestige of the good old days before the fixed-commission structure for [securities brokers] was overturned is precious to the industry. The SEC is studying the issues raised by the Papilsky decision, and the industry is gearing up to defend the status quo. (p. 90)

8. The analysis does not deal with the contractual arrangements between members of the underwriting syndicate or between underwriters and the selling group. The interactions among syndicate members is illustrated by Christenson (pp. 24-27).

9. The issuer may also have an informational advantage regarding its own profitability, for example, but unless that information can be communicated to the market so that it affects the demand for the securities, it is not of concern here.

10. Demand is assumed to be independent of the type of contract agreed to by the issuer and the banker except for the indirect effect of the contract on the distribution effort and the pricing decision.

11. For a best efforts arrangement the entire issue will be sold at an uncertain price rather than a stabilized offer price, but such an arrangement is optimal only when there is symmetric information, complete observability, and the issuer is risk neutral while the banker is risk averse. These conditions are not reasonable, so the issue will be assumed to be offered to the market at a specified offer price p.

12. Stoll (1975) concludes "Thus, stabilization appears to occur in response to falling prices and presumably in an attempt to shore them up. The evident lack of success of stabilization makes one wonder why it is engaged in and how the managing underwriter disposes of the stock he purchases." In the model considered here the banker disposes of the securities at $p(\theta, a)$.

The determination of the price $p(\theta,a)$ is difficult to characterize as Friend (1965, p. 34) states: "Some firms may prefer to carry securities in inventory rather than mark them down when selling proves difficult at offering prices: others may simply dispose of 'sticky' issues at the best prices obtainable after termination of syndicate selling operations." The price $p(\theta)$ thus represents an average of the prices received for the

13. An example of such a demand function is

$$Q(p,a,\theta) = M(a,\theta) - pN(a,\theta)$$

with $M_a, M_\theta > 0$ and $N_a, N_\theta < 0$.

14. The case in which informational asymmetry is present prior to signing the contract is also important but will not be considered here.

15. In practice, a banker's compensation depends on a variety of other factors including whether the banker manages the issue and the percentage of the issue he underwrites. For example,

> Nowadays a not atypical spread on a large industrial stock offering of, say, \$100 million might be 3 1/2 percent, or \$3.5 million. For being sole manager, Morgan Stanley generally gets 20 percent of that (\$700,000 in this example) as compensation for devising the selling strategy and selecting and marshalling the other underwriting firms that participate as members of the syndicate. The 20 percent is the industry norm; if there are two or more comanagers, they will usually get equal shares of that.
>
> If Morgan Stanley were to underwrite and sell, say, 20 percent of the shares in the example - as well it might as long as no co-managers were involved - it would receive 20% of the remainder of the spread. That would add another \$560,000, for a total of almost \$1.3 million. (<u>Fortune</u>, February 27, 1978, p. 88).

The distribution of the commission payment among members of the syndicate will not be considered here.

16. An alternative interpretation of the function U is a market valuation function given an investment $(x - S^*)$, so that EU represents the market value prior to the issue period. Concavity then corresponds to decreasing returns to investment.

17. Some investment banking houses are reputed for their distributional ability which suggests that the formation of syndicates may be due at least in part to differential ability to place securities.

18. Alternatively, the issuer may be considered to maximize a weighted sum of his expected utility and the expected utility of the banker given by

$$W = \iint [U(x - S^*) + \lambda V(S^*, a)] g(x|\omega;p,a) f(\omega) dx d\omega,$$

where λ weights the banker's interests relative to the issuer's interests.

19. The response function satisfying (3) for a payment function $T(p)$ is assumed to be unique, although in general, uniqueness is difficult to verify.

20. Concavity of V in S^* implies that the indifference curve is convex.

21. Dividing (11) by v_T and rearranging yields

$$\frac{u_T}{v_T} = \lambda - \psi'(\omega) - \psi(\omega)\left(\frac{v_{T\omega}}{v_T} + \frac{f'(\omega)}{f(\omega)}\right) .$$

The left side is positive for all ω, and hence if there exists no differentiable function $\Psi(\omega)$ such that the right side is positive for all ω, no solution to the issuer's program exists in the class of unbounded functions (see Mirrlees (1974) (1976)).

22. To see this let $(\alpha(p),\beta(p))$ be an optimal contract in (16)-(18). If $\alpha(p) < 1$ or $\beta(p)$ is non-constant, consider a commission function with $\hat{\alpha} = 1$ and $\hat{\beta}$ given by

$$\beta = \iint [(1 - \alpha(p(\omega)))\cdot x(p(\omega),a(\omega),\theta) - \beta(p(\omega))] f(\theta|\omega) f(\omega) d\theta d\omega.$$

A risk averse issuer would be strictly better off with a contract with parameters $(\hat{\alpha},\hat{\beta})$ than with $(\alpha(p),\beta(p))$, since with $(\hat{\alpha},\hat{\beta})$ he receives the expected value of his share of the net proceeds under the contract $(\alpha(p),\beta(p))$. Because of risk neutrality the banker is indifferent between $(\hat{\alpha},\hat{\beta})$ and $(\alpha(p),\beta(p))$, given the response functions $(\alpha(\omega),p(\omega))$, and hence is at least as well off by choosing its optimal response function given $(\hat{\alpha},\hat{\beta})$.

23. This deviation from the first-best risk sharing contract involves losses to the issuer, and those losses are measured by the multipler $\xi(\omega)$ associated with the constraint in (18). The adjoint equation for the program in (16)-(18) is obtained by maximizing the Lagrangian

$$L = \int [U + \lambda(V - \bar{V}) + \xi(\omega)(V_*'\cdot\alpha^* x_a - W'(a))] f(\theta|\omega)d\theta$$

with respect to a which yields

$$\int U'(1 - \alpha^*)x_a f(\theta|\omega)d\theta + \xi(\omega)\partial^2 EV/\partial a^2 = 0,$$

where $\partial^2 EV/\partial a^2$ is the second-order condition which is negative by assumption. Since $x_a > 0$ when $Q < B$, and $\alpha^* \epsilon (0,1)$ when both the issuer and the banker are risk averse, the first term is positive. This implies that $\xi(\omega)$ is positive indicating that the issuer always prefers higher effort.

24. This example assumes that $c=0$. If $c > 0$, no solution exists.

25. Under a system of delegation the offer price will be set according to the response function $p_B(\omega)$ satisfying (21). To characterize $p_B(\omega)$ as a function

of ω, recall that an increase in ω results in a stochastically dominant distribution of θ. Thus, if $V_* x_p$ in (21) is increasing in θ, the effect will be to increase the price. The choice of effort does not influence this condition by an envelope argument, so evaluating yields

$$\frac{\partial}{\partial\theta}(V_*' x_p) = V_*'' \alpha^* x_\theta x_p + V_*' x_{p\theta} = V_*'\left(x_{p\theta} - \alpha^* x_\theta x_p r\right).$$

Since $x_{p\theta} > 0$ by assumption, the derivative x_p is negative for $\theta \in [\underline{\theta}, \theta^o)$, so $\frac{\partial}{\partial\theta}(V_*' x_p) > 0$ on that interval. On $(\theta^o, \bar{\theta}]$, $x_p > 0$, but since V_*' is decreasing in θ, less "weight" (V_*') is given to those values. This suggests the rather natural result that $p_B^*(\omega) > 0$. A similar reasoning can be applied to obtain conditions that guarantee that $p_I^*(\omega) > 0$.

26. The hypothesis analogous to that in Proposition 1 required for this result is

$$\frac{\partial}{\partial\omega}\left(\frac{EV_p(p,\beta,\omega)}{EV_\beta(p,\beta,\omega)}\right) > 0, \text{ where}$$

$$EV(p,\beta,\omega) = \int V_*(\alpha \cdot x(p,\hat{a}(\omega),\theta) + \beta(p)) f(\theta|\omega) d\theta - W(\hat{a}(\omega)),$$

and $\hat{a}(\omega)$ is the best choice of effort given p, α, β and ω.

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