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Informational Asymmetry and the Demand for IPOs:
An explanation of Underpricing

By Peter Karlis and Carolyn Stumph

Abstract:

There exists large informational asymmetries in the stock market, particularly in the primary market where initial public offerings are made. This paper examines the large initial gains observed in a previous study and explains them using game theory. The process of bringing an IPO to the market involves the issuing firm, the investment bank and the investors. This paper will discuss the strategic relationships that exist between these entities and why each either accepts a smaller gain or demands a risk premium based on the level of uncertainty they face. Accompanying the economic theories discussing these relationships is evidence from previous empirical studies siting underpricing in the process of bringing an initial public offering to the market.

Introduction

In the stock market, the prices of actively traded shares change by the second as buy and sell orders continually update the demand of a given stock. If the efficient market hypothesis holds true for the stock exchanges, any alteration of a stock price reflects a change in its issuer's valuation. This value is determined by many factors and the valuation changes as either firm specific or general market news becomes available to the public. The laws governing the stock exchanges are in place to ensure that all investors have access to the same information. Uniform information allows investors to pay exactly what they think a company is worth based on the same information that all other investors have. Theoretically, there is no crowding effect to aid those who have superior information. Crowding occurs when those with superior information compete with those with inferior information for valuable companies only, raising the probability that those with inferior information acquire shares in low value companies. Also absent in a situation of perfectly symmetric information is the need for any signaling mechanisms by sellers of stock to either stimulate or suppress demand.

Accepting these market theories creates somewhat of a problem when attempting to analyze initial public offerings. In a study by Loughran and Ritter on IPO issues from 1990 through 1998, with more than three thousand initial public offerings during that period, the average gain in the first day of trading was 14.1% varying somewhat with the performance of the market. However, in 1999 more than 43% of all IPOs saw first day gains soar past 100%; only 3.7% of IPOs did so in 1998 and the trend for the future is still increasing (Barker 1999). If we assume that the market price of the stock, dictated by supply and demand, is representative of the company's value, then the large gains characteristic of initial public offerings reflect the fact that

the IPO issuing price agreed upon by the underwriter and the issuing firm is beneath the actual per share valuation of the company. Why this underpricing exists has been the subject of considerable debate and many theories have come to the forefront of the economic discussion explaining why IPOs tend to exhibit large first day gains. Among them are Su and Fleisher who stated, "A common perception is that underpricing of initial public offerings is a challenge to market efficiency, and that it may hurt emerging firms trying to raise capital for expansion"(1999). This study separated various theories according to their ideas about the implications of underpricing on market efficiency, many of which cannot reconcile the large first day gains experienced with IPOs with an assumption of efficient markets.

Underpricing raises concern because the difference between the IPO offering price and the market price is money left on the table by the issuing firm. The whole purpose of bringing an IPO to market is to raise capital for the firm. The more stock holder equity a company can obtain, the easier it is for that company to take on debt or go back to the market to issue more stock. Underpricing costs firms millions of dollars and greatly increases the cost of raising money. Some have even gone so far as to suggest that issuing firms should be able to write off lost funds due to underpricing on their corporate taxes. The large dollar amounts that hang in the balance during an IPO have prompted researchers to locate and find solutions to the underpricing anomalies in order to allow issuing firms to fully capitalize on their initial public offerings.

Studies breaking down the various demand components of IPOs have typically pointed to uncertainty to explain why companies agree to underpriced IPO contracts. Uncertainty is present in almost every aspect of bringing an IPO to market and is usually related to issuing firm and investment bank size, reputation, and market conditions (Author 1999). The cause of most

uncertainty is imperfect information. There exists, in fact, huge informational asymmetries in the IPO markets, and various economic theories about such markets still argue over which entities do and which do not have reliable information regarding the value of a firm.

There are many entities involved in the initial public offering process. Each group has its own agenda and acts rationally toward its own financial gain. The firm making the offering, the investment bank, the auditing firm (which will be regarded as part of the investment bank's services in this study), and the investors all interact in the process of bringing an initial public offering to the market. The pricing of a company's stock in the IPO is greatly dependent on which of these entities possess perfect information about the issuing firm, and which entities must rely on the others to report the information to them. The latter must rely on signaling to infer the true value of a stock and must give the more informed entities incentive to provide accurate data about the firm's true value. Through these two mechanisms, the IPO price is agreed upon and may or may not reflect the actual worth of the company.

Today, investment banks stand blocking the path to the capital markets. The reason for this is that an individual firm would incur crippling costs if it attempted to float a stock offering on its own. To sell the stock, the firm would have to discount the price on each share far below its actual value for liquidity and risk premiums that the investors would face. The investment bank is strategically positioned to take advantage of the economies of scale in their business and bring companies' stock to the markets with exposure that currently cannot be duplicated by individual firms without substantial expense. Because of this, some underpricing is attributed to the fact that the investment bank, through its reputation and services, adds some demand to the stock and pushes the per share price above the initially agreed upon contract price. However, previous

research has found that this added demand only explains a small part of the initial gains. The answer to the rest of the underpricing lies in the deal made between the issuing firm and the investment bank as well as the informational asymmetries that are encountered during the negotiations and the actual IPO to the investors.

This is a classic example of how game theory works in that the strategic interaction between the various economic agents, acting rationally to maximize their expected benefit or mitigate their possible loss, determines the ultimate outcome. A simplified description of this strategic interaction is given by Peter Bernstein in *Against The Gods* where he states,

> *Game theory states that the true source of uncertainty lies in the intentions of others...every decision we make is the result of a series of negotiations in which we try to reduce uncertainty by trading off what other people want in return for what we want ourselves* (Bernstein 232).

The interactions between the various entities can be broken down into two specific situations, each with its own strategic interaction. The first is the negotiations that take place between the issuing firm and the investment bank. Here we encounter a principal/agent problem with the investment bank acting as an agent of the company making the stock offing (principal). The second application of game theory takes place in the actual IPO where some of the individual investors have superior information, and others invest randomly. In this case, underpricing exists as a tool to keep the uninformed investors' money in the market. The third application is one where investors use signals from the issuing firm, acting in conjunction with the investment bank, to gauge their demand for the stock.

Literature Review and Applied Theory

Part A: The Principal - Agent Problem

In a 1982 study, Baron analyzes the principal-agent problem with respect to IPO underpricing (Eisenbeis and McEnally 1995). Baron's assumption that firm insiders know more about the true issuing firm value than others led to this game theory approach. In his analysis, the principal can choose from three different contracts to make the offering to the public. First, the firm can choose a pure distribution contract in which the investment bank is payed a set fee to simply sell as many shares as possible to the public at a set price. Second, the issuing firm can attempt to sell the shares themselves to the public which is an extremely costly and, in many cases, infeasible option. The third contract is one in which the issuing firm can opt to have the investment bank underwrite the offering.

In this last case, the investment bank would purchase all of the shares to be in public float from the issuing firm and then turn around and sell them to the public at a price agreed upon in the negotiations between the issuing firm and the bank. This sale to the public is promoted by an effort level that the investment bank privately selects. This effort level, combined with other factors, inevitably determines the demand for the shares. This last case is the one where game theory analysis is applicable and it proceeds as follows.

The theory starts with an arbitrary set of market conditions (θ) that will determine the demand for issuing firm's stock. No entity knows this actual value. However, the investment bank knows the probability distribution of (θ), denoted as (δ). After learning (δ), the investment bank reports (d) regarding the market conditions to the issuing firm. The variable *(d)* may or may

not be equal to (δ), and the issuing firm knows this and takes this into account when setting the price of its shares.

The proceeds from the sale of shares (x) is shown as a probability distribution given price per share, effort level of bank, and (δ). After the price is agreed upon, the investment bank privately selects its effort level (e). Then, payment to the bank is given as the probability distribution {s (p,d,x)}, and the returns to the issuer are (x-s). The costs incurred by the agent for the effort level chosen are {c(e)}. Agent returns are then given by {s - c(e)}. In Baron's explanation, each entity knows all of the above and takes this information into account when choosing its actions.

The uncertainty in this situation is centered on the principle's trust that the agent will report *(d* = δ). Since this trust will vary, and rarely ever be one hundred percent, the issuing firm must create a contract where its expected benefit is highest in the case that *(d)* does not equal (δ). Baron presents the revelation principal to determine the type of contract that will be agreed upon. The revelation principal introduces the idea that there exists a contract such that the agent does not stand to gain by reporting *(d)* not equal to (δ). Thereby, the principal is assured a reasonably accurate measure of (δ). Therefore, contract constraints for the principal will be such that, if (δ) is true, then claiming (δ) must be at least as beneficial to the agent as claiming *(d)*, regardless of the actual value of (δ) or *(d)*. So, {e(d,(δ))} must maximize the returns to the agent, (s-c), and those returns must be equal to or greater than some minimum level of return required by the agent so that the agent will actually agree to work for the principal. The underlying theory here is that the more the agent is guaranteed to be compensated, relative to the service being performed, the more likely it will be to report truthful information to the principal. So, as the issuer's trust in the

investment bank decreases, so does the issuer's certainty that (*d*) will be an accurate report of (δ). As issuing firm's uncertainty of the true value of (δ) increases, so does their willingness to accept a lower priced contract.

It is necessary to explain the investment bank's position to more clearly interpret the conclusions of Baron's model. It is in the investment bank's best interest to have the IPO be oversubscribed, where there are more buy orders than available shares at the offering price. When this is the case, the investment bank is allowed to ration shares to selected investors. Also, if demand is high, the price will inevitably rise after the shares are on the market, giving us the underpricing. These investors usually include the investment bank's preferred customers who stand to make higher than average stock market returns on these underpriced shares. The reasoning outlined here is similar to that tested in the 1999 study by Dongwei Su and Belton M. Fleisher. In that study, underpricing in Chinese IPOs was examined, where informational asymmetries are more pronounced than in US markets. This study found that underpricing was used as a means of bribing bureaucrats who would then make large returns on the shares that were allocated to them by the firm or investment bank. Here too, share rationing by the entity (issuing firm or investment bank) exacerbates the underpricing because the degree to which the shares are underpriced will depend on the size of the desired bribe and the importance of the bureaucrat being bribed. This same study is also applicable to the issuing U.S. firm's motivation to underprice. Just as the investment banks hold the valuable market information (δ), the Chinese bureaucrats also had privileged inside market information, which the study found they were not willing to release without adequate compensation, facilitated by the allotment of underpriced shares.

Therefore, just as in Chinese offerings, although the investment bank does not hold any of the shares to be sold later at the higher market values, it does benefit from IPO underpricing. From (δ) the bank can determine the price that is necessary to raise the demand sufficient to achieve amount of oversubscription desired. By accepting a lower price from the investment bank, the principal allows the investment bank to turn around and sell the shares at a lower price, thereby making the initial returns the public sees on a stock's opening day possible.

Part B: The Adverse Selection Model

A 1986 study by Rock gives an in-depth explanation of the investment bank's motivation for underpricing the stock. His model looks at the problem faced by the investment bank from a different perspective. Here, the transaction of focus is between the investment bank and the individual investors where adverse selection is shown to be key in determining the degree of underpricing a stock experiences.

Although the amount of information possessed by each individual investor will vary from person to person, for simplification in his model, Rock splits investors up into two groups: informed and uninformed. Informed investors are assumed to have superior information and know the intrinsic value of issuing firms. These informed investors only invest in companies that are high quality firms. On the other hand, the uninformed investors have no information about the issuing companies and invest funds randomly in all public stock offerings. The informed investors then compete with the uninformed investors only for the issues from high quality firms. This produces a crowding effect that leaves the uninformed investors obtaining shares in low quality firms with greater frequency. Now, if this were the case, then the uninformed investors

would always receive negative returns on their investments and so choose not to participate in the IPO market.

This poses a major problem for the issuing firms. If the funds that would be available from the uninformed investors are taken out of the market, the lowered demand would be insufficient to make IPOs worthwhile to companies because they would not be able to sell all of their shares if they are priced at the accurate valuation of the company. Rock proposes that to solve this problem, the issuing firms will agree to lower offering prices in order to leave some money on the table for the uninformed investors. By underpricing the offerings, they allow the uninformed investors to receive positive returns on their investments and so, induce them to participate in the IPO market. The key to this situation is that the issuer (either the issuing firm or the investment bank in this example) is under obligation to sell all of the shares in the offering. In Rock's model, all the entities know all of the above information and take this into account when participating in an IPO. Rock's hypothesis is backed up by data collected in a 1998 study by Datar and Mao which found that countries with low stock market participation have more severe underpricing than countries with high public participation in the stock ownership(Su and Fleisher 1999). Su and Fleisher later used this finding to suggest that the Chinese government encouraged IPO underpricing as a means of encouraging their citizens to buy into the IPO market.

Rock's model defines the demand for shares in an IPO in equation (1). This equation yields the total funds investors are willing to spend. The variables are defined in the table below with "good" IPOs refering to offerings with the price per share less than the true value per share ($P < V$), and "bad" IPOs refering to offerings where price per share is greater than the true value per share ($P > V$).

(1) Demand = [NT + $I] if P < V *or* [NT] if P > V, where

P = Price per share
V = True (Market) share value with cumulative distribution F(V) and mean value E(V)
$I = Funds invested by Informed investors if P < V
N = Number of uninformed investors
T = Fraction of wealth invested by uninformed investor (Wealth = 1)

If the rationing of shares is random, as assumed by Rock, then T is a determining factor in the probability of an uninformed investor obtaining shares of a "good" IPO. With a fixed number of shares available and fixed informed investor spending, the more an uninformed investor spends the higher the probability he or she will acquire shares of "bad" IPOs. The relationship is defined in equation (2) with the additional variables defined in table below:

(2) $b = \min [pz / (NT + I), 1]$

{T varies directly with the ratio b_e / b_e'}, where

Z = Number of shares in the offering
b = Probability of Uninformed Investor obtaining shares with P < V
b' = Probability of Uninformed Investor obtaining shares with P > V
b_e = Uninformed Investor perception of b
b_e' = Uninformed Investor perception of b'

While the actual probability of the uninformed investor receiving shares in a "good" IPO is dependent on the fraction of wealth invested, the fraction of wealth invested will vary directly with how strongly one believes he or she will obtain shares in a "good" IPO and therefore receive a positive return. So, pricing shares at E (V) will eliminate the uninformed investors from the market because, in that case, b < b'. With informed investors investing a fixed dollar amount in "good" IPOs, as uninformed investors increase fraction of their wealth invested (as T increases),

the crowding effect is exacerbated and their expected gain decrease as the b/b' ratio decreases. For them to participate, P must be less than E(V). In this case, the uninformed investors would experience positive returns on investments in the IPO, thus raising the value of b_e. As b_e rises, the ratio b_e / b_e' also rises. And since T has a positive relationship to this ratio, it also rises thus showing increased participation from the uninformed investor.

Another way to explain what Rock is saying here is that uninformed investors are avoiding what is known as the "winner's curse." This occurs whenever two interested parties are bidding on something they both desire. If one of the parties does not know the true value of that item and bids up the price over this true value, the informed party will drop out and the uninformed will be stuck with paying more than whatever the true value was. So, the uninformed won the bidding and the right to buy, but payed too much; hence the coined term "the winner's curse." If the uninformed participants believe that the price they end up paying will not be greater than the value of the stock and subsequently avoid the winner's curse even in a situation where they outbid the informed investors, they will choose to participate in the market.

Rock's model is subject to several criticisms which must be kept in mind when assessing this model's usefulness in explaining underpricing in the U.S. capital markets. Rock's model assumes a democratic distribution of shares which is very unrealistic. The rationing of shares by investment banks serves to worsen the uninformed investor's probability (b) of getting shares in "good" IPOs as they tend not to be the investment bank's good customers and close business partners. Also, it is unclear how subject to error his model is for its simplistic separation of investors into just two groups. While application to the actual IPO market takes some

manipulation, Rock does shed light on sources of underpricing by dissecting the informational asymmetries that exist in the market.

Part C: Signaling Theory

Aside from lowering the offering price of an issue, the only other way to insure oversubscription is to raise the demand for the offering. This is done through a series of signaling mechanisms that are used by both the issuing firm and the investment bank acting in conjunction to stimulate demand from investors. In previous studies, various intrinsic characteristics of the investment bank and the issuing firm were found to have a great impact on the first day returns of IPOs (Author 1999). Taking advantage of the asymmetries that exist in the market, the sellers a of stock attempt to signal their value to investors by portraying their company as having positive characteristics in order to boost demand for their shares. This added demand from signaling effects serves to raise the stock price beyond the original valuation of the company, thus resulting in underpricing.

The motivation for the issuing firm to ensure underpricing has several different aspects. First, the issuing firm wants all of its shares to be sold, and all the investors that bought the shares to experience positive returns. These positive returns will build confidence among investors and therefore make it easier for the company to return to the capital markets to make a second, seasoned offering. This intentional underpricing is known as "grandstanding" a stock offering and works to attract considerable attention and prestige to the issuing firm. Issuing firms essentially prove to investors that their stock will perform well by displaying large initial gains.

The second motivation comes when companies make IPOs, but then continue to closely hold the shares among firm insiders. Because issuing stock dilutes ownership, firms whose

original owners desire to retain control of the company use the share allocation that oversubscription allows to place shares with hand picked investors. In this process, insiders can also ensure that no single entity acquires a large portion of the shares during the IPO but, instead, the shares are dispersed in smaller allotments. By doing this, the original owners can decrease the chances of an investor taking advantage of the low IPO price and buying a large enough number of shares to actually take control of the voting majority in the company.

Signaling models of IPOs start from the assumption that the issuing firm has superior information. This model is favored among financial theorists because of this realistic assumption and its implications. One would normally assume that the insiders in a company know more about the actual value of that company than do any outsiders, including the investment bank and auditors. Because of this, insiders can manipulate how the public perceives them. In 1989, several signaling models proposed by Allen and Faulhaber, Grinblatt and Hwang, and Welch found IPO underpricing to be an equilibrium outcome when issuing firms have better information than the potential investors.(Su and Fleisher 175)

In the case of original ownership, if when making an IPO, the company insiders choose to retain a large portion of the shares, the only logical conclusion would be that they expect the shares to go up in value. Leland and Pyle applied this particular signaling theory to financial markets in their 1977 study. They concluded that since the firm owners are presumably risk averse and their ownership interest in the issuing firm represents a large and undiversified risk, then retaining shares in a low value firm is much more costly than retaining shares in a high value firm (Eisenbeis and McEnally 1995). If insiders thought that the IPO price overvalued the shares,

then they would choose to sell the shares at the time of the IPO in order to obtain this value before the market adjusted the price downward to meet the actual value of the company.

Knowing that investors use this reasoning, it is easy to see how the original owners of a company could retain shares of the company in the IPO for the sole purpose of signaling their confidence in the stock to outside investors, subsequently raising demand for the offering. An excerpt from the Su and Fleisher study of Chinese underpricing states:

> *As long as the revelation probability for the issuers' quality is neither too large nor too small, there exists a separating equilibrium where high-value issuers signal their quality by retaining a portion of shares and underpricing initial offerings, and low-value issuers sell all of their shares and do not underprice.* (Su and Fleisher 175)

In a recent study of 142 IPOs throughout the 1990's, ownership retention was found to be significant to the .08 level as an explanatory variable in a regression with percent first day IPO gains as the dependant variable (Author 1999).

The next demand component that can affect an issuing firm's stock price is the reputation of the investment bank that underwrites the stock offering. The theories surrounding this variable are conflicting because two, separate and counteracting effects emerge as the investment bank's reputation improves. The effect that bank reputation has on underpricing will depend on which effect is most powerful in the market at the time of the offering.

In a 1998 study by Carter, Dark and Singh, the affects of Underwriter reputations on both initial returns and long run performance was examined. Building on several previous studies, they used three different measurements of reputation and found that, "each of the reputation proxies is significantly related to IPO initial returns; the better the reputation of the underwriter, the less is the short-run underpricing"(Carter, Dark, Singh 1998). The study assumes what potential

investors will use historical data available about the investment bank to judge its credibility. Therefore, in order to protect its ability to float stock issues in the future, the bank will refuse to underwrite low value companies and will raise its standards as its reputation improves. As given by previous theories, high value firm's require far less underpricing than low value firms, so an investor can subsequently expect less underpricing from stock sold by an investment bank of high value.

The second effects counters with backlash from the first effect. A 1999 study of IPOs found that as investment bank reputation, proxied by market capitalization, increases, so does the degree of underpricing observed on the first day of trading (Author 1999). Accounting for this effect is the theory that a more reputable investment bank will inspire investor confidence and thus boost demand for the stock. Because investors assume the investment bank is risk averse and desires to protect its reputation, they would also assume that the bank would be careful not to underwrite a low valued company, or a company with a per share value lower than the IPO offering price. Low valued companies would then actively attempt to recruit the services of the most prestigious investment bank possible to add credibility to their offering making their company seem like a high valued firm.

Investors can minimize their downside risk by buying from a larger investment bank. If the stock offering turns out to be severely overpriced and there is found to be some fault on the part of the investment bank , i.e. audit misconduct, the investment bank and the issuing firm could be the target of securities litigation where angry investors seek to redeem the funds they lost on the overpriced stock. In this case, an investor would perceive his or her chances of receiving restitution as being much higher with a larger investment bank. So, even if the issuing firm is a

risky investment, an investor might put money into it anyway believing that the large investment bank (a proxy for reputation) is a safeguard against losing the investment.

The differing effects of the two theories on IPO underpricing trap the issue in a circular reasoning pattern that has no clear outcome. The actual effect that the underwriter's reputation will have on a particular stock depends on each effects' respective strength, which will be determined mostly by which effect investor's believe will dominate the opinions of other potential investors.

Game Theory Integration

As previously discussed, when taking a corporation public, the firm has several options available for the contract with the investment bank stipulating the terms of compensation. If the investment bank is assumed to have superior information, the market information they possess would allow for the calculation of their compensation for each contract type and the minimum required compensation given by the revelation principle(Baron). Baron's description of the IPO underpricing as result of the principal-agent problem that exists between the issuing firm and the investment bank is an extension of a more general theory of how strategic interaction between two entities determines a certain equilibrium outcome in the presence of moral hazard.

With the help of a principal-agent model laid out by Prajit Dutta, the moral hazard that results from the relationship described by Baron's model can be visually depicted. The progression begins with the issuing firm choosing a compensation contract defining the method and amount of compensation, after which the investment bank chooses an effort level based on that contract. Each effort level produces a different outcome in a given set of market conditions with higher levels of effort corresponding to higher expected revenue. The investment bank

knows the probability distribution of the market conditions and the expected revenue from each effort level and market condition combination. Dutta divides the resulting revenue outcomes into three categories: good(G), medium(M), and bad(B), which represent varying total dollar amounts produced by the IPO (Dutta 1995). Baron's market conditions variable (δ) can be linked to each possible outcome to yield the expected revenue value based on each effort level and set of market conditions $[(\delta_G),(\delta_M),(\delta_B)]$. This variable ($\delta$) gives the probability of each out come (G, M, or B) occurring.

Also known by the investment bank is the disutility (d) they will receive for the effort exerted in floating the issue and its marginal utility (U) function of the portion of the revenue it keeps as compensation. Effort is separated into two categories: high and low with disutilties (d_H) and (d_L). The situation can be diagramed (see figure 1) using a combination of Baron's and Dutta's models.

The wages paid to the investment bank (agent) are specified by the following equations:

(3) $W = [\, G\,(\delta_G)\,]\,(S) + F$

$W = [M\,(\delta_M)]\,(S) + F$

$W = [B\,(\delta_B\,)]\,(S) + F$

S = % Payment to Agent

F = Set fee agreed to by principal and agent

W = Wages paid to investment bank (agent)

Given special assumptions: $G > M > B$

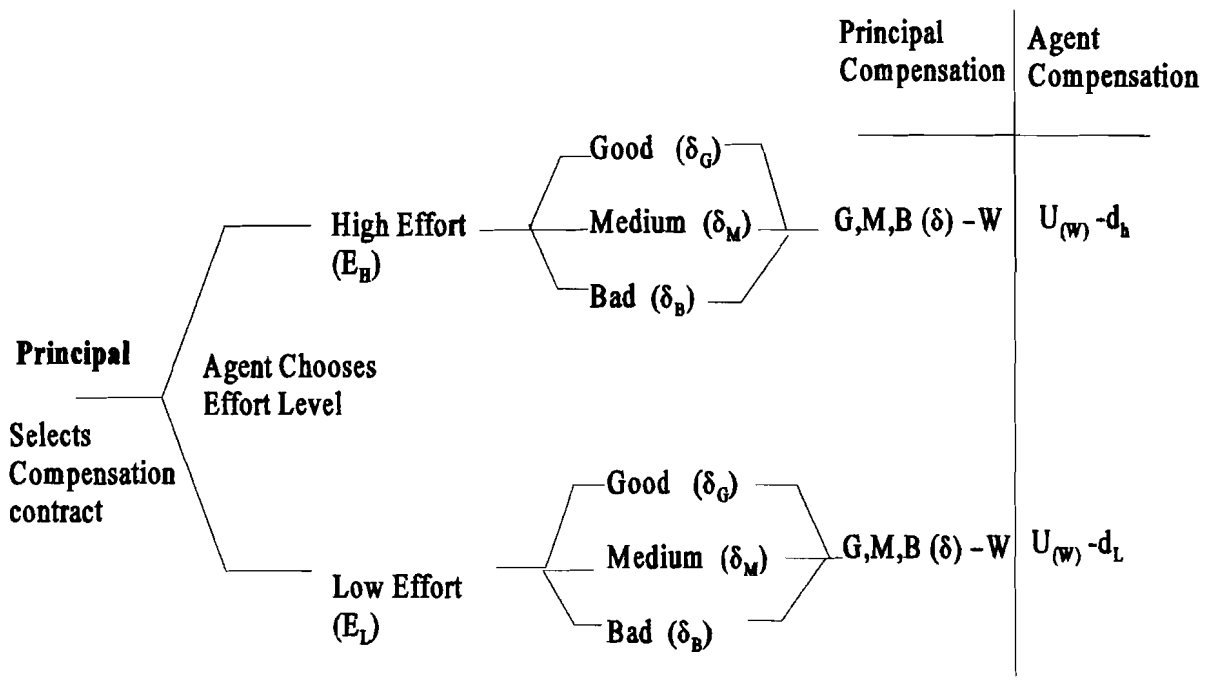
$d_H > d_L$.

There are infinitely many selectable effort levels, many of which have overlapping probability distributions. This makes the resulting outcome sufficiently vague to the principal so that the

principal cannot tell by the outcome which effort level the agent selected (Dutta).

Baron outlined the revelation principle in his explanation of the principal-agent problem as something the issuing firm considers when deciding how much to compensate the investment bank. The same reasoning is employed when the investment bank determines the minimum compensation (W) it will accept to sell a company's stock at a given effort level. The value for (W) can either be a portion of the revenue raised (as depicted in figure 1) or a set fee, but in either case must be above some minimum value in order for the agent to work for the principal. Dutta posits (S) as a necessary element for the agent to select anything other than the lowest effort level as would be the case in a "pure wage scheme" where W = F. In a franchise scheme, the agent uses the expected values given by the diagram to assess which effort level to chose as well as whether or not to take on a project.

(Figure 1)



As in many theories of underpricing, including all those mentioned in this paper, trust and uncertainty are the key factors leading to underpricing in this model. The principal cannot directly observe the actions of the agent. So, to ensure that the agent acts in the best interest of the principal, the principal must offer some incentive to the agent. In the case of a franchise scheme, the issuing firm accepts a defined amount for its shares and then the investment bank turns around and sells the shares, bearing all the risk. The way that the principal increases the percent of the total revenue kept by the investment bank as part of its wages is to agree to an underpriced contract. By increasing the marginal benefit gained to the investment bank for each share sold, the principal can influence which effort level is selected by the agent by altering the pricing in the contract they enter into. So, through this underpricing, the issuing firm lowers its cost of information by ensuring a high effort level without incurring the expenses that would be necessary in order to directly observe the agent's actions.

Model Summary and Conclusions

Underpricing occurs at several different points in the process of bringing an initial public offering to market. To reiterate each model and its respective position in the total IPO picture can offer insight into how the models work together to allow the large initial gains from an IPO.

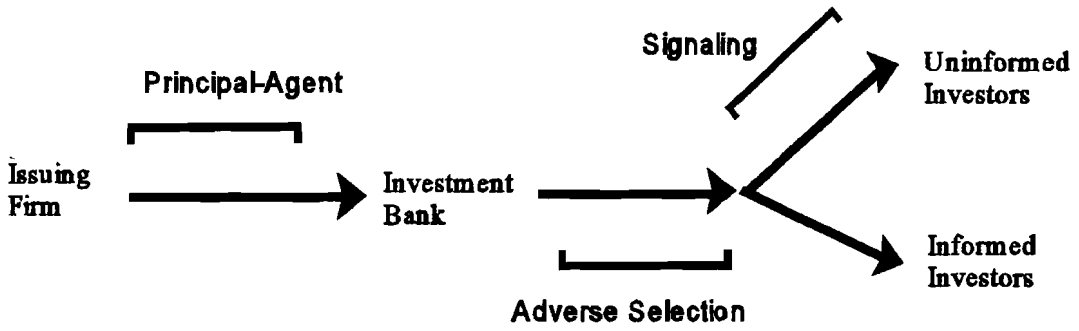
The first instance of underpricing comes from Baron's model where the issuing firm and the investment bank must overcome the adverse effects of the principal-agent problem. Here the underpricing stems from the supplier of the shares and is used as a tool to entice the agent to cooperate with the principal's agenda by truthfully disclosing their knowledge of the market conditions and putting forth sufficient effort to market the offering of shares.

The second instance of underpricing is outlined in the Adverse Selection Model given by Rock's 1986 findings. Here, the shares are again intentionally underpriced by the supplier of shares (either the issuing firm or the investment bank in this case) in order to improve the market conditions and thus the quantity of shares demanded. This is accomplished by lowering the price of shares sufficiently to allow uninformed investors, who invest randomly in all IPOs, to experience positive returns on their investments. They then choose to keep their money in the market for IPOs and raise the total demand for all IPO shares.

The third instance of IPO underpricing occurs by a series of signaling mechanisms within the context of the Adverse Selection Model. This observed underpricing does not occur by means of an entity intentionally underpricing a company's shares, but rather as a result of added demand for the shares from the investors. The added demand is encouraged by several methods used by a firm to signal its value to the uninformed (or under informed) investors. The signaling effects found to be significant in the a previous study were insider share retention and investment bank reputation(a proxy for reputation)(Author 1999).

These three interactions take place in the order presented by the following diagram (figure 2) and work together to produce the initial gains observed in the first day of trading for IPO shares. Following the chronology depicted here, the underpricing observed by means of the principal-agent model is necessary in order for the underpricing of the adverse selection model to be implemented. After which, the signaling effects raise the market price above the actual valuation of the shares.

(Figure 2)



In conclusion, the empirical evidence of underpricing in initial public offerings can be traced to the informational asymmetries that exist between the issuing firm, the investment bank, and the individual investors. In the strategic relationships that are engaged in between these entities, IPO shares are either discounted as a means of providing incentives to overcome asymmetrical information, or increased in value as investors pay a premium for shares signaled to be of high value. The underlying uncertainty in the valuation of an issuing firm is the reason that underpricing exists.

Future Research

There are many possibilities within the scope IPO underpricing to further present research. In the context of this paper, there exists questions about how the adverse-selection model works to allow uninformed investors into the IPO market. One of the problems with Rock's work is that it does not specify why the uninformed investors begin investing in the market. The dilemma is whether these investors continue to invest in IPOs because they experience positive returns, or whether they invest in IPOs simply because they believe that the new stock issues will be

underpriced. If the latter is true, how do they learn this information if not from IPO historical information. Also unclear is to what extent share rationing exacerbates the underpricing. Rock assumes that shares are given out by lottery, which is a very unrealistic assumption, especially in the United States and other countries where rationing is perfectly legal in the cases of oversubscribed offerings.

Signaling theories are abundant and empirical models which attempt to explain IPO underpricing through signaling have had limited success. Although insider share retention and investment bank reputation are among the more significant variables in many regressions, there are a host of other possible explanations. More variables with better proxies will continue to improve results as they become available. This is particularly true for characteristics of the investment bank including reputation, past performance, size, and preferred industry.

The informational asymmetries that exist and allow each of these underpricing mechanisms to thrive are quickly being addressed and eradicated in today's rapidly strengthening information infrastructure. The internet now allows instantaneous access to dynamic market information previously unavailable to all but those closest to the capital markets. In addition, many firms are experimenting with using the internet to market and sell shares of an IPO directly to the public, bypassing the investment bank altogether and overcoming the staggering marketing costs that once accompanied the initial sale of stock. As firms embrace this new technology, the face of the investment world is changing. To what extent this transformation will affect the traditional market for IPOs is unclear and research in this area will unquestionably play an integral role in the study of IPO activity in the future.

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