Local Underwriter Oligopolies and IPO Underpricing

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Abstract

Even though a large number of investment banks compete for initial public offerings (IPOs), we posit that the real competition takes place in a series of local oligopolies based on industry specialization. We develop a model of IPO underpricing in which issuing firms face local oligopolists with market power because the issuers care about the non-price dimensions of IPO underwriting. We test our model implications using two non-price dimensions: all-star analyst coverage and underwriter prestige. Our empirical analysis documents that underpricing is higher during periods when all-star analyst coverage is more important. We posit that venture capitalists are especially focused on all-star analyst coverage, and develop the analyst lust theory of the underpricing of VC-backed IPOs. Consistent with this theory, we find that VC-backed IPOs are more underpriced when the lead underwriter provides all-star analyst coverage.

Keywords: IPOs, Underwriters, Oligopoly, Underpricing, Venture Capital, Analysts

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1. Introduction

The average initial public offering (IPO) in the U.S. during 1993-2007 had a first-day return of 24%, despite the large number of underwriters competing for deals. The co-existence of many underwriters and high underpricing raises many questions. For instance, from the supply side, when underwriters have many peers to compete with, can they still win business while leaving large amounts of money on the table?[1] From the demand side, since issuers have many IPO underwriters to choose from, why do they hire underwriters that result in such large foregone proceeds?

The IPO underwriting market is characterized by many competing underwriters and no obvious large barriers to entry, typifying a perfectly competitive market. However, perfect competition is inconsistent with the high underpricing observed, which suggests that this structure does not correctly describe the IPO underwriting market. Instead, we posit that even though a large number of investment banks compete for IPOs, the real competition takes place in a series of local oligopolies based on industry specialization.

Most theoretical models of IPO underpricing focus on two types of interactions, either between the underwriter and investors or between the underwriter and the issuer. The first kind of interaction is exemplified in Rock (1986), Benveniste and Spindt (1989), and Welch (1992), in which the underwriter needs to underprice shares in order to induce investors to participate in IPOs. An implicit assumption in these models is that the underwriters act in the best interest of issuing firms to maximize IPO proceeds.

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[1] Money on the table is defined as the number of shares issued multiplied by the difference between the first closing market price and the offer price. It is the dollar value of underpricing.

Another set of articles (Baron (1982), Loughran and Ritter (2002, 2004) and Ljungqvist and Wilhelm (2003)) focuses on the interaction between the underwriter and the issuer. These articles drop the assumption that underwriters are acting in the best interest of issuing firms, but instead are underpricing IPOs more than is needed, at least some of the time. Many of these articles focus on cross-sectional differences in the desire of issuers to minimize underpricing.

All of the above mentioned articles share the feature that there is no interaction between underwriters. In other words, there is no model of the supply of underwriting services.

In this paper, we develop a new theory of IPO underpricing that takes into consideration the competitive nature of the IPO underwriting market and the key features of underwriters and issuers. We follow recent papers in assuming that underwriters want to underprice IPOs more than is needed. Unlike other articles, we model the supply side of the IPO underwriting market as composed of a large number of competitive underwriters and a set of local oligopolies based on industry specialization. For the demand side, we propose a more general form of the issuer's objective function posited in Loughran and Ritter (2004), which states that issuers care not only about IPO proceeds, but also about non-price dimensions such as coverage from influential analysts.

In our model, the IPO underwriting industry is characterized by a series of local oligopolies due to the desire of issuing firms for research coverage by influential analysts, with this analyst coverage bundled with underwriting. The equilibrium of the non-cooperative repeated game has several cross-sectional and time-series implications. The model predicts that the existence of oligopolistic underwriters exercising their market power results in greater underpricing for issuers that care about the non-price dimensions of IPO underwriting, and thus are less focused on maximizing IPO proceeds. Furthermore, a time-series prediction of the model

is that there should be higher underpricing during periods when the non-price dimensions are more important.

Our model also generates a new theory of the underpricing of venture capital-backed IPOs: the analyst lust theory. We posit that venture capitalists (VCs) are rationally focused on the market price on the day when shares in the company are distributed to limited partners, which is typically six months after the IPO. We assume that this market price is boosted by coverage from influential analysts. Because of their concern with this price, VCs have a greater lust for all-star analyst coverage, resulting in greater underpricing for VC-backed IPOs with all-star analyst coverage that is bundled with IPO underwriting.

In our empirical analysis, we test our model predictions for two non-price dimensions: all-star analyst coverage and underwriter prestige. Specifically, we find that issuers using a bookrunner that bundles underwriting with influential analyst coverage are subject to 11% more underpricing, and issuers with a prestigious lead underwriter are underpriced by about 5% more during 1993-2007.[2] Using average analyst compensation as a proxy for the importance of analyst coverage, we find that the incremental underpricing associated with all-star analyst coverage is higher during periods when all-star analyst coverage is more important. Using venture capital-backing as a proxy for a greater willingness to pay for coverage from an influential analyst, we find that VC-backed issuers with all-star coverage are 22% more underpriced than issuers without all-star coverage, holding other things constant.

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[2]All bookrunners are lead underwriters, but not all lead underwriters are bookrunners. The bookrunner (or bookrunners) is in charge of allocating shares, especially to institutional investors, although some of this activity may be delegated to the other underwriters in a syndicate. We use the term (lead) underwriter and bookrunner interchangeably in much of the paper.

2. The Model

2.1 Model Development

2.1.1. Underwriters

We follow recent papers and drop the assumption that underwriters' interests are aligned with the issuers, suggesting that they may want to underprice IPOs more than is needed. Underwriters can benefit from underpricing IPOs in several ways. Underwriters can allocate these underpriced shares to investors in exchange for soft dollar commission business (Loughran and Ritter (2002, 2004), Reuter (2006), and Nimalendran, Ritter, and Zhang (2007)), or to executives to sway their decision in choosing which investment banking firm to hire, a practice known as spinning (Liu and Ritter (2009)). Through these channels, underwriters can share the money left on the table by the issue.[3]

Offsetting the benefits, a cost to underwriters of excessive underpricing is lower gross spread revenue, which is typically seven cents for every dollar decrease in the offer price. Since we do not have the detailed information needed to measure the benefits of underpricing, we assume that the benefit to underwriters of underpricing IPOs outweighs its cost, conditional on underwriting a deal. Although an underwriter would like to underprice IPOs, if issuers want to avoid excessive underpricing, an underwriter will win fewer IPO mandates if it underprices too much. From an underwriter's point of view, the profit-maximizing level of underpricing depends on the elasticity of demand for its services with respect to underpricing, which in turn depends upon the competitive environment that it faces.

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[3] A crude estimate for the underwriter's share of the money left on the table is around 30% to 40% based upon conversations with senior investment banking executives, although this number may vary for different underwriters. Corroborating evidence can be found from regression analysis using quarterly commission revenue and money left on the table figures for IPOs underwritten by Robertson Stephens.

2.1.2. Issuers

When choosing an IPO underwriter, issuers care about many dimensions of the underwriting service, which can be categorized into price and non-price dimensions.[4] The issuer's objective function can be expressed as:

$$\alpha_1 \cdot Net\ IPO\ Proceeds\ + \sum_{i=1}^{n} \beta_i X_i, \tag{1}$$

where the $Net\ IPO\ Proceeds$ (number of shares offered times the net proceeds per share) represents the price dimension, the weights α_1 and the β_is satisfy the condition that $\alpha_1 + \sum_{i=1}^{n} \beta_i = 1$, and the X_is are the issuer's perceived value of the n non-price dimensions such as underwriter quality, industry expertise, aftermarket price support, and analyst research coverage.

A special case of equation (1) is analyzed by Loughran and Ritter (2004), where the issuer's objective function has three components:

$$\alpha_1 \cdot Net\ IPO\ Proceeds + \alpha_2 \cdot Proceeds\ from\ Future\ Sales + \alpha_3 \cdot Side\ Payments, \tag{2}$$

where $\alpha_1 + \alpha_2 + \alpha_3 = 1$. They assume that the proceeds from future sales are boosted by bullish coverage from influential analysts. Loughran and Ritter posit that there will be more underpricing when issuers place a positive weight on α_2 (the analyst lust hypothesis) or α_3 (the spinning hypothesis). The analyst lust hypothesis is tested and confirmed by Cliff and Denis (2004) and the spinning hypothesis is tested and confirmed by Liu and Ritter (2009).

Most of the IPO literature has implicitly or explicitly assumed that the first term in equations (1) and (2) is the only term that enters the objective function of issuers, suggesting that

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[4] The focus on price versus non-price dimensions has also been used to explain changes in the gross spreads on junk bonds. Livingston and Williams (2007) document that the gross spreads on junk bond offers were higher when Drexel Burnham Lambert was underwriting junk bonds in the 1980s than afterwards. They posit that after Drexel liquidated in 1990, the competition between underwriters became less focused on non-price dimensions bundled with underwriting and more focused on the fees, resulting in a drop in the gross spreads.

issuers seek to achieve the highest offer price possible. If issuers care about the non-price dimensions of IPO underwriting, however, then they are willing to use underpricing (i.e. agree to a lower offer price) to pay for these other dimensions.

2.1.3. All-Star Analysts

The empirical evidence on the market's reaction to coverage decisions suggests that it is rational for firms to value analyst coverage. The impact of analyst coverage on firm value can be estimated from the announcement effects of analyst initiation, stoppage, and resumption decisions. Bradley, Jordan, and Ritter (2008) report a 3% announcement abnormal return for firms with unanticipated analyst coverage initiations in the year after the IPO (exclusive of anticipated initiations at the end of the quiet period). Kelly and Ljungqvist (2007) show that firm value declines when a research analyst terminates coverage. When analysts resume the coverage of "neglected" stocks, Demiroglu and Ryngaert (2009) find that these stocks experience a 4.8% announcement abnormal return.

While the evidence suggests that analysts are valuable, some analysts are more influential than others. The most well-known analyst ranking is done by *Institutional Investor* magazine, which polls buy-side institutional investors every year to rank sell-side analysts. In October, the magazine publishes its All-America research team, which names the top three analysts and a few runner-ups in each industry, where the top three analysts are designated as all-stars. Fang and Yasuda (2009) report that recommendations from all-star analysts have larger announcement effects than those made by other analysts. Consequently, we use the *Institutional Investor* all-star designation as our measure of which analysts are most sought-after by issuing firms.

2.1.4. Local Oligopolies

Of the non-price dimensions, an underwriter's industry expertise is particularly

important. In a survey of 336 chief financial officers (CFOs) who attempted to take their

companies public in 2000-2002, Brau and Fawcett (2006, Table IV) report that the top three

criteria that issuers use in selecting a lead IPO underwriter are, based on an importance scale of 1

(low) to 5 (high), the underwriter's overall reputation and status (4.39/5), the quality and

reputation of the research department/analyst (4.25/5), and the underwriter's industry expertise

and connections (4.24/5). Whether an underwriter specializes in an industry partly depends on

the expertise of its research analyst in that industry. By choosing the underwriter, the issuer can

receive coverage from the underwriter's analyst who specializes in that industry, which is

bundled with underwriting.[5] As long as issuing firms value this non-price dimension, despite the

large number of investment banks competing for IPOs, the IPO underwriting market is best

characterized as a series of local oligopolies based on industry specialization. In general, since an

underwriter's expertise in a given industry is related to the influence of its analyst who covers

that industry, we frame our analysis in terms of analyst coverage.

A number of papers model an imperfectly competitive underwriting market in an attempt

to explain IPO underpricing (Fu and Li (2007)) or the clustering of gross spreads (Gordon

(2003), Chen (2008), and Lowery (2008)). All of these models use a game theoretic framework

and rely on assumptions such as capacity constraints and barriers to entry in the IPO

underwriting industry to produce an equilibrium with tacit collusion among underwriters. Our

model differs from these other models in that we assume only a subset of underwriters has some

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[5] Bradley, Jordan, and Ritter (2008, pp. 109-110) report that 98% of lead underwriters initiated coverage within one year of the IPO for their sample IPOs in 1999-2000.

market power in each industry, and that only a subset of issuers is willing to pay for the differentiated product offered by these underwriters.

2.2   The Basic Model

For our basic model, we focus on one of the non-price dimensions, coverage from an influential research analyst, which is also used to proxy for underwriter industry expertise. Although there are many possible lead underwriters of IPOs, if issuing firms have a preference for coverage from an influential research analyst, and if analyst coverage is bundled with underwriting, then the small number of underwriters with the most influential analysts in a given industry will have some market power. In other words, even though the investment banking industry might be very competitive, if issuing firms have a preference for an underwriter with an influential analyst covering their industry, the underwriting industry will consist of a series of local oligopolies. We model one of the local oligopolies in an infinitely repeated non-cooperative game of issuers buying underwriting services.

The model starts with a single period, where a period denotes the length of time between IPOs in that industry. Suppose that there are N underwriters in the market and a unit mass of issuers. Issuers differ in their preference parameter θ, the perceived importance of having an all-star analyst, where θ is distributed uniformly on the $[0, 1]$ interval. θ is closely associated with the weight β_i that corresponds to coverage from an influential analyst in equation (1) or the weight α_2 on future proceeds in equation (2). The value of θ for each issuer is not observed by the underwriters, but the distribution of θ is public knowledge. Each issuer wants to buy one unit of underwriting service from a single underwriter. Of the N underwriters, three of them have an all-star analyst. The perceived value of being covered by an all-star analyst is given by A, which, for simplicity, we assume is constant across issuers.

An issuer's net surplus from going public at underpricing level u is

$$M(1 - u) + \theta A, \tag{3}$$

where M is the market value of the shares being sold net of the gross spread (which is held constant across all issues) and u is the cost of going public in terms of the underpricing level.[6] For ease of modeling, we measure the underpricing level u as the underpricing relative to the market price, u = (market price – offer price)/market price, instead of relative to the offer price, which is the more conventional definition that we use in our empirical work. The first part of the net surplus, $M(1 - u)$, is the proceeds (net of the gross spread) from selling a fixed number of shares at the initial public offering. The second part of the net surplus, θA, is the value of all-star analyst coverage to the issuer, A, weighted by the issuer's preference for an all-star analyst, θ. A can be interpreted as the perceived temporary increase in the market value of the retained shares due to favorable coverage from an all-star analyst at the time when the firm or insiders subsequently sell shares. The specification of equation (3) is similar to maximizing an objective function that is a weighted average of the proceeds in periods 1 and 2, a specification that has been used in many signaling (e.g., Miller and Rock (1985) and Grinblatt and Hwang (1989)) and nonsignaling (e.g., Chemmanur (1993) and Aggarwal, Krigman, and Womack (2002)) models.

The profit to underwriter i is

$$\pi_i = M(u_i - \bar{u})D_i, \tag{4}$$

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[6] We make the assumption that all IPOs have the same size. This simplifies the model and focuses attention on the implications of different preference for all-star analyst coverage. Although more complicated models can be constructed varying size and other dimensions, the main qualitative predictions of the model should remain the same. There would, however, be a cross-sectional implication that larger deals should have less excess percentage underpricing, in order to satisfy the inequality (13) in our model.

where $\bar{u}$ is the amount of underpricing needed to compensate investors for ex-ante uncertainty of issue valuation, which for simplicity is assumed to be the same across all issues. The cost of underwriting the issue is assumed to be covered in the gross spread, which is taken as exogenous here.[7] D_i is the demand for underwriter i's service. The underpricing charged is not a direct cost in that the money left on the table (uM) does not go into the underwriter's pocket directly. Instead, underwriters indirectly profit from underpricing. Here, without loss of generality, we assume that 100% of the incremental underpricing $M(u_i - \bar{u})$ flows back to the underwriters through indirect channels, such as collecting soft dollars from rent-seeking investors.

If $N - 3$ is large, then underwriters without an all-star analyst will not be able to charge $u > \bar{u}$ because they behave in a market that is akin to a perfectly competitive market with a large number of underwriters and homogeneous services. Therefore, they will set $u = \bar{u}$. Notice that if none of the underwriters that are willing to do a deal has an all-star analyst, the entire underwriting market behaves like a perfectly competitive market.

The aggregate demand for these $N - 3$ underwriters can be calculated by finding an issuer with parameter $\hat{\theta} \in [0, 1]$ that is indifferent between choosing an underwriter with or without an all-star analyst, which occurs when

$$M\left(1 - \min_j u_j\right) + \hat{\theta}A = M(1 - \bar{u}) + \hat{\theta}0, \qquad \text{j=1, 2, 3} \qquad (5)$$

where $\min_j u_j$ indicates the least underpricing associated with any of the three underwriters with market power. Rearranging equation (5) yields

$$\hat{\theta} = \frac{M(\min_j u_j - \bar{u})}{A}. \qquad (6)$$

Consequently, issuers with $\theta < \frac{M(\min_j u_j - \bar{u})}{A}$ will choose an underwriter without an all-star analyst and issuers with $\theta > \frac{M(\min_j u_j - \bar{u})}{A}$ will choose one of the three underwriters with an all-star analyst.

Now we consider the level of underpricing that the three underwriters with an all-star analyst will charge. Suppose they follow symmetric strategies and charge the same price $\dot{u}$, so the aggregate demand for their service from a unit mass of issuers is

$$\dot{D} = 1 - \hat{\theta} = 1 - \frac{M(\min_j u_j - \bar{u})}{A} = 1 - \frac{M(\dot{u} - \bar{u})}{A}. \tag{7}$$

The underpricing level $\dot{u}$ that maximizes $\dot{\pi} = M(\dot{u} - \bar{u})\,\dot{D}$, the aggregate profit of the three underwriters that have an all-star analyst in the given industry, occurs when

$$\frac{\partial \pi}{\partial \dot{u}} = M\dot{D} + M(\dot{u} - \bar{u})\frac{\partial \dot{D}}{\partial \dot{u}} = 0. \tag{8}$$

Differentiating equation (7) with respect to $\dot{u}$ and substituting both this expression for $\frac{\partial \dot{D}}{\partial \dot{u}}$ and equation (7) for $\dot{D}$ into (8) gives

$$1 - \frac{M(\dot{u} - \bar{u})}{A} - (\dot{u} - \bar{u})\frac{M}{A} = 0. \tag{9}$$

Solving for $\dot{u}$ in equation (9) yields

$$\dot{u} = \bar{u} + \frac{A}{2M}. \tag{10}$$

In words, the excess underpricing $(\dot{u} - \bar{u})$ that underwriters are able to implement is higher the more that all-star coverage boosts the market value of the shares to be sold in the future (A) and the less is the market value of the shares issued (M). Both of these effects intuitively follow from the issuers' decision to sacrifice IPO proceeds in order to boost the proceeds from future sales, whether in the form of a follow-on offering or open market sales by insiders.

The aggregate demand for underwriters offering all-star coverage from the unit mass of issuers is then $\dot{D} = 1 - \frac{M(\dot{u}-\bar{u})}{A} = \frac{1}{2}$. Thus, only issuers with $\theta > \frac{1}{2}$ will choose an underwriter with an all-star analyst. For the other issuers, the desire for an all-star analyst is too small to justify the greater underpricing that would be required. The aggregate profit of the three underwriters is

$$\dot{\pi} = M(\dot{u} - \bar{u}) \, D = M(\dot{u} - \bar{u})\frac{1}{2}, \tag{11}$$

since $\frac{1}{2}$ of issuers choose to hire an underwriter with an all-star analyst when the oligopolists are setting the profit-maximizing (monopoly) level of excess underpricing. Substituting equation (10) into equation (11) gives aggregate underwriter profits of

$$\dot{\pi} = M \left(\bar{u} + \frac{A}{2M} - \bar{u} \right) \frac{1}{2} = \frac{A}{4}. \tag{12}$$

Thus, each of the three underwriters earns a profit of $\frac{A}{12}$ and each has $\frac{1}{6}$ of the market.

In a single period game, each of the three underwriters has an incentive to charge a slightly lower price than $\dot{u}$ to acquire all of the aggregate profit. In an infinitely repeated game, the other underwriters can punish the deviating party by reverting to the one-shot Nash equilibrium strategy of setting $\dot{u} = \bar{u}$, forcing the profits to go to zero. Thus, if all three underwriters with market power charge $\dot{u} = \bar{u} + \frac{A}{2M}$, then all three underwriters get an expected profit of $\frac{A}{12}$ on this and every subsequent IPO in this industry. If an underwriter cheats on the other oligopolists and successfully wins the mandates of all issuers with a value of $\theta_i \geq \frac{1}{2}$, then it gets $\frac{A}{4}$ - ε in the cheating period, and a profit of zero afterwards. In order for underwriter j's payoff from not cheating to be greater than or equal to the payoff from cheating, we need to have

$$PV_j^{No\ Cheat} = \frac{A}{12}\left(1 + \frac{1}{i}\right) \geq \frac{A}{4} - \varepsilon = PV_j^{Cheat}, \tag{13}$$

That is, for the pricing strategy of charging $\dot{u} = \bar{u} + \frac{A}{2M}$ to be incentive compatible, the discount

rate i must be less than $\frac{1}{2}$ per period, where a period is defined as the length of time between

IPOs in this industry.

We thus have the standard result that the cooperative outcome can be sustained in the

infinitely repeated non-cooperative game with a trigger strategy of not deviating provided no

underwriter has ever cheated in the past when equation (13) is satisfied.[8] This equilibrium

assumes that underwriters have the belief that if any underwriter cheats, the other underwriters

will 'punish' the underwriter by choosing the one-shot Nash equilibrium strategy of setting

$u = \bar{u}$ forever.[9]

Although we are modeling the IPO underwriting market as a repeated game, much of our

analysis is analogous to Dutta and Madhaven's (1997) model of Nasdaq bid-ask spreads as the

equilibrium of a non-cooperative dynamic game among competing market makers.[10] In the case

of a dynamic game, the value of analyst coverage A and the discount rate per period i would

vary with time. For instance, i varies since the expected length of time between IPOs in a given

industry is higher when deal volume is low than when the IPO market is booming. In general, the

dynamic game treatment would replace the $1/i$ perpetuity formula in equation (13) with the

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[8] As with all similar trigger strategies, the trigger strategy described is not renegotiation proof.

[9] Although each of the three underwriters has an incentive to undercut the other two in the model, in reality, they have less incentive to do so. For instance, since lead underwriters share allocation responsibility and profits with members of the chosen underwriting syndicate, they could punish deviating underwriters by banning them from their syndicates in the future. The threat of being excluded from future syndicates increases the cost of deviating for underwriters, making it easier to sustain the oligopolistic equilibrium. Furthermore, the cheating underwriter's all-star analyst may not have the capacity to cover all IPOs won by the underwriter.

[10] In their model, payment for order flow limits the ability of a market maker to gain market share by reducing its bid-ask spread, lowering the incentive to do so.

present value of the expected profits, where the present value factor would depend upon time-varying parameters.

Thus far, we have been discussing equation (13) as if an underwriter with an all-star analyst will continue to have an all-star analyst forever. If there is less than perfect autocorrelation, the discount rate i is equal to the relevant discount rate plus the per-period probability of not having an all-star analyst (i.e., i is the sum of the required return plus the decay rate). The discount rate i is smaller the more frequent are deals in a given industry and the greater is the autocorrelation (persistence) of all-star status for a given underwriter's analyst. This analysis suggests that it is easier for underwriters to charge higher underpricing when the frequency of deals and the persistence of all-star status are high. If the inequality in equation (13) is not satisfied because analyst turnover is high or deals in the industry are infrequent, then the competitive equilibrium will have the excess underpricing $(\dot{u} - \bar{u})$ determined by whether Cournot, Bertrand, or Von Stackelberg conjectures are assumed, which would be lower than the "first-best" excess underpricing of $\frac{A}{2M}$.

In our analysis, if the incentive compatibility condition, equation (13), is satisfied, the three underwriters with all-star analysts in an industry form a local oligopoly and earn oligopoly profits. This is possible because some issuers view having an all-star analyst as an important part of their objective function, and analyst coverage is bundled with underwriting. Because of this feature, the underwriting market changes from a perfectly competitive market to a market composed of a perfectly competitive submarket and local oligopolies of underwriters with an all-star analyst in specific industries.

From the basic model, we derive the following three implications:

Implication 1: Issuers that choose an underwriter with an all-star analyst are more underpriced than issuers that choose an underwriter without an all-star analyst.

This implication follows from the model where the underwriter with an all-star analyst charges $\dot{u} = \bar{u} + \frac{A}{2M}$ and the underwriter without an all-star analyst charges $u = \bar{u}$.

Implication 2: Underwriters with an all-star analyst have a larger market share in that industry than underwriters without an all-star analyst.

In the model, the market share for all underwriters if none of them have an all-star analyst is $1/N$, and N is large. When three of the underwriters have an all-star analyst, each of them has demand of $1/6$ of the market for IPOs in that industry, which is greater than if they do not have an all-star analyst. For each of the other $N - 3$ underwriters, their market share is $\frac{1}{2(N-3)}$ of the IPOs in that industry, with aggregate demand of $1/2$ for these $N - 3$ underwriters.

Implications 3a and 3b: Excess underpricing is lower when a) all-star analyst turnover is high, or b) the frequency of deals in the industry is low, providing there is persistence of turnover and deal frequency.

In order for the inequality in equation (13) to be satisfied, the discount rate i must be less than $\frac{1}{2}$ per period. In a dynamic setting, since i increases with increasing analyst turnover and decreasing IPO frequency, in periods where analyst turnover is high or deals in the industry are infrequent, underpricing is determined by the competitive equilibrium, which results in less underpricing than in the "first-best" equilibrium.

2.3   Time Varying Value of Analyst Coverage

How does an underwriter's rent from having an all-star analyst, in terms of the level of underpricing, change as the model parameters change? For the basic model, the aggregate

demand function for all-star analyst coverage can be written as $(1 - \theta) = 1 - \frac{M}{A}(u - \bar{u})$ and the

aggregate supply function can be written as $(1 - \theta) = \frac{M}{A}(u - \bar{u})$, where $1 - \theta$ is the quantity of

issuers buying all-star coverage. We can plot the supply and demand functions below in Figure

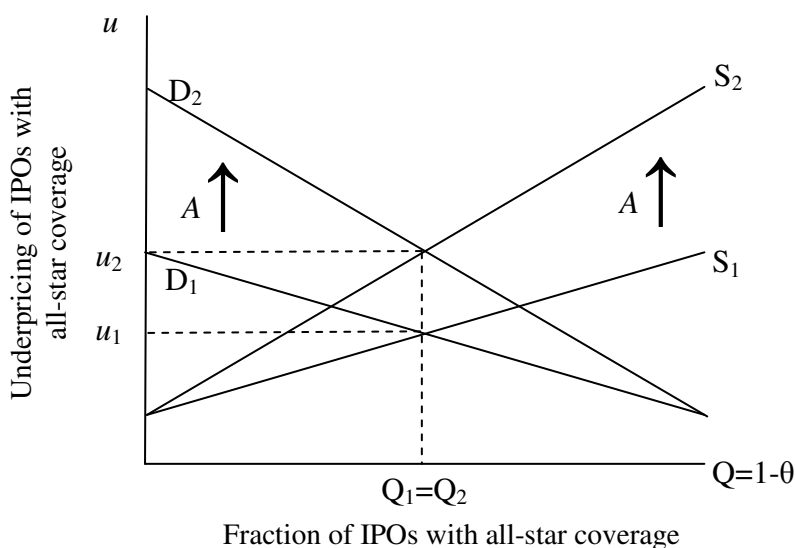1. Note that supply equals demand at $\theta = 1/2$.

Figure 1

The intersection of D_1 and S_1 is the equilibrium underpricing u_1 charged by underwriters

with an all-star analyst. When the perceived value of all-star analyst coverage, A, increases, D_1

increases to D_2 and S_1 increases to S_2, which intersect at a higher underpricing level u_2. The

supply curve shifts in response to the increase in demand because the underwriters are

oligopolists – they know that they can underprice more for any given fraction of issuers buying

all-star coverage. Due to this response by the oligopolistic underwriters, if the desirability of all-

star coverage increases because of, for instance, an increase in A, the increased demand does not

result in more issuers hiring an underwriter with an all-star analyst. Instead, we have:

Implication 4: As the value of all-star analyst coverage increases, the underpricing charged for having an all-star analyst increases.

The underpricing difference between underwriters with and without an all-star analyst in the issuer's industry is $\frac{A}{2M}$. As A increases, the difference increases as illustrated in Figure 1.

2.4 Perfectly Observed Willingness to Pay

In the basic model, we assume that the distribution of θ is known, but an individual issuer's willingness to pay for all-star analyst coverage, θ_i, is unobserved. Here we consider the case when the values of θ_i are perfectly observable by the underwriters.

The $N - 3$ underwriters without an all-star analyst still charge underpricing of $\bar{u}$ as in the basic model. For the three underwriters with an all-star analyst, they will charge u_i so that the issuer's surplus from choosing an underwriter with an all-star analyst is the same as its surplus from an underwriter without an all-star analyst, such that

$$M(1 - \bar{u}) + \theta_i 0 = M(1 - u_i) + \theta_i A. \tag{14}$$

Solving for u_i in equation (14) yields

$$u_i = \bar{u} + \theta_i \frac{A}{M}. \tag{15}$$

With u_i as above, the three underwriters charging the same u_i would have a market share of 100% since all issuers would (weakly) prefer having an all-star analyst if the surplus from issuing is the same with or without an all-star analyst. Since underwriters charge $u_i = \bar{u} + \theta_i \frac{A}{M}$, which is proportional in θ_i, an issuer with a higher θ_i pays a higher u_i than an issuer with a lower θ_i. In other words, when θ_i can be observed or inferred by underwriters, underwriters will exercise price discrimination. From this analysis, we derive the following implication:

Implication 5: If issuers' willingness to pay can be inferred by the underwriters, the level of underpricing an issuer pays for all-star analyst coverage is proportional to its willingness to pay.

Due to the limited capacity of all-star analysts and reputation concerns, it may not be in the best interest of the three underwriters to provide underwriting service coupled with all-star analyst research to all issuers. Since modeling the cost of overextending all-star analyst service is outside the scope of this paper, we assume that this cost is C_A expressed as a fraction of the market value M. Thus, the three underwriters do not sell underwriting service to issuers with $u_i < C_A$ or $\theta_i < (C_A - \bar{u})\frac{M}{A}$ and sell to all issuers with $\theta_i \geq (C_A - \bar{u})\frac{M}{A}$ by charging $u_i = \bar{u} + \theta_i\frac{A}{M}$. With this opportunity cost included, even with the ability to observe the values of θ_i, the oligopolistic underwriters will refuse to underwrite companies with a low value of θ_i, just as is true in the base case model.

We identify issuers with a greater willingness to pay for all-star coverage as those that are VC-backed. Venture capitalists are rationally focused on post-issue coverage because they typically invest in young companies with a high ratio of growth opportunities to assets in place, do not sell shares in the IPO, and then make distributions to their limited partners after the IPO, typically when the "lock-up" period expires, usually 180 days after the IPO. The performance of venture capitalists is largely measured based on the internal rate of return realized by their limited partners, calculated using the market price on the distribution date. Importantly, unlike corporate executives, both the limited partners and general partners of venture capital firms frequently sell most or all of their shares in a portfolio company on or shortly after the distribution date, thus they are much more focused on the intermediate-term stock price than on the long run performance of the company.

Based on our model, we propose a new theory of the underpricing of VC-backed IPOs: the analyst lust theory.[11]

> *The analyst lust theory of the underpricing of VC-backed IPOs: Because VCs have a greater willingness (a higher θ_i) to use underpricing to pay for all-star analyst coverage that is bundled with IPO underwriting, IPOs with all-star analyst coverage should have greater underpricing if they are VC-backed than if they are not.*

The VC literature has proposed two theories to explain the differential underpricing of VC-backed IPOs. The certification theory of venture capital suggests that VC-backing can certify the fairness of IPO pricing due to reputation concerns, so VC-backed IPOs should be less underpriced than non-VC backed IPOs (Megginson and Weiss (1991), Li and Masulis (2007), and Ivanov, Krishnan, Masulis, and Singh (2008)). The grandstanding theory predicts that young VCs are more likely to bring their portfolio companies to the market sooner, thus their companies are riskier (Gompers (1996)). Combined with the hypothesis that underpricing compensates for risk, the grandstanding theory predicts that the effect of underpricing is stronger for the IPOs of younger venture capital organizations.[12]

Another paper by Hoberg and Seyhun (2009) also posits that VC-backed IPOs will be underpriced more than other IPOs, but their rationale is different from ours—they assume that

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[11] Loughran and Ritter (2004) coined the term "analyst lust" to identify the willingness of issuing firms to forego IPO proceeds in order to attain coverage from an all-star analyst affiliated with the IPO underwriter. They posit that firms for which there are high growth opportunities relative to the value of assets in place would be more focused on analyst coverage. Unlike us, they do not identify VC-backed issuers as those that are particularly focused on analyst coverage due to the importance of the distribution date.

[12] These effects should be mitigated in regressions that include other risk proxies such as ln(assets) and tech and internet dummies.

venture capitalists conspire with underwriters, whereas our game-theoretic model does not involve any overt collusion between these players.

2.5   Model Extensions

The simple model above only concerns the pricing of all-star analyst services. Similar reasoning can be made for other non-price dimensions considered in the issuer's objective function in equation (1), such as aftermarket support, side-payments (spinning), the quality of the underwriter, or commercial bank loans that are bundled with underwriting. There are, however, some distinctions. The number of underwriters with an all-star analyst in a particular industry is, by the convention of *Institutional Investor*, limited to just three at a time. Although there are costs of providing other services, the barriers to entry may not be as restrictive as is the case for analysts, where only three analysts per industry are designated as all-stars.

In addition to the local oligopolies based on all-star analysts examined in the model, we attempt to capture the effect of larger oligopolies by focusing on underwriter prestige. One reason for this choice is that underwriter reputation is the most important criteria identified by Brau and Fawcett's (2006) survey of issuers, and it can be easily determined based on the well-known (among academics) Carter and Manaster (1990) ranking system. This proxy is also reasonable because the overall quality of underwriter is related to the quality of its distribution network, aftermarket support, and other non-price dimensions. With this proxy we can further clarify the notion of local oligopolies. For example, if there are six prestigious underwriters that have some expertise in a particular industry and only three of them have an all-star analyst, then we can say the larger local oligopoly is made up of six underwriters while the more exclusive one has only three.

As long as issuers care about underwriter quality, prestigious underwriters are expected to earn rents on that. This logic predicts a positive relation between underwriter reputation and the level of underpricing, in contrast to the negative relation predicted by certification models. Moreover, we expect that the model implications derived for the case of all-star analyst coverage should apply to underwriter reputation as well.

3. Empirical Analysis

3.1 Data

Our sample is composed of 4,486 U.S. IPOs from 1993-2007 meeting criteria that are common in the empirical IPO literature. The sample starts in 1993 rather than earlier because our all-star analyst coverage variable is available only for years 1993-2007, mainly due to the availability of Thomson Reuters's IBES database starting in year 1993. The IPO data are from Thomson Financial's new issues database with hundreds of corrections and fill-ins of missing data based upon information from Dealogic for 1990-2007, the Graham Howard-Todd Huxster set of IPO prospectuses from 1975-1996 given to Jay Ritter, EDGAR for 1996-2007, and other sources. We exclude closed-end funds, REITs, SPACs, ADRs, banks and S&Ls, unit offers, partnerships, and IPOs with an offer price of less than $5.00 per share. Appendix Table provides a detailed description of the variables used in our analysis, and a listing of the data sources.

The two main variables used in the empirical tests are a measure of all-star analyst coverage and a measure of underwriter prestige. By far the best measure of who institutional investors consider to be the most influential analysts covering specific industries each year is the annual ranking in *Institutional Investor* (*II*) magazine's October issue (Cliff and Denis (2004)). Following a survey of buy-side institutional investors during the summer, *II* publishes a listing of

the top three analysts in each of approximately 70 industries, along with a few analysts per industry who are designated as "runners up." The industries vary from year to year. For example, in 1993 there was no separate "Internet" industry, whereas in the last decade of our sample period there is. There are approximately 3,000 sell-side analysts each year during our sample period, and with only three individuals in each of about 70 industries being designated as all-stars, less than 10% of analysts achieve one of these designations in any given year.

The *II* all-star ranking has been used in Dunbar (2000), Cliff and Denis (2004), Clarke, Khorana, Patel, and Rau (2007), Fang and Yasuda (2009), Liu and Ritter (2009), Hao (2009), and other articles as a measure of influence. In this paper, we construct our all-star analyst coverage variable as a dummy that equals one if an all-star analyst (top three) from a lead underwriter has covered the stock within a year after its IPO, and zero otherwise. For IPOs in year t, we use the October issue of *II* for year t-1 to classify IPOs as to whether coverage from a lead underwriter was provided by an all-star analyst.

In Table 1, we present a transition matrix showing the probability of retaining all-star status in year t+1 if an analyst was an all-star in year t, for t=1983-2006. In Panel A, we document that 75.3% of all-stars (top three) in year t repeat as an all-star in year t+1. Of the 24.7% of all-stars who do not repeat, approximately half drop to runner-up status and the other half drop off the list, in some cases because of retirement or movement to the buy side. Panel B documents that of the analysts who are rated number 1 in their industry in year t, there is a 67.2% probability of repeating as the number 1 analyst, and a 90% probability of maintaining all-star status. These probabilities are similar to the numbers reported by Fang and Yasuda (2009).

The underwriter prestige variable is based on the underwriter's Carter and Manaster (1990) rank, as updated on Jay Ritter's website. The measure ranks each underwriter on the basis

of a 1 to 9 scale, where 9 is the highest rank. We designate an underwriter as being in the top tier if it has a rank of 8 or above. We use this measure as a proxy for the various non-price dimensions that issuers care about, such as the service quality, the distribution channel, and influence within the investing community.

Of the five model implications from Section 2, four concern the underpricing level. The other, implication 2, predicts that underwriters with an all-star analyst have a larger market share than underwriters without an all-star analyst. For this prediction, we find corroborating evidence from previous studies. For instance, according to Dunbar (2000), underwriters increase their market share of IPOs if they add an all-star analyst, and Clarke, Khorana, Patel, and Rau (2007) report the same result for IPOs and follow-on offerings combined. Since this prediction has already been tested, we focus on the four model implications for underpricing in this paper.

3.2 Underpricing

In this section, we test the four model implications concerning the relation between all-star analyst coverage and underpricing and an analogous model implication concerning underwriter prestige. In particular, we test whether IPOs with all-star analyst coverage from a lead underwriter are more underpriced than those without (implication 1). We also test whether the underpricing associated with all-star analyst coverage is lower in periods when the IPO frequency is low (implication 3b), and whether all-star analyst coverage is associated with more underpricing in periods when all-star analyst coverage is more important (implication 4). Lastly, we test whether issuers with a higher willingness to pay for all-star analyst coverage have even more underpricing (implication 5). We identify issuers with a greater willingness to pay for all-star coverage as those that are backed by VCs, based on our analyst lust theory of VC-backed

IPOs. We do not test whether underpricing is lower when all-star analyst turnover is higher (implication 3a) because there is insufficient time-series variation in analyst turnover.

3.2.1 Effect of Top-tier and All-Star on Underpricing

To estimate the quantitative effect on IPO underpricing of top-tier underwriter or all-star analyst status, we need to hold other things constant. Table 2 presents ordinary least squares (OLS) regressions in which the level of underpricing (the percentage first-day return from the offer price to the closing price) is the dependent variable. We use the firm characteristic variables ln(assets), a tech dummy, an internet dummy, and a venture capital (VC) dummy as control variables. In addition, we include share overhang, defined as the ratio of retained shares to the public float (shares issued), as an additional control variable (see Bradley and Jordan (2002)). This variable captures both incentive effects and valuation effects.[13] We also include two time-period control variables: a bubble dummy (equal to one if an IPO takes place in 1999-2000, and zero otherwise) and a post-bubble dummy (equal to one if an IPO takes place in 2001-2007, and zero otherwise).

The main variables of interest are a dummy variable for whether the IPO had a top-tier lead underwriter (equal to one if the updated Carter-Manaster ranking was eight or above on a 1 to 9 scale) and an all-star analyst coverage dummy (equal to one if the company is covered by an *Institutional Investor* all-star analyst employed by a bookrunner within 12 months of the IPO, and zero otherwise). The regression equation is as follows:

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[13] The incentive effect interpretation is that the smaller the fraction of the firm sold (and therefore the higher the overhang), the less is the incentive of the issuer to limit underpricing. The valuation effect interpretation is that if the firm is going to raise a fixed amount of money, the higher the valuation on the firm, the lower is the fraction that must be sold (and therefore the higher the overhang). A high valuation is likely to be correlated with greater uncertainty about the company's valuation, possibly resulting in greater expected underpricing.

$$\text{First-Day Return}_i = a_0 + a_1\text{TopTierUnderwriter Dummy}_i + a_2\ln(\text{Assets})_i +$$
$$a_3\text{Tech Dummy}_i + a_4\text{Internet Dummy}_i + a_5\text{Share Overhang}_i + a_6\text{VC Dummy}_i +$$
$$a_7\text{All-star Dummy}_i + a_8\text{Bubble Dummy}_i + a_9\text{Post-bubble Dummy}_i + e_i, \qquad (16)$$

where e_i is the residual for IPO i.

Row 1 of Table 2 reports regression results without the all-star dummy in regression

equation (16). Under this model specification, the top-tier dummy has a coefficient of 5.71

(t=4.18), implying 5.71% more underpricing, ceteris paribus. This result is consistent with the

model implication that issuers that are focused on non-price dimensions, as proxied by the top-

tier underwriter dummy, are more underpriced than others, and is inconsistent with the negative

coefficient predicted by the certification hypothesis.

We add the all-star dummy as one of the independent variables in row 2 of Table 2. First,

note that the coefficient of 10.59 (t=4.71) on the all-star dummy indicates that IPOs with all-star

analyst coverage from a lead underwriter are 10.59% more underpriced than those without,

which is consistent with our first model implication relating all-star coverage to underpricing.

This significantly positive coefficient estimate is consistent with, although a bit smaller than, the

coefficient reported in Cliff and Denis (2004) for 1993-2000.

Second, note that when the all-star dummy is added, the coefficient on the top-tier

dummy drops from 5.71 (t=4.18) to 4.09 (t=3.07), a decrease of 1.62%. The smaller effect of the

top-tier dummy on underpricing is due to the correlation between the top-tier dummy and the all-

star dummy, as 96% of all-star analyst coverage comes from a prestigious underwriter. This

suggests that when the all-star dummy is not included in the model specification, the top-tier

dummy overestimates the effect of underwriter prestige on underpricing due to an omitted

variable bias. Since about 18% of IPOs in our sample have all-star coverage, the quantitative

effect of the omitted variable bias should be 0.18×10.59×0.96=1.83, which is close to the actual change of 1.62 in the top-tier coefficient.

The all-star analyst dummy also suffers from an omitted variable bias. Investment banking firms generally form teams of corporate finance personnel organized on industry lines – a health care group, a technology group, a financial institutions group, etc. If the investment banking firm has an all-star analyst covering biotechnology, it will generally find it optimal to also employ high-quality personnel in health care corporate finance. Since we do not have data on the quality of these other personnel, the regression specification attributes the effect of this complementary team to the analyst, resulting in an omitted variable bias that is likely to overstate the impact of an all-star analyst on underpricing. Bradley, Choi, and Clarke (2009) report that underwriters gain market share when they hire experienced corporate finance personnel from competitors. They do not examine IPO underpricing, however.
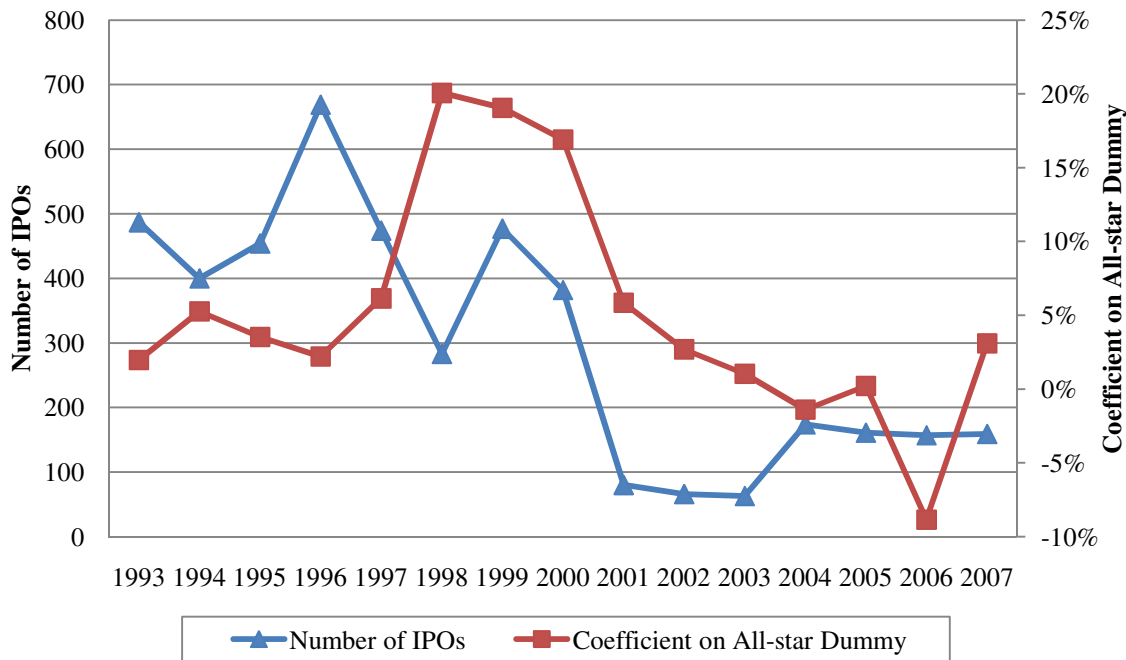
3.2.2. Effect of IPO Frequency on Underpricing

Implication 3b of the model is that the incremental underpricing associated with all-star analyst coverage is lower in periods when the frequency of deals in the industry is low. The reason is that when the deal frequency is low, the discount rate per period, where a period is defined as the length of time between IPOs in this industry, is large. Since the discount rate per period must be less than $\frac{1}{2}$ in order to obtain the "first-best" equilibrium underpricing, when the deal frequency in an industry is too low to satisfy this condition, there should be less underpricing.

As previously mentioned, the discount rate i is the sum of the required return plus the decay rate of an underwriter's all-star status. If the required return is 10% per year and the all-star status decay rate is 24.7% per year, and if 20% of all-stars switch underwriters each year

(giving a decay rate per underwriter of [1-0.753(0.8)]×100%=39.4%), then in round numbers i = 10% + 40% = 50% per year, so an expected IPO frequency of more than one deal per industry per year is necessary to meet the implicit collusion equilibrium condition that $i \leq 0.5$.

In order to see how the effect of all-star analyst coverage on underpricing changes with the IPO frequency, we run regression equation (16) each year (without the bubble period and the post-bubble period dummies). In Figure 2, we graph the yearly regression coefficients on the all-star dummy. We also graph the number of IPOs per year, which is used as a proxy for overall deal frequency per industry since it is compared to the average underpricing across all industries.

Figure 2. Number of IPOs and coefficients on all-star dummy from underpricing regressions for 1993 to 2007. The number of IPOs is the size of the sample used in each yearly underpricing regression. The coefficients on the all-star dummy are from 15 yearly regressions specified as First-Day Return$_i$ = a_0 + a_1TopTierUnderwriter Dummy$_i$ + $a_2$ln(Assets)$_i$ + a_3Tech Dummy$_i$ + a_4Internet Dummy$_i$ + a_5Share Overhang $_i$ + a_6VC Dummy$_i$ + a_7 All-star Dummy$_i$ + e_i, for years 1993 to 2007.
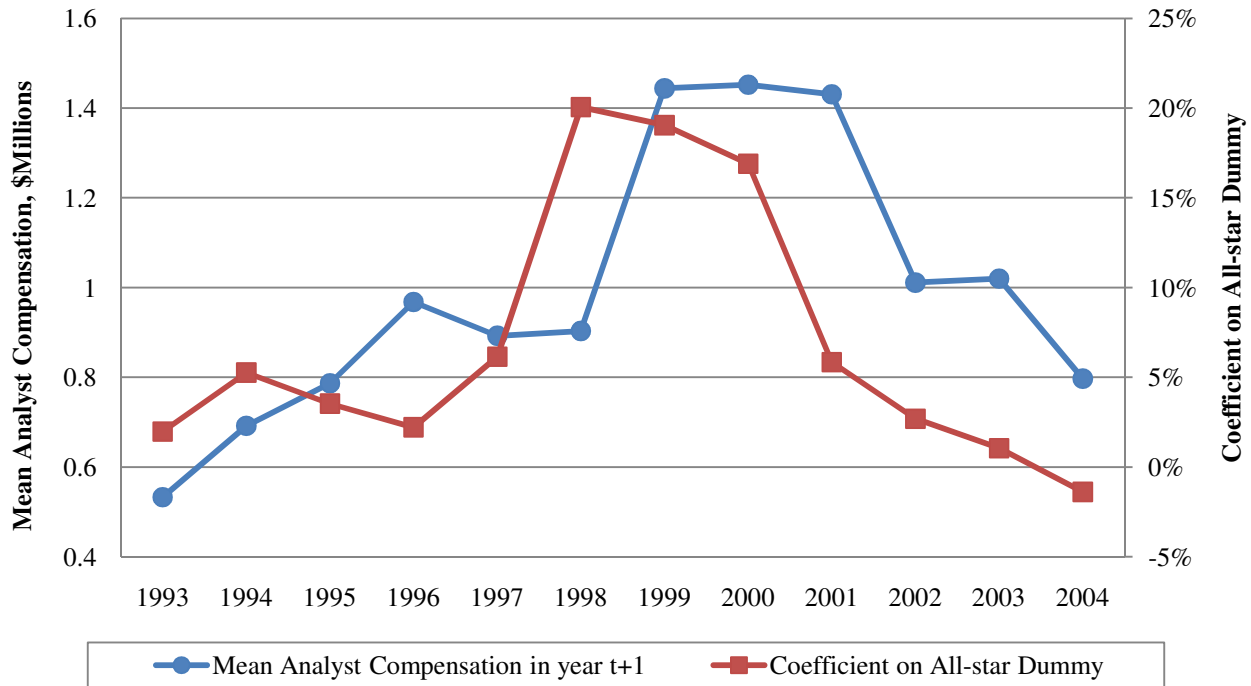
As is evident from Figure 2, the number of IPOs decreased sharply after the tech stock bubble burst in 2000. In particular, the average number of IPOs per year from 1993 to 2000 is 453, whereas the average number of IPOs per year from 2001 to 2007 is only 123. Based on the prediction that underpricing is lower when the deal frequency is low, we expect the incremental underpricing associated with all-star analyst coverage to be small during 2001 and 2007. As shown in Figure 2, the coefficient on the all-star dummy is indeed low from 2001 to 2007, during which period the average coefficient on the all-star analyst dummy is indistinguishable from zero.

3.2.3. Effect of Time-Varying Value of Analyst Coverage on Underpricing

Our fourth model implication is that the effect of all-star analyst coverage on underpricing should be greater in periods during which all-star analyst coverage is more important. In order to test this implication, we need a measure of how the importance of all-star analyst coverage has changed over time. We posit that analyst compensation is related to the importance of all-star analyst coverage since more demand for their services should translate into higher salary and bonus. If compensation is a good proxy for the importance of all-star analysts, then changes in compensation can indicate changes in the importance of all-star analysts. Thus, we test the joint hypothesis that i) underpricing is higher when analyst coverage is more important, and ii) analyst compensation is a good proxy for the importance of analyst coverage.

Using data on annual compensation of analysts (with or without all-star status) in a large investment bank for 1994-2005 provided in Table 1 of Groysberg, Healy, and Maber (2008), we graph the inflation-adjusted mean total compensation by year in Figure 3. We lag the mean analyst compensation by one year since the compensation in year t+1 is largely based on the performance in year t. As is evident from the graph, there is a clear upward trend in analysts'

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compensation through the 1990s, peaking during the bubble period before tapering off in the

early 2000s.

Figure 3. Mean analyst compensation and coefficients on all-star dummy from underpricing regressions for 1993 to 2004. The inflation-adjusted mean analyst compensation data comes from Table 1 of Groysberg, Healy, and Maber (2008). The compensation data is lagged by one year, i.e., the value for year t+1 is graphed in year t. The coefficients on the all-star dummy are from 12 yearly regressions specified as First-Day Return$_i$ = a_0 + a_1TopTierUnderwriter Dummy$_i$ + $a_2$ln(Assets)$_i$ + a_3Tech Dummy$_i$ + a_4Internet Dummy$_i$ + a_5Share Overhang $_i$ + a_6VC Dummy$_i$ + a_7 All-star Dummy$_i$ + e_i, for years 1993 to 2004.

In Figure 3, the coefficients on the all-star analyst dummy from the underpricing

regressions conducted on samples using only the IPOs in a given calendar year for years 1993 to

2004 roughly mirror the variation in average analyst compensation, although there seems to be a

lagged relation between the two series, despite compensation for year t+1 being graphed in year

t. This may be due to analysts' compensation packages being negotiated on a multi-year basis, or

the smoothing of bonuses, or both, which introduces multi-year lags between compensation and its cause.

During the post-bubble period, the incremental underpricing associated with all-star analyst coverage seems low compared to the importance of all-star analysts in Figure 3. The low coefficients on the all-star dummy in 2001-2007, we hypothesize, are partly due to the implementation of Regulation Full Disclosure (FD) in October 2000, which requires publicly traded companies to disclose material information to all investors at the same time. This regulation limits the proprietary information analysts may acquire from a company and pass along to favored institutional clients in private telephone calls, therefore reducing the value of analysts and influence as perceived by institutional investors (Doukas, Kim and Pantzalis (2005)). In addition, the 2003 Global Settlement that criticized analysts' biased research due to conflicts of interest may have reduced the perceived value of analyst research in the later periods. Furthermore, as previously mentioned, the low frequency of IPO deals during the post-bubble period can also partly explain the lack of a reliably positive coefficient.

Overall, Figure 3 suggests that the importance of analysts, as proxied by their level of compensation, is related to the amount of rents that underwriters can extract from selling their services bundled with IPO underwriting. In other words, we find the effect of all-star analyst coverage on underpricing to be greater in periods when all-star analysts are more important, which is consistent with the fourth model implication.

3.2.4. Cross Sectional Effect on Underpricing

In this subsection, we test implication 5 of our model, which states that if underwriters can observe an issuer's willingness to pay for all-star coverage, the issuers with a higher willingness to pay will have even more underpricing. We use the presence of venture capital

backing to proxy for the importance of all-star coverage based on our analyst lust theory of VC-backed IPOs.

In the underpricing regressions, we use the interaction between the all-star analyst and VC dummies to measure the effect of coverage from an all-star analyst for VC-backed IPOs. The model specification is:

$$\text{First-Day Return}_i = a_0 + a_1\text{TopTierUnderwriter Dummy}_i + a_2\ln(\text{Assets})_i + a_3\text{Tech Dummy}_i + a_4\text{Internet Dummy}_i + a_5\text{Share Overhang}_i + a_6\text{VC Dummy}_i + a_7\text{All-star Dummy}_i + a_8\text{All-star} \times \text{VC Dummy}_i + a_9\text{Bubble Dummy}_i + a_{10}\text{Post-bubble Dummy}_i + e_i. \qquad (17)$$

In row 2 of Table 2, the coefficient on the VC dummy is 3.61 (t=2.57) and the coefficient on the all-star dummy is 10.59 (t=4.71). The only difference between rows 2 and 3 in Table 2 is that row 3 includes an interaction of the VC dummy and the all-star analyst coverage dummy. The coefficient of 19.51 (t=3.99) on the interaction term is economically important. This is consistent with the fifth model implication, which states that if underwriters can observe the values of θ_i, among issuers that do hire an underwriter with an all-star analyst, the issuers with a higher willingness to pay for analyst coverage will be underpriced by more than other issuers.

In row 3 of Table 2, the coefficient on the VC dummy drops from a reliably positive 3.61 to a statistically and economically insignificant 0.37 (t=0.26) when the VC×all-star dummy interaction term is included. The coefficient on the all-star dummy drops from a reliably positive 10.59 to a statistically insignificant 2.66 (t=1.22). Taking the sum of the interaction term and the all-star dummy coefficients (19.51 + 2.66 = 22.17), our point estimate is that VC-backed IPOs are underpriced by 22% more when they have all-star coverage than when they do not. In other words, the evidence is that VC-backed firms are underpriced by more, but only when they receive coverage from an all-star analyst employed by a bookrunner.

The analyst compensation numbers reported in Figure 3 suggest that all-star analyst coverage was most important during the bubble period. Thus, the model's fourth implication suggests that the VC×all-star interaction coefficient should be higher for the 1999-2000 subperiod than for the other subperiods. In rows 4-6 of Table 2, we report subperiod results for 1993-1998, 1999-2000, and 2001-2007. For the 1993-1998 subperiod in row 4, the coefficient on the VC×all-star interaction dummy variable is 7.55 (t=2.05), while the coefficient on the all-star dummy of 4.05 (t=1.61) is positive and marginally significant. For the bubble subperiod in row 5, the coefficient on the interaction dummy is 25.53 (t=1.92), indicating 25.53% more underpricing when a VC-backed firm receives coverage from an all-star analyst employed by a bookrunner in the bubble period. This is consistent with the model's fourth implication that the VC×all-star interaction effect should be larger in the bubble period, when the value of all-star coverage, A, is higher. In this regression, the coefficient on the all-star dummy is 4.29 (t=0.45), with the statistical insignificance due to a very high variance of first-day returns. In row 6, IPOs from the post-bubble period of 2001-2007 are used and neither the all-star nor interaction dummies are economically or statistically significant.

For the 1993-2007 period, the effect of venture capital on underpricing is 3.61%, but when the VC×all-star interaction is added, the effect of venture capital is reduced to a statistically insignificant 0.37%. Both the positive and the essentially zero coefficients are inconsistent with the certification theory, which predicts a negative coefficient. In addition, the level of underpricing of VC-backed IPOs without an all-star analyst is not different from non VC-backed IPOs in all periods except for the bubble period, where the effect is positive and significant. Furthermore, we find that VC-backed IPOs with an all-star analyst are significantly

more underpriced, by 19.51%, in 1993-2007. This is consistent with our analyst lust theory of the underpricing of VC-backed IPOs.

To summarize, it is important to account for the effect from all-star analysts when measuring the effect of VC-backing on underpricing. If the interaction between all-star analyst and VC dummies is missing from the regression, the estimate of the VC coefficient is overstated. In particular, when the interaction term is added, for all periods except the bubble period, VC-backed IPOs without an all-star analyst are not significantly different from other IPOs. This suggests that most if not all of the effect of venture capital on underpricing comes from the VC-backed IPOs that have all-star analyst coverage provided by their IPO bookrunner.

3.2.5. Robustness Checks

In our regression specifications, we have taken the explanatory variables as exogenous. Although top-tier underwriter status can be considered endogenous, when we control for endogeneity with an instrumental variable regression, our conclusions do not qualitatively change. It is also possible that all-star analyst coverage is an endogenous variable, with a company that would have high underpricing for unspecified exogenous reasons being more attractive for an underwriter with an all-star analyst in the issuer's industry. Unfortunately, we have been unable to find an identifying variable that predicts all-star coverage that is unrelated to underpricing.[14]

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[14] Cliff and Denis (2004) report instrumental variable regressions with an instrument for analyst coverage on IBES, but not for all-star coverage.

4.   Conclusions

We develop a new theory of the underpricing of IPOs. Despite a large number of investment banking firms, we posit that the IPO underwriting industry is characterized by a series of local oligopolies. As long as issuers care about non-price dimensions such as all-star analyst coverage, a limited number of underwriters with all-star analysts will acquire some market power and earn rents on the IPOs of firms in any given industry.

We model one of these local oligopolies and develop several implications for the effect of all-star analyst coverage on the underwriter's market share of the IPOs in an industry and the level of underpricing. The model can also be applied to yield implications for other non-price dimensions such as underwriter reputation.

In our empirical section, we confirm the results of others that IPOs with all-star coverage from their bookrunner are underpriced by about 11% more than other IPOs, and IPOs with top-tier underwriters are underpriced by about 5% more than other IPOs. In addition, we find that the effect of all-star analyst coverage on underpricing is positively related to the importance of all-star analyst coverage over time and to the frequency of IPO activity.

We also test the cross-sectional hypothesis that issuers that are more focused on all-star analyst coverage will be underpriced more if they have all-star analyst coverage provided by the bookrunner. Our analyst lust theory of VC-backed IPOs posits that venture capitalists, which are especially focused on the stock price six months after the IPO, should have their IPOs underpriced more. By looking at the interaction of the presence of VC-backing and coverage by an all-star analyst employed by the bookrunner, we identify a previously undocumented pattern: IPOs exhibiting both of these characteristics are underpriced by 22% more than IPOs with no all-star analyst coverage. When this interaction term is included, the effect of VC backing by itself is

reduced to zero, suggesting that the effect of VC-backing on underpricing is due to the greater focus by venture capitalists on all-star analyst coverage.

Finally, our model can also be used to explain existing empirical findings and generate new empirical implications in non-IPO areas. For instance, Kang and Liu (2007) find that the prices of corporate bonds are lower if there is a close prior lending relationship between banks and their client issuers. This result can be interpreted as commercial bank loans that are tied-in with bond underwriting being one of the non-price dimensions that issuers care about and from which investment banks expect to earn a rent. Furthermore, our model and its implications can be extended readily to seasoned equity offerings (SEOs). Consistent with our model, Mola and Loughran (2004) report that the hiring of an underwriter with a high number of all-star analysts is associated with greater underpricing of SEOs. Their sub-period results are also consistent with our time-series prediction that the effect of analyst coverage on underpricing is higher in periods during which analyst coverage is more important.

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Appendix Table

The data consists of 4,486 U.S. operating firm IPOs from 1993-2007 for which the offer price is at least $5.00 and complete data on all of the variables is available. Unit offers, ADRs, banks and S&Ls, and IPOs not listed on CRSP within six months of issuing have also been excluded. Variable means are provided where applicable. All dollar values are in dollars of 2003 purchasing power using the Consumer Price Index.

Variable	Definition	Source	Mean
First-day return	Percentage change from the offer price to the first day closing price	Thomson Financial's SDC, with corrections by the authors	24.5%
Proceeds	The offer price times the number of global shares offered, excluding overallotment options, expressed in millions of dollars	Thomson Financial's SDC, with corrections	$120.5m
Top-tier dummy	Equals one (zero otherwise) if the lead underwriter has an updated Carter and Manaster (1990) rank of 8 or more	Jay Ritter's web site	67.8%
Assets	Firm's pre-issue book value of assets, expressed in millions of dollars	Thomson Financial's SDC, with corrections by the authors	$798.0m
Tech dummy	Equals one (zero otherwise) if the firm is in the technology business (Defined in Appendix D of Loughran and Ritter (2004))	Thomson Financial's SDC, with corrections by the authors	41.8%
Internet dummy	Equals one (zero otherwise) if the firm is in the Internet business (Defined in Appendix D of Loughran and Ritter (2004))	Jay Ritter's web site	12.3%
Age	Calendar year of offering minus the calendar year of founding (Defined in Field and Karpoff (2002) and Appendix A of Loughran and Ritter (2004))	Jay Ritter's web site	7 years (median)
Share overhang	Ratio of retained shares to the public float	Thomson Financial's SDC, with corrections by the authors	3.05
VC dummy	Equals one (zero otherwise) if the IPO was backed by venture capital	Thomson Financial's SDC, with corrections from Paul Gompers, Josh Lerner, Jerry Cao, and the authors	38.8%
Bubble dummy	Equals one (zero otherwise) if the IPO occurred during 1999-2000		19.1%
Post-Bubble dummy	Equals one (zero otherwise) if the IPO occurred during 2001-2007		19.2%
All-Star dummy	Equals one (zero otherwise) if the IPO is covered by an *Institutional Investor* all-star analyst from the bookrunner within one year of the IPO. IPOs in year t are deemed to be covered by an all-star from October of year t-1 if this analyst initiates coverage within 12 months of the IPO.	I/B/E/S, Investext, and other sources; Lily Fang, Dan Bradley, and Jonathan Clarke; *Institutional Investor*'s annual October issue for 1995-2007	18.3%
VC×All-star dummy	An interaction of the VC dummy with the All-star dummy		7.3%

Table 1

Probabilities of Retaining All-star Status from Year t to Year t+1

For the 24 years during 1983-2006, this table reports the transition probabilities for a sell-side analyst ranked by *Institutional Investor* magazine in year t as an all-star (top three) or a runner-up. Year t+1 covers 1984-2007. The row represents the status in year t and the columns represent the status in year t+1. For example, in Panel B, for analysts ranked as the number 2 all-star in year t, 18.6% have moved up to a number 1 ranking in year t+1. This table reports the transition probabilities for individual analysts, whether or not they switch employers. Thus, they can be viewed as upper bounds on the probability that a given investment banking firm will maintain all-star or runner-up status from year t to year t+1. Panel A is identical to Panel B except that it combines the first, second, and third ranked all-star analysts in each industry into a single "all-star" category. The "no rank" category includes analysts who are no longer sell-side analysts as well as those that still are, but are not a ranked all-star or runner-up in year t+1. There are a total of 5,017 ranked analysts and 3,302 runner-ups in year t.

Panel A: Transition Matrix for All-star Status

From\To	All-star	Runner-up	No rank
All-Star	75.3%	12.7%	12.0%
Runner-up	22.3%	45.7%	32.0%

Panel B: Transition Matrix for All-star Rank

From\To	1	2	3	Runner-up	No rank
1	67.2%	16.5%	6.2%	1.6%	8.4%
2	18.6%	39.4%	21.9%	8.2%	11.8%
3	5.3%	17.3%	38.5%	24.1%	14.8%
Runner-up	1.8%	4.9%	15.6%	45.7%	32.0%

Table 2

First Day Return OLS Regression for 4,486 IPOs from 1993-2007

The sample in rows 1 to 3 includes 4,486 operating firm IPOs over 1993-2007 for which the offer price is at least $5.00 and complete data on all of the variables are available. Unit offers, ADRs, banks and S&Ls, closed-end funds, partnerships, SPACs, and IPOs not listed on CRSP within six months of issuing have also been excluded. The subperiods have 2,767, 860, and 859 observations with average first-day returns of 16.0%, 64.3% and 12.1%, respectively, with an average over the entire sample of 24.5%. The dependent variable in all regressions is the percentage first-day return from the offer price to the first-day closing price. The top-tier underwriter dummy takes a value of one if the lead underwriter has an updated Carter and Manaster (1990) rank of 8 or more, and zero otherwise. Ln(assets) is the natural logarithm of the pre-issue book value of assets, expressed in millions of dollars of 2003 purchasing power using the CPI. The tech dummy takes a value of one (zero otherwise) if the firm is in the technology business, and the Internet dummy is similarly defined (industries are defined in Appendix D of Loughran and Ritter (2004)). Share overhang is the ratio of retained shares to the public float (the number of shares issued). The VC dummy takes a value of one (zero otherwise) if the IPO was backed by venture capital. The All-star analyst dummy takes a value of one if one or more of the bookrunners had an *Institutional Investor* all-star analyst (top 3) cover the stock within 12 months of the IPO. The VC×All-star dummy is an interaction of the VC dummy with the All-star dummy. The Bubble dummy takes on a value of one (zero otherwise) if the IPO occurred during 1999-2000, and the Post-bubble dummy takes on a value of one (zero otherwise) if the IPO occurred during 2001-2007. Heteroskedasticity-consistent t-statistics are in parentheses.

$$\text{First-Day Return}_i = a_0 + a_1\text{Top-Tier Underwriter Dummy}_i + a_2\ln(\text{Assets})_i + a_3\text{Tech Dummy}_i + a_4\text{Internet Dummy}_i + a_5\text{Share Overhang}_i + a_6\text{VC Dummy}_i + a_7\text{All-star Dummy}_i + a_8\text{VC}\times\text{All-star Dummy}_i + a_9\text{Bubble Dummy}_i + a_{10}\text{Post-bubble Dummy}_i + e_i$$

Period	Intercept	Top-Tier Dummy	ln(Assets)	Tech Dummy	Internet Dummy	Share Overhang	VC Dummy	All-star Dummy	VC× All-star Dummy	Bubble Dummy	Post-bubble Dummy	R^2_{adj}
(1) 1993-2007	4.42 (2.50)	5.71 (4.18)	-2.16 (-6.09)	4.69 (4.13)	26.15 (6.16)	4.85 (9.98)	3.64 (2.52)	-	-	23.81 (8.93)	-5.26 (-5.52)	26.3%
(2) 1993-2007	5.74 (3.19)	4.09 (3.07)	-2.57 (-6.80)	4.76 (4.19)	25.79 (6.14)	4.70 (9.75)	3.61 (2.57)	10.59 (4.71)	-	23.25 (8.76)	-4.94 (-5.19)	26.8%
(3) 1993-2007	6.68 (3.79)	4.80 (3.68)	-2.43 (-6.41)	4.68 (4.13)	25.41 (6.05)	4.50 (9.42)	0.37 (0.26)	2.66 (1.22)	19.51 (3.99)	23.08 (8.73)	-4.67 (-4.87)	27.3%
(4) 1993-1998	13.06 (9.50)	2.77 (2.88)	-2.07 (-6.71)	5.44 (5.46)	30.13 (3.31)	2.30 (6.75)	-1.91 (-1.77)	4.05 (1.61)	7.55 (2.05)	-	-	12.8%
(5) 1999-2000	-4.52 (-0.56)	19.17 (2.83)	-4.98 (-3.01)	18.18 (3.23)	16.56 (2.30)	8.32 (6.20)	13.54 (2.28)	4.29 (0.45)	25.53 (1.92)	-	-	20.3%
(6) 2001-2007	4.44 (1.91)	3.18 (2.00)	-0.53 (-1.53)	2.68 (1.73)	3.00 (1.04)	2.19 (4.58)	0.95 (0.57)	-0.22 (-0.14)	-0.14 (-0.04)	-	-	7.6%