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Local underwriter oligopolies and IPO underpricing ☆

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ABSTRACT

We develop a theory of initial public offering (IPO) underpricing based on differentiated underwriting services and localized competition. Even though a large number of investment banks compete for IPOs, if issuers care about non-price dimensions of underwriting, then the industry structure is best characterized as a series of local oligopolies. We test our model implications on all-star analyst coverage, industry expertise, and other non-price dimensions. Furthermore, we posit that venture capitalists (VCs) 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 much more underpriced when they have coverage from an all-star analyst.

1. Introduction

The average initial public offering (IPO) in the U.S. during 1993–2008 had a first-day return of 24%, despite the large number of underwriters competing for deals. The coexistence 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 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.

In this paper, we develop a theory of IPO underpricing that resolves this inconsistency. We posit that issuers care not only about IPO proceeds, but also about non-price dimensions of IPO underwriting such as underwriter

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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.

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quality, industry expertise, and analyst coverage from influential analysts. Alternatively stated, underwriters are selling differentiated products. Since a limited number of underwriters can provide these services for a given company, the IPO underwriting market is best characterized as a series of local oligopolies.

We model the supply side of the IPO underwriting market as composed of a large number of competitive underwriters and, on any given deal, a small number of underwriters with market power. This market power arises from the desire of issuing firms for research coverage by influential analysts, with this analyst coverage bundled with underwriting. The equilibrium of the noncooperative repeated game generates several testable implications. The model predicts that the existence of oligopolistic underwriters exercising their market power results in greater underpricing for the issuers that are less focused on maximizing IPO proceeds. Furthermore, the model predicts that the underpricing attributable to the non-price dimensions varies with the value and the cost of providing these services, the deal frequency, and the issuer's willingness to pay for the non-price dimensions.

The 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 to 1 year after the IPO. We assume that this market price is boosted by coverage from influential analysts, which we measure by using the "all-star" designation in the October issue of *Institutional Investor* magazine. Because of their concern with this price, VCs have a greater lust for all-star analyst coverage that is bundled with IPO underwriting, resulting in greater underpricing for VC-backed IPOs with all-star analyst coverage.

Empirically, we find that issuers using a bookrunner that bundles underwriting with influential analyst coverage are subject to 9% more underpricing during 1993–2008.[2] We also find that the incremental underpricing associated with all-star analyst coverage is higher for issuers that perceive all-star analyst coverage as more valuable and during periods when all-star analyst coverage is more important. Moreover, we find that the effect of all-star analyst coverage on underpricing is lower in periods when the IPO volume in an industry is low.

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 have 20% more underpricing (e.g., 38% rather than 18%) when they have all-star coverage than when they do not, holding other things constant. Moreover, when the relation between VC-backing and all-star analyst coverage is controlled for, the effect of VC-backing itself on underpricing is reduced by more than 50%, suggesting that most of the effect of VC-backing on underpricing is due to the greater focus by venture capitalists on all-star analyst coverage. Surprisingly, there is no reliable relation between all-star analyst coverage and underpricing for non-VC-backed IPOs.

Our model also generates predictions regarding other non-price dimensions. For example, our model predicts that underwriters possessing an attribute valued by issuers, such as industry expertise, will be able to underprice more. When we test this prediction using IPOs from 1980 to 2008, we find that issuers that hire an underwriter with more industry experience are underpriced by 3–5% more. Based on our model, we also construct an issuer-specific Herfindahl-Hirschman Index (HHI) measure of the market share concentration of the underwriters that the issuer is likely to hire. The HHI measure is used to proxy for non-price dimensions that are not explicitly accounted for. Consistent with our prediction, we find that this measure is positively associated with IPO underpricing. Additionally, we use top-tier underwriter status to proxy for other services that high quality underwriters provide. Consistent with prior findings, we find that prestigious lead underwriters are associated with less underpricing during the 1980s, but with more underpricing in later periods. We interpret this pattern as being consistent with the evolution of the IPO underwriting market from competing on the basis of maximizing IPO proceeds, which we label the price dimension, to competing on non-price dimensions.

When we examine VC-backed and non-VC-backed IPOs separately, the findings suggest that underwriter competition in these two markets focuses on different non-price dimensions, further highlighting the special pricing objectives of the VCs. Finally, in assessing the economic importance of the non-price dimensions, we find that their combined effect can account for 30% of the average underpricing.

Our paper is related to a large literature on IPO underpricing. 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. By contrast, Baron (1982), Loughran and Ritter (2002, 2004), and Ljungqvist and Wilhelm (2003) focus on the interaction between the underwriter and the issuer. These latter articles assume that underwriters want to underprice IPOs more than is needed and focus on cross-sectional differences in the desire of issuers to minimize underpricing. In particular, Loughran and Ritter (2004) explain why an issuer would knowingly hire an underwriter that in expectation will excessively underprice its IPO, but they do not explain why competition between underwriters does not lower the expected underpricing to competitive levels.

A common feature in all of the above-mentioned articles is that interactions between competing underwriters do not come into play. In other words, the supply of underwriting services is not modeled. In this paper, we explicitly account for interactions between competing underwriters and develop a new theory of IPO underpricing in which there is excessive underpricing in equilibrium.

[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 terms (lead) underwriter and bookrunner interchangeably in much of the paper.

2. The model

2.1. The objectives of underwriters and issuers

2.1.1. Underwriters

A number of papers model an imperfectly competitive underwriting market in an attempt to explain IPO underpricing (Fu and Li, 2007; Hoberg, 2007) and/or the clustering of gross spreads (Gordon, 2003; Chen, 2008; Lowery, 2008). Most of these models use a game-theoretic framework and rely on assumptions such as heterogeneously informed underwriters or capacity constraints and barriers to entry in the IPO underwriting industry to produce an equilibrium with tacit (implicit) collusion among underwriters.

Unlike these models, we focus on differentiated IPO underwriting services and localized competition in the IPO underwriting market. Thus, we assume that only a subset of underwriters has some market power in each industry, and that only a subset of issuers is willing to pay for the differentiated product offered by these underwriters.

For our model, we follow recent papers and assume that underwriters want to underprice IPOs more than is needed. Underwriters can benefit from underpricing IPOs in several ways. First, underwriters can allocate underpriced shares to investors in exchange for soft dollar commission business (Loughran and Ritter, 2002, 2004; Reuter, 2006; Hoberg, 2007; Nimalendran, Ritter, and Zhang, 2007). Goldstein, Irvine, and Puckett (in press) estimate that an additional \$1 excess commission payment to the lead underwriter results in IPO share allocations that generate \$2.21 in investor gross profits, implying that 45% of the money left on the table is captured by the underwriter. Second, underwriters can allocate underpriced IPOs to executives to sway their decision in choosing which investment banking firm to hire, a practice known as spinning (Liu and Ritter, 2010). Through these channels, underwriters can capture much of the money left on the table. Partly 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 for moderate-sized U.S. IPOs.

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.

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.[3] The issuer's objective function can be expressed as

$$\alpha_1\,\textit{Net IPO proceeds} + \sum_{i=2}^{n} \alpha_i X_i \tag{1}$$

where the *Net IPO proceeds* (number of shares offered times the net proceeds per share) represents the price dimension, the weights satisfy the condition that $\sum_{i=1}^{n} \alpha_i = 1$, and the X_i's are the issuer's perceived value of the $n-1$ non-price dimensions such as underwriter quality, industry expertise, aftermarket price support, side payments to executives, commercial bank loan tie-ins, and analyst research coverage.

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

$$\alpha_1\,\textit{Net IPO proceeds} + \alpha_2\,\textit{Proceeds from future sales} + \alpha_3\,\textit{Side payments} \tag{2}$$

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). Empirically, the analyst lust hypothesis is examined by Cliff and Denis (2004) and the spinning hypothesis is examined by Liu and Ritter (2010).

Most of the IPO literature has implicitly or explicitly assumed that the first term in Eqs. (1) and (2) is the only term that enters the objective function of issuers, suggesting that 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 dimensions.[4]

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). Given these preferences, an underwriter's ability to win IPO mandates from firms in an industry partly depends on the expertise of its research analyst in that industry.

[3] The focus on price versus non-price dimensions has also been used to explain changes in the gross spreads on junk bonds. Livingston and

(*footnote continued*)
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.

[4] We assume that the non-price dimensions are paid for through underpricing rather than explicit payments (the gross spread) given the evidence from Chen and Ritter (2000) that the gross spreads for almost all moderate-sized U.S. IPOs from 1990 to 1998 are clustered at exactly 7%. If underwriters can only capture part of the money left on the table, then charging through the gross spread appears to be a better way of collecting rents. One possible reason that non-price services are not paid for through the gross spread is that issuers do not regard opportunity costs (money left on the table) as equivalent to direct costs (gross spreads).

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]

While our analysis can be extended to other non-price dimensions, we focus on all-star analyst coverage in the model. 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) and Khorana, Mola, and Rau (2009) show that firm value declines when a research analyst terminates coverage. When analysts resume the coverage of "neglected" stocks, Demiroglu and Ryngaert (2010) find that these stocks experience a 4.8% announcement abnormal return.

Analyst coverage can generate more publicity for a firm and increase the firm's visibility among institutional investors, which can drive up demand, thus increasing firm value in the short run. 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 runners-up in each industry, where the top three analysts are designated as all-stars. Empirically, all-star analyst status has been used by many studies as a measure of analyst influence and is positively correlated with analyst pay and underwriting deal flow. Consequently, we use the *Institutional Investor* all-star designation as our measure of which analysts are most sought-after by issuing firms.

2.2. The basic model

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 game of issuers buying underwriting services. Our procedure is to solve for the cooperative outcome in a one-period model, and then state the necessary conditions for the one-period equilibrium to be supportable in an infinitely repeated noncooperative game.

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, which is distributed uniformly on the [0.1] interval, and represents the relative importance of having all-star analyst coverage. For example, an issuer that intends to conduct a follow-on offering shortly after the IPO might have a high θ, whereas an issuer for which the insiders have no intention of selling shares during the next few years might have a low θ. θ is closely associated with the weight α_i that corresponds to coverage from an influential analyst in Eq. (1) or the weight α_2 on future proceeds in Eq. (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 effect on the market value of retained shares from being covered by an all-star analyst is given by A.

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

$$M - U + \theta A \tag{3}$$

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 in dollars (the money left on the table). The first part of the net surplus, $M-U$, is the net proceeds from selling a fixed number of shares at the initial public offering. The second part of the net surplus, θA, is the effect of all-star analyst coverage on value, A, multiplied by the issuer's preference for an all-star analyst, θ. Eq. (3) is a special case of Eqs. (1) and (2). The specification is equivalent to an objective function that is a weighted average of firm value in periods 1 and 2 in a two-period model.

The profit to underwriter k is

$$\pi_k = (\gamma(U - \overline{U}) - C)D_k \tag{4}$$

where $\overline{U}$ is the dollar amount of underpricing needed to compensate investors for the ex-ante uncertainty of issue valuation, which for simplicity is assumed to be the same across all issues (or, in our empirical work, is captured by control variables), and C is the cost of providing all-star analyst coverage ($C=0$ when no all-star coverage is provided). D_k is the demand for underwriter k's service. The cost of underwriting the issue is assumed to be covered in the gross spread, which is taken as exogenous here. We assume that a fraction γ of the incremental money left on the table $U - \overline{U}$ flows back to the underwriters through indirect channels, such as collecting soft dollars from rent-seeking investors. We do not model IPO investors because the rest of the incremental underpricing, $(1-\gamma)(U - \overline{U})$, goes to the investors, thus ensuring their participation.

[5] Degeorge, Derrien, and Womack (2007) present evidence on the bundling of IPO underwriting and subsequent analyst coverage. Bradley, Jordan, and Ritter (2008, pp. 109–110) report that 98% of lead underwriters initiated coverage within 1 year of the IPO for their sample IPOs in 1999–2000, and Gao, Ritter, and Zhu (2011) find that 98% of IPOs during 2001–2009 had coverage from a lead underwriter within 1 year of the IPO. Both of these papers restrict their samples to IPOs with a file price midpoint of at least $8 per share.

If N is large, then the $N-3$ underwriters without an all-star analyst will not be able to charge $U>\overline{U}$ because they behave in a perfectly competitive market with a large number of underwriters and homogeneous services. Therefore, they will set $U=\overline{U}$. 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.

Now we consider the level of underpricing that the three underwriters with an all-star analyst will charge. If the three underwriters do not cooperate, then under Bertrand competition, each of the three underwriters charges $U=\overline{U}+(C/\gamma)$ and obtains zero profit.[6]

If the three underwriters collude and charge the same level of underpricing $\dot{U}$ (where the dot notation indicates collusion values), then the aggregate demand for their service from a unit mass of issuers 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

$$M-\dot{U}+\hat{\theta}A=M-\overline{U} \tag{5}$$

Thus, the aggregate demand is

$$\dot{D}=1-\hat{\theta}=1-\frac{\dot{U}-\overline{U}}{A} \tag{6}$$

The underpricing level $\dot{U}$ that maximizes $\dot{\pi}=(\gamma(\dot{U}-\overline{U})-C)\dot{D}$, the aggregate profit of the colluding underwriters, occurs when

$$\frac{\partial\pi}{\partial\dot{U}}=\gamma\dot{D}+(\gamma(\dot{U}-\overline{U})-C)\frac{\partial\dot{D}}{\partial\dot{U}}=0 \tag{7}$$

Differentiating Eq. (6) with respect to $\dot{U}$ and substituting both this expression for $\partial\dot{D}/\partial\dot{U}$ and Eq. (6) for $\dot{D}$ into (7) and solving for $\dot{U}$ yields

$$\dot{U}=\overline{U}+\frac{\gamma A+C}{2\gamma} \tag{8}$$

Substituting Eq. (8) into (6), the aggregate demand from the unit mass of issuers for underwriters offering all-star coverage is then $\dot{D}=1-((\dot{U}-\overline{U})/A)=(1/2)-(C/2\gamma A)$. Thus, only issuers with $\theta>(1/2)+(C/2\gamma A)$ will choose an underwriter with an all-star analyst. Intuitively, the collusive equilibrium (monopoly) profits of the underwriters has marginal revenue equal to marginal cost with only the minority of issuers with a sufficiently high θ choosing an underwriter with an all-star analyst. The aggregate profit of the three underwriters is

$$\dot{\pi}=(\gamma(\dot{U}-\overline{U})-C)\dot{D}=\frac{\gamma A}{4}-\frac{C}{2}+\frac{C^2}{4\gamma A} \tag{9}$$

which is greater than zero as long as $A>(C/\gamma)$. Thus, each of the three underwriters earns $\dot{\pi}/3$ or one-third of the monopoly profit and each has $1/6-(C/6\gamma A)$ of the market in the collusive outcome.

Although the collusive equilibrium maximizes their joint profits, each of the three underwriters has an incentive to undercut the other two and capture a larger market share. Generally, in an infinitely repeated game, each underwriter decides whether to cooperate by evaluating the following equation:

$$PV^{No\ Coop}=\pi_D+\pi_N\left(\frac{1}{1+i}+\frac{1}{(1+i)^2}+\cdots\right)$$
$$\le\frac{1}{M}\dot{\pi}\left(1+\frac{1}{1+i}+\frac{1}{(1+i)^2}+\cdots\right)=PV^{Coop} \tag{10}$$

where π_D is the one-time deviating profit, π_N is the profit after deviation detection, i is the discount rate, and M is the number of underwriters sharing the monopoly profit, which is three in our case. Note that the right-hand side of Eq. (10) decreases with increasing M, which makes cooperation less attractive. This is where localized competition is important because it results in M being much smaller than the total number of underwriters N.

Game theory's folk theorem states that the cooperative outcome of the single-period game can be sustained in an infinitely repeated noncooperative game with a trigger strategy that makes π_N low, provided that there is a sufficiently low discount rate i to satisfy inequality (10).

In our model, the ability of the oligopolists to penalize a deviating underwriter is complicated by the fact that the observable underpricing is a stochastic outcome of expected underpricing. Thus, a grim trigger strategy involving the end of cooperation when a lower than $\dot{U}$ level of underpricing is observed is not desirable since a random shock could create lower underpricing and trigger noncooperation forever thereafter. A more implementable trigger strategy as described in Green and Porter (1984) is that the underwriters enter into a punishment state for a finite number of periods after observing a previously agreed-upon value in a trigger set. This finite punishment prevents the underwriters from entering into a punishment phase forever due to a random shock. Furthermore, the punishment could be triggered only if underpricing is sufficiently low (not merely less than $\dot{U}$).[7] Moreover, it could be conditioned on information about each underwriter's market share.[8]

With such a trigger strategy, the three underwriters can maintain the collusive underpricing level given a sufficiently low discount rate i.[9] In such a case, the three

[6] Bertrand rather than Cournot competition is assumed because it is more natural to think of underwriters competing on price rather than on quantity since underwriters play an active role in setting prices.

[7] It is reasonable to assume that the issuer makes the underwriter choice subject to some noise, as in Hoberg (2007), since the underpricing U is not perfectly observed before the issuer chooses an underwriter. This suggests that charging a level of underpricing just below the collusive underpricing $\dot{U}$ will not be enough to win all business from other underwriters. Thus, a deviating underwriter needs to charge a sufficiently lower underpricing than $\dot{U}$ so that issuers may respond. The lower underpricing needed not only limits the potential gain from deviation, but also facilitates detection.

[8] Even though the trigger set can only contain imperfectly correlated public signals of the underwriter's actions, what is important is that the underwriters know a deviation on their part increases the probability of detection, thus deterring them from cheating. Also, including additional information such as the underwriter's market share in the trigger set increases the strength of the signal and facilitates detection.

[9] Indeed, the equilibrium discussed is not unique as any level of profit can be supported up to the monopoly level with sufficient cooperative conditions. However, the equilibrium we discuss yields

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 to be 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 that have an all-star analyst in a specific industry.

From the basic model, we derive the following six implications concerning IPO underpricing:

Underpricing implication: 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 $\dot{U}=\overline{U}+((\gamma A+C)/2\gamma)$ and the underwriter without an all-star analyst charges $U=\overline{U}$.

Differential analyst influence implication: The underpricing charged for having an all-star analyst is higher for issuers with a higher perceived effect of all-star analyst coverage, A, and is higher in periods when all-star analyst coverage is more important.

The underpricing difference between underwriters with and without an all-star analyst in the issuer's industry is $(\gamma A+C)/2\gamma$. The difference increases with A, where A can vary in both the cross-section and time series.

Coverage cost implication: As the cost 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 $(\gamma A+C)/2\gamma$. As C increases, the difference increases.

Analyst turnover and deal frequency implication: 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.

If there is less than perfect autocorrelation of having an all-star analyst from year to year, the discount rate i for computing the present value of underwriter profits in Eq. (10) is equal to the relevant required return plus the per-period probability of losing an all-star analyst (i.e., i is the sum of the required return plus the decay rate). When the deal frequency is low, the discount rate per period, where a period is defined as the length of time between IPOs in an industry, is large. Thus, the discount rate i is larger the less frequent are deals in a given industry and the less persistent is the all-star status for a given underwriter's analyst. When the discount rate i exceeds a critical value, the present value condition to sustain the oligopolistic equilibrium is no longer satisfied. Thus, the ability of underwriters to charge higher underpricing disappears when the frequency of deals or the persistence of all-star status is low.

Underwriter concentration implication: The average underpricing and the Herfindahl-Hirschman Index (HHI) measuring underwriter concentration for an industry both increase as the effect of all-star analyst coverage, A, increases.[10] *Thus, HHI and underpricing should be positively correlated cross-sectionally.*

The average underpricing for the industry is

$$U_{Avg}=\left(\frac{1}{2}-\frac{C}{2\gamma A}\right)\left(\overline{U}+\frac{\gamma A+C}{2\gamma}\right)+\left(\frac{1}{2}+\frac{C}{2\gamma A}\right)\overline{U}$$

which is increasing in A. The HHI for the industry is

$$\frac{1}{3}\left(\frac{1}{2}-\frac{C}{2\gamma A}\right)^2+\frac{1}{N-3}\left(\frac{1}{2}+\frac{C}{2\gamma A}\right)^2$$

which is increasing in A for $A>(CN/\gamma(N-6))$. Holding other parameters constant, suppose we have two industries, where the value of a non-price dimension in industry 1 is A_1, the value of a non-price dimension in industry 2 is A_2, and $A_1<A_2$. Consequently, we have $HHI_1<HHI_2$ and $U_{Avg1}<U_{Avg2}$.

2.3. Perfectly observed willingness to pay

In the basic model, we assume that the distribution of θ is known, but an individual issuer i's preference or willingness to pay for all-star analyst coverage, θ_i, is unobserved. Here, we consider the case in which the values of θ_i are perfectly observable by the underwriters and derive the following implication:

Willingness to pay implication: 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.

The $N-3$ underwriters without an all-star analyst still charge underpricing of $\overline{U}$ as in the basic model. For the three underwriters with an all-star analyst, if they can observe the issuer's willingness to pay, they will price discriminate and charge U_i for issuer 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

$$M-U_i+\theta_i A=M-\overline{U} \tag{11}$$

Solving for U_i in Eq. (11) yields

$$U_i=\overline{U}+\theta_i A \tag{12}$$

At this underpricing level, the underwriter only underwrites issuers with $\theta_i>(C/\gamma A)$, for which the underwriter's profit, $\pi=(\gamma(U_i-\overline{U})-C)D_i$, is greater than zero. Due to the cost of all-star analysts, it is not in the best interest of the underwriters to provide underwriting service coupled with all-star analyst research coverage to all issuers in a given industry. Since underwriters charge $U_i=\overline{U}+\theta_i A$, an issuer with a higher θ_i pays a higher U_i than an issuer with a lower θ_i.

Issuers with a greater willingness to pay for all-star coverage (a high θ_i) may include those IPOs that are VC-backed. Venture capitalists are rationally focused on

(*footnote continued*)
the maximum profit for the three underwriters, and thus is of more interest than other equilibria.

[10] The HHI for an industry is the sum of the squared market shares of the underwriters in that industry, and is bounded above by 1.0 for a monopolistic industry and is bounded below by zero for an industry composed of atomistic competitors.

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 beginning when the "lock-up" period expires, usually 180 days after the IPO. A common measure of the performance of venture capitalists is the internal rate of return realized by their limited partners, calculated using the market price on the distribution dates. 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 distributions. Consequently, they are much more focused on the intermediate-term stock price than on the long-run performance of the company. Thus, based on our willingness to pay implication, we propose a new theory of the underpricing of VC-backed IPOs: the analyst lust theory.[11]

Analyst lust theory of the underpricing of VC-backed IPOs: Because venture capitalists have a greater preference 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.

In contrast to our analyst lust theory's prediction that VC-backed IPOs should have higher underpricing, the certification theory predicts less underpricing for VC-backed IPOs because VC-backing can certify the fairness of IPO pricing due to reputation concerns (Barry, Muscarella, Peavy, and Vetsuypens, 1990; Megginson and Weiss, 1991; Li and Masulis, 2007; Krishnan, Ivanov, Masulis, and Singh, in press).

Additionally, two more papers discuss the underpricing of VC-backed IPOs. The grandstanding theory predicts that young VCs are more likely to bring their portfolio companies to the market sooner (Gompers, 1996). Combined with the hypothesis that underpricing compensates for risk, the grandstanding theory predicts more underpricing for the IPOs of younger venture capital organizations.[12] The grandstanding theory generates a cross-sectional prediction, but does not necessarily make a prediction regarding the underpricing of VC-backed IPOs relative to other IPOs. Another paper, by Hoberg and Seyhun (2009), posits that VC-backed IPOs will be underpriced more than other IPOs, but their rationale is different from ours—they assume that venture capitalists exchange favors with underwriters, whereas our game-theoretic model does not involve any quid pro quo arrangement between these players.

[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 employed by 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] This effect should be mitigated in regressions that include other risk proxies such as ln(assets) and tech and Internet dummies. Table 5 of Gompers (1996) reports that, controlling for other firm characteristics, there is more underpricing for IPOs backed by less experienced venture capitalists.

2.4. Model extensions

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

3. Data

The full sample is composed of 7,319 U.S. IPOs from 1980 to 2008 meeting criteria that are common in the empirical IPO literature. The tests in Section 5 that involve all-star analysts are conducted on a subsample of 4,510 IPOs that starts in 1993 because our all-star analyst coverage variable is available only for years 1993–2008, mainly due to the availability of Thomson Reuters' I/B/E/S recommendations database starting in year 1993.[13]

The IPO data are from Thomson Financial's new issues database with hundreds of fill-ins of missing data and corrections based upon information from Dealogic for 1990–2008, the Graham Howard-Todd Huxster set of IPO prospectuses from 1975 to 1996 given to Jay Ritter, EDGAR for 1996–2008, and other sources. We exclude closed-end funds, REITs, SPACs, ADRs, banks and S&Ls, unit offers, partnerships, IPOs with an offer price of less than $5.00 per share, and IPOs not listed on CRSP within six months of issuing. We also exclude 22 IPOs using auctions rather than bookbuilding because of the lack of underwriter discretion in allocating shares. The appendix provides a detailed description of the variables used in our analysis, and a listing of the data sources.

4. The nature of the IPO underwriting market's competitive environment

Before testing the model implications, it is worth noting several aspects of the IPO underwriting market that are suggestive of its competitive structure and the evolution of this structure over time. The patterns are documented in Internet Appendix Figs. IA–1 through IA–3.

First, for moderate-size IPOs, there is little competition on the basis of gross spreads. In all but 1 year beginning in 1995, 90% or more of moderate-size IPOs have paid gross spreads of exactly 7%. The clustering at 7% is the basis for

[13] I/B/E/S is far from comprehensive in its analyst recommendations file. In collaboration with Dan Bradley, Jonathan Clarke, Lily Fang, Ayako Yasuda, and others, we augment I/B/E/S recommendations from lead underwriter analysts in the year following the IPO with information from Bloomberg, Briefing.com, First Call, Investext, and online searches to identify initiations.

our model's treatment of the gross spread as exogenous and underpricing as endogenous.

Second, top-tier underwriters (those with a Carter-Manaster rank of 8 or above) are able to provide many ancillary services. The market share of IPO lead underwriter positions for the 20 or so top-tier underwriters has been over 50% in every year since 1985, and over 70% in every year beginning in 1999.

Third, there has been an uptrend in the number of managing underwriters and the number of bookrunners per IPO. One of the reasons for adding more managers is to secure more analyst coverage.

All three of these patterns are consistent with the view that underwriters compete on non-price dimensions to win business.

5. All-star analyst coverage

In the empirical analysis, we focus on the all-star analyst dimension because it is narrow and well-defined, thus providing a good setting to test our model implications. However, we test the main model underpricing implication on other non-price dimensions in Section 6 to demonstrate the applicability of our theory beyond the all-star analyst dimension.

In this section, we test the five model implications concerning the relation between all-star analyst coverage and underpricing. In particular, we test whether IPOs with all-star analyst coverage from a lead underwriter are more underpriced than those without (*underpricing implication*). We also test whether all-star analyst coverage is associated with more underpricing when all-star analyst coverage has a greater effect on value (*differential analyst influence implication*) or when the cost of all-star analyst coverage is higher (*coverage cost implication*). In addition, we test whether the underpricing associated with all-star analyst coverage is lower in periods when there are few deals (*deal frequency implication*). We do not test whether underpricing is lower when all-star analyst turnover is higher (*analyst turnover implication*) because there is insufficient time-series variation in analyst turnover. Lastly, we test whether issuers with a higher willingness to pay for all-star analyst coverage have even more underpricing (*willingness to pay implication*). We identify issuers with a greater willingness to pay as those that are VC-backed, based on our analyst lust theory of VC-backed IPOs.

5.1. The all-star analyst coverage variable

By far the best measure of who institutional investors consider to be the most influential analysts covering specific industries is the annual ranking in *Institutional Investor* (*II*) magazine's October issue. 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 sell-side analysts achieve this designation 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, 2010), Hao (2011), Liu and Ritter (2010), 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 untabulated analysis, we calculate the probability of retaining all-star status in year $t+1$ if an analyst was an all-star in year t, for $t=1983$–2007. We find that 75% of all-stars (top three) in year t repeat as an all-star in year $t+1$. Of the 25% 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. These probabilities are similar to the numbers reported by Fang and Yasuda (2010).

5.2. The effect of all-star coverage on underpricing

To test the *underpricing implication*, we estimate the quantitative effect on IPO underpricing of all-star analyst coverage while holding other variables constant. Table 1 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), 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.[14] We also include industry fixed effects based on 49 Fama-French (1997) industries and year fixed effects in all but the first two regressions.[15] To account for error dependencies across industry and year, the standard errors are adjusted for two-dimensional clustering at the industry and year level.

[14] 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.

[15] Fama-French industries are defined on the basis of four-digit SIC codes. We use the 49 industries as defined on Ken French's Web site rather than the 48 industries defined in the published article. The primary difference is that the old industry, computers, has been split into hardware and software, with some software companies that were previously grouped into business services moved into computer software.

Table 1
IPO underpricing regressions with an all-star analyst coverage dummy.

The sample in columns 1–4 includes 4,510 U.S. operating firm IPOs from 1993 to 2008 with an offer price of at least $5 and meeting other criteria. The subperiod samples in columns 5–7 have average first-day returns of 15.9%, 64.5%, and 12.1%, respectively, with an average over the entire sample of 24.4%. The dependent variable in all regressions is the percentage return from the offer price to the first-day closing price. The Top-tier dummy equals one (zero otherwise) if the lead underwriter has an updated Carter and Manaster (1990) rank of 8 or more. ln(Assets) is the natural logarithm of the firm's pre-issue book value of assets in millions of dollars. The Internet dummy equals one (zero otherwise) if the firm is in the Internet business. Share overhang is the ratio of retained shares to the public float (the number of shares issued). The VC dummy equals 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 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 2001–2008. Year fixed effects based on the IPO year and industry fixed effects based on the 49 Fama-French industries are included, where the coefficients are not reported for brevity. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry.

	(1) All IPOs	(2) All IPOs	(3) All IPOs	(4) All IPOs	(5) 1993–1998	(6) 1999–2000	(7) 2001–2008
Top-tier dummy	5.90	5.84	5.58	4.21	2.89	13.03	4.03
	(1.70)	(1.83)	(1.74)	(1.52)	(1.20)	(0.83)	(2.78)
Ln(Assets)	−2.38	−2.33	−2.38	−2.70	−2.12	−4.57	−0.98
	(−3.14)	(−4.14)	(−3.75)	(−3.59)	(−5.71)	(−2.81)	(−1.60)
Internet dummy	28.41	26.01	24.65	24.31	29.37	23.81	0.85
	(5.67)	(5.09)	(4.76)	(4.91)	(1.76)	(3.54)	(0.30)
Share overhang	5.05	4.92	5.06	4.94	2.44	8.81	2.02
	(3.35)	(3.34)	(3.23)	(3.38)	(5.79)	(3.55)	(3.77)
VC dummy	5.00	5.65	5.79	5.89	0.43	24.69	5.49
	(1.46)	(1.92)	(1.89)	(1.97)	(0.30)	(3.03)	(3.88)
All-star dummy	–	–	–	8.82	4.62	18.81	0.82
				(2.56)	(2.80)	(7.11)	(0.62)
Bubble dummy	23.83	24.03	–	–	–	–	–
	(4.66)	(4.28)					
Post-bubble dummy	−5.06	−2.95	–	–	–	–	–
	(−2.58)	(−1.87)					
Year fixed effects	No	No	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes
N	4,510	4,510	4,510	4,510	2,796	853	861
R^2_{adj}	26.2%	27.1%	27.4%	27.8%	14.4%	21.2%	13.1%

The main variable of interest is 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:

$$\begin{aligned} \text{First-day return}_i = {} & a_0 + a_1 \text{ Top Tier Underwriter dummy}_i \\ & + a_2 \ln(\text{Assets})_i + a_3 \text{ Internet dummy}_i \\ & + a_4 \text{ Share overhang}_i \\ & + a_5 \text{ VC dummy}_i + a_6 \text{ All-star dummy}_i \\ & + \sum_{j=1}^{48} c_j \text{ Industry dummy}_j \\ & + \sum_{t=1}^{T-1} d_t \text{ Year dummy}_t + e_i, \end{aligned} \tag{13}$$

where Industry dummy$_j$ is the industry fixed effect for industry j, Year dummy$_t$ is the year fixed effect for year t, and e_i is the residual for IPO i.

We also include a top-tier underwriter dummy in the model specification, measuring whether the IPO had a top-tier lead underwriter (equal to one if the updated Carter-Manaster ranking was 8 or above on a 1–9 scale). This measure can be used 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. As long as issuers care about underwriter quality, prestigious underwriters are expected to earn rents. This logic predicts a positive relation between underwriter reputation and the level of underpricing, in contrast to the negative relation predicted by certification models. Although we include the top-tier underwriter dummy here as one of the standard controls, we defer further discussion to Section 6 when the full 1980–2008 sample is used for estimation. We do not include in our regression a price revision variable, measured as the percentage change from the midpoint of the filing range to the offer price. This variable has high predictive power, but it is very likely to be endogenous.[16]

In column 1 of Table 1, we present the baseline regression results without industry and year fixed effects, but using a coarser set of time controls, the bubble and post-bubble dummies. Adding the industry fixed effects in column 2

[16] In the later part of the 1990s and 2000, underwriters used a "walkup strategy" for some IPOs, where the file price was set low intentionally, with the expectation of an upward revision in order to create the impression of a "hot issue." Not all issuers will agree to this walkup strategy because there is a risk that the underwriters will use their bargaining power to ex-post take advantage of the issuer and set the offer price too low (i.e., hold up the issuer). This holdup risk may be of less concern for the issuers with a preference for the non-price dimensions of underwriting since they are less focused on maximizing the IPO proceeds, which suggests a positive relation between the usage of a walkup strategy and the non-price dimensions. This relation poses a problem with estimating the effect of the non-price dimensions on underpricing if the price revision is included, since part of the effect of the non-price dimension variables is captured by the price revision. We test the above implications empirically and, in unreported results, find patterns consistent with these predictions.

increases the R^2 by 0.9% from 26.2% to 27.1%. Using year fixed effects in column 3 instead of the period dummies increases the R^2 slightly to 27.4%. In column 3, where regression results without the all-star dummy are reported, the top-tier dummy has a coefficient of 5.58 (t=1.74), implying 5.58% 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 certification hypothesis.

In column 4 of Table 1, we add the all-star dummy as one of the independent variables. The new addition increases the R^2 by 0.4% from 27.4% to 27.8%. The coefficient of 8.82 (t=2.56) on the all-star dummy indicates that IPOs with all-star analyst coverage from a lead underwriter are 8.82% more underpriced than those without, which is consistent with our *underpricing implication*. This significantly positive coefficient estimate is consistent with, although a bit smaller than, the coefficient reported in Cliff and Denis (2004) for 1993–2000.

When the all-star dummy is added, the coefficient on the top-tier dummy drops from 5.58 (t=1.74) to 4.21 (t=1.52), a decrease of 1.37. 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 in our sample 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.[17] Since about 18% of IPOs in our sample have all-star coverage, the quantitative effect of the omitted variable bias should be $0.18 \times 8.82 \times 0.96 = 1.52$, which is close to the actual change of 1.37 in the top-tier coefficient.

The subperiod results are presented in columns 5–7 of Table 1. The coefficient on the all-star dummy is higher in the bubble period than in the pre- and post-bubble periods. In particular, the coefficient on the all-star dummy in 2001–2008 is small and statistically insignificant. We take note of this pattern here and defer further discussions to subsequent sections.

5.3. The varying effect of analyst coverage on underpricing

Our *differential analyst influence implication* suggests that the effect of all-star analyst coverage on underpricing should be greater for issuers when all-star analyst coverage has a larger effect on market value (a higher A) and should be greater in periods when all-star analyst coverage is more valuable. Based on the idea that analyst coverage is more valuable for firms with more growth options relative to assets in place, we use assets and age as proxies for the value of A, since smaller firms and younger firms among the IPO universe derive more of their value from growth options, and thus receive greater benefits from coverage by influential analysts. Moreover, since IPOs in the technology industry are difficult to value for many investors, and they frequently derive most of their value from growth options, we posit that they also tend to have a higher value of A.

In order to test how underpricing changes with the varying value of all-star analyst coverage both cross-sectionally and over time, we use industry Tobin's Q as a measure of firm growth options to proxy for the importance of all-star analyst coverage. For an IPO, its Industry-year Q is calculated as the median Tobin's Q of firms in the same Fama-French 49 industry classification in the IPO calendar year using the entire COMPUSTAT universe. Thus, if firms in some industries derive more value from growth options during some periods, the yearly Tobin's Q measure would capture the higher values of A.

We test each of these proxies for the value of analyst coverage in columns 1–4 of Table 2 separately. In column 1, we add an interaction of ln(Assets) and the all-star analyst dummy to the Table 1, column 4 specification. The coefficient of the interaction term is -4.55 (t=-2.47), which has the predicted sign, suggesting that IPOs with smaller assets pay a higher price for all-star analyst coverage in terms of percentage underpricing. For instance, a small firm with \$20 million in total assets pays $30.99 - 4.55 \times \ln(20) = 17.4\%$ in underpricing, while a larger firm with \$200 million in total assets pays $30.99 - 4.55 \times \ln(200) = 6.9\%$ in underpricing. When age is used in column 2, a negative coefficient of -4.84 (t=-1.59) is observed as predicted, although it is not statistically significant at conventional levels. Similarly, when we test the interaction of a technology dummy and the all-star dummy in column 3, we observe a positive coefficient as predicted, with a point estimate of 20.17 (t=6.81).

In column 4, we add Industry-year Q and an interaction of Industry-year Q and the all-star dummy. The *differential analyst influence implication* suggests that the effect of all-star analyst coverage on underpricing is greater when the effect of all-star analyst coverage is larger, as we expect it to be when industry Tobin's Q is higher, predicting a positive coefficient on the interaction term. The coefficient on the interaction term is 10.30 (t=9.76), consistent with the prediction. In terms of its economic interpretation, this coefficient implies that in an industry that has changed from no growth options (a Tobin's Q of one) to deriving half of its value from growth options (a Tobin's Q of two), IPOs in the industry are expected to pay 10.30% more in underpricing when they hire an underwriter providing all-star coverage.

Including the interaction terms in regressions can introduce a multicolinearity problem. To detect the presence of this problem, we calculate variance inflation factors (VIFs) for the interaction terms and report the

[17] 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, i.e., 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.

Table 2
IPO underpricing regressions with all-star analyst dummy and interactions.

The sample includes 4,510 U.S. operating firm IPOs from 1993 to 2008. The dependent variable in all regressions is the percentage first-day return. Age is the difference between the IPO year and the founding year. The Tech dummy equals one (zero otherwise) if the firm is in the technology or Internet business. Industry-year Q is the median Tobin's Q of firms in the same industry in the IPO year using the entire Compustat universe. The other explanatory variables are defined in the appendix. Year fixed effects based on the IPO year and industry fixed effects based on the 49 Fama-French industries are included, where the coefficients are not reported for brevity. Interaction term VIF reports the variance inflation factor for the interaction term in the corresponding regression. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry.

	(1)	(2)	(3)	(4)
Top-tier dummy	2.96	4.10	4.76	4.20
	(1.21)	(1.49)	(1.62)	(1.56)
Ln(Assets)	−1.61	−2.41	−2.68	−2.51
	(−3.70)	(−4.01)	(−3.42)	(−3.80)
Internet dummy	24.19	23.61	26.52	23.78
	(4.88)	(4.98)	(4.38)	(5.72)
Share overhang	4.82	4.82	4.72	4.86
	(3.44)	(3.45)	(3.30)	(3.39)
VC dummy	5.60	5.48	5.66	5.95
	(1.95)	(1.93)	(1.89)	(1.92)
All-star dummy	30.99	20.07	0.26	−10.55
	(2.70)	(2.03)	(0.24)	(−5.81)
Ln(1+Age)	–	−0.25	–	–
		(−0.38)		
Tech dummy	–	–	−10.56	–
			(−1.74)	
Industry-year *Q*	–	–	–	10.24
				(3.61)
Ln(Assets) × All-star dummy	−4.55	–	–	–
	(−2.47)			
Ln(1+Age) × All-star dummy	–	−4.84	–	–
		(−1.59)		
Tech dummy × All-star dummy	–	–	20.17	–
			(6.81)	
Industry-year *Q* × All-star dummy	–	–	–	10.30
				(9.76)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Interaction term VIF	9.37	6.43	2.06	6.61
N	4,510	4,510	4,510	4,510
R^2_{adj}	28.2%	28.0%	28.5%	28.9%

results in Table 2. A common rule of thumb is treating any VIF in excess of 10.0 as evidence of multicolinearity. While none of the VIFs reported in Table 2 exceed 10.0, in unreported regressions, we conduct additional robustness checks for specifications with high VIFs (greater than 5.0) by partitioning the sample into two subsamples based on the variable of interest (assets, age, and industry-year Q) and running a separate regression for each subsample and compare the coefficients on the all-star dummy. We find similar results using the subsample tests, suggesting that the significant results in Table 2 are not driven by multicolinearity.

Finally, the *differential analyst influence implication* can also help to explain the subperiod results in Table 1 that we noted earlier. The average Industry-year Q increased from 1.74 to 2.35 between 1993–1998 and 1999–2000, which suggests that the coefficient on the all-star dummy should be greater in the bubble period than in the pre-bubble period. This prediction is confirmed in Table 1, where the all-star dummy coefficient is 4.62 (t=2.80) in the pre-bubble period and 18.81 (t=7.11) in the bubble period, where the two coefficients are statistically different from each other at the 1% level. Moreover, the low coefficient of 0.82 (t=0.62) on the all-star dummy for the post-bubble period may be partly due to the declining value of all-star analyst coverage, as measured by a lower Tobin's Q of 1.79.

The low coefficient on the all-star dummy in 2001–2008 may also be partly due to the implementation of Regulation Fair Disclosure (Reg FD) in October 2000, which would not be captured by the Tobin's Q proxy. Reg FD 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.

5.4. The effect of varying cost of all-star analyst on underpricing

In Table 3, we test the *coverage cost implication* that a higher cost of all-star analyst coverage is associated with

Table 3
IPO underpricing regressions with proxies for the cost of all-star analyst coverage.

The sample includes 4,510 U.S. IPOs from 1993 to 2008. The dependent variable in all OLS regressions is the percentage first-day return. Number of firms covered is the number of firms covered by the all-star analyst during the 1 year prior to the IPO. Busy dummy equals one (zero otherwise) if the number of firms covered is greater than ten. The other explanatory variables are defined in the appendix. Year fixed effects based on the IPO year and industry fixed effects based on the 49 Fama-French industries are included, where the coefficients are not reported for brevity. Interaction term VIF reports the variance inflation factor for the interaction term in the corresponding regression. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry.

	(1)	(2)
Top-tier dummy	4.14	4.15
	(1.51)	(1.51)
Ln(Assets)	−2.70	−2.70
	(−3.57)	(−3.58)
Internet dummy	24.28	24.30
	(4.89)	(4.88)
Share overhang	4.94	4.93
	(3.38)	(3.39)
VC dummy	5.92	5.89
	(1.97)	(1.96)
All-star dummy	5.89	6.63
	(2.60)	(2.62)
Number of firms covered × All-star dummy	0.38	–
	(1.19)	
Busy dummy × All-star dummy	–	6.45
		(1.24)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Interaction term VIF	2.00	1.47
N	4,510	4,510
R^2_{adj}	27.8%	27.8%

higher underpricing. One way to measure the varying cost of all-star analysts is to examine capacity constraints. An analyst covers a limited number of firms. Thus, the marginal cost is higher if an analyst at full capacity is asked to cover another firm.[18] This translates into the prediction that the more firms the analyst is covering before the IPO, the higher is his or her cost of covering a particular IPO, thus demanding higher underpricing.

For each IPO covered by an all-star analyst, we use I/B/E/S to find the number of firms the analyst is covering during the 1 year before the IPO. The median number of firms covered is ten, which may be an underestimation since the I/B/E/S universe does not have complete analyst coverage for all firms. We interact the number of firms covered with the all-star dummy in column 1 of Table 3. The coefficient on the interaction term is 0.38 (t=1.19), which is positive but statistically insignificant. In column 2, we transform the number of firms covered variable into a busy dummy that equals one if the number of firms covered is greater than the median value of ten. The coefficient on the interaction between the busy dummy and the all-star dummy is 6.45 (t=1.24), again positive, but lacking statistical significance.

5.5. *The effect of IPO frequency on underpricing*

The *deal frequency implication* states 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 an industry, is large. Since the oligopolistic pricing equilibrium is less sustainable when the discount rate per period is high, there should be less underpricing when the deal frequency in an industry is low.

To test this implication, we estimate the expected industry volume based on past industry volume. In particular, for each IPO, we calculate the number of IPOs that went public in the same Fama-French 49 industry in the previous calendar year. We run the regression specified in Eq. (13) for IPOs with low lagged industry volume and high lagged industry volume separately in columns 1 and 2 of Table 4. When the sample of IPOs with low lagged industry volume (ten or fewer firms) is used, the coefficient on the all-star dummy is 1.74 (t=0.85). This low and insignificant coefficient on the all-star dummy contrasts with a coefficient of 14.20 (t=3.87) for IPOs with high lagged industry volume (more than ten firms).[19]

Similarly, when an interaction of the natural logarithm of lagged industry volume and the all-star dummy is added in column 3 of Table 4 using the entire sample of 4,510 IPOs during 1993–2008, the coefficient on the interaction term is 5.39 (t=3.79), which suggests that higher lagged industry volume is associated with a greater effect of all-star analyst coverage on underpricing, consistent with the prediction. The coefficient on the lagged industry volume is statistically insignificant, consistent with the finding in Lowry and Schwert (2002) that past IPO volume is not related to future IPO underpricing. In the column 3 regression, although the all-star dummy has a value of −4.23 (t=−1.77), when combined with an interaction coefficient of 5.39 and a value of lagged volume of $\ln(1+27.8)=3.36$ for the mean industry, the implied effect of all-star coverage in the 1993–2008 period is $-4.23+5.39\times3.36=13.9$, or 13.9% more underpricing for an industry with average volume.[20]

In terms of time-series patterns, the average industry volume in the prior year for IPOs from 1993 to 1998, 1999 to 2000, and 2001 to 2008 is, respectively, 26.8, 50.3, and

[18] Sell-side analysts are paid indirectly out of revenue generated from investment banking deals that they assist in attracting and soft dollars paid by institutional investors. Since institutional investors care more about large capitalization firms, foregoing coverage on one of these stocks to cover an IPO creates an opportunity cost for the analyst due to the foregone soft dollar revenue.

[19] In unreported results, industry volume based on the past 2 years, rather than 1 year, or a lower cutoff point of five instead of ten IPOs, yield similar results.

[20] Since the volume for certain industries may be higher in the bubble period, there is some concern that the volume result may be driven by higher underpricing in the bubble period in general. Although we already control for year fixed effects, we address this concern further by running the Table 4 regressions without the bubble period. The regressions (unreported) yield similar qualitative results. Furthermore, we use a weighted least squares estimation where the weights are the inverse of the number of IPOs in a given year. This reduces the influence of the bubble period, and again similar results are observed.

Table 4
IPO underpricing regressions with industry volume and all-star analyst variables.

The sample in column 1 includes 1,645 U.S. IPOs for which ten or fewer firms in its corresponding Fama-French (1997) 49 industry went public in the previous year. The sample in column 2 includes 2,865 U.S. IPOs for which more than ten firms of its industry went public in the previous year. The sample in column 3 includes 4,510 U.S. operating firm IPOs in 1993–2008. The dependent variable in all OLS regressions is the percentage first-day return. ln(1+Lagged IndVolume) is the natural logarithm of the number of IPOs in the same industry that went public in the previous calendar year before an IPO. Ln(1+Lagged IndVolume) × All-star dummy is an interaction of Ln(1+Lagged IndVolume) and the all-star dummy. The other explanatory variables are defined in the appendix. Year fixed effects based on the IPO year and industry fixed effects based on the 49 Fama-French industries are included, where the coefficients are not reported for brevity. Interaction term VIF reports the variance inflation factor for the interaction term in the corresponding regression. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry.

	(1) Volume ≤ 10	(2) Volume > 10	(3) All IPOs
Top-tier dummy	2.31	4.81	4.43
	(1.24)	(1.48)	(1.56)
Ln(Assets)	−2.04	−3.11	−2.66
	(−3.54)	(−3.38)	(−3.76)
Internet dummy	25.13	21.73	24.08
	(1.83)	(6.56)	(4.79)
Share overhang	3.95	5.27	4.77
	(3.48)	(3.46)	(3.43)
VC dummy	2.26	7.21	5.63
	(1.66)	(1.78)	(1.95)
All-star dummy	1.74	14.20	−4.23
	(0.85)	(3.87)	(−1.77)
Ln(1+Lagged IndVolume)	–	–	−1.16
			(−0.88)
Ln(1+Lagged IndVolume) × All-star dummy	–	–	5.39
			(3.79)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Interaction term VIF	–	–	4.11
N	1,645	2,865	4,510
R^2_{adj}	21.3%	28.6%	28.1%

8.9. The particularly low volume in the post-bubble period can partially explain the low coefficient on the all-star dummy in this period observed in column 7 of Table 1.

5.6. The analyst lust theory of VC-backed IPOs

The *willingness to pay implication* posits that if underwriters can infer the issuer's willingness to pay, the underwriters will engage in price discrimination and leave more money on the table. In Section 2.3, the analyst lust theory of underpricing for VC-backed IPOs was described, and we test this hypothesis here. In the underpricing regressions, we use the interaction between the all-star analyst and VC dummies to measure the incremental effect of coverage from an all-star analyst for VC-backed IPOs. The model specification is

$$\begin{aligned}\text{First-day return}_i &= a_0 + a_1 \text{ Top Tier Underwriter dummy}_i\\ &\quad + a_2 \ln(\text{Assets})_i + a_3 \text{ Internet dummy}_i\\ &\quad + a_4 \text{ Share overhang}_i\\ &\quad + a_5 \text{VC dummy}_i + a_6 \text{ All-star dummy}_i\\ &\quad + a_7 \text{VC All-star dummy}_i\\ &\quad + \sum_{j=1}^{48} c_j \text{Industry dummy}_j + \sum_{t=1}^{T-1} d_t \text{ Year dummy}_t + e_i. \end{aligned} \tag{14}$$

Column 1 of Table 5 includes an interaction of the VC dummy and the all-star analyst coverage dummy. The coefficient on the interaction term is 18.03 (t=5.59), which is economically important and is consistent with the analyst lust theory of the underpricing of VC-backed IPOs. When the interaction term is added, the coefficient on the VC dummy is 2.88 (t=1.37). This estimate can be compared with the value of 5.89 (t=1.97) on the VC dummy in column 4 of Table 1, where the interaction term is not included.

With the inclusion of the VC × All-star dummy interaction, the coefficient on the VC dummy drops more than 50% from a reliably positive value of 5.89 to a statistically insignificant 2.88. Since 38.8% of IPOs are VC-backed and 7.1% of IPOs are both VC-backed and covered by an all-star analyst, the coefficient of 18.03 on the VC × All-star dummy interaction term suggests that the effect of the interaction on the VC dummy coefficient should be 18.03 × 0.071/0.388 = 3.29, which is close to the actual change of 3.01 in the VC dummy coefficient from 5.89 to 2.88. In both cases, the positive coefficients on the VC dummy are inconsistent with the certification theory, which predicts a negative coefficient.

At the same time, the coefficient on the all-star dummy drops from a reliably positive value of 8.82 in column 4 of Table 1 to a statistically insignificant 1.53 (t=0.60) in column 1 of Table 5. Taking the sum of the interaction term and the all-star dummy coefficients (18.03 + 1.53 = 19.56), our point estimate is that VC-backed IPOs are underpriced by 20% more when they have all-star coverage than when they do not. In other words, the evidence is that VC-backed firms are

Table 5
IPO underpricing regressions with venture capital and all-star analyst coverage.

The sample in columns 1 and 5 includes 4,510 U.S. IPOs from 1993 to 2008. Columns 2–4 include subperiod results for 1993–1998, 1999–2000, and 2001–2008, respectively. The dependent variable in all OLS regressions is the percentage first-day return. The VC × All-star dummy is an interaction of the venture capital (VC) dummy with the All-star dummy. The other explanatory variables are defined in the appendix. Year fixed effects based on the IPO year and industry fixed effects based on the 49 Fama-French industries are included, where the coefficients are not reported for brevity. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry.

	(1) All IPOs	(2) 1993–1998	(3) 1999–2000	(4) 2001–2008	(5) All IPOs
Top-tier dummy	4.82	3.22	13.70	4.04	4.48
	(1.68)	(1.33)	(0.91)	(2.78)	(1.65)
Ln(Assets)	−2.54	−2.05	−4.32	−0.98	−2.40
	(−3.47)	(−5.69)	(−2.18)	(−1.58)	(−3.60)
Internet dummy	24.01	29.51	23.75	0.83	23.42
	(4.81)	(1.77)	(6.44)	(0.30)	(5.39)
Share overhang	4.74	2.34	8.72	2.02	4.71
	(3.34)	(6.15)	(3.41)	(3.64)	(3.32)
VC dummy	2.88	−1.12	21.54	5.34	4.13
	(1.37)	(−0.89)	(5.71)	(2.92)	(1.73)
All-star dummy	1.53	0.72	9.40	0.54	−14.78
	(0.60)	(0.45)	(0.71)	(0.29)	(−4.77)
VC × All-star dummy	18.03	11.58	13.98	0.94	11.17
	(5.59)	(3.32)	(1.06)	(0.20)	(2.61)
Industry-year *Q*	–	–	–	–	11.29
					(4.22)
Industry-year *Q* × All-star dummy	–	–	–	–	6.07
					(3.99)
Ln(1+Lagged IndVolume)	–	–	–	–	−0.05
					(−0.03)
Ln(1+Lagged IndVolume) × All-star dummy	–	–	–	–	2.82
					(3.93)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Interaction term VIF	1.97	1.69	3.54	1.62	–
N	4,510	2,796	853	861	4,510
R^2_{adj}	28.3%	14.9%	21.2%	13.0%	29.1%

underpriced by more, but only when they receive coverage from an all-star analyst employed by a bookrunner.

As mentioned previously, the high average industry Tobin's *Q* during 1999–2000 suggests that all-star analyst coverage is more valuable during the bubble period. Thus, the *differential analyst influence implication* suggests that the VC × All-star interaction coefficient should be higher for the 1999–2000 subperiod than for the other subperiods. In columns 2–4 of Table 5, we report subperiod results for 1993–1998, 1999–2000, and 2001–2008. For the 1993–1998 subperiod in column 2, the coefficient on the VC × All-star interaction dummy variable is 11.58 (t=3.32). For the bubble subperiod in column 3, the coefficient on the interaction dummy is 13.98 (t=1.06), which is slightly higher than the coefficient for the pre-bubble period, but the estimate lacks statistical significance due to the high variance in underpricing during this period. In column 4, IPOs from the post-bubble period of 2001–2008 are used and both the all-star and the interaction dummies are close to zero, possibly because of the reduced importance of analyst research due to regulatory changes. Additionally, the lower point estimate for 2001–2008 is also consistent with the *deal frequency implication*, which predicts a smaller effect when deal frequency is low.

Overall, Table 5 results suggest that a large portion 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. Thus, it is important to account for the effect of all-star analysts when measuring the effect of VC-backing on underpricing. If the interaction between the all-star analyst and VC dummies is missing from the regression, the estimate of the VC coefficient is overstated.

On a different note, the results in Table 5 suggest that non-VC-backed IPOs with all-star analysts are not more underpriced than other IPOs, since the coefficient on the all-star dummy in column 1 of Table 5 is not reliably different from zero. This raises two questions. First, when we control for the finding that VC-backed IPOs with all-star analysts are more underpriced, do the interaction results in Tables 2 and 4 still hold? Second, since the VC × All-star interaction results are consistent with the notion that VCs have special pricing objectives, does this also suggest that VC-backed and non-VC-backed IPOs are priced differently in other aspects? We examine these two questions next.

To address the first question, in addition to the VC × All-star interaction in the underpricing regression, we add an Industry-year *Q* × All-star dummy interaction to test for the *differential analyst influence implication* and a ln(1+Lagged IndVolume) × All-star dummy interaction to test for the *deal frequency implication*. We do not include other proxies of firm growth options to avoid a multicolinearity problem and we do not test the *coverage cost implication* here since it yielded insignificant results when previously tested. The regression results are reported in column 5 of Table 5. The main variables of interest are the three interaction terms, where the VC × All-star dummy interaction has a coefficient of 11.17 (t=2.61), the Industry-year Q × All-star dummy interaction has a coefficient of 6.07 (t=3.99), and the Ln(1 + Lagged IndVolume) × All-star dummy interaction has a coefficient of 2.82 (t=3.93). All three interaction terms are positive and significant, which suggests that controlling for the presence of VC-backed IPOs with all-star analysts does not subsume the findings of earlier tests.

In order to address the second question of how VC-backed and non-VC-backed IPOs are priced differently in the context of our theory, we proceed in two steps. In step one, we focus on the all-star analyst dimension and test how underpricing varies along its different aspects for IPOs with and without VC-backing. In step two, we focus on the other non-price dimensions and test how their effects on underpricing differ for VC-backed and non-VC-backed IPOs. We undertake step one here and defer the analysis of the second step to Section 6 when the other non-price dimensions are examined.

In Table 6, we test each of the model implications for the all-star analyst dimension on VC-backed and non-VC-backed IPOs separately. The VC-backed IPO sample consists of 1,751 IPOs, or 38.8% of the 4,510 IPOs. 321 (18.3%) of the 1,751 VC-backed IPOs and 505 (18.3%) of the 2,759 non-VC-backed IPOs are covered by an all-star analyst from the lead underwriter. First, we note that most of the interaction term coefficients in Panels A to G of Table 6 are significant in the VC-sample, while they are mostly not significant in the non-VC sample. Second, the magnitudes of the interaction term coefficients suggest that the effect of all-star analyst coverage on underpricing is more sensitive in the VC sample than in the non-VC sample to proxies for the importance of all-star coverage, the cost of analyst coverage, and IPO frequency, although the differences are not always statistically significant. For instance, the coefficient on the Ln(Assets) × All-star dummy interaction in Panel A is −12.12 (t=−10.18) in the VC sample, which is seven times the coefficient of −1.62 (t=−0.91) in the non-VC sample. The interaction terms in the other panels also exhibit similar patterns, with the exception of Panel D, where the coefficient on the Industry-year Q × All-star dummy interaction is higher in the non-VC sample (although it is less significant).

Overall, the results in Table 6 highlight the importance of the all-star analyst dimension to VC-backed IPOs. The empirical evidence is consistent with our hypothesis that VCs are more focused on the intermediate-term value of the firm over which influential analysts can exert more influence. Their special objective suggests that VCs have a higher willingness to pay for all-star analysts using underpricing and are more sensitive to different aspects of the all-star analyst dimension.

5.7. Costs and benefits of all-star analyst coverage to issuers

We can calculate the incremental money left on the table due to all-star analyst coverage as $(OP_{nostar}-OP_{star})N_{issued}$, where OP_{nostar} is the offer price in the absence of all-star analyst coverage, OP_{star} is the offer price with all-star analyst coverage, and N_{issued} is the number of shares issued in the IPO. We can estimate the offer price without all-star analyst coverage as $OP_{nostar}=P_1/(P_1/OP_{star}-0.0882)$, where P_1 is the first-day closing price, OP_{star} is the offer price observed, and 0.0882 is the coefficient on all-star coverage from the regression in column 4 of Table 1, expressed as a decimal rather than a percentage. The money left on the table due to all-star analyst coverage is then estimated to be $17.5 billion in total for the 826 firms with an all-star analyst, or an average of $21 million per firm.

The benefits of all-star analyst coverage to issuers are more difficult to quantify since some benefits are indirect. As a start, in untabulated results, we estimate the announcement returns to analyst recommendation initiations, reiterations, upgrades, and downgrades. All-star analysts tend to have greater announcement effects than non-all-star analysts across different recommendation types. The most notable difference is for an upgrade to strong buy, where we observe a 1.92% (t=2.66) larger announcement effect in spite of the fact that all-star analysts tend to cover larger firms.[21] Using the IPO first-day closing price to estimate its market value, a 1.92% increase in the mean market value of $1.52 billion for the 826 firms translates into a $29 million increase in market value per firm. Even without accounting for other benefits of all-star analyst coverage such as more publicity and a potentially larger institutional investor following, a strong buy recommendation upgrade alone is enough to counter the cost of $21 million in terms of money left on the table. At the very least, this suggests that it is rational for issuers to perceive coverage from an all-star analyst as important and that it is worthwhile to pay for this coverage through higher IPO underpricing. Finally, some issuers may receive greater benefits from analyst coverage than others. For example, Aggarwal, Krigman, and Womack (2002) find that research coverage is positively correlated with insider selling at the lockup expiration and Martin (2010) finds that IPOs backed by venture capitalists are more likely to receive optimistic recommendations during the lockup period.

5.8. Robustness checks

5.8.1. Alternative explanations

An alternative explanation for the effect of all-star analyst coverage on underpricing is that the incremental underpricing is not due to underwriters having market power, but instead is used to cover the higher costs of all-star analyst coverage. Under this alternative story, higher underpricing for IPOs with all-star coverage can arise in a

[21] Using I/B/E/S data for our 1993–2008 IPOs, we calculate the abnormal three-day announcement returns for recommendations in the 2 years after the IPO day as the compounded three-day stock return from the event day 0 to day 2 minus the compounded market return (using the CRSP value-weighted index) for the same three days. We account for confounding news effects by deleting all recommendations where multiple recommendations are announced on the same day. The abnormal three-day announcement returns for analyst recommendations (initiation, reiteration, upgrade, and downgrade) are estimated to be 0.61%, 0.29%, 4.24%, and −0.74% for all-stars and 0.43%, −0.05%, 3.24%, and −0.54% for non-all-stars. When we examine strong buy recommendation upgrades, the abnormal three-day announcement returns for recommendations by all-stars and non-all-stars are, respectively, 5.29% and 3.37%, with a difference of 1.92% (t=2.66).

Table 6
IPO underpricing regressions with all-star analyst interactions sorted by VC category.

The sample includes 4,510 U.S. IPOs from 1993 to 2008, where 1,751 IPOs are backed by VCs and 2,759 IPOs are not backed by VCs. Panels A to G present regression results for subsamples based on whether IPOs are VC-backed or not. The model specification used for each panel is specified in the panel title. The dependent variable in all OLS regressions is the percentage first-day return. Only coefficients on the relevant variables are presented, where coefficients on the other variables are not reported for brevity. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry. Coefficients in the VC-sample are in bold if they are statistically different from their counterparts in the non-VC sample at the 5% level or better. Explanatory variables are defined in the appendix.

	VC		Non-VC	
Variable	Estimate	*t*-Stat	Estimate	*t*-Stat
Panel A: Using Table 2 (column 1) model specification				
Ln(Assets)	**0.51**	(0.40)	−2.01	(−4.92)
All-star dummy	**59.54**	(4.43)	11.53	(0.96)
Ln(Assets) × All-star dummy	**−12.12**	(−10.18)	−1.62	(−0.91)
Panel B: Using Table 2 (column 2) model specification				
Ln(1+Age)	1.10	(0.57)	−0.67	(−1.04)
All-star dummy	18.73	(1.61)	7.56	(0.93)
Ln(1+Age) × All-star dummy	−3.57	(−0.57)	−1.87	(−0.82)
Panel C: Using Table 2 (column 3) model specification				
Tech dummy	−9.57	(−1.10)	−4.95	(−2.78)
All-star dummy	−1.32	(−0.93)	0.09	(0.08)
Tech dummy × All-star dummy	19.12	(11.01)	10.47	(1.48)
Panel D: Using Table 2 (column 4) model specification				
Industry-year *Q*	7.08	(1.69)	8.39	(2.10)
All-star dummy	2.52	(0.33)	−17.08	(−2.13)
Industry-year *Q* × All-star dummy	4.06	(7.42)	12.48	(2.32)
Panel E: Using Table 3 (column 1) model specification				
All-star dummy	**7.86**	(3.04)	−0.49	(−0.26)
Num. of firms covered × All-star dummy	0.60	(5.07)	0.38	(1.41)
Panel F: Using Table 3 (column 2) model specification				
All-star dummy	**9.89**	(3.01)	−0.25	(−0.19)
Busy dummy × All-star dummy	6.60	(3.77)	8.06	(1.21)
Panel G: Using Table 4 (column 3) model specification				
Ln(1+Lagged IndVolume)	−0.96	(−0.24)	−1.35	(−1.19)
All-star dummy	−2.93	(−0.37)	−5.81	(−1.58)
Ln(1+Lagged IndVolume) × All-star dummy	4.66	(2.13)	3.58	(1.57)
N		1,751		2,759

market of perfect competition, without any underwriters having market power. There are several reasons, however, to doubt this story as a complete explanation.

First, the incremental money left on the table due to all-star analyst coverage is large compared to the costs of providing research coverage. Although there may be costs of providing analyst coverage other than the salary and bonus paid, an average of $21 million per IPO seems far too large to be attributed to the costs alone, given that a typical all-star analyst is covering ten or more stocks. Second, our model implications and empirical results show that the effect of all-star analyst coverage on underpricing varies with IPO industry volume and the importance of all-star analyst coverage. It is difficult to account for the magnitude of these patterns with the cost story. Third, we show that issuers with a higher willingness to pay for all-star analyst coverage have even more underpricing. Although it is possible for the costs of all-star analyst coverage to vary across firms, differential costs alone are hard to reconcile with the magnitude of the incremental underpricing difference between issuers with varying degrees of willingness to pay.

While administrative and employment costs alone are unlikely to account for the observed patterns, there is still a concern that reputation costs can be large. Specifically, asking all-star analysts to cover and promote stocks that they otherwise would not cover may harm their reputation and result in the loss of all-star status. Since all-star analysts are valuable to underwriters in attracting investment banking business, losing all-star status can lead to millions in foregone revenue, which needs to be compensated ex-ante with higher underpricing. While this story is sensible, it makes a critical assumption that coverage of IPOs underwritten by the lead underwriter results in the loss of all-star status. To test this hypothesis directly, we examine the effect of IPO coverage on all-star status empirically in Internet Appendix Table IA-1. We find that an all-star analyst covering an IPO underwritten by its lead underwriter in year $t-1$ has a positive effect on the analyst being an all-star in year t. However, we do not find that covering an IPO with high underpricing, covering an IPO backed by venture capital, or covering a VC-backed IPO with high underpricing in year $t-1$ has any significant effect on all-star status in year t. Thus, the empirical evidence is not consistent with the reputation cost story.

Another alternative story is that all-star analysts are being bullish on some potential IPO firms and have convinced their investment banks to underwrite these IPOs. If the all-star analysts are right that these IPOs do have higher first-day returns, then a positive correlation between all-star analyst coverage and IPO underpricing would be observed. The key underlying assumption in this story is that all-star analysts have superior forecasting ability and they have the ability to spot winners among IPO firms for which there is little information available. However, there is a lack of consistent evidence supporting this assumption. For instance, according to surveys of institutional investors in *Institutional Investor* magazine, all-star analysts are valued for their industry knowledge, not for their stock-picking abilities. Moreover, this story suggests that all-star analyst coverage proxies for some unobservable part of underpricing, or that all-star analyst coverage is an endogenous variable. We address this issue in the next section.

5.8.2. Endogeneity

In our regression specifications, we have taken the explanatory variables as exogenous. Although top-tier underwriter status can be considered endogenous, in unreported regressions, when we control for endogeneity with an instrumental variable regression as in Table 6 of Loughran and Ritter (2004), 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. If this story is correct, then underpricing causes all-star analyst coverage, rather than all-star analyst coverage causing underpricing.

To account for the possibility that all-star coverage may be endogenous, we use a two-stage estimation procedure similar to those used in Lowry and Shu (2002) and Cliff and Denis (2004).[22] The regression results are reported in the Internet Appendix Table IA-2, where a coefficient of 9.50 (t=3.43) on the all-star instrument is observed. This coefficient estimate is virtually identical to the estimate of 8.82 (t=2.56) reported in Table 1, suggesting that our results are not driven by endogeneity.

6. Other non-price dimensions

In Section 5, we focused on the all-star analyst dimension and in this section, we focus on the other non-price dimensions. One of the non-price dimensions tested is industry expertise. Another test focuses on an issuer-specific HHI measure, which is used to proxy for some non-price dimensions that are not explicitly measured. Additionally, the underwriter quality dimension is tested on the full sample of IPOs from 1980 to 2008 and discussed in more detail. Finally, we assess the economic significance of our regression results.

Table 7
IPO underpricing regressions with industry expertise variables.

The sample consists of 7,319 U.S. IPOs from 1980 to 2008 meeting criteria listed in the appendix. The dependent variable in all OLS regressions is the percentage first-day return. Ln(1+Number of industry IPOs) is the natural logarithm of one plus the number of IPOs in the same Fama-French 49 industry underwritten in the 5 years before the IPO. Industry experience is the natural logarithm of one plus the number of IPOs in the same Fama-French 49 industry underwritten by the lead underwriter in the 5 years before the IPO. High industry experience dummy equals one (zero otherwise) if the lead underwriter has underwritten more than five IPOs in the same industry in the 5 years before the IPO. Top-5 dummy equals one (zero otherwise) if the lead underwriter is one of the five top underwriters in the given industry based on the number of IPOs underwritten in the 5 years before the IPO. The All-star dummy is set to zero for IPOs from 1980 to 1992. The other explanatory variables are defined in the appendix. Year fixed effects based on the IPO year and industry fixed effects based on the 49 Fama-French industries are included, where the coefficients are not reported for brevity. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry.

	(1)	(2)	(3)
Top-tier dummy	2.31	2.14	2.16
	(1.19)	(1.15)	(1.13)
Ln(Assets)	−2.47	−2.42	−2.47
	(−3.84)	(−3.85)	(−3.79)
Internet dummy	26.63	26.59	26.70
	(4.97)	(5.04)	(4.95)
Share overhang	3.35	3.34	3.36
	(2.82)	(2.81)	(2.83)
VC dummy	3.69	3.65	3.69
	(1.85)	(1.83)	(1.85)
All-star dummy	9.55	9.50	9.56
	(2.53)	(2.53)	(2.52)
Ln(1+Number of industry IPOs)	−1.53	−1.48	−1.15
	(−2.27)	(−2.08)	(−1.63)
Industry experience	1.77	–	–
	(3.50)		
High industry experience dummy	–	5.68	–
		(9.56)	
Top-5 dummy	–	–	3.47
			(3.60)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
N	7,319	7,319	7,319
R^2_{adj}	28.1%	28.1%	28.1%

6.1. Industry expertise

The main model implication is that if issuers care about a non-price dimension, they are expected to pay for it with more underpricing. Or phrased differently, IPOs using an underwriter that is strong in a non-price dimension are more underpriced than those IPOs using an underwriter that is weak. We test this implication for the non-price dimension of industry expertise in Table 7 using three different measures of industry expertise.

Our first industry expertise proxy, Industry experience, is the natural logarithm of one plus the number of IPOs in the same industry a given lead underwriter has underwritten in the 5 years prior to an IPO.[23] The proxy is motivated by how underwriters pitch to prospective issuers. In order to win a

[22] Cliff and Denis (2004) report instrumental variable regressions with an instrument for analyst coverage on I/B/E/S, but not for all-star analyst coverage.

[23] For IPOs from 1980 to 1984, data on IPOs from 1975 to1979 are also used in the calculations.

Table 8
IPO underpricing regressions with issuer-specific HHI.

The full sample consists of 7,319 U.S. IPOs from 1980 to 2008. The dependent variable in all OLS regressions is the percentage first-day return. For each IPO, its Issuer-specific HHI is the sum of the squares of the market shares of underwriters that are matched with the issuer on the basis of top-tier status, size, and industry. The All-star dummy is set to zero for IPOs from 1980 to 1992. The other explanatory variables are defined in the appendix. Year fixed effects based on the IPO year and industry fixed effects based on the 49 Fama-French industries are included, where the coefficients are not reported for brevity. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry.

	(1) 1980–2008	(2) 1993–2008	(3) 1980–1989	(4) 1990–1998	(5) 1999–2000	(6) 2001–2008
Top-tier dummy	2.40	4.72	−2.48	3.12	14.68	5.32
	(1.25)	(1.70)	(−3.46)	(1.74)	(0.93)	(2.66)
Ln(Assets)	−2.50	−3.00	−1.07	−2.17	−5.59	−1.08
	(−3.78)	(−3.75)	(−3.56)	(−5.34)	(−3.09)	(−1.75)
Internet dummy	26.52	24.22	−2.01	28.77	23.30	0.86
	(4.95)	(4.95)	(−0.62)	(1.88)	(3.46)	(0.30)
Share overhang	3.34	4.86	0.26	2.18	8.67	2.04
	(2.81)	(3.38)	(1.20)	(6.07)	(3.21)	(3.78)
VC dummy	3.69	5.79	0.30	0.14	24.87	5.56
	(1.85)	(1.93)	(0.57)	(0.13)	(3.19)	(4.08)
All-star dummy	9.58	8.27	–	4.32	17.50	0.77
	(2.52)	(2.56)		(2.71)	(4.47)	(0.59)
Top-5 dummy	3.50	4.81	1.05	3.65	7.45	−0.15
	(3.44)	(5.20)	(3.18)	(1.75)	(1.81)	(−0.12)
Issuer-specific HHI	5.05	14.82	2.27	8.95	43.45	5.01
	(2.81)	(4.45)	(1.15)	(2.26)	(2.65)	(1.06)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	7,319	4,510	2,006	3,599	853	861
R^2_{adj}	28.1%	28.0%	5.2%	14.6%	21.3%	13.1%

particular IPO mandate, underwriters need to show that they understand the firm's business and can successfully market the firm to institutional investors. A way to demonstrate such industry expertise is to provide a record of similar firms that the underwriter has taken public in the past. In our test, we define similar IPOs as those in the same Fama-French (1997) 49 industry.

In order to use the full sample from 1980 to 2008 in Table 7, we set the all-star dummy to zero for IPOs prior to 1993 when analyst information became available, with the year fixed effects for these years incorporating the effects of the missing information. In addition to the usual controls, we include a control for the number of IPOs in the same Fama-French 49 industry that went public in the 5 years before a given IPO. Since we are interested in the number of IPOs underwritten by the lead underwriter, including ln(1+Number of industry IPOs) ensures that our lead underwriter experience measure is not merely picking up general industry activity. In column 1 of Table 7, we use Industry experience. A coefficient of 1.77 (t=3.50) on this industry expertise measure is consistent with the model prediction that issuers pay for non-price dimensions of IPO underwriting by leaving more money on the table. Economically, the coefficient of 1.77 suggests that an underwriter with extensive experience in an issuer's industry (e.g., having underwritten ten IPOs in the past 5 years in the same industry), charges 4.2% (1.77 × ln(1+10)) more in underpricing than an underwriter with no experience.

In column 2 of Table 7, we use a high industry experience dummy, which equals one if the lead underwriter has underwritten more than five IPOs in the same industry in the prior five calendar years and zero otherwise. This dummy variable has a coefficient of 5.68 (t=9.56), indicating that high industry expertise is paid for with 5.68% more underpricing, on average. Lastly, in column 3, we construct a top-5 dummy that equals one (zero otherwise) for the top five underwriters in an industry based on IPO volume in the past 5 years. This measure has the advantage that it is not sensitive to volume differences across industries and thus, is also used in Table 8. The effect of this variable on underpricing is 3.47 (t=3.60). Overall, using three different proxies for industry expertise, we confirm the model prediction that issuers choosing an underwriter with more expertise in their industry have higher underpricing.

6.2. Issuer-specific HHI

The *underwriter concentration implication* suggests a relation between industry HHI and industry average underpricing. The rationale is that under certain conditions, as the value of non-price dimensions increases, both the market share of the dominant underwriters and the average industry underpricing increase. This relation provides a way for us to estimate the effect of non-price dimensions that are not explicitly measured.

The idea is to estimate an HHI for the underwriting market that each issuer is likely to face. For each IPO i, we find a set of underwriters that fits three criteria. First, the underwriter has underwritten one IPO or more in the same

Fama-French 49 industry during the five calendar years prior to IPO *i*. Second, the underwriter has the same top-tier status as IPO *i*'s lead underwriter. Third, the underwriter has underwritten IPOs in a similar size range as IPO *i*. The size range for each underwriter is estimated based on the minimum and maximum inflation-adjusted proceeds of IPOs that the underwriter has underwritten over the entire sample period of 1980–2008.[24] Thus, the underwriters that fit these criteria are compatible with IPO *i* in terms of industry, top-tier status, and size specialization. For these underwriters, we calculate their market share within the set of IPOs they have underwritten during the 5 years prior to IPO *i* that are in the same industry. Finally, issuer-specific HHI is calculated as the sum of the squares of the underwriters' market share. Intuitively, issuer-specific HHI approximates the market concentration of an underwriting market faced by a particular issuer.

At one extreme, if all underwriters are similar, then they should have similar market shares, and thus a lower HHI. At the other extreme, if some underwriters have market power on account of their non-price dimensions, then the resulting oligopoly will show up in a higher HHI. Hence, we expect a positive relation between the issuer-specific HHI and IPO underpricing. In Table 8, we test this prediction in column 1 where the full sample of 7,319 IPOs from 1980 to 2008 is used. The coefficient on the issuer-specific HHI variable is 5.05 ($t=2.81$), confirming our prediction. The point estimate suggests that, on average, issuers facing a market with one dominant player (HHI close to one) pay 5% more in underpricing than those facing a dispersed market (HHI close to zero). The fact that the coefficients on the other non-price dimension variables barely change when the issuer-specific HHI is added suggests that the issuer-specific HHI captures some additional non-price dimensions beyond those that are already measured.

6.3. Top-tier underwriters

We have already tested and found a positive relation between the underwriter's top-tier status and IPO underpricing for a subsample of IPOs from 1993 to 2008 in Tables 1–5. In Table 8, we include the earlier years and conduct the tests on a sample of IPOs from 1980 to 2008.

For the full sample results in column 1 of Table 8, the top-tier dummy has a coefficient of 2.40 ($t=1.25$), implying 2.40% more underpricing. The subperiod results are interesting in that the coefficient on the top-tier dummy is -2.48 ($t=-3.46$) in 1980–1989, while the post-1989 subperiod coefficients are all positive. This change in sign of the top-tier underwriter coefficient has been documented by other studies, but the reason for the change is not clear.

The certification theory of IPO underpricing predicts a negative coefficient as observed in the 1980s, while our local oligopolies theory of IPO underpricing predicts a positive coefficient as observed in later subperiods. These conflicting predictions can be reconciled when their underlying assumptions are examined. The certification theory is based on the premise that issuers want to minimize IPO underpricing and underpricing is necessary to compensate investors for the risks of investing. Due to reputation concerns, prestigious underwriters aid in certifying IPO value and help issuers to raise more IPO proceeds, and thus are associated with lower underpricing.

In Section 4, we observed that competition between underwriters on the basis of gross spreads fell dramatically during the 1980s and 1990s. If underwriters compete on the gross spread, it suggests that the gross spread is an important decision criterion for issuers in choosing an underwriter. It also means that issuers are more price sensitive, so they care more about how cheaply they can raise money in an IPO. In terms of the subperiods, it suggests that issuers are more price sensitive and underwriters competed more on fees in the 1980s than in later periods. Thus, the certification theory is more applicable in the 1980s and the negative coefficient on the top-tier underwriter dummy for the 1980s is consistent with this interpretation. In the later subperiods, however, we posit that underwriters compete less on gross spread and more on non-price dimensions. This suggests that issuers are willing to pay for these services, which corresponds to a positive coefficient on the top-tier underwriter dummy.

The subperiod results in columns 2–6 of Table 8 suggest that the effect of the non-price dimensions on IPO underpricing is much smaller in the 1980s than in the 1990s and the bubble period. This is consistent with the notion that the non-price dimensions are less important in the 1980s than later on. In addition, the generally smaller coefficients on the non-price dimensions in the post-bubble period may be partly due to the low volume of IPOs in this period, consistent with the *deal frequency implication*.

Finally, if oligopolistic underwriters are able to win mandates in spite of greater expected underpricing, we would expect all of our empirical results to hold if we measure underpricing using the midpoint of the original file price range rather than the actual offer price. In untabulated results, we confirm this prediction. Indeed, the results tend to be even stronger, suggesting that the oligopolistic underwriters intentionally low-ball the filing price range. These results corroborate the findings in Lowry and Schwert (2004) that the midpoint of the filing range is not an unbiased predictor of the offer price.

6.4. Non-price dimensions and VC-backing

In Section 5.6, we found that the all-star analyst dimension is more important for IPOs backed by venture capitalists. In Table 9, we examine whether the effects of other non-price dimensions on underpricing differ for VC-backed and non-VC-backed IPOs. First, we confirm the earlier finding that the all-star analyst dimension is more important for VC-backed IPOs. Similar to the all-star analyst result, we find that the effect of the top-tier dummy on underpricing is positive and marginally significant in the VC sample, but is not significantly different from zero in the non-VC sample, although the point estimates of 2.92 and 2.17 do not differ much.

[24] For example, since the smallest IPO that Goldman Sachs underwrote was for $14.05 million (in $ of 2003 purchasing power) in proceeds, Goldman would not be considered a candidate underwriter for the 1,461 IPOs in our sample during 1980–2008 that were smaller than this.

Table 9
IPO underpricing regressions with non-price dimension variables sorted by VC category.

Columns 1 and 2 include 7,319 U.S. IPOs from 1980 to 2008 and columns 3 and 4 include 4,510 IPOs from 1993 to 2008. The samples are partitioned by VC-backing status. The dependent variable in all OLS regressions is the percentage first-day return. The All-star dummy is set to zero for IPOs from 1980 to 1992. The other explanatory variables are defined in the appendix. Year fixed effects based on the IPO year and industry fixed effects based on the 49 Fama-French industries are included, where the coefficients are not reported for brevity. The *t*-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry.

	1980–2008		1993–2008	
	(1) VC	(2) Non-VC	(3) VC	(4) Non-VC
Top-tier dummy	2.92	2.17	4.74	5.40
	(1.79)	(0.79)	(2.03)	(1.15)
Ln(Assets)	−1.54	−2.17	−2.08	−2.62
	(−1.68)	(−3.56)	(−1.74)	(−2.92)
Internet dummy	17.70	27.77	15.49	26.81
	(6.09)	(3.11)	(10.27)	(2.97)
Share overhang	5.68	1.79	7.85	2.63
	(2.87)	(3.89)	(3.77)	(5.26)
All-star dummy	14.09	3.17	10.82	2.37
	(3.34)	(1.23)	(2.76)	(1.02)
Top-5 dummy	5.18	2.24	7.24	2.51
	(2.56)	(2.51)	(3.16)	(1.72)
Issuer-specific HHI	5.69	3.92	17.58	11.95
	(1.93)	(2.03)	(2.12)	(3.12)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
N	2,557	4,762	1,751	2,759
R^2_{adj}	33.1%	16.8%	32.0%	16.5%

As for the other two non-price dimension variables, we find that the coefficients on the top-5 dummy and the issuer-specific HHI are both economically and statistically significant for the VC and non-VC samples. The point estimates indicate that the effect of these two variables on underpricing is higher in the VC sample. Overall, the Table 9 results show that all four non-price dimensions are relevant for VC-backed IPOs, while only the industry expertise and underwriter concentration dimensions are relevant for non-VC-backed IPOs. These findings suggest that VC-backed and non-VC-backed IPOs are competed for along different non-price dimensions, further highlighting the special pricing objectives of the venture capitalists.

6.5. *The economic significance of the non-price dimensions*

How important are the non-price dimensions economically? To answer this question, we calculate the economic effect of the non-price dimensions by multiplying their coefficient estimates in the underpricing regressions with their sample means. For example, if 18% of the IPOs have coverage from an all-star analyst and these IPOs are 8.82% more underpriced on average, then the total effect of the all-star analyst dimension on underpricing is 0.18×8.82 or 1.6%.

Given the coefficient estimates in column 1 of Table 8 for the top-tier dummy, the all-star dummy, the top-5 industry expertise dummy, and the issuer-specific HHI, and the sample means for the 1980–2008 period, we estimate that the total effect of these four non-price dimensions on underpricing is $2.40 \times 0.61 + 9.58 \times 0.11 + 3.50 \times 0.23 + 5.05 \times 0.19 = 4.3\%$. To assess how large this effect is, we compare it to the average underpricing during this period, which is 18.2%. Thus, the effect of the non-price dimensions on underpricing accounts for 24% (4.3%/18.2%) of the average underpricing in 1980–2008. Note that this number is probably underestimated since the all-star dummy is only available for part of the period.

Similarly, based on the regression results in column 2 of Table 8 for the 1993–2008 period, we estimate that the effect of the non-price dimensions on underpricing is $4.72 \times 0.68 + 8.27 \times 0.18 + 4.81 \times 0.23 + 14.82 \times 0.16 = 8.2\%$. Since the average underpricing is 24.4% in 1993–2008, the effect of the non-price dimensions on underpricing accounts for 34% (8.2%/24.4%) of the average underpricing.

More interestingly, we estimate the effect of the non-price dimensions on underpricing during the bubble period when the underpricing is particularly high. Using the estimates in column 5 of Table 8 and the variable sample means during 1999–2000, we estimate that the effect of the non-price dimensions on underpricing is $14.68 \times 0.82 + 17.50 \times 0.26 + 7.45 \times 0.25 + 43.45 \times 0.10 = 22.8\%$. Given that the average underpricing during the bubble period is 64.5%, the effect of the non-price dimensions on underpricing accounts for 35% (22.8%/64.5%) of the average underpricing.

Taken together, the numbers suggest that the effect of the four non-price dimensions on underpricing is economically important as their total effect accounts for about 30% of the average underpricing.

7. Conclusion

Most theories of IPO underpricing are based on information asymmetry and agency explanations. We depart from previous approaches by drawing analogies between an IPO underwriting market and a typical product market. In this way, we develop a theory of the underpricing of IPOs based on differentiated underwriting services and localized competition.

Despite a large number of investment banking firms competing for IPOs, we posit that the IPO underwriting industry is best characterized as a series of local oligopolies due to the preference of issuers for non-price dimensions that are bundled with underwriting. Consequently, a limited number of underwriters that can provide these non-price dimensions will acquire some market power and earn rents on the IPOs of firms in any given industry. Moreover, the rent varies with the value and the cost of the non-price dimensions, the deal frequency, and the issuer's willingness to pay for the differentiated services.

Empirically, we find evidence consistent with our model predictions. In particular, we find that IPOs are more underpriced when they have coverage from an all-star analyst, when their underwriters have better quality or more industry expertise, and when they face a more concentrated underwriting market.

We also propose and test the analyst lust theory of VC-backed IPOs. 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: VC-backed IPOs that are covered by an all-star analyst are underpriced by 20% more than VC-backed IPOs with no all-star analyst coverage. When this interaction term is included, the effect of VC backing by itself is substantially reduced, suggesting that most of the effect of VC-backing on underpricing is due to the greater focus by venture capitalists on all-star analyst coverage. Moreover, consistent with VCs having special pricing objectives, we find that VC-backed IPOs are also more sensitive to different aspects of the all-star analyst dimension than non-VC-backed IPOs.

Finally, our theory can also be used to explain existing empirical findings and generate new predictions in non-IPO areas. For instance, Kang and Liu (2007) find that the offer prices of corporate bonds are lower if there is a close prior lending relationship between banks and their client issuers. This bond underpricing can be interpreted as indicating that a non-price dimension that issuers care about is commercial bank loans that are tied-in with bond underwriting, and from which investment banks earn rents. Also, consistent with our theory, 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 seasoned equity offerings. Their subperiod 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.

Appendix A

A detailed description of the variables used in our analysis, and a listing of the data sources are shown in Table A1.

Table A1
Variable definitions.
The full sample consists of 7,319 operating firm IPOs from 1980 to 2008 and the subsample consists of 4,510 operating firms IPOs from 1993 to 2008 going public in the U.S. for which the offer price is at least $5.00 and complete data on all of the variables are available. IPOs using auctions, unit offers, ADRs, banks and S&Ls, and IPOs not listed on CRSP within six months of issuing are excluded. Relevant variable means and standard deviations [in brackets] for the full sample and the subsample are reported. All dollar values are in dollars of 2003 purchasing power using the Consumer Price Index.

Variable	Definition	Source	Full sample mean [SD]	Subsample mean [SD]
First-day return	Percentage change from the offer price to the first-day closing price	Thomson Financial's new issues database with corrections	18.2% [39.9%]	24.4% [48.3%]
Proceeds	The offer price times the number of global shares offered, excluding overallotment options, expressed in millions of dollars	Thomson Financial's new issues database with corrections	$96.0m [$341.4m]	$123.7m [$421.6m]
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	61.4%	68.0%
Assets	Firm's pre-issue book value of assets, expressed in millions of dollars	Thomson Financial's new issues database with corrections	$590.2m [$6,723.8m]	$790.1m [$8,265.5m]
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	7.5%	12.1%
Tech dummy	Equals one (zero otherwise) if the firm is in the technology or Internet business defined in Appendix D of Loughran and Ritter (2004)	Thomson Financial's new issues database with corrections	36.5%	41.7%
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	8 years (median)	7 years (median)
Share overhang	Ratio of retained shares to the public float	Thomson Financial's new issues database with corrections	2.9 [2.0]	3.0 [2.1]
VC dummy	Equals one (zero otherwise) if the IPO was backed by venture capital	Thomson Financial's new issues database with corrections from Paul Gompers, Josh Lerner, Jerry Cao, and the authors	34.9%	38.8%
Bubble dummy	Equals one (zero otherwise) if the IPO occurred during 1999–2000		11.7%	18.9%
Post-bubble dummy	Equals one (zero otherwise) if the IPO occurred during 2001–2008		11.8%	19.1%
All-star dummy	Equals one (zero otherwise) if the IPO is covered by an *Institutional Investor* all-star analyst (top 3) from the bookrunner within 1 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 1992–2007	11.3%	18.3%
VC $\times$ All-star dummy	An interaction of the VC dummy with the All-star dummy		–	7.1%

Table A1 (*continued*)

Variable	Definition	Source	Full sample mean [SD]	Subsample mean [SD]
Industry-year Q	The median Tobin's Q of firms in the same Fama-French 49 industry in the IPO year using the entire Compustat universe, with Q defined as (assets-book equity+MV of equity)/assets, where MV of equity is the number of shares outstanding times the market price at the end of the fiscal year	Compustat	–	1.9 0.8
Number of firms covered	The number of firms covered by the all-star analyst during the 1 year prior to the IPO (mean is based on the sample of IPOs with an all-star analyst)	I/B/E/S	–	11.7 [6.4]
Busy dummy	Equals one (zero otherwise) if the number of firms covered by an all-star analyst is greater than ten (the median)	I/B/E/S	–	6.2%
Lagged industry volume	The number of IPOs of the same industry that went public in the previous calendar year before an IPO, using the (revised) 49 industries in Fama and French (1997)	Thomson Financial's new issues database with corrections; Kenneth French's Web site	–	27.8 [33.7]
Number of industry IPOs	The number of IPOs of the same Fama-French 49 industry that went public in the 5 years before an IPO	Thomson Financial's new issues database with corrections	82.4 [99.2]	112.6 [114.4]
Industry experience	The number of IPOs of the same Fama-French 49 industry underwritten by the lead underwriter in the 5 years before an IPO	Thomson Financial's new issues database with corrections; Kenneth French's Web site	2.0 [5.5]	2.6 [6.8]
High industry experience dummy	Equals one (zero otherwise) if a lead underwriter has underwritten more than five IPOs in the same Fama-French 49 industry in the 5 years before the IPO	Thomson Financial's new issues database with corrections	9.8%	13.8%
Top-5 dummy	Equals one (zero otherwise) if a lead underwriter is one of the five top underwriters in the given Fama-French 49 industry based on the number of IPOs underwritten in the 5 years before the IPO	Thomson Financial's new issues database with corrections	22.7%	22.6%
Issuer-specific HHI	The sum of the squares of the market shares of underwriters that are matched with the issuer on the basis of top-tier status, size, and industry	Thomson Financial's new issues database with corrections	0.19 [0.19]	0.16 [0.16]

Appendix B. Supplementary data

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.jfineco.2011.01.009.

References

Aggarwal, R., Krigman, L., Womack, K., 2002. Strategic IPO underpricing, information momentum, and lockup expiration selling. Journal of Financial Economics 66, 105–137.

Baron, D., 1982. A model of the demand for investment banking advising and distribution services for new issues. Journal of Finance 37, 955–976.

Barry, C., Muscarella, C., Peavy, J., Vetsuypens, M., 1990. The role of venture capital in the creation of public companies: evidence from the going-public process. Journal of Financial Economics 27, 447–471.

Benveniste, L., Spindt, P., 1989. How investment banks determine the offer price and allocation of new issues. Journal of Financial Economics 24, 343–362.

Bradley, D., Choi, H., Clarke, J., 2009. Working for the enemy? The impact of investment bankers on deal flow. Unpublished Working Paper, University of South Florida, Hongik University, Georgia Institute of Technology.

Bradley, D., Jordan, B., 2002. Partial adjustment to public information and IPO underpricing. Journal of Financial and Quantitative Analysis 37, 595–616.

Bradley, D., Jordan, B., Ritter, J., 2008. Analyst behavior following the IPO: the 'bubble period' evidence. Review of Financial Studies 21, 101–133.

Brau, J., Fawcett, S., 2006. Initial public offerings: an analysis of theory and practice. Journal of Finance 61, 399–436.

Carter, R., Manaster, S., 1990. Initial public offerings and underwriter reputation. Journal of Finance 45, 1045–1067.

Chen, H., 2008. Strategic pricing in the IPO underwriting market. Unpublished Working Paper, University of New Mexico.

Chen, H., Ritter, J., 2000. The seven percent solution. Journal of Finance 55, 1105–1131.

Clarke, J., Khorana, A., Patel, A., Rau, R., 2007. The impact of all-star analyst job changes on their coverage choices and investment banking deal flow. Journal of Financial Economics 84, 713–737.

Cliff, M., Denis, D., 2004. Do IPO firms purchase analyst coverage with underpricing? Journal of Finance 59, 2871–2901.

Degeorge, F., Derrien, F., Womack, K., 2007. Analyst hype in IPOs: explaining the popularity of bookbuilding. Review of Financial Studies 20, 1021–1058.

Demiroglu, C., Ryngaert, M., 2010. The first analyst coverage of neglected stocks. Financial Management 39, 555–584.

Doukas, J., Kim, C., Pantzalis, C., 2005. The two faces of analyst coverage. Financial Management 34, 99–125.

Dunbar, C., 2000. Factors affecting investment bank initial public offering market share. Journal of Financial Economics 55, 3–41.

Fama, E., French, K., 1997. Industry costs of equity. Journal of Financial Economics 43, 153–193.

Fang, L., Yasuda, A., 2009. The effectiveness of reputation as a disciplinary mechanism in sell-side research. Review of Financial Studies 22, 3735–3777.

Fang, L., Yasuda, A., 2010. Are stars' opinions worth more? The relation between analyst reputation and recommendation values. Unpublished Working Paper, INSEAD and UC Davis.

Field, L., Karpoff, J., 2002. Takeover defenses of IPO firms. Journal of Finance 57, 1857–1889.

Fu, F., Li, E., 2007. Underwriter collusion and IPO pricing. Unpublished Working Paper, Singapore Management University and University of Michigan.

Gao, X., Ritter, J., Zhu, Z., 2011. Where have all the IPOs gone? Unpublished working paper, University of Hong Kong, University of Florida, The Chinese University of Hong Kong.

Goldstein, M., Irvine, P., Puckett, A. Purchasing IPOs with commissions. Journal of Financial and Quantitative Analysis, in press. doi:10.1017/S0022109011000317.

Gompers, P., 1996. Grandstanding in the venture capital industry. Journal of Financial Economics 42, 133–156.

Gordon, B., 2003. The seven percent illusion? Unpublished Working Paper, Columbia Business School.

Green, E., Porter, R., 1984. Noncooperative collusion under imperfect price information. Econometrica 52, 87–100.

Hao, Q., 2011. Litigation risk, offer-failure risk, and initial public offerings. Journal of Corporate Finance 17, 438–456.

Hoberg, G., 2007. The underwriter persistence phenomenon. Journal of Finance 62, 1169–1206.

Hoberg, G., Seyhun, N., 2009. Do underwriters collaborate with venture capitalists in IPOs? Implications and evidence. Unpublished Working Paper, University of Maryland and University of Michigan.

Kang, J., Liu, W., 2007. Is universal banking justified? Evidence from bank underwriting of corporate bonds in Japan. Journal of Financial Economics 84, 142–186.

Kelly, B., Ljungqvist, A., 2007. The value of research. Unpublished Working Paper, University of Chicago, New York University.

Khorana, A., Mola, S., Rau, R., 2009. Is there life after loss of analyst coverage? Unpublished Working Paper, Georgia Institute of Technology, Arizona State University, University of Cambridge.

Krishnan, C., Ivanov, V., Masulis, R., Singh, A. Venture capital reputation, post-IPO performance, and corporate governance. Journal of Financial and Quantitative Analysis, in press. doi:10.1017/S0022109011000251.

Li, X., Masulis, R., 2007. Venture capital investments by IPO underwriters: certification or conflict of interest? Unpublished Working Paper, Vanderbilt University.

Livingston, M., Williams, G., 2007. Drexel Burnham Lambert's bankruptcy and the subsequent decline in underwriter fees. Journal of Financial Economics 84, 472–501.

Liu, X., Ritter, J., 2010. The economic consequences of IPO spinning. Review of Financial Studies 23, 2024–2059.

Ljungqvist, A., Wilhelm, W., 2003. IPO pricing in the dot-com bubble. Journal of Finance 58, 723–752.

Loughran, T., Ritter, J., 2002. Why don't issuers get upset about leaving money on the table in IPOs? Review of Financial Studies 15, 413–443.

Loughran, T., Ritter, J., 2004. Why has IPO underpricing changed over time? Financial Management 33 (3), 5–37.

Lowery, R., 2008. Imperfect monitoring and fixed spreads in the market for IPOs. Unpublished Working Paper, University of Texas at Austin McCombs School of Business.

Lowry, M., Schwert, G.W., 2002. IPO market cycles: bubbles or sequential learning? Journal of Finance 57, 1171–1200.

Lowry, M., Schwert, G.W., 2004. Is the IPO pricing process efficient? Journal of Financial Economics 71, 3–26.

Lowry, M., Shu, S., 2002. Litigation risk and IPO underpricing. Journal of Financial Economics 65, 309–336.

Martin, J., 2010. Prop ups during lockups. Unpublished Working Paper, University of Amsterdam.

Megginson, W., Weiss, K., 1991. Venture capitalist certification in initial public offerings. Journal of Finance 46, 879–903.

Mola, S., Loughran, T., 2004. Discounting and clustering in seasoned equity offering prices. Journal of Financial and Quantitative Analysis 39, 1–23.

Nimalendran, M., Ritter, J., Zhang, D., 2007. Do today's trades affect tomorrow's IPO allocation? Journal of Financial Economics 84, 87–109.

Reuter, J., 2006. Are IPO allocations for sale? Evidence from mutual funds. Journal of Finance 60, 2289–2324.

Rock, K., 1986. Why new issues are underpriced. Journal of Financial Economics 15, 187–212.

Welch, I., 1992. Sequential sales, learning, and cascades. Journal of Finance 47, 695–732.