Multiple Bookrunners in IPOs*

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ABSTRACT

In the last decade, there has been a dramatic change in syndicate structure for IPOs; while at the same time fees (gross spreads) have not changed. The increasing number of multiple bookrunners in the IPOs of recent years can be explained by (1) the increased issue size, (2) the significantly reduced amount of available IPO business after 2000, (3) the decreased importance of all-star analyst coverage, and (4) the increased number of buyout-backed IPOs. The benefits of multiple bookrunners to an issuer include improved bargaining power, which is reflected in the high file price ranges and high offer prices relative to the first-day closing market prices, and the participation of commercial banks with their loan tie-ins.

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I. Introduction

In the last decade, IPO underwriting syndicates have undergone substantial changes. Syndicate size has shrunk, although the number of managing underwriters has increased. Until the late 1990s, almost all IPOs had a single lead underwriter, which was also the sole bookrunner responsible for collecting indications of interest from institutional investors and allocating shares to institutions. In a very brief number of years, multiple bookrunners, once unheard of, have become the norm. In contrast, gross spreads, controlling for inflation-adjusted proceeds, have not changed, in spite of dramatically fluctuating deal volume.

The recent literature on underwriting syndicates in general and IPO syndicates in particular has emphasized the information-generation benefits of syndicates. This paper presents an alternative explanation for the existence of syndicates and especially for the dramatic increase in the frequency of joint bookrunners. We present a model of the choice of single vs. joint bookrunners by an issuing company in which the equilibrium of a non-cooperative game determines the amount of IPO underpricing. Empirical tests using U.S. IPOs from 2001-2005 support this bargaining model and do not support the information generation framework.

Most traditional IPO syndicate analyses suggest that underwriters help to generate accurate information from investors, which is then incorporated into the offer price. For instance, Corwin and Schultz (2005) posit that more co-managers result in more information generation, as well as more subsequent analyst coverage and more market makers. They test the information generation hypothesis by relating the adjustment of the final offer price from the midpoint of the original file price range to the number of co-managers, finding a positive relation. We argue that this pattern is also consistent with a bargaining interpretation. We conduct empirical tests to differentiate between these two interpretations. Our tests decisively reject the information generation hypothesis in favor of a bargaining interpretation of the empirical patterns.

We use a bargaining model that is based on the agency problem between bookrunners and issuers to help explain IPO syndicate structure, especially the IPOs with multiple bookrunners. As in Loughran and Ritter (2002, 2004), we assume that bookrunners leave more money on the table than the amount needed to induce adequate demand for the issue because of the soft dollar commission revenue they expect to receive in the aftermarket.[1] Multiple bookrunners result in

[1] Money left on the table is calculated as the difference between the offer price and the first closing market price, multiplied by the number of shares sold. Soft dollars are commission payments in excess of direct execution costs.

less money being left on the table because multiple bookrunner IPOs give the issuers more bargaining power both when initially choosing bookrunners, and at the pricing meeting, which results in a higher offer price.

Not only does our bargaining model explain the offer price adjustment at the pricing meeting differently from the information generation model, our model also predicts that the competition among bookrunners will result in a higher file price range relative to the subsequent market price, which cannot be explained by the information generation model. According to the information generation model, the file price range will not be affected by the number of bookrunners, because it is decided prior to the roadshow process during which the information is collected. In contrast, our bargaining model predicts that prospective underwriters will commit to a higher file price range as their optimal equilibrium response in seeking to win the mandate. Our empirical analysis confirms the prediction of the bargaining model that the original file price range will be higher, relative to the subsequent market price.

A crucial assumption in our model is that multiple bookrunners compete for business on the basis of analyst coverage, file prices, and offer prices, rather than the fees that they charge. Consistent with this assumption, the gross spreads for multiple bookrunner IPOs are indistinguishable from those on single bookrunner IPOs after controlling for issue size. For moderate size single and multiple bookrunner IPOs, the gross spreads remain at 7%. This lack of competition on spreads can be explained by implicit collusion among bookrunners, as posited by Chen and Ritter (2000). Deviating from the implicit collusion equilibrium by cutting fees in order to win a deal is easily observable by other underwriters. On the other hand, an underwriter can offer a higher file price range to win the underwriting mandate without triggering a reaction because it is difficult for other underwriters to be sure that there is a deviation, given the inherent subjectivity over what constitutes a high file price range when there is valuation uncertainty. In equilibrium, bookrunners charge the same fees, and no issuer wants to cut fees to win a mandate because it fears the consequences of instigating a price war. In our model, although moderate size issuers are facing a high gross spread of 7%, they can play multiple bookrunners off against each other to bargain for a high file price and offer price.

Our bargaining model shows that the agency problem between bookrunners and issuers is reduced in multiple bookrunner IPOs, which is manifested in less underpricing. This is one of the three main contributions of our paper. Two other contributions are that (1) we both document and explain the accelerating number of multiple bookrunner IPOs in recent years, and (2) we develop a model that explains when an issuer will choose multiple bookrunners versus a single bookrunner.

In 1995, no U.S. IPOs had multiple bookrunners. In 2001 alone, the percentage of multiple bookrunner IPOs increased to 19% from the 2000 level of 7%. By 2005, 50% of IPOs had multiple bookrunners. Our model can be used to explain this dramatic increase in the number of multiple bookrunner IPOs in the post-bubble period.

In our model, issuers and underwriters are associated by mutual choice, as modeled by Fernando, Gatchev, and Spindt (2005). From the issuers' perspective, our model predicts that an increasing number of companies will hire multiple bookrunners when the relative importance of all-star analyst coverage decreases. We posit that the combination of structural change in analyst coverage after the Global Settlement in April 2003 and the dramatically decreased number of IPOs and changed composition of issuers reduced the importance of analyst coverage in the post-bubble period.

From a supply perspective, our model predicts that investment banks are more likely to accept joint bookrunning when the issue size increases and when there is less deal volume. The larger issue sizes and reduced activity levels in recent years make an increasing percentage of the issues profitable for joint-bookrunners. Our data analysis shows that the willingness to accept a multiple bookrunning deal for an investment bank is negatively related to the ratio of the amount of available IPO business to a bank's underwriting capacity.

Despite multiple bookrunners having benefits to issuers, not all IPO companies can or will have multiple bookrunners. From a demand perspective, the preference of the issuers between a higher IPO offer price today versus all-star analyst coverage later on explains their choice between a single bookrunner and multiple bookrunners. A necessary condition for an issuing company to hire multiple bookrunners is that the proceeds from its IPO are large enough so that each bookrunner can get enough revenues to meet its reservation utility.

We assume that it is more costly for an underwriter to provide coverage from an all-star analyst than from a non-all-star. Some issuing companies would trade all-star analyst coverage from a single bookrunner for a higher offer price provided by multiple bookrunners. A bookrunner gets less revenue in multiple bookrunner IPOs both because it has to share the revenue with other bookrunners in the syndicate, and because there is less soft dollar commission revenue since less money is left on the table in equilibrium. Thus, some issuers may not be able to convince multiple bookrunners to run the book jointly and provide all-star analyst coverage. We posit that small high-risk issuing companies prefer a single bookrunner with all-star analyst coverage to multiple bookrunners without all-star analyst coverage. All-star analyst coverage is very important to small high-risk companies, which have a strong desire for publicity because of the higher market price resulting from the recommendations from an all-star analyst.

If a buyout firm-backed issuer does choose multiple bookrunners, the relationship between the financial sponsors of buyout-backed companies and commercial banks will help commercial banks to be invited as one of the multiple bookrunners. Buyout-backed IPOs are companies going public for which a private equity firm (PE firm, not including venture capital) is a pre-issue owner.[2] Another consideration in choosing a bookrunner for PE-backed IPOs is the existence of relationship banks. Relationship banks might bring buyout deals to the attention of the private equity firm and help the PE firm finance the buyout deal. The PE firm wants to reward the relationship bank with an IPO deal.

The rest of the paper is as follows. Section II contains a literature review and hypothesis development. In Section III, we build up an analytical model to explain the costs and benefits of multiple bookrunners as well as the reasons for the increasing number of multiple bookrunners. In Section IV, we provide supporting empirical analysis. We present the conclusions in Section V.

II. Related Literature

When a company decides to make a public equity offering using bookbuilding, it first selects one or more investment banks that will be managing underwriters. One or more managers are selected as the lead underwriters. In most cases, lead underwriters are bookrunners. Lead underwriters/bookrunners take on most of the responsibilities of the managing underwriters, which might include due diligence, marketing of the issue, pricing, price stabilization, market

[2] The buyout-backed IPOs that we study here overlap with traditional leveraged buyout (LBO) IPOs. The traditional LBO company is defined as a publicly held company or entire division that goes back to private ownership, with a large amount of debt financing involved. The buyout-backed IPOs that we analyze here may have neither been publicly held nor had a large amount of debt. They are partly or fully owned by private equity firms. Their leverage ratios before the IPOs are usually high, which is similar to the traditional LBO. “This particular pool of IPO candidates [buyout-backed IPOs] has more than one financial sponsor, and each shop has its own favorite investment bank,” according to Colleen M. O’Connor’s article, “Investment Banks Contend with Intensifying Valuation Disagreements”, in the August 22, 2005, *Investment Dealers Digest*.

making, and analyst research coverage of the stock. Other managers (known as co-managers) are expected to provide analyst coverage, and they may be allocated some shares to distribute to retail clients or, in the case of a cold deal, additional shares to allocate to institutional investors. Lead underwriters/bookrunners also help select other non-managing syndicate members with the issuers. Non-managing underwriters (other syndicate members) may, in some situations, help sell the stock and provide analyst coverage. In the last decade, however, non-managing underwriters seldom have gotten the chance to allocate any shares except for cold IPOs. They play almost no role in the IPO process and, since 2003, they have become an endangered species: in 2004, for the first time, the majority of IPOs had syndicates with only managing underwriters.

Although all bookrunners are lead underwriters, occasionally there is a co-lead that is not a bookrunner. Bookrunners generally have more responsibilities and receive more benefits than lead underwriters if there are co-leads that are not one of the bookrunners.[3] In this situation, the bookrunner or bookrunners are responsible for the institutional share allocations and receive the highest proportion of the gross spread revenues. In a single bookrunner IPO, the bookrunner typically allocates the majority of the shares and harvests at least half of the 7% gross spread revenue for normal-sized IPOs.[4] The rest goes to the co-managers and other syndicate members, with diminishing proportions. The single bookrunner also collects the IPO league table credits from Thomson Financial, Dealogic, and other sources.[5] In joint bookrunning IPOs, league table credit is shared equally among the bookrunners.

In practice, gross spreads are 7% for moderate size IPOs (approximately $25 to $100 million, exclusive of overallotment options), and lower for larger deals. Each bookrunner in a joint bookrunner IPO typically receives 30% to 40% of the total gross spread revenue and the bookrunners may or may not allocate the IPO shares jointly. Given the higher percentage of gross spread revenues and shares for allocation received by a sole bookrunner in single

[3] A handful of IPO issues have three or even four bookrunners. Some of the bookrunners may not do any work on a deal, but collect fees and league-table credits. They are called "phantom" bookrunners. The phantom bookrunners exist only in large IPOs with proceeds of more than $400 million, according to Britt Erica Tunick's article "GIVE TITLE," in the Dec. 13, 2004, *Investment Dealers Digest*.

[4] For example, CSFB, the sole bookrunner, allocated 3.4 million of the 4.025 million share (including the overallotment option) Gadzoox IPO on July 20, 1999. CSFB also allocated 7.2 million of the 10.35 million MP3 shares offered on July 21, 1999 according to the U.S. SEC's complaint regarding CSFB's IPO allocation practices on January 22, 2002. The link is available through Jay Ritter's IPO links, http://bear.cba.ufl.edu/ritter/ipolink.htm.

[5] The league table is the ranking of investment banks in terms of the total gross spreads of IPOs credited to bookrunners. It is a market share ranking.

bookrunner IPOs, investment banks should prefer being a single bookrunner to being a joint bookrunner.

Several IPO syndicate theories can be used to explain the benefits of multiple bookrunners for the issuers. The earliest hypothesis for the existence of syndicates is the underwriter risk-sharing hypothesis, which posits that multiple bookrunners work together to share the risk of unsuccessful IPOs (Wilson (1968), Mandelker and Raviv (1977), and Chowdhry and Nanda (1996)). Currently, most investment banks are large public firms. The amount of money involved in a normal IPO deal is small relative to their book equity. As a result, risk sharing would not be an important concern for them.

The largest category of IPO syndicate hypotheses is based on asymmetric information between the IPO investors and issuers. One branch of asymmetric information theory posits that underwriters help issuers gather information from investors. Baron and Holmstrom (1980) posit that it is optimal for the issuer to delegate the offer price decision to the banker, which has superior information about market demand. In order to mitigate the banker-issuer agency problem, the dollar amount of the commission will be a function of the offer price. In equilibrium, the offer price will increase with favorable information.

Benveniste and Spindt (1989) posit that the investment banker elicits information about the market value of an IPO from regular investors during the preselling period. These regular investors are compensated with favorable allocations of underpriced IPOs to induce truthful disclosure of their private information.

Corwin and Schultz (2005) show that there is more price adjustment and less IPO underpricing when multiple bookrunners are employed. They interpret this as consistent with the hypothesis of information production regarding investor demand by syndicate members during the bookbuilding period. Specifically, they report that the offer price is more likely to be revised in response to positive private information and that there is less underpricing if the syndicate has more co-managers. Our empirical work also shows this pattern. However, we find that multiple bookrunner IPOs are less underpriced even before the roadshow process begins, a pattern not identified by Corwin and Schultz. Specifically, the file prices of multiple bookrunner IPOs are closer to the first market closing prices than is the case for single bookrunner IPOs. We also show that there is a greater responsiveness of the offer price to positive market returns when there are multiple bookrunners, consistent with our bargaining model.

A second branch of asymmetric information theory is based on the hypothesis that underwriters help to convey information about an issuer to investors. Commercial banks with a previous lending relationship have proprietary information about an issuer. This helps to reduce the costs involved in collecting information of an issuer. Therefore, commercial banks and investment banks, cooperating in a security underwriting syndicate, play a better certification role and underwrite challenging issues.

Drucker and Puri (2005) show that concurrent lending and underwriting generates informational economies of scope. Lenders/Underwriters share this benefit with issuers through lower underwriter fees in seasoned equity offerings (SEOs) and discounted loan yield spreads. Ljungqvist et. al. (2006) find that a lending relationship helps a bank win a lead underwriting mandate of an equity or debt deal. Yasuda (2005) finds that bank relationships have positive and significant effects on underwriter choice in the U.S. corporate bond underwriting market, over and above their effects on underwriting fees, particularly for highly information sensitive issuers such as junk-bond issuers and first-time issuers. Song (2004) posits that coalitions between investment banks and commercial banks enhance the underwriting abilities of the syndicates for public bond offerings. Banks in hybrid syndicates get mutual benefits because of their complementary abilities. In the empirical analysis, we find that commercial banks are very likely to be chosen as bookrunners in multiple bookrunner IPOs. However, our evidence suggests that tie-ins with lending, rather than certification effects, help the commercial banks win the IPO business.

Another hypothesis for the existence of underwriting syndicates is that the structure of the underwriting syndicate helps to solve the moral hazard problem in team production. Pichler and Wilhelm (2001) posit that by sharing the net benefits of security issuance between the issuer and underwriters, the issuer can motivate a larger syndicate to exert high effort. The reputational concern of a lead banker enables more bankers to exert high-level effort in a syndicate.

With the exception of Baron and Holmstrom (1980) and Pichler and Wilhelm (2005), all of the above asymmetric information theories assume that there are no agency problems between issuers and underwriters. In our bargaining model, bookrunners compete with each other both in competing to win a mandate and to curry favor with the issuer after the managing underwriters are chosen, which results in a high-level effort. More importantly, we also consider the agency problem caused by the bookrunners' inclination to leave more than the necessary amount of money on the table in return for the receipt of soft dollar commission revenue. Competition between multiple bookrunners results in a high file price range and less money on the table.

As an alternative to the asymmetric information explanation for underwriting syndicates, the analyst coverage hypothesis posits that one or more book managers with an *Institutional Investor* all-star analyst are included as managing underwriters in order to get subsequent all-star analyst coverage. There is evidence that the pursuit of coverage by an all-star analyst affects the choice of the lead underwriter and the pricing of IPOs. Dunbar (2000) shows that underwriters with all-star analysts gain market share.

Cliff and Denis (2004) find that the first-day returns of issuing companies are higher when the lead underwriter has an all-star analyst in the industry of the issuing company. Both Dunbar (2000) and Bradley (2006) report that co-managing all-stars are common and have a significant positive impact on underpricing. In our model, we assume that by paying more than the competitive gross spread and leaving money on the table, the issuer can sometimes get all-star analyst coverage in the aftermarket.

In the remainder of the paper, we model the issuer's choice of multiple bookrunners versus single bookrunners with a bargaining model. Specifically, we investigate how the equilibrium price and utilities of each player are determined in a non-cooperative game.

III. Analytical Model

Our bargaining model is built on the conflict of interest between the issuer and the underwriters. Loughran and Ritter (2002, 2004) posit that bookrunners would like to leave money on the table because of the soft dollars received in return for hot IPO allocations. Another motivation for leaving money on the table for underwriters is that underwriters do not need to put as much effort into the IPO selling effort (Baron (1982)).

1. The Time Line

We assume that the IPO process has four stages, as shown in Figure 1. In the first stage, issuers shop around for bookrunners. Underwriters and issuers collect information on each other and choose each other mutually as modeled by Fernando, Gatchev, and Spindt (2005). The issuer first estimates its utility and the bookrunners' utilities. The decision of hiring one or two bookrunners is then made based on the issuer's expectation of the utility of different choices. To simplify the model, in the multiple bookrunner analyses, we only discuss IPOs with two bookrunners. The underwriters also consider their utilities based on the issuer's offer and decide if they want to be a bookrunner. In practice, bookrunners will also help issuers pick other syndicate members. To simplify the model, we don't consider other syndicate members here.

In deciding whether to hire one or two bookrunners, the issuer simultaneously chooses whether to request all-star analyst coverage or not, after considering both the possibility of getting it and the costs and benefits involved in all-star analyst coverage. A bookrunner that can offer all-star analyst coverage (based on whether it has an all-star analyst in the company's industry) requires higher compensation.

Also, the potential bookrunners discuss feasible file price ranges with the issuer. This discussion continues even after bookrunners are chosen.[6] In the multiple bookrunner IPOs, a bookrunner that insists on giving a very low file price range faces the threat of being kicked out of the syndicate by the issuer.

After a preliminary prospectus is issued, bookrunners then exert effort during the roadshow process. Although the effort level is not observable to the issuers, they can estimate the effort of bookrunners via the difference between the offer price and the file price midpoint, conditional on changes in general market conditions. The possibility of being a bookrunner in follow-on offerings is determined by the effort level it exerts during the IPO process and the file price range it provides. In multiple bookrunner IPOs, the bookrunner with a low effort and a low file price range is more likely to be excluded from the follow-on offering than a bookrunner in the single bookrunner IPO. This is because the competing bookrunner may provide a high effort and a high file price range, and the issuer will prefer the competing bookrunner in the follow-on offering.

Finally, shares are distributed. In our model, we assume each bookrunner allocates half of the shares, which is determined in advance. Underwriters subsequently provide (or do not provide, if an underwriter does not have an all-star analyst) all-star analyst coverage as they agree in advance.

In winning the IPO mandate and maximizing its own utility, a bookrunner has two choice variables, and two discrete choices for each variable: a high or low file price range, and a high or low effort level. The offer price is endogenously determined. Exogenous company characteristics

[6] In general, the file price range is not given in preliminary prospectus (usually, SEC form S-1). It is usually given in an amended filing (S-1/A).

discussed in this paper are (a) the size and (b) the risk of the issuing company. In our model, we do not consider the reputations of the bookrunners. We also do not consider changes in market conditions during the roadshow process in our model, although we do control for market returns in our empirical tests.

2. The Utility Functions

(1) Issuer's Utility

Loughran and Ritter (2004) assume that the issuer is risk neutral and the issuer's utility function is

$$\alpha_1 \text{IPO Proceeds} + \alpha_2 \text{Proceeds from Future Sales} + \left(1-\alpha_1-\alpha_2\right)\text{Side Payments}$$

In our model, we omit the Side Payments term, because it is less important after the Global Settlement of 2003, which prohibits "spinning" (the allocation of hot IPOs to corporate executives or venture capitalists in return for corporate investment banking business).

Following Chemmanur (1993) and Loughran and Ritter (2004), we assume that the Proceeds from Future Sales is affected by analyst coverage. The reasoning is that affiliated all-star analyst coverage increases the demand for the stock and hence the price of the stock at which insiders can subsequently sell their shares. Using 7,400 analyst recommendations from 1999-2000, Bradley, Jordan, and Ritter (2007) and others show that analyst coverage from affiliated and unaffiliated analysts from 30 calendar days to one year after the IPO is greeted with a positive market reaction. Rather than measuring the estimated wealth increase from analyst coverage, we put analyst coverage directly into the issuer's utility function. Furthermore, we assume that all-star analyst coverage provides higher utility to the issuer than does non-all-star analyst coverage.

$$\text{AnalystCoverage}=\begin{cases}\text{AC}_{\text{high}} \\ \text{AC}_{\text{low}}\end{cases} \qquad \text{AC}_{\text{high}} > \text{AC}_{\text{low}} \tag{1}$$

We further assume both issuer and bookrunners are risk neutral. The issuer wants to maximize the combined value of short-term and long-term proceeds, with long-term proceeds affected by risk and analyst coverage through the impact of these two variables on the future market price. We have the issuer's utility function as follows:

$$U_{issuer} = \underbrace{OP \times N_{IPO}}_{\text{IPO Proceeds}} + \underbrace{\left(N_{post} - N_{IPO}\right)\left(Close + (Neg \times Risk + AnalystCoverage)\right)}_{\text{Proceeds from Future Sales}}$$
$$Float = \frac{N_{IPO}}{N_{post}} \tag{2}$$

where N_{post} is the total shares outstanding after the issue and N_{IPO} is the number of shares issued in the IPO, which is a proportion (Float) of N_{post}. We use Close to stand for the first closing market price, which is exogenous and reflects the true value of the issuing company.

In the issuer's utility function, Risk is used to measure the uncertainty of the issuing company. If the issuing company has high uncertainty, Risk would be high given market conditions and underwriter characteristics. If the issuing company is of low uncertainty, Risk would be low. We use Neg, a negative constant number, to parameterize the effect of Risk on the issuer's utility. In other words, high risk will reduce the issuer's utility. The positive variable, AnalystCoverage, reduces the negative effect of Risk. The effect of all-star analyst coverage on a particular issuer depends not only on AC_{high} / AC_{low}, but also on the Risk of the issuing company. The benefit of all-star analyst coverage is larger for the high Risk company than for the low Risk company. [We need to fix this—eq. (2) has an additive effect that makes the previous sentences false.] AnalystCoverage captures the importance of analyst coverage on a particular company at a particular time.

There are three rounds of competition among bookrunners. In the first round, they compete to win the underwriting mandate. Banks with an all-star analyst in the issuer's industry have market power, and they know that they can provide a lower price (P_0^L) to win the underwriting mandate than the banks without an all-star analyst, which will provide P_0^H.

$$P_0 = \begin{cases} P_0^L & \text{w/all-star} \\ P_0^H & \text{w/o all-star} \end{cases} \tag{3}$$

In the second round of competition, the issuer discusses the file price range with the bookrunners. In multiple bookrunner IPOs, the number of shares that each bookrunner allocates depends on the P_{mid} each bookrunner provides. A bookrunner that gives the lower P_{mid} will be kicked out of the syndicate. The bookrunner that provides the higher P_{mid} becomes the single bookrunner in this scenario. The price change from P_0 to P_{mid} depends on the market conditions change between the time that the two prices are provided. If market conditions were bad, bookrunners have no choice but to reduce the projected offer price in order to induce buyers to purchase the shares. If market conditions were good, bookrunners have the choice of increasing the projected price or not. We only consider the case of good market conditions in our model. We assume that the price can be increased $\bar{\vartheta}$ given the good market condition.

$$P_{mid}=P_0+\vartheta \qquad \vartheta \sim U\left[0, \bar{\vartheta}\right] \tag{4}$$

In the third round of competition, the bookrunners exert their effort and the issuer discusses the offer price with the bookrunners. The offer price, OP, is endogenously decided as a function of the midpoint of the file price range, $P_{mid,}$ and Effort.

$$OP=P_{mid}+Effort+\varepsilon=P_0+\vartheta+Effort+\varepsilon \tag{5}$$

Effort is the effort provided by a bookrunner during the road show process. A bookrunner can either give high or low effort. The bookrunner that provides a higher offer price than a competing joint bookrunner will win the mandate do the follow-on offer of the issuer.

$$Effort=\begin{cases} a_H \\ a_L \end{cases} \qquad (a_H>a_L) \tag{6}$$

We study the efforts of the underwriters after they are selected as the bookrunners. Pichler and Wilhelm (2001) study the effort exerted after the underwriting team is chosen but before the selection of the lead underwriter. They posit that managing underwriters have to exert some effort to win the lead underwriting business.

In practice, lead underwriters are typically selected first or simultaneously with other managing underwriters. In our model, we focus on the effort of bankers after they are selected as bookrunners/lead underwriters. The continuous competition between bookrunners after they are selected as the leads/bookrunners results in a higher effort level in equilibrium relative to the single bookrunner IPOs, as discussed in our following analysis.

In addition to being a function of P_{mid} and Effort, the offer price is a random variable that depends on exogenous uncertain factors, which are represented by ε . ε follows a uniform distribution from –b to b, i.e.

$$\varepsilon \sim U(-b,b) \tag{7}$$

(2) Bookrunners' Utility:

We assume that the bookrunners are risk neutral. The two bookrunners in the multiple bookrunner IPO pursue symmetric strategies, although they may differ in whether they possess an all-star analyst. Each bookrunner in the two bookrunner IPO has a utility function as follows:

$$\begin{aligned} &U_{\text{bookrunner}}^{\text{Multiple}} = \text{TotalUnderwriterRevenue} \times \text{Allocation} - \text{EffortCost} - \text{AnalystCost} + B_{\text{SEO}} \\ &\text{TotalUnderwriterRevenue} = \text{GrossSpread} + \text{Softdollars} \end{aligned} \quad (8)$$

where B_{SEO} is the benefit from follow-on offerings (also known as seasoned equity offerings (SEOs)) of this company that the bookrunner expects to receive. Allocation is the number of shares that each bookrunner allocates, which is determined by the issuer based on the P_{mid} that each bookrunner provides. To avoid additional complexity, we assume that the gross spread revenue is split proportionally in the same ratio as the share allocation in equilibrium, although this need not be the case in practice (See Chen and Ritter (2000)).

Since we omit other syndicate members in our model (co-managers as a group generally receive a constant proportion of the gross spread revenue, and receive few shares to allocate to clients, except for cold IPOs), for simplicity we assume that all gross spread revenue goes to the bookrunners. It will not significantly change the analytical results by adding a parameter to indicate that a certain percent of gross spread revenue is received by the bookrunners. The "GrossSpread" plus the "Softdollars" are the total revenues of the bookrunners. Since we are discussing the representative issuer and bookrunners in our model, we assume that the gross spread is 7% of proceeds.[7] Thus, the gross spread revenue is

$$\text{GrossSpread} = 0.07 \times \text{OP} \times N_{\text{IPO}} \quad (9)$$

"Softdollars" is the commission income received in return for hot IPO allocations, which is a function of underpricing. The fraction of the money left on the table that flows back to the underwriter through soft dollar commission revenue is a constant number β ($0<\beta<1$). During the bubble period, practitioners have told us that this number was about 0.3 (30%) in practice.

$$\text{Softdollars} = \beta \times (\text{Close-OP}) \times N_{\text{IPO}} \quad (10)$$

After substituting (9) and (10) back into (8) and simplifying, we get

[7] For deals with proceeds greater than $100 million (2006 purchasing power), the gross spread is typically less than 7% for U.S. IPOs.

$$U_{Bookrunner}^{Multiple} = [0.07 \times OP + \beta \times (Close\text{-}OP)] \times N_{IPO} \times Allocation\text{-}EffortCost\text{-}AnalystCost + B_{SEO} \quad (11)$$

EffortCost is the cost to the bookrunners for providing effort. We assume bookrunners are effort averse, i.e., EffortCost is a convex function of the effort. A high effort level results in high EffortCost.

$$Effort = \begin{cases} a_H \leftrightarrow EffortCost_{high} \\ a_L \leftrightarrow EffortCost_{low} \end{cases} \quad (12)$$

AnalystCost depends on the type of analyst. The cost of an all-star analyst ($AnalystCost_{high}$) will be higher for a bookrunner than the cost of a non-all-star analyst ($AnalystCost_{low}$).

$$AnalystCoverage = \begin{cases} AC_{high} \leftrightarrow AnalystCost_{high} \\ AC_{low} \leftrightarrow AnalystCost_{low} \end{cases} \quad (13)$$

In the single bookrunner IPO, the utility of the bookrunner is as follows:

$$\begin{aligned} U_{Bookrunner}^{single} &= TotalUnderwriterRevenue\text{-}EffortCost\text{-}AnalystCost + B_{SEO} \\ &= [(0.07 \times OP + \beta \times (Close\text{-}OP)] \times N_{IPO}\text{-}EffortCost\text{-}AnalystCost + B_{SEO} \end{aligned} \quad (14)$$

(3) Reservation Utility:

We assume that the issuer's reservation utility is -exp(-0) = -1. Each bookrunner's reservation utility is 0.

3. The Expected Utilities Due to the Uncertainty

(1) The Expected Utility of the Issuer

$$Expected(U_{issuer}) = E\left[OP \times N_{IPO} + (N_{post}\text{-}N_{IPO})(Close + (Neg \times Risk + AnalystCoverage))\right]$$

After substituting equations (2) and (5), we have the following formula:

$$Expected(U_{issuer}) = E\left[N_{IPO} \times \begin{pmatrix} -P_{mid} - \left(\frac{1}{Float} - 1\right)(Close + (Neg \times Risk + AnalystCoverage)) \\ -Effort - \varepsilon \end{pmatrix}\right]$$

After integration, we have:

$$Expected(U_{issuer}) = N_{IPO} \times \begin{pmatrix} -P_{mid} - \left(\frac{1}{Float} - 1\right)(Close + (Neg \times Risk + AnalystCoverage)) \\ -Effort \end{pmatrix} \quad (15)$$

(2) The Expected Utility of Each Bookrunner in Multiple Bookrunner IPOs

$$\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}}) = E\left\{[0.07\times\text{OP}+\beta\times\left(\text{Close-OP}\right)]\times\text{Allocation}\times N_{\text{IPO}}\text{-EffortCost-AnalystCost-}B_{\text{SEO}}\right\}$$

As shown in Appendix A, each bookrunner allocates one half of all the shares. After substituting equation (5) in, we have the expected utility of each multiple bookrunner:

$$\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner1}})=\left[0.07\times\left(P_0+\vartheta_1\right)+(0.07\text{-}\beta)\times\text{Effort}+\beta\times(\text{Close-}\left(P_0+\vartheta_1\right))\right]\times\frac{1}{2}\times N_{\text{IPO}}$$
$$\text{-EffortCost-AnalystCost+E}\left[B_{\text{SEO}}\right] \quad (16)$$

(3) The Expected Utility of the Single Bookrunner

$$\text{Expected}(U^{\text{single}}_{\text{Bookrunner}}) = E\left\{[(0.07\times\text{OP}+\beta\times\left(\text{Close}-\text{OP}\right)]\times N_{\text{IPO}}\text{-EffortCost}-\text{AnalystCost+}B_{\text{SEO}}\right\}$$

After simplification, we have

$$\text{Expected}(U^{\text{single}}_{\text{Bookrunner}})=E\left\{\begin{array}{l}(\frac{7}{100}\times P_{\text{mid}}+(\frac{7}{100}\text{-}\beta)\times\text{Effort}+\beta\times(\text{Close-}P_{\text{mid}}))\times N_{\text{IPO}}\\ \text{-EffortCost-AnalystCost+E}\left[B_{\text{SEO}}\right]\end{array}\right\} \quad (17)$$

The difference of expected utilities between the single bookrunner and multiple bookrunners is attributable to two aspects. First, two bookrunners split the total bookrunner revenue, whereas the single bookrunner gets all of the bookrunner revenue, including the expected SEO underwriting revenue. Second, the expected underwriting revenue is different for single bookrunner IPOs and multiple bookrunner IPOs. The offer price will be higher in equilibrium for single versus multiple bookrunner IPOs, resulting in less money being left on the table. Thus, less soft dollar commission revenue will be received, although with a higher offer price there will be slightly more gross spread revenue. In addition, more effort will be expended in equilibrium in the multiple bookrunner case, lowering the expected utility of each bookrunner.

4. Propositions

(1) The Availability and the IPO Pricing of Multiple Bookrunners

Proposition 1: Each bookrunner provides a higher level of the file price midpoint and inputs a higher level of effort in the joint-bookrunning IPO than in the sole-bookrunning IPO, holding constant issuing company and bookrunner characteristics. The joint-

bookrunners will have lower expected utilities than will the single bookrunner on a given IPO.

When a potential underwriter expects to face more competition, it will offer a higher file price range in order to get more shares to allocate. The higher final offer price is a result of the competition of multiple bookrunners in the pricing meeting, not as a result of the cooperation between two bookrunners in generating information. Our framework is supported by anecdotal evidence. As quoted in the *Wall Street Journal*, "'They (investment banks) really competed continually to deliver value (in multiple bookrunner IPOs),' says Greg Stanger, CFO of Expedia Inc, 'It was a nice change: Typically, a bank will work hard to win a piece of business then, once they've been hired, they sometimes feel demonstrating their ability isn't as crucial.'"[8]

Proof of Proposition 1:

The two choice variables in the single bookrunner's utility are P_{mid} and the level of Effort. The offer price is endogenously generated from P_{mid} and the level of Effort. From the expected utility expression equation (17), the coefficient on P_{mid} is $\left(\frac{7}{100}-\beta\right)\times N_{IPO}$. As long as the proportion of money left on the table that flows back to the underwriters (β) is higher than the gross spread of 7%, we will have a negative coefficient on P_{mid}. Since β is about 0.3 in practice, the single bookrunner will prefer low P_{mid}. Soft dollar commissions paid by rent-seeking investors if the IPO is underpriced remove the incentive of the sole bookrunner to recommend a higher file price range. This results in ϑ equals zero. Although market conditions are good, the single bookrunner will not increase the file price range, and its midpoint, P_{mid}, accordingly.

The other choice of the single bookrunner is the effort level. The bookrunner is effort averse. If the bookrunner increases the effort level, both Effort and EffortCost will increase. According to (17), we have

$$\Delta\text{Expected}(U^{\text{single}}_{\text{Bookrunner}}) = (\frac{7}{100}-\beta)\times N_{IPO}\times\Delta\text{Effort}-\Delta\text{EffortCost}$$

[8]McGee, Suzanne "Deals & Deal Makers: As 'Joint Bookrunning' Grows, The Complications Rise as Well," *Wall Street Journal*, April 13, 2000.

Since $\left(\frac{7}{100}\text{-}\beta\right)<0$ according to our assumption, the coefficients on both ΔEffort and ΔEffortCost are negative. The increasing Effort and EffortCost will decrease the utility of the bookrunner. In equilibrium, the single bookrunner chooses a_L.

In multiple bookrunner IPOs, there is a two-stage competition between bookrunners after they are chosen. The first stage is the competition on P_{mid}.

If a bookrunner chooses the low file price while the opponent chooses the high file price, the one that chooses the low file price is facing the risk of being kicked out of the syndicate and losing out on follow-on offerings. As shown in Appendix A, if one bookrunner provide $\vartheta_1 < \overline{\vartheta}$, the other bookrunner can always be better off by providing $\vartheta_2 = \frac{\overline{\vartheta}+\vartheta_1}{2}$. In equilibrium each bookrunner provides $\overline{\vartheta}$ and receives an allocation of half of the shares.

The second stage is the competition on the effort level. The payoff (utility) matrix of each bookrunner under different choices of Effort is as follows:

	a^H	a^L
a^H	$\left[E(U^H_{HH}), E(U^H_{HH})\right]$	$\left[E(U^H_{HL}), E(U^L_{HL})\right]$
a^L	$\left[E(U^L_{LH}), E(U^H_{LH})\right]$	$\left[E(U^L_{LL}), E(U^L_{LL})\right]$

If the issuer can distinguish the effort level of each bookrunner, i.e., there is no overlap between high effort and low effort (a_L+b<a_H-b), each bookrunner will provide high effort in multiple bookrunner IPOs. If the issuers cannot observe effort directly, the effort level of each bookrunner is reflected in the offer price that each bookrunner provides with a random error ε. We need $E(U^H_{LH})>E(U^L_{LL})$ and $E(U^H_{HH})>E(U^L_{HL})$ to make sure that no collusion exists and the high-high choice is the Nash equilibrium. Appendix B gives the proof. If the competing bookrunner gives low effort, the other bookrunner is always better off by exerting high effort, which satisfies $a_H \in \left(\frac{B_{SEO}\times a_L\text{+A-2bR}}{B}, \frac{B_{SEO}\times a_L\text{+A+2bR}}{B}\right)$, where A and B are defined in

Appendix B. If the competing bookrunner exerts high effort, the bookrunner that exerts low effort can always get higher expected utility by exerting high effort, which satisfies $a_H > \frac{4b^2 N_{IPO}(0.07-\beta)+Ba_L}{B_{SEO}-8b^2}$. Thus, high-high choice is the only equilibrium in this game.

Figure 2 shows the expected relationship between the prices and the number of bookrunners according to our model. The first closing market price is assumed to be exogenous. The midpoint of the file price range is higher when there are multiple bookrunners, as a result of the increasing competition among bookrunners. The offer price will be adjusted according to the effort. If the effort is high, as is the case with multiple bookrunners, the price will adjust upward for a high percentage of the price difference between P_{mid} and Close. Consequently, less money is left on the table.

No banks would choose to jointly run a book with other banks if they have a choice of being the sole bookrunner. The utility of each multiple bookrunner is always lower than the utility of the single bookrunner, which is proved in Appendix C. In multiple bookrunner IPOs, banks have to share the profits with competitors and they get lower profits all together, both because of duplicative effort costs and because of less money being left on the table.

The next question is whether the bookrunners want to stay in the multiple bookrunner syndicates or not, given that they know they have to provide P_{mid}^H and a_H. This depends on the utility that they will get in the IPO and their reservation utilities. We assume the reservation utility of the bookrunners is 0 in our model. As long as multiple bookrunners can achieve positive utility, they will agree to be bookrunners. If we decrease the reservation utility of the banks, we will observe joint-bookrunners in both smaller and riskier IPOs that otherwise would not have been lucrative enough to attract more than a sole bookrunner.

After the bursting of the bubble following March 2000, the number of IPOs decreased to a rate of less than one fourth the number during the bubble period. At the same time, the number of active bookrunners only decreased by half. The capacity for each bookrunner remained high, because investment banks do not want to lay off all their excess employees at once, although the bonuses of the workers can be reduced. Because of the excess capacity, investment banks needed to win business but were leery of cutting their percentage fees (gross spreads). As a result, the issuers' bargaining power over non-fee dimensions increased significantly. Investment banks were left with no choice but to accept the joint bookrunning business. If they did not maintain activity in the underwriting business, they risked losing personnel whose expertise would be hard to replace when there is an upturn in underwriting activity. Alternatively stated, we are arguing that from the boom times of 1991-2000 to the depressed activity levels of 2001-2005, the goal of bookrunners switched from earning a large amount of money by sole bookrunning and collecting soft dollars through high underpricing, to surviving in the IPO business until good times return. The decreased reservation utility partly explains the increased number of multiple bookrunners in recent years. Our following empirical analysis supports this argument. We find that the willingness of a bank to accept joint bookrunning is negatively related to its current bookrunning business relative to its working capacity.

(2) Size Effect

Although multiple bookrunners will agree to a higher offer price as a result of less bargaining power and more effort exerted by each of the bookrunners than by a single bookrunner, this does not mean that all companies can and will choose multiple bookrunners. Bookrunners and issuers are mutually chosen. Fernando et al (2005) argue that the matching of underwriters and issuers is positive assortative and that matches are based on companies' and underwriters' relative characteristics at the time of issuance. In other words, high-quality companies and reputable underwriters are very likely to choose each other, because this combination will generate a higher amount of surplus than the high and low (or low and high) matched pairs. Proposition 2 gives the size cutoff that determines whether an issuer can choose multiple bookrunners or not.

Proposition 2: Two bookrunners will run the IPO book jointly only when the issue size is large enough to ensure that each of them will have a non-negative utility. In other words, the gross spread revenue and the soft dollar revenue should be large enough to cover the duplicative effort costs of two bookrunners. If all-star analyst coverage is present, the minimum size is even larger.

Proof of Proposition 2:

Let us first consider the multiple bookrunners' case. To have $\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}})>0$, we must have the market value (Size) of the issue satisfying the following condition:

$$\text{Size}>\frac{\text{EffortCost}_{\text{H}}+\text{AnalystCost-}\frac{1}{2}\text{B}_{\text{SEO}}}{\frac{1}{2}\left[\left(\frac{7}{100}\text{-}\beta\right)\times\left(\text{P}_0+\overline{\vartheta}+\text{a}_{\text{H}}\right)+\beta\times\text{Close}\right]}\text{Close} \tag{18}$$

Since the AnalystCost for an all-star analyst will be higher than for a non-all-star analyst, the investment banks will require a relatively large size of the issuing company when they promise all-star analyst coverage, given that other aspects of the issuing company are equal.

In the single bookrunner IPO, the sufficient condition for $\text{Expected}(\text{U}_{\text{Bookrunner}}^{\text{Single}})>0$ is the following:

$$\text{Size}>\frac{\text{EffortCost}_{\text{L}}+\text{AnalystCost-B}_{\text{SEO}}}{\left(\frac{7}{100}\text{-}\beta\right)\times\left(\text{P}_0+\text{a}_{\text{L}}\right)+\beta\times\text{Close}}\text{Close} \tag{19}$$

From (18) and (19) we find that multiple bookrunners will require larger minimum company size than the single bookrunner, because the gross spread revenue is shared between two bookrunners, and each bookrunner has to provide a high effort level and a $\overline{\vartheta}$(resulting in a higher offer price and thus less money left on the table decreasing the soft dollar revenue).

A bookrunner with an all-star analyst market power. It can win the underwriting mandate by providing $\text{P}_0{}^{L}$, which is less than the price ($\text{P}_0{}^{H}$) of the bookrunner without an all-star analyst. According to (18) and (19), we get the minimum size requirements for different types of bookrunners as follows.

$$\text{Size}_{\text{Non-all-star}}^{\text{Single}}<\text{Size}_{\text{All-star}}^{\text{Single}},\ \text{Size}_{\text{Non-all-star}}^{\text{Multiple}}<\text{Size}_{\text{All-star}}^{\text{Multiple}}$$

When the size of the issuing company is less than $\text{Size}_{\text{Non-all-star}}^{\text{Single}}$, no bookrunner will work for this issuer since the utility of the bookrunner will be negative. If the size of the issuing company is smaller than $\text{Size}_{\text{Non-all-star}}^{\text{Multiple}}$, the issuer can only have a single bookrunner, even though multiple bookrunners will provide a higher P_{mid} and OP accordingly. When the size is larger than $\text{Size}_{\text{All-star}}^{\text{Multiple}}$, the issuer will choose multiple bookrunners with all-star analyst coverage for sure. We provide a numerical example in Appendix D.

When the company size is smaller than $\text{Size}_{\text{All-star}}^{\text{Multiple}}$, but larger than both $\text{Size}_{\text{Non-all-star}}^{\text{Multiple}}$ and $\text{Size}_{\text{All-star}}^{\text{Single}}$, the choice of the issuing company may vary according to the relative importance of analyst coverage. The following proposition explains the issuer's choice.

(3) Analyst Coverage

Proposition 3: The issuer may prefer a single bookrunner with all-star analyst coverage to multiple bookrunners without all-star analyst coverage when the relative benefit of all-star analyst coverage is large enough. Issuers with high risk gain more benefits from all-star coverage.

Proof of Proposition 3:

In Proposition 2, we discussed when the issuer can choose a multiple bookrunner IPO. However, it does not mean the issuer will always choose multiple bookrunners when it can. Here, we discuss when the issuer will choose a multiple bookrunner IPO. Suppose the issue size is larger than $\text{Size}^{\text{Single}}_{\text{Non-all-star}}$, but smaller than $\text{Size}^{\text{Multiple}}_{\text{All-star}}$. Let's compare the utility of the issuer under two choices, a single bookrunner with all-star analyst coverage or two bookrunners without all-star analyst coverage. In the single bookrunner IPO, if the bookrunner promises to provide all-star analyst coverage, the P_{mid} will be P_0^L. AC will be AC_{high}. At the same time, the cost of analyst coverage, AnalystCost, will be $\text{AnalystCost}_{high}$. Substituting P_0^L and AC_{high} into equation (15), we will get the following expected utility function of the issuer.

$$\text{Expected}(U_{\text{issuer}}) = N_{\text{IPO}}\left(P_0^L + \left(\frac{1}{\text{Float}}\text{-}1\right)\left(\text{Close+(Neg}\times\text{Risk+AC}_{\text{high}})\right)\text{-Effort}\right) \tag{20}$$

In the multiple bookrunner IPOs, if the analyst coverage will be non-star analyst coverage AC_{low}, which may generate less positive market reaction, the P_{mid} will be $P_0^H + \bar{\vartheta}$, and. The cost of analyst coverage to the bookrunner will be AnalystCost_{low}.

$$\text{Expected}(U_{\text{issuer}}) = N_{\text{IPO}}\left(P_0^H + \bar{\vartheta} + \left(\frac{1}{\text{Float}}\text{-}1\right)\left(\text{Close+(Neg}\times\text{Risk+AC}_{\text{low}})\right)\text{-Effort}\right) \tag{21}$$

Let:

$$\Delta = U^{\text{Single}} - U^{\text{Multiple}}$$

If $\Delta = U^{\text{Single}} - U^{\text{Multiple}} > 0$, a single bookrunner is a better choice, meaning that all-star analyst coverage is more important than the high P_{mid} provided by multiple bookrunners for the issuer. Substituting (20) and (21) into the difference Δ, we get

$$\Delta = \left(P_0^H + \bar{\vartheta} - P_0^L + \left(\frac{1}{\text{Float}} - 1 \right)(AC_{high} - AC_{low}) + (\text{Effort}_{low} - \text{Effort}_{high}) \right) \times N_{IPO}$$

If $\Delta = U^{Single} - U^{Multiple} > 0$, then AC_{high}-AC_{low} satisfies the following condition:

$$AC_{high} - AC_{low} > \frac{P_0^H - P_0^L + \bar{\vartheta} + (\text{Effort}_{high} - \text{Effort}_{low})}{\left(\frac{1}{\text{Float}} - 1 \right)} \tag{22}$$

If the issuer satisfies this condition, a single bookrunner with all-star analyst coverage will be chosen. The numerical example in Appendix E gives an example. Note that the higher is the issuer's risk, the more likely that the condition for a single bookrunner with all-star coverage will be satisfied.

If we allow AC_{high} and AC_{low} to change over time, this condition can be used to explain the changing number of multiple bookrunner IPOs. When all-star analyst coverage becomes relatively less important to issuing companies on the market, i.e. $AC_{high} - AC_{low}$ becomes small, and the fraction of issuing companies that hire multiple bookrunners will increase.

During the bubble period, more than one company on average went public each business day. It was hard for the issuing companies to attract public attention. All-star analyst coverage was a very important concern, especially for growth stocks in the technology and internet sectors. These companies would prefer all-star analyst coverage to multiple bookrunners, although multiple bookrunners would give them a higher offer price. After 2000, the number of IPOs dropped dramatically and the proportion of young growth companies dropped dramatically. It has become relatively easier for IPO companies to get publicity. Good offer prices (maximizing proceeds) have become their big concern. Thus, the decreased importance of analyst coverage results in a higher percentage of companies choosing multiple bookrunners.

To summarize, our model generate both cross-sectional and time series predictions. The model predicts that both the file price range and the offer price will be closer to the first-day market closing price for multiple bookrunner IPOs because of the competition among bookrunners. When issue size increases, banks are more likely to accept being joint bookrunners. High-risk companies are more likely to use a single bookrunner with all-star analyst coverage. We now test these predictions of our model.

IV. Data and Empirical Analysis

Our data source for IPOs over 1995-2005 is Thomson Financial's SDC new issue database, with corrections from Dealogic and other sources. In our analysis, we exclude best efforts offers, auction offers, ADRs (American Depository Receipts), closed-end funds, REITs (Real Estate Investment Trusts), banks and savings & loans, partnerships, unit offers, and IPOs with an offer price below $5.00 per share. We hand-collect the number of total syndicate members for IPOs from 1996-1998 from prospectuses on EDGAR. The number of syndicate members for 1999-2005 and the number of managing underwriters for each IPO are downloaded from SDC. Information on company founding dates is from Jay Ritter's website. Data on analyst coverage is from IBES, Investext, and other sources, and is cross-tabulated with Institutional Investor all-star analyst designations with the assistance of Lily Fang and Xiaohui Gao.

(Table I is about here)

IV A. Empirical Patterns

Table I shows that the percentage of IPOs that use multiple bookrunners increased in the late 1990s and increased more sharply starting in 2001. In 1995 and 1996, all IPOs used a single bookrunner. In 1997 and 1998, 3 IPOs in each year used multiple bookrunners. By 2001, there was a sharp increase in the percentage of IPOs using multiple bookrunners. This proportion increased from 7.2% in 2000 to 18.5% in 2001, coincident with a sharp increase in the percentage of multiple lead underwriters, a sharp decrease in the number of IPOs, and an even sharper drop in the number of small IPOs. In 2005, 50% of IPOs used multiple bookrunners.

Continuing the trend documented in Chen and Ritter (2000), Loughran and Ritter (2004) Corwin and Schultz (2005), and Ljungqvist, Marston, and Wilhelm (2006), Table I shows that over time issuers use more managing underwriters and fewer other syndicate members. The median number of managers in the syndicates increased from two for IPOs in 1995-1997 to four managers for IPOs in 2001-2005. The median syndicate size dropped from 19 syndicate members in 1995 to only five syndicate members in 2005. In the last decade, non-managing underwriters played little or no role in the underwriting syndicate, except for occasionally getting some shares for allocation to retail clients in cold IPOs (Chen and Ritter, 2000). About 66% of IPOs have no non-managing underwriters in 2005.[9]

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9 A careful reader of Table I might note that in 2004 and 2005, the median number of managers is 4 and the median number of total syndicate members is 5, while at the same time, the majority of IPOs have no non-managing

(Table II is about here)

In 2001, the number of IPOs decreased dramatically from the level prevailing in 1995-2000. The number of IPOs in 2001 was less than one-fourth of the number of IPOs in 2000, as shown in Table I. The number of active bookrunners dropped from 60 to 30 at the same time, as shown in Table II. This means that each bank was facing half of the previous bookrunning opportunities. The evidence suggests that banks strongly desired to generate income from underwriting IPO issues. They competed in various ways except for cutting gross spreads. Prestigious banks began to accept running the book jointly, which was consistent with the dramatic increase in the percentage of joint bookrunners in 2001, as seen in Table I. Table II shows that the top 10 bookrunners had 92.6% of the market share in 2001. It was a difficult IPO underwriting business market, especially for small banks.

At the same time, the mean and median issue sizes of IPOs increased dramatically. The mean proceeds for IPO issues increased from $171.1 million in 2000 to $424.3 million in 2001. The median increased from $79.7 million to $107.2 million. Because of the larger issue sizes, a higher percentage of IPOs became profitable for joint-bookrunners.

(Figure 3 is about here)

According to our Proposition 2, the issue size is a critical factor in an IPO company's selection of bookrunners. If the issue size is very small, the multiple bookrunners cannot generate enough profits from the underwriting to meet their reservation utilities. Empirically, Figure 3 shows that the percentage of companies using multiple bookrunners increases as the issue size increases, consistent with the prediction of Proposition 2. For the smallest issue size deciles with the proceeds less than $32 million, only 11% of the IPOs use multiple bookrunners. While 73% of the IPOs use multiple bookrunners in the largest issue size deciles with the proceeds more than $460 million.

(Table III is about here)

IV B. The Matching of Issuers with Underwriters

Issuers and underwriters choose each other mutually. This matching affects how many bookrunners will be used in an IPO, which in turn affects the bargaining power of the issuer in the pricing meeting. Table III demonstrates that the issue size plays an important role in the

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syndicate members. This is possible because the median of (A+B) may not equal the median of (A) plus the median of (B).

matching of issuers and bookrunners. In our model, we assume that both issuers and bookrunners maximize their own utilities, and match with each other. According to this assumption, we infer that most high prestige banks won't accept jointly running the book of a small size IPO, since there is insufficient revenue to cover their costs. Less prestigious banks might accept joint bookrunning for that given size, because they have lower costs and don't have much choice. The results in Table III are consistent with this prediction. The IPOs with larger issue sizes are more likely to hire multiple bookrunners. Issuing sizes are put into 10 size deciles according to the expected proceeds. Size1 means the smallest issuing size. Size10 is the biggest. The reputation of bookrunners is measured by either the Carter-Manaster (CM) rank or the market share of the bookrunners. The bookrunners with the highest CM ranking, which is 9, are the most reputable ones. The lowest CM ranking is 1, which stands for the least reputable bookrunners.

We follow the Megginson-Weiss (MW) method in the definition of market share of the bookrunners. The market share of each bank for an IPO is the total dollar amount of IPO proceeds that the bank works as a bookrunner to the total proceeds from all IPOs, measured over the three calendar years prior to the IPO. If there are N bookrunners in an IPO issue, proceeds are attributed on a 1/N basis. If one bank merges with another bank, the proceeds of both the acquiring bank and the target bank over the past three years are counted as the proceeds of the merged bank over the past three years. For example, the market share of CSFB in 2001 includes DLJ from the previous 3 year, because CSFB acquired DLJ in 2000. We define a variable Distance to measure the goodness of matching.

$$\text{Distance}=\frac{\text{Reputation-}\overline{\text{Reputation}_t}}{\text{STD}_t^{\text{Rep}}}-\frac{\text{Size-}\overline{\text{Size}_t}}{\text{STD}_t^{\text{size}}}$$

Reputation of the bookrunner is either market share or CM rank, and $\overline{\text{Reputation}_t}$ is the mean reputation of all bookrunners of a particular year t. $\text{STD}_t^{\text{Rep}}$ is the standard deviation of the reputation of all bookrunners of year t. $\frac{\text{Reputation-}\overline{\text{Reputation}_t}}{\text{STD}_t^{\text{Rep}}}$ is used to measure the deviation of the bookrunner's reputation from the mean level. $\frac{\text{Size-}\overline{\text{Size}_t}}{\text{STD}_t^{\text{size}}}$ is used to measure the deviation of the issuing size from the mean level for year t. A large value of Distance means that the issue size is small relative to the bank's reputation value.

Table III shows that the average Distance, measured either in DistanceCM or in DistanceMS, decreases while the number of bookrunners increases. The average DistanceMS is -0.011 for two bookrunner IPOs. If a small issuer hires a bank with high reputation value, for example that the DistanceMS is more than 0.5, it is very unlikely the bank would accept to jointly run the book with another bank. If a prestigious bank runs the book of a relatively small issue, the issuer can only use single bookrunner, which result in less bargaining power at the pricing meeting.

(Figure 4 is about here)

IV C. The Effect of Multiple bookrunners on underpricing

Our Proposition 1 assumes that multiple bookrunners compete over the P_{mid} and offer price, instead of the gross spread. Our Proposition 1 also predicts that issuers can make multiple bookrunners play against each other, which results in a high P_{mid} and a high offer price, even after controlling for the issue size. Our empirical evidence supports our assumptions and the prediction of Proposition 1. Figure 4 shows that the gross spreads for multiple bookrunner IPOs have no material difference from the gross spreads for single bookrunner IPOs in each proceeds category. The gross spread clustering at 7% for moderate-size deals is apparent.

The total returns, defined as the (closing price-offer price)/offer price, and the initial returns, defined as the (offer price-P_{mid})/P_{mid}, are quite different for single and multiple bookrunner IPOs. From Table IV, we observe that multiple bookrunner IPOs have lower initial returns in 7 out of 10 size categories, and lower total returns in 8 out of 10 size categories. These patterns support the argument that issuers have more bargaining power in multiple bookrunner IPOs and bookrunners provide both a high P_{mid} and offer price. We also notice that issuers have large bargaining power to have two bookrunners play against each in large issue size multiple bookrunner IPOs. For example, Table IV shows that IPO underpricing is reduced by 48% ((13.01-6.78)/13.01) on average when the issuers hire multiple bookrunners for the issues with proceeds larger than $460 million. We posit that this reduction is because banks are more worried about losing the bookrunning business when it is a large issue. Banks compete with the competing bank more aggressively when they are both bookrunners. Issuers have more bargaining power to achieve a higher offer price.

(Table IV is about here)

The issue size plays a very important role in determining the gross spread, the initial return, and the total return. In Table V, we use OLS regression to estimate the effect of the number of bookrunners on the gross spread, the initial return, and the total return after controlling for the issue size. We find that large issues have low gross spreads. For every 1% increase in the Ln(proceeds), the gross spread decreases by 0.53 basis points. After controlling for issue size, the number of bookrunners has no effect on the gross spread.

(Table V is about here)

We also estimate the effect of the number of bookrunners on the initial return in the second regression of Table V. It shows that underpricing is reduced as the number of bookrunners increases, after controlling for the size and other characteristics of the issuing companies. The coefficient on the number of bookrunners implies that underpricing is reduced by 2.5% for each additional bookrunner.

The market return of the 15 trading days before the issuing date has a positive effect on the underpricing, which is consistent with the findings in Loughran and Ritter (2002), Lowry and Schwert (2002), and Ince (2007). This manifests that offer prices are not fully adjusted to reflect publicly available information.

Corwin and Schultz (2005) attribute the low underpricing of multiple bookrunner IPOs to the information generation of more managers. They assume that the difference between the closing price and the midpoint of the file price is the total asymmetric information. Multiple bookrunners will adjust a higher percentage of this asymmetric information than a single bookrunner because of the superior information generation. We argue that the difference between the file price and the closing price is partly attributable to the bookrunner's intentional underpricing to get soft dollar commission revenue. Issuers have higher bargaining power in multiple bookrunner IPOs, thus the file price is high and closer to the closing price. Several papers support our argument. Ince (2007) finds that agency conflicts play a central role in the partial adjustment of the offer price using 1985-2003 IPO data. Houston, James, and Karceski (2006) find that underwriters low-ball the file price range systematically, especially in the 1999-2000 bubble period.

Our regression in row 6 shows that the total return also decreases with the increasing number of bookrunners in each IPO. Since the midpoint is established at the beginning of the road show process, this price does not reflect information generation during the road show.

Multiple bookrunners give a high file price midpoint, which cannot be explained by the information generation of the bookrunners during the roadshow, but can be explained by our bargaining model. The coefficients in row 6 imply that for a \$20 closing price and \$15 midpoint of single bookrunner IPO, one more bookrunner results in approximately \$1 higher midpoint($(20\text{-}15)/15\text{-}(20\text{-}P_{mid}^{Multiple})/P_{mid}^{Multiple}=8.35\%$, $P_{mid}^{Multiple}=16$).[10] For an offering selling shares with a market value of \$100 million, the -8.35% coefficient implies that using multiple bookrunners results in approximately \$8 million more in proceeds for the issuing firm, relative to if a sole bookrunner was employed. This is consistent with our bargaining model.

Our Proposition 3 predicts the tradeoff between the high offer price provided by multiple bookrunners and receiving all-star analyst coverage from a single bookrunner. Consistent with the prediction of our model, Table VI shows that single bookrunner IPOs with all-star analyst coverage have a larger initial return and total return than multiple bookrunner IPOs without all-star analyst coverage. The competition of multiple bookrunners results in a higher P_{mid} and offer price relative to the closing price. On average, Issuers leave 41% ((14.88%-10.54%)/10.54%) more money on the table to get all-star analyst coverage. We also notice that issuers that hire a single bookrunner with all-star coverage have a larger issue size (Ln(Proceeds)) on average than the multiple bookrunner IPOs without star analyst coverage. This supports the Proposition 3 prediction that some issuers choose a single bookrunner with all-star coverage and leave more money on the table, even though their issue sizes are large enough for multiple bookrunners with a higher offer price.

(Table VI is about here)

IV D. Buyout-backed IPOs

Since not all issuing companies can or will choose to use multiple bookrunners in their IPOs, we want to know how the issuing companies and multiple bookrunners matched with each other.

First, we consider the characteristics of the issuing companies that use multiple bookrunners. Table VII shows that buyout-backed companies are very likely to use multiple bookrunners in their IPOs. We also observe a rapid increase in the buyout-backed IPO market. In 2001, the total proceeds from buyout-backed IPOs were about \$3 billion. In 2002, the proceeds increased to \$4.3 billion. In 2005, the total proceeds increased to \$15.2 billion. As can be seen,

[10] The results are robust to using the closing market price in the denominator rather than the OP or midpoint.

2005 was a stellar year for buyout-backed IPOs. Not only do we observe growth in the proceeds of buyout-backed IPOs, we also notice that the number and percentage of buyout-backed IPOs in relation to all IPOs has increased significantly in recent years. Table VII shows that only 1-7% of IPOs were buyout-backed IPOs from 1995 to 2000. In 2005, 41% of the IPOs were buyout-backed IPOs. The proceeds from buyout-backed IPOs as a percentage of total IPOs increased from 7.3% in 2000 to 55% in 2005.

(Table VII is about here)

One reason for a higher propensity to have multiple bookrunners in buyout-backed IPOs is that private equity (PE) firms usually have relationship banks that help them in tender offers, trading securities, providing bank loans, and underwriting other securities. These relationships will help the PE firms to convince banks to do joint-bookrunning IPOs. Another reason is that PE firms want to reward relationship banks with IPO underwriting business for the buyout deals that banks helped to carry out previously, and to curry favor for future deals. Buyout-backed companies are usually backed by several private equity firms. Different private equity firms have different preferred banks. PE firms prefer to use their own preferred banks in the IPOs. Figure 5 shows that buyout-backed IPOs have a higher percentage of multiple bookrunners than non-buyout IPOs in eight out of 10 offer-size deciles. This shows that buyout-backed companies are more likely to use multiple bookrunners than non-buyout-backed companies, after controlling for proceeds. In the largest size category, in which IPOs have proceeds of more than $460 million, all 56 buyout-backed companies use multiple bookrunners.

Size and buyout-backed features are the two most important company characteristics in determining the propensity to use multiple bookrunners. The third company characteristic we discuss is the risk of the issuing company. Risk can reflect either technological or valuation uncertainty. We use a technology industry dummy (including internet companies) and daily stock price volatility in the aftermarket to measure the risk of the issuing company. If it is a technology company, it should have higher risk than a non-technology company. According to our model, this type of company should prefer all-star analyst coverage over multiple bookrunners. High volatility companies should also have the same preference. We define the volatility of the company as the variance of the daily market-adjusted return using the CRSP value-weighted market in the first 20 trading days after the IPO, commencing on the day after the first trading day.

Second, we consider the characteristics that affect whether a bank will be selected as a bookrunner. Table VIII shows that issuers are more likely to include commercial banks (CB) as a bookrunner when they use multiple bookrunners. About 30% of the sole bookrunners are commercial banks. More than 50% of the multiple bookrunner IPOs have a commercial bank as one of the bookrunners. Although not shown in Table VIII, we also find that among the companies that choose multiple bookrunners, the small companies tend to choose pure IB bookrunner. The probability of hybrid bookrunners increases with the issue sizes. In 2004 only 45 out of 305 *Institutional Investor* all-star analysts were affiliated with commercial banks. All of the other all-stars are affiliated with investment banks. This is consistent with the hypothesis that small companies choose IBs because they care about the analyst coverage provided by IBs, and large companies are more concerned about their future borrowing ability.

(Table VIII is about here)

Third, we also consider the factors that affect the decision of the banks regarding their willingness to be multiple bookrunners. From the bookrunner's perspective, we predict that banks are less likely to accept running the IPO book jointly when they have a large amount of IPO underwriting business that is close to their full working capacity. We use the number of IPOs that the bank is currently working on as a bookrunner when the bank considers to run this particular book (the filing date), to the total number of IPO issues that the bank has been a bookrunner on in the previous three years. We call this ratio pipeline. When a bookrunner has far less business than its full working capacity, it will be more likely to accept joint bookrunning.

Finally, we use probit regressions to estimate the factors that affect the choice of single bookrunner vs. multiple bookrunners by both issuers and bookrunners in Table IX. We have 528 IPOs from 2001 to 2005. If one IPO has more than one bookrunner, we treat each bookrunner as a separate observation, because bookrunners in one IPO may have different characteristics.

The two regressions use two variables separately to estimate the match of the issuer's reputations and issuing sizes. DistanceCM is $\frac{\text{CMRank-}\overline{\text{CMRank}_t}}{\text{STD}_t^{\text{CMR}}} - \frac{\text{Size-}\overline{\text{Size}_t}}{\text{STD}_t^{\text{size}}}$. DistanceMS is $\frac{\text{Mktshare-}\overline{\text{Mktshare}_t}}{\text{STD}_t^{\text{Mkt}}} - \frac{\text{Size-}\overline{\text{Size}_t}}{\text{STD}_t^{\text{size}}}$. When we calculate the MarketShare, we use the SDC code of the lead parent to calculate all the IPO issues that a particular bank works as a bookrunner. If two banks merged, the previous IPO issues that both banks worked as bookrunners are counted as the previous deals of the merged bank.

We also use four underwriter characteristics, i.e., Relative Pipeline, Allstar Dummy, and Allstar Total. Here, we use relative pipeline, which is defined as follows:

$$\text{RelativePipeline} = \frac{\text{Pipeline}}{\text{Market share} \times \text{Total proceeds of all IPOs}}$$

The relative pipeline measures how busy a bookrunner is given its reputation and market condition. We use the pipeline divided by the product of the market share of the bookrunner in the past calendar year and the proceeds of all IPOs in the past twelve months. In the bookrunner characteristics, we also include Allstar Dummy in the regression, which indicates whether the bookrunner provides all-star analyst coverage for this IPO. Allstar total is the number of all-star analysts from all bookrunners covering the company. For an IPO with two bookrunners, Allstar total can take on the value of 0, 1, or 2.

(Table IX is about here)

Consistent with our previous univariate analyses, the results from both methods show that the larger the distance is, the less likely the IPO is to have multiple bookrunners. It means that more reputable banks are less likely to be one of the multiple bookrunners given the issue size. The regressions also show that relative pipeline has a negative coefficient, which means that the banks would not want to be the joint bookrunners if they have relatively high amount of other IPO business to do. Multiple bookrunner IPOs are more likely to have more all-star analyst covering the IPOs, which is manifested by the positive coefficient on Allstar Total. This result is rather mechanical. Multiple bookrunner IPOs might mechanically have more analysts covering the issue, although each all-star is less likely to promise coverage due to the smaller benefit received by the bank. The negative coefficients on the Allstar dummy are consistent with this prediction. Commercial banks are more likely to be one of the multiple bookrunners, instead of running the book alone.

The regression in Table IX estimates the effect of issuing company characteristics on the choice of single bookrunner vs. multiple bookrunners. Large issue-size company and buyout-backed companies are more likely to use multiple bookrunners, which is consistent with our univariate analyses. We also find a significantly negative coefficient on tech dummy as predicted due to the desire for all-star analyst coverage.

V. Conclusion

We explain the increasing number of multiple bookrunner IPOs in recent years by using a bargaining model. Our model assumes that when there are multiple bookrunners, competition between the bookrunners reduces the tendency to "hold up" the issuing firm after winning the mandate. Specifically, in equilibrium, joint bookrunners will give a high midpoint of the file price range after they enter the IPO syndicate and will give a high effort level in the roadshow process because they are facing the threat of being kicked out of the syndicate or will receive a low allocation of shares to distribute to investors. Further, a low effort level jeopardizes being chosen to underwrite follow-on issues of the company. The main explanation of the high offer prices of multiple bookrunner IPOs is the low bargaining power of the bookrunners relative to the issuing company when they are facing the two threats. The low bargaining power is reflected in the high file price range at the beginning of the road show, which cannot be explained by information generation during the road show process, and the high offer price. Our empirical evidence is consistent with the predictions of this model.

Not all companies that can use multiple bookrunners will use them because of the tradeoff between a high offer price and receiving all-star analyst coverage. When the issuing companies are facing a choice between multiple bookrunners without all-star analysts and a single bookrunner with an all-star analyst, they will consider the relative utilities of two decisions. High-risk companies are very likely to choose a single bookrunner with all-star analyst coverage.

The issuer's choice also depends on the relative importance of the analyst coverage. If we allow this relative importance to change over time, we can use it to explain the increasing fraction of IPOs that use multiple bookrunners in recent years. When the number of IPOs is large, the all-star analyst coverage becomes very important. At this time, it is hard for the issuing companies to get public attention. All-star analyst coverage gives the issuing company a very good opportunity to attract public attention. Many issuers will optimally choose all-star coverage over a high offer price. When the number of IPOs is small, the high issuing price becomes the first order of concern for the issuer. A high offer price is more attractive to the issuers than the all-star analyst coverage. This helps explain the increasing number of multiple bookrunners after 2001.

Our analytical model shows that the issue size must be large enough to include multiple bookrunners in the syndicate and to make each bookrunner profitable from the issuing business. Our data show that the issue sizes increase dramatically after 2001, permitting the rapidly increasing number of multiple bookrunners. The decreasing number of IPO companies in recent years may also have reduced the costs of the underwriters, which makes more multiple bookrunner IPOs acceptable to the underwriters.

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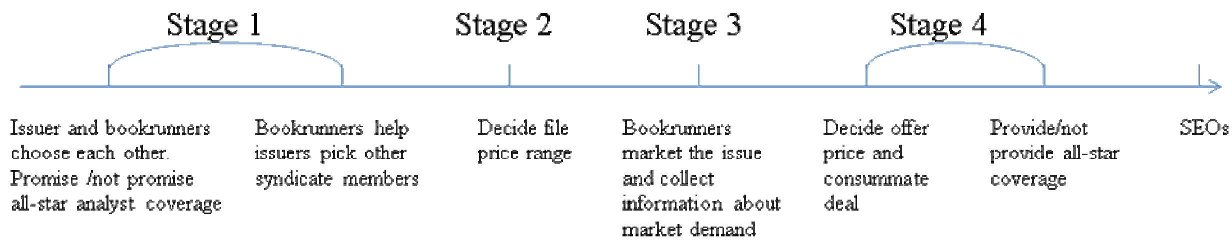

Figure 1

Figure 1 plots the IPO process from the formation of the underwriting syndicate to the aftermarket analyst coverage.

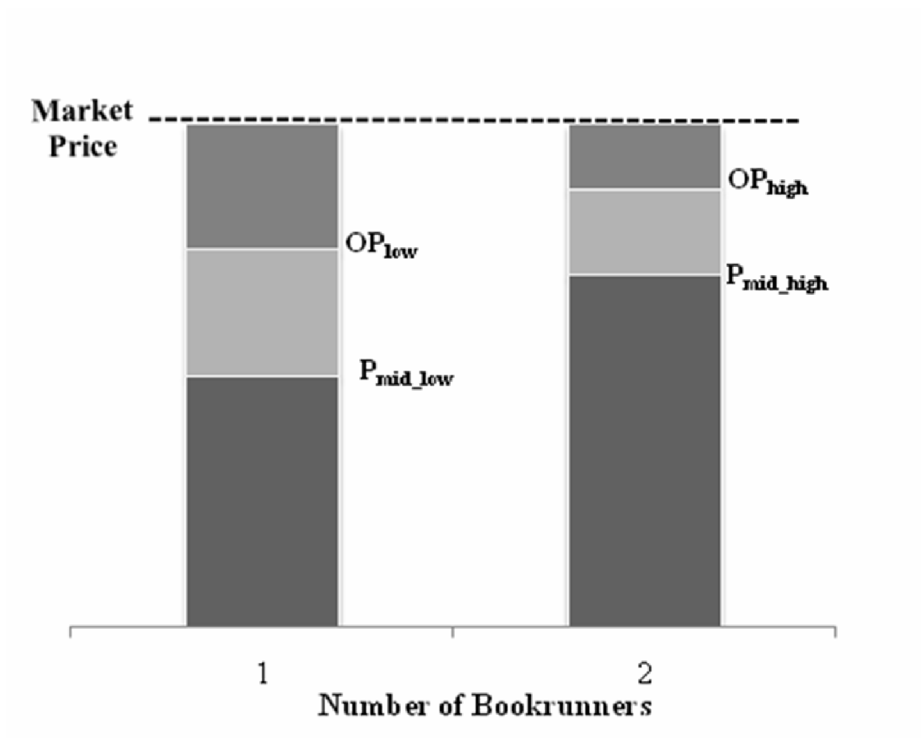

Figure 2

Figure 2 plots the relationship between the number of bookrunners and the IPO stock prices. P_{mid} is the midpoint of the file price range. OP is the offer price. Market price is the first closing market price, which is exogenous. With multiple bookrunners, both the equilibrium file price range midpoint and the offer price are higher than with a sole bookrunner.

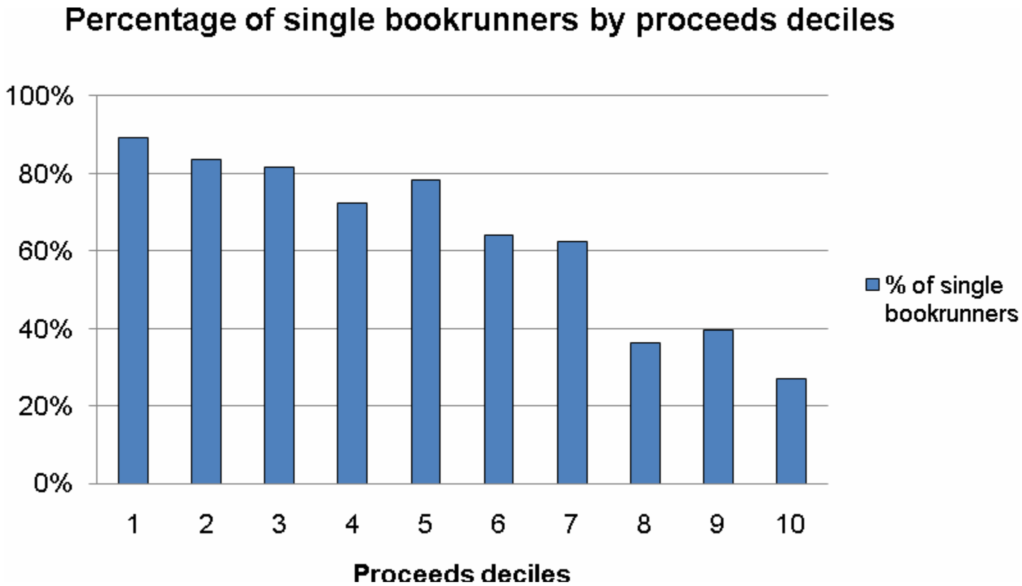

Figure 3

Figure 3 shows the percentage of single bookrunners by proceeds deciles for IPOs from 2001 to 2005. We put 528 IPO companies into 10 proceeds categories with 54 observations in each proceeds category except for the largest proceeds category, which has 56 observations. Category 1 IPOs have proceeds of \$0~32.0 million, Category 2: \$32.1~49.0, Category 3: \$49.1~63.0, Category 4: \$63.1~78.0, Category 5: \$78.1~98.0, Category 6: \$98.1~126.0, Category 7: \$126.1~164.0, Category 8: \$164.1~225.0, Category 9: \$225.1~460.0, Category 10: \$460.1 and higher. No inflation adjustments have been made, and proceeds are global proceeds, not including any overallotment shares that are exercised.

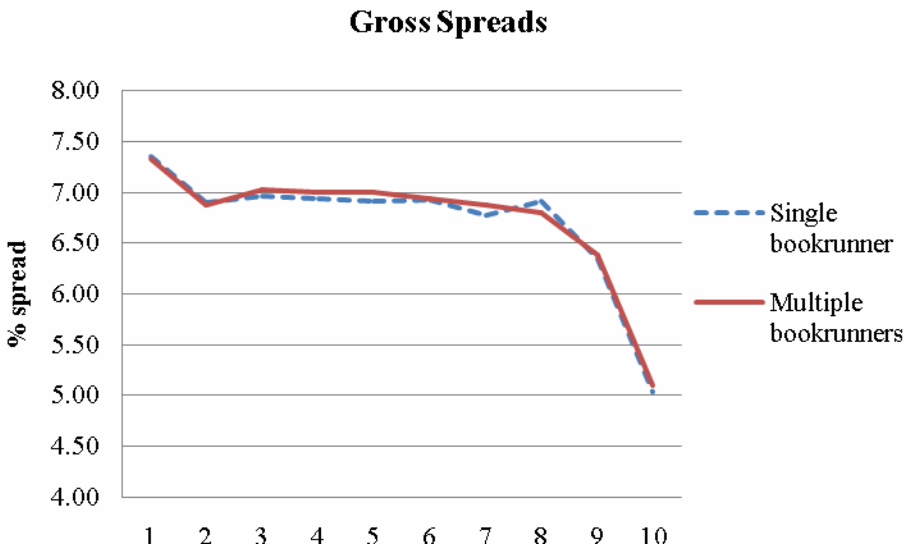

Figure 4

Figure 4 shows the mean percentage gross spreads by proceeds deciles for single bookrunner IPOs and multiple bookrunner IPOs from 2001 to 2005. The slight dip in category 2 is attributable to the lower spreads on several auction IPOs conducted by WR Hambrecht+Co.

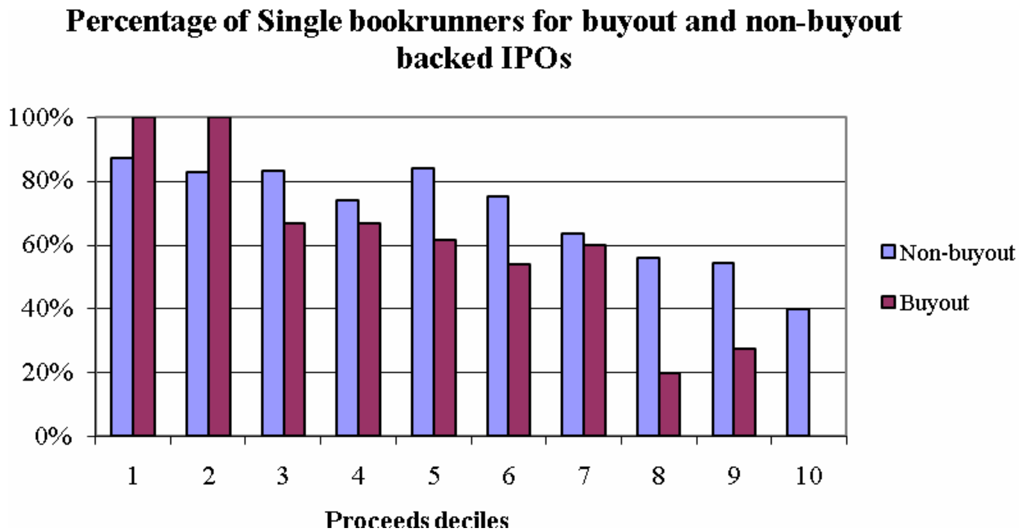

Figure 5

Figure 5 shows the percentage of single bookrunners for buyout- and non-buyout-backed IPOs by proceeds deciles (2001-2005).

Table I

Underwriting syndicate structures by years

This table shows the percentage of multiple bookrunner IPOs, the percentage of multiple lead underwriter IPOs, the average and median number of 1) bookrunners, 2) lead underwriters, 3) all managers, and 4) all syndicate members in underwriting syndicates, and the percentage of U.S. IPOs with zero non-managing underwriters from 1995-2005. We exclude best-efforts offers, auction offers, ADRs (American Depository Receipts), closed-end funds, REITs (Real Estate Investment Trusts), banks and savings & loans, partnerships, unit offers, and IPOs with an offer price below $5.00 per share. Data are from Thomson Financial, with corrections.

Year	# of IPOs	% with Multiple Book-runners	# of Bookrunners		% of Multiple Leads	# of Leads		# of Managers		# of Syndicate Members		% of IPOs with Zero Non-managing Underwriters
			Mean	Median		Mean	Median	Mean	Median	Mean	Median	
1995	437	0	1.00	1	0.7%	1.01	1	2.27	2	----	----	----
1996	640	0	1.00	1	0.6%	1.01	1	2.44	2	19.89	19	5.6%
1997	461	0.7%	1.01	1	2.2%	1.02	1	2.52	2	18.52	18	7.8%
1998	270	1.1%	1.01	1	4.1%	1.05	1	2.87	3	16.39	17	9.3%
1999	470	4.7%	1.05	1	11.9%	1.12	1	3.43	3	16.40	15	5.6%
2000	374	7.2%	1.08	1	21.1%	1.22	1	3.72	3	15.39	14	5.9%
2001	78	19.2%	1.19	1	54.3%	1.54	2	4.41	4	15.88	14	3.9%
2002	64	28.1%	1.31	1	47.7%	1.52	1	4.77	4	14.91	12	4.7%
2003	60	31.7%	1.32	1	48.4%	1.53	1	4.00	4	8.43	8	25.0%
2004	172	36.6%	1.40	1	62.6%	1.71	2	4.47	4	6.63	5	51.7%
2005	155	49.7%	1.62	1.5	61.9%	1.81	2	4.74	4	6.28	5	65.8%

Table II

Summary statistics for bookrunners

The table lists the summary statistics for bookrunners by years: # of bookrunners is the total number of investment banks or commercial banks who act as bookrunner for at least one IPO in that particular year. Ratio of # of IPO to # of bookrunners is the total number of IPOs / the number of bookrunners. Total gross spreads of the top-10 bookrunners are measured in billion dollars. The market share of each bookrunner is the total gross spread revenue of that bookrunner from all IPOs divided by the total gross spread revenue from all bookrunners in that year. If two banks jointly run one book, each is attributed half of the credits. All of the gross spread revenue from a deal is attributed to the bookrunner(s). The total market share, using gross spread revenue, of top-10 bookrunners are the sum of market shares by the 10 bookrunners with the largest amount of gross spread revenue. Proceeds are global proceeds, not including any overallotment shares that are exercised. Mean and Median of proceeds from each IPO are listed in the last two columns. No inflation adjustments are made.

Year	# of Bookrunners	Ratio of # of IPOs to # of Bookrunners	Average # of IPOs for Each Bookrunner	Average # of IPOs for Top 10 Bookrunners	Total Gross Spread Revenues of Top 10 Bookrunners	Total Market Share of Top 10 Bookrunners	Proceeds from Each IPO	
							Mean	Median
1995	148	4:1	3.8	24.9	$1.28b	71.4%	$60.1m	$32.0m
1996	165	5:1	5.1	32.4	$1.88b	67.1%	$64.3m	$34.6m
1997	164	3.5:1	3.8	19.6	$1.35b	60.2%	$66.6m	$33.8m
1998	119	3:1	3.1	16.2	$1.42b	75.5%	$119.9m	$42.5m
1999	84	6.5:1	6.7	37.3	$3.14b	84.6%	$135.1m	$61.7m
2000	60	7.5:1	7.9	36.5	$3.55b	87.3%	$171.1m	$79.7m
2001	30	3:1	3.8	8.2	$1.45b	92.6%	$424.3m	$107.2m
2002	34	2.5:1	3.1	7.9	$1.16b	93.2%	$336.0m	$117.0m
2003	30	2.5:1	3.5	6.9	$0.71b	84.2%	$150.8m	$106.8m
2004	53	4.5:1	6.5	24.1	$2.16b	84.9%	$180.3m	$82.6m
2005	61	3.5:1	5.4	21.2	$1.69b	79.7%	$173.5m	$109.7m

Table III

The matching of issuers and bookrunners

This table shows the matching of issuers and bookrunners for IPOs from 2001 to 2005. IPOs with missing Carter-Manaster rankings are deleted. N is the number of IPOs. If there is more than one bookrunner in an IPO, each bookrunner is counted as a separate observation for computing the distance. CM rank is the Carter-Manaster rank of the bookrunner. The bookrunners with the highest CM ranking, which is 9, are the most reputable ones. The lowest CM ranking is 1, which stands for the least reputable bookrunners. The market share of each bank for an IPO is the total dollar amount of IPO proceeds for that bank on which it is a bookrunner to the total dollar amount of all IPOs in the three calendar years prior to the IPO. All IPOs are assigned to expected proceeds ($P_{mid} \times Size$) deciles. For the smallest expected proceeds category, size equals one. For the largest proceeds category, size equals 10. The average sizes are listed in the following table by the number of bookrunners. DistanceCM is $\frac{\text{CMRank-}\overline{\text{CMRank}_t}}{\text{STD}_t^{\text{CMR}}} - \frac{\text{Size-}\overline{\text{Size}_t}}{\text{STD}_t^{\text{size}}}$. DistanceMS is $\frac{\text{Mktshare-}\overline{\text{Mktshare}_t}}{\text{STD}_t^{\text{Mkt}}} - \frac{\text{Size-}\overline{\text{Size}_t}}{\text{STD}_t^{\text{size}}}$.

# of Bookrunners	N	Size Decile Means	CM Rank Means	DistanceCM Means	Market Share Means	DistanceMS Means
1	341	4.05	7.51	0.623	0.105	0.494
2	333	6.05	8.32	0.457	0.094	-0.011
3	82	9.02	8.72	-0.879	0.102	-1.130

Table IV

Comparison of the mean initial and total returns for IPOs with single bookrunner and multiple bookrunners

This table compares the initial returns and the total returns for 528 IPOs from 2001-2005 with single bookrunner and multiple bookrunners, after classifying an IPO into a proceeds decile. Initial return is defined as the (closing price-offer price)/offer price. Total return is the (closing price-midpoint of file price range)/midpoint of file price range.

		# of IPOs		Mean Initial Return, %		Mean Total Return, %	
Size	Proceeds	Single Bookrunner	Multiple Bookrunners	Single Bookrunner	Multiple Bookrunners	Single Bookrunner	Multiple Bookrunners
1	<$32m	44	6	7.7	3.5	-6.7	-27.5
2	$32~49m	42	8	9.9	7.9	-12.7	-26.0
3	$49~63m	44	10	9.1	24.6	2.0	28.4
4	$63~78m	39	15	13.5	3.3	12.8	-2.1
5	$78~98m	45	12	10.7	13.6	12.3	19.6
6	$98~126m	35	19	17.9	13.7	23.8	10.4
7	$126~164m	32	20	17.4	18.0	27.2	20.5
8	$164~225m	20	34	15.1	10.5	15.1	8.0
9	$225~460m	21	32	13.0	6.8	21.7	7.4
10	>$460m	14	36	13.3	7.0	21.4	4.6
Total		336	192	12.2	10.4	11.7	4.4

Table V

Number of bookrunners and different underwriter compensation and return measures

The table lists coefficient estimates from OLS regressions with the percentage Gross spread, initial return, and total return as the dependent variables. Total return is defined as the (closing price-midpoint of file price range)/midpoint of file price range. Initial return is the (closing price-offer price)/offer price. Ln(proceeds) is the inflation-adjusted log of proceeds. CRSPVW15 is the CRSP value-weight 15 trading day percentage return before the IPO. LBO dummy equals 1 if the IPO company is backed by buyout firms, and it equals 0 otherwise. VC dummy equals 1 if the IPO company is backed by venture-capital firms, and it equals 0 otherwise. Spinoff dummy equals 1 for spin-offs. P-values are in parentheses.

	Intercept	# of Bookrunners	Ln(Proceeds)	CRSPVW15	Buyout Dummy	VC Dummy	Spinoff Dummy	N	R^2
Gross Spread	9.33	-.000	-0.55					528	59.3%
	(<0.001)	(0.991)	(<0.001)						
Gross Spread	9.35	-.041	-0.54		0.16	-0.03	-0.19	528	60.9%
	(<0.001)	(0.310)	(<0.001)		(0.003)	(0.492)	(0.015)		
Initial Return	8.61	-2.70	1.47	0.90	-2.58	2.26	-3.70	528	5.8%
	(0.039)	(0.029)	(0.096)	(<0.001)	(0.127)	(0.288)	(0.104)		
Initial Return	17.74	-2.87	0.57	0.70	-2.40	4.34	-3.37	388	7.1%
(>0)	(0.001)	(0.033)	(0.582)	(0.006)	(0.197)	(0.069)	(0.174)		
Initial Return	-5.61	-0.16	0.74	0.32	-0.95	-2.42	-1.47	140	10.5%
(≤0)	(0.001)	(0.865)	(0.053)	(0.040)	(0.331)	(0.028)	(0.202)		
Total Return	-14.51	-8.35	7.77	2.27	-5.29	0.29	-9.13	528	10.3%
	(0.048)	(0.002)	(<0.001)	(<0.001)	(0.106)	(0.941)	(0.092)		

Table VI

Trade-off between star analyst coverage of single bookrunner and high offer price of multiple bookrunners

This table shows the average initial return and total return in each category for IPOs from 2001-2005. N is the number of IPOs in the category. No all-star means no bookrunners' *Institutional Investors* all-star analyst covered the issue in the year after the IPO. One all-star means one bookrunner's all-star analyst covered the issue. Total return is defined as the (closing price-midpoint of file price range)/midpoint of file price range. Initial return is the (closing price-offer price)/offer price. Ln(proceeds) is the inflation-adjusted log of proceeds. Proceeds are global proceeds, not including any overallotment shares that are exercised. 19 IPOs with more than one all-star analyst covering the issue are not included in the table, because the initial returns and total returns are mainly driven by Ln(proceeds).

		No All-star	One All-star
Single Bookrunner	N	278	68
	Ln(Proceeds)	4.19	5.07
	Initial Return	11.22%	14.88%
	Total Return	6.06%	18.59%
Multiple Bookrunners	N	100	77
	Ln(Proceeds)	4.84	5.49
	Initial Return	10.54%	10.77%
	Total Return	6.80%	7.32%

Table VII

Buyout-backed IPOs by years

This table shows how many issues are buyout-backed IPOs each year and the percentage of these issues to the total number of IPOs. This table also gives the total global proceeds, excluding overallotment options, from buyout-backed IPOs and its percentage to the total proceeds from all IPOs.

Year	# of IPOs	# of Buyout-backed IPOs	% of Buyout-backed IPOs	Proceeds from Buyout-backed IPOs (in $ millions)	Proceeds from Buyout-backed IPOs as % of Total
1995	437	14	3.2%	1,730.8	6.6%
1996	640	13	2.0%	880.1	2.1%
1997	461	5	1.1%	398.0	1.3%
1998	270	20	7.4%	3,043.8	9.4%
1999	470	29	6.2%	6,883.5	10.8%
2000	374	19	5.1%	4,662.0	7.3%
2001	81	16	19.8%	3,059.1	8.9%
2002	65	21	32.3%	4,304.4	19.7%
2003	62	19	30.6%	4,490.7	48.0%
2004	174	41	23.6%	8,681.1	27.7%
2005	160	66	41.3%	15,248.7	54.9%

Table VIII

Statistics of bank reputation, analyst coverage, and CB for different number of bookrunners

The table presents statistics of bookrunners, which includes the market share, bookrunner's all-star analyst coverage, and commercial bank or investment bank for 528 IPOs from 2001-2005. Each bookrunner is taken as a separate observation, resulting in 756 observations. CM rank is the Carter-Manaster rank. Market share is the proceeds-weighted market share of IPOs of the bookrunners in the previous three years before the IPO. Analyst coverage dummy equals 1 if a bookrunner's all-star analyst covers the IPO in the aftermarket; it is 0 if it is non-all-star analyst coverage. If a bookrunner is a commercial bank, CB=1, otherwise it equals 0. The mean and standard deviation (STD) of Market Share, Analyst Coverage, and CB are reported conditional on the number of bookrunners. N is the number of observations.

	One Bookrunner		Each of Two Bookrunner		Each of Three Bookrunners	
	Mean	STD	Mean	STD	Mean	STD
CM Rank	7.537	2.324	8.317	1.476	8.708	0.598
Market Share	0.105	0.087	0.094	0.075	0.102	0.075
Analyst Coverage	0.189	0.392	0.263	0.441	0.378	0.488
CB	0.246	0.432	0.402	0.491	0.390	0.491
Number of Observations	341		333		82	

Table IX

Probit regressions for number of bookrunners

The table reports estimation results for two Probit regressions with the dependent variable being the bookrunner dummy. If the IPO has multiple bookrunners, the bookrunner dummy equals 1. It equals 0 otherwise. The sample is composed of 528 IPOs from 2001-2005. If there is more than one bookrunner in an IPO, each bookrunner is taken as a separate observation, resulting in 756 observations. We use two matching variables in the two regressions separately. DistanceCM is is $\frac{\text{CMRank-}\overline{\text{CMRank}_t}}{\text{STD}_t^{\text{CMR}}} - \frac{\text{Size-}\overline{\text{Size}_t}}{\text{STD}_t^{\text{size}}}$. DistanceMS is $\frac{\text{Mktshare-}\overline{\text{Mktshare}_t}}{\text{STD}_t^{\text{Mkt}}} - \frac{\text{Size-}\overline{\text{Size}_t}}{\text{STD}_t^{\text{size}}}$. MarketShare is the proceeds-weighted market share of the bookrunner in the preceding three years. CM Rank is the Carter-Manaster (CM) rank on a 1 to 9 scale. The bookrunners with the highest CM ranking, which is 9, are the most reputable ones. Investment bank characteristics include relative pipeline, allstar dummy, allstar total, and CB dummy. Pipeline is the number of IPOs in process for which the bank is a bookrunner when the bank considers to run the book (the filing date) for a particular IPO, to the total number of IPO issues that the bank has worked as a bookrunner in the previous three years. Relative pipeline, $\frac{\text{Pipeline}}{\text{Market share} \times \text{Total proceeds of all IPOs in the year}}$, is an alternative measure of how busy a bookrunner is. The number of previous IPO issues for both the acquiring banks and the target banks are included if a merger happens before the filing date of the IPO issue. Allstar Dummy equals 1 if the issuing company is covered by the all-star analyst of a bookrunner. Allstar total is the total number of bookrunners' all-star analysts covering the company. Expected Proceeds is the P_{mid} times the issuing shares, measured in millions. LBO Dummy equals 1 if the IPO company is backed by a buyout firm, and it equals 0 otherwise. VC Dummy equals 1 if it is backed by a venture capital firm. Tech Dummy equals 1 if it is a tech company. Ln(1+age) is the log of 1 plus the number of years from a company's founding. Volatility is the variance of market-adjusted daily stock return to the value-weighted market return in the 20 trading days after the IPO. Float is the ratio of shares issued to the total shares outstanding. P-values are in parentheses.

	(1)	(2)
Intercept		-1.797
		(0.002)
Matching variables		
DistanceCM	-0.193	
	(0.003)	
DistanceMS		-0.327
		(<0.001)
Bookrunner Char.		
Relative Pipeline	-0.466	-0.530
	(0.019)	(0.009)
Allstar Dummy	-0.103	-0.094
	(0.044)	(0.065)
Allstar Total	0.294	0.281
	(<0.001)	(<0.001)
CB Dummy	0.428	0.324
	(0.003)	(0.028)
Issuer Char.		
Ln (Expected Proceeds)	0.410	0.355
	(<0.001)	(0.001)
LBO Dummy	0.782	0.810
	(<0.001)	(<0.001)
VC Dummy	0.332	0.418
	(0.086)	(0.034)
Volatility	0.026	0.021
	(0.346)	(0.338)
Tech Dummy	-0.309	-0.267
	(0.026)	(0.054)
Ln(1+age)	-0.125	-0.122
	(0.048)	(0.055)
Float	0.003	0.003
	(0.382)	(0.327)
N	756	756
Pseudo R^2	22.03%	23.29%

Appendix A.

Assume bookrunner 1 provides $P_{mid1}=P_0+\vartheta_1$ ($\vartheta_1<\bar{\vartheta}$). If bookrunner 2 provides the same price it will allocate one half of the shares. The following steps show how the bookrunner 2 can improve its utility by providing higher P_{mid1}. If bookrunner 2 choose $\vartheta_2 > \vartheta_1$, its utility is:

$$\begin{aligned}\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner2}})=&\left[0.07\times\left(P_0+\vartheta_2\right)+(0.07\text{-}\beta)\times\text{Effort}+\beta\times(\text{Close-}\left(P_0+\vartheta_2\right))\right]\times N_{IPO}\\ &\text{-EffortCost-AnalystCost+E}\left[B_{SEO}\right]\end{aligned}$$

If bookrunner 2 choose ϑ_1, its utility is:

$$\begin{aligned}\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner21}})=&\left[0.07\times\left(P_0+\vartheta_1\right)+(0.07\text{-}\beta)\times\text{Effort}+\beta\times(\text{Close-}\left(P_0+\vartheta_1\right))\right]\times\frac{1}{2}\times N_{IPO}\\ &\text{-EffortCost-AnalystCost+E}\left[B_{SEO}\right]\end{aligned}$$

Each bookrunner's expected utility must be higher than its reservation utility 0, i.e., $\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}})>0$. From equation (15), we know

$$\frac{7}{100}\times\left(P_0+\vartheta\right)+(\frac{7}{100}\text{-}\beta)\times\text{Effort}+\beta\times(\text{Close-}P_0\text{-}\vartheta)>0$$

Suppose $\bar{\vartheta}$ is the highest level of ϑ. From the above formula, we have

$$\bar{\vartheta}<\frac{\beta\times\text{Close}}{(\beta\text{-}0.07)}-\text{Effort-}P_0 \tag{23}$$

No matter what's the choice of bookrunner in the next round of competition, in order to have $\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner2}})>\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner21}})$, we need to have

$$\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner2}})\text{-Expected}(U^{\text{Multiple}}_{\text{Bookrunner21}})>0$$

$$\begin{aligned}&\left[(\frac{7}{100}\times\left(P_0+\vartheta_2\right)+(\frac{7}{100}\text{-}\beta)\times\text{Effort}+\beta\times(\text{Close-}P_0\text{-}\vartheta_2))\times\text{Size}\right]\\ &\text{-}\left[(\frac{7}{100}\times\left(P_0+\vartheta_1\right)+(\frac{7}{100}\text{-}\beta)\times\text{Effort}+\beta\times(\text{Close-}P_0\text{-}\vartheta_1))\times\frac{1}{2}\text{Size}\right]>0\end{aligned}$$

After simplification, we have

$$\frac{\beta\times\text{Close}}{(\beta\text{-}\frac{7}{100})}\text{-Effort-}P_0>2\vartheta_2\text{-}\vartheta_1 \tag{24}$$

If one bookrunner gives ϑ_1, the other bookrunner can always better off by providing $\vartheta_2 = \frac{\bar{\vartheta}+\vartheta_1}{2}$ ($\vartheta_1 < \vartheta_2 \le \bar{\vartheta}$). Because $2\vartheta_2 - \vartheta_1 = \bar{\vartheta} < \frac{\beta \times \text{Close}}{(\beta - \frac{7}{100})}$-Effort-$P_0$, condition in (24) is satisfied.

Appendix B.

The following two conditions need to be satisfied for the high-high effort to be the only Nash equilibrium.

(1) $\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}})^{H}_{LH} > \text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}})^{L}_{LL}$

(2) $\text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}})^{H}_{HH} > \text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}})^{L}_{HL}$

$$(1)\ \text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}})^{H}_{LH} > \text{Expected}(U^{\text{Multiple}}_{\text{Bookrunner}})^{L}_{LL}$$

$$= \frac{1}{2}\left[\left(\frac{7}{100}-\beta\right)\times\left(\overline{P_{mid}}+a_H\right)+\beta\times\text{Close}\right]\times N_{IPO}+B_{SEO}\times\int_{a_L+b}^{a_H+b} f_H(\varepsilon_1)d\varepsilon_1+\text{Bseo}\times\int_{a_H-b}^{a_L+b} f_H(\varepsilon_1)\int_{a_L-b}^{\varepsilon_1} f_L(\varepsilon_2)d\varepsilon_2 d\varepsilon_1-\text{EffortCost}_H$$

$$> \frac{1}{2}\left[\left(\frac{7}{100}-\beta\right)\times\left(\overline{P_{mid}}+a_L\right)+\beta\times\text{Close}\right]\times N_{IPO}+B_{SEO}\times\int_{a_L-b}^{a_L+b} f_L(\varepsilon_1)\int_{a_L-b}^{\varepsilon_1} f_L(\varepsilon_2)d\varepsilon_2 d\varepsilon_1-\text{EffortCost}_L$$

We assume that a bookrunner that provides a low offer price will lose the mandate for future SEO to the bookrunner that provides a higher offer price. High effort does not guarantee the future SEO business, but it gives the bookrunner more opportunity to win the business. If one bookrunner provides high effort and the offer price that it gives is higher than $\overline{P_{mid}}+a_L+b$, it will kick out the bookrunner that provides low effort for sure and get all of the benefit of SEOs. If the offer price that one bookrunner provides is between $\delta_H\text{Close}+a_H-b$ and $\delta_L\text{Close}+a_L+b$, its benefits from future SEOs depends on the price its competing bookrunner provides. If its opponent provides a higher price, it loses all the future SEO benefits. $f(\varepsilon)$ is the p.d.f. of ε. $f_L(\varepsilon)=f_H(\varepsilon)=\frac{1}{2b}$. Without losing generality, we assume $\text{EffortCost}=(\text{Effort})^2$. After simplification and integration, we have

$$\frac{1}{2}\left(\frac{7}{100}-\beta\right)\times a_H\times N_{IPO}+\frac{B_{SEO}\left(a_H-a_L\right)}{2b}+\frac{B_{SEO}}{4b^2}\left[\left(a_H-a_L-b\right)\left(a_L+2b-a_H\right)+\frac{1}{2}\left(a_L+b-a_H\right)^2-\frac{1}{2}b^2\right]-a_H^2$$
$$>\frac{1}{2}\left(\frac{7}{100}-\beta\right)\times a_L\times N_{IPO}+\frac{1}{2}B_{SEO}-\frac{1}{2}a_L^2 \tag{25}$$

In order to satisfy this condition, we need to have

$$a_H\in\left(\frac{B_{SEO}\times a_L+A-2bR}{B},\frac{B_{SEO}\times a_L+A+2bR}{B}\right)$$
$$R=\sqrt{Ca_L^2-Da_L+E},\ A=4bB_{SEO}+2N_{IPO}\left(\frac{7}{100}-\beta\right)b^2,\ B=8b^2+B_{SEO},\ C=8b^2-B_{SEO},\ D=16bB_{SEO}+8b^2N_{IPO}\left(\frac{7}{100}-\beta\right) \tag{26}$$
$$E=b^2{N_{IPO}}^2\left(\frac{7}{100}-\beta\right)^2+2{B_{SEO}}^2+\left(4bN_{IPO}\left(\frac{7}{100}-\beta\right)-16b^2\right)B_{SEO}$$

If one bookrunner provides a_L, the other bookrunner can always provide $a_H\in\left(\frac{B_{SEO}\times a_L+A-2bR}{B},\frac{B_{SEO}\times a_L+A+2bR}{B}\right)$ and get better off.

(2) $\text{Expected}(U_{\text{Bookrunner}}^{\text{Multiple}})_{HH}^{H}>\text{Expected}(U_{\text{Bookrunner}}^{\text{Multiple}})_{HL}^{L}$

Similarly, we have

$$\frac{1}{2}\left(\frac{7}{100}-\beta\right)\times a_H\times N_{IPO}+B_{SEO}\times\int_{-b}^{+b}f_H(\varepsilon_1)\int_{-b}^{\varepsilon_1}f_H(\varepsilon_2)d\varepsilon_2 d\varepsilon_1-\text{EffortCost}_H$$
$$>\frac{1}{2}\left(\frac{7}{100}-\beta\right)\times a_L\times N_{IPO}+B_{SEO}\times\int_{a_H-b-a_L}^{+b}f_L(\varepsilon_1)\int_{-b}^{\varepsilon_1}f_H(\varepsilon_2)d\varepsilon_2 d\varepsilon_1-\text{EffortCost}_L \tag{27}$$

In order to have $E(U_{HH}^{H})>E(U_{HL}^{L})$, we only need

$$a_H>\frac{4b^2N_{IPO}\left(0.07-\beta\right)+Ba_L}{B_{SEO}-8b^2} \tag{28}$$

If the competing bookrunner exerts high effort, the bookrunner, who exerts low effort, can always get higher expected utility by exerting high effort which satisfies condition (28), High-high choice is the only equilibrium in this game.

We notice if the benefit from follow-on issues is smaller than $8b^2$, the equilibrium does not exist. Under this condition, $\text{Expected}(U_{\text{Bookrunner}}^{\text{Multiple}})_{LH}^{H}>\text{Expected}(U_{\text{Bookrunner}}^{\text{Multiple}})_{LL}^{L}$, while $\text{Expected}(U_{\text{Bookrunner}}^{\text{Multiple}})_{HH}^{H}<\text{Expected}(U_{\text{Bookrunner}}^{\text{Multiple}})_{HL}^{L}$. Each bookrunner expects the other bookrunner takes mixed strategy. Each bookrunner is expected to exert effort $a=\frac{a_H+a_L}{2}$. They both give P_{mid}^{H} in the first step. Thus, the offer price is higher than the offer price of single bookrunner.

Appendix C.

Single bookrunner's expected utility is always higher than each joint bookrunner's utility. In a multiple bookrunner IPO, each bookrunner provides $P_0+\overline{\vartheta}$ and Effort_{high}. We have

$$\text{Expected}(U^{multiple})=\frac{1}{2}\left((\frac{7}{100}\text{-}\beta)\times\left(P_0+\overline{\vartheta}\text{+Effort}_{high}\right)+\beta\times\text{Close})\right)\times N_{IPO}$$
$$\text{-EffortCost}_{high}\text{-AnalystCost+}(\frac{7}{100}\text{-}\beta)\frac{N_{IPO}}{\text{Close}}\sigma^2$$

Since $(\frac{7}{100}\text{-}\beta)\frac{N_{IPO}}{\text{Close}}\sigma^2<0$, we have

$$\text{Expected}(U^{single})\text{-Expected}(U^{multiple})$$
$$>\left[\left((\frac{7}{100}\text{-}\beta)\times\left(P_0\text{+Effort}_{low}\right)+\beta\times\text{Close})\right)\times N_{IPO}\text{-EffortCost}_{low}\text{-AnalystCost}\right]$$
$$\text{-}\left[\frac{1}{2}\left((\frac{7}{100}\text{-}\beta)\times\left(P_0+\overline{\vartheta}\text{+Effort}_{high}\right)+\beta\times\text{Close})\right)\times N_{IPO}\text{-EffortCost}_{high}\text{-AnalystCost}\right]$$

Since $\text{Expected}(U^{single})>0$, we have $(\frac{7}{100}\text{-}\beta)\times\left(P_0\text{+Effort}_{low}\right)+\beta\times\text{Close})>0$. Thus we have

$$\text{Expected}(U^{single})\text{-Expected}(U^{multiple})$$
$$>\left[\frac{1}{2}\left((\frac{7}{100}\text{-}\beta)\times\left(P_0\text{+Effort}_{low}\right)+\beta\times\text{Close})\right)\times N_{IPO}\text{-EffortCost}_{low}\right]$$
$$\text{-}\left[\frac{1}{2}\left((\frac{7}{100}\text{-}\beta)\times\left(P_0+\overline{\vartheta}\text{+Effort}_{high}\right)+\beta\times\text{Close})\right)\times N_{IPO}\text{-EffortCost}_{high}\right]$$

$\left(P_0\text{+Effort}_{low}\right)\text{-}\left(P_0+\overline{\vartheta}\text{+Effort}_{high}\right)<0$, $(\frac{7}{100}-\beta)<0$ and $\text{EffortCost}_{low}<\text{EffortCost}_{high}$, we have

$\text{Expected}(U^{single})>\text{Expected}(U^{multiple})$.

Appendix D.

Numerical example for Proposition 2:

We assume the variables in our model have the following values:

Close = 20; $\overline{\vartheta}=1$; $P_0=16.2$;

AC_{high} = -Neg * 0.60; AC_{low} = -Neg * 0.20; $\text{AnalystCost}_{high}$ = 1.44; AnalystCost_{low} = 0.48;

$a_H = 1.2$; $a_L = 0.8$; $EffortCost_{high} = a_H^2$; $EffortCost_{low} = a_L^2$; r=0.05

b = 3; Bseo = 4; Float = 0.30; Neg = -8; $\beta = 0.3$;

$Risk_{high}$= 0.3; $Risk_{low}$ = 0.1;

Size= from 25 to 410 million dollars

We have the following relationship between issue size and the utility of each bookrunner:

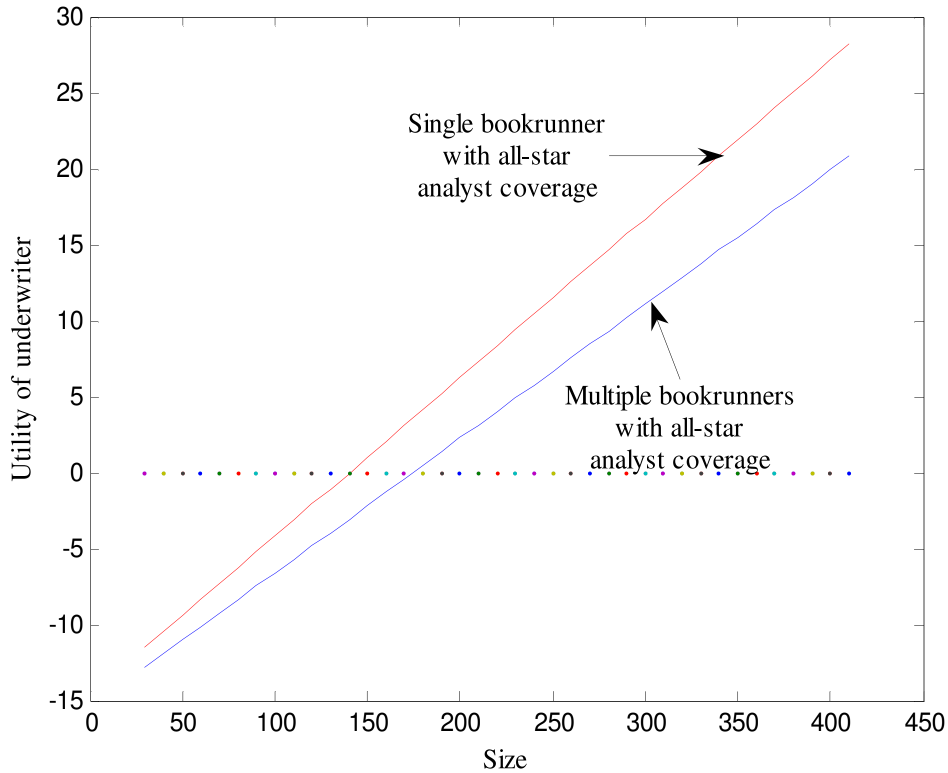

Figure 7

In this example, we assume that the multiple bookrunner issue and single bookrunner issue have the same type of analyst coverage. In other words, both have all-star analyst coverage, or both have non-all-star analyst coverage. We define the underpricing and total returns as follows:

Underpricing=(Close-OP)/OP

Totalreturn1=(Close-P_{mid})/P_{mid}

	Single Bookrunner	Multiple Bookrunners
Issuer's utility	-0.1548	-0.1443

Underpricing	17.7 %	8.7%
Total Return	23.5%	16.3%

Figure 7 shows that the issuer always gets lower underpricing, higher offer price, higher P_{mid}, and higher utility from multiple bookrunners. Most importantly, only when the size of the issuer is larger than 175 is the expected utility of each multiple bookrunner larger than 0 from joint bookrunning. Bookrunners accept running the book jointly. When the issue size is between 140 and 175, the utility of multiple bookrunners is less than 0. In this case, bookrunners will only accept sole bookrunning. When the size is smaller than 140, no bookrunner will work for this issuer.

Appendix E.

When AC_{high} minus AC_{low} is large, the issuer will prefer multiple bookrunners without an all-star analyst to a single bookrunner with an all-star analyst. We have the following example:

(1) ***Numerical Example1 for Proposition3:***

Close = 20; $\bar{\vartheta} = 1$; $P_0 = 16.2$;

$AC_{high} = 4.8$; $AC_{low} = 1.6$; $AnalystCost_{high} = 16$; $AnalystCost_{low} = 14$;

$a_H = 1.2$; $a_L = 0.8$; $EffortCost_{high} = a_H^2$; $EffortCost_{low} = a_L^2$; r=0.05

b = 3; Bseo = 4; Float = 0.30; Neg = -8; $\beta = 0.3$;

$Risk_{high} = 0.3$; $Risk_{low} = 0.1$;

Size= from 25 to 410 million dollars

.

Given the numerical data above, the issuer's utilities under different choices are as follows:

Single Bookrunner without all-star	Single Bookrunner with all-star	Multi Bookrunner without all-star	Multi Bookrunner with all-star
-0.1732	-0.1548	-0.1614	-0.1443

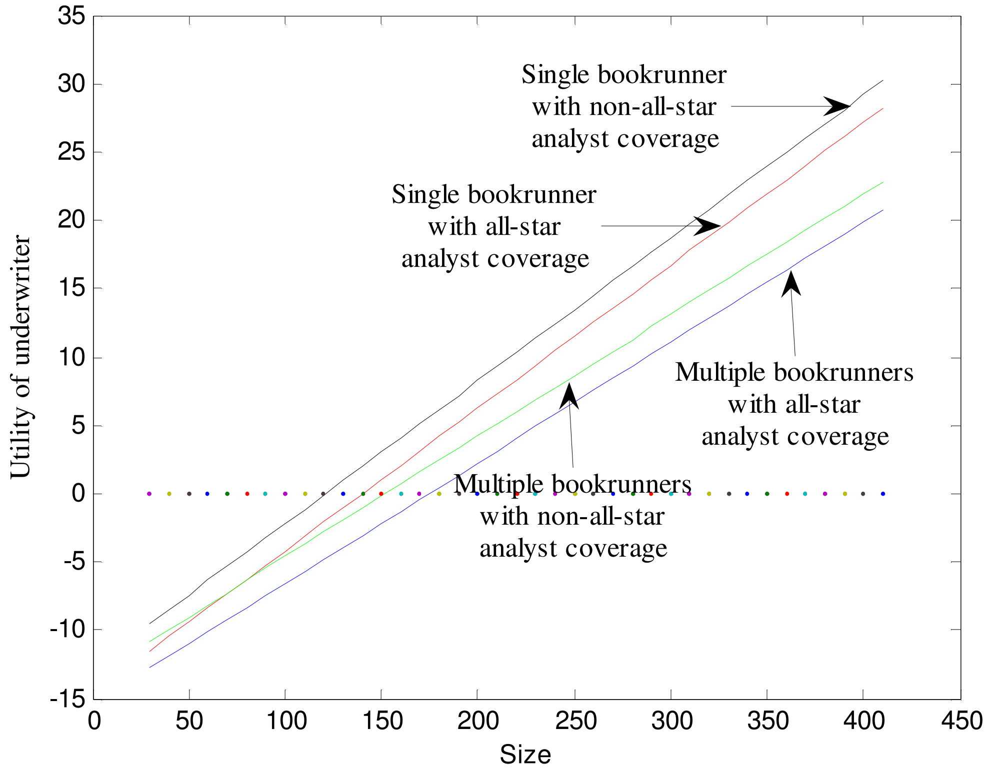

Figure 8

When the issue size is larger than 175, the issuer will choose multiple bookrunners with all-star analyst coverage, giving the highest expected utility of -0.14434. When the size is lower than 175, the issuer does not have enough gross spread revenue and underpricing to pay for the bookrunners with an all-star analyst. When the issue size is between 152 and 175, the issuer will have a choice between one bookrunner with all-star analyst coverage and two bookrunners without all-star analyst coverage. Under both choices of the issuer, bookrunners have positive utilities. The issuer's utility from multiple bookrunners without all-star analyst coverage is -0.1614, which is smaller than -0.1548, the utility of bookrunner from sole bookrunning IPOs with all-star analyst coverage. The issuer will choose a single bookrunner with all-star analyst coverage. When the issue size is between 140 and 152, the issuer can only use a single bookrunner, because the utilities of the multiple bookrunners are below their reservation utilities. They will not accept running the book jointly. Issuer will use a single bookrunner with all-star analyst coverage. When the issue size is between 120 and 140, the issuer can only choose single bookrunner without all-star analyst coverage. When the size is smaller than 120, no bookrunner will work for the issuer. In this example, $\Delta = 0.0066 > 0$.

When AC_{high} minus AC_{low} becomes smaller overtime, the issuer will prefer multiple bookrunners without an all-star analyst to a single bookrunner with an all-star analyst coverage. We have the following example:

(2) Numerical example 2 for Proposition 3:

Close = 20; $\overline{\vartheta} = 1$; $P_0 = 16.2$;

$AC_{high} = 3.2$; $AC_{low} = 1.6$; $AnalystCost_{high} = 16$; $AnalystCost_{low} = 14$;

$a_H = 1.2$; $a_L = 0.8$; $EffortCost_{high} = a_H^2$; $EffortCost_{low} = a_L^2$; r=0.05

b = 3; Bseo = 4; Float = 0.30; Neg = -8; $\beta = 0.3$;

$Risk_{high} = 0.3$; $Risk_{low} = 0.1$;

Size= from 25 to 410 million dollars

The difference between numerical Example 1 and Example 2 is the AC_{high} is lower in Example 2.

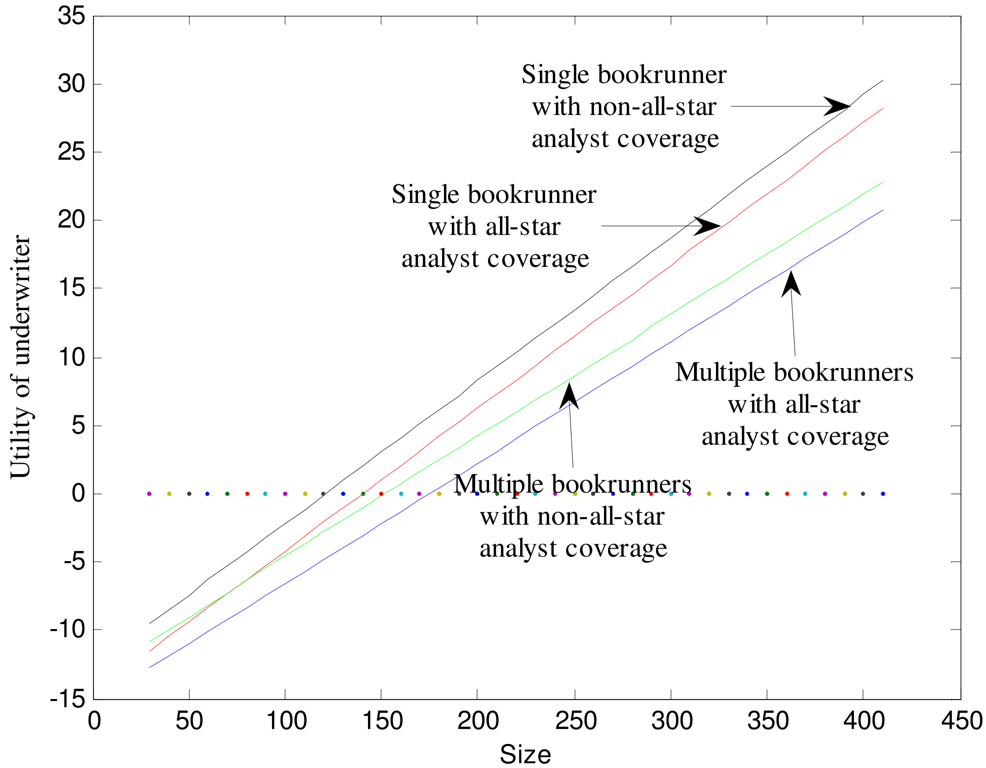

Figure 9

Given the numerical example above, the issuer's utilities under the four choices will be

Single Bookrunner without all-star	Single Bookrunner with all-star	Multi Bookrunner without all-star	Multi Bookrunner with all-star
-0.1732	-0.1637	-0.1614	-0.1527

When the issue size is in the range between 152 and 175, the issuer also has the choice of a single bookrunner with all-star analyst coverage and multiple bookrunners without all-star analyst coverage. The bookrunners' utilities are larger than zero under these two choices. However, the issuer will use multiple bookrunners without all-star analyst coverage in this example, since the utility of the issuer with multiple bookrunners is -0.1614, which is higher than -0.1637, the utility of the issuer with a single bookrunner. In this numerical example, $\Delta = -0.0023 < 0$.

The reason for the issuer to choose the multiple bookrunners in this case is that the relative importance of the all-star analyst coverage is decreased. In the previous example, AC_{high} -AC_{low} equals 0.4. In this example, AC_{high} -AC_{low} equals 0.2. The benefit high P_{mid} in multiple bookrunner IPOs exceeds the benefit of all-star analyst coverage in single bookrunner IPOs. In other words, the price factor P_{mid} dominates the all-analyst coverage factor, which makes $\Delta < 0$. Therefore, the issuer will choose multiple bookrunners without all-star analyst coverage.