IPO Underpricing During the Boom: A Block-Booking Explanation[1]

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Abstract

A bank can efficiently underwrite individually difficult to value IPOs by offering them as a package deal to a stable coalition of investors (block-booking). Block-booking banks set offer prices to equalize downside risk across their offerings, not expected returns. Examining US IPOs over the 1986 to 2003 period, I find that this is so. Given the return distribution on non-tech IPOs during non-boom years, equalizing downside risk implies that the average initial return on tech/boom IPOs equals 48% (actual value: 46%). The block-booking theory accounts for both the direction and magnitude of differences in average initial returns across IPO types.

Key words: Initial public offerings; Underpricing; Book-building, Asymmetric Information; Investment banking

JEL classifications: G24; D82; G32; G18

Intuitively, it might seem obvious that banks will set offer prices on the IPOs they underwrite so as to (more or less) equalize their expected initial returns (whatever the reason for underpricing in the first place). Yet banks do not in fact behave in this way: the average initial return on tech IPOs during the boom of the late 90's exceeded 45%, while the average initial return on non-tech IPOs during non-boom years fell below 10%. Given such a disparity between what intuition may lead one to expect and what actually happens, one is left with two possibilities: either A) the intuition is correct, implying that the IPO market seriously malfunctioned during the boom; or B) the intuition is wrong, implying that one needs a better understanding of what drives underpricing before concluding that tech IPO initial returns during the boom were excessive.

Most people looking at underpricing during the boom conclude that the market did indeed malfunction, even if they disagree about why. Ljungqvist and Wilhelm [2003], for example, argue that a decline in insider stock ownership during the boom decreased the incentive of firm management to control the banks' natural incentives to give the firm away. Loughran and Ritter [2002] argue that insiders became so rich during the boom due to high valuations that they just didn't pay much attention to offer prices. And while both of these explanations are consistent with (some) increases in underpricing, both contain more than a hint of special pleading in that the imperfect incentives to which they allude pervade the entire economy–where they do not in general result in "mispricing" on anything like the scale one observes in the IPO market.[2]

But if the boom did not totally dull IPO firm management's natural propensity to truck and barter, then there must have been a reason why underpricing increased during the boom in a well functioning IPO market. To see what this reason might be, consider first what it is that banks are trying to do when setting a firm's offer price. We know from the enormous volatility in IPO initial returns that banks set offer prices without possessing any very precise idea of share market value. This state of affairs creates a problem for the bank: any offer price it sets that exceeds an offering's worst case market value presents investors with the opportunity to "lemon-dodge",

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[2] For example, Ljungqvist and Wilhelm [2003] found that insider ownership declined from an average of 63.9% before the boom to an average of 51.8% during the boom. That is, they found that IPO firms during the boom were far more closely held than most public corporations, yet most public corporations do not routinely overpay for the goods and services they acquire to anything like the extent that boom-time IPO firms "overpaid" for underwriting services (a NonTech/NonBoom firm can convert $1's worth of future cash-flow into $1 now at a cost of 20 cents' worth of future cash-flow, while that same transformation costs a Tech/Boom firm 90 cents' worth of future cash-flow). As to the Loughran and Ritter [2002] explanation, if the wealth the boom unexpectedly showered down really dulled incentives, it is difficult to see why that factor should have affected IPO firm management to a greater extent than the investment bankers or fund managers on the other side of the table.

that is, to refuse to participate in an offering that the bank happens to overprice.[3] Since lemon-dodging creates no new wealth but will impose social costs (offerings fail, etc.), the offering process would proceed in a more efficient manner if investors would just remain ignorant about an IPO share's precise market value when making their participation decision. The task facing the bank, then, is to design an offering process such that investors choose to remain ignorant even though doing so is not in their immediate self-interest.

A bank accomplishes this task by pooling together its IPOs and offering them to a stable coalition of investors as a package deal. This practice, known as block-booking, works as follows.[4] The bank offers shares in each of its IPOs to coalition investors at a price greater than their worst-case value but less than their expected value, thereby making membership in its coalition valuable. To counteract the incentive to lemon-dodge present in each individual offering, a bank commits to eject any investor who does lemon-dodge from its coalition (a bank can do so as it allocates shares at its discretion). An investor must therefore choose between remaining in the coalition (and obtaining on average underpriced shares in the future) and lemon-dodging once. The bank then sets each IPO's offer price at the maximum level such that investors choose to remain in the coalition.

The key pricing implication of block-booking is that a bank sets offer prices to equalize *downside risk* across its offerings, not *expected returns*. To see this, note that the gain an investor expects to obtain by remaining in the bank's coalition is independent of the characteristics of the bank's current offering. The bank raises an IPO's offer price from its worst-case value until the benefits of lemon-dodging (avoiding downside risk) equals this constant coalition benefit. An IPO's expected return is then whatever it is, as determined by the shape of the right-tail of its share value distribution.

I test this prediction on US IPOs over the 1986 to 2003 period. I divide IPOs into 4 types (Tech/Boom, Tech/NonBoom, NonTech/Boom, NonTech/NonBoom) and see if downside risk (the integral of the return distribution from -100% to 0%) is the same for each type. I find that this is so. For example, while the expected initial return of a tech IPO during the boom exceeded that of a non-Tech IPO during non-Boom years by over 35 *percentage points*, the

[3] To take advantage of this option, an investor does not need to accurately estimate an IPO firm's market value (a very hard problem), it need only know enough to know if the bank got it wrong (a much easier problem).

[4] Kenney and Klein [1983] were the first to explore the economics of block-booking. Following Gondat-Larralde and James [2004] and building upon Benveniste and Spindt [1989] and Benveniste and Wilhelm [1990], I apply their general analysis to the specifics of the IPO market.

Tech/Boom return distribution's downside risk exceeded the NonTech/NonBoom return distribution's downside risk by a trivial 9 *basis points*.[5] One can put this result another way: given that the observed downside risk of NonTech/NonBoom IPOs, pricing Tech/Boom IPOs so as to equalize downside risk across the two types implies that the average initial return on Tech/Boom IPOs will equal 48% (with a 95% confidence interval spanning the range of 45% and 51%).[6] The observed value of the average initial return on Tech/Boom IPOs is 46%.[7] The block-booking theory is the only IPO theory of which I am aware that yields precise quantitative predictions regarding underpricing. The fact that the block-booking theory's predictions are supported by the data thus provides strong evidence in support of that theory.

Turning to share allocation, Gondat-Larralde and James [2004] show that a block-booking bank will form a single coalition of investors to which it will allocate shares in all of its IPOs. Using a unique data set that allows them to identify original investors in all UK IPOs over the 1997 to 2000 period that raised at least £10 million, they find that banks do allocate shares in this manner. The pricing evidence discussed here and the allocation evidence discussed by Gondat-Larralde and James [2004] therefore suggests that banks do indeed block-book their IPOs.

Previous Literature

A theory of the IPO process needs to explain four key aspects of the IPO market, viz., the fact of underpricing, the volatility of initial returns within IPO types, the difference in expected initial returns across IPO types (e.g., Tech/Boom and NonTech/NonBoom), and share allocation. In the extensive IPO literature (see Ritter and Welch [2002] for an excellent survey), the Information Extraction (IE) theory pioneered by Benveniste and Spindt [1989], Benveniste and Wilhelm [1990], and Sherman and Titman [2001] does the best job of explaining the market, so I concentrate on that theory here.[8]

In the IE theory, projects consist of a single observable type that comes in two (or more) flavors (e.g., high value and low value) observable by investors alone. The bank seeks to obtain the information on flavor from investors in order to set IPO offer prices more accurately. To

[5] The block-booking theory can therefore explain the "risk"/expected return relationship documented by Asquith, Jones and Kieschnick [1998], building upon earlier papers by Beatty and Ritter [1986] and Ibbotson, Sindelar, and Ritter [1988].

[6] I bring this equality about by multiplying observed offer prices by a scalar, holding share market value constant.

[7] The theory yields equally accurate predictions for average initial returns on the other IPO types I consider.

[8] The IE theory also draws heavily upon Kenney and Klein's [1983] work on block-booking.

extract this information, the bank forms a stable coalition of investors and rewards the investors who provide their information with underpriced shares (engaging in a repeat game with a stable set of investors reduces the average discount needed to sustain the equilibrium). In this framework, however, an investor has an incentive to declare an IPO's value to be lower than it in fact is so as to get high value shares at a low price. To limit an investor's incentive to engage in such behavior, the bank allocates shares in IPOs the investors declare to be of high value to the coalition (at a discount), and the bank offers the IPOs its investors declare to be of low value to non-coalition investors at their expected value.

The IE approach can explain the fact of underpricing and (in part) why banks form investor coalitions.[9] However, the IE approach provides little insight into why initial returns are so volatile. That is, while the IE theory is not inconsistent with high return volatility (maybe the investors just don't have much information to provide despite the extremely generous compensation banks offer for it), it would also be consistent with low volatility. One would definitely expect high return volatility if a bank block-books, however, as the whole point of block-booking is to sell IPOs shares without undertaking the socially wasteful expenditure that would be needed to put a precise and accurate value on each individual IPO.

The IE theory also provides only a limited explanation for why expected underpricing varies between IPOs. It is true that, in the IE theory, projects of different unobservable flavours of a single observable type may be underpriced by different amounts for the reasons discussed above.[10] But, a bank has no reason to underprice one observable type by more than another observable type (as there is no reason for the bank to compensate investors for providing information that the bank can easily observe all by itself). So, the IE theory can not explain why, for example, Tech/Boom IPOs are underpriced by more than NonTech/NonBoom IPOs.

Ljungqvist and Wilhelm [2003] and Loughran and Ritter [2002] seek to explain why underpricing varies across IPO types by modelling expected underpricing as the outcome of a bargaining game between an entrepreneur and the bank (if underpricing increases, it is because the bank wins). They argue in their various ways that an entrepreneur's incentive to bargain hard declined

[9] That is, while the IE approach does imply that banks form coalitions, it does not imply that they allocate shares in *all* of their IPOs to coalition investors. Gondat-Larralde and James [2004], consistent with results from less detailed samples (see, for example, Hanley and Wilhelm [1995], Cornelli and Goldreich [2001], and Aggarwal, Prabhala, and Puri [2002]) find instead that each bank forms a single coalition to which it allocates shares in all of its IPOs.

[10] Of course, banks will benefit if investors reveal information they already possess on an IPO firm's market value. Gondat-Larralde and James [2004] show how a bank can induce investors to reveal this information (almost) costlessly within the block-booking framework.

during the boom, leading to an increase in expected underpricing. As I noted above, while this approach provides a prediction as to the direction of expected underpricing during the boom, the magnitude of the effect is implausible.

The block-booking theory too argues that firms were different during the boom. But, what differed was not the incentive for entrepreneurs to bargain, but the share value distribution of the projects they sought to bring public. Given the change in the nature of the projects entrepreneurs presented to the banks, underpricing increased in a predictable (in both direction and magnitude) way.

Organization of the Paper

I begin by applying Kenney and Klein's [1983] block-booking model to the IPO market, showing that a block-booking bank underprices IPO shares on average, prices in a manner that leads to high return volatility, equalizes downside risk across its offerings, and allocates IPO shares to a stable coalition of investors. I then test the equalization of downside risk prediction. Conclusions follow.

I. Block-Booking and IPOs

A. Set-up and Assumptions

I model the IPO process as a game involving entrepreneurs with projects to sell, investors with money to invest, and a bank that intermediates between the two.

Projects

In each period T Fate endows an entrepreneur with a project selected at random from the set of possible projects Ω, with Ω known to both the bank and investors. The value of the period T project is V_T. V_T is drawn at random from distribution W_T, with density w_T. V_T ranges over $[V_{T,Min}, V_{T,Max}]$. W is observable by both the bank and investors, and can vary from project to project. The project consists of a single infinitely divisible share.[11]

[11] I assume here that IPOs come in generally observable types and explore how expected underpricing varies across types. Gondat-Larralde and James [2004] investigate block-booking in the more traditional context of a single IPO type that comes in variety flavors observable to investors alone.

The Bank

The bank competes for the business of risk neutral entrepreneurs by devising an underwriting method that is successful,[12] and, conditional upon achieving success, maximizes expected offer price. The bank does not discriminate between projects (i.e., projects that look identical to the bank on the basis of its information at the time offer price is set must have the same offer price). The bank sets offer prices and selects the investors to whom it offers shares at its discretion. For simplicity, we assume that the bank charges a fixed fee for underwriting projects. I set this fee to 0 for convenience.

The bank can observe T's share value distribution W_T before setting its offer price P_T, but it can not observe T's actual value V_T (the closing price on the first day of trading) until after trading starts. The bank can not set a project's offer price at a level higher than its best estimate of the project's value. For simplicity, I assume that this constraint does not bind in the analysis below.

Investors

Investors behave competitively, are risk neutral, and maximize profits (π). Investors and the bank live forever. It follows that the bank and investors can form long-term relationships if they so wish.

Each investor the bank selects for a given IPO invests \$1. I incorporate the idea that investors, by virtue of their trading activities, possess information on project value not known to the bank by assuming that they can detect if $V_T < P_T$ (at some small cost ε) when presented with a concrete offer to buy. An investor "lemon-dodges" when he avoids participating in an ex-post overpriced IPO.

Sequence of Play

Each period consists of the following phases:

τ_1: An entrepreneur presents his project to the bank. The bank and investors observe its share value distribution W_T.

τ_2: The bank sets T's offer price P_T and offers the share to investors whom it selects;

[12] I make this assumption for convenience, but my results require only that having a deal fail imposes a cost. Sherman [2002] shows that auctions have a higher probability of failure than book-building (of which block-booking is an example), and argues that this risk accounts why underwriters do not use auctions to allocate IPO shares.

τ_3: The selected investors decide whether or not to pay ε and learn if $V_T < P_T$;

τ_4: If the investors choose to purchase, the offering is successful and trading begins.

The Underwriting Problem

Ideally, the bank would simply set a share's offer price equal to its expected value and invite a group of investors selected at random to purchase at that price. And, if investors had no choice but to remain ignorant about the share's precise value, then this offering method would succeed (an investor's expected profit from accepting the offer is non-negative). However, lemon-dodging renders this naïve strategy untenable, as investors will find it worthwhile to pay ε and learn if $V_T < P_T = E[V_T]$ before making their purchase decisions.

To overcome lemon-dodging, the bank could just set T's offer price at $V_{T,Min}$. But the bank could do better by devising an underwriting method such that investors find it optimal to remain ignorant about T's precise value. A bank can bring this state of ignorance about by block-booking its IPOs.

B. Block-Booking

To block-book, a bank enters into a repeat game with a stable coalition on investors. It offers the investors the following deal:

- The bank underprices its IPO shares on average, thereby making coalition membership valuable;
- The bank ejects from its coalition any investor who lemon-dodges; and
- The bank sets each IPO's offer price at the maximum level such that an investor finds the profits of remaining in the coalition higher than the expected profits of lemon-dodging once.[13]

[13] For simplicity, I assume that the bank can detect lemon-dodging with probability 1. As lemon-dodging becomes harder to detect, the average discount the bank must offer to get block-booking to work will increase.

Implementing Block-Booking

Suppose that the bank sets T's offer price to P_T. Recalling that an investor invests $1 in each offering for which he is selected, the expected return an investor obtains by remaining in the bank's coalition (buying in all cases) equals

$$E\left[\pi_{BB,T}\right] = -\left| \int_{V_{T,Min}}^{P_T} \frac{V_T - P_T}{P_T} \; w_T \; dV \right| + \int_{P_T}^{V_{T,Max}} \frac{V_T - P_T}{P_T} \; w_T \; dV \qquad (1)$$

$$= -\lambda_T\left[P_T\right] + U_T\left[P_T\right]$$

λ (U) measures downside (upside) risk, that is, the portion of the investor's expected return due to the possibility that V_T may be less than (greater than) P_T. Obviously, $\lambda[V_{T,Min}] = 0$ and $\partial\lambda/\partial P > 0$.

If an investor lemon-dodges, he avoids downside risk but he loses future coalition profits of χ. Hence,

$$E\left[\pi_{LD,T}\right] = U_T\left[P_{T,BB}\right] - \chi \qquad (2)$$

In equilibrium the bank sets offer price at the maximum level (P_{BB}) such that

$$E\left[\pi_{BB,T}\right] = E\left[\pi_{LD,T}\right] \qquad (3)$$

$$\Rightarrow \lambda_T\left[P_{T,BB}\right] = \chi$$

Let us now explore the implications of this equilibrium on the pattern of IPO underpricing.

Proposition 1: A block-booking bank underprices its IPOs on average

> Proof: If the bank sets offer prices such that $P > V_{Min}$, then $\lambda > 0$ for all T. It follows that $\chi > 0$ in equilibrium. Since $E[P] \leq E[V]$ in all cases, and since $\chi = 0$ if $E[P] = E[V]$, the bank must underprice its IPOs on average to bring this equilibrium about.
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> ∴

Proposition 2: If a bank block-books, then an IPO's offer price (adjusted for expected underpricing) will be a noisy predictor of its market value.

Proof: Suppose that a bank uses the offering process to extract T's market value from investors and compensates the investors for providing that information by underpricing T by an amount determined by some known function J and information available to the bank I_T. Then $E[(P_T + J[I_T]) - V_T] \approx 0$. If a bank block-books, however, then the most that one can infer about V_T from the information available to the bank is $E[V_T]$. Since $E[E[V_T] - V_T] \neq 0$, the offer price a block-booking bank sets will be a noisy predictor of its market value even after adjusting for expected underpricing.

∴

Proposition 3: A block-booking bank sets offer prices to equalize downside risk across its offerings.

Proof: A bank sets offer price on IPO T such that $\lambda_T = \chi$. χ is independent of the current offering. Hence,

$$\lambda_Y[P_{Y,BB}] = \chi = \lambda_Z[P_{Z,BB}] \ \forall \ Y, Z \tag{4}$$

∴

*Proposition 4: A block-booking bank does **not** set offer prices to equalize expected returns across its offerings. The expected return on a high-risk IPO will exceed that of a low-risk IPO*

Proof: If a bank block-books, then $E[R_Y] = \lambda_Y[P_{Y,BB}] + U_Y[P_{Y,BB}]$ and $E[R_Z] = \lambda_Z[P_{Z,BB}] + U_Z[P_{Y,BB}]$. Since $\lambda_Y[P_{Y,BB}] = \lambda_Z[P_{Z,BB}]$, it follows that $E[R_Y] = E[R_z]$ iff $U_Y[P_{Y,BB}] = U_Z[P_{Z,BB}]$, which is not in general true. If $U_Y[P_{Y,BB}] > U_Z[P_{Z,BB}]$ (intuitively, if Y's share value distribution has a long right tail relative to Z's), then $E[R_Y] > E[R_z]$.

∴

Propositions 1 and 2 demonstrate that the block-theory yields implications consistent with the most obvious features of the empirical IPO return distribution (on average underpricing and high return volatility). The key implication of the block-booking theory is that a block-booking bank sets offer prices so as to equalize downside risk (proposition 3). And, if banks do behave in this way, then one would expect that different observable IPO types are underpriced by different amounts on average (proposition 4). I turn to testing propositions 3 and 4 now.

II. Downside Risk and IPO Pricing

A. Operationalizing the Test

While it is of course not possible to see any one IPO's downside risk, one can observe the downside risk of the type Z IPO return distribution. Denote this number by Λ_Z. If a bank block-books, then it prices all IPOs of type Z such that $\lambda_Z = \lambda_{BB}$, where λ_{BB} denotes equilibrium downside risk. It follows that $\Lambda_Z = \lambda_{BB}$. Since there is general agreement that NonTech/NonBoom IPOs were priced reasonably (average initial returns of about 9%), I set λ_{BB} equal to $\Lambda_{NonTech/NonBoom}$. I then test the block-booking theory by seeing if

$$\Lambda_{NonTech/NonBoom} = \Lambda_\theta \tag{5}$$

where θ = Tech/Boom, Tech/NonBoom, or NonTech/Boom.[14]

B. The IPO Sample

I obtain my IPO data from SDC Platinum, supplemented by Datastream. The base sample consists of all common stock US IPOs with an offer date on or between 1 January 1986 and 21 September 2003 with an SDC Exchange Code equal to either American Stock Exchange, Nasdaq, NYSE, or OTC. I exclude all IPOs that SDC classifies as "financial sector" (closed-end funds, REITs, etc.), unit offerings, and ADRs. I also exclude IPOs with an offer price of less than $5. 4421 IPOs remain in the sample after these exclusions. Of these IPOs, SDC either did not report a closing price on the first trading day or reported a closing price such that the initial return fell below -40% in 151 cases. For these cases I checked the SDC closing price against the Datastream closing price in the 77 cases where it was possible to match using SEDOL numbers. I used the Datastream closing price in these cases (except in one case where the closing price was

[14] In order to get as good an estimate of downside risk as possible, I pool together all IPOs of a given type even though the IPOs in each group were underwritten by banks of varying levels of prestige. By taking this approach, then, I am ignoring the extensive literature on the relationship between equilibrium underpricing and bank prestige (see, for example, Carter, Dark, and Singh [1998], Michaely and Shaw [1994], or Carter and Manaster [1990]). However, the magnitude of the bank prestige effect is small relative to the difference in underpricing across IPO types, and so failing to take this effect into account will not greatly affect my results. Furthermore, it is likely that, in light of the results presented here, previous work on the determinants of underpricing did not properly control for how expected underpricing varies across IPO types. Extending the analysis here to incorporate individual bank effects may be worthwhile.

below 10 cents), and deleted the remaining 85 IPOs from the sample. The final sample consists of 4336 IPOs.[15]

I classify an IPO as a "Tech" IPO if SDC assigns that IPO a High Tech Industry classification and as a "Boom" IPO if its offer date fell on or between 1 January 1995 and 31 December 2000. See Table I for summary statistics on these groups.

C. Downside Risk Across IPO Types

So as to obtain an accurate idea of the mean and variation of the average return and downside risk of the four IPO types I consider, I use a Monte Carlo consisting of 10,000 trials. For each trial b I draw N_Z IPOs with recall from the type Z IPO return distribution, where N_Z denotes the number of type Z IPOs in the sample, and then compute R_Z and Λ_Z for each IPO type. I take NonTech/NonBoom IPOs as my base case, and report the average and standard deviation of the trial $R_{NonBoom/NonTech}$'s and $\Lambda_{NonBoom/NonTech}$'s in Panel A of Table 2. To test the block-booking hypothesis, I calculate $R_{\theta,b} - R_{NonBoom/NonTech,b}$ and $\Lambda_{\theta,b} - \Lambda_{NonBoom/NonTech,b}$ for each trial b for each IPO type θ. I report the average and standard deviations of these relative returns and downside risks in Panel B of Table II.

Consider returns first. As the first two columns of Panel B demonstrate, the average return for all type θ IPOs significantly exceeds (in both an economic and a statistical sense) that of NonTech/NonBoom IPOs. To illustrate, the average return on Tech/Boom IPOs exceeds that of NonTech/NonBoom IPOs by over 3600 basis points, with a standard deviation of only 200 basis points. So, type θ and NonTech/NonBoom IPOs definitely do not have the same return distribution.

Now consider downside risk (the last two columns in Panel B). Despite the fact that expected returns differ dramatically across IPO types, differences in downside risk are both trivial in absolute magnitude and statistically insignificant. To take each type in turn: the relative downside risk of Tech/Boom IPOs averages a mere 9 basis points (standard deviation of 13 basis points), the relative downside risk of Tech/NonBoom averages -12 basis points (standard

[15] Leaving in all of the low return IPOs (using the SDC derived initial return) does not materially alter any of the results reported below.

deviation of 12 basis points), and the relative downside risk of NonTech/Boom IPOs averages -20 basis points (standard deviation of 12 basis points as well).

The evidence therefore indicates that banks set offer prices on the IPOs they underwrite such that downside risk is equalized across offerings.

Just How Hard Is Equalizing Downside Risk?

The above results do not of course rule out the possibility that banks could be setting offer prices in some way that just happens to equalize downside risk across their offerings without their trying to do so (i.e., without block-booking). This alternative "chance" explanation is plausible if the equalization of downside risk result would still hold for large and systematic variations in type θ IPO offer prices. That is, consider multiplying a given type θ's offer prices by a scalar α. If one finds that one cannot reject the hypothesis that $\Lambda_\theta = \Lambda_{NonBoom/NonTech}$ for a wide range of alphas, then the fact that I found that $\Lambda_\theta = \Lambda_{NonBoom/NonTech}$ is not very surprising, and does not provide strong support for the block-booking hypothesis. On the other hand, if the $\Lambda_\theta = \Lambda_{NonBoom/NonTech}$ result holds for only a very small range of alphas for each type θ IPO, then the probability that banks just happen to choose offer prices in a manner that equalizes downside risk is small. The results above are thus unlikely to arise by chance, and so provide strong evidence for the hypothesis that banks block-book.

To perform this robustness test, note that the Monte Carlo analysis above suggests that the best point estimate of $\Lambda_{NonBoom/NonTech}$ is 74 basis points, and that $\Lambda_{NonBoom/NonTech}$ lies in the range of 56 basis points to 92 basis points (74 basis points ± 2 standard deviations). For each type θ IPO I therefore calculate the scalar by which one would have to multiply offer prices to put sample Λ_θ equal to 74 basis points (α_{Point}), 56 basis points (α_{Low}), and 92 basis points (α_{High}). I report these results in Table III.

Given the results above, it is no surprise to find that α_{Point} is very close to 1 in all cases (0.99 for Tech/Boom IPOs, 1 for Tech/NonBoom IPOs, and 1.01 for NonTech/NonBoom IPOs). More interestingly, the gap between α_{Low} and α_{High} is also very narrow in all cases (0.05 in the case of Boom/Tech IPOs and 0.02 for Tech/NonBoom and NonTech/Boom IPOs). That is, for Tech/Boom, Tech/NonBoom, and NonBoom/Tech IPOs, offer prices are precisely where they need to be to bring about the equalization of downside risk result. Moreover, systematically altering any type's offer prices by a couple of percentage points either up or down would cause this result to no longer hold. It follows that the notion that banks somehow price IPOs without regard to downside risk, and that this other method just happens to result in the equalization of downside risk across IPO types by chance, is highly implausible.

The block-booking theory predicts that banks set offer prices so as to equalize downside risk across their offerings. The analysis above demonstrated that banks do in fact set offer prices in a manner that produces this result, and the robustness test here demonstrates that this equalization result is highly unlikely to arise by chance. Thus, the pricing evidence strongly suggests that banks block-book their IPOs.

D. Underpricing During the Boom

If a bank block-books, it sets offer prices so as to equalize downside risk across its offerings. Returns are then whatever they are, as determined by the relevant share value distribution. To calculate the average return one would expect to observe on type θ IPOs given the return distribution on NonTech/NonBoom IPOs and assuming that banks do block-book, then, one first multiplies type θ IPO offer prices by the scalar needed to bring the equalization of downside risk result about and then calculates an average return with these adjusted offer prices holding share market value (initial closing prices) constant.

To carry out this exercise, I continue to assume that equilibrium downside risk equals that of NonTech/NonBoom IPOs. Using the offer price scalars discussed above, I calculate the range of offer prices consistent with block-booking by constructing the following three offer price vectors for each type θ IPO: $\mathbf{P}_{\theta,\mathrm{Point}} = \mathbf{P}_{\theta} * \alpha_{\mathrm{Point}}$, $\mathbf{P}_{\theta,\mathrm{Low}} = \mathbf{P}_{\theta} * \alpha_{\mathrm{Low}}$, and $\mathbf{P}_{\theta,\mathrm{High}} = \mathbf{P}_{\theta} * \alpha_{\mathrm{High}}$. I then calculate average returns for each IPO type given these vectors of offer prices. One may find these predicted returns in Table IV.

To take the extreme case of Tech/Boom IPOs first, the block-booking theory's point estimate of $E[R_{\mathrm{Tech/Boom}}]$ is 48%, with a 95% confidence interval of 45% to 51%. Recall that the actual average return on Tech/Boom IPOs was 46%. The block-booking theory does an equally good job predicting returns on NonTech/Boom and Tech/NonBoom IPOs. The block-booking theory can therefore perfectly account for both the direction and magnitude of variations in average initial returns across IPO types.

III. Conclusion

"Betrayal on Wall Street" (in the words of a *Fortune* headline) is perhaps the consensus explanation for the magnitude of IPO underpricing during the boom (academics may express this thought using the more refined term of "agency conflict" as in Ritter and Welch [2002], but the meaning is the same). Greedy investment bankers "rather than raise the most money for the side they're supposed to be representing...ply mutual funds and hedge funds with artificially cheap shares...and then get repaid with high commission stock trades".[16] IPO firm management fell prey to the machinations of the bankers through a combination of naivety (non-rational decision making) and sloth (incentives insufficiently strong to induce them to perform the job shareholders hired them to do). Indeed, one can seemingly chart the decline of ethical standards in the IPO market by calculating the "money left on the table" as a result of underpricing (see Ritter and Welch [2002] for the numbers).

The story of greed and corruption destroying a sound and established institution such as the IPO market in the pre-boom years is an old and satisfying one. Yet one cannot help but think that this story does a disservice to the people involved. If a goose ripe for the plucking walked in the door, would an investment banker version 1986 really just send it on its way? I think not. Were the entrepreneurs in the pre-boom years really more financially sophisticated and business minded than those of 10 or 15 years later? This supposed alteration of character too seems rather implausible.

The block-booking theory departs from the premise that the IPO market looks the way it does because it has evolved to solve the very difficult problem of how to place shares of uncertain value with investors knowledgeable enough to lemon-dodge (that is, investors who might know just enough to know when the bank gets a share's offer price wrong, giving them the opportunity to decline to participate in offerings the bank happens to overprice). To successfully and efficiently market IPOs in these circumstances, the bank forms a stable coalition of investors and offers them the following deal: the investors will always accept the shares the bank offers, the bank will in turn underprice shares on average (though not in each case) so as to make coalition membership valuable, and the bank will eject any investor who does lemon-dodge from

[16] "Betrayal on Wall Street", *Fortune*, 14 May 2001. It seems only just to add that, in retrospect, issuers have little to complain about.

the coalition. An investor then faces the choice of remaining in the bank's coalition and getting on average underpriced shares in the future and lemon-dodging once. The bank underprices each offering to the extent necessary to make remaining in the coalition the more profitable choice.

The block-booking theory yields the very strong prediction that banks set offer prices so as to equalize downside risk across the IPOs they underwrite. Testing this implication with data on US IPOs over the 1986 to 2003 period, I find that banks do set offer prices in a manner that equalizes downside risk, and that this result is highly unlikely to arise by chance. Thus, the evidence strongly suggests that banks deliberately set offer prices so as to equalize downside risk. Since the block-booking hypothesis is the only theory of the IPO process of which I am aware that yields this prediction, the observed pattern of underpricing implies that banks do indeed block-book their IPOs.

If a bank block-books, then an IPO's expected return will be determined by the equilibrium level of downside risk and its share value distribution. That is, if a bank sets an IPO's offer price to equalize downside risk, an IPO's offer price is determined by the left-tail of its return distribution. Holding the left-tail (and so downside risk) of the share value distribution constant, stretching out the right-tail will increase an offering's expected value and so (given a constant offer price) its expected return. An IPO with a share value distribution with a long right tail will then have a high expected return in equilibrium.

The share value distribution of tech IPOs during the boom had a very long right-tail. Assuming that banks set offer prices on Tech/Boom IPOs such that their downside risk equaled that of NonTech/NonBoom IPOs, the implied expected return on Tech/Boom IPOs equals 48% (with a 95% confidence band stretching from 45% to 51%). The actual average initial return on sample Tech/Boom IPOs equaled 46%. The block-booking theory can therefore perfectly account for the increase in initial returns we observed during the boom. If one wishes to assign blame for this rise, then, one can but conclude: the fault lies not in the stars (Mary Meeker…), but in the firms themselves.

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Table I

IPO Sample: Summary Statistics

I obtain my IPO data from SDC Platinum, supplemented by Datastream. The base sample consists of all common stock US IPOs with an offer date on or between 1 January 1986 and 21 September 2003 with an SDC Exchange Code equal to either American Stock Exchange, Nasdaq, NYSE, or OTC. I exclude all IPOs that SDC classifies as "financial sector" (closed-end funds, REITs, etc.), unit offerings, and ADRs. I also exclude IPOs with an offer price of less than $5. 4421 IPOs remain in the sample after these exclusions. Of these IPOs, SDC either did not report a closing price on the first trading day or reported a closing price such that the initial return fell below -40% in 151 cases. For these cases I checked the SDC closing price against the Datastream closing price in the 77 cases where it was possible to match using SEDOL numbers. I used the Datastream closing price in these cases (except in one case where the closing price was below 10 cents), and deleted the remaining 85 IPOs from the sample. The final sample consists of 4336 IPOs. I classify an IPO as a "Tech" IPO if SDC assigns that IPO a High Tech Industry classification and as a "Boom" IPO if its offer date fell on or between 1 January 1995 and 31 December 2000.

IPO Type	Number	Global Proceeds ($1996 Millions)		Initial Returns	
		Average ($Millions)	Standard Deviation	Average	Standard Deviation
NonTech/NonBoom	1300	48	95	9.45%	21.90%
Tech/Boom	1402	68	157	45.96%	73.18%
Tech/NonBoom	888	45	127	13.49%	31.44%
NonBoom/Tech	746	72	146	15.41%	25.41%

Table II

Returns and Downside Risk

In this table I report the average return (R) and downside risk (Λ) of each IPO type relative to that of NonBoom/NonTech IPOs. Downside risk equals the integral of the return distribution from –100% to 0%. To compute a standard deviation, I construct 10,000 return distributions for each type of IPO by drawing with recall a random sample of size N from each type's return distribution, where N equals the number of IPOs of that type in the sample. For each return distribution draw for each type θ IPO, θ = Tech/Boom, Tech/NonBoom, and NonTech/Boom, I calculate R_θ and Λ_θ and subtract that draw's NonTech/NonBoom value of R and Λ. The average difference is then the average of the difference for each draw, and the standard deviation is the standard deviation of this vector of differences.

A. The NonTech/NonBoom Base Case

$R_{NonBoom/NonTech}$		$\Lambda_{NonBoom/NonTech}$	
Average (Basis Points)	Standard Deviation	Average (Basis Points)	Standard Deviation
946	61	74	9

B. Relative Returns and Downside Risk

IPO Type	$R_\theta - R_{NonBoom/NonTech}$		$\Lambda_\theta - \Lambda_{NonBoom/NonTech}$	
	Average (Basis Points)	Standard Deviation	Average (Basis Points)	Standard Deviation
Tech/Boom	3650*	203	9	13
Tech/NonBoom	406*	123	-12	12
NonTech/Boom	596*	110	-20	12

A "*" denotes a statistically significant difference (P-Value < 0.01).

Table III

Underpricing Precision

On the basis of the Monte Carlos described in Table II, the point estimate of downside risk (Λ) for NonBoom/NonTech IPOs equals 74 basis points, with the 95% confidence interval spanning 56 basis points to 92 basis points. If Λ_θ lies below 56 basis points (above 92 basis points), then type θ IPOs are underpriced (overpriced) relative to NonBoom/NonTech IPOs. α_{Point} is the scalar by which one would have to multiply type θ offer prices (holding day 1 closing prices constant) to put Λ_θ equal to 74 basis points, and α_{Low} (α_{High}) is the scalar by which one would have to multiply type θ offer prices (holding day 1 closing prices constant) to put Λ_θ below 56 basis points (above 92 basis points).

IPO Type	α_{Point}	α_{Low}	α_{High}
Tech/Boom	0.99	0.96	1.01
Tech/NonBoom	1	0.99	1.01
NonTech/Boom	1.01	1	1.02

Table IV

Expected Underpricing Given Block-Booking

If a bank block-books, then it will set offer prices on type θ IPOs such that the downside risk of type θ IPOs (Λ_θ) equals that of NonBoom/NonTech IPOs. The point estimate of NonBoom/NonTech IPO downside risk equals 74 basis points, with a 95% confidence interval ranging from 56 basis points to 92 basis points (see Table II). In this table I multiply type θ offer prices by the scalars needed to bring about this equality (as described in Table 3) and calculate the implied average expected return on type θ IPOs (holding initial closing prices constant).

IPO Type	Actual Average Return	Expected Average Return Given Block-Booking		
		Point Estimate (Λ_θ = 74 bp)	Lower Bound (Λ_θ = 92 bp)	Upper Bound (Λ_θ = 56 bp)
Tech/Boom	46%	48%	45%	51%
Tech/NonBoom	13%	13%	12%	14%
NonTech/Boom	15%	14%	14%	15%