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The Role of Retail Investors in Book Built IPOs: Evidence from India

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Abstract

It is a widely observed phenomenon that IPOs tend to be oversubscribed with total bids greatly exceeding the shares available for purchase; moreover, most investors acknowledge that they must accordingly inflate their bids given the expectation of rationing. The current literature has not considered the effects of inflated bids or overbidding in equilibrium of a book built IPO with both informed and uninformed bidders, while then using the equilibrium to predict underpricing. This paper proposes an IPO economic model in which Bayesian equilibrium can occur in a book built IPO with both oversubscription of aggregate shares and overbidding of individual demand. The paper also makes a conjecture about the potential link between subscription data and underpricing. Empirically, this paper tests if the conclusions of the economic model are consistent with the Indian IPO market for finding equilibrium and predicting underpricing. Finally, this paper will show that retail investors are both vital for stability and secondary performance in a book built IPO.

CLASSIFICATION: D44, G11

KEYWORDS: IPO, Book Building, Underpricing, Retail Investors

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3.1 Introduction

During the summer of 2012, the social media giant Facebook went public. Despite extraordinary levels of media coverage, reports of investor demand exceeding the number of shares available by five-fold (Cowan, 2012), and claims of a "retail investor craze" (Alistair and Oran, 2013), the stock drastically underperformed expectations. By the end of the first week, Facebook's stock had fallen nearly 20%, and bankers and investors were left questioning the IPO process. Was the underperformance of the Facebook IPO inevitable despite the supposedly high level of investor (notably retail) interest? Or was it simply an anomaly unique to Facebook's high profile?

In order to better understand the mechanisms underlying the IPO process, this paper will seek to combine auction theory with empirical observations related to the Indian IPO market in order to challenge and improve upon the current literature. In particular, the current literature has shown that given an expectation of rationing in fixed price auctions due to aggregate oversubscription of total shares, bidders have an incentive to overbid, or overstate their individual demand for shares at the final price (Parlour and Rajan, 2005; Grimm, Kovarik, and Ponti, 2007). However, the literature has not considered the effects on Bayesian equilibrium in a book building setting with public bidding and price discovery due to banker-investor interaction. Moreover, the literature has not analyzed these potential side effects on predicting share underpricing - namely whether subscription data matches these predictions. Lastly, the literature has failed to consider how bidders (institutional and retail) with different degrees of private information could alter the equilibrium bidding outcome and secondary performance.

Accordingly, this paper will attempt to reengineer the IPO model of rationing put forth by Parlour and Rajan (2005), with insight from the model of Grimm, Kovarik, and Ponti (2007). The new model will attempt to show that oversubscription, an empirical trait of IPOs, and overbidding, a commonly acknowledged bidding strategy, can both exist simultaneously in a bidding equilibrium. This paper will then attempt to show that the conclusions of the theoretical model are consistent with the broader literature on IPO mechanisms and IPO underpricing. Finally, this paper will show that these conclusions also apply specifically for the Indian IPO market and then test for their presence with the given Indian IPO data, while looking for any possible predictions of underpricing.

In contrast to Khurshed, Pande, and Singh (2009), I will not treat all oversubscription as proof of unmet demand. Rather, I will use the model to understand how and when subscription data can predict secondary performance. Moreover, I will attempt to disprove Chiang, Qian, and Sherman's (2010) conjecture that return chasing and overbidding by retail bidders can lead to instability in IPOs. Instead, I will show that retail investors are vital for both stability and secondary performance in book built IPOs, and their access to IPOs should likely be expanded and not restricted as Chiang, Qian, and Sherman contend.

3.2 Literature Review

3.2.1 Auction Theory

Auctions with fractional shares in which bidders demand multiple units were first considered by Wilson (1979). In these auctions, bidders submit prices for different numbers of shares, and the seller then sets the clearing price. Wilson compared the share auction to the traditional unit auction with only one good available. Wilson famously concluded that "a share auction is subject to manipulation by bidders" (p. 676). Examining cases with and without proprietary information, Wilson consistently found that in multi-unit share auctions, bidders were able to alter their strategies to lower prices.

The literature continued to develop for these divisible good auctions with bidders competing on both price and quantity. The topic became especially popular as the U.S. Treasury started experimenting with various auction styles in the 1980s and 1990s. The Treasury had sought to limit the cornering of securities in the hands of a few large banks and investors by limiting bid sizes to prevent overbidding; traditionally, securities were allocated on a pro rata basis at the stop-out or clearing yield. Moreover, the Treasury switched to a uniform price auction in place of a discriminatory price auction (TreasuryDirect, 2013). Traditionally, there had been two arguments in favor of the uniform price auction. First, Friedman (1960) argued that discriminatory pricing discourages uniformed bidders because of the winner's curse; this would allow for a few large bidders to collude. Second, McAfee and McMillan (1987) demonstrated that a second price auction tends to yield more revenue for risk neutral bidders because it helps lower the effect of the winner's curse and thus leads to more aggressive bidding. However, Back and Zender (1993) found that these assumptions about the second price auction do not necessarily extend to multi-unit auctions. They argue that in multi-unit auctions bidders consider marginal cost rather than price, so bidders actually submit steep demand curves. In effect, this leads to lower prices and collusive-like outcomes; thus, the conclusions in favor of the second price auction over the discriminatory auction do not generalize. Continuing upon this research, Wang and Zender (2002) examined from a game theory perspective the differences between a uniform price auction and a discriminatory auction for a divisible good. They concluded that with symmetric bidders, the strategic bidding aspect of the uniform price auction leads to lower expected revenue compared to the discriminatory auction. However, if bidders are risk averse, then certain equilibrium can lead to higher expected revenue in the uniform price auction. Although this literature never focused exclusively on IPOs, it laid the groundwork for considering the effects of bid manipulation in all divisible good auctions.

In the case of a fixed price auction, there is the potential for rationing to occur if aggregate demand exceeds aggregate supply. In a study of United Kingdom IPOs, Cornelli and Goldreich (2001) found that bidders on average were allocated half of their bids, but this seems to violate all theories of profit maximization by the book runners. Nevertheless, Parlour and Rajan (2005) considered whether different allocation rules could potentially increase revenue in a one-shot book building model. However, they actually found that rationing reduces the effect of the winner's curse and may in fact increase seller revenue. Parlour and Rajan concluded that "oversubscription and rationing are not prima facie evidence that the issue price was sub-optimal, and the issuer could have raised more revenue" (p. 34). Moreover, they determined that investor demand depends on the investor's anticipation of the allocation mechanism. Under a system of pro rata rationing, all bidders, including low signal investors, bid higher than they would in the absence of rationing. As the level of rationing increases, the seller must increasingly allocate shares to low signal investors, leading to a potential trade-off with the level of rationing. Building upon the model of Parlour and Rajan, Grimm, Kovarik, and Ponti (2007) designed a model for repeated fixed price auctions. Grimm, Kovarik, and Ponti concluded that in cases with uncertain demand, "in equilibrium bidders overstate their true demand in order to alleviate the effects of being rationed" (p. 402). Most importantly, they found that in cases where prices are low relative to the values of bidders, bidders will overstate their demand relatively more than when prices are high.

3.2.2 IPO Process (Book Building vs. Auctions)

A decision for a company to go public represents the most important decision in its financial life. Companies must decide how many shares to issue, how to price them, and then how to distribute those shares. Accordingly, typically companies will hire an outside investment bank to initiate the process and then they will consider two possible mechanisms to price and allocate the shares: auctions or book building. In an auction, the company hires a bank to help decide the number of shares, share price, and allocation rules before information on investor demand is received. Bidders then request a certain number of shares, which are then divided according to the allocation rules. Dutch auctions can also be used in which the share price is incrementally lowered until investor demand equals the supply of shares being offered. In the book building process, instead, the underwriting bank goes on roadshows to present the company to investors. They collect individual levels of interest and then set the price accordingly. After receiving orders at the final price, the bank has the ability to allocate a specific number of shares to any investors. Thus, unlike the pure fixed price auction, a book built IPO includes both discretionary allocation and a dynamic process of price setting between the bankers and the investors.

In recent years, book building has become the primary method of conducting an IPO in most countries (with the notable exceptions of Israel and Taiwan). Even though many countries allow both processes, book building still tends to be the most popular choice for several reasons. Sherman (2000) argues that the flexibility to allocate shares allows underwriters to "lower the excess returns of uniformed investors, thus lowering the required level of underpricing" (p. 698). Moreover, Sherman (2005) believes that the riskiness of the auction (the bank must sit back and wait for orders) leads to the potential for undersubscription and overpricing. Finally, Sherman (2005) argues that there may simply be an adverse selection issue. Companies that choose the auction avoid the thorough scrutiny of investors during the book building process. Thus, Sherman (2005) concludes that when a small, relatively unknown company elects for the auction process, investors may interpret it as a signal that the issuer wants to discourage the thorough scrutiny of the book building process. Although most countries have switched entirely to the book building process as the most common form of offering, the strategic aspects of bid manipulation in a fixed price auction still apply to book building when allocation occurs on a pro rata basis.

3.2.3 IPO Underpricing and Oversubscription

It has been well documented that IPOs tend to exhibit abnormally high first day returns upon listing - otherwise known as underpricing. There are several prominent theories for the causes of underpricing. According to the adverse selection theory, Rock (1986) argues that informed investors and the investment bank know the true value of the stock and uniformed investors invest randomly. Banks must then underprice IPOs to gain demand from uninformed bidders or risk having insufficient demand from uninformed investors. According to the principal-agent theory, Eisenbeis and McEnally (1995) argue that firms must rely on investment banks to determine their true value. The issuing firm must then "leave money on the table" for the investment bank to have an incentive to participate. A third theory from Benveniste and Spindt (1989) argues that allocation allows underwriters to extract private information from investors. In turn, Hanley (1993) argues that underpricing allows banks to compensate informed investors for helping in the pricing process by revealing their private information. A final potential explanation from Loughran and Ritter (2002) is that underwriters substitute underpricing for fees; they are able to capture rent from the issuers which can be passed to favored clients.

According to Loughran, Ritter, and Rydqvist (1994), underpricing has occurred in all 25 countries in which IPO market data is available. However, Loughran, Ritter, and Rydqvist find that the degree of underpricing varies based on the mechanism of the IPO and the country. Moreover, IPOs in all countries have been associated with large levels of oversubscription such as in the study by Brennan and Franks (1997) for the United Kingdom. To explain the oversubscription, Chowdhry and Sherman (1996) have argued that information leakages occur between the setting of the offer price and the issue closure. The information leakage can include rumors about market demand, company performance, or investor sentiment. Chowdhry and Sherman believe this leads investors, who may have been previously uniformed, "to realize that the offer price is 'too low'" (p. 361).

They conclude that information leakages should lead to two extremes: IPO failure if the price is 'too high' and high levels of oversubscription if the price is 'too low.'

Additionally, the results have been mixed as to the relationship between the IPO mechanism and underpricing. Theoretically, book building may allow for greater underpricing as banks can dispense high profits to favored investors. Accordingly, studies by Hanley and Wilhelm (1995) and Aggarwal, Prabhala, and Puri (2002) find that underpricing occurs more as a greater proportion of shares are allocated to institutional investors. Similarly, Derrien and Womack (2003) find that auction procedures in France tend to lead to lower levels of underpricing. However, Sherman (2000) argues that greater flexibility in allocation during book building should lead to lower underpricing. Accordingly, Ljungqvist, Jenkinson, and Wilhelm (2003) find that book built issues do not show any less underpricing than auctions. Moreover, Kutsuna and Smith (2003) find that book building reduces underpricing for well-established Japanese firms. Thus, despite many misconceptions about book building as a tool of cronyism, book building may be a more efficient IPO mechanism under certain conditions.

3.3 Economic Model

I will now build a game representing the book built IPO. The goal of the model is to determine if a bidding equilibrium can exist with oversubscription of aggregate shares and overbidding of individual demand. In the game, there are two sets of players: bankers and investors (or bidders). Both are involved in an IPO with pro rata allocation of shares and publicly visible bidding activity over a period of time. (It will be assumed that all bidders have time to submit all the bids they wish.) These assumptions allow for empirical testing within the Indian IPO market. Given the literature on the strengths of book building as a tool for price discovery and not cronyism, these assumptions seem plausible for most countries. The bankers meet frequently with the investors during roadshows leading up to the actual IPO in order to gauge investor interest. The bankers work to determine the number of shares to be made available and then the price of the shares. They determine the range of appropriate prices before the listing and then close in on the final price throughout the listing process. The bankers' main objective is to ensure that the IPO closes in equilibrium with at least full subscription for all shares; anything less is considered a failure to effectively price the shares.

On the other side, investors are seeking to maximize their own utility, which depends on both their demand for shares and their expectation of secondary share performance or underpricing. Qualitatively, the bidders' utility would be increasing in both aspects. Their individual demand for shares (d) is effectively set by the pricing of the bankers, so they will each attempt to receive shares between 0 and d. The total number of shares to be issued will be normalized to one, so d is a fraction of the total shares available. It will be assumed that the bankers would not want any single investor to corner the market, so d will be set as less than one by assumption.

The expectation of underpricing can be taken as either exogenous or endogenous. In the case of the former, each bidder would then only choose to maximize the number of shares he receives and thus seek to receive the number of shares equal to his demand. Moreover, assuming perfect competition, no single investor can change the secondary performance of the shares. In the case of the latter, the expectation of underpricing would likely never be decreasing on demand, so each bidder's maximum utility would still arise by receiving the number of shares equal to his demand. Additionally, it is irrelevant for the qualitative existence of equilibrium whether the bidder is risk adverse, risk neutral, or risk seeking; the shape of the utility curve will only affect the quantitative levels of the equilibrium variables. Therefore, for simplicity a linear utility function will be used such that the bidder will still seek to receive shares equal to his true demand. Finally, it will be assumed that there are N bidders each with the same demand for the shares. This is a plausible condition considering all information about each company is publicly available and shared during the road show process, so it would be expected that barring insider information all informed investors would have similar equity valuations. Lastly, it will be taken as a given that no bidder will ever bid less than his true demand; with or without rationing, it would always increase utility to bid up to his true demand.

3.3.1 Game I: No Overbidding

Player i must determine the best response bid of b_i to all other players bidding their true demand of d in order to ensure that he actually is allocated his true demand of shares.

$$d = \frac{b_i}{(N-1)d + b_i} \tag{3.1}$$

The numerator of equation 3.1 represents the individual bid of player i, and the denominator represents the total amount of bids in the market. Thus, the ratio of the two represents the pro rata allocation of shares to player i for the total normalized share.

$$\frac{b_i}{d} = \frac{(N-1)d}{1-d} \tag{3.2}$$

Assuming that the IPO is never undersubscribed, there are two cases according to equation 3.2 for the player i's bid and demand. First, if the IPO is perfectly subscribed, all bidders will bid their true demand. Formally,

$$N \cdot d = 1 \implies b_i = d$$

Second, if the IPO is oversubscribed, all bidders will bid higher than their true demand due to an expectation of rationing. That is:

$$N \cdot d > 1 \implies b_i > d$$

Therefore, the bidding strategies must be modified to include players scaling their bids above their individual demand.

3.3.2 Game II: Overbidding

All players scale their demands by bidding their demand multiplied by some constant $c \geq 1$. Player i must determine the best response bid to scale his own true demand of $c_i d$ to all other players scaling their true demand by c.

$$d = \frac{cd}{(N-1)cd + c_i d} \tag{3.3}$$

The numerator of equation 3.3 represents the individual bid of player i, and the denominator represents the total amount of bids in the market. Thus, the ratio of the two represents the pro rata allocation of shares to player i for the total normalized share.

$$\frac{c_i}{c} = \frac{(N-1)d}{1-d} \tag{3.4}$$

Assuming that the IPO is never undersubscribed, according to equation 3.4 there are two cases for the relationship between player i's level of bid scaling and the other bidders' level of bid scaling. First, if the IPO is perfectly subscribed, all bidders will bid their true demand. Formally,

$$N \cdot d = 1 \implies c_i = c = 1$$

Second, if the IPO is oversubscribed, all bidders will scale their true demand by a factor higher than all other bidders. That is:

$$N \cdot d > 1 \implies c_i > c$$

In this case, it would be expected that bidders would be incentivized to keep overbidding each other, leading to the unstable outcome of all bidders bidding infinity. However, this is not observed in practice. Oversubscription is observed ubiquitously, but even the highest level of subscription observed in India since 2007 is 160.56 times oversubscribed for the total IPO. Thus, in a stable oversubscribed IPO there must be some separate disincentive to overbid that counterbalances the incentive to overbid from the expectation of rationing.

3.3.3 Game III: Overbidding and Retail Imitation

This game will introduce asymmetric information between two groups of bidders. The N bidders are the qualified institutional bidders that presumably have greater knowledge, experience, and expertise in the IPO and equity industry. As shown by Khurshed, Pande, and Singh (2009) in their study of the Indian IPO market, the early bids of institutional bidders are imitated by retail investors during the final days of the book building period. This suggests a possible cost to overbidding, which will now be included. The institutional bidders will still attempt to maximize utility and receive their own true demand; accordingly, the banks will have to price shares to ensure that the institutional bidders receive their true demand in order to reach a stable bidding equilibrium. This potential accommodation of institutional bidders has been shown in the literature on underpricing. Book built IPOs revolve around the relationships between the banks and large bidders. The banks extract rent from the bidders via pricing and demand and thus need to keep large bidders happy. From a platform perspective, the IPO system requires the presence of large bidders to maintain it, so the banks have a second incentive to keep large bidders happy.

The N bidders know that for the total amount that they bid, there will be a specific amount of retail bidding that occurs in response. This bidding will come at their expense as the greater level of total bidding will lead to greater rationing of their own bids. Retail bidders observe only the amount of bidding by the institutional bidders, but they do not know the true demand of the institutional bidders, which is the institutional bidders' private information; this also implies that the retail bidders cannot know the level of institutional bid scaling. These features are supported by the findings of Chiang, Qian, and Sherman (2010) for Taiwan in which the bids of institutional bidders are consistent with all assumptions of informed bidders and retail bidders "exhibit evidence of return chasing" (p. 1202). The model will start with the most general case of equation 3.5 with an exponential retail demand function. QIB represents the total bids for the qualified institutional bidders. RII represents the total bids for the retail individual investors. Intuitively, α and β must both be greater than zero for the retail bidding to be increasing on the total bidding from the institutional bidders. Depending on the value of β, the retail bidding will increase at an increasing, constant, or decreasing rate. Formally:

$$RII = \alpha(QIB)^{\beta} \tag{3.5}$$

$$\frac{dRII}{dQIB} = \alpha\beta(QIB)^{\beta-1} > 0, \text{ for } \beta > 0, \alpha > 0$$

$$\frac{d^2RII}{dQIB^2} = \alpha\beta(\beta-1)(QIB)^{\beta-2}$$

In particular,

$$\frac{d^2 RII}{dQIB^2} > 0, \text{ for } \beta > 1, \alpha > 0$$

$$\frac{d^2 RII}{dQIB^2} = 0, \text{ for } \beta = 1, \alpha > 0$$

$$\frac{d^2 RII}{dQIB^2} < 0, \text{ for } 0 < \beta < 1, \alpha > 0$$

All players scale their demands by bidding their demand multiplied by some constant $c \geq 1$. Player i must determine the best response bid to scale his own true demand of $c_i d$ to all other players scaling their true demand by c and taking into account the imitation of retail investors.

$$d = \frac{c_i d}{(N-1)cd + c_i d + \alpha((N-1)cd + c_i d)^\beta} \tag{3.6}$$

The numerator of equation 3.6 represents the individual bid of player i, and the denominator represents the total amount of bids (institutional and retail) in the market - including the expected imitation of retail bidders. Equation 3.6 presents three possible cases for the equilibrium solution given the possible values of β and the constraints on c.

Case 1: $\beta = 1$ and $c \geq 1$

$$\frac{c_i}{c} = \frac{ND(1+\alpha) - d(1+\alpha)}{1 - d(1+\alpha)} \tag{3.7}$$

Assuming that the IPO is never undersubscribed, according to equation 3.7 there are two cases for the relationship between player i's level of bid scaling and the other bidders' level of bid scaling. First, if the IPO is perfectly subscribed with the expectation of the entry by the retail bidders, all institutional bidders will bid their true demand. Formally,

$$(1+\alpha)N \cdot D = 1 \implies c_1 = c = 1$$

Second, if the IPO is oversubscribed with the expectation of the entry by the retail bidders, all institutional bidders will scale their true demand by a factor higher than all other institutional bidders - leading to an unstable equilibrium. That is:

$$(1+\alpha)N \cdot D > 1 \implies c_1 > c$$

Thus, for a linear imitation function, the only equilibrium is for the bankers to ensure perfect subscription. A linear retail demand function cannot provide an equilibrium with both oversubscription and overbidding; the other option is for a non-linear retail demand function. Taking the natural log of equation 3.6 yields the following:

$$\ln \alpha + \beta \ln((N-1)cd + c_i d) = \ln(c_i - (N-1)cd - c_i d) \tag{3.8}$$

It will be assumed for equilibrium that c_i/c. This results in the following equilibrium condition:

$$\ln c = \frac{\ln(1 - Nd) - \beta \ln(Nd) - \ln \alpha}{\beta - 1} \tag{3.9}$$

The final two cases of equilibrium are now examined.

Case 2: $\beta > 1$ and $c \geq 1$

In this case, the denominator of equation 3.9 must be greater than zero, and given the constraints on c, this yields the condition below that the numerator of equation 3.9 must be greater than or equal to zero.

$$\ln(1 - Nd) - \beta \ln(Nd) - \ln \alpha \geq 0$$

$$1 - Nd - \alpha(Nd)^{\beta} \geq 0$$

But the investment banks will always ensure that there is never any undersubscription. Therefore, the total bids of both institutional and retail investors must equal the normalized total share count of one.

$$1 - Nd - \alpha(Nd)^{\beta} = 0$$

This then implies that equation 3.9 is equal to zero, and thus:

$$c = 1$$

In this case, when $\beta > 1$ and retail imitation increases at an increasing marginal rate, the only stable equilibrium is for the IPO to be perfectly subscribed, including the expectation of the entry by the retail bidders. This leads all institutional bidders to bid their true demand, and all bidders (both institutional and retail) to be allocated their bids. The high level of imitation makes it impossible for the institutional investors to ever receive their true demand in an oversubscribed IPO because the cost of imitation is always greater than the benefit from overbidding; therefore, the banks must simply ensure perfect subscription.

Case 3: $\beta < 1$ and $c \geq 1$

In this case, the denominator of equation 3.9 must be less than zero, and given the constraints on c, this yields the condition below that the numerator of equation 3.9 must be less than zero.

$$\ln(1 - Nd) - \beta \ln(Nd) - \ln \alpha < 0$$

Therefore, the total bids of both institutional and retail investors must be greater than the normalized total share count of one.

$$1 - Nd - \alpha(Nd)^{\beta} < 0$$

This then implies that equation 3.9 is greater than zero, and thus:

$$c > 1$$

In this case, when $\beta < 1$ and retail imitation increases at a decreasing marginal rate, the only stable equilibrium is for the IPO to be oversubscribed, including the expectation of the entry by the retail bidders. This allows for a stable equilibrium with overbidding of true demands. The low level of imitation makes it possible for the institutional investors to still receive their true demand in an oversubscribed IPO because the costs of imitation eventually equilibrate to the benefits of overbidding.

In conclusion, the model shows that a bidding equilibrium can occur in oversubscribed IPOs if there is a cost to overbidding (i.e., imitation by other bidders). If the imitation occurs at a constant or increasing rate, then there can be no stable equilibrium with overbidding and oversubscription. Bankers will then choose to price the shares to ensure perfect subscription including the expected retail bidding. Institutional investors will bid their true demand and receive that many shares; retail investors will get exactly as much as they bid. This suggests that in the case of increasing or constant marginal rates, demand should vary very little above perfect subscription. Therefore, all investors would be satisfied with their allocation, and most secondary performance would likely be due to external market conditions or information leakages (Chowdhry and Sherman, 1996).

If the imitation occurs at a decreasing marginal rate, then bankers will price the shares to ensure oversubscription, including the expected retail bidding. Institutional investors will scale their bids above their true demand and still receive their demanded shares; retail investors will be allocated shares less than their bid. This suggests that in the case of diminishing marginal rates, bids by institutional investors should have no relationship with secondary pricing; banks ensure that institutional investors receive as many shares as they really demand. However, it is unclear whether retail bids will have a connection to secondary performance since retail investors do not know the institutional investors' private demand or level of bid scaling. To put it simply, retail investors may or may not grasp that institutional investors are inflating their bids and by how much. If retail investors understand that the institutional investors have scaled their bids, then retail share rationing should not be a surprise to the retail investors. Retail investors would understand that they were rationed at the same level as the institutional investors and that the high levels of institutional bids do not translate exactly into high levels of institutional demand. On the other hand, if retail investors do not understand that institutional investors have scaled their bids, then the high levels of institutional bids would be perceived as high levels of institutional demand; therefore, the high degree of retail share rationing would come as a surprise to the retail investors leaving them to believe that they have unmet demand. Thus, retail bidding would potentially predict secondary performance. In the next section, I will test which of those outcomes are observed in practice using data from the IPO Indian market.

3.4 Data

I will now attempt to bring the model's prediction to the data. I will focus on the Indian IPO market both because of the availability of subscription data and the unique regulations that are comparable to the economic model. India represents an interesting and useful case study for IPOs. Until 1992, Indian issuers and banks had little to no pricing or allocation flexibility; in 1999, pricing flexibility was allowed and, more importantly, discretionary allocation was allowed for certain types of investors. Under these new regulations, retail investors, qualified institutional buyers, and non-institutional buyers are each treated as three bidder pools and are given a fixed portion of all shares. The proportion of shares allocated to each investor group is currently 50% for qualified institutional bidders, 35% for retail bidders, and 15% for non-institutional high net worth bidders. Additionally, the 1999 regulations allowed for a choice between fixed price auctions with pro rata allocation and a hybrid book building process. In this hybrid process, a fixed price auction was used for retail investors and a book building process with allocation for the qualified institutional bidders. Since 1999, book building has become the nearly unanimous choice for Indian IPOs. For example, book building was used for 36 of 37 successful IPOs in 2011. Bubna and Prabhala (2008) discovered that between 1999 and 2005, Indian book built IPOs demonstrated less underpricing compared to fixed price auctions. They also highlighted the strange phenomena that despite lower underpricing, book built IPOs demonstrated greater oversubscription and book built oversubscription was less sensitive to underpricing. This confirms the theory that book built IPOs lead to greater information discovery prior to offering.

In 2005, Indian regulation once again changed, and underwriters in the book building process were no longer permitted to control allocation for qualified institutional buyers; all allocation was done pro rata within each investor group. As Bubna and Prabhala (2008) eloquently note, "so what the Indian IPO market calls a book built IPO after November 2005 is a dirty Dutch auction in the parlance of the auction literature" (p. 9). Indian IPOs now combine the unique bidding strategies of fixed price auctions (since there is no possibility of cronyism in allocation) with the positive price discovery effects of book building.

The Indian IPO process is fully transparent. By regulation, all investors must submit public bids throughout the book building process. This allows for observation of the cumulative bids of each investor group as the book is built each day; on the other hand, IPO subscription data and bids are privately held by the investment banks in the United States. Khurshed, Pande, and Singh (2009) found that non-institutional bidders tend to follow the lead of institutional buyers during the book building process, likely due to the revealing of private information of large buyers. They determined that institutional bids that occur on the first or second day are highly correlated to retail bids in the final or penultimate day of the book building process. Moreover, they found that in the aftermarket, IPO performance and underpricing is strongly determined by the level of oversubscription by retail investors, which they take as a proxy for unmet demand. However, they find no connection between institutional oversubscription and underpricing, which they can only presume is due to institutional bidders being "satisfied." On the other hand, Chiang, Qian, and Sherman (2010) found in their study of Taiwanese IPO auctions that the entry of more informed institutional bidders led to greater underpricing, and the entry of overbidding and return chasing retail bidders led to lower underpricing. For this reason, they suggest that the presence of retail bidders could lead to instability in IPO outcomes, and thus the access of retail bidders should potentially be restricted. However, these results likely do not generalize for book built IPOs; their study does not account for the consequences of price revealing and setting that arises from the interaction between bankers and investors.

Between the beginning of 2007 and January 2013, 303 IPOs were filed with the Securities and Exchange Board of India. 287 of these IPOs were successful, and the other 15 were withdrawn due to poor investor interest. Of the successful IPOs, 32 were issued via the fixed price mechanism; the other 255 were issued via the book building mechanism. Subscription and secondary performance data is only available through the SEBI for 251 of the successful book built IPOs[1]. Of these 251 IPOs, I excluded 9 of those from my analysis because they had zero qualified institutional bidder interest, which would be inconsistent with the regression, which relies on the natural log of bidder demand. Below is a table with the summary statistics for the 242 IPOs to be examined in the paper.

[1] Data not available for Veto Switchgears, Thejo Engineering, Spice Telecom, or Binani Cement.

DATA SUMMARY

Year	N	Avg. Size (Rs Cr)	Avg. Total Subscription (Times)	Min.	Max.	Avg. Underpricing (%)	Min.	Max.
2007	89	370.00	31.79	0.97	160.56	29.28	-42.17	241.75
2008	31	586.98	11.02	1.04	133.44	12.53	-39.45	159.57
2009	21	919.36	9.17	1.04	39.54	9.74	-29.07	129.25
2010	61	592.14	16.80	0.96	93.60	13.55	-37.21	103.98
2011	30	195.77	4.36	1.11	35.21	10.10	-63.78	153.50
2012	10	674.52	11.97	1.03	54.13	5.15	-13.09	25.68
Total	242	492.45	19.17	0.96	160.56	18.10	-63.78	241.75

In the first column is the number of IPOs per year, which has varied dramatically depending on the general conditions of the market. In the second column is the average size of each IPO in the Indian currency. In the third column is the average total subscription (aggregate of all three investor groups) for each year. The data suggests that certain years display significantly higher aggregate oversubscription. Nevertheless, the fourth and fifth columns reveal that the minimum subscription is almost always greater than one and the maximum can reach incredible highs (but never infinity as game one and two of the model would suggest). In the sixth column is the average underpricing for each year. In a similar fashion to the subscription, certain years display much higher underpricing; this may be a result of the subscription level and/or market conditions. The final two columns show the minimum and maximum levels of underpricing for each year, revealing that banks still fail on many occasions to correctly price the shares; however, the upside risk appears to be much greater than the downside risk.

3.5 Empirical Strategy

First, the theory of retail imitation is tested with the log-linear regression of equation **??** based on the log of 3.10, which comes from the economic model.

$$\alpha \left(QIB_{sub_i} \cdot Issue\ Size_i \cdot 50\% \right)^{\beta} = RII_{sub_i} \cdot Issue\ Size_i \cdot 35\% \tag{3.10}$$

$$\begin{aligned} &\ln \alpha + \beta \ln \left(QIB_{sub_i} \cdot Issue\ Size_i \cdot 50\% \right) + \epsilon_i \\ &= \ln \left(RII_{sub_i} \cdot Issue\ Size_i \cdot 35\% \right) \end{aligned} \tag{3.11}$$

QIB_{sub} represents the subscription level for the qualified institutional bidders. RII_{sub} represents the subscription level of the retail individual investors. The subscription level is then multiplied by the size of the IPO and then by the respective portion of shares allocated to each investor class; this then yields the total bid size of each investor group. Non-institutional high net worth bidders (or NII) bidders were excluded as they represent a small portion of the IPO; moreover, it is less obvious how they fit into the economic model of private information as a large client of the banks, but still not as a large institution with research capacities.

The regression will first test whether the sign on α is greater than zero as the economic model predicts.

$$H_0^1 : \alpha = 0$$

$$H_1^1 : \alpha > 0$$

Second, the regression will test if the sign on β is directionally correct as greater than zero.

$$H_0^2 : \beta = 0$$

$$H_1^2 : \beta > 0$$

Third, if β is greater than zero, then the regression will test if β falls in the range above one or between one and zero.

$$H_0^3 : \beta > 0$$

$$H_1^3 : \beta > 1$$

The results of the regression of equation **??** are below:

SUMMARY OUTPUT

Regression Statistics	
Adjusted R Square	0.6169
Observations	242

	Coefficients	*Standard Error*	*P-value*
Intercept	2.4599	0.1603	1.68E-37
ln(QIB*X*.5)	0.4836	0.0245	3.88E-52

The regression has an adjusted R^2 over 60%. Both $\ln\alpha$ and β are statistically significant at a p-value of .01. The results imply an α of 11.7032; the positive sign confirms the positive relationship between observed institutional bidding and the retail bidding response. Thus, the alternative hypothesis of H_1^1 that α is greater than zero cannot be rejected at the 1% statistical significance level. The fact that the regression suggests that α is much larger than one seems to imply that retail bidders simply represent a much larger source of demand compared to the institutional bidders.

The regression results also reveal that β is both greater than zero and less than one with a p-value of .01. Thus, the alternative hypothesis of H_1^2 that β is greater than zero cannot be rejected at the 1% significance level. Moreover, the alternate hypothesis of H_1^3 cannot be accepted at any meaningful significance level; therefore, β is positive and less than one. The empirical results strongly indicate conditions of sign and range that would lead one to conclude that a stable equilibrium occurs with oversubscription and overbidding as shown by the third case of the third game of the IPO model. This result is consistent with the empirical observations that oversubscription occurs and the widespread belief that overbidding occurs.

The Indian IPO data was also used to recreate the results of Khurshed, Pande, and Singh (2009) to see whether there is a connection between subscription and underpricing, or first day returns. This is tested using the following regression, which is very similar to the model of Khurshed, Pande, and Singh (but excludes company age since incorporation, NII bidding, and pre-listing underpricing since they have no economic significance given the scope of the model):

$$\beta_0 + \beta_1 \cdot Market\ Returns_i + \beta_2 \left(RII_{sub_i} \cdot Issue\ Size_i \cdot 35\%\right) + \beta_3 \left(QIB_{sub_i} \cdot Issue\ Size_i \cdot 50\%\right) + \epsilon_i = Underpricing_i \tag{3.12}$$

In a similar fashion to the regression in (11), total retail and institutional bids were backed into given subscription level, issue size, and share allocation percentages. Market returns were determined as the percentage change in the S&P CNX Nifty Index between the opening and the closing of the bidding process on the IPO.

First, I test if market returns are significant predictors of underpricing, implying the sign on β_1 is non-zero.

$$H_0^4 : \beta_1 = 0$$

$$H_1^4 : \beta_1 \neq 0$$

Second, I test if retail bidding is a significant predictor of underpricing, implying the sign on β_2 is non-zero.

$$H_0^5 : \beta_2 = 0$$

$$H_1^5 : \beta_2 \neq 0$$

Third, I test if institutional bidding is a significant predictor of underpricing, implying the sign on β_3 is non-zero.

$$H_0^6 : \beta_3 = 0$$

$$H_1^6 : \beta_3 \neq 0$$

The results of the regression of equation **??** are below:

SUMMARY OUTPUT

Regression Statistics	
Adjusted R Square	0.0918
Observations	242

	Coefficients	*Standard Error*	*P-value*
Intercept	-19.9863	8.7338	0.0230
Market Returns	2.3478	0.9777	0.0171
ln(RII*X*.35)	8.1793	2.4987	0.0012
ln(QIB*X*.5)	-0.9113	1.5382	0.5541

While the R^2 may not be as high as the results of Khurshed, Pande, and Singh, this is likely due to the exclusion of a few explanatory variables with little economic significance to my model and different sample periods. Khurshed, Pande, and Singh focus on the period of 1999 to 2008; however, this ignores many of the changes in Indian regulation mentioned in the previous section. Thus, this paper likely presents a more consistent and economically meaningful range of variables and time periods.

Nevertheless, the results for the independent variables are similar in terms of sign and significance. β_1 is significant at a p-value of .01. Thus, the alternative hypothesis of H_1^4 that β_1 is non-zero cannot be rejected at the 1% significance level. Market returns are a significant positive predictor of IPO underpricing, which is to be expected considering it is an equity offering. An increase in the markets of 1% during the bidding process, on average leads to an increase in underpricing by 2.3478%.

Most importantly, β_2 is statistically significant at a p-value of .01, whereas β_3 is not statistically significant at any meaningful p-value. Retail demand is a significant positive predictor of underpricing. A 1% increase in retail demand is predicted to lead to an increase in underpricing by $.01 \cdot 8.1793$ or .081793%. On the other hand, the null hypothesis of H_0^6 cannot be rejected at any meaningful significance level; institutional demand has no predictive power for underpricing.

These results on the coefficients are identical in direction and significance to Khurshed, Pande, and Singh. The authors can only explain the importance of retail oversubscription for predicting underpricing by calling it a proxy for unmet demand; they assert that for some unknown reason institutional bidders are "satisfied." However, this ignores the fact that by this explanation for the predictive power of retail demand, institutional oversubscription would also count as unmet demand. The authors fail to provide a causal explanation for why one and not the other would predict underpricing. On the other hand, the model presented in this paper presents a theoretical explanation of this question. In the equilibrium case for $\beta < 1$ as found in the data, institutional bidders overbid their true demand but in the end receive their true demand in shares. In contrast, retail bidders simply observed the institutional bids without knowing the institutional demand or the precise level of bid scaling. The empirical results of all retail unmet demand leading to oversubscription suggests that the retail bidders simply imitated the institutional bids but did not factor in the level of bid scaling, and thus they perceived their rationing to be too high. This inability to fully understand that the bidders they were emulating scaled their bids likely leads the retail bidders to overestimate their own rationing. This final result is consistent with Chiang, Qian, and Sherman (2010), even though their data focuses on IPO auctions and not book built IPO, that there is a great amount of inexperience on the part of retail bidders.

3.6 Conclusion

This paper attempted to understand the phenomenon of oversubscription, overbidding, and underpricing in the IPO market. Removing the effects of subjectivity and cronyism in the book building process (which are still likely unimportant based on the current literature), oversubscription and underpricing were observed in the Indian IPO markets under the context of a model that incorporates overbidding. Given that banks have a clear goal to ensure full subscription at minimum to their IPOs, overbidding can occur in a stable equilibrium, which is a commonly held assumption by bankers and investors, if and only if there is a cost to overbidding - namely the presence of retail imitation. Given the presence of two types of bidders, bankers must accommodate the presence of institutional bidders by ensuring they receive their full demand in shares after rationing, while allowing retail bidders to copy the observed bidding of institutional bidders. This leads institutional bidders to be satisfied with their allotments, and thus contrary to economic intuition, their oversubscription is no indicator of unmet demand and therefore secondary performance. On the other hand, retail bidders are left guessing the level of demand and overbidding by the institutional bidders; the Indian IPO market indicates that the retail bidders are systematically underestimating or ignoring the overbidding. Accordingly, the retail bidders perceive their rationing as too high, leading retail oversubscription to predict secondary performance.

In conclusion, the Facebook IPO likely revealed that much about subscription data is still not understood on Wall Street, and many aspects have not been addressed thoroughly in the literature. Several of these issues, namely oversubscription (or fixed price auctions with rationing), overbidding, and undersubscription have been addressed individually in the literature, but none have considered how all three potentially work together in a book building setting. As demonstrated in this paper, subscription data can still have economic meaning, despite the ubiquitous presence of overbidding, when conditions resemble the Indian book built IPO. However, this leads to a break down in pure economic connection between demand and prices in the case of institutional bidders but not in the case of retail bidders. Retail investors can and do alter the outcome of IPOs - and not necessarily for the worse. The Facebook IPO may have left investors and bankers too jaded to the fact that oversubscription can predict underpricing if certain conditions arise: specifically, an efficient price discovery process, public knowledge of subscription levels, and pro rata rationing (or as the literature suggests, a book building allocation not based on cronyism). The high level of retail interest in the Facebook IPO and the relatively poor performance of the stock early on may simply be an outlier case and not the norm. Perhaps bankers running book built IPOs need to better appreciate the benefit of having retail investors participate in their IPOs since their presence may ensure not only stability, but also positive returns for their coveted institutional investors.

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