

Why Do IPO Auctions Fail?*

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Abstract

We document a somewhat surprising regularity: of the many countries that have used IPO auctions, virtually all have abandoned them. The common explanations given for the lack of popularity of the auction method in the US, viz., issuer reluctance to try a new experimental method, and underwriter pressure towards methods that lead to higher fees, do not fit the evidence. We examine why auctions have failed and verify, to the extent possible, that they are consistent with what academic theory predicts. Both uniform price and discriminatory auctions are plagued by unexpectedly large fluctuations in the number of participants. The free rider problem and the winner's curse hamper price discovery and discourage investors from participating in auctions. Calculating the optimal bids in large multi-unit common value auctions with endogenous entry imposes a huge computational burden. With IPOs taking place sporadically, and each firm being different, auctions are likely to end up being unstable.

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"Improbable as it is, all other explanations are more improbable still."

Sherlock Holmes in "Sliver Blaze," 1892, by Sir Arthur Conan Doyle

Book building is the primary method through which initial public offerings (IPOs) are brought to the market in the United States (US). An ongoing debate in the academic literature explores the advantages and disadvantages of the book building method, relative to sealed bid auctions. On the one hand, the greater control and flexibility of book building provides substantial benefits to issuers.¹ On the other hand, the book building procedure necessarily gives the underwriter substantial discretion over allocations. When agents are given discretion, there is always the potential for abuse, and the scandals following the internet bubble suggest that at least some abuses have occurred in practice². Moreover, there is a general agency problem between underwriters and issuers that has not yet been fully explored for IPOs.³ Thus there are both advantages and disadvantages to the flexibility offered by book building.

In the search for an alternative, much of the focus has been on auctions, which have been extremely successful in a wide range of alternative settings. With sealed bid auctions, theory also offers trade-offs – auction theory predicts that sealed bid auctions will lead to very accurate pricing under some circumstances but to substantial problems under others. In this case, the theoretical differences are in the underlying assumptions regarding information structures and the determinants of entry. If information is endowed (i.e. costless) and bidder entry is predictable, auctions should be relatively efficient. But if accurate estimates of IPO share values are difficult to produce and entry is uncoordinated, theory predicts that auction outcomes may be far less desirable (see Sherman, 2005).

Because theory predicts varying outcomes for both auction and book building IPOs, it is worth examining the available evidence regarding the track records of each method. In this paper we offer evidence on overall usage patterns for many countries – the ‘market test’ - and then examine IPO auction outcomes in more detail. We find that, when standard auctions have

¹ As first shown by Benveniste and Spindt (1989) and Benveniste and Wilhelm (1990). Ritter and Welch (2002), Ljungqvist (2004) and Wilhelm (2005) offer reviews of the academic IPO literature.

² See Loughran and Ritter (2004) for discussion of the scandals and overall trends in IPO underwriting.

³ with the notable except of Biais, Bossaerts and Rochet (2002), for the French regulatory regime.

had to compete with another method - either with fixed price public offers⁴ or with book building - auctions have been driven out.

The lack of popularity of auctions cannot be explained by either lack of familiarity or by differences in underwriting fees. The fees for fixed price public offers in most countries have been the same as those for auctions, leaving investment banks with no incentive to favor one method over the other based on fees. In spite of that, when issuers have been allowed to choose between fixed price public offers and auctions, the former method has prevailed and auctions have lost out⁵. And when fixed price public offers later were faced with competition from book building, the fixed price public offer method has generally lost out, although not as completely as the auction method.

The observation that auctions have consistently lost out to other methods is an important piece of evidence but is not, by itself, sufficient to conclude that the predictions of auction theory are correct. We therefore examine the reasons why auctions have failed and verify, to the extent possible, that they are consistent with auction theory in an IPO setting.

The auction method is old and well established, and has been particularly successful for the largest security issue markets – those for government debt, particularly US Treasury securities; and auctions have been frequently used for new preferred stock issues in the United Kingdom (UK), particularly for government-owned utilities⁶. Treasury auctions are held frequently at regular time intervals, with a core of regular participants. Further, close substitutes to the securities being issued are already trading actively in the market, making valuation relatively easy and precise⁷. Preferred stocks of regulated utilities are relatively easy to value since they resemble high quality bonds. In contrast, IPOs occur less frequently, at sporadic intervals, and their value is difficult to determine. Each issue is different and may

⁴ With fixed price public offers, the price is set before any information on demand is received, as shown by Loughran, Ritter and Rydqvist (1994, Table 2). With book building (a term coined in the 1990s), the underwriter arranges for investors to attend a road show and then collects indications of interest, which are used to fill (build) the order book. The offering price is set only after the order book is full, giving the underwriter some idea of demand. With standard auctions, pricing and allocation are based on bids, using pre-established rules. Sherman (2005) argues that the main difference between the methods, from a regulatory standpoint, is the underwriter's discretion over allocations with book building. With either fixed price public offers or sealed bid auctions, underwriters may, and sometimes do, hold road shows before the offer price is set. They are allowed to ask for feedback but, without control over allocations, they cannot give investors an incentive to offer reliable feedback.

⁵ The only exception that we know of is France, which used a unique auction method that discouraged free riders.

⁶ In the six month period from Oct. 1, 1974 to March 31, 1975, all seven preferred stock issues in the UK used "Offers for Sale by Tender", i.e. auctions. The issuers were all local waterworks or water companies.

⁷ Nevertheless, Goldreich (2005) shows that even uniform price Treasury auctions lead to underpricing.

attract a different set of participants. Therefore, theory predicts that IPO auctions may face wide variations in the number of participants. We find evidence supporting this prediction.

A well established problem in auction theory is the winner's curse faced by bidders in a common value setting. Auction participants can adjust for this by shaving their bids, but this adjustment depends on the number of other investors that choose to enter the auction. If bidders do not know how many will participate in the auction, there may be unpleasant surprises. Auctions that have an unexpectedly large number of random entrants will on average be grossly oversubscribed and overpriced, while those that, by chance, have an unexpectedly low number of participants may be undersubscribed. We find that this is indeed the case.

When it is costly to gather information relevant to valuing a new issue, investors who do so must be rewarded. Standard auctions do not guarantee this. In fact, in uniform price auctions, some participants may have an incentive to free ride on the effort of others, by bidding high. Any such free riding will make the auction clearing price volatile and uninformative, contributing to the failure of the market for the issue. We find evidence of this.

The winner's curse and free rider problems can be overcome if all bidders adjust their entry and bidding decisions accordingly, but this is complicated. Large multi-unit IPO auctions will work only if essentially all potential participants are highly knowledgeable, disciplined and sophisticated, yet the very nature of IPOs – occurring sporadically, with each issuer different – makes it difficult for millions of potential investors to all obtain that high level of skill and sophistication. If only a small fraction of potential investors fail to reach that level, it may not be optimal for sophisticated investors to enter at all. We find suggestive evidence that unsophisticated return-chasers have tended to overbid, driving away other bidders.

The magnitude of underpricing is often mentioned as a disadvantage of the book building method. However, underpricing in fixed price offers tends to be larger than underpricing under either auctions or book building. In spite of that, we find that the fixed price public offer method has driven out auctions, when both were allowed. Hence the money left on the table through underpricing, in and of itself, does not appear to be the primary issue⁸.

Discriminatory auctions have many of the same shortcomings as standard uniform price auctions. Both discriminatory and uniform price auctions suffer from uncertainty about the

⁸ In other words, objective functions for issuers that are based on IPO proceeds alone appear inadequate. Loughran and Ritter (2004) offer a more general objective function. In addition, Sherman and Titman (2002), Sherman (2005) and Chemmanur and Liu (2004) analyze IPO methods assuming that the issuer's objective

number of bidders, and neither guarantees that a stable set of serious investors has an incentive to devote time and resources to evaluating each offering. The most successful IPO auctions have been of the “dirty”⁹ type that attempt to approximate the book building approach.

The debate on IPO methods in the US has largely focused on two extremes: either the status quo, or the use of standard sealed bid auctions, which mandate simple, rigid allocation and pricing rules. There are, however, alternatives that fall somewhere in between the opaque allocation system currently used and the elimination of all underwriter discretion or control. Jagannathan and Sherman (2005) propose reforming the bookbuilding method to introduce greater transparency of the allocation process, in a way that still allows underwriters to consider all relevant factors when allocating and pricing offerings. Large fund management companies already use such systems to determine allocations of trades, taking into account many variables in a balanced, relatively transparent way.

The rest of the paper is organized as follows. Section I establishes trends in the use of IPO methods, including the many countries that have tried and abandoned the auction method. Section II shows that the failure of auctions cannot be explained by lack of familiarity or by pressure from investment banks to use book building. Section III lays out the problems that we would expect to find with IPO auctions in theory, including the winner’s curse with endogenous entry (III.A), the free rider problem (III.B), and the overall difficulties reaching a robust, stable equilibrium (III.C). We conclude this section with a general summary of theoretical predictions regarding large, multi-unit sealed bid auctions (III.D).

Section IV examines evidence of uncertainty in IPO auctions, including fluctuations in the number of bidders (IV.A), undersubscription (IV.B) and overall instability (IV.C). In the subsection on instability, we would first explore Argentina's experience (IV.C.1), where the success of the first auction led too many investors to flood into the second, precipitating a market crash; then Singapore's two year experiment with the method (IV.C.2), and last our more quantitative analysis of Singapore's experience (IV.C.3). Section V concludes.

function includes more than just maximizing expected one-time proceeds.

⁹ A “dirty” IPO auction is a uniform price auction where they “leave something on the table” by pricing below market-clearing. Uniform price auctions, often mistakenly called Dutch or Vickrey auctions, are multi-unit sealed bid auctions in which all winning bidders pay the same price. The price paid may be the market-clearing price (the highest price that allows all shares to be sold), or it may be below the clearing price, leading to increased rationing. We will focus on $X+1^{\text{st}}$ price auctions, where the company is auctioning off X shares and the price is based on the $X + 1^{\text{st}}$ highest bid. In practice, for IPO auctions with thousands of bidders for millions of shares, it is extraordinarily rare for the X -highest bid to be at a different price than the $X+1$ -highest bid. In a discriminatory

I. Global Patterns

When Margaret Thatcher, Prime Minister of the UK, began privatizing British companies, she set off major changes around the world in government, in industries and in IPO methods. Before then, the IPO method in most countries outside the US was fixed price public offers (a.k.a. open offers, universal offers or often simply called “the IPO method”). The trend towards floating extremely large public companies forced countries to try new methods and to coordinate IPOs across borders, since many privatizations were too big to be absorbed entirely by the local market. The wave of privatizations led to experimentation first with auctions and then with the US book building method.

Table 1 summarizes the IPO methods used in various countries. More detailed information is given in Appendix D, which is available on the Social Science Research Network¹⁰ and on request, and which shows that most countries allow the use of many methods. We do not know of any country that had formerly allowed auctions and then changed their regulations to prohibit or limit them – the general trend in the last two decades has been to allow greater choice among issuers. The book building method was once rare outside the US but is now common. Auctions have been tried in more than 20 countries but are rare today.

The rarity of IPO auctions is not due to unfamiliarity. Auctions were used in Italy, Portugal, Sweden, Switzerland and the UK in the 1980s, and in Argentina, Malaysia, Singapore and Turkey in the 1990s, but they were abandoned in all of these countries well before book building was introduced. Auctions were required for many years in Japan, yet quickly vanished once book building was allowed.

In France, auctions were popular in the first half of the 1990s. On the regulated exchanges, they gradually lost market share to a restricted form of book building over several years, then dried up quickly in 1999 when a more standard form of book building was allowed. Auctions continued to be used on the unregulated over-the-counter market (the *Marche Libre* or Free Market) for several more years, although they eventually seem to have dried up there,

auction, each winning bidder pays his or her own bid.

¹⁰ At <http://ssrn.com/abstract=892026>. Appendix A gives additional information on IPO auction methods in various countries. It should be noted that Table 1 focuses on methods used within various countries. Issuers may instead list elsewhere, rather than in the domestic market. Ljungqvist, Jenkinson and Wilhelm (2003) examine both international and purely domestic IPOs.

also. There were, however, two IPO auctions in France in early 2005¹¹, which came after there had been no auctions on regulated French exchanges for half a decade. It remains to be seen whether the two auctions indicate a temporary phenomenon inspired by Google.

Auctions were the only method allowed in Israel for a decade. The law requiring their use expired in December, 2003, although book building was still banned. The only IPOs that we know of in Israel since then have been debt rather than equity IPOs. Of those debt IPOs, two of the three effectively chose fixed price public offer, rather than an auction¹². Legislation that would allow book building is pending but has not yet been passed.

Many countries have used hybrids – combinations of any two of the three methods. There have been hybrid auction/public offer and auction/book building IPOs, but the most common combination is book building/public offer. For most hybrids, book building (or sometimes an auction) is used to set the price and to allocate shares to institutional and foreign investors, while a fixed price public offer tranche is reserved for local retail investors that do not participate in the price-setting process. Hybrid book building/auctions on the exchange are used in Chile because of regulations, but the offer price is set through book building¹³.

In Latin America, auctions have been used in Brazil and Peru in the past. Latin American markets were quiet for much of the last decade, with delistings outnumbering listings in Brazil, Argentina and Chile¹⁴. Thus it was hard to predict if auctions were gone completely. However, Brazilian, Chilean and later Argentinean IPO markets began picking up in 2004-2005, and book building has been the dominant method, with no auctions that we know of.

Since 1995, Taiwan has allowed both auctions and book building, in addition to the traditional fixed price public offers. Taiwan's auctions are similar to those that were once required, and are still allowed, in Japan – discriminatory (pay-what-you-bid) auctions followed

¹¹ The two 2005 auctions were for Cafom, on the Second Marche in January and for MG International, on Alternext in June. Cafom chose an unusually narrow range for accepted bids - the minimum bid was €11.65; the offering price was €13.50; and only bids between €13.50 and €14 were accepted, although bids had gone as high as €20. There have been no further auctions in France as of July, 2006.

¹² The actual restriction was against setting a maximum price in an auction. Technically, all IPOs even before the 10-year restriction were auctions, but issuers were allowed to set a maximum as well as a minimum price for the auction. Issuers before 1993 tended to set their maximum price so low that the offering was highly like to price at the upper limit, effectively making it a fixed price offer. Since December, 2003, at least two of the first three debt IPOs chose to set a maximum price (actually a minimum yield), effectively using the fixed price method.

¹³ Pension funds may only purchase shares through an exchange in Chile, so some IPO shares are sold on the floor of the exchange, after the offering price has been set and the rest of the shares have been allocated through book building. Such auctions may occur only minutes before general trading on the same floor. In its 2003 IPO, La Polar cancelled the auction completely and distributed its shares through a bookbuild and through brokerages.

¹⁴ For example, Chile had no IPOs at all from 1998 to 2001 and only one each in the years 2002 and 2003.

by fixed price public offer tranches. Book building is allowed only in certain restrictive circumstances¹⁵ and is not used. Auctions were initially popular but lost market share over time, with more and more issuers returning to fixed price public offers.

In the US, the investment bank WR Hambrecht has been encouraging issuers to use auctions since mid-1999. The method got much publicity when Google, a popular search engine company, chose to use the auction method for its August, 2004 IPO, but still the auction method is not popular in the US. As of September, 2006, there have been 18 US IPO auctions, 17 of them using WR Hambrecht's OpenIPO auction method.

Thus out of 46 countries, auctions have been tried in more than 20, and yet all except France, Israel, Taiwan and the US seem to have abandoned them entirely, and auctions are rare even in these last four countries. Book building is gaining in popularity or is already the dominant method in 34 of the 46 countries. Fixed price public offer is still used in smaller countries and for smaller offerings, and is common for the retail tranche of hybrids.

II. Auctions versus Bookbuilding: Popular Explanations

II.A. Were Issuers Unwilling to Try a New Method?

One explanation for the low numbers of IPO auctions in the US is that the auction method is simply too new and experimental, and that issuers are afraid to try an unproven method. However, this 'lack of familiarity' argument cannot explain the overall rejection of the auction method around the world. First, the mere fact that IPO auctions have been used in nearly half the countries for which we have information implies that quite a few issuers have been willing to experiment. More importantly, if we look at relative usage patterns over time, issuers have been most enthusiastic about IPO auctions when the method was new, and they generally became less willing to use it after they had become more familiar with the method.

Figure 1 shows the relative auction usage patterns over time in four countries. For Singapore, Taiwan and Turkey, the main alternative method was fixed price public offers, which had been the traditional method in those countries. Auctions were first allowed in 1993

¹⁵ when the majority of the shares sold are primary. Auctions may only be used when the majority are secondary shares (sold by current stockholders). Most companies planning an IPO first issue new shares to existing stockholders, who then sell the shares to the public, thus making the firms ineligible to use book building. This is done reportedly because it is believed that primary issues leads to greater regulatory scrutiny and to a longer delay.

in Singapore¹⁶ and Turkey, and in 1995 in Taiwan. In France, both auctions and fixed price public offers had been used for decades, but book building was first introduced in the 1990s, while unrestricted book building was only allowed beginning in 1999.

As can be seen from Figure 1 for the three countries in which the IPO auction method was newly introduced, auctions captured their greatest market share early on, with two-thirds or more of issuers choosing to use auctions when they were relatively new. As issuers became more familiar with the method over time, a lower proportion of them chose to use the auction method. Hence, it is hard to argue that, in these countries, the disappearance of IPO auctions was due to lack of familiarity or to an unwillingness of issuers to try a new method.

One obvious question is whether issuers in these countries were truly allowed to choose freely between IPO methods. Although there were no regulatory restrictions that prevented issuers from using auctions, strong differences between the groups of issuers using different methods might imply some other sort of barrier, such as underwriter reluctance to underwrite auctions for some issuers. Therefore, in Tables 2 and 3, we compare fixed price public offers and auctions in Singapore, Turkey and on the French Free Market based on both industry and amount of funds raised¹⁷.

II.A.1 Singapore

Table 2.A presents data from the Singapore Exchange (SGX; formerly the Stock Exchange of Singapore or SES) for both Main Board and Sesdaq offerings. Sesdaq was established to attract smaller, younger companies, and had more relaxed listing requirements.¹⁸ The fixed price public offers on Sesdaq were substantially smaller than any of the Main Board IPOs, but the two Sesdaq auctions were much larger than other Sesdaq IPOs and raised more than the median amount raised by Main Board auctions or fixed price public offers. Hence the two Sesdaq auctions are comparable to Main Board offerings, in terms of size. It is possible that most Sesdaq listings were too small to be able to use the auction method, so much of our later analysis will be reported both including and excluding Sesdaq offers.

¹⁶ The graph shows only uniform price auctions for Singapore. Singapore also had one discriminatory auction in 1991 and one in 1992. Uniform price auctions were first allowed in 1993.

¹⁷ Comparisons of French Second and Nouveau offerings can be found in Derrien and Womack (2003) and Degeorge, Derrien and Womack (2006). Hsu and Hung (2005) compare Taiwan IPOs by method.

¹⁸ Requirements for a Main Board listing included five years of operating experience and three successive years of profits, as well as S\$15 million in paid-up capital, which was approximately US\$9.4 million in early 1994. All further dollar amounts for Singapore data are expressed in Singapore dollars, denoted only by \$, not S\$.

For Main Board IPOs, the mean and median funds raised are smaller for fixed price public offers than for auctions, even when the Singapore Telecom (SingTel) auction, an outlier in terms of size, is excluded. However the smallest auction was on the Main Board and raised only \$15.7 million, slightly less than the smallest Main Board fixed price public offer. The median funds raised was \$48 million for auctions (\$44 million excluding SingTel) and \$38 million for fixed price public offers. Six of the 18 Main Board auctions raised less than the median for fixed price public offers. Sunright, the last company to do an auction, raised \$37.5 million, which was slightly below the median fixed price public offer. Their management later told us that they were given the choice of auction or fixed price, by the underwriter, fairly late in the process after the offer price and fees had been set.¹⁹

II.A.2 France

Table 2.B presents French Free Market (Marche Libre) data from the Euronext website. In terms of offering size, the Free Market auctions were in the middle, attempting to raise only about half as much, on average, as book building IPOs but substantially more than fixed price public offers. The largest auctions hoped to raise quite a bit more than the average for bookbuilds, while the smallest were smaller than the mean (but not the median) for fixed price public offers. The amounts reported are based on the number of shares for sale, not the shares actually purchased. French Free Market offerings during this period were often heavily undersubscribed, as we will discuss later in the paper.

Of the four countries whose usage patterns are shown in Figure 1, France differs from the others in several ways. First, the auction method had been allowed for several decades in France. Second, a form of book building was in use during the period shown, in addition to auctions and fixed price. Last, the disappearance of auctions from the regulated exchanges seems to have been driven by a regulatory shift.

Derrien and Womack (2003) found that sequential hybrid book building was less efficient than auctions in France. While interpreting this finding it is important to keep in mind that before 1999, the only form of hybrid book building that was allowed in France was a

¹⁹ It should be noted that these auctions were open to all Singapore citizens, and that participation was relatively easy. Orders were taken through ATMs (automated teller machines) beginning in 1993, so investors could place bids in most of the Singapore auctions studied in this paper by simply stopping by the closest ATM. Some IPO auction supporters have claimed that past track records for the IPO auction method are inapplicable, because they did not include 'new technology' (i.e. the internet). But countries around the world managed to open up their IPO processes to large numbers of potential investors long before online ordering was a possibility, as with Singapore's

sequential hybrid, where the price must be set many days in advance, to allow time for the public to place their orders. As the modeling in Chowdhry and Sherman (1996a) demonstrates, requiring that prices be set far in advance adds risk, leading to higher levels of underpricing. Once the more modern, simultaneous hybrid book building method was allowed in France in 1999, auctions quickly vanished from the regulated exchanges²⁰. The 1999 regulatory change seems to explain the timing of auctions drying up on the French regulated exchanges, although it does not explain why they were still used for several more years on the unregulated over-the-counter Free Market (Marche Libré).

II.A.3 Turkey

Table 2.C gives data on IPOs in Turkey, from the Istanbul Stock Exchange (ISE) website. Auctions and fixed price IPOs were extremely similar in terms of size, while issues using the third method, Sales on the ISE were substantially smaller. In this last method, the issuer registers an opening price and then is allowed to simply begin normal trading on the exchange at that price. Sales on the ISE are typically preceded by private placements.

II.A.4 Categorization by Industry

Table 3 gives breakdowns of IPOs by industry, for these same three countries, showing that auctions were used in a broad range of industries. The overall industry pattern is similar for auction and non-auction methods. We also looked at the timing of the IPOs, to see whether they were spread out or clustered, and did not find excessive clustering of IPOs in one time period for any of the three countries.²¹ These findings indicate that issuers in Singapore, France and Turkey were free to choose their auction method.

It is clear, in all four of the countries shown in Figure 1, that the disappearance of auctions was not due to issuers' lack of familiarity with the auction method. Similarly in Japan, issuers were forced to use auctions from 1989 to 1997. In spite of the long period during which IPOs in Japan were accomplished exclusively through auctions, the method was abandoned as soon as issuers were given the option of instead using book building.

system to take bids through ATMs.

²⁰ With the exception of the two IPO auctions in 2005 that were mentioned in Section I.

²¹ The importance of this has been shown by Schultz (2003). For Singapore, the mean number of days between auctions was 27 days, with a median of 24 and a standard deviation of 18 days. There were 6 separate months with no IPOs, 4 months with only one, 6 months with 2 IPOs and only one month with 3 IPOs in the same month (February, 1994, with a Main Board IPO on February 2 and the only two Sesdaq IPOs on February 15 and 21). The longest gaps between IPOs were 57 days in 1993 and 54 days in 1994, both around the month of August (the Ghost Month, when IPOs are considered unlucky).

Of course, there is not enough evidence to conclusively reject the ‘lack of familiarity’ argument for each and every country. It may explain why auctions never caught on in some countries with very limited usage, such as Germany, Australia or the US, or in countries that have never tried auctions at all. It may also explain why corporate debt and seasoned equity auctions never caught on, even though there was a race between three investment banks to introduce online corporate bond auction platforms in 2000²², and WR Hambrecht convinced an issuer to try its OpenFollowon online seasoned equity auction method²³. But the overall IPO evidence is that issuers in many countries have been willing to experiment with both auctions and book building, and that issuers became less likely to choose auctions as they gained familiarity with the method.

II.B. Underwriter Pressure for Using the Bookbuilding Method

Another explanation suggested by Ausubel (2002) for the failure of issuers to use IPO auctions is that investment banks have pressured issuers to use book building rather than auctions because the fees, and hence profits, are higher for book building. This argument is somewhat inconsistent – it assumes that underwriters have sufficient market power to keep book building fees artificially high, and sufficient power to force issuers to use the book building method in spite of the high fees, but that they do not have sufficient power to demand artificially high fees for auctions²⁴.

Regardless, this argument cannot explain the disappearance of auctions in most countries, because auctions have usually been replaced by fixed price public offers, and public offer fees are typically as low as, or even lower than, the fees for auctions. Ljungqvist, Jenkinson and Wilhelm (2003) show that average fees tend to be quite low for fixed price public offers across most countries, substantially below those for book building²⁵.

²² On August 10, Deutsche Bank and Bear Stearns each auctioned off their own debt on their newly-developed platforms, while WR Hambrecht held its first OpenBook debt auction, for Dow, on August 15, 2000. WR Hambrecht handled a second OpenBook auction, for Ford Motor Credit, in March, 2001. It reportedly also attempted an auction for Dayton Hudson, but the bid-taking system crashed during the auction.

²³ Overstock, a company that also went public through an OpenIPO, used the OpenFollowon method in May of 2004 but chose a traditional marketed offering for its next follow-on in November, 2004.

²⁴ A perhaps related argument is given by Degeorge, Derrien and Womack (2006), who show a correlation in France between greater publicity/analyst attention for IPOs and the use of book building rather than an auction (they do not analyze the fixed price public offers in their sample). They argue that underwriters induced issuers to use book building by convincing them of the value of other services (more analyst attention) but do not explain why such services would be bundled only with book building, rather than with all three methods in use at the time.

²⁵ Similarly, Chahine (2001), examining French data from 1996 to 2000, found that the mean, median and

A third alternative explanation to consider is that underwriters might be pressuring issuers to use methods that lead to higher initial returns, so that the underwriters can allocate the underpriced shares to their favored clients. This explanation is often heard in the US but cannot explain the choice between auctions and fixed price public offers, since neither method allows the underwriter to control allocations²⁶.

II.C. Do Issuers Prefer the Method that Minimizes Expected Underpricing?

Much analysis of IPOs either implicitly or explicitly assumes that issuers always prefer the offering method that leads to the lowest expected initial return, regardless of risk or other considerations²⁷. There are, however, many reasons to believe that issuers care about other aspects of the process beyond just the expected initial return. An IPO is an expensive way to raise capital and is seldom worthwhile if the company's one and only goal is a one-time fundraising, particularly since the costs of being public are on-going.

An IPO opens the way to future fundraising in the public markets and establishes a market price for the company's stock. The stock price is used as a benchmark by employees, customers, suppliers and competitors. It affects employee morale as well as the company's bargaining position in various types of negotiations. Thus, an issuer benefits from establishing an accurate, sustainable long-term price, which may require a core of institutional investors that will be interested in following the company long term²⁸.

Another reason to go public is to give current stockholders such as the founders, venture capitalists and angel investors a chance to diversify by liquidating at least part of their holdings. Such investors usually cannot sell until the end of the lock up period and thus care about the eventual stock price, and not just either the offer price or the first day's trading price. If a deep, liquid market is not established, those investors may be unable to sell their shares at a reasonable price, even after the time and expense of an IPO.

standard deviation of gross spreads were slightly lower for fixed price than for auctions. In most countries, when auctions were first used, the fees were the same for auctions as for fixed price public offers.

²⁶ Many countries allow orders in fixed price public offers to be favored on the basis of order size, but this usually involves favoring small over large orders. Chowdhry and Sherman (1996b) show that favoring small orders may reduce the Rock (1986) winner's curse. Parlour and Rajan (2005) also examine rationing in IPOs.

²⁷ See, for example, Kaneko and Pettway (2003).

²⁸ although, during the internet bubble, many companies seemed more focused on short term hype than on a sustainable, long term equilibrium. One could argue that this strategy turned out to be sub-optimal in most cases.

Companies that go public but do not attract a following may end up being ignored and stuck in the so-called Orphanage²⁹. If they do not attract an institutional investor following, they will not be followed by analysts and will not be monitored closely enough to be accurately priced. This means that they will be unable to do follow-on equity offerings and will tend to trade at a substantial discount, due to their illiquidity and added risk. In order to minimize this possibility, firms may be willing to pay, through underpricing, to attract the attention of serious investors in the IPO. This may explain the importance of analyst coverage found in Loughran and Ritter (2004) and Cliff and Denis (2004)³⁰.

Thus there are many reasons why issuers may care about more than maximizing the proceeds of a one-time security sale. Those who nevertheless maintain that issuers should focus only on minimizing underpricing will find that they are unable to explain the failure of auctions, since auctions have most often been driven out by fixed price public offers, long before book building appeared. Fixed price public offers have generally led to initial returns that are substantially above the average for either auctions or book building³¹.

Table 4 shows the initial returns for Singapore IPOs in 1993-1994, comparing auction and fixed price public offer first day returns. Singapore allowed only hybrid auctions, with the fixed price and auction tranches occurring simultaneously. The minimum auction price (i.e. the reservation price) could not be less than the price for the public offer tranche, and in practice, they were always the same. Table 4.A gives figures for all IPOs, while 4.B looks at only Main Board IPOs, since Sesdaq fixed price public offers were substantially smaller (see II.A.1 for the differences in listing requirements between the Mainboard and Sesdaq).

Since Singapore's auctions were hybrids, we consider underpricing from the issuer's standpoint. The weighted average initial return is the average of the auction and fixed price initial returns, weighted by the number of shares offered in each tranche. As Table 4.A shows, the weighted average underpricing for all auctions was 16.1%, substantially lower than the 36.9% for pure fixed price public offers. The difference is significant using a one tailed test, with a t-statistic of 2.41.

²⁹ Orphan stocks are also known as wallflowers. See Barron's Dictionary of Finance and Investment Terms.

³⁰ See Sherman and Titman (2002) for a list of additional reasons why issuers may prefer more accurate pricing.

³¹ See, for example, Ljungqvist, Jenkinson and Wilhelm (2003) and Loughran, Ritter and Rydqvist (1994). A key exception to this may be France. Derrien and Womack (2003) found lower initial returns for fixed price public offers than for auctions in France, while Chahine (2001) found a lower median but higher mean, relative to auctions. Thus, perhaps the only country in which auctions led to at least as much underpricing as fixed price public offers was also the only country in which auctions held their own against fixed price public offers.

This brings up the question of why issuers did not sell more shares through the auction rather than the fixed price tranche, given that the auction clearing price could never be below, and was generally substantially above, the price in the fixed price public offer tranche. Issuers were required by law to sell a minimum proportion of shares through a fixed price tranche³², so one might guess that this choice was driven by a binding regulatory constraint. However, most issuers were required to sell only 30% of their shares through the fixed price tranche, yet the mean was 48% and the median was 50%. All but one of the twenty companies that used an auction substantially exceeded the minimum required shares for the fixed price tranche, while even that last company slightly exceeded the requirement.

Thus, many companies in Singapore chose a pure fixed price public offer even though average initial returns were lower for auctions, and nearly all companies that used an auction chose to sell more shares than necessary through the public offer tranche, even though this seemed to increase total underpricing. We can find no evidence in the Singapore data that issuer choices were driven primarily by a desire to minimize underpricing. All else being equal, however, it is likely that companies would prefer less underpricing to more. Thus, it seems likely that the decision to avoid auctions is being driven by some other factor that more than offsets the higher apparent underpricing.

III. Why IPO Auctions May Fail

In this section, we discuss what we believe to be the main explanations for the failure of IPO auctions: the winner's curse with endogenous entry, and the free rider problem. We next describe why these problems may be especially difficult to overcome in an IPO auction setting. Last, we outline the predictions of theory regarding large multi-unit sealed bid auctions.

When we discuss IPO auctions in this paper, we generally mean standard sealed bid auctions, either uniform price or discriminatory (pay what you bid). If the term "auction" was defined in a sufficiently broad sense to include an optimally designed mechanism, such an

³² Shares offered in the fixed price public offer tranche had to be a minimum of 40% or \$3 million, whichever was larger, for offerings below \$12.5 million; 35% or \$5 million, whichever was larger, for offerings between \$12.5 million and \$25 million; and 30% or \$8.75 million, whichever was larger, for offerings above \$25 million.

optimal IPO auction would be more likely to resemble book building, rather than the simple, rigid, standard sealed bid auctions that people normally think of³³.

III. A. The Winner's Curse

There is an adverse selection and consequent winner's curse problem for both uniform price and discriminatory auctions – those who get an allocation may have bid too high.³⁴ When the number of participants in an auction is unpredictable, the problem of adjusting for the winner's curse is particularly difficult, adding risk to the process. Oil lease auctions suggest that even experts face this risk.

The winner's curse problem in common value auctions stems from the fact that, even if each investor has a valuable estimate of the value of the shares, each individual signal is less accurate than the aggregation of all of the signals. Since the signal has a “noise” component to it, if a bidder were to bid the value indicated by her signal and win in the auction, in part it would be because the bid was “too high” – the bidder probably bid much more than the value indicated by the signals received by all the bidders. Thus, observing the consensus estimate of all bidders will cause each bidder to revise her original estimate. Since the winning bidders are, by definition, the highest bidders, they are most likely to revise their estimates downward. If unwary bidders bid their full valuation without adjusting for this, they will tend to overbid.

The solution to the winner's curse is for all entrants to shave their bids accordingly, to adjust for the upward bias in unadjusted winning bids. This adjustment must take into account both the expected number of other bidders and the nature of the information sets of those other bidders. Optimal bid shaving works on average, although there will still be some variations in realized returns. Clearly, even when information gathering is costless (endowed information), a high level of sophistication and computational capability is required to figure out how to bid in an auction taking winner's curse into account.

In practice, bidders apparently find it difficult to adequately adjust their bids for the winner's curse. Bazerman and Samuelson (1983), using experiments with MBA students, showed that winning bidders were subject to the winner's curse. Kagel and Levin (1986)

³³ For example, the optimal auction in Spatt and Srivastava (1991) incorporates both pre-play communication and participation restrictions. Jagannathan and Sherman (2005) offer several suggestions for a method that combines aspects of book building and standard auctions to make the process more transparent and less vulnerable to conflicts of interest while retaining many of the advantages of book building.

³⁴ Those ordering shares in a fixed price public offer also face a winner's curse, as modeled by Rock (1986). But

showed that even moderately experienced bidders tended to bid aggressively, compared to what they would bid under a risk neutral Nash equilibrium. Engelbrecht-Wiggins and Katok (2005) showed that bidders had an even harder time calculating their bids in experimental auctions with endogenous entry. Hendricks, Porter, and Boudreau (1987) examined the return to bidders in outer continental shelf oil lease auctions in the Gulf of Mexico for the period 1954-1969. They found that returns were a decreasing function of the number of bidders and that returns were negative with sufficiently large participation, thus illustrating the risks that even professional bidders face due to endogenous entry.

For an auction that is open to huge numbers of potential entrants but can profitably absorb only a small fraction of that potential, there will be no pure strategy equilibrium that leads to a successful auction. Thus we must consider mixed strategy equilibria, but these require an even higher level of computational sophistication among bidders. Moreover, even if all potential entrants correctly calculate the optimal entry probability, there is still the risk that a large number of investors may unexpectedly enter all at once, since there is no coordination of ex post realized entry. Unexpectedly high entry may lead to the auction clearing price being substantially above the intrinsic value of the issue.

The following example illustrates this potentially large increase in the winner's curse risk due to uncertainty in the number of bidders. For expositional convenience, we assume that each investor observes the value of the stock being auctioned with noise. Each investor's observation is independent of the observation of other investors and is normally distributed with a mean of \$20 (the true value of the stock) and a standard deviation of \$6. There are 100 shares being sold, and each investor bids for only one share. The market clearing price will thus be the 101st-highest bid.

Suppose each bidder bids her estimate of the value of a share based on her observation. Figure 2 shows the distribution of bids and the auction clearing price for N bidders, with N fixed at 120, 200, 500, and 1000 for one randomly chosen auction for each value of N . In each auction shown, the average of all bids gives a fairly good estimate of the value of the shares, but the clearing price usually does not. The clearing prices in the auctions shown range from 27% below true value (winner's virtue) with only 120 bidders to almost 45% above the true value (winner's curse) with 1,000 bidders.

for fixed price public offers, only the probability of getting shares is affected, not the price paid.

Figure 2 shows only one outcome for each value of N , the number of participants. We also examined 100 randomly generated auctions for each N , to examine the variations in the auction clearing price. The average of all the bids in 100 auctions was very close to \$20, the true value, for all five levels of N . The auction clearing price, however, showed variation across 100 auctions: the clearing price had a range of \$3.93 around a mean of \$14.07 for $N = 120$; a range of \$2.95 around \$19.92 for $N = 200$; a range of \$2.14 around \$24.96 for $N = 500$; and a range of \$1.83 around \$27.74 for $N = 1000$.

An investor who had observed the results for 100 auctions with the number of bidders, N , fixed at 200 might conclude that the auction clearing price was on average \$19.92, and that the average of all auction bids (a measure of the true value of the stock) was \$19.96. The winner's curse would be rather small (-\$0.08, or -0.16% of the true value of the stock being auctioned) for this case of 200 bidders for 100 units, since that is the one case in which we would expect the mean bid and the clearing price to be similar, without bid-shaving. An investor who is willing to tolerate a maximum loss of, say \$2, may be content to bid his observed value of the stock without any adjustment for risk. In the 100 auctions we observed with N fixed at 200, the auction clearing price ranged from \$18.32 to \$21.27, and such a bidder would have lost at most \$1.27.

Suppose investors participate in such an auction under the assumption that the number of bidders is exactly 200. If the actual number of bidders unexpectedly turned out to be 1000 (i.e., 10 times oversubscribed, which is not unusual), the likely loss would be substantial, averaging about \$7.65 (38% of the true value of the stock being auctioned). An investor who was willing to tolerate a maximum loss of \$2 would be subject to a large unpleasant surprise – she could have experienced a loss that was more than 3.8 times larger than expected – illustrating the potentially severe nature of the risk due to the winner's curse when there is large and unexpected variation in the number of participants in a uniform price auction. The risks increase further when the precision of the information available to other participants in the auction is not known, or when it is possible that at least some bidders may not be sophisticated enough to calculate the optimal bid.

One might argue that variation in the number of bidders, from 120 to 1,000, is excessive, but this must be put in the context of the number of potential bidders. In Singapore's IPO auctions, out of a population of roughly 2.5 million, the number of auction

bidders varied from 1,128 for Eng Wah to 67,524 for STIC and 162,492 for Singapore Telecom. The quantity bid varied from a low of 0.18 times the number of shares offered to a maximum of 14 times, with the median being 2.63 times (see Table 6).

Unlike in auctions for US Treasury securities, the shares being auctioned in an IPO are difficult to value and differ greatly from one auction to the next. The number of investors who have the necessary ability to value the shares of any one offering, and the nature of the information they possess, would vary substantially, in an unpredictable manner, across different IPOs. This makes it even more difficult for a potential bidder to perform the complicated optimal bid-shaving calculation that is necessary for an auction to succeed. Sherman (2005) observes that the uncertainty regarding the number of bidders in an auction adds risk³⁵.

One reason for the failure of auctions, therefore, would be the risk of unpredictably large fluctuations in the number of participants, since, in a sealed bid IPO auction, participants do not know in advance how many other bidders will choose to enter³⁶. In situations where the winner's curse is extreme, bidders must optimally shave their bids so much in a sealed bid auction that expected proceeds may be higher through a posted price mechanism (see Campbell and Levin, 2006, Bulow and Klemperer, 2002, and Viswanathan and Wang, 2000). Issuers may therefore prefer bookbuilding or fixed price public offer methods that help minimize the risks due to variations in the number of participants, and to differences in the quality of the information they possess, thereby increasing the probability of a successful IPO.

III.B. The Free Rider Problem

In uniform price auctions, the expense of producing a reasonable bid may also lead to a moral hazard problem. When information collection is costly, and when other bidders have done the analysis needed to value an issue, the incentive is there for a new bidder to enter and

³⁵ French and McCormick (1984) show that auction bidders may recover fixed evaluation costs in an auction with endogenous entry, but they assume that entry is coordinated so that the ex post number of entrants is always optimal and known in advance by each bidder, which greatly reduces the risk each bidder faces. Other auction models that include endogenous entry and information production in a common value setting include Hausch and Li (1993) and Harstad (1990), both of which consider only the single unit case. Levin and Smith (1994) and Bajari and Hortacsu (2003) model endogenous entry in a single-unit, endowed information setting. Matthews (1987) considers information production in single-unit auctions with risk-averse buyers. Habib and Ziegler (2003) show that posted-price selling of corporate debt could be superior to an auction, if there is a cost to evaluation.

³⁶ One of the unique aspects of the Google auction in the US in August, 2004, could potentially have helped to alleviate this problem. Google's was the only IPO auction that we know of in which bidders were required to get a unique bidder ID from the issuer in advance, if they wanted to bid in the auction. This meant that the issuer knew the maximum number of potential bidders and could have announced this information before the auction. Google

bid high without collecting any information at all, since the auction clearing price will hopefully be set by those who have already done the necessary analysis. This will break any pure strategy equilibrium; the auction will be a failure³⁷.

There may be a mixed strategy equilibrium in which each bidder balances the probability of free riding and getting underpriced shares without investing in information gathering against the risk that too many free riders might enter all at once, driving the price to excessive levels. The optimal number of free riders would be well below $X+1$ in an $X+1$ st price auction. Informed investors would adjust their entry and information acquisition decisions for the expected entry of free riders. On average, the effect of free riders would be to reduce the incentive of other investors to produce information, thus making the auction pricing process less efficient and on average more noisy. Sherman (2005) shows that each investor optimally collects less information in a uniform price than in a discriminatory auction, because of the moral hazard problem in uniform price auctions³⁸.

The fact that less information would be produced in an equilibrium with free riders means that less underpricing would be needed to compensate informed investors. Unfortunately, however, there will also be positive expected returns for the uninformed free riders, and so total underpricing may not decrease at all and might even increase. In addition, some auctions will be overpriced. Since the only cost that free riders face in the mixed strategy equilibrium is this possibility of overpricing, free riders will choose their probability of entry such that there is a significant risk of such an outcome. The expected or average number of free riders would be low enough to prevent them from overpricing most auctions, of course. But, without coordination of entry, the ex post actual number of bidders in some auctions would be high enough to cause the shares to be substantially overpriced.³⁹

did not, however, choose to make the information public.

³⁷ Kyle (1989) points out that under certain conditions, no one may invest in gathering information in equilibrium.

³⁸ The model predicts that there will be a moral hazard or free rider problem with uniform price auctions but does not incorporate excessively high bids by totally uninformed bidders. This was left to future research.

³⁹ Bortolotti, Megginson and Smart (2006) show that auctions, in the form of block trades, have increased dramatically in the last decade and have become quite common around the world for seasoned equity offerings. The success of these SEO auctions fits well with our findings for IPOs, since the block trade auctions are single-unit auctions among a small group of sophisticated buyers – investment banks. The investment bank that wins the auction buys all of the shares at the winning bid price and then resells them on the market. With only one buyer, there is no room for free riders. Because the shares are relatively easy to value (since they are already trading) and the number of potential bidders is relatively small, these auctions are closer to Treasury bill auctions than to the types of auctions that have been used for IPOs.

Excessively high bids are probably the best way to distinguish the free rider problem from the more commonly recognized winner's curse problem that was discussed in the previous subsection. The key difference between the winner's curse and the free rider problem is that the winner's curse does not lead people to bid more than they genuinely believe the shares to be worth. If they are optimally adjusting, they will shave their bids. If they are naïve and do not adjust, they will still bid no more than the expected value. With the free rider problem, however, bidders may deliberately bid an excessive amount, since the whole point is to blindly bid high enough to be "first in line" for the shares, rather than devoting time and resources to coming up with a reasonable bid. Thus, bids which are too high to reflect any reasonable valuation are good indications of free riders⁴⁰.

III.C. Difficulties Reaching a Robust, Stable Equilibrium

We have now laid out two problems with auctions – the winner's curse and the free rider problem – both of which can be solved, in a sense, through sufficient bid-shaving. If all bidders are sophisticated and are bidding optimally, then they will lower their entry probabilities and shave their bids to allow a return for their time and effort evaluating the stock and preparing a bid, and then will further adjust their entry probabilities and bids in response to the risks of free riders and the winner's curse. That would lead to substantial underpricing on average – perhaps more than would be needed for a posted price mechanism such as a fixed price public offer – even when a stable equilibrium may be possible.

But a stable equilibrium may require that investors have extensive computational capabilities, which may not be feasible even for sophisticated investors. Moreover, it is important that all potential investors, and not just a substantial portion of them, are able to calculate and implement the strategy correctly. Uninformed entry imposes a cost on the sophisticated investors that are devoting time and resources to correctly valuing the shares, thus making them less willing to enter, yet the uninformed are relying on these sophisticated investors to set an appropriate price. For the equilibrium to work, the uninformed must carefully calculate their entry probabilities so that they do not drive out the investors that they are relying on in the price-setting process.

⁴⁰ An example of this was the IPO auction of Global Securities (Global Menkul Degerler A.S.), one of Turkey's leading investment banks and brokerages, in May, 1995. The minimum bid in the auction was 6,000 Turkish Lira, but bids went as high as 100,000 Turkish Lira, a 1,567% premium over the minimum. During the first three

The analysis in Viswanathan and Wang (2000) supports this view. They show that there may not be a linear equilibrium when adverse selection is severe. With book building the investment bank coordinates entry, while with a fixed price public offer at least the price is not subject to entry fluctuations. Thus either method may be more robust than an IPO auction open to large numbers of unsophisticated investors, although this has not yet been fully modeled. We illustrate the possibility of such instability using Singapore IPO auctions.

Our earlier discussion of a free rider was of someone who chose not to invest time and resources evaluating the current issuer – i.e. chose not to do due diligence on the current offering – but who still understood auction theory and how to calculate the optimal entry and bidding strategies, given the expected strategies and information sets of all other potential bidders. In addition, there may be a more general type of free rider – we will call them return-chasers – that do not understand the system but are simply attracted to any investment that has a good recent track record⁴¹. If some investors are more likely to enter the current auction when the last few have led to high returns, and if they also have a tendency to overbid, then it is very hard to imagine a stable equilibrium with auctions.

From the issuer's standpoint, such potential instability of the IPO auction method may be a serious deterrent. As discussed in II.C, issuers have many goals in mind during an IPO, including the ability to do future fund-raising in the market or to have a stock price that serves as a benchmark for employees, suppliers and customers who want to track the condition of the company. Thus companies would tend to prefer a more accurate aftermarket valuation of their shares, which requires attracting a following among analysts and informed investors. In order to guarantee that a stock develops a following and does not get overlooked, the issuer somehow needs to compensate investors for their time and effort evaluating the new security. Book building can perform this role⁴².

months of aftermarket trading, Global Securities' stock price fell by 56.1% (a 60.5% market-adjusted drop).

⁴¹ One can think of such an investor either as a type of irrational noise trader or as one who rationally chooses not to become 'informed' regarding optimal bidding strategies, given the substantial cost of learning auction theory.

⁴² Underpricing as a way of inducing costly evaluation has been modeled in Sherman (1992), Chemmanur (1993), Sherman (2000), Sherman and Titman (2002) and Busaba and Chang (2003). Yung (2005) models costly evaluation by both investors and the underwriter. Cornelli and Goldreich (2001), Jenkinson and Jones (2004) and Cornelli and Goldreich (2003) offer evidence on whether or not bookbuilding performs this role in practice. Cornelli, Goldreich and Ljungqvist (2005) offer evidence that grey market trading reflects information from retail investors, and that institutional investors respond to this information in a sophisticated way. Aussenegg, Pichler and Stomper (2005) also explore grey market trading for IPOs.

Issuers may also be concerned that there may not be sufficient interest from investors, leading to a failed IPO. Going public is an important and very public step in the life of a company, and the cost of a failed IPO is large. In the words of Martin Manley, Chairman and CEO of Alibris⁴³, "Taking a company public is like getting a heart transplant: you only do it once and you need it to be done very, very well. It is not a decision driven by price." With book building, an underwriter cannot make investors like an offering but can ensure that a sufficient number of investors attend the road show and seriously consider it. With fixed price public offers, the issuer can at least price the offering low enough to make success more likely⁴⁴. Issuers and underwriters have little control in standard sealed bid auction, since they do not choose either the offer price or allocations.

Sherman (2005) shows that book building, by providing a superior trade-off between information production and proceeds maximization, has the potential to dominate both uniform price and discriminatory auctions. When information gathering is costly, Sherman (1992) and Chemmanur and Liu (2003) show that even fixed price public offers allow underwriters to induce more accurate valuations, compared to auctions⁴⁵.

III.D. Summary of Predictions from Auction Theory Models

Table 5 presents the predictions of theory regarding the underpricing and aftermarket performance of standard auctions. The auction method should be relatively successful when information gathering is not an issue, and when auctions for the same type of securities are held at regular intervals so that the pool of participants in the auction is stable⁴⁶. Auctions will be less reliable when a reward for information gathering and price discovery is important, when the number of bidders varies significantly over time in an unpredictable manner, or when a large number of bidders may try to free ride on the information gathering efforts of others.

⁴³ See Mr. Manley's blog, Jam Side Down, at http://www.martinmanley.com/ipo_diaries/. Alibris held an IPO auction through WR Hambrecht in May, 2004, but cancelled it after observing the bids.

⁴⁴ This may explain the high average initial returns for fixed price public offers relative to other methods. See Chowdhry and Sherman (1996a) for a model of underpricing of public offers as insurance against failure.

⁴⁵ Sherman (1992) models only fixed price (best efforts) IPOs, showing that costly evaluation may be induced even in a fixed price public offer. Chemmanur and Liu (2003) compare such an offering to a uniform price auction. Sherman (2005) also shows that, when information acquisition is costly, increasing the number of potential bidders in an auction (beyond the minimum sufficient number) either lowers the mean or increases the variance, or both, in both the number of bidders and the accuracy of the auction price.

⁴⁶ Note that, with a relatively small numbers of potential bidders in a regular series of auctions, collusion is a problem and hence has been the subject of much academic research. For IPOs, however, where millions of shares are being auctioned to millions of potential bidders, collusion is unlikely to be a major concern.

To summarize our conclusions regarding IPO methods: (a) Auctions have a large risk of failure due to uncertainty about the number of bidders and the consequent large winner's curse and free rider problems. Auction participation rates may be unstable unless virtually all potential bidders, including inexperienced uninformed investors, are able to implement complicated optimal entry and bidding strategies. (b) Fixed price public offers may dominate auctions when it comes to maximizing proceeds, inducing information gathering, and the transparency and the ease with which the method can be implemented. (c) When information gathering is relatively more important, book building may be preferred, as it may lead to better price discovery and lower underpricing. However, book building requires a relatively efficient market where underwriters compete with each other and thus is more likely to replace fixed price public offers in more developed economies with well-regulated, transparent markets.

IV. Evidence of Uncertainty in IPO Auctions

As discussed in III.C, auctions may not always lead to stable, robust equilibria, given the uncertainty and the incentives they impose on investors. In this section we show evidence of participation fluctuations (IV.A) and undersubscription (IV.B), both of which might occur periodically even in a stable equilibrium. In IV.C, we show evidence that the winner's curse and free riders, particularly return-chasers, may have led to instability and ultimately to issuers rejecting the auction method.

IV.A. Evidence of Participation Fluctuations

There are many indications of fluctuations in participation levels for IPO auctions. When Japan auctioned off parts of its railway system, the 1993 auction of Japan Railway (JR) East drew 18,670 bidders, while the 1996 auction of JR West drew only 3,395 bidders, a decrease of more than 80%. 335,000 JR West shares (20%) were left unsold. When Argentina auctioned off its first telecommunications company, Telefonica, in December, 1991, it hoped for at least 80,000 bids from local investors but received more than 100,000. When it auctioned off its other telecommunications company, Telecom, just a few months later, the auction drew more than 270,000 applications from local investors.

Amihud, Hauser and Kirsch (2002) found large fluctuations in the number of bidders for IPO auctions in Israel. Similarly, Kandel, Sarig and Wohl (1999) looked at 28 auctions

over 3 years in Israel and found that orders ranged from 1,388 to 13,518⁴⁷. Lin, Lee and Liu (2003) and Hsu and Shiu (2004) report wide fluctuations in bidder numbers for Taiwan's IPO auctions. There is also evidence of variation in the demand for Singapore auctions, as is shown in Table 6. Subscription levels ranged from the Vickers Ballas auction, which was 1,300% oversubscribed (at the minimum bid), to Sunright, which was 82% undersubscribed. The number of bids ranged from 1,128 for Eng Wah to 162,492 for Singapore Telecom⁴⁸.

IV.B. Evidence of Undersubscription

Many IPO auctions have been undersubscribed, when too few bidders chose to enter. IPOs may of course be undersubscribed under any method, because investors scrutinized the offering and did not like it. But auctions (and fixed price public offers) carry an additional risk – that offerings may be undersubscribed simply because too many investors did not happen to consider them. This is not a risk for book building where the underwriter manages the process, making sure that enough investors attend the road show and consider the shares. With fixed price public offers, the shares may at least be substantially underpriced to reduce this risk. Thus auctions carry an additional risk of undersubscription, although suggestive evidence from small samples cannot prove that the increase in risk was significant in practice.

Jenkinson and Mayer (1988) report that 3 out of 6 UK privatization auctions between 1982 and 1987 were undersubscribed, while one was 500% oversubscribed. The undersubscribed offerings included Britoil, which was 73% undersubscribed (i.e. bids were received for only 27% of the shares being offered) and Enterprise Oil, which was 74% undersubscribed. The auction tranche of Sunright, the last IPO auction in Singapore, was 82% undersubscribed, even though the public offer tranche, which was held at the same time as the auction, was oversubscribed.

Two of the most-respected Asian telecoms, Korea Telecom and Singapore Telecom, were auctioned off in October of 1993, at a time when Asian telecom stocks were hot. The Singapore Telecom auction was heavily oversubscribed and priced far above expectations, but the Korea Telecom auction was vastly undersubscribed, receiving bids for only 10% of available shares. Given the strong reputation of Korea Telecom and the popularity of Asian

⁴⁷ Multiple orders were allowed, so the number of orders might overestimate the number of bidders.

⁴⁸ Table 6 also shows substantial variation in demand for fixed price shares in the same offerings, so participation variation is not unique to the auction tranche. However, participation variation does not lead to greater return risk

telecoms at the time, this offering is a reminder that no company is so well established that investor participation in an auction is assured. In August of 2000, the Chunghwa Telecom IPO auction in Taiwan was only 72% subscribed, leaving 80.8 million shares unsold⁴⁹.

Most of these examples – Britoil, Enterprise Oil, Korea Telecom and Chunghwa Telecom – were very large, well known companies. At the other extreme in terms of size were the French IPO auctions on the unregulated over the counter *Marche Libré* or Free Market. All 26 of these French auctions⁵⁰ in 2002-2004 were greatly undersubscribed, with the mean and median subscription rates both below 20% (i.e. more than 80% undersubscribed). While other IPO methods also led to undersubscription during this period, as shown in Table 7, subscription rates were dramatically higher for the other methods. In 2002, the mean subscription rates were 19% for the 14 auctions and 69% for the 8 bookbuilds. In 2003, the mean subscription rates were 19% for the 10 auctions and 143% for the 3 bookbuilds. In 2004, the mean subscription rates were 15% for the 3 auctions, more than 200% for the 3 bookbuilds, and 141% for the 12 fixed price public offers.

An example of the extreme undersubscription of these auctions is Leon Gas, which tried to sell 30,000 shares in its December, 2003 auction but received bids for only 210 shares. Of the more than two dozen auctions in those three years, even the most successful sold fewer than half the shares (41.6%). It is possible that the extreme undersubscription of these French auctions led to the return of fixed price public offers for Free Market IPOs.

As we saw in Table 2.B, the French Free Market auctions were small, with the average auction hoping to raise less than € 1 million⁵¹. Such offerings may seem too small to be of interest, but they add to the overall evidence. IPO auctions have been used for a wide range of issues, from small ones on France's Free Market to large privatization offerings raising \$1 billion or more, such as Singapore Telecom, Argentina Telefonica, JR East or Japan Tobacco. Undersubscription has occurred for both the biggest and the smallest IPO auctions.

Data on the actual number of failed offerings may sometimes be difficult to obtain, for either auctions or fixed price public offers, since underwriters have an incentive to place their

for investors in a fixed price public offer, since it will not affect the price.

⁴⁹ For Chung Hwa Telecom in Taiwan, many argued afterwards that the reservation price had been set too high. This cannot explain Korea Telecom, which is one of the few IPO auctions that did not set a reservation price.

⁵⁰ This excludes a 27th IPO auction, for Parfex, because the details are not available on the Euronext website.

⁵¹ The bookbuilt IPOs during this period were larger but still small by most standards, while the fixed price public offers were even smaller than the auctions (although the amounts actually raised were similar for auctions and fixed price public offers, since the auctions were so heavily undersubscribed).

own orders in an offering that is underwritten. After all, if the underwriter will be forced to buy the shares either way, why not make the offering appear successful? For IPO auctions in Israel, the Securities Authority found that many auctions that had been reported as having been strictly oversubscribed had, in fact, been undersubscribed, after adjusting for bids by the underwriter⁵².

IV.C. Evidence of Instability

Stable auctions may not be achievable when return-chasing free riders are present. Figure 1 suggests that some sort of updating of expectations occurs over time in countries that use IPO auctions. Perhaps initially, investors participate in auctions based on the expectation that free riders will not be an issue. Sooner or later, however, underpricing attracts more and more return-chasers, eventually leading to poor returns for winning bidders. As IPO auctions fail to provide reasonable returns because of high entry and over-bidding, investors update their priors regarding IPO auction risk and expected return, becoming less willing to participate, and so the probability of an undersubscribed auction increases. If issuers persist in using the method, the reduced number of bidders may eventually lead to higher initial returns, restarting the cycle. However, after observing such volatility, issuers may instead turn to a more robust method, even if that method on average leads to greater underpricing.

IV.C.1 Argentina's Experience

Argentina's short experiment with IPO auctions illustrates how the success of one auction may lead to problems with the next. Argentina began a massive privatization program with the auction of shares in Telefonica de Argentina in December, 1991. Institutional demand was lower than expected, since many professional investors thought that the minimum bid price was too high. However, massive interest by retail investors drove the auction clearing price to 45% above the minimum bid. The stock rose another 20% during aftermarket trading, and the auction was described as a "smashing success".

The next privatization, for Argentina Telecom, came less than four months later. Because the Telefonica auction had been such a success, many were eager to cash in on the Telecom auction. In fact, bankers were so eager that they "set up booths in the streets of downtown Buenos Aires offering to lend investors 80 percent of the purchase price of Telecom

⁵² "Issues over subscribed due to underwriters" by Dafna Zucker and Golan Fridenfeld, Israel Business Arena,

shares”.⁵³ Up to one-fourth of the shares purchased in the Telecom IPO were financed through 90 day loans of between 80% and 100% of the purchase price. Bids totaled almost 6 billion pesos, although the government had only hoped to raise 1 billion pesos. The auction price was bid up to almost twice the reservation price, due to the strong demand from local investors. The initial return on Telecom’s IPO (based on the first day’s closing price) was 3.6%, which means that the stock would be considered fairly accurately priced in most academic studies.

But the auction price was unsustainable. By the time the 90 day margin loans were due, the stock price had fallen far enough that many discouraged investors chose not to meet margin calls on their Telecom shares, while others sold other shares to meet their Telecom margin calls. Brokerages had to dump more and more shares onto the market because of missed margin calls, causing a general market crash and the cancellation of up to 20 other planned IPOs in Argentina. Telecom was later described as “viciously overpriced”. The reason for this, according to a banker at Banco de Galicia, was that “Everyone had seen how well Telefonica (the other telephone privatization) had gone, and their total analysis was ‘if Telefonica was a sell-out then Telecom will be too’. What happened was that the Dutch-auction system exacerbated things because people pushed up their price to make sure they would get shares.”⁵⁴

IV.C.2 Singapore’s Experience

IV.C.2.a Evidence of Free Riders

In Singapore, there were several examples of extremely high bids, a strong indication of the presence of free riders (as discussed in III.B):

- Singapore Technologies Industrial Corporation (STIC), May 1993: the reservation price was \$0.85, the clearing price was \$1.20, but bids went up to \$9.80, a 1,053% premium (all premia are relative to the reservation price);
- Hwa Tat Lee (HTL), September 1993: the reservation price was \$0.60, the clearing price was \$1.02, but bids went up to \$10.20, a 1,600% premium;
- Singapore Telecom, October 1993: the reservation price was \$2.00, the market-clearing price was \$3.60 but bids went as high as \$100.00 per share, a 4,900% premium;
- Eng Wah, July 1994: the reservation price was \$0.65, the clearing price was \$0.66, but bids went as high as \$7.80, a 1,100% premium.

Globes (Online), August 11, 2004. A similar practice has been used in Hong Kong, for fixed price public offers.

⁵³ “Argentina’s Stock Regulator Faces Daunting Task”, The New York Times; August 24, 1992, Section D, p. 3.

⁵⁴ “YPF sets equity standards”, by Danielle Robinson, Euromoney; London; Jul 1993, p. 19.

In the case of Singapore Telecom, the reservation price of \$2.00 translated to a prospective price-earnings (PE) multiple of 27 times. Many analysts considered this excessive for a well run but mature company, and thus many banks put caps of \$2.00 or \$3.00 per share on the bids of those who borrowed to pay for their orders. In the end, the highest bid was 50 times the reservation price, implying a prospective PE of 1,350 times – hardly a reasonable valuation estimate for a mature company in an established industry. Even so, the stock price rose another 15% the first day to close at \$4.14, “after which it was downhill all the way”.⁵⁵ Although there was no dramatic crash, the stock price drifted steadily downward for more than a year, while the market as a whole was slightly up during the same period.

In 2001, the outgoing chairman of Singapore Telcom called the auction price “exuberant” and “too expensive”, making it “difficult for the stock to see meaningful movement upwards, despite the company chalking up sterling profit growth which exceeded analysts' expectations every year for the first five to six years after the launch”. At the time that the outgoing chairman made these remarks, the stock price was \$1.90, far below the \$3.60 auction price, even though “in terms of fundamentals, the company has done well”.⁵⁶

IV.C.2.b Initial and One-Month Returns – Low and Declining Over Time

IPO auctions in Singapore offered positive returns on average, at least for investors that flipped (staged) by selling on the first possible day. The mean (median) return was 4.6% (2.8%), or 2.8% (0.6%) on a market-adjusted basis. The standard deviation of returns was 8.7% (9.1%, market-adjusted), and fully half of the auctions led to negative market-adjusted initial returns, so auctions were not without risk even for flippers.

For those that did not sell their shares on the first day possible, returns were lower. More than half of the auctions (13 out of 20) led to negative returns for investors that sold one month after the shares began to trade, using either adjusted or raw returns. The raw (market-adjusted) one month returns had a mean of -0.5% (-3.7%), a median of -2% (-1.7%), and a standard deviation of 12.4% (11.5%).

Moreover, as can be seen in Figure 3.A which shows one month raw auction returns ordered chronologically, returns got worse over time. Investors would have made money on five of the first six uniform price auctions in Singapore, if they had bought at the auction strike

⁵⁵ “Half-million SingTel shares change hands at \$ 3.60”, by Goh Soo May, The Straits Times (Singapore), January 26, 1996, Money Section, pg. 72.

⁵⁶ “SingTel's IPO priced 'too high'”. by Tammy Tan , Straits Times (Singapore), 27 Aug 2001.

price and sold after the shares had traded for one month. The average raw return on the first five offerings was 10.4%, for this holding period. However, the returns were negative for six of the last seven auctions done in Singapore, with an average one-month return of -5.5% for these auctions, which were known as tenders. People noticed the poor performance, complaining that auctioned IPO shares were falling below their auction strike price on the aftermarket and joking that they must be catching a new disease called “tenderitis”⁵⁷.

A similar pattern is shown in Figure 3.B, which gives one month excess returns for Main Board auctions only⁵⁸, relative to the All-Sing Index, a capitalization-weighted index of all stocks listed on the Stock Exchange of Singapore. The results are similar if we calculate the one month returns relative to the Straits Times Index (blue chips) or Sesdaq Index (smaller, younger companies), or if we use two month returns. For investors that were learning and updating their priors over time, auctions were becoming less attractive.

Aftermarket performance among fixed price public offers was similar to that of auctions, if both are measured from the first day of trading. The poor aftermarket performance did not lead to negative returns for investors that participated in fixed price IPOs, however, since initial returns were substantially higher for public offers. Investors that regularly received shares in fixed price public offers and held those shares for at least a month or two did well on average, while investors that regularly received shares in IPO auctions saw declining and eventually negative returns. Thus auctions were a questionable investment, given the risk, even for those that flipped the first day, and they were clearly a poor investment for anyone that planned to hold their shares for a month or more. And in equilibrium, it is not a feasible strategy for everyone to sell (and for no one to buy) on the first day of trading.

The incentive for free riders to enter should have been lower in Singapore's IPO auctions, given their use of simultaneous hybrids with fixed price tranches. Such hybrids are better than pure auctions at reducing the effect of free riders on the pricing process, since they offer uninformed investors a way to participate without distorting the price, just as non-competitive bids in US Treasury auctions allow smaller buyers to participate 'safely'. Buyers in the fixed price tranche never end up paying more, and frequently pay less, on the shares that they are allocated. However, since there is a limit to the size of the fixed price tranche,

⁵⁷ “New strategies needed for future IPOs”, Ven Sreenivasan, Singapore Straits Times, p. 13, February 3, 1995.

⁵⁸ This excludes the two Sesdaq auctions, Aztech and Datapulse, which both occurred in February, 1994. The Aztech and Datapulse auction raw one-month returns can be seen in Figure 3.A, roughly in the middle of the

investors may be allocated very few shares, particularly in hot offerings. Thus, expected rationing of fixed price shares may still lead some free riders to bid in the auction.

IV.C.2.c Lower Participation Rates Over Time, and Undersubscription

In the long run, an offering method that does not provide good returns for investors may not be able to continue to attract them. For Singapore, there is evidence that investors eventually became discouraged with auctions, although they were still relatively interested in public offers. For Liang Huat Aluminum (the 5th-to-last), the auction reservation price was \$0.57. The fixed price tranche, also at \$0.57, was 750% oversubscribed, yet the auction was 38% undersubscribed. For the next three auctions - Eng Wah, Superbowl and Pokka - the number of applicants for fixed price shares was lower than for previous fixed price tranches but still around 29,000. However, the number of bidders for the auction tranche, which had averaged around 49,000 for the first 9 auctions, averaged only 1,300 (a 97% reduction) for these three auctions near the end of the cycle.

Although demand was substantially lower for these later auctions, there was still evidence of extremely high bids, indicating that at least some free riders persisted while other investors were dropping out. In the Liang Huat Aluminum auction which was 38% undersubscribed, bids went as high as \$2.00, a 251% premium over the minimum. In the next auction, for Eng Wah, the reservation price was \$0.65 and the market-clearing price was only one cent higher, but bids went as high as \$7.80, a 1,082% premium over the minimum.

We talked to the management of Sunright, the last company to do an IPO auction in Singapore, about why they chose an auction. They explained that they were offered a choice by their underwriters - they could either do a pure fixed price public offer at \$0.75 per share, or else sell part of the shares through an auction tranche with a reservation price of \$0.75 per share. Since the offering was fully underwritten (meaning that the underwriter would buy any unpurchased shares at \$0.75 per share), and the fees were the same, the reservation price of \$0.75 meant that a hybrid auction could not possibly result in lower proceeds than a pure fixed price public offer. There was “only one way up from the fixed price”⁵⁹.

However, the results of the Sunright auction may have made underwriters hesitant to offer such deals in the future, while the negative publicity surrounding the auction results could

auctions when ordered chronologically.

⁵⁹ E-mail from Kenneth Tan, Director of Sunright Ltd., Dec. 21, 2001.

not have been appreciated by the issuer. Sunright's fixed price tranche of 30 million shares was 22% oversubscribed, but the 20 million share auction tranche was only 18% subscribed (i.e. 82% undersubscribed), leaving the offering 20% undersubscribed overall. More than ten times as many shares were ordered in the fixed price tranche as in the auction, even though investors could have bid for shares in the auction at \$0.75.

Although only two out of twenty uniform price IPO auctions in Singapore were undersubscribed, it must be remembered that the sample size, in this case, was endogenous. Regarding the first of the two undersubscribed auctions, Liang Huat Aluminum, a Straits Times article from June 27, 1994 claimed that the undersubscription of the auction was "an accident waiting to happen" and said that it should be taken not as a thumbs down for the company or its prospects but as a sign that investors were becoming "disenchanted" with the IPO auction (a.k.a. tender) system⁶⁰. The article noted that "Of the seven issues with tender tranches this year, only Aztech is trading above its strike price", and that "With Liang Huat, it seems many investors had become so disillusioned with the IPO system that they did not bother tendering".

The decline in the number of bidders in IPO auctions over time, combined with the declining returns to auction bidders and the fact that the two undersubscribed offerings came near the end of the experiment with auctions, all suggest that it was no coincidence that issuers never chose to do another IPO auction after the Sunright auction was substantially undersubscribed.

To summarize, we have shown evidence of bidders placing unreasonably high bids in IPO auctions (IV.C.2.a); deteriorating and eventually negative returns over time to bidders in Singapore's IPO auctions (IV.C.2.b); and lower average bidder numbers over time, eventually leading to some undersubscribed offerings (IV.C.2.c). The evidence is consistent with return-chasers overbidding and driving out serious investors.

IV.C.3 A Quantitative Analysis of the Singapore Experience

The available data on auctions is sparse and not easily amenable to rigorous quantitative analysis using statistical methods, since most countries that have tried IPO auctions gave up on them after a few years, leading to small samples. For the IPO auctions that have been done, data on participation levels are often unavailable⁶¹. We have data on the full sample of uniform

⁶⁰ "Investors start casting jaundiced eye over IPOs" by Russell Baker, Straits Times, June 27, 1994, p. 38.

⁶¹ In the US for example, even the clearing price in the auction, much less the overall subscription level, is not

price IPO auctions done in Singapore, all 20 of them, and will attempt a quantitative characterization of that data in this section. This is albeit a bit brave, given our sample size.

We argued in Section III.A that a high subscription rate (a large number of bids) in an auction may lead to overpricing of the auction, while a low subscription rate may lead to underpricing, due to the winner's curse. We further argued in III.B and III.C that free riders, including return-chasers, may disrupt the bidding process. We examine the data in three steps to see whether there is support for our conjectures.

First, we look for return chasing behavior to test whether high returns to participating in the preceding auction leads to a higher participation rate, using the following regression

$$S_{Ai} = \alpha_0 + \alpha_1 S_{Fi} + \alpha_2 r_{i,\text{lag}30d} + u_i \quad (1)$$

where

S_{Ai} is the subscription rate in the i^{th} auction;

S_{Fi} is the subscription rate in the fixed price tranche;

$r_{i,\text{lag}30d}$ is the return that would have been obtained by buying in the $(i-2)^{\text{nd}}$ auction and selling one month after trading begins.

For the return from a previous auction, $r_{i,\text{lag}30d}$, we use the return from 2 auctions ago because the one month return on the $(i-1)^{\text{st}}$ auction is in general not available by the time the i^{th} auction is open for bidding⁶². We also considered the following variation of equation (1) above:

$$N_{Ai} = \alpha_0 + \alpha_1 N_{Fi} + \alpha_2 r_{i,\text{lag}30d} + u_i \quad (1')$$

where

N_{Ai} is the number of persons bidding in the i^{th} auction divided by the dollar value of shares offered in the auction tranche, at the reservation price;

N_{Fi} is the number of persons bidding in the i^{th} auction's fixed price tranche divided by the dollar value of shares offered in the fixed price tranche.

Our conjecture is that some investors are return chasers, and that such investors tend to bid too high in auctions. In other words, return chasers are less likely to shave their bids optimally and may even attempt to free ride. However, the number of participants in an issue may also vary due to variation in the underlying demand for the stock, unrelated to the presence

generally available.

⁶² In two cases we had to use the 30 day return on the $(i-3)^{\text{rd}}$ auction since the return on the $(i-2)^{\text{nd}}$ auction was not available when the i^{th} auction opened.

of return-chasing investors. Thus we use S_{Fi} fixed price tranche orders, as a proxy for the underlying demand for the stock, to control for such variation. In Singapore, the auction and fixed price tranches occurred simultaneously, rather than sequentially as in many other countries, making fixed price tranche demand a good proxy of overall demand.

The estimated coefficients (t-values in parentheses) for equation (1) are, respectively: 0.74 (0.85), 0.18 (4.27), and 14.18 (3.50). The adjusted R-Squared is 60%. The corresponding figures for equation (1') are: 0.00 (0.77), 0.03 (3.29), and (0.001) (2.26) with an adjusted R-Squared of 39%. Thus, both higher underlying demand and a higher return to participating in a recent auction led to higher participation in the current auction. In fact, unreported regressions showed that past returns and subscription rates were also significantly positively related for the fixed price tranches of auctions and for pure fixed price public offers.

Second, we examine whether the subscription rate in the auction affects the auction clearing price using the following regression:

$$\left(\frac{P_A - P_F}{P_F} \right)_i = \alpha_0 + \alpha_1 S_{Ai} + \alpha_2 S_{Fi} + u_i \quad (2)$$

where

P_A is the auction clearing price.

P_F is the price for the fixed price tranche (and the reservation price in the auction).

As in the case of equation (1), we also consider the following variation of equation (2)

$$\left(\frac{P_A - P_F}{P_F} \right)_i = \alpha_0 + \alpha_1 N_{Ai} + \alpha_2 N_{Fi} + u_i \quad (2')$$

The assumption is that some of the variation in the subscription rate was due to return-chasing investors who did not adequately adjust their bids for the winner's curse, or perhaps even attempted to free ride, and thus bid too high. As before, we use S_{Fi} as a proxy for the variation in underlying demand for the stock for reasons other than the presence of return-chasing investors. The coefficients (t-values) for equation (2) are: 0.0163 (0.12); 0.0769 (2.88); and 0.0079 (1.08); the adjusted R-Squared is 44%. The corresponding numbers for equation

(2') are: 0.10 (0.74), 313.97 (3.30), and 15.15 (-0.13), with an adjusted R-Squared of 39%. Thus we found that the clearing price in the auction tends to be higher when more bidders enter and order more shares, even after adjusting for underlying demand for the stock itself.

While a higher participation rate in the auction is positively related to a higher auction clearing price, the higher price may be “rational,” reflecting a higher intrinsic value of the issue over and above that reflected in the fixed price (and over and above the higher value reflected in fixed price tranche demand). To rule out this possibility, in the third step, we therefore examine whether a higher auction clearing price is related to a lower return following the auction using the following regression:

$$r_{30d, au, i} = \alpha_0 + \alpha_1 \left(\frac{P_A - P_F}{P_F} \right)_i + u_i \quad (3)$$

where

$r_{30d, au, i}$ denotes the 30 day aftermarket return, starting from the auction clearing price.

The estimated parameters (t-values) are: 0.04 (1.25) and -0.10 (-1.74) with an adjusted R-Squared of 10%. The evidence supports the view that high auction prices in general are associated with lower returns to auction investors, although auction theory would predict that, if investors are bidding optimally and are fully anticipating increased entry, then higher bids would tend to lead to higher expected returns (see Sherman, 2005).

To summarize, these findings are consistent with our story, which is that poorly informed investors (both free riders, and bidders who did not adequately shave their bids) disrupted the bidding process, and that this along with the added risk due to endogenous entry eventually drove investors and issuers away from the auction method. This is another way to summarize the evidence in IV.C.2 that some potential bidders in Singapore did not understand the auction method and were influenced by past returns⁶³. Chiang, Qian and Sherman (2006) examine Taiwan's discriminatory IPO auctions and also find evidence of return-chasing, particularly among retail bidders⁶⁴.

⁶³ The conclusions do not change if we use excess returns over the Singapore stock market index instead of raw returns in the regressions.

⁶⁴ The Taiwan dataset is important because it is a relatively large sample of discriminatory auctions, and because data is available on all bids, as opposed to only summary statistics. With discriminatory auctions, returns vary even among winning bidders in the same auction, since some investors pay more than others. Nevertheless for some countries, such as Japan, data is available only on weighted average bidder returns rather than on all bidder

V. Conclusion

In this paper, we first established a surprising empirical regularity – that IPO auctions have been tried in more than 20 countries, and have been rejected in favor of other methods for bringing new equity issues to the market. IPO auctions have been used for issues of all sizes, from very small to very large. The auction methods used have varied, yet the outcomes have been surprisingly consistent: When issuers have been given a choice, they have generally chosen not to use auctions once they became familiar with the method.

We did not find support for the common explanations offered for the unpopularity of IPO auctions in the US – that issuers were reluctant to use a new, experimental method, or that underwriters pressured issuers to use methods for which they charged higher fees or were able to allocate underpriced shares. We also did not find that issuers consistently preferred the offering method that led to the lowest initial returns. There is little, if any, support for the popular view that auctions lead to highly accurate pricing and hence to a very low mean and variance of initial returns.

In Singapore and in other countries, we found evidence suggesting the presence of return chasing free riders who placed unrealistically high bids, apparently relying on other bidders to perform due diligence and engage in price discovery. Eventually, investors began to lose money on IPO auctions in Singapore, leading to lower participation levels and undersubscribed offerings. The number of orders was still relatively high for public offer tranches but was substantially lower for auctions of the same shares. Finally, issuers and underwriters gave up on the auction method and returned to fixed price public offers, a method that had traditionally been more stable, although also more costly in terms of underpricing.

We have shown that auctions have led to undersubscription and to extreme mispricing in practice, but it must be noted that other IPO methods have also led to withdrawn offerings and to mispricing. Thus the evidence of problems with standard auctions may, on its own, be insufficient to establish which IPO method is superior. At the very least, however, the data tell us something about which auction models best fit the existing evidence. The observed track record of IPO auctions appear consistent with costly evaluation/endogenous entry models but not with endowed information/full entry models, as shown in Table 5. Given that people have

initial returns. Liu, Wei and Liaw (2001) were the first to examine data on all bids for Taiwan's IPO auctions.

used the latter models to argue the superiority of the auction method, it is important to note that they do not fit the data. Moreover, the very non-existence of large, stable samples of IPO auctions, despite the fact that more than 20 countries have experimented with standard sealed bid IPO auctions, is consistent with models that predict that IPO auctions may be problematic.

We found that participation variations have been a major source of problems for IPO auctions. There is a trade-off with auctions in terms of the optimal participation level. Drawing too much attention may mean insufficient adjustment for the winner's curse or the entrance of too many free riders, while too little attention makes it more likely that the offering might fail. Even at the optimal number of entrants, there may be too many free riders and not enough serious investors in the mix, since the issuer/underwriter cannot control who enters.

With book building, the underwriter can act as a gatekeeper, coordinating the number and type of entrants. With an auction, on the other hand, someone who invests time and money evaluating an offering can easily be squeezed out by a thousand free riders. Although the relationships between investment banks and investors can lead to abuse under book building, a key problem with auctions is that they cannot guarantee serious consideration, particularly for smaller, less important offerings. Without some way to screen out free riders and ensure the participation of serious investors, IPO auctions are highly risky for both issuers and investors.

Our findings are consistent with our expectations: that fixed price public offers should replace auctions in most or all economies, because fixed price public offers can control risk and limit some of the problems with auctions that we have discussed; and book building should replace fixed price public offers in more developed markets that have good institutions and an activity level sufficient to sustain a competitive investment banking industry.

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Appendices

Appendix A. More information on the types of auctions used for IPOs.

Several types of IPO auctions have been used. Brazil, Japan, Malaysia, the Philippines, Singapore, Taiwan and the UK have used discriminatory auctions, while Argentina, Australia, Brazil, Finland, France, Israel, Malaysia, the Netherlands, New Zealand, Norway, Peru, Portugal, Singapore, Turkey, the UK and the US have used uniform price auctions. Dirty (priced below market clearing) auctions have been used in Australia, Belgium, Finland, France, Hungary, Malaysia, New Zealand, Turkey, the UK and the US.

Not long after WR Hambrecht's introduction of online IPO auctions to the US, Ord Minnett's eCapital⁶⁵ distributed shares in two Australian online IPO auctions. Both underwriters used uniform price, sealed bid, dirty auctions⁶⁶, although eCapital called its process a "book build". For the eCapital auctions, the updated weighted average bid price was posted online twice a day during the auction period and bidders were allowed to change their bids, thus making them somewhat similar to the type of open auctions advocated by Ausubel (2002). In South Korea, several Direct Public Offerings have used Internet auctions, although this method cannot legally be used if the company wants to list on the KSE or KOSDAQ.

Appendix B. Do auctions price shares accurately?

There is a popular misconception, perpetuated in part by journalists, that auctions in theory lead to highly accurate prices. The general idea is that an auction reveals the true demand curve, since each person bids what he or she is willing to pay. In Subsection III.D and Table 5, we showed that this is not true in theory, except under some extremely unrealistic assumptions. In practice, there are many examples of highly inaccurate IPO auction prices (assuming that the first day's closing price is a good estimate of the 'true' value).

Of course, book built and fixed price public offer IPOs have also frequently led to offer prices that were far from the first day's aftermarket price. Table 4 showed that, at least for our

⁶⁵ The two auctions, for Health Communications Network (HCN) and ChaosMusic, occurred in 1999. Since then, Ord Minnett merged with Chase and J.P. Morgan, and eCapital appears to be closed, reportedly because both auctions led to overpricing, thanks to free riders.

⁶⁶ Hambrecht allows dirty auctions, at the discretion of the issuer. There has also been one hybrid book building/auction in the US, for Instinet, priced on May 23, 2001. The price was set and most of the shares were allocated through book building, but bidders in the auction portion, managed by WR Hambrecht, each received about 13.4% of their bid, provided that their bid was at or above the issue price of \$14.50.

Singapore sample, auctions seemed to price IPO shares more accurately than fixed price public offers. Nevertheless, Table 4 also showed that the variance in auction initial returns was far from zero. We will now give examples to demonstrate that IPO auctions, in practice, have sometimes led to very large positive or negative initial returns. Some examples of large positive initial returns from IPO auctions include:

- Tenaga Nasional, Malaysia, May 1992, 34%: Malaysia's first auction was a hybrid discriminatory auction/public offer. Initial returns for winning bids ranged from 23% to 34%, even though the market-clearing price in the auction was almost 46% above the 4.50 ringgit reservation price. The initial return for the public offer was 94%.
- DDI (an affiliate of Kyocera), Japan, September 1993, 49%: Bids went as high as ¥6.02 million/share. The offer price was set at ¥3.7 million, because most successful bids were concentrated at that price. The first day's close was at ¥5.5 million.
- East Japan Railway, Japan, October 1993, 58%: JR East soared 70% above the market-clearing price the first day, only to drop back down to around the ¥370,000/share offer price within two days. Winning bids ranged from ¥352,000 to ¥623,000, so the highest bidders were still out of the money when the stock closed at ¥600,000 the first day.
- Petron, the Philippines, Sept. 1994, 63%: Hybrid discriminatory auction/public offer. The first day's closing price was 63% above the lowest winning bid, 23% above even the highest bid, 39% above the highest foreign bid and 136% above the reservation price. The fixed price tranche drew 459,133 subscribers.
- Andover.net, US, December, 1999, 252.1%: The offering was priced at \$18 even though the clearing price was \$24, reportedly to avoid any delay. The first day's closing price was 164% above even the auction clearing price.
- Peet's Coffee and Tea, US, January, 2001, 63.3%: Since this was a US auction, we know little about the bids that were placed. It is possible that the clearing price was above the \$8.00 offer price.
- El Al, Israel, June 2003, 40%: Demand was low in the auction – they sold fewer shares than expected, all priced at the minimum bid. The shares began trading on the Tel Aviv Stock Exchange just two days later, closing up 40% the first day and up a total of 112% by the end of the second trading day.

Some examples of negative initial returns from IPO auctions are:

- Japan Telecom, September 1994, down 14.5% from the weighted average bid price of ¥5.44 million/share on the first day, and down another 10% by the end of the week: The lowest successful bid was ¥5.22 million, but the public offer price (set after the auction) was ¥4.7 million, showing that the auction bids were considered unrealistic. The weighted average bid price gave the company a P/E of 219 times prospective earnings, in a mature telecom market. Bids went as high as ¥6.0 million. The stock closed its first day down 22.5% from the highest winning bid price.

- Japan Tobacco, October 1994, down 23.5% the first day, and it kept falling from there: The auction had been unusually enthusiastic, with a weighted average winning bid of ¥1.438 million/share for shares that institutional investors valued at no more than ¥800,000. Successful bids ranged from ¥1.362 million to ¥2.11 million. It closed the first day at ¥1.10 million, and the second day at ¥1.06 million (down more than 26% from weighted average bid price). The highest bidders lost almost 48% the first day. 41% of the shares were never sold. After 2 weeks of trading, it was at ¥956,000, down 33.5% from the weighted average winning bid.
- Global Securities (Global Menkul Degerler A.S.), Turkey, May 1995, down 11% the first hour: The minimum or reservation price was set at TL6,000 per share, but bids went as high as TL100,000. The auction price was set at TL9,750, a 62.5% premium. The price fell by 56.1% (giving a market-adjusted return of -60.5%) over the first three months of trading.

Thus, there are many examples of extreme initial returns resulting from IPO auctions. These clearly do not prove that auctions are inferior to other issue methods, but they show that the pricing accuracy of the sealed bid IPO auction method should not be taken for granted.

Appendix C. Do auctions lead to less underpricing, relative to book building?

The overall evidence on this question is surprisingly weak, since virtually the only relevant samples are from France and Japan, plus perhaps Germany and Australia (which did only two auctions each) or eventually Israel (where legislation to allow bookbuilding is pending, after ten years of mandated auctions).

- France: A unique, theoretically sound version of auctions co-existed with a restricted, sub-optimal form of book building and with fixed price public offers, for several years; once the restrictions on book building were lifted, auctions dried up; during the overlap period, initial returns were lower for auctions than for sequential hybrid book building.
- Japan: Auctions and book building did not overlap in Japan, but they were used in close succession. Kutsuna and Smith (2004) found a small but statistically significant increase in initial returns under book building, and also found that a wider range of companies, including younger start-ups, were able to go public under book building.

The evidence hints that auctions may lead to less underpricing, but it is inconclusive.

Appendix D. More country-specific detail on which IPO methods are allowed and used

This appendix is posted separately on the Social Science Research Network at the address: <http://ssrn.com/abstract=892026>. The appendix is also available directly from either author.

Table 1. Summary of IPO Methods Used in Various Countries. A blank in any column means that, to the best of our knowledge, the method was not used. The “first introduced” years are the earliest years that we were able to find but may be later than the actual year of first use. On whether the book building method is now dominant or gaining in popularity, the answer is in the judgment of the main source listed in the last column, or our best estimate if no other source was available. News article sources for any country are available upon request.

Traditional method(s)		Auctions		Book Building		Main Sources	
		First introduced	Apparently abandoned	First Introduced	Now dominant or gaining?		Hybrid with Fixed Price
Europe							
Austria	Fixed price			1992	yes	yes	Letter - Wiener Borse (Vienna Stock Exchange), 14 June 1996
Belgium	Fixed price	1980s	1991	1993	yes		News articles; Ljungqvist, Jenkinson and Wilhelm (2003)
Czech Rep.	Fixed price			1992	yes	yes	E-mail, the Czech Securities Commission, 10/26/99
Denmark	Fixed price			1993	yes	yes	News articles
Finland	Fixed price			1993	yes	yes	E-mail, Financial Supervision Authority of Finland, 11/29/99; ^Letter - Mandatum & Co., 30 May 1996; www.rata.bof.fi
France	Auctions, fixed price	1960s	1999?	1993	yes	yes	E-mail - Listing Division, Paris Bourse SBF SA, 7/28/2000, ^Derrien and Womack (1999)
Germany	Fixed price	only 2		1995	yes	yes	E-mail-BAWe(Bundesaufsichtsamt für den Wertpapierhandel) 2/2/2000, www.bawe.de; ^E-mail - DGBank, 11/18/99
Greece	Fixed price			1994	yes	yes	News articles.
Hungary	Fixed price			1995	yes	yes	E-mail-Hungary Banking & Capital Mkt Supervision 11/30/99
Ireland	Fixed price			1992	yes	yes	E-mail, Irish Stock Exchange, 9/15/ 99
Italy	Fixed price	1980s	1986	1992	yes	yes	E-mail, Borsa Italiana S.p.A. 11/24/99; ^Italian Stock Exchange Commission (CONSOB) web page, www.consob.it
Luxembourg	Fixed price			1996	yes	yes	Ljungqvist, Jenkinson and Wilhelm (2003)
Netherlands	Fixed price	1980s	1989	1994	yes	yes	E-mail, Stichting Toezicht Effectenverkeer (Securities Board Of The Netherlands), Oct. 1999
Norway	Fixed price			1995	yes	yes	E-mail - Banking, Insurance and Securities Commission of Norway, Sep. 99; ^Letter - Oslo Bors, 14 June 1996
Poland	Fixed price	1993?		1995	yes	yes	News articles.
Portugal	Fixed price	1987	1992	1995	yes	yes	E-mail, Comissão do Mercado de Valores Mobiliários (www.cmvm.pt), 11/11/99.
Spain	Fixed price	Only 2	1998	1993	yes	yes	E-mails, Bolsa de Bilbao 11/16/99; *Comisiã Nacional Del Mercado De Valores 9/23/99, 10/18/99.
Sweden	Fixed price	1980s	1980s	1993	yes	yes	Letter Finansinspektionen (Financial Supervisory Authority), 12/18/1996; E-mail OM Stockholm Exchange 7/25/2000.
Switzerland	Fixed price	1980s	1980s	1995	yes	yes	E-mail - Switzerland Stock Exchange, 11/24/99; ^Letter - Zurcher Borse (Zurich Stock Exchange), 4 June 1996
U. K.	Fixed price	1960s	1987	1992	yes	yes	General sources; Brennan and Franks (1997); Levis (1990)

PANEL B

	Traditional method(s)	Auctions		Book Building		Main Sources	
		First introduced	Apparently abandoned	First Introduced	Now dominant or gaining?		Hybrid with Fixed Price
North & South America							
Argentina	Fixed price	1991	1992	1993	yes	yes	E-mail - Comisi�n Nacional De Valores 1/29/99
Barbados	Fixed price						Letter - Securities Exchange of Barbados, 8/28/97
Brazil	Fixed price	yes			yes	yes	E-mail, Comiss�o de Valores Mobili�rios 9/20/99;
Canada	Bookbuild				yes	yes	^www.bndes.gov.br.; *Letter - Bolsa Do Rio, 26 Aug. 1996
Chile	Fixed price				yes	yes	E-mail Com. des Valeurs Mobili�res du Qu�bec, 10/29/99
Mexico	Fixed price						E-mail Sup. de Valores y Seguros 10/99; Santiago SE 11/99
Paraguay	Fixed price	yes		1996	yes	yes	E-mail, Bolsa Mexicana de Valores Sept. & Nov. 1999
Peru	Fixed price	1999	--		yes	yes	E-mail - Comision Nacional de Valores, Oct 99
U. S.	Bookbuild				yes	yes	E-mail - Lima Stock Exchange, 10/20/99
Asia/Pacific							
Australia	Fixed price	1999	1999	1992	yes	yes	Letter - Australian Stock Exchange, 23 April 1996
Bangladesh	Fixed price				yes	yes	News articles.
China	Fixed price			1993	yes	yes	News articles.
Hong Kong	Fixed price				yes	yes	News articles, general sources.
India	Fixed price			1993	yes	yes	SEBI web page, Dec. 99; *Bombay Stock Exchange, 4/13/96;
Indonesia	Fixed price				yes	yes	^Assoc. of Merchant Bankers of India, 5/27/96.
Japan	Fixed price	1989	1997	1997	yes	yes	Indo. Cap Mkt Supervisory Agency(BAPEPAM) 9/24/99
Korea	Fixed price	1993?			yes	yes	Pettway (1999); News articles.
Malaysia	Fixed price	1992	1994	1995	yes	yes	E-mail, Korea Securities Research Institute 10/26/99; ^Korea
New Zealand	Fixed price				yes	yes	Stock Exchange fax, International Relations, April 13, 1996
Philippines	Fixed price	1994	1994		yes	yes	E-mail, Kuala Lumpur Stock Exchange, 1996; web page.
Singapore	Fixed price	1991	1994		yes	yes	E-mail 10/15/99 Sec. & Exchange Commission of New
Sri Lanka	Fixed price						Zealand; ^Fax - Cavill White Securities Ltd., 21 May 1996
Taiwan	Fixed price	1995	?		yes	yes	News articles.
Thailand	Fixed price				yes	yes	E-mail - Stock Exchange of Singapore, 10/11/99; web page.
Africa/MidEast							
Kenya	Fixed price						Letter - Colombo Stock Exchange, 26 May, 1997
Israel	Auctions,	< 1993	?				E-mail Chinese Securities Association, 11/2/99
Jordan	fixed price			1995	no	yes	Letter - Securities and Exchange Commission, 14 May 1996;
Pakistan	Fixed price						Fax, Capital Markets Authority, 4/3/00
South Africa	Fixed price	1993	1997		yes	yes	e-mails - Tel Aviv Stock Exchange, Feb., Sept. and Oct. 1999
Turkey	Fixed price				yes	yes	E-mail, Amman Stock Exchange, 24 June, 1997, web page.
							E-mail, SEC of Pakistan, 12/01/99; ^web page - Karachi SE
							Web page, e-mail - Johannesburg Stock Exchange, 10/99.
							Istanbul Stock Exchange: Email, 3/99; Fax, 17 June 1996

Table 2. Comparison of offering sizes for auctions and other IPOs**2.A Offering sizes for IPOs in Singapore (in millions of Singapore Dollars), 1993-1994.**

The Singapore Telecom IPO was more than 12 times as large as the next-largest Singapore auction and was perhaps the largest IPO auction ever (raising more in total proceeds than, for example, the US IPO of the popular search engine company Google, which occurred more than a decade later). Since this was clearly an outlier in terms of offering size, we also report the proceeds for Main Board auctions excluding SingTel.

	Mean	Median	Standard Deviation	Maximum	Minimum
Main Board Auctions	337.6	48.4	1,002	4,332	16
Main Board Auctions, Excluding Singapore Telecom	102.7	44.8	99	338	16
Main Board Fixed Price	56.5	37.7	54	200	17
Sesdaq Auctions	67.2	67.2	33	90	44
Sesdaq Fixed Price	11.6	9.3	7	30	4

2.B Offering sizes for French Free Market IPOs (in thousands of Euros), 2002-2004.

	Mean	Median	Standard Deviation	Maximum	Minimum
Fixed Price	517.1	35	685	1,875	7.9
Auctions	739.5	600	554	2,291	150.0
Bookbuilding	1,493.6	1,050	954	4,200	818.9

2.C Offering sizes for IPOs in Turkey (in billions of Turkish Lira), 1994-1995. "Sale on the ISE" is a method in which shares begin trading directly on the Istanbul Stock Exchange.

	Mean	Median	Standard Deviation	Maximum	Minimum
Fixed Price	387.8	240.0	455	1950	50.0
Auctions	378.7	304.8	288	1121	11.3
Sale on ISE	96.5	108.7	40	143	10.6

Table 3. Industry comparison, auctions and other IPOs, based on ICB classifications**3.A Singapore IPOs by Industry, 1993-1994.**

	Fixed price	Auctions	% Auctions	Total IPOs in Industry
Basic Materials	2	2	50%	4
Industrials	15	5	25%	20
Consumer Goods	3	3	50%	6
Consumer Services	4	1	20%	5
Telecommunications		1	100%	1
Financials		4	100%	4
Technology	7	4	36%	11
Total:	31	20	39%	51

3.B France Free Market IPOs by Industry, 2002-2004.

	Fixed Price	Auctions	Bookbuilding	% Auctions	Total IPOs in Industry
Basic Materials		1		100%	1
Industrials	3	7	4	50%	14
Consumer Goods	3	3	2	38%	8
Health Care	1	2	1	50%	4
Consumer Services	1	3	4	38%	8
Telecommunications	1	1	1	33%	3
Utilities	1	1	1	33%	3
Financials		2	2	50%	4
Technology	3	7		70%	10
Total:	13	27	15	49%	55

3.C Turkey IPOs by Industry, 1994-1995.

	Fixed Price	Auctions	Sale on ISE	% Auctions	Total IPOs in Industry
Basic Materials	3	5	3	45%	11
Industrials	3	4	1	50%	8
Consumer Goods	6	10	1	59%	17
Consumer Services	1			0%	1
Financials	8	6	3	35%	17
Total:	21	25	8	46%	54

Table 4. Initial returns for Singapore IPOs, 1993-1994 The average initial return for an auction is the weighted average of the initial return on the auction tranche and the initial return on the public offer tranche. The T-stats are for the difference between the means of pure fixed price public offers and one or both tranches of the auctions, in a one-tailed test.

4.A. Initial returns for all IPOs. There were 51 IPOs in 1993-1994 in Singapore, including 31 pure fixed price public offers and 20 hybrid auctions.

	Mean	Median	Standard deviation	Maximum	Minimum	T-stat
Auction tranche	4.6%	2.8%	8.7%	22.5%	-6.0%	3.90
Fixed price tranche, auctions	51.3%	33.2%	49.1%	188.9%	2.0%	-1.06
Pure fixed price	36.9%	18.2%	44.9%	131.1%	-11.0%	-
Average for hybrid auctions	16.1%	11.7%	13.9%	47.9%	0.4%	2.41

4.B. Initial returns for only Main Board IPOs, 1993-1994. There were 29 Mainboard IPOs in 1993-1994 in Singapore, including 11 pure fixed price public offers and 18 hybrid auctions.

	Mean	Median	Standard deviation	Maximum	Minimum	T-stat
Auction tranche	3.3%	2.4%	8.2%	22.5%	-6.0%	1.74
Fixed price tranche, auctions	49.0%	28.0%	51.3%	188.9%	2.0%	-0.94
Pure fixed price	30.5%	2.2%	51.6%	131.1%	-11.0%	-
Average for hybrid auctions	14.4%	9.9%	13.5%	47.9%	0.4%	1.02

Table 5. Predictions of various models for the results of a sealed bid uniform price auction open to a large number of potential investors (high N)

Models	Average initial return	Variance in initial returns	Aftermarket price accurate?	Varying participation levels?	Free rider problem?
Independent private values	Zero	Low or zero	Yes	No	No
Endowed signals; full entry	Zero	Low or zero	Yes	No	No
Endowed signals; endogenous entry	Positive (if entry costs)	Positive, possibly high	Yes	Yes	No
Costly evaluation; endogenous entry	Positive (evaluation & entry costs)	Positive, possibly high	Not necessarily	Yes	Yes

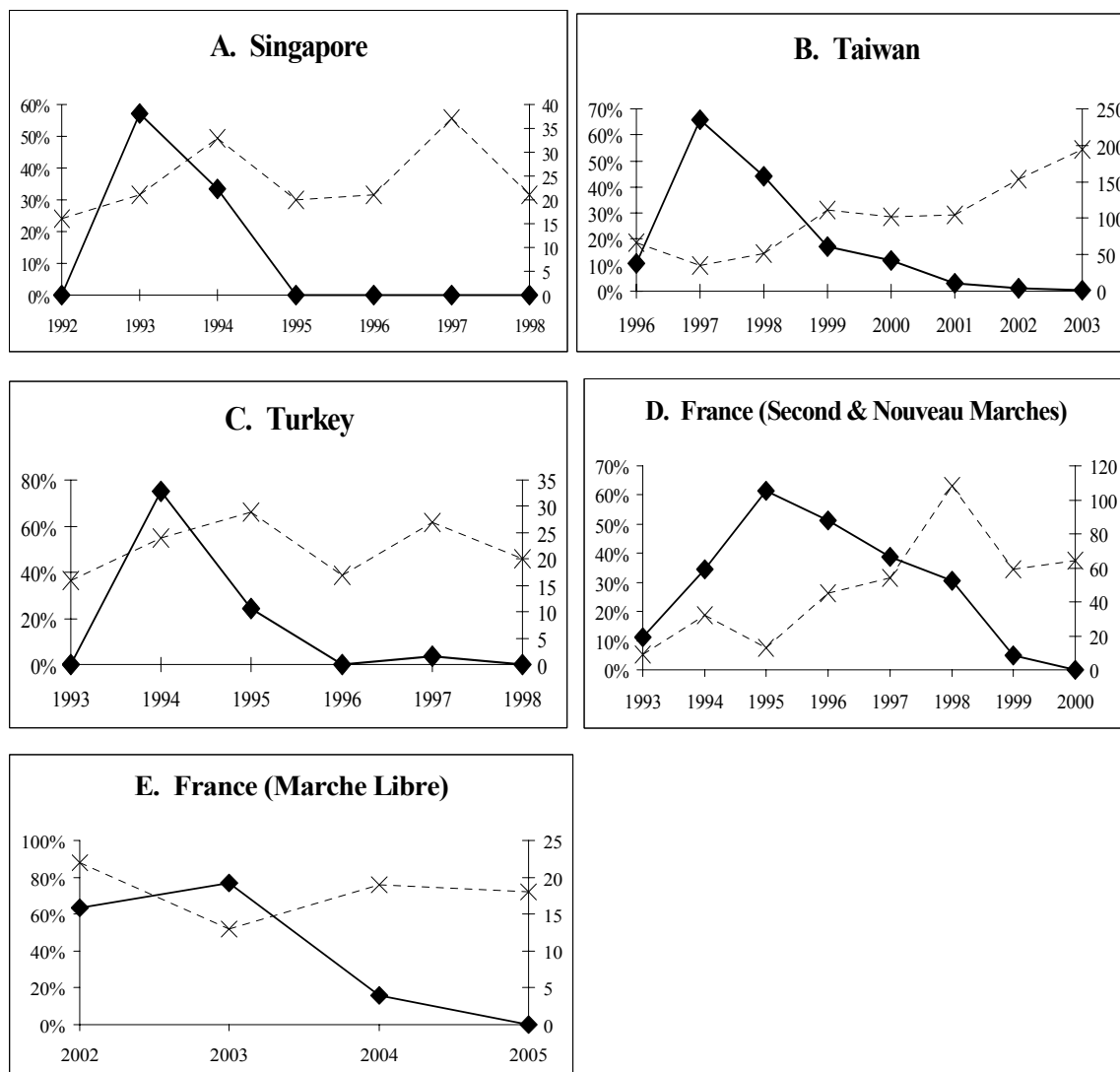
Table 6. Participation variations for Singapore IPO auctions, 1993-1994. Data include all 20 auctions except for the number of applications, which is based on only 19 of the 20 IPO auctions in Singapore during this time period. The missing application numbers are for Sunright, the last auction, which was heavily undersubscribed and chose not to release the number of bidders. The subscription rate is the ratio of shares applied for to shares available, so a subscription rate below one means that the offering was undersubscribed, while a subscription rate of 11 means that the offering was 1,000% (ten times) oversubscribed. Shares applied for and available are in 1,000s.

	Mean	Median	Standard deviation	Maximum	Minimum
Subscription rate, fixed price	15.63	12.40	12.39	41.00	1.22
Subscription rate, auction	3.99	2.63	3.44	14.00	0.18
# Applications, fixed price	176,446	159,848	167,386	795,272	28,036
# Applications, auction	25,046	7,765	39,513	162,492	1,128
Shares applied for, fixed price	426,161	322,034	384,333	1,672,000	32,042
Shares applied for, auction	325,950	113,577	626,730	2,800,000	3,600
Shares available, fixed price	52,409	24,700	117,908	550,000	9,737
Shares available, auction	71,071	29,400	119,625	550,000	12,000

Table 7. French Marche Libre IPOs, 2002-2004. Subscription rates for 49 of 54 IPOs during 2002, 2003 and 2004. We are missing the data on one auction (Parfex) in 2003 and four fixed price public offers in 2004. A subscription rate below 100% means that the offering was undersubscribed, while a subscription rate of 120% means that the offering was 1.2 times subscribed, or 20% oversubscribed. Source: the Euronext website.

	Mean	Median	Standard Deviation	Maximum	Minimum	% of IPOs Undersubscribed
Auctions	18%	20%	12%	42%	0.7%	100%
Bookbuilding	120%	88%	86%	348%	1.2%	60%
Fixed Price	141%	85%	212%	658%	2.2%	75%

Figure 1. How auction use evolved over time in four countries. In each graph, the X's (right axis; connected by dashed lines) give the number of total IPOs per year in that country, while the diamonds (left axis; connected by solid lines) are the percentages of IPO auctions out of all IPOs.



Sources for Figure 2: A. Singapore – E-mail from the Stock Exchange of Singapore, October, 1999. B. Taiwan – The data was given to us by K.C. John Wei. See Liu, Wei and Liaw (2001) and, for 2002-2003 data, Hsu and Hung (2005). C. Turkey – E-mail from the Istanbul Stock Exchange, March, 1999. D. France Second and Nouveau Marches – From Derrien and Womack (2003) and Chahine (2001). E. France Marche Libre – Euronext website (www.Euronext.com, in IPO Archives).

Figure 2. Distribution of simulated bids for various entry levels. Bids were generated from a normal distribution with a mean of \$20 and standard deviation of \$6. There are 100 shares being sold, so the clearing price is the price of the 101st-highest bid, shown by the dark line.

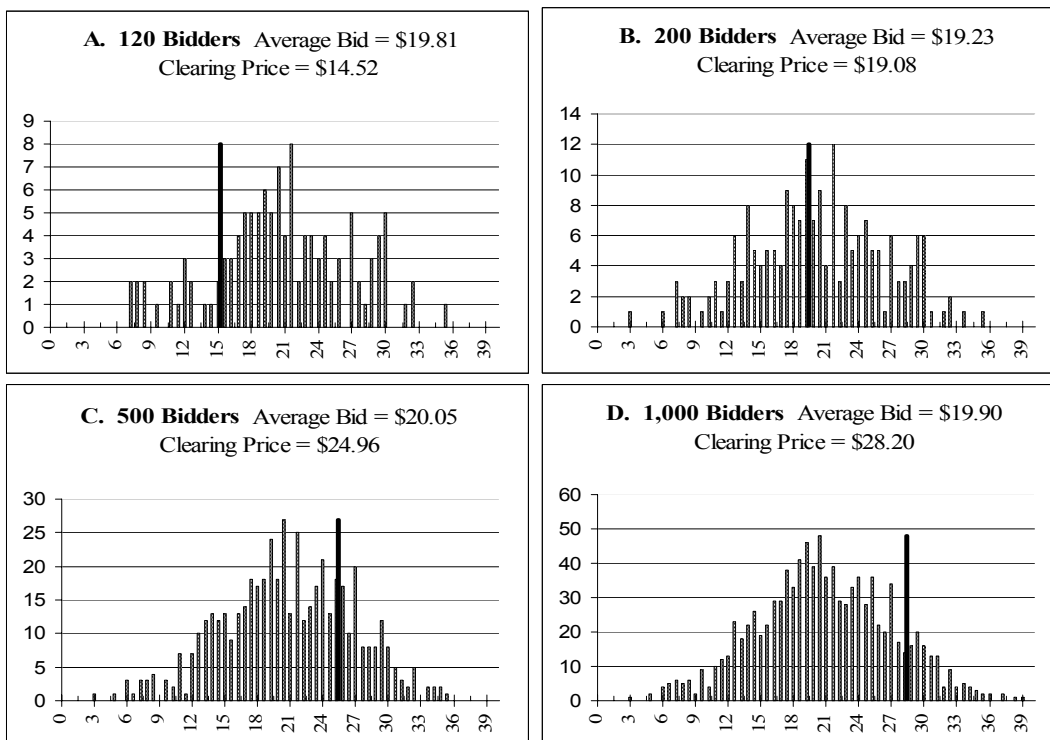


Figure 3. One month buy-and-hold returns for Singapore auctions, ordered chronologically. Singapore's auctions are ordered by date to show how the returns to bidding evolved over time. 3.A. gives raw one month returns for all 20 auctions. 3.B. shows only the 18 Main Board auctions (excluding Datapulse and Aztech on Sesdaq in February, 1994), giving one month returns relative to the All-Sing Index, a capitalization-weighted index of all listed stocks. The 4-offering moving average is the average return on the last 4 offerings (or all previous, if fewer than 4).

