NBER WORKING PAPER SERIES

WHY DO IPO AUCTIONS FAIL?

Ravi Jagannathan Ann E. Sherman

Working Paper 12151 http://www.nber.org/papers/w12151

NATIONAL BUREAU OF ECONOMIC RESEARCH 1050 Massachusetts Avenue Cambridge, MA 02138 March 2006

We would like to thank Reena Aggarwal, Robert Battalio, Shane Corwin, Alexander Ljungqvist, Jay Ritter, Paul Schultz, Michael Sher, Sheridan Titman, and S. Viswanathan for useful comments; Gjergji Cici, Huijing Fu, Andrei Jirnyi, Jintana Kumeranakerd, Tim Lavelle, , David Paredes, Mariya Todarova, and Andrew Y. C. Wong for research assistance; and M.J. van den Assem, Marc Goergen, Geeta Hemrajani, Richard Pettway, Jhinyoung Shin, John Wei and the many officials at various stock exchanges, regulatory agencies and research institutes for help in gathering the information used in this study. Most of the sources of information used in this study are listed in Appendix D (available on request) along with country-specific information. Some of the material in Appendix D circulated in an earlier working paper titled "Global Trends in IPO Methods: Book Building vs. Auctions". Any inaccuracies or errors are, of course, entirely our own. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

©2006 by Ravi Jagannathan and Ann E. Sherman. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Why Do IPO Auctions Fail? Ravi Jagannathan and Ann E. Sherman NBER Working Paper No. 12151 March 2006 JEL No. G24, G28, G32

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 U.S., 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. That may explain the inaccurate pricing and poor aftermarket performance of IPOs using auctions.

Ravi Jagannathan J.L. Kellogg Graduate School of Management 2001 Sheridan Road Leverone/Anderson Complex Evanston, IL 60208-2001 and NBER rjaganna@kellogg.northwestern.edu

Ann E. Sherman University of Notre Dame Department of Finance P.O. Box 399 Notre Dame, IN 46556-0399 <u>asherman@nd.edu</u>

"*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 new equity issues are brought to the market in the U.S. A number of papers have appeared in the academic literature¹ showing that, under certain circumstances, the greater control and flexibility of the book building method provides substantial benefits to issuers, while standard auctions may not work well for initial public offerings (IPOs). The commonly held view in the popular press, however, appears to be that standard auctions would lead to better outcomes and that, but for the investment banks' market power, the book building method would not have survived². Some have even argued that U.S. issuers should be forced to use auctions³. If the academic view is wrong, then whenever standard auctions are allowed to compete against the book building method, auctions should drive out book building.

In this paper we provide evidence that the opposite has happened. When standard auctions have had to compete with another method - either with fixed price public offerings 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 fixed price offerings have competed with auctions, the former method prevailed and auctions lost out⁴. And when fixed price public offers later were faced with competition from book building, the public offer method has generally lost out, although not as completely as the auction method.

 ¹ See Ritter and Welch (2002), Ljungqvist (2004) and Wilhelm (2005) for reviews of the academic IPO literature.
² Examples include "IPO Market Comes Back to Life", by Rachel Emma Silverman. Wall Street Journal, New

York, N.Y.:Nov 11, 2003. pg. D.1. "Dutch auction IPO scheme grabs insider interest", The Red Herring (www.redherring.com), October 30, 2003. "BofI Holding Has Textbook Auction IPO", 15 March 2005, Dow Jones News Service.

³ See, for example, "The Value of Trust". Economist Staff, The Economist, June 07, 2002. The U.S. Securities and Exchange Commission even asked for public comments on whether issuers should be forced to use auctions, because few have so far been willing to use them voluntarily.

⁴ Out of more than 20 countries that have used auctions, the only exception to this that we have found is France, where auctions were able to compete successfully with fixed price public offers and did not vanish until unrestricted book building was allowed. France used a somewhat unique auction method that discouraged free riders.

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 academic view is right. We therefore examine the reasons why auctions have failed and verify, to the extent possible, that they are consistent with what we expect to find based on our reading of the literature.

The auction method is old and well established, and has been particularly successful for the largest security issue markets – those for government debt, particularly U.S. Treasury securities. 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 precise. In contrast, IPOs occur less frequently, at sporadic intervals, and their value is difficult to determine. Each issue is different and may attract a different set of participants. Therefore, theory predicts that IPO auctions may face wide variations in the number of participants, which will contribute to their failure. 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 will be bidding in the auction. If bidders do not know how many others will enter, there may be unpleasant surprises. Some issues will be grossly oversubscribed and perhaps overpriced, while others will be grossly undersubscribed and perhaps underpriced. 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 standard 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, and contribute to the failure of the market for the issue. We examine this possibility in our empirical study.

The magnitude of underpricing is often mentioned as a disadvantage of the book building method. However, underpricing in fixed price offerings tends to be larger than underpricing under either auctions or book building. In spite of that, we find that the fixed price offering 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 issue. We find that discriminatory auctions have many of the same shortcomings as standard uniform price auctions. Both discriminatory and uniform price auctions suffer from a lack of coordination 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"⁵ type that attempt to approximate the book building approach.

With the book building method, the offering price is set below the expected aftermarket value of the issue. Those investors who regularly contribute to the price discovery process are rewarded through larger allocations. This procedure necessarily gives the underwriter discretion over allocation. The main complaint about book building appears to come from the fact that, in some cases, this discretion has been abused⁶. However, that does not justify eliminating all discretion by mandating simple, rigid rules for both allocations and pricing, as in a standard auction. We instead suggest greater transparency of the allocation process, but in a way that allows the underwriter to consider all relevant factors when allocating and pricing an offering. Large fund management companies already use such systems to determine allocations of trades, taking into account many variables in a balanced, relatively transparent way. We also suggest a separate retail tranche, since the availability of the internet should make it cost-effective to open up IPOs to all investors, as is done in most other countries.

The rest of the paper is organized as follows. Section I establishes trends in the use of various IPO methods, including the large number of countries that have tried and then abandoned the auction method. Section II shows that the failure of auctions cannot be explained by lack of familiarity with auctions or pressure from investment banks for using book building. Section III summarizes the predictions of various IPO models for the performance of sealed bid auctions open to a large number of investors, and uses a simple example to demonstrate that uncertainty about the number of participants in an auction increases the variance in initial returns for uniform price auctions, even when investors are endowed with

⁵ 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 $X+1^{st}$ price auctions, where the company is auctioning off X shares and the price is based on the $X + 1^{st}$ 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. Many countries have also used discriminatory (a.k.a. pay what you bid) IPO auctions.

⁶ And from the agency problems in the issuer/underwriter relationship. This was modeled for the French environment in Biais, Bossaerts and Rochet (2002), but the problem in general has not been fully explored.

information about the issue. Section IV examines the risks faced by investors and firms when using IPO auctions in practice, while Section V offers evidence of free riders in many IPO auctions who bid very high to get an allocation, assuming that the auction clearing price would be set by others who would do the necessary due diligence, discover what the issue is worth, and base their bids on that. We find that such free riders may have been responsible for the declining investor participation and increased risk of failure over time in Singapore auctions. Section VI discusses discriminatory auctions, Section VII briefly discusses whether modern technology makes IPO auctions more or less attractive, and Section VIII concludes.

I. Global Patterns

When Margaret Thatcher, Prime Minister of the United Kingdom, 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 United States 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 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 countries⁷. The table shows that the traditional IPO method in most countries was fixed price public offer, but that most countries now use book building. 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 U.K. 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 quite popular on the regulated exchanges in the first half of the 1990s. They gradually lost market share to a restricted form of book building over several

⁷ Appendix A gives other information on IPO methods in various countries. Table 1 is a summary of the more detailed country information in Appendix D (available on request, since it is fairly long). Note that this table focuses on methods used within various countries. Issuers can also list elsewhere, rather than in the domestic market. Ljungqvist, Jenkinson and Wilhelm (2003) examine both international and purely domestic IPOs.

years, then dried up fairly quickly in 1999 when unrestricted 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 the method became gradually less popular than book building. However, there were two IPO auctions in France in 2005 – one on the Second Marche in January, shortly before the Second Marche was folded into Eurolist, and one on the new Alternext, designed for smaller, younger companies⁸. The Second Marche auction IPO came after there had been no auctions on regulated exchanges in France for half a decade, so it remains to be seen whether the two auctions were flukes 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. Of the IPOs that have occurred in Israel since issuers have again been allowed some choice in terms of method, at least two of the three have effectively chosen "fixed price," otherwise known as "fixed price public offer," or "public offer," rather than an auction⁹. 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 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 building¹⁰.

In Latin America, auctions have been used in Brazil and Peru in the past. Latin

⁸ The Alternext auction was for MG International, in June 2005. The Second Marche auction was for Cafom. Cafom's minimum bid was 1.65. The offering price was 3.5, and only bids between 3.50 and 4 were accepted, although bids had gone as high as 20.

⁹ The actual restriction was on setting a maximum price. 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 many offerings hit the limit, making the offering method effectively similar to a fixed price offering. Since issuers were once again allowed to set a maximum price (actually a minimum yield), effectively returning to the fixed price system. There have not, to our knowledge, been any equity IPOs on the Tel Aviv Stock Exchange since the restriction requiring auctions was lifted.

¹⁰ Pension funds are only allowed to purchase shares through an exchange in Chile, so some 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 the beginning of general trading on the same exchange. In its 2003 IPO, La Polar cancelled the auction completely and distributed those shares through the bookbuild and through brokerages.

American markets were quiet for many years, with delistings outnumbering listings in Brazil, Argentina and Chile¹¹. Thus it was hard to predict if auctions were gone completely or might resurface. 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 have been able to find.

Since 1995, Taiwan has allowed both auctions and book building, in addition to the traditional fixed price public offers. The auctions in Taiwan are similar to those that were once required, and are still allowed, in Japan – discriminatory (pay-what-you-bid) auctions followed by fixed price public offer tranches. Book building is allowed only in certain restrictive circumstances¹² and is not used. Auctions were initially popular but lost market share over time, with more and more issuers returning to 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 U.S. As of November, 2005, there had been 15 U.S. IPO auctions, 14 of them using WR Hambrecht's OpenIPO auction method.

In other words, out of more than 45 countries, auctions have been tried in more than 20 countries, yet all except France, Israel, Taiwan and the U.S. seem to have abandoned them entirely, and auctions are rare even in those last four countries. Book building is gaining in popularity or is already the dominant method in 34 of the 46 countries. Public offer is still used in smaller countries and for smaller offerings, and is common for the retail tranche of hybrids.

II. Auctions vs Bookbuilding: Myths

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

A frequently-offered explanation for the low numbers of IPO auctions in the U.S. is that the auction method is simply too new and experimental, and that issuers are afraid to take a

¹¹ Chile had no IPOs at all from 1998 to 2001 and only one each in the years 2002 and 2003. Argentina also went many years without even one IPO, and is still somewhat behind Brazil and Chile in its recovery.

¹² In Taiwan, book building can only be used when the majority of the shares sold are new shares, whereas auctions can only be used when the majority of the shares are existing shares sold by current stockholders. It is commonly believed that issuing new shares in an IPO leads to much greater regulatory scrutiny and a long delay. Therefore, most companies planning an IPO in Taiwan first issue new shares to existing stockholders, who then sell the shares to the public in the IPO.

chance on an unproven method. 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 must have been willing to experiment (although, of course, issuers had no choice in Japan and Israel). More importantly, if we look at relative usage patterns over time, issuers have seemed to be most enthusiastic about IPO auctions when the method was new, and they became less willing to use the method once they had time to become familiar with it.

Figure 1 shows the relative auction usage patterns over time in four countries. For the first three countries, Singapore, Taiwan and Turkey, the alternative method was fixed price public offers¹³, which had been the traditional method in those countries. Auctions were first allowed in 1993 in Singapore¹⁴ and Turkey, and sometime during 1995 in Taiwan.

As can be seen from Figure 1, auctions tended to capture the greatest 'market share' early on in these countries, 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.

Singapore began allowing IPO auctions in 1991. There was one discriminatory auction there in 1991 and another in 1992, but the method was not popular, so uniform price auctions were allowed beginning in February, 1993¹⁵. There were 20 uniform price IPO auctions in Singapore in 1993 and 1994, out of 51 total IPOs, with the last IPO auction, Sunright, occurring in October, 1994. Our data are from the Singapore Exchange (SGX; formerly the Stock Exchange of Singapore or SES), and include both Main Board and Sesdaq offerings. 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. Sesdaq was established to attract smaller, younger companies and hence had more relaxed requirements. There were

¹³ As discussed earlier, book building is allowed in Taiwan but is restricted, so effectively the choice was between auctions and fixed price public offers. It should also be recalled that Taiwan used discriminatory rather than uniform price auctions.

¹⁴ 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.

¹⁵ Uniform price auctions were known as "single strike price tenders" or as "French tenders", since similar IPO auctions were being used in France. The earlier discriminatory or pay-what-you-bid auctions were known in Singapore as "Dutch tenders". This use of the term 'Dutch' is closer to the original Dutch auction (open,

18 auctions and 11 fixed price offerings on the Main Board in 1993-1994, with the remaining two auctions and 20 fixed price offerings on Sesdaq.

The Sesdaq fixed price offerings were substantially smaller than any of the Main Board offerings, as can be seen in Table 2. The two Sesdaq auctions, however, were much larger than the other Sesdaq IPOs. Both of the Sesdaq auctions raised more than the median amount raised by either Main Board auctions or Main Board fixed price offers, and hence appear comparable to Main Board offerings, in terms of size. It is possible that most Sesdaq listings were too small to be able to use an auction, so we report results both including and excluding Sesdaq fixed price offers, where appropriate.

For Main Board IPOs, the mean and median funds raised are smaller for fixed price public offers than for auctions, even when Singapore Telecom (SingTel), which was an extremely large offer that used an auction, is excluded. However the smallest auction was on the Main Board and raised only S\$15.7 million, whereas the smallest Main Board fixed price offering raised S\$17.2 million. The median funds raised was S\$48 million for auctions (S\$44 million if SingTel is excluded) and S\$38 million for fixed price. Six of the 18 Main Board auctions raised less than the median for fixed price. Sunright, the last company to do an auction, raised \$37.5 million, which was slightly below the median fixed price offering, and 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 offering price and fees had been set.

Table 3 gives a breakdown of Main Board offerings by sector. It shows that no sector was "shut out" of auctions. Although there were some sectors with no fixed price offerings, each sector had at least one auction¹⁶. Moreover, there were more auctions than fixed price public offers during this time period on the Main Board (18 versus 11).¹⁷ Thus, analysis by size

descending price) than is the common misuse of the term in financial markets to apply to uniform price auctions.

¹⁶ The sector with the lowest proportion of auctions was Capital Goods, in which 4 of the 5 companies used fixed price public offers. All of the Capital Goods Sector IPOs were by companies in the Construction Industry. The one that used an auction, Rotary Engineering, raised slightly less than Koh Brothers Group, a Construction Industry issuer that used a fixed price public offer. Moreover, the auction issuer that raised the lowest amount for a Main Board IPO, Pokka, was in the same sector and industry (Non-cyclical Capital Goods, specifically Food Processing) as the largest fixed price offering. Pokka raised only S\$15.7 million through an auction, which implies that the Food Processing company Transpac, which raised S\$200 million, could also have used an auction if it had wished.

¹⁷ We also looked at the timing of the IPOs, to see whether they were spread out or clustered. The importance of this was shown by Schultz (2003). 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

and by sector, as well as anecdotal reports from issuers, all indicate that Singapore's Main Board issuers were free to choose the auction method.

Of the four countries whose usage patterns are shown in Figure 1, France differs from the others in several ways. First, a form of book building was in use during the period shown, in addition to auctions and fixed price. Second, the auction method had been allowed for many years in France, whereas it was new in the other countries during the time period shown. Third, there was a regulatory change during this period that seemed to have a big effect on IPO patterns. Before 1999, the only form of hybrid book building that was allowed in France was sequential hybrids, where the price is set through book building but must be set many days in advance, to allow time afterwards for the public to order shares through the public offer tranche. Derrien and Womack (2003) found that sequential hybrid book building in France was less efficient than French auctions because the price had to be set so far in advance¹⁸.

Beginning in 1999, open pricing was allowed in France. This type of simultaneous hybrid, where the public offer and book building tranches are simultaneous rather than sequential, was by then standard in most countries, since open pricing allows the offering price to be set shortly before the shares begin trading. As Chowdhry and Sherman's (1996a) model shows, having to set the price too far in advance adds risk and requires higher levels of underpricing. Once the more modern, simultaneous hybrid book building method was allowed in France in 1999, auctions vanished from the regulated exchanges¹⁹.

However, there were still auctions occurring in France on the unregulated over-thecounter Marche Libre (Free Market). These seem to be drying up (as seen in Figure 1.E), but it is too soon to say for sure. One interesting aspect of this example is that use of the fixed price method had dried up but then returned. There were no Free Market fixed price public offers in 2002 and 2003, but there were 12 in 2004, as auction use was declining. The other IPOs on the Free Market were the older sequential hybrid bookbuilds (Placement et Offre à Prix Ferme or PG/OPF). But on July 18, 2005, Rackham was the first Marche Libre IPO to use a

days in 1993 and 54 days in 1994, both around the month of August (the Ghost Month, when IPOs are considered unlucky).

¹⁸ Derrien, DeGeorge and Womack (2006) also offer evidence on the period before simultaneous hybrid bookbuilding was allowed in France.

¹⁹ As mentioned in Section I, however, auctions might be re-emerging in France. After more than half a decade without any auctions on the Premier, Second or Nouveau Marches in France, there was one auction on the Second Marche in January, 2005, and another on the newly formed Alternext exchange in June, 2005. It is too early to say if these two offerings were flukes, perhaps inspired by the Google IPO, or if they are the beginning of a new wave

simultaneous hybrid bookbuild (Placement et Offre à Prix Ouvert or PG/OPO), combining book building with an open price offering.

Although the French example is somewhat messier than the other three, 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 for many years, 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. Last, the fact that so many countries have adopted book building over the last decade or so argues against the idea that IPO issuers around the world are unwilling to try new methods.

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. But the overall evidence is that issuers in many countries have been willing to experiment with both auctions and book building, but that issuers became less likely to use auctions as they gained familiarity with the method.

II.B. Underwriter Pressure for Using the Bookbuilding Method

Some have suggested that investment banks pressure issuers to use book building rather than auctions because the fees are higher for book building. This argument is somewhat inconsistent – it assumes that underwriters have sufficient 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 auctions. Regardless, this argument cannot explain the disappearance of auctions in most countries, because auctions were usually 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 public offers across most countries, substantially below those for book building. Chahine (2001), examining French data from 1996 to 2000, found that the mean, median and standard deviation of gross spreads were slightly lower for fixed price than for auctions²⁰.

of IPO auctions in France on the regulated markets.

²⁰ The difference was small and was perhaps due to the smaller average size of public offers.

The 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. Worldwide, the method that has led to the highest initial returns has been fixed price public offers, where underwriters have little or no discretion in allocating shares²¹. Issuer preferences for public offers over auctions cannot be explained by an underwriter desire to allocate underpriced shares.

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

Others have suggested that an issuer should always prefer the offering method that leads to the lowest expected initial return. An implicit assumption in this argument is that a company inevitably trades at the exact same price on the first day in the aftermarket, regardless of the IPO process or method. Thus, it is often assumed that the method with the lowest average initial returns must be maximizing the issuer's proceeds from the offering, and hence that offering methods should be judged only on the average initial returns without regards to the standard deviation of initial returns, the possible riskiness of the process or the potential effect on aftermarket liquidity. For example, the IPO auction method offered in the US by investment bank WR Hambrecht has received a lot of support among academics and in the financial press, and Co-CEO Clay Corbus felt comfortable promoting the method by referring to its track record, saying that "On average, Hambrecht IPOs rise 4% on the first day"²², even though at the time the standard deviation of initial returns on WR Hambrecht OpenIPOs was 81%.²³

Although it is clear to academics and the financial press that companies should think only of minimizing the expected change between the offering price and the first day's trading price, issuers frequently ponder other aspects of the process. Written guides for companies on

²¹ Many countries allow orders to be favored on the basis of 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 show that rationing may reduce the winner's curse for investors. ²² MSN Money, "IPOs return to make the rich richer – again", by Michael Brush, Nov. 2004,

http://moneycentral.msn.com/content/P92944.asp. Presumably Corbus was referring to the median rather than the mean. At the time, there had been 10 OpenIPOs. The median initial return on those first 10 OpenIPOs was 2%, while the mean was 30%.

²³ If we include subsequent OpenIPOs through Nov. 2005 plus Google (which was not an OpenIPO, although WR Hambrecht was involved in the offering), the standard deviation of all 16 US IPO auction initial returns is 64.5%.

the going public decision emphasize that 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 (and are much higher now, due to the Sarbanes Oxley Act).

In addition to the initial funds brought in, 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 stock price, which may require a core of institutional investors that will be interested in following the company long term.

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 offering 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.

Companies that go public but do not attract a following often end up being ignored. Since they are not followed by analysts or institutional investors, they are unable to do followon equity offerings, are not monitored closely enough to be accurately priced and tend to trade at a substantial discount due to their illiquidity. In order to avoid this, firms may be willing to pay (through underpricing) to attract the attention of serious investors²⁴.

Nevertheless, those who 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. Nearly all studies of fixed price public offers have found that they tend to lead to quite high initial returns, substantially above the average initial returns for either auctions or book building. See, for example, Ljungqvist, Jenkinson and Wilhelm (2003) and Loughran, Ritter and Rydqvist (1994). The key exception to this may be France. Derrien and Womack found lower initial returns for fixed price than for auctions in France, while Chahine found a lower

²⁴ See Sherman and Titman (2002) for a list of additional reasons why issuers may prefer more accurate pricing.

median but higher mean, relative to auctions. Thus, the one country in which auctions led to at least as much underpricing as fixed price was also the one country in which auctions held their own against fixed price²⁵.

Table 4 shows the initial returns for Singapore IPOs in 1993 and 1994, comparing auction and fixed price first day returns. IPO auctions in Singapore were known as tenders. Singapore only allowed hybrid auctions, with a fixed price tranche that took place first, before the auction. The minimum tender price (i.e. reservation price) could not be less than the fixed price for the public offer tranche. 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 the Sesdaq fixed price offerings were substantially smaller. Table 4 shows that initial returns were substantially higher for pure public offers than for auctions. Even for the same offering, the return to the public offer tranche tended to be substantially higher than the return to winning shares in the auction.

But, since Singapore's auctions were hybrids with part of the shares sold through a public offer tranche, we also consider underpricing from the issuer's standpoint. The average initial return is the weighted average of the auction and fixed price initial returns, weighted by the number of shares offered in each tranche. As Table 4 shows, the weighted average underpricing for auctions was below the level for pure fixed price offerings, but not by as much as one might have expected. The t-statistic for the difference in means in Table 4.A, for the full sample, is -1.38.

This brings up the question of why issuers did not sell more shares through the tender (i.e. the auction) rather than the fixed price tranche, given that the tender price could never be below, and was generally substantially above, the public offer price. Issuers were required by law to sell a minimum proportion of shares through a fixed price tranche²⁶, so one might guess that this choice was driven by a binding regulatory constraint. However, most of the

²⁵ France is unique in that both auctions and public offers (plus a restricted form of hybrid book building) were allowed for many years, and yet auctions were not being driven out by public offers. This might be due to the unique aspects of French auctions (which discouraged free riders), or it might simply be due to the fact that the market share that would otherwise have been taken by public offers was gradually being taken by book building instead. Note that auctions were also replaced by book building rather than public offers in Japan, but fixed price public offers had been banned in Japan since 1989. Thus, issuers in Japan had no choice until book building was allowed.

²⁶ Shares offered in the 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.

companies 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 the 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 are 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 will try to explain the failure of the IPO auction method, which we documented in Section I. To foreshadow, the auction and IPO literature indicate that auctions are dominated by fixed price public offers, at least in the environments that are most appropriate for IPOs – common value or affiliated values, with costly information production and endogenous entry. In such environments, auctions may be too risky and lead to both an unusually difficult winner's curse problem and a free rider problem. There is uncertainty over the number of bidders that will enter, and in some cases the auction may not be stable. Thus we would expect standard sealed bid auctions to be driven out by fixed price public offers in all countries.

Theory indicates that book building has significant advantages over both of the other offering methods in these settings, but book building also gives underwriters substantial power and discretion. There is a risk that the underwriter will misuse this control²⁷. Thus book building is more likely to dominate fixed price public offers in more developed countries with

²⁷ The IPO scandals that followed the late-1990s tech bubble in the US show that there is reason for concern even in countries with well-developed markets.

good institutions and sufficient competition among investment banks, but fixed price may be optimal in smaller, less active markets.

Most of the theoretical literature focuses on trying to explain why IPOs are underpriced at the offer. Of the common explanations of IPO underpricing, many rely on the actions and choices of the issuer or underwriters. Such explanations have little to say about IPO auctions, which allow investors to price shares with little or no role for either issuers or underwriters. We therefore focus on the assumptions made in various theoretical models regarding the information that investors have or are able to obtain, and on their incentives to place bids that reflect that information.

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 IPO auction, such an optimal IPO auction would be more likely to resemble book building, rather than the simple, rigid, standard sealed bid auctions that people normally think of²⁸.

In order to analyze the optimality of various IPO methods, we need to consider the goals of the issuer in going public. Auction theory indicates that standard sealed bid auctions are not the best IPO method even if issuers care only about maximizing expected proceeds, except under extreme and unrealistic assumptions. Moreover, if issuers are risk averse, or if they care about aftermarket liquidity or their ability to issue more shares at a reasonable price in the future, IPO auctions lead to additional problems.

III.A. Maximizing Seller's Expected Proceeds

It is often assumed among academics that issuers should care only about raising as much money as possible in their IPO. We showed in Section II that this is inconsistent with the revealed preferences of issuers, since the fixed price public offer method virtually always leads to higher average initial returns and yet has been consistently preferred to auctions. But even if we were sure that issuers cared only about maximizing their one-time expected proceeds from the IPO, sealed bid IPO auctions would not be generally optimal.

²⁸ 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.

It is well established in auction theory that standard sealed bid auctions are revenuemaximizing in an independent private values setting with full entry, at least when there is relatively little risk of collusion^{29.} With independent private values, each person has her own value for the object, and that valuation remains the same regardless of the opinions of others. This setting underlies much of the folk wisdom regarding IPO auctions – that each person will bid what he is 'willing to pay', allowing the auction to reveal the 'true demand curve'. The private values assumption, however, does not fit IPO shares, which will be traded actively on the aftermarket and which will have future payoffs that depend on the success of the company.

The more appropriate assumption for an IPO would be either common value or affiliated values, where affiliated (i.e. correlated or interdependent) values are somewhere between pure private values and one common value. In a common value setting, it is possible that auctions will lead to zero underpricing under the assumptions that many investors are endowed with a signal that allows them to effortlessly make an informed estimate of the total value of the shares, and that all of those investors will choose to enter and bid in the auction³⁰. However, even with endowed information, it has been shown that fixed price public offers (i.e. a posted price mechanism) may dominate standard auctions (see Campbell and Levin, 2006, Bulow and Klemperer, 2002, and Viswanathan and Wang, 2000). In situations where the winner's curse is extreme (such as the example we show in Section III.F), bidders must optimally shave their bids so much in a sealed bid auction that expected proceeds may be higher through a posted price mechanism.

In addition to the problems that arise with endowed information, sealed bid auctions may lead to even greater difficulties under the more realistic assumption of costly evaluation. After all, IPOs are for new stocks that have not traded before. Their value depends on forecasts of the future of the company, the industry and the economy as a whole. To evaluate a new company and its management, forecasting how it will measure up against its competitors,

²⁹ Ausubel (2002) and Chen and Wilhelm (2005) model IPO auctions in independent private values settings.

³⁰ Models that assume a complete, endowed signal and full entry include Benveniste and Wilhelm (1990) and Biais and Faugeron-Crouzet (2002). Benveniste and Spindt (1989) assumes that investors each receive a marginal rather than a complete signal on the value of the shares. Such an information structure would make it quite difficult for investors to place bids in a sealed bid auction. Kyle (1989) characterizes the Nash equilibrium in an endowed information economy where each trader submits a demand schedule after taking into account the effect of her demand on the market clearing price. He also provides sufficient conditions for a unique linear equilibrium with endogenous information acquisition. However, Kyle assumes that one can shortsell the asset (i.e., negative quantities in the bid/demand schedule are allowed). This is not so in auctions, and hence his results are not directly applicable in auction situations.

requires time and effort. Without such effort, even those with serendipitous³¹ knowledge of the company cannot translate that knowledge into a dollar estimate of the value of the shares. And to bid in an auction, one needs a precise dollar amount and not merely a 'good feeling' about the stock. Although bookbuilding and fixed price public offers may be able to incorporate 'fuzzy' information from investors that have a good or bad impression of the company but have not actually run the numbers, auctions require investors to place precise bids and puts much weight on the exact dollar amount of each bid.

III.B. When Issuers Prefer Accurate Valuations

Thus, sealed bid auctions may not be the optimal mechanism even if we believe that issuers care about nothing except maximizing the expected proceeds from a one-time share issue. More importantly, there is abundant evidence that 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. As we discussed in Section II.C, both of these reasons imply that companies would tend to prefer a more accurate valuation of their shares, which requires attracting a following among analysts and informed investors. But those investors have many alternatives, and evaluating a new stock requires more effort than simply sticking with their current portfolio. In order to guarantee that a stock develops a following and does not get overlooked (i.e. does not become a so-called orphan stock), the issuer somehow needs to compensate investors for their time and effort evaluating the new security. Book building can perform this role, as shown in Sherman and Titman (2002)³².

With uniform price or discriminatory auctions, on the other hand, Sherman (2005) shows that these standard auctions cannot guarantee a return to investors. Costly evaluation is possible in an auction but cannot be specifically induced by the seller. Sherman's model shows that book building is more efficient at matching the issuer's preferences, whether the issuer prefers less underpricing or a more accurate evaluation, and thus that it can dominate standard uniform price and discriminatory auctions. She uses a stylized example to show that book

³¹ As in Subrahmanyam and Titman (1999).

³² Underpricing as a way of inducing costly evaluation was first modeled in Sherman (1992). 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

building may even lead to both more information production and lower underpricing for the same offering, but the more general result is that it can always more closely match the issuer's preferences, yielding a superior trade-off between information production and proceeds maximization.

Thus if there is any cost, even a small one, to evaluating shares that have never traded before, then theory predicts that auctions may not lead to accurate valuations. Chemmanur and Liu (2003) show that even fixed price public offers allow underwriters to induce more accurate valuations, compared to uniform price auctions³³.

III.C. Issuers May Be Risk Averse

Issuers may also be concerned about the riskiness of the IPO process itself. Going public is an important and very public step in the life of a company, and the cost of a failed IPO is large. With bookbuilding, 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 likely³⁴. Issuers and underwriters have little control in standard sealed bid auction, since they do not choose either the offering price or allocations.

A key risk with IPO auctions is endogenous entry, as shown by Sherman (2005)³⁵. When there are many potential bidders, each deciding independently whether or not to enter an auction, it adds uncertainty. Even if the expected number of entrants is optimal, there is ex post variation and thus the risk, for any one offering, of either too many or too few entrants. Too many entrants compete away the returns of each bidder and may lead to overpricing and hence

in a sophisticated way. Aussenegg, Pichler and Stomper (2005) also explore grey market trading for IPOs.

³³ Chemmanur and Liu model only uniform price and not discriminatory auctions. Busaba and Chang (2003) and Sherman (2000) also model costly evaluation of IPOs, but not for auctions. Yung (2005) models costly evaluation by both investors and the underwriter.

³⁴ This explains the high average initial returns for fixed price public offers relative to either book building or auctions. See Chowdhry and Sherman (1996a) for a model of underpricing of public offers as insurance against failure, and see Ljungqvist, Jenkinson and Wilhelm (2003) on the difference in initial returns between book building and fixed price public offers.

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.

to losses for investors. Too few entrants may cause the auction to be undersubscribed. Endogenous entry also greatly complicates the bid preparation process, as we will show in Section III.F. Greater variation in the returns to bidding, combined with greater difficulty even calculating the optimal bid, both tend to discourage serious informed participation in IPO auctions, which lowers the probability that the resulting auction price will be fairly accurate.

III.D. Issuers May Prefer a Liquid Aftermarket

Most papers in the standard auction literature do not consider situations where the asset is traded after the auction. The few notable exceptions are concerned mainly with Treasury auctions and include Viswanathan and Wang (2000) and Back and Zender(1993). As we pointed out in the introduction, Treasury securities are different from IPOs in that they are much easier to evaluate and are auctioned regularly, at frequent intervals, to a steady set of regular investors. IPOs occur sporadically (including occasional heavy waves), each is unique and difficult to evaluate, and each attracts a somewhat different set of investors.

In a private-values setting, by definition, an "efficient" auction involves allocating the units to those that value it most, so that no additional transactions are necessary after the auction is completed. However, when allocating infinitely-lived investment securities in a common value setting, later aftermarket trading is inevitable and may be considered desirable. IPO issuers typically want their stock price to serve as a benchmark and want the option to do later follow-on equity offerings, but these require attracting an investor following, and those investors would value liquidity.

Book building, as well as fixed price offerings where the offer price is set sufficiently low, allow the underwriter to induce investors to devote time and resources to evaluating an offering. Once investors have done their due diligence, they are more likely to follow the stock in the future. A sufficient institutional investor following will help to induce one or more analysts to cover the stock, which then lowers the marginal cost of information for other investors. All of this increases the chance that the stock will trade actively in the aftermarket. With an auction, on the other hand, it is possible that an active following and a liquid aftermarket will develop on its own, but the issuer cannot ensure that development.

III.E. The Free Rider Problem

In uniform price auctions, the expense of producing a reasonable bid may 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 bid high without collecting any information at all, since the auction clearing price will be set by those who have already done the necessary analysis. That will break any pure strategy equilibrium; the auction will be a failure³⁶.

There is 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+1st 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). We find evidence of free riders in IPO auctions in several countries.

III.F. The Winner's Curse with Endogenous Entry

In addition to the moral hazard or free rider problem with uniform price auctions, there is an adverse selection and consequent winner's curse problem for both uniform price and discriminatory auctions. 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. We will provide an example to illustrate this issue. When the risk is large; clearly investors may decide to wait and buy once the issue starts trading. But if no one participates, the incentive is there for a few to participate and bid low, so there is inherent instability in auctions. Viswanathan and Wang (2000) provide some theoretical support for such a situation developing. They show that there may not be a linear equilibrium when the adverse selection is severe. We illustrate the possibility of such instability using Singapore IPO auctions.

³⁶ Kyle (1989) points out that under certain conditions, no one may invest in gathering information in equilibrium. Viswanathan and Wang (2000) provide an example of a single price common value auction where the winner's curse is so severe that there is no linear equilibrium; i.e., the auction fails.

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. 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. Hence 'winning' the auction will also mean overpaying (the 'curse').

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 information sets of those other bidders. Optimal bid shaving works on average, although there will still be some variations in realized returns. Clearly, even with endowed information, investors need a high level of sophistication in order to optimally shave their bids to adjust for the winner's curse. Thus, if most or all investors are guaranteed to enter the auction (presumably because of zero entry, as well as information, costs), and if they all shave their bids by the optimal amount to adjust for the winner's curse, then auctions will lead to relatively accurate pricing in this environment, with a low mean and variance of initial returns.

However, some of the evidence indicates that bidders may find it difficult to adequately adjust their bids for the winner's curse. Bazerman and Samuelson (1983), using experiments where MBA students participated, showed that winning bidders were subject to winner's curse. Kagel and Levin (1986) showed that even moderately experienced bidders who had earlier participated in at least one experimental auction tended to bid aggressively when compared to what they would bid under risk neutral Nash equilibrium. 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. Their finding of negative returns in situations with unexpectedly large participation is consistent with the view that even professional bidders cannot adjust sufficiently accurately for winner's curse in single price common value auctions with 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 a high level of computational sophistication among bidders and a reasonably accurate estimate of the number of participants. Without coordination, there is always the risk that a large number of unsophisticated investors may unexpectedly enter all at once, leading to the auction clearing price being substantially above the intrinsic value of the issue. This would compound the uncertainty due to the winner's curse.

The following example illustrates the 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 average of all bids is close to the true value, allowing for the discreteness in the number of bidders. The auction clearing price, on the other hand, ranges 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.

We also examined 100 randomly generated auctions for each value of the number of participants, N, to examine the variations in the auction clearing price. The average of all the bids in 100 auctions was very close to the true value for all the five values for the number of bidders, 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 would learn 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 winner's curse 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 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 number of bids 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 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 lack of control over entry to the auction adds risk, and shows that each investor optimally collects

less information in a uniform price than in a discriminatory auction, because of the free rider or moral hazard problem in uniform price auctions³⁷.

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 enter³⁸. Issuers may therefore prefer bookbuilding or fixed price offering 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.G. Summary of Predictions from Auction Theory Models

Table 5 presents the predictions of theory regarding the underpricing and aftermarket performance of standard auctions. It is evident that auctions will 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 stable³⁹. Auctions will be unreliable 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. A costly evaluation/endogenous entry model is the only model that can simultaneously explain a positive mean and variance in IPO auction initial returns, inaccurate aftermarket prices, varying participation levels and a free rider problem. We find evidence of all of these in IPO auctions in Singapore and elsewhere.

To summarize: (a) Auctions have a large risk of failure due to uncertainty about the number of bidders, and the consequent large adverse selection (winner's curse) problem; (b) Fixed price public offers may dominate auctions when it comes to maximizing revenue, inducing information gathering, and the transparency and the ease with which it can be

³⁷ 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.

³⁸ 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 did not, however, choose to make the information public.

³⁹ Note that, with a relatively small numbers of potential bidders in a regular series of auctions, collusion may pose a problem and hence has been the subject of much academic research. For IPOs, however, where millions of shares are being auctioned to millions, even tens of millions, of potential bidders, collusion is unlikely to be a major concern.

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 but it needs a more efficient market where underwriters compete with each other, and may come to replace fixed price in more developed economies with good and transparent markets. That is what we find.

IV. Uncertain Number of Bidders and Auction Price Risk: Empirical Evidence

IV.A. Variations in Participation Levels

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 East (JR East) drew 18,670 bidders, while the 1996 auction of Japan Railway West (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 the 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 13,518⁴⁰. Lin, Lee and Liu (2003) found wide fluctuations in bidder numbers for Taiwanese IPO auctions.

There is also evidence of such variation as mentioned above in demand for Singapore tenders, as is shown in Table 6. Subscription levels ranged from the Vickers Ballas tender, 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 Telecom. Table 6 also shows substantial variation in demand for fixed price shares in the same offerings, however, so participation variation is not unique to the auction tranche.

Large unexpected variation in the number of participants increases the risk of undersubscription, in addition to increasing the risk due to winner's curse. With book building, an underwriter can convince investors to attend the road show and at least give some sort of

⁴⁰ Median: 2,486. Standard deviation: 3,151. Multiple orders were allowed, so the number of orders might overestimate the number of bidders.

feedback, since investors that refuse to consider one offering may be cut out of future offerings. With fixed price, an underwriter can at least set the offering price low enough to get the attention of investors. With an auction, an underwriter can only wait and hope.⁴¹ Many IPO auction failures have been blamed on either too many or too few bidders entering the auction. Jenkinson and Mayer (1988) report that half (3 out of 6) of UK privatization tenders between 1982 and 1987 were undersubscribed, while one was 500% oversubscribed. In 1994, the auction tranche of Sunright, the last IPO auction in Singapore, was 82% undersubscribed (i.e. bids equaled only 18% of available shares), even though the public offer tranche a few days earlier had been 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 SingTel 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. In August of 2000, the Chunghwa Telecom IPO auction in Taiwan was only 72% subscribed, leaving 80.8 million shares unsold⁴².

The longest string of undersubscribed IPO auctions was in France, on the unregulated over the counter Marche Libre or Free Market, over the last few years. All 26 of the French IPO auctions⁴³ 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

⁴¹ This is particularly true with sealed bid auctions, since each bidder knows nothing about the other bids until the auction is closed. Coordination might be less of a problem with something closer to an open auction, such as the Ord Minnett eCapital "book builds" in Australia in 1999. In these online auctions for individual investors, the updated weighted average bid price was posted twice a day. Thus, if the auction was being overlooked and the price was excessively low, it was possible that more bidders would be attracted by the posted bid price. However, an open auction might subject an offering to the risk of cascades (Welch, 1992). WR Hambrecht, the US investment bank that offers OpenIPO sealed bid IPO auctions, also offers OpenBook and OpenFollowon, which are open online auctions in which institutional (but not retail) investors can see the distribution of other bids before placing bids in a debt or seasoned equity offering. There has been one OpenFollowon, by Overstock.com (a company which also went public through an OpenIPO), as well as two OpenBooks.

 $^{^{42}}$ One problem with these examples is that there is no way to distinguish between offerings that were undersubscribed because investors scrutinized the offering and didn't like it – a risk for both auctions and book building – and offerings that were undersubscribed because too many investors simply didn't happen to look at the offering – a risk for auctions but not for book building, since the underwriter coordinates the process, making sure that enough investors attend the road show and consider the offering. For Chung Hwa Telecom in Taiwan, many argued afterwards that the reservation price had been set too high. This cannot explain Korea Telecom, since the reservation price was not publicly announced.

 $^{^{43}}$ There were actually 27 IPO auctions in this time period, but information on the Parfex auction is missing form the Euronext website.

methods also led to undersubscription during this period, as shown in Table 7, the subscription rates were dramatically higher for the other methods.

In 2002, there were 14 French Free Market auctions with a mean subscription rate of only 19% and 8 bookbuilds with a mean subscription rate of 69%. In 2003, there were 10 auctions with a mean subscription rate of 19% and three bookbuilds with a mean subscription rate of 143%. In 2004, there were three auctions with a mean subscription rate of 15%, three bookbuilds with a mean subscription rate over 200%, and 12 fixed price offerings with a mean subscription rate of 141%. Thus, all IPOs were undersubscribed in 2002, but auctions were far more undersubscribed. As bookbuilds did dramatically better in 2003 and 2004, auctions still failed dramatically, eventually leading to the return of fixed price offerings. 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%).

Data on the actual number of failed offerings may sometimes be difficult to obtain, for either auctions or fixed price offerings, since underwriters have an incentive to place their own orders in an offering that is underwritten. For IPO auctions in Israel, a Securities Authority report officially confirmed that many Tel Aviv Stock Exchange IPOs had been undersubscribed but were described by the issuers and in newspaper articles as having been oversubscribed. The true subscription level was reported by the underwriter in some, but not all, cases. The Securities Authority found that many IPOs that were reported as having been strictly oversubscribed had, in fact, been undersubscribed⁴⁴.

For Singapore, 10% (2 out of 20) of the IPO auctions were undersubscribed, while 6.5% (2 out of 31) of the fixed price offerings were undersubscribed. Although this is a matter of opinion, it does not appear to us that the increased risk of failure, by itself, was sufficient to explain the abandonment of IPO auctions in Singapore. Thus in Section V we will consider explanations related the free learning to rider problem predicted by costly evaluation/endogenous entry models.

IV.B. Evidence of Successful Auctions in Relatively Stable Settings

⁴⁴ A similar practice was used in Hong Kong, for fixed price public offers. This problem does not occur for book building since the only true guarantee for book building is given at the last moment, after the order book has been filled. For underwritten auctions or public offers, however, the guarantee is given before demand has been observed.

In addition to the many other types of objects and services that have been auctioned, sealed bid auctions are regularly and successfully used for the largest, most liquid security sales – those for government debt in, among other countries, the US, Japan and Germany. For example, in the US, 13-week US Treasury bills (T-bills) are auctioned off each Monday⁴⁵. T-bills differ from IPOs in two key ways – ease of evaluation, and regularity. First, a central feature of IPO issuers is that they are companies for which there is no available market price. They are often new, young companies, and often risky. With 13 week T-bills, on the other hand, the bills have been trading in the when issued market since the Thursday before the auction, plus there are off-the-run T-Bills with very similar characteristics, as well as bills that originally had, say, 52 weeks to maturity but now only have 13 weeks remaining. In other words, virtually identical securities are trading in many different forms at the time that auction bids are placed.

The other key difference is that T-bill auctions occur so frequently and regularly, with a regular set of bidders. There are 22 primary dealers that are expected to regularly participate in US Treasury auctions. Much auction theory has focused on situations in which there are relatively small numbers of bidders in a repeated setting (for, say, drilling rights or construction contracts). With IPOs, however, the goal of most IPO auctions is to open up the auction to 'everyone', which means that there are thousands of potential bidders, the vast majority of whom do not enter most auctions but could enter, at any time. IPO auctions occur sporadically (often in waves), and most issuers have relatively unique aspects that may appeal to a different set of bidders each time.

The success of auctions for the deepest, most liquid, most uniform issuance process must be contrasted with the lack of success in using auctions to sell other financial securities such as corporate debt. In 2000, three investment banks introduced methods for auctioning corporate debt. On August 10, Deutsche Bank and Bear Stearns each held their first debt auctions on their newly-developed platforms, while WR Hambrecht held their first OpenBook debt auction on August 15, 2000⁴⁶. There have to date been only a few corporate debt auctions,

⁴⁵ Goldreich (2005) shows that even uniform price Treasury auctions lead to underpricing.

⁴⁶ Deutsche Bank's 21 hour auction began first, while Bear, Stearns' 2 hour auction began later but ended earlier. Both claimed to be the first to hold corporate debt auctions. Although WR Hambrecht's auction came 5 days later, it was the first (and only) investment bank to convince an outside issuer, Dow, to use the method. Deutsche Bank and Bear Stearns each auctioned off their own debt but never managed to get another company to use the process.

with none for several years⁴⁷. Similarly, WR Hambrecht has offered an auction method for seasoned equity offerings (SEOs), OpenFollowon, for many years but has attracted only one offering by Overstock, a company that also went public through an OpenIPO. After using the OpenFollowon method once in May of 2004, Overstock chose a traditional marketed offering for its next follow-on in November, 2004.

Bartolotti, 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.

V. The Free Rider Problem

Stable auctions may not be achievable if free riders cannot be prevented from entering the auction⁴⁸. Figure 1 suggests that learning 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, too many free riders may enter, leading to poor returns for winning bidders. As IPO auctions fail to provide reasonable returns because of the effect of free riders, investors would tend to update their priors regarding IPO auction risk and expected return, becoming less willing to participate, and so the probability of an undersubscribed auction would increase.

V.A. Argentina's Experience

This explanation seems consistent with Argentina's short experiment with IPO auctions.

⁴⁷ WR Hambrecht handled the fourth, for Ford Motor Credit, in March, 2001. It reportedly attempted a fifth debt auction, for Dayton Hudson, when the bid-taking system crashed during the auction itself, not far from the end.

⁴⁸ This might be why IPO auctions were successful for longer in France than in any other country. A unique aspect of French auctions is that they throw out the highest bids, thus discouraging free riders. As mentioned earlier, all bids above ≤ 14.00 were rejected in the January, 2005 Cafom auction. Bids ranged from ≤ 1.65 (the minimum) up to ≤ 20 , but only bids between ≤ 3.50 (the offering price) and ≤ 14.00 were accepted, with those

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. In fact, some bankers urged the government to call off the auction, thinking that it would flop with such a high minimum price. 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 Buenos Aires Exchange was the hottest-performing market in the world in 1991, and many that had not bid in the Telefonica auction regretted their decision.

The next privatization, for Argentina Telecom, came less than four months later. Because the Telefonica auction had been such a success, most 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 shares".⁴⁹ 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 was only hoping to raise about P1 billion. 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.

Unfortunately, the auction price was unsustainable. By the time the 90 day margin loans were due, Telecom shares had fallen far enough that discouraged investors chose not to meet margin calls, both for Telecom and for other stocks. 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

bidding in that range each getting about 31% of their orders.

⁹ "Argentina's Stock Regulator Faces Daunting Task", The New York Times; August 24, 1992, Section D, p. 3.

make sure they would get shares."50

V.B. Distinguishing Free Riders from the Winner's Curse

Excessively high bids are probably the best way to distinguish the free rider problem from the more commonly recognized winner's curse problem, which was discussed in Section III. 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 they expect the shares to be worth. With the free rider problem, however, bidders may deliberately bid an excessive amount, since the whole point is to blindly bid high in order to be "first in line" for the shares, rather than devoting time and resources to coming up with a reasonable bid.

Thus, the winner's curse produces sincere bids that may, ex post, turn out to be somewhat too high. The free rider problem, on the other hand, may lead to unrealistically high bids, since bidders are specifically trying to bid above all reasonable bids in order to guarantee an allocation. Therefore, bids which are too high to reflect any reasonable valuation are signs of a free rider problem. 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 reservation price (minimum bid) in the auction was 6,000 Turkish Lira, but bids went as high as TL100,000, a 1,567% premium over the minimum.

In Singapore, there were several examples of extremely high bids, a strong indication of the presence of free riders:

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

⁵⁰ "YPF sets equity standards", by Danielle Robinson, Euromoney; London; Jul 1993, p. 19.

In the case of Singapore Telecom, the reservation price of S\$2.00 translated to a prospective price-earnings multiple of 27 times. Many analysts considered this excessive for a well run but mature company, and thus many banks put caps of S\$2.00 or S\$3.00 per share on the bids of those who borrowed to pay for their orders. As one banker said, "There has to be a cap. Otherwise, people may bid as high as \$10 or \$12."⁵¹ In the end, the highest bid was 50 times the reservation price, implying a prospective PE of 1,350 – hardly a reasonable valuation estimate for a mature company in an established industry.

V.C. Effect of Free Riders on Post IPO Price Performance

Thus there were clear signs of the presence of free riders bidding in Singapore's auctions. By themselves, a few unreasonably high bids need not lead to substantial overpricing, but it may only be a matter of time before enough free riders all enter the same auction, since entry is uncoordinated. In addition, even informed bidders that do not appreciate the extent of the winner's curse with endogenous entry (demonstrated in Section III.F) may fail to shave their bids sufficiently and thus may contribute to overvaluation of the shares in the auction. It is reasonable to expect the IPO auction process to eventually produce overpriced offerings that fall in price on the aftermarket, perhaps followed by undersubscription problems with subsequent auctions. There have been many allegations that uniform price auctions tend to overprice IPOs, leading to systematic price drops in aftermarket trading. As one participant put it, the stock price following a "Dutch" auction tends to fall "like a shot duck"⁵².

IPO auctions that fell in price on the aftermarket have included Argentina Telecom and Global Securities of Turkey, both mentioned earlier, as well as Petronas Dagangan of Malaysia (November, 1994) and Singapore Telecom. For Singapore Telecom, as discussed earlier, the reservation price was a fairly hefty S\$2 per share and yet bids went as high as S\$100. The market-clearing price was S\$3.60, an 80% premium over the already-high minimum and translating into an historic price-earnings multiple of 54 times. Even so, the stock price rose

⁵¹ "Telecom issue: Banks cap tender prices of borrowers", by Tan Sung, The Straits Times, Singapore, October 14, 1993, Money Section Back Page.

⁵² "Database Float Goes Online For Bids", by Sue Lowe, 11/04/1999 Sydney Morning Herald, p. 34. The quote is from Gordon Fell, Joint Managing Director of Ord Minnett, an Australian investment bank that arranged two online IPO auctions in 1999 but then gave up on the process, reportedly because the offering prices didn't hold up well in the aftermarket.

another 15% the first day to close at S\$4.14, "after which it was downhill all the way".⁵³ 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 S\$1.90, far below the S\$3.60 tender price or the S\$4.14 first day peak, even though "in terms of fundamentals, the company has done well".⁵⁴

This trend continued and worsened with subsequent IPO auctions (known as tenders) in Singapore. People complained that tendered IPO shares were falling below the tender strike price on the aftermarket and joked that they must be catching a new disease called "tenderitis"⁵⁵. There was a clear downward trend over time in the return to buying shares in the auctions and then holding them for one or two months from the time that they began trading. More than half of the auctions (10 out of 18) were priced below their auction price one month after they began trading. The median return to buying in the auction and selling one month later was -2% (while the mean was 1%). With a standard deviation of 11%, there seems to have been little compensation for the risk involved in buying shares through an auction and holding them for at least a month. For investors who held the shares for two months, the median return was -4%, with a standard deviation of 20%.

Moreover, the returns to bidding got lower over time, as can be seen in Figure 3.A, with the auctions ordered chronologically. Investors would have made money on five of the first six uniform price auctions in Singapore, if they had bought at the tender strike 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, for the last seven tenders done in Singapore, six of the seven returns would have been negative, giving an average return of -5.5%. Results are similar for a two month holding period, and are similar after adjusting for various market returns.

⁵³ "Half-million SingTel shares change hands at \$ 3.60", by Goh Soo May, The Straits Times (Singapore), January 26, 1996, Money Section, pg. 72.

⁵⁴ "SingTel's IPO priced 'too high". by Tammy Tan, Straits Times (Singapore), 27 Aug 2001.

The pattern is even more striking in Figure 3.B, which shows one month excess returns for Main Board auctions only⁵⁶, 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 moth returns relative to the Straits Times Index (Singapore blue chips) or the Sesdaq Index (smaller, younger companies). Thus, for investors that were learning and updating their priors over time about how auctions will perform, 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 the shares for at least a month or two did well on average, while investors that participated regularly in IPO auctions saw declining and eventually negative returns. Thus auctions were a poor investment for anyone that did not flip their shares on the first day. 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.

There is also evidence that investors had noticed that auctions (tenders) were leading to lower returns over time. On July 2, 1994, the Business Times section of the Straits Times reported on a report by a local investment bank, Yamaichi Merchant Bank, arguing that the tender system led to overpricing, since winning bidders generally did not have to pay the prices that they bid. The report argued that stocks were likely to sink below their strike price "within the first few weeks of trading"⁵⁷, based on the investment bank's study of recent IPOs. Discussions of this phenomenon ('tenderitis') in Singapore's popular press at the time focused on whether stocks were trading above or below their original strike prices, which is why we present raw returns in Figure 3.A (with market-adjusted returns in 3.B).

V.D. 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

⁵⁵ "New strategies needed for future IPOs", Ven Sreenivasan, Singapore Straits Times, p. 13, February 3, 1995.

⁵⁶ 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 auctions when ordered chronologically.

⁵⁷ "The ups and downs of tendering for IPO shares" by Agnes Chen, Singapore Straits Times Business Times,

eventually became discouraged with auctions, even though they were still relatively interested in public offers.

For Liang Huat Aluminum (the 5th-to-last Singapore auction), the reservation price for the tender was S\$0.57. The fixed price tranche, also at S\$0.57, was 750% oversubscribed, and yet the tender portion was 38% undersubscribed. Even though the tender was heavily undersubscribed, bids went as high as S\$2.00, a 251% premium over the fixed price. 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 (28,036, 29,833 and 30,060 respectively). The number of bidders for the tender 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 cycle⁵⁸.

We have talked to the management of Sunright, the last company to do an IPO auction in Singapore, about why they chose an auction rather than a pure public offer. They explained that they were offered a choice by their underwriters - they could either do a pure fixed price public offer at S\$0.75 per share, or else sell part of the shares through an auction tranche at a reservation price of S\$0.75 per share. Since the offering was fully underwritten (meaning that the underwriter would buy any unpurchased shares at S\$0.75 per share), and the fees were the same, the reservation price of S\$0.75 meant that a hybrid auction could not possibly result in lower proceeds than a pure fixed price offering. 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 not have been appreciated by the issuer. Sunright's fixed price tranche of 30 million shares was 22% oversubscribed, but the 20 million share tender 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 S\$0.75, the fixed price of the earlier tranche.

July 2, 1994, p. 5.

⁵⁸ Although many bidders had clearly become discouraged, there were still a few free riders. In the Eng Wah auction, although the reservation price was \$0.65 and the market-clearing price \$0.66, bids went as high as \$\$7.80, a 1,082% premium.

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

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 tender portion 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 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".

Our December 21, 2001 e-mail from Kenneth Tan, Director of Sunright, the last company to do an IPO auction in Singapore, said that the company had been advised by its underwriter that "market conditions were then weighing against handsome Tender Tranche premiums" and that they were aware that the offering might be undersubscribed. 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.

While we have been unable to find much evidence on Portugal's IPO auctions from 1987 through 1992, it appears that they may also have given up on the auction method after problems with undersubscription. Portugal's last IPO tender, for the insurance company Mundial Confianca in April 1992, left 34.6% of the shares unsold.

To summarize, we have shown evidence of:

- bidders placing unreasonably high bids in IPO auctions in Singapore (and elsewhere);
- deteriorating and eventually negative returns over time to bidders in Singapore's IPO auctions ('tenderitis'); and
- lower average bidder numbers over time, eventually leading to some undersubscribed offerings.

These are all consistent with a free rider/learning explanation, where investors and issuers gradually realized that auctions were risky and did not offer a sufficient return for that risk.

V.E. A Quantitative Analysis of the Singapore Experience

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

The available data on auctions is sparse and not easily amenable to rigorous quantitative analysis using statistical methods. As we have pointed out, 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 is often unavailable⁶¹. We were able to obtain reliable data on participation levels, auction prices and returns for 16 of the 20 IPO auctions⁶² in Singapore. Here we attempt a quantitative characterization of the data, which is albeit a bit brave given our sample size.

We argued in Section III.F 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. The data indicate that the subscription rate positively affects the auction clearing price. When we regress the auction subscription rate (and a constant) on the price ratio (the percent premium of the auction price over the fixed public offer price, which was set earlier and which equals the reservation price in the auction), we get a positive and statistically significant coefficient for the subscription rate and an adjusted R-squared of 34.0%. A higher number of bids in the auction tends to lead to a higher auction clearing price.

This, by itself, does not mean that the price is being run up by exogenous entry, because we are not observing the entire demand curve. In our simple example in Section III.F, the value of the shares was held constant and there was no reservation price, so the auction bids always reflected the full range of valuations of entrants. In practice, of course, there are two offsetting effects in auctions: a high number of bids may reflect an unusually high proportion of investors placing a high valuation on the stock (above the reservation price), or it may simply mean that there was a random increase in the number of bids placed, without adequate bid-shaving to adjust for the higher entry level. Without observing the full range of valuations, including those below the reservation price, the market cannot distinguish between genuinely high or low demand and the type of random fluctuations in entry that we demonstrated in Section III.F.

To separate these two effects in the data, we would ideally do more sophisticated decomposition of the returns to bidding in auctions. With only 16 observations, however, we

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

⁶² We lost two observations, IPC Corp. and Sunright, because we could not get reliable subscription data and two,

instead employ relatively simple analysis on r, the one month return to winning bidders in the auction, using the following regression:

$$r_i = \alpha_0 + \alpha_1 \left(\frac{P_A - P_F}{P_F}\right)_i + \alpha_2 S_{Fi} + u_i \tag{1}$$

where

r is the return to buying in the auction and selling one month after trading begins. P_A is the auction clearing price.

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

We use the subscription rate for the fixed price tranche, S_F , to control for overall demand for the shares. Fixed price orders are a good proxy of underlying demand for the shares because they are orders for the same shares, collected simultaneously from the same set of potential investors, with the reservation price (minimum bid) in the auction equal to the fixed offering price. Investors chose whether to order in the auction or the fixed price tranche (or both), with the trade-off being that the limit on the number of shares ordered was much lower for the fixed price tranche (usually 1,000 or 5,000 shares, where 1,000 is a 'round lot' in Singapore), but the price was typically lower, and could not be higher, than for the auction.

We are looking for evidence of inadequate bid-shaving by investors that had to adjust for the winner's curse in Singapore's IPO auctions. But, of course, even investors participating in the fixed price tranches of these offerings faced a winner's curse, as shown by Rock (1986)⁶³. If investors found it difficult to adjust for the winner's curse even in relatively straight-forward cases, then they may have miscalculated their entry decisions for the fixed price portion, as well as the auction portion, of these offerings. Nevertheless, the entry decision for the fixed price tranche was less subject to error, and hence the fixed price subscription rate is a relatively clean measure of underlying demand that will help to differentiate between high auction bids due to true demand and high bids due to inadequate bid-shaving.

The results are consistent with our expectations. The coefficient for the fixed price subscription rate is positive and significant at the 2% level in a one-tailed test, meaning that

STIC and Vickers Ballas, because they were later taken over and we could not get aftermarket trading prices. ⁶³ although Chowdhry and Sherman (1996b) showed that the winner's curse would have been reduced by the

strict upper limit on the size of orders.

higher underlying demand for the shares led to higher returns to auction bidders⁶⁴. The coefficient for the auction premium is negative and significant at the 10% level in a one-tailed test, meaning that a higher auction clearing price tended to lead to lower returns for bidders, an indication that the higher price was not due to higher underlying value but to excessively high bids. The adjusted R-Squared for the regression is 14.3%.

Last, we find evidence that past auction returns affected future participation. This is either evidence of irrational behavior on the part of auction bidders, or of learning over time. Either is consistent with our story, which is that poorly informed investors (both free riders, and bidders that 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. We regress the auction participation rate on the 1-month raw return since placement on the stock two issues back. We use the next-to-last auction return rather than the last auction return since the one-month return to the most recent auction would not yet have been observable to auction bidders in some cases. The coefficient is positive and significant, with an adjusted R-squared of 41.97%. This is another way to summarize the evidence in Sections V.C and V.D that potential bidders in Singapore did not understand the auction method from the beginning and were influenced by past returns.

VI. Discriminatory Auctions: Japan's Experience

We have seen that there may be substantial free rider problems with uniform price auctions. One way to reduce the free rider problem is to use discriminatory (pay-what-you-bid) auctions instead. This reduces the moral hazard problem, since each person knows that he will have to pay whatever he bids, but this also increases the winner's curse problem, especially given the uncertainty about the number of bidders.

As we discussed in section 3.C, in uniform price and discriminatory auctions there is no assurance that an investor will be compensated fairly for the time and effort spent on gathering and analyzing information necessary for valuing a new equity issue. Consequently, there is no way to guarantee the participation of a sufficient number of serious investors who carefully evaluate and bid in each auction. The large random variations in the number of participants in

⁶⁴ In other words, the auctions led to 'partial adjustment' as predicted in Sherman (2005). See also Loughran and Ritter (2002) on partial adjustment.

an IPO makes it difficult to determine how a bid should be adjusted to account for the winner's curse, making auctions risky even for those bidders that are both informed and sophisticated enough to solve the optimal bid-shaving calculations. For a naïve, uniformed bidder, discriminatory auctions would be even riskier. We should therefore expect significant underpricing on average, large fluctuations in initial returns and in aftermarket performance, and an increased risk of investors losing money.

A discriminatory auction, by definition, introduces larger variability in investor returns, since the various winning bidders may pay very different prices. Analysis of discriminatory IPO auctions in the literature has tended to focus only on the returns to those that pay the weighted average winning bid price in each auction, so we often cannot observe the full range of returns. But clearly, relative to the average return, some will do better and some will do worse, meaning that there is additional ex ante uncertainty for each bidder.

Of the many countries that have tried discriminatory IPO auctions, the two countries that have done the most are Japan and Taiwan. The original auctions used in both countries were quite similar, although Japan later made changes to their regulations in response to some problems with price discovery in the auctions. Japan began requiring auctions in 1989, and first allowed book building as an alternative in 1997. Taiwan allowed auctions beginning in 1995. Both used sequential hybrids, with a subsequent fixed price public offer tranche.

A key difference is that Taiwanese issuers were given an alternative – pure fixed price public offers⁶⁵. Figure 1.B shows that auctions were fairly popular in their first few years in Taiwan but lost popularity later, thus indicating that there may have been some learning over time. Unfortunately, we have not found any research on Taiwanese IPOs that examines the returns on their IPOs chronologically, as we did for Singapore's IPOs in Figure 3. On the other hand, several papers have examined Japan's abrupt transition from auctions to book building (for instance Kaneko and Pettway, 2001, and Kutsuna and Smith, 2004). In Japan's case, issuers had been forced to use auctions for many years and had thus had plenty of time to learn what to expect from the method before they were given a choice. Once Japanese issuers were allowed to choose, auctions quickly vanished.

⁶⁵Actually Taiwanese issuers had a third alternative, as reported earlier. Book building may also be used in Taiwan, but only for IPOs selling primary shares, while auctions may only be used for an IPO of secondary (already issued) shares. We have been told that issuers in Taiwan believe that they will receive an inconvenient amount of regulatory scrutiny if they sell new shares in their IPO, and so it is common practice to issue more shares to existing stockholders before the IPO, and then to sell those shares in the IPO itself.

For Taiwan, Liu, Wei and Law (2001) found positive initial returns, measured from the weighted average winning bid price to the price at the end of the first non-hit day (since IPOs in Taiwan often cannot trade freely during the days immediately following the IPO date, due to daily price limits on the exchange). However, Lin, Lee and Liu (2003) found that these positive initial returns are followed by significant negative market-adjusted returns for the first week or more on the aftermarket. Looking at the market-adjust return from the weighted average winning bid price to the price on day 20 of aftermarket trading (long enough, they argue, to include both the climb towards the first non-hit day and the drop that tends to occur after the stock has begun to trade freely), they found that the mean, median and standard deviation of these returns were 2.8%, 1.1% and 25.7%, respectively. The market-adjusted 20 day returns ranged from -54% to +90%. The unadjusted mean, median and standard deviation of 20 day returns were 2.4%, -1.6% and 30.5%.

Thus, in terms of raw returns from Taiwan's IPO auctions, the median return to an investor who regularly bid the weighted average winning bid price and sold her stock on the 20th trading day following the IPO date would have been -1.6%; the return standard deviation would have been 30.5%. Half the bidders would have done worse than -1.6%, with at least some of the other half getting positive returns. Raw returns at the weighted average winning bid ranged from -58% to +89%. Unfortunately, Lin, Lee and Liu (2003) did not report returns for the offerings chronologically, so we do not know if the worst returns tended to come later in the sample, perhaps accompanied by lower participation rates over time. But the evidence indicates that bidding in Taiwanese IPO auctions was risky, with possibly poor compensation for the risk involved.

We also have evidence of large variation in the number of bidders in Taiwan's auctions, from Hsu and Shiu (2004). For the 77 IPO auctions from January 1996 through April 2000, the mean and median of the number of bids were 987 and 645, while the standard deviation of the number of bids was 1,120. When bids are divided between institutional and retail or between large and small, every sub-category also has a standard deviation greater than either the mean or median. They do not report whether there were any trends over time in the number of bidders. In terms of subscription, the auctions ranged from being 61% undersubscribed to being 1,620% oversubscribed. Thus, there is evidence of wide variation in bidder participation for Taiwanese auctions; even the most sophisticated bidders would have found it difficult to

adjust their bids appropriately for winner's curse. There is evidence of positive initial returns followed by significant negative aftermarket returns, so that as many as half of the winning bidders might have received negative market-adjusted overall returns, if they did not flip their shares quickly enough in the aftermarket.

For Japan, we have not found papers that report variation in the number of bidders. However, evidence from Kutsuna and Smith (2004) suggests that more than half of winning auction bidders lost money, in terms of initial returns. That paper focuses on returns to the subsequent fixed price tranche, rather than on the returns to auction bidders. Nevertheless, by combining two sets of numbers, we can infer that the first day's aftermarket price was, on average, half a percent below the weighted average winning bid. The median first day's closing price was 3.1% below the median weighted average winning bid, implying that many winning auction bidders in Japan lost money if they sold on the first day of trading. They also found evidence that some types of issuers may have been unable to go public at all, when only auctions were allowed.

In addition to the evidence that many auction bidders would have lost money if they flipped on the first day of aftermarket trading, Kerins, Kutsuna and Smith (2003) found that, for Japanese IPO auctions listed on JASDAQ from 1995 to 1997, the mean one-month adjusted aftermarket return was around -2.8%, with a median between -4.5% and -5.0%. They do not explore this aspect of the data⁶⁶, but it implies that auction bidders who held onto their shares for the first few weeks did even worse than those who sold on the first day.

Many examples can be found in the financial press of the risks of bidding in Japanese IPO auctions, suggesting that a number of bidders did not adequately shave their bids for the winner's curse, and thus bid too high. In the 1993 East Japan Railway (JR East) auction, the highest winning bidders paid 77% more per share than the lowest winning bidders. Even when the stock climbed 62% from the weighted average winning bid price in the first two days of aftermarket trading, the highest winning bidders still were not "in the money" (and after those first two days, the stock began a long decline).

In the Japan Tobacco auction the next year, bids were so high that "the results shocked even the most seasoned equities analysts"⁶⁷. Some bidders later cancelled their bids, even

⁶⁶ Neither do they explain what the adjusted aftermarket returns are. It's possible that the returns are relative to the JASDAQ daily index returns for the same period.

⁶⁷ The Nightly Business Report, Friday September 9, 1994, on U.S. public television.

though this meant forfeiting their 30% deposits, and only 59% of the Japan Tobacco shares were sold, in the end. Investment bankers worried that the "tendency of overheating in IPO price-setting share auctions could chase ordinary investors away. The initial prices fetched by Kyowa Engineering Consultants Co. and some other firms that debuted on the OTC market earlier this year turned out to be peak prices, as those stocks subsequently fell below their IPO prices"⁶⁸. This suggests that, as in Figure 2, even sophisticated bidders may have difficulty shaving their bid down to adjust sufficiently for the winner's curse on auctions that, ex post, turned out to have attracted an unusually large number of bidders.

To summarize, uncertainty regarding the number of participants and their level of interest makes it risky for an investor to bid in an IPO auction, whether it is a uniform price auction or a discriminatory auction. An investor may, instead, rationally choose to wait and buy the stock after the issue starts trading. But then the IPO may fail and the stock may never trade, if too many investors choose to wait.

VII. Does modern technology make auctions more attractive?

Some have argued that the track record of IPO auctions a decade or more ago is irrelevant, because those auctions were unable to use "modern technology" (i.e. the Internet). The argument seems to be that only the Internet allows auctions to be truly opened up to everyone; and that expanding the pool of potential bidders through online auctions will stabilize the number of bidders in an auction. However, that may not happen. Sherman (2005) shows that, when information acquisition is costly, increasing the number of potential bidders in an auction either increases the variance in the number of bidders or lowers the mean, or both, for both uniform price and discriminatory auctions.

Moreover, most countries around the world have long opened their IPOs to a large number of investors. Privatizations have led to some large offerings in relatively undeveloped countries, and yet everyone was accommodated. The 1994 Petron IPO in the Philippines attracted nearly half a million participants. Malaysia's Petronas Gas IPO was so popular that order forms were collected in Merdeka Stadium, since the stadium was designed to offer parking for large numbers at once (they were expecting a rush close to the deadline). India and

⁶⁸ "IPOs Gather Steam On Stock Market", Jiji Press Ticker Service, August 26, 1993.

Malaysia began requiring application forms to be printed in newspapers, to make them easier for large numbers of people to obtain.

In Singapore, IPO orders have been taken through ATMs (automated teller machines) since 1993, meaning that people could have placed bids in the Singaporean auctions studied in this paper by simply stopping by the closest ATM. Roughly half the population of Singapore participated in the November, 1993 Singapore Telecom IPO⁶⁹. Thus, IPOs were open to large numbers of investors even when there was no Internet, and hence the Internet is unlikely to solve the problems that made auctions fail.

VIII. 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. Issuers chose not to use auctions once they became familiar with the method, if they were given either fixed price public offers or book building as an alternative.

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 very low mean and variance of initial returns.

In Singapore and in other countries, we found evidence of free riders who placed unrealistically high bids, presumably assuming that other bidders had done their due diligence and engaged in price discovery. An unexpectedly large number of free riders can cause the auction clearing price to be unrealistically high, leading to aftermarket underperformance. We found evidence of frequent price drops during aftermarket trading, leading auction bidders to end up with negative returns, particularly if they failed to flip their shares quickly once trading began.

⁶⁹ "Singapore Telecom shares 4 times oversubscribed", Japan Economic Newswire, Kyodo News Service, Singapore, Oct. 29, 1993.

This underperformance primarily came later in our Singapore sample, after auctions had been in use for some time. 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.

Discriminatory auctions, where every winning bidder pays his bid price, do not suffer from a free rider problem but still face the winner's curse. One might argue that the winner's curse problem is easily remedied in theory, as long as all bidders are sophisticated enough to follow the optimal bid-shaving policy. However, this is not an easy task in practice, particularly when the effort necessary to gather information, the amount of information available to other bidders, and the number bidders are all unknown and vary substantially across issues. Given these uncertainties, an investor may be tempted to wait and buy the shares after the issue starts trading. But then, if a substantial number of investors chooses to wait, the issue may never start trading. Evidence from Taiwan and Japan lends support for this view.

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 inaccurate pricing, undersubscriptions, volatility and apparent free rider problems with IPO auctions are consistent with costly evaluation/endogenous entry models but do not appear to be consistent with endowed information/full entry models or with private values models, as shown in Table 5. Given that people have used the latter models to argue the superiority of the auction method, it is important to note that those models 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 what we expected to find in terms of participation variations: that they have been a major source of problems for IPO auctions around the world. 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 discussed earlier; and book building should replace fixed price public offers in more developed markets, with good institutions and an activity level sufficient to sustain a competitive investment banking industry.

References

Amihud, Yakov, Shmuel Hauser, and Amir Kirsh (2003) "Allocations, adverse selection, and cascades in IPOs: Evidence from the Tel Aviv Stock Exchange," *Journal of Financial Economics* 68, 137-158.

Aussenegg, Wolfgang, Pegaret Pichler and Alex Stomper, 2005, IPO Pricing with Bookbuilding and a When-Issued Market, *Journal of Financial and Quantitative Analysis* forthcoming.

Arosio, Roberto, Giancarlo Giudici and Stefano Paleari, 2000, Underpricing and Money "Left on the Table" in Italian IPOs, Unpublished paper, Politecnico di Milano.

Ausubel, L. M., 2002, Implications of Auction Theory for New Issues Markets, Unpublished paper, University of Maryland.

Back, K., and J. Zender, 1993, Auctions of Divisible Goods, *The Review of Financial Studies* 6, 733-764

Bajari, P. and A. Hortacsu, 2003, The winner's curse, reserve prices, and endogenous entry: empirical insights from eBay auctions, *Rand Journal of Economics* 34, 329-355.

Bartolotti, Bernardo, William Megginson and Scott Smart, 2006, The Rise of Accelerated Seasoned Equity Underwritings, Unpublished paper, University of Oklahoma.

Bazerman, M.H., and W.F. Samuelson, 1983, I Won the Auction But Don't Want the Prize, *Journal of Conflict Resolution*, 27, 618-634.

Benveniste, Lawrence and Paul Spindt, 1989, How Investment Bankers Determine the Offer Price and Allocation of New Issues, *Journal of Financial Economics* 24, 343-361.

Benveniste, Lawrence and William Wilhelm, 1990, A Comparative Analysis of IPO Proceeds under Alternative Regulatory Regimes, *Journal of Financial Economics* 28, 173-207.

Biais, Bruno and Anne Marie Faugeron-Crouzet, 2002, IPO Auctions: English, Dutch,...French and Internet, *Journal of Financial Intermediation* 11, 9-36.

Biais, Bruno, Peter Bossaerts and Jean-Charles Rochet, 2002, An Optimal IPO Mechanism, *Review of Economic Studies* 69, 117-146.

Bierbaum, Juergen and Veronika Grimm, 2002, Selling Shares to Retail Investors: Auction vs. Fixed Price, Unpublished paper, Humboldt University of Berlin.

Bulow, Jeremy and Paul Klemperer, 2002, Prices and the Winner's Curse, *Rand Journal of Economics* 33 (1), 1-21.

Busaba, Walid and Chun Chang, 2002, Bookbuilding vs. Fixed Price Revisited: The Effect of Aftermarket Trading, Unpublished paper, University of Western Ontario.

Camp, Grame and Robert Munro, 2000, Underpricing in New Zealand: A comparison of the fixed price and book-building methods, Unpublished paper, University of Auckland.

Campbell, Colin and Dan Levin, 2006, When and Why Not to Auction, *Economic Theory* 27, 583-596.

Chahine, Salim, 2001, Mispricing in IPO Methods and the Predictive Ability of Investors' Interest for New Issues, Unpublished paper, Audencia-Nantes School of Management.

Chemmanur, Thomas and Huanliang Mark Liu, 2003, How Should A Firm Go Public? A Dynamic Model of the Choice Between Fixed Price Offerings and Auctions in IPOs Privatizations, Unpublished paper, Boston College.

Chen, Zhaohui and William Wilhelm, 2005, A Theory of the Transition to Secondary Market Trading of IPOs, Unpublished paper, University of Virginia.

Chowdhry, Bhagwan and Ann Sherman, 1996a, International Differences in Oversubscription and Underpricing of Initial Public Offerings, *Journal of Corporate Finance* 2, 359-381.

Chowdhry, Bhagwan and Ann Sherman, 1996b, The Winner's Curse and International Methods of Allocating Initial Public Offerings, *Pacific-Basin Finance Journal* 4, 15-30.

Cornelli, Francesca and David Goldreich, 2001, Book Building and Strategic Allocation, *Journal of Finance* 56, 2337 - 2369.

Cornelli, Francesca, Goldreich, David and Alexander Ljungqvist, 2005, Investor Sentiment and Pre-IPO Markets, *Journal of Finance* forthcoming.

Degeorge, François, François Derrien and Kent Womack, 2006, Analyst Hype in IPOs: Explaining the Popularity of Bookbuilding, Unpublished paper, Tuck School of Business, Dartmouth College.

Derrien, Francois and Kent Womack, 2003, Auctions vs. Book-Building and the Control of Underpricing in Hot IPO Markets, *Review of Financial Studies* 16, 31-61.

French, Kenneth and Robert McCormick, 1984, Sealed Bids, Sunk Costs and the Process of Competition, *Journal of Business* 57, 417-441.

Goergen, Marc G.J., 1997, The Transfer of Control in British and German IPOs, Unpublished paper, University of Manchester.

Goldreich, David, 2005, Underpricing in Discriminatory and Uniform-Price Treasury Auctions, *Journal of Financial and Quantitative Analysis* forthcoming.

Habib, Michel and Alexander Ljungqvist, 2001, Underpricing and Entrepreneurial Wealth Losses in IPOs: Theory and Evidence, *Review of Financial Studies* 14, No. 2, 433-458.

Habib, M. and A. Ziegler, 2003, Why government bonds are sold by auction and corporate bonds by posted-price selling. Research paper 78. Foundation for the Advancement of Monetary Education, New York.

Harstad, R. M., 1990, Alternative common-value auction procedures: revenue comparisons with free entry, *Journal of Political Economy* 98, 421-429.

Hausch, Donald and Lode Li, 1993, A common value auction model with endogenous entry and information acquisition, *Economic Theory* 3, 315-334.

Hendricks, K.R., R.H.Porter, and C.A. Wilson, 1994, Auctions for Oil and Gas Leases with an Informed Bidder and a Random Reservation Price, *Econometrica*, 62, 1415-1444.

Hsu, Yenshan and Cheng-yi Shiu, 2004, Information Content of Investors' Bids in IPO Auctions: Evidence from Taiwan, *Journal of Financial Studies* 12, No. 1, 27-50.

Jagannathan, Ravi and Ann Sherman, 2005, Reforming the Bookbuilding Process for IPOs, *Journal of Applied Corporate Finance* 17, 67-72.

Jenkinson, T. and H. Jones, 2004, Bids and allocations in European IPO book building. *Journal of Finance* 59, 2309-2338.

Jenkinson, Tim and Colin Mayer, 1988, The Privatization Process in France and the U.K., *European Economic Review* 32, 482-490.

Jenkinson, Tim, Morrison, Alan D., and William J. Wilhelm, 2005, Why are European IPOs so rarely priced outside the indicative price range?, *Journal of Financial Economics* forthcoming.

Kagel, J.H., and D. Levin, 1986, The Winner's Curse and Public Information in Common Value Auctions, *American Economic Review*, 76, 894-920.

Kandel, Shmuel, Oded Sarig and Avi Wohl, 1999, The Demand for Stock: An Analysis of IPO Auctions, *Review of Financial Studies* 12, 227-247.

Kaneko, Takashi and Richard Pettway, 2001, Auctions versus Book Building Underwriting of Japanese IPOs: OTC, Mothers and NASDAQ-Japan Issues, Unpublished paper, University of Missouri.

Kerins, Francis, Kenji Kutsuna and Richard Smith, 2003, "Why Are IPOs Underpriced? Evidence from Japan's Hybrid Auction-Method Offerings," Unpublished paper, Claremont Graduate University.

Kutsuna, Kenji and Richard Smith, 2004, "Why Does Book Building Drive Out Auction Methods of IPO Issuance? Evidence from Japan," *Review of Financial Studies* 17, # 4, 1129-1166.

Kyle, Albert S., 1989, "Informed Speculation with Imperfect Competition," *Review of Economic Studies* 56, 317-356.

Levin, D. and J. L. Smith, 1994, Equilibrium in auctions with entry, *American Economic Review* 84, 585-599.

Lin, Ji-Chai, Yi-Tsung Lee, and Yu-Jane Liu, 2003, Why Have Auctions Been Losing Market Shares to Bookbuilding in IPO Markets?, Unpublished paper, Louisiana State University.

Liu, Y.-J., Wei, K. C. J., Liaw, G., 2001. On the demand elasticity of initial public offerings: an analysis of discriminatory auctions. *International Review of Finance* 2, 151-178.

Loughran, Tim and Jay R. Ritter, 2002, Why don't issuers get upset about leaving money on the table in IPOs? *Review of Financial Studies* 15, 413-444.

Loughran, Tim and Jay R. Ritter and Kristian Rydqvist, 1994, Initial Public Offerings: International Insights, *Pacific-Basin Finance Journal* 2, 165-199.

Ljungqvist, Alexander, Jenkinson, Tim, and William J. Wilhelm, 2003, Global integration in primary equity markets: The role of U.S. banks and U.S. investors. *Review of Financial Studies* 16, 63-99.

Ljungqvist, Alexander, and William J. Wilhelm, 2002. IPO Allocations: Discriminatory or Discretionary? *Journal of Financial Economics* 65, 167-201.

Ljungqvist, Alexander, 2004, "IPO Underpricing: A Survey". Handbook In Corporate Finance: Empirical Corporate Finance, B. Espen Eckbo, ed.

Matthews, S., 1987, Comparing auctions for risk averse buyers: A buyer's point of view, *Econometrica* 55, 633-646.

Parlour, Christine and Uday Rajan, 2005, Rationing in IPOs, Review of Finance 9, 33-63.

Ritter, Jay and Ivo Welch, 2002, Review of IPO activity, pricing, and allocations. *Journal of Finance* 57(4), 1795-1829.

Rock, K. (1986). Why New Issues are Underpriced? Journal of Financial Economics 15, 187-212.

Schultz, Paul, 2003. Pseudo Market Timing and the Long-Run Underperformance of IPOs, *Journal of Finance* 58, 483–517.

Sherman, Ann, 1992, The Pricing of Best Efforts New Issues, Journal of Finance 47, 781-790

Sherman, Ann, 2000, IPOs and Long Term Relationships: An Advantage of Book Building, *Review of Financial Studies* 13, 697-714.

Sherman, Ann, 2005, Global Trends in IPO Methods: Book Building versus Auctions With Endogenous Entry, *Journal of Financial Economics* 78 (3), 615-649.

Sherman, A., Titman, S., 2002. Building the IPO order book: underpricing and participation limits with costly information, *Journal of Financial Economics* 65, 3-29.

Spatt, C. and S. Srivastava, 1991, Preplay communication, participation restrictions, and efficiency in initial public offerings, *Review of Financial Studies* 4, 709-726.

Subrahmanyam, A. and Sheridan Titman, 1999, The going public decision and the development of financial markets, *Journal of Finance* 54, 1045-1082.

Viswanathan, S. and James J.D. Wang, 2000, Auctions with When-Issued Trading: A Model of the U.S. Treasury Markets, *Manuscript*, Duke University.

Welch, Ivo, 1992, Sequential Sales, Learning and Cascades, Journal of Finance 47, 695-732.

Wessels, R.E., 1989, The Market for Initial Public Offerings: An Analysis of the Amsterdam Stock Exchange, in: A Reappraisal of the Efficiency of Financial Markets, NATO ASI Series, F54, Springer-Verlag, Berlin, 323-348.

Wilhelm, William, 2005, Bookbuilding, Auctions, and the Future of the IPO Process. Journal of Applied Corporate Finance 17, 2-13.

Yung, Chris, 2005, IPOs with Buy- and Sell-Side Information Production: The Dark Side of Open Sales, *Review of Financial Studies* 18, 327-347.

Appendices

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

Several types of IPO auctions have been used. Brazil, Japan, Malaysia, the Philippines, Singapore, Taiwan and the U.K. have used discriminatory (pay what you bid) auctions, while Argentina, Australia, Brazil, Finland, France, Israel, Malaysia, the Netherlands, New Zealand, Norway, Peru, Portugal, Singapore, Turkey, the U.K. and the U.S. have used uniform price auctions⁷⁰. Chile uses an auction on the exchange, which is similar to an English (open, ascending bid) auction. "Dirty Dutch" auctions (where the price is set below market-clearing) have been used in Australia, Belgium, Finland, France, Hungary, Malaysia, New Zealand, Turkey, the United Kingdom and the United States, and have been especially common for IPOs in Belgium, France and the U.K.

Not long after WR Hambrecht's introduction of online IPO auctions to the US, Ord Minnett's eCapital⁷¹ distributed shares in two Australian IPOs through a similar method. Both underwriters used uniform price, sealed bid, dirty auctions⁷², although eCapital called its process a "book build". 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.

Table 1 also shows that all but 10 of the 46 countries we examine have used book building. Of the 10 countries that (to the best of our knowledge) have not yet used book building, some of the countries have inactive stock markets – such as Sri Lanka, Bangladesh, Paraguay – and some restrict book building – such as Taiwan and Israel.

Last, Table 1 shows that the public offer/fixed price method is very common

⁷⁰ In financial markets, uniform price auctions are sometimes (mistakenly) called Dutch auctions. A Dutch auction is an open, descending bid auction, such as the method that is often used to sell flowers and produce in the Netherlands: First a high price is called out, then progressively lower prices are called until someone agrees to purchase at least some of the units. Those units are sold at that price and then the auction is restarted, often at a somewhat higher price, and the price continues to descend until all units are sold. In the end, units may be sold at many different prices. Thus, the closest sealed-bid equivalent to a Dutch auction would be a discriminatory, not a uniform price, auction.

⁷¹ 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.

⁷² 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.

worldwide, at least in terms of the number of countries that use it. It is becoming less common, particularly for larger issues and in larger, more active markets. Nevertheless, public offer remains popular and unlikely to vanish completely. It is an efficient, low cost way to distribute shares to retail investors, avoiding the high fixed costs of road shows (Ljungqvist, Jenkinson and Wilhelm, 2003, document the lower direct costs). It doesn't rely on long term relationships between the underwriter and investors, as does book building. The pay-in-advance feature allows orders to be collected from many unknown investors without a risk of subscriber defaults, and it often has the added benefit of generating float for the issuer. For relatively inactive markets such as Barbados, which had only 3 IPOs in 1994, none in 1995 and 2 in 1996, the public offer method has strong cost advantages.

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, since an auction "more accurately equates supply and demand", because each person bids what he or she is willing to pay. In Section III, we showed that this is not true in theory, except under some extremely unrealistic assumptions. In practice, there are many examples of highly inaccurate auction prices (assuming that the first day's closing price is a good estimate of the 'true' value).

Of course, book built and public offer IPOs have also frequently led to offering prices that were very far from the first day's aftermarket price. Table 4 showed that, at least for our Singapore sample, auctions seemed to price IPO shares more accurately than fixed price public offers. Nevertheless, Table 4 also showed that the variance in initial returns was far from zero. We will now give examples to show 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 tender was a hybrid discriminatory auction/public offer. Initial returns for winning tenders ranged from 23% to 34%, even though the market-clearing price in the tender 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 yen/share. The offering price was set at 3.7 million, because most successful bids were concentrated at that price. The closing price on the first day of trading was 5.5 million yen.

- Singapore Telecom, October 1993, 39% at peak: SingTel's auction price of S\$3.60 was far above expectations, yet it traded almost 39% higher on the first day of trading, at S\$5.00 per share, before closing at S\$4.14 a share, up only 15%. After the first day's trading, the stock fell slowly but steadily for more than a year.
- 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 (i.e. nearly half a million Filipinos participated in the IPO).
- Andover.net, US, December, 1999, 252.1%: The offering was priced at \$18 even though the clearing price was \$24, reportedly because Andover did not want to delay the offering in order to file an amended price range with the SEC. The first day's closing price was 164% above 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 offering price.
- El Al, Israel, June 2003, 40%: Demand was low in the auction, with all shares (and warrants) selling 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.

Unlike book building and fixed price, which are both far more likely to err on the side of positive initial returns (due in part to aftermarket price support, at least in some cases), there are examples of large negative as well as positive IPO auction initial returns, particularly if the issue is followed beyond just the first day or two, as shown in subsection V.C. Some examples of negative initial returns from IPO auctions are:

- Japan Telecom, September 1994, down 14.5% from the weighted average bid price on the first day, and down another 10% by the end of the first week: The lowest successful bid was 5.22 million yen/share, 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 yen/share, with a weighted average of 5.44 million yen/share. The stock closed its first day at 4.65 million yen, 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 yen for shares that institutional investors valued at no more than 800,000. Successful bids ranged from 1.362 million to 2.11 million yen. It closed the first day at 1.10 million yen/share, and the second day at 1.06 million yen/share (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.

Thus, there are many examples of extreme initial returns resulting from IPO auctions. This does not prove that auctions are inferior to other issue methods but does show that the data are not consistent with the independent private values models and endowed information/fixed entry models that predict IPO auctions led to extremely accurate prices.

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 (only two auctions in each) or eventually Israel (where legislation to allow bookbuilding is pending, after ten years of mandated auctions).

- France: An unique, theoretically sound version of auctions co-existed with a restricted, sub-optimal form of book building, as well as the fixed price method, 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 is inconclusive. The question of which method - auctions or book building – leads to less underpricing is still an open question.

Table 1. Summary of IPO Methods Used in Various Countries. A blank in any column means, to the best of our knowledge, is that 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 the question of whether the book building method is now dominant or gaining in popularity, the answer given is in the judgment of the main source for that country listed in Appendix D. For the most part, the source was someone at the regulatory agency or exchange for that country.

		Aucti	Auctions Book Building			5
	Traditional	First	Apparently	First	Now dominant	Hybrid with
	method(s)	introduced	abandoned	Introduced	or gaining?	Fixed Price
Europe						
Austria	Fixed price			1992	yes	yes
Belgium				1993	yes	
Czech Republic	Fixed price					
Denmark	Fixed price			1992	yes	yes
Finland	Fixed price			1993	yes	yes
	Auctions, fixed					
France	price	1960s	1999?	1993	yes	yes
Germany	Fixed price	only 2		1995	yes	yes
Greece	Fixed price			1994	yes	yes
Hungary	Fixed price			1995	yes	yes
Ireland	Fixed price			1992		yes
Italy	Fixed price	1980s	1986	1992	yes	yes
Luxembourg				1996	yes	
Netherlands	Fixed price	1980s	1989	1994	yes	yes
Norway	Fixed price			1995	yes	yes
Poland	Fixed price	1993?		1995	yes	yes
Portugal	Fixed price	1987	1992	1995	yes	yes
Spain		Only 2	1998	1993	yes	yes
Sweden	Fixed price	1980s	1980s	1993	yes	yes
Switzerland	Fixed price	1980s	1980s	1995	yes	yes
United Kingdom	Fixed price	1981	1986?	1992?	yes	yes

PANEL A

PANEL B.

		Auct	Auctions Book Building			g
	Traditional	First	Apparently	First	Now dominant	Hybrid with
	method(s)	introduced	abandoned	Introduced	or gaining?	Fixed Price
N. & S. America						-
Argentina		1991	1992	1993	yes	yes
Barbados	Fixed price				·	2
Brazil	Fixed price	yes			yes	yes
Canada	Book building	-			yes	yes
Chile					yes	-
Mexico	Fixed price				-	
Paraguay	Fixed price					
Peru	Fixed price	yes		1996	yes	yes
United States	Book building	1999			yes	yes
Asia/Pacific					-	
Australia	Fixed price	1999	1999	1992	yes	yes
Bangladesh	Fixed price					
China	Fixed price				yes	yes
Hong Kong	Fixed price			1993	yes	yes
India	Fixed price			1993	yes	yes
Indonesia	Fixed price				yes	yes
Japan	Fixed price	1989	1997	1997	yes	yes
Korea	Fixed price	1993?			yes	yes
Malaysia	Fixed price	1992	1994	1995	yes	yes
New Zealand	Fixed price				yes	yes
Philippines	Fixed price	1994	1994		yes	yes
Singapore	Fixed price	1991	1994		yes	yes
Sri Lanka	Fixed price					
Taiwan	Fixed price	1995	?			
Thailand	Fixed price				yes	yes
Africa/Middle Eas	t					
Kenya	Fixed price					
	Auctions, fixed					
Israel	price	< 1993	?			
Jordan	Fixed price					
Pakistan	Fixed price			1995	no	
South Africa	Fixed price					yes
Turkey	Fixed price	1993	1997		yes	yes

Table 2. Funds raised in Singapore IPOs (in S\$ millions). There were 11 Main Board public offers and 18 Main Board auctions in 1993-1994, as well as 20 Sesdaq public offers and two Sesdaq auctions. 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 U.S. 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.

			Standard		
	Mean	Median	deviation	Maximum	Mininum
Main Board Auctions	337.64	48.4	1,001.5	4,332	16
Main Board Auctions, Excluding					
Singapore Telecom	102.67	44.8	99.2	338	16
Main Board Public Offers	56.50	37.7	53.6	200	17
Sesdaq Auctions	67.20	67.2	32.8	90	44
Sesdaq Public Offers	11.55	9.3	7.1	30	4

Table 3.	Singapore	IPOs by	Sector.	1993-1994.

	·	Public			%	
	Auctions,	offers,		Public	Auctions,	Total
	Main	Main	Auctions,	offers,	Main	IPOs in
Sector:	Board	Board	Sesdaq	Sesdaq	Board	Sector
Basic Materials	3	2	0	5	60%	10
Capital Goods	1	4	0	3	20%	8
Conglomerates	1	0	0	0	100%	1
Consumer Cyclicals	1	0	0	1	100%	2
Consumer/Non-						
cyclical	2	1	0	1	67%	4
Financials	3	0	0	0	100%	3
Services	3	1	0	5	75%	9
Technology	2	2	2	5	50%	11
Transportation	2	1	0	0	67%	3
Total:	18	11	2	20		

Table 4.A. Initial returns for all Singapore IPOs, 1993-1994. There were 51 IPOs in 1993-1994 in Singapore, including 31 pure fixed price public offers and 20 hybrid auctions. The average initial return for a tender is the weighted average of the initial return on the tender tranche and the initial return on the public offer tranche.

			Standard		
	Mean	Median	deviation	Maximum	Minimum
Tender tranche	4.2%	2.7%	9.0%	24.8%	-14.5%
Fixed price tranche of tenders	49.5%	35.3%	42.0%	137.5%	-1.3%
Pure fixed price	35.8%	20.2%	41.6%	131.1%	-8.8%
Average for tender offerings	24.1%	18.1%	18.2%	58.8%	-1.3%

Table 4.B. Initial returns for Singapore 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.

	Standard							
	Mean	Median	deviation	Maximum	Minimum			
Tender tranche	3.3%	2.7%	7.9%	22.5%	-14.5%			
Fixed price tranche of tenders	47.8%	29.7%	44.0%	137.5%	-1.3%			
Pure fixed price	30.5%	2.1%	48.5%	131.1%	-8.8%			
Average for tender offerings	22.4%	17.0%	18.1%	58.8%	-1.3%			

Table 5.	Predictions	of	various	models	for	the	results	of	a	sealed	bid	uniform	price
auction op	oen to a large	e nu	mber of	potentia	ıl inv	vesto	ors (high	ı N))				

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

Table 6. Participation variations for Singapore IPO auctions, 1993-1994. Subscription rates are for the tender (auction) and fixed price tranches of all 20 auctions, while the number of applications is based on only 18 of the 20 IPO auctions in Singapore during this time period. The two missing application numbers are for IPC (the first uniform price auction that was done in Singapore) and Sunright (the last). 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.

			Standard		
	Mean	Median	deviation	Maximum	Minimum
Subscription rate, fixed price	15.05	11.20	12.36	41.00	1.22
Subscription rate, tender	3.99	2.63	3.44	14.00	0.18
Number applications, fixed price	171,674	164,894	170,907	795,272	28,036
Number of applications, tender	26,006	8,413	40,430	162,492	1,128
Shares applied for, fixed price					
('000)	434,086	458,745	278,934	920,416	54,392
Shares applied for, tender ('000)	350,692	113,577	656,773	2,800,000	16,031
Shares available, fixed price ('000)	51,342	25,940	79,920	350,000	9,737
Shares available, tender ('000)	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.

			Standard			% of IPOs
	Mean	Median	Deviation	Maximum	Minimum	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). 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 101^{st} -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 returns for 18 of the 20 auctions (all except STIC and Vickers Ballas, the 2nd and 8th). 3.B. shows only the 16 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).



