Why Have IPO Auctions Failed the Market Test?[*]

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Abstract

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

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

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

Book building is the primary method through which initial public offerings (IPOs) are brought to the market in the United States (US). An ongoing debate in the academic literature explores the advantages and disadvantages of the book building method, relative to sealed bid auctions. On the one hand, the greater control and flexibility of book building provides substantial benefits to issuers.[1] In addition, book building requires very little sophistication from participants. All that participants have to do is to truthfully share whatever value-relevant information they have about the issue; and the underwriter makes an attempt to allocate shares in such a way that it is in the interest of the participants to do so.

On the other hand, the book building procedure necessarily gives the underwriter substantial discretion over allocations. When agents are given discretion, there is always the potential for abuse, and the scandals following the internet bubble suggest that abuses have occurred in practice[2]. Thus there are both advantages and disadvantages to the flexibility offered by book building. Moreover, there is a general agency problem between underwriters and issuers that has not yet been fully explored in the IPO literature[3]. When that is taken into account, there may be alternatives to the book building method that may be better from the perspective of the issuing firm.

In the search for an alternative, much of the focus has been on auctions, which have been extremely successful in a wide range of alternative settings. With sealed bid auctions, theory also offers trade-offs. Auctions are relatively more transparent, giving little discretion to the auction administrator, and are consequently less subject to manipulation and abuse[4]. If information is endowed (i.e. costless) and bidder entry is predictable, auctions should be relatively efficient. But if accurate estimates of IPO share values are difficult to produce and entry is uncoordinated, theory predicts that auction outcomes may be less desirable (see Sherman, 2005). Participating in an IPO auction requires sophistication on the part of bidders.

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[1] As first shown by Benveniste and Spindt (1989) and Benveniste and Wilhelm (1990). Ritter and Welch (2002), Ljungqvist (2004) and Wilhelm (2005) offer reviews of the academic IPO literature.
[2] See Loughran and Ritter (2004) for discussion of the scandals and overall trends in IPO underwriting.
[3] A notable exception is Biais, Bossaerts and Rochet (2002), for the French regulatory regime.
[4] The Salomon Treasury bond scandal of 1991 suggests that auctions may not be immune to manipulation

They must figure out how much the other bidders know, and what bidding strategies they will use. That can be difficult, especially when there is uncertainty about the nature of the other participants in the auction[5].

Because theory predicts varying outcomes for both auction and book building IPOs, it is worth examining the available evidence regarding the track records of each method. In this paper we offer evidence on overall usage patterns for many countries – the 'market test' - and then examine IPO auction outcomes in more detail. We find that, when standard auctions have had to compete with another method - either with fixed price public offers[6] or with book building - auctions have been driven out.

The lack of popularity of auctions cannot be explained by either lack of familiarity or by differences in underwriting fees. The fees for fixed price public offers in most countries have been the same as those for auctions, leaving investment banks with no incentive to favor one method over the other based on fees. In spite of that, when issuers have been allowed to choose between fixed price public offers and auctions, the former method has prevailed and auctions have lost out[7]. And when fixed price public offers later were faced with competition from book building, the fixed price public offer method has generally lost out, although not as completely as the auction method.

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

The auction method is old and well established, and has been particularly successful for the largest security issue markets – those for government debt, particularly US Treasury securities; and auctions have been frequently used for new preferred stock issues in the United

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[5] The following quote of Munger from Poor Charlie's Almanack (2006, page 18) suggests that even sophisticated investors may find it difficult to figure out how to bid: "The problem with closed bid auctions is that they are frequently won by people making a technical mistake, as in the case with Shell paying double for Belridge Oil."

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

Kingdom (UK), particularly for government-owned utilities[8]. 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[9]. Preferred stocks of regulated utilities are relatively easy to value since they resemble high quality bonds. In contrast, IPOs occur less frequently, at sporadic intervals, and their value is difficult to determine. Each issue is different and may attract a different set of participants. Therefore, theory predicts that IPO auctions may face wide variations in the number of participants. We find evidence supporting this prediction.

A well established problem in auction theory is the winner's curse faced by bidders in a common value setting. Auction participants can adjust for this by shaving their bids, but this adjustment depends on the number of other investors that choose to enter the auction. If bidders do not know how many will participate in the auction, how much they know, and how they will bid,, there may be unpleasant surprises. Auctions that have an unexpectedly large number of random entrants will on average be grossly oversubscribed and overpriced, while those that, by chance, have an unexpectedly low number of participants may be undersubscribed. We find that this is indeed the case. When it is costly to gather information relevant to valuing a new issue, investors who do so must be rewarded. Standard auctions do not guarantee this. In fact, in uniform price auctions, some participants may have an incentive to free ride on the effort of others, by bidding high. Any such free riding will make the auction clearing price volatile and uninformative, contributing to the failure of the market for the issue. We find evidence of this.

An extensive literature in mechanism design is focused toward designing systems that are less vulnerable to errors on the part of participants, and that place less reliance on each participant's sophistication and discipline. For example, a truth-telling mechanism requires relatively little sophistication on the part of participants, because their optimal strategy is simply to truthfully report their information and preferences. An auction in which bidders have to shave their bids for the winner's curse is clearly not a direct truth-telling mechanism and requires sophistication on the part of the bidders. We find evidence indicating the presence of

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[7] The only exception that we know of is France, which used a unique auction method that discouraged free riders.
[8] In the six month period from Oct. 1, 1974 to March 31, 1975, all seven preferred stock issues in the UK used "Offers for Sale by Tender", i.e. auctions. The issuers were all local waterworks or water companies.
[9] Nevertheless, Goldreich (2005) shows that even uniform price Treasury auctions lead to underpricing.

unsophisticated return-chasing bidders who tend to overbid. That would impose costs on other sophisticated bidders, making it less attractive for them to participate in IPO auctions..

The magnitude of underpricing is often mentioned as a disadvantage of the book building method. However, underpricing in fixed price offers tends to be larger than underpricing under either auctions or book building. In spite of that, we find that the fixed price public offer method has driven out auctions, when both were allowed. Hence the money left on the table through underpricing, in and of itself, does not appear to be the primary concern for issuing firms[10].

Discriminatory auctions have many of the same shortcomings as standard uniform price auctions. Like uniform price auctions, discriminatory auctions require sophistication on the part of investors, where mistakes made by unsophisticated bidders can impose large costs on others. Uncertainty about the number of bidders affects both types of sealed bid auctions, and there is no guarantee that a stable set of serious investors has an incentive to devote time and resources to evaluating each IPO. Given that, it is therefore not surprising that the most successful IPO auctions have been of the "dirty"[11] type.

The debate on IPO methods in the US has largely focused on two extremes: either the status quo, or the use of standard sealed bid auctions, which mandate simple, rigid allocation and pricing rules. There are, however, alternatives that fall somewhere in between the opaque allocation system currently used and the elimination of all underwriter discretion or control. We offer several suggestions for modified auctions that, we hope, may combine the transparency of standard auctions with the flexibility and simplicity of book building. We also examine some of the unique features of US IPO auctions.

The rest of the paper is organized as follows. Section I establishes trends in the use of IPO methods, including the many countries that have tried and abandoned the auction method. Section II lays out the problems that we would expect to find with IPO auctions in theory,

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[10] In other words, objective functions for issuers that are based on IPO proceeds alone appear inadequate. Loughran and Ritter (2004) offer a more general objective function.

[11] 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. In a discriminatory auction, each winning bidder pays his or her own bid.

including the winner's curse with endogenous entry, the free rider problem, and the overall difficulties reaching a robust, stable equilibrium, including the possibility of return-chasers.

Section III examines the uncertainty in IPO auctions due to fluctuations in the number of bidders, undersubscription free riding and return chasing. Section IV shows that the rejection of the auction method cannot be explained by lack of familiarity or by pressure from investment banks to use book building.   In Section V, we offer six proposals for improving IPO auctions. Most of the proposals have been used at some point, in some country.   Section VI concludes.

I. Global Patterns

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

Table 1 summarizes the IPO methods used in various countries. More detailed information is given in Appendix C, which is available on the Social Science Research Network[12] and on request, and which shows that most countries allow the use of many methods. We do not know of any country that had formerly allowed auctions and then changed their regulations to prohibit or limit them – the general trend in the last two decades has been to allow greater choice among issuers. The book building method was once rare outside the US but is now common. Auctions have been tried in more than 20 countries but are rare today.

The rarity of IPO auctions today is not due to unfamiliarity. Auctions were used in Italy, Portugal, Sweden, Switzerland and the UK in the 1980s, and in Argentina, Malaysia, Singapore and Turkey in the 1990s, but they were abandoned in all of these countries well

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[12]   At http://ssrn.com/abstract=892026. It should be noted that Table 1 focuses on methods used within various countries. Issuers may instead list elsewhere, rather than in the domestic market. Ljungqvist, Jenkinson and Wilhelm (2003) examine both international and purely domestic IPOs.

before book building was introduced. Auctions were required for many years in Japan, yet quickly vanished once book building was allowed.

In France, auctions were popular in the first half of the 1990s. On the regulated exchanges, they gradually lost market share to a restricted form of book building over several years, then dried up quickly in 1999 when a more standard form of book building was allowed. Auctions continued to be used on the unregulated over-the-counter market (the Marche Libre or Free Market) for several more years, although they eventually seem to have dried up there, also. There were, however, two IPO auctions in France in early 2005[13], which came after there had been no auctions on regulated French exchanges for half a decade.

Auctions were the only method allowed in Israel for a decade. The law requiring their use expired in December, 2003, after which issuers were allowed to effectively choose a fixed price offering by setting a maximum price for the auction. Many of the IPOs between 2004 and mid-2007 chose to set a relatively low maximum price for their offerings, thus effectively choosing fixed price over auction[14]. In July 2007, a long-debated change went into effect, allowing book building for the first time. It is too soon at this point to tell how auctions will compete with book building in the Israeli market.

Many countries have used hybrids – combinations of any two of the three methods. There have been hybrid auction/public offer and auction/book building IPOs, but the most common combination is book building/public offer. For most hybrids, book building (or sometimes an auction) is used to set the price and to allocate shares to institutional and foreign investors, while a fixed price public offer tranche is reserved for local retail investors that do not participate in the price-setting process. Hybrid book building/auctions on the exchange are used in Chile because of regulations, but the offer price is set through book building[15].

In Latin America, auctions have been used in Brazil and Peru in the past. Latin American markets were quiet for much of the last decade, with delistings outnumbering listings

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[13] The two 2005 auctions were for Cafom, on the Second Marche in January and for MG International, on Alternext in June. There have been no further auctions in France as of the end of July, 2007.

[14] The law for one decade had forbidden the use of a maximum price. Technically, Israel was using auctions even before this, but it had become standard to set the maximum price so low that it was virtually sure to be hit, thus effectively making the method a fixed price method. In 2007, Itamar Medical, Maayan Ventures, Clal Finance and Brainsway all set maximum prices for their IPOs, and all ended up being priced at those maximums, but we have not yet been able to verify what proportion of all TASE IPOs set maximum prices.

[15] Pension funds may only purchase shares through an exchange in Chile, so some IPO shares are sold on the floor of the exchange, after the offering price has been set and the rest of the shares have been allocated through

in Brazil, Argentina and Chile[16]. Thus it was hard to predict if auctions were gone completely. However, Brazilian, Chilean and later Argentinean IPO markets began picking up in 2004-2005, with even stronger activity in 2006, and book building has been the dominant method, with no auctions that we know of.

Since 1995, Taiwan has allowed both auctions and book building, in addition to the traditional fixed price public offers. Taiwan's auctions are similar to those that were once required, and are still allowed, in Japan – hybrids in which discriminatory (pay-what-you-bid) auctions were followed by fixed price public offer tranches. Auctions were initially popular but lost market share over time, with more and more issuers returning to fixed price public offers. Book building was originally allowed only in certain restrictive circumstances[17] but has gained popularity in the last few years.

In the US, the investment bank WR Hambrecht has been encouraging issuers to use auctions since mid-1999. The method got much publicity when Google, a popular search engine company, chose to use the auction method for its August, 2004 IPO, but still the auction method is not popular in the US. As of July, 2007, there had been 20 US IPO auctions, 19 of them using WR Hambrecht's OpenIPO auction method. Google was not an OpenIPO and was lead-underwritten by Credit Suisse and Morgan Stanley. In July, 2007, Netsuite filed for an IPO using an auction lead-managed by Credit Suisse, only the second US IPO auction that was not lead managed by WR Hambrecht (although WR Hambrecht is still expected to be closely involved in the Netsuite auction). US IPO auctions are discussed in more detail in Section V.

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

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book building. Such auctions may occur only minutes before general trading on the same floor. In its 2003 IPO, La Polar cancelled the auction completely and distributed its shares through a bookbuild and through brokerages.

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

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

Thus out of 46 countries, auctions have been tried in more than 20, and yet all except France, Israel, Taiwan and the US seem to have abandoned them entirely, and auctions are rare even in these last four countries. Book building is gaining in popularity or is already the dominant method in at least 35 of the 46 countries. Fixed price public offer is still used in smaller countries and for smaller offerings, and is common for the retail tranche of hybrids.

II. Why IPO Auctions May Fail to be Chosen by Issuers

In this section, we discuss what we believe to be the main reasons for the lack of popularity of IPO auctions and outline the predictions of theory regarding large multi-unit sealed bid auctions.

II.A. The Winner's Curse

There is an adverse selection and consequent winner's curse problem for both uniform price and discriminatory auctions – those who get an allocation may have bid too high.[18] The solution to the winner's curse is for all entrants to shave their bids down by the appropriate amount. That adjustment will depend on both the expected number of other bidders and the nature of the information they possess and requires a high level of sophistication and computational capability on the part of all the bidders. In practice, numerous studies have found that bidders apparently find it difficult to adequately adjust their bids for the winner's curse[19]. Oil lease auctions suggest that even experts face this risk. 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 and thus make mistakes.

As Sherman (2005) observes, uncertainty regarding the number of bidders in an auction adds risk[20]; an unexpectedly high number of bidders results in the auction clearing price being

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[18] Those ordering shares in a fixed price public offer also face a winner's curse, as modeled by Rock (1986). But for fixed price public offers, only the probability of getting shares is affected, not the price paid.

[19] Bazerman and Samuelson (1983), using experiments with MBA students, showed that winning bidders were subject to the winner's curse. Kagel and Levin (1986) showed that even moderately experienced bidders tended to bid aggressively, compared to what they would bid under a risk neutral Nash equilibrium. Engelbrecht-Wiggins and Katok (2005) showed that bidders had an even harder time calculating their bids in experimental auctions with endogenous entry. Hendricks, Porter, and Boudreau (1987) examined the return to bidders in outer continental shelf oil lease auctions in the Gulf of Mexico for the period 1954-1969. They found that returns were a decreasing function of the number of bidders and that returns were negative with sufficiently large participation, thus illustrating the risks that even professional bidders face due to endogenous entry.

[20] French and McCormick (1984) show that auction bidders may recover fixed evaluation costs in an auction with

too high. The following example provides an illustration. Suppose each risk neutral 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 through a uniform price auction in which each investor bids for exactly one share. The auction 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 1 shows the distribution of bids and the auction clearing price for N bidders, with N fixed at 120, 200, 500, and 1000 for one randomly chosen auction for each value of N. In each auction shown, the average of all bids gives a fairly good estimate of the value of the shares, but the clearing price usually does not. The clearing prices in the auctions shown range from 27% below true value (winner's virtue) with only 120 bidders to almost 45% above the true value (winner's curse) with 1,000 bidders.

Figure 1 shows only one outcome for each value of N, the number of participants. When we examine 100 randomly generated auctions for each N, the average of all the bids in 100 auctions was very close to $20, the true value, for all five levels of N. The auction clearing price however had a range of $3.93 around a mean of $14.07 for N = 120; $2.95 around $19.92 for N = 200; $2.14 around $24.96 for N = 500; and $1.83 around $27.74 for N = 1000.

First, notice that truth telling (bidding ones estimate of the value) results in an average profit of almost zero when the number of bidders is 200. That is because the auction clearing price in that case is the median of the value estimates of the 200 bidders. Since the estimates are Normally distributed around the true value, the auction clearing price is about the same as the average of the value estimates of all the bidders. When the number of bidders exceed 200, the auction clearing price is an upward biased estimator of the true value – bidding one's estimate of the true value will on average result in a loss, and that is the winner's curse.

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,

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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.

the likely loss would be substantial, averaging about $7.74 (38% of the true value of the stock being auctioned). Randomness in the number of bidders therefore increases the risk associated with the winner's curse, and rational risk averse investors would demand a risk premium for bearing that risk. When investors are sufficiently risk averse, uncertainty about the number of bidders and what those bidders know can increase the compensation investors demand for bearing the winner's curse by such a large amount that expected proceeds may be higher through a fixed price offer (see Campbell and Levin, 2006, Bulow and Klemperer, 2002, and Viswanathan and Wang, 2000). Issuers may therefore prefer other offer methods, to help minimize the effects of variations in the number and informedness of participants.

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. In other words, there were almost 60 times as many bidders for the STIC auction as for Eng Wah (while Singapore Telecom has 144 times as many bidders), whereas in our example the maximum is only about 8 times the minimum.

II.B. Reward for Information Production and the Free Rider Problem

It is difficult to reward investors for price discovery by investing in costly information gathering activities in an auction, unless the number of bidders is restricted. Further, in uniform price auctions, the expense of producing a reasonable bid may also lead to a moral hazard problem. When information collection is costly, and when other bidders have done the analysis needed to value an issue, the incentive is there for a new bidder to enter and bid high without collecting any information at all, since the auction clearing price will hopefully be set by those who have already done the necessary analysis. This will break any pure strategy equilibrium[21].

There may be a mixed strategy equilibrium in which each bidder balances the probability of free riding and getting underpriced shares without investing in information gathering against the risk that too many free riders might enter all at once, driving the price to excessive levels. The optimal number of free riders would be well below X+1 in an X+1st

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

price auction. Informed investors would adjust their entry and information acquisition decisions for the expected entry of free riders.

One effect of free riders would be to reduce the incentive of other investors to produce information, thus making the auction pricing process less informationally efficient, As Sherman (2005) shows, discriminatory auctions do not have the free rider problem – each investor optimally collects more information[22] – but the issues that arise due to the winner's curse, discussed earlier, are accentuated. A second effect of free riders is that some auctions will be vastly overpriced. The only cost that free riders face in this mixed strategy equilibrium is the possibility of overpricing, and so free riders will keep increasing the entry probability sufficiently until in equilibrium the risk of overpricing is large enough to offset the average gains of free riding.

Excessively high bids are probably the best way to distinguish the free rider problem from the more commonly recognized winner's curse problem that was discussed in the previous subsection. The key difference between the winner's curse and the free rider problem is that the winner's curse does not lead people to bid more than they genuinely believe the shares to be worth. If they are optimally adjusting, they will shave their bids. If they are naïve and do not adjust, they will still bid no more than their estimate of the value. With the free rider problem, however, bidders may deliberately bid an excessive amount, since the whole point is to bid high enough to be "first in line" for the shares, rather than devoting time and resources to coming up with a reasonable bid. Thus, bids which are too high to reflect any reasonable valuation are good indications of free riders[23].

II.C. Difficulties Reaching a Robust, Stable Equilibrium

We have now laid out two problems with auctions – the winner's curse and the free rider problem – both of which can be solved, in a sense, through sufficient bid-shaving. If all bidders are sophisticated and are bidding optimally, then they will lower their entry probabilities and shave their bids to allow a return for their time and effort evaluating the stock and preparing a bid, and then will further adjust their entry probabilities and bids in response to

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[22]   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.

[23]   Some examples of extreme bids are those for Singapore Telecom in 1993 and Japan Telecom in 1994. Both were mature, established companies that were likely to face increased competition in already-saturated markets in the future. Yet the highest bid for Singapore Telecom would have given it a prospective price/earnings ratio (P/E)

the risks of free riders and the winner's curse. While a stable equilibrium is possible, it is likely to be one where the auction clearing price is substantially below the true value of the stock given the information available to all investors – perhaps even less than the price that would be needed for a fixed price public offer.

Our earlier discussion of a free rider was of someone who chose not to invest time and resources evaluating the current issuer – i.e. chose not to do due diligence on the current offering – but who still understood auction theory and how to calculate the optimal entry and bidding strategies, given the expected strategies and information sets of all other potential bidders. In addition, there may be a more general type of free rider – we will call them return-chasers – who do not understand the system but are simply attracted to any investment that has a good recent track record[24]. Suppose some investors are more likely to enter the current auction when the last few have led to high returns, and that they also have a tendency to overbid due to insufficient bid-shaving or to attempted free-riding. To the extent that their behavior is unpredictable, they would impose costs on the sophisticated investors – and some of them may decide to wait until the issue starts trading. That would have a destabilizing effect on the IPO auction. Issuers may therefore be concerned that there may be insufficient interest from investors, leading to a failed IPO.

II.D. Summary

Table 2 presents a summary of the above discussion. The auction method should be relatively successful when information gathering is not an issue, and when auctions for the same type of securities are held at regular intervals so that the pool of participants in the auction is stable[25]. Auctions will be less reliable when a reward for information gathering and price discovery is important, when the number of bidders varies significantly over time in an unpredictable manner, or when a large number of bidders may try to free ride on the information gathering efforts of others. Auction participation rates may be unstable unless virtually all potential bidders, including inexperienced uninformed investors, are able to

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of more than 1,000 times, while the weighted average winning bid for Japan Telecom gave it a P/E of 219 times.

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

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

implement complicated optimal entry and bidding strategies. Appendix D illustrates these observations through numerical examples.

Fixed price public offers may dominate auctions when it comes to maximizing proceeds, inducing information gathering, and the transparency and the ease with which the method can be implemented. When information gathering is relatively more important, book building may be preferred, as it may lead to better price discovery and lower underpricing. However, book building requires a relatively efficient market where underwriters compete with each other and thus is more likely to replace fixed price public offers in more developed economies with well-regulated, transparent markets.

III. Evidence of Uncertainty in IPO Auctions

In section II we observed that when the number of participants in an IPO is uncertain, bidding in an auction may become complicated even for sophisticated investors. In this section we present evidence of participation fluctuations (III.A) and undersubscription (III.B), both of which might occur periodically even in a stable equilibrium. In III.C, we present evidence suggesting that the winner's curse and free riders, particularly return-chasers, may have led to instability and ultimately to issuers rejecting the auction method in Singapore.

III.A. Evidence of Fluctuations 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 (JR) East drew 18,670 bidders, while the 1996 auction of JR West drew only 3,395 bidders, a decrease of more than 80%. 335,000 JR West shares (20%) were left unsold. When Argentina auctioned off its first telecommunications company, Telefonica, in December, 1991, it hoped for at least 80,000 bids from local investors but received more than 100,000. When it auctioned off its other telecommunications company, Telecom, just a few months later, the auction drew more than 270,000 applications from local investors.

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

over 3 years in Israel and found that orders ranged from 1,388 to 13,518[26]. Lin, Lee and Liu (2003) and Hsu and Shiu (2004) report wide fluctuations in bidder numbers for Taiwan's IPO auctions. There is also evidence of variation in the demand for Singapore auctions, as is shown in Table 3. Subscription levels ranged from the Vickers Ballas auction, which was 1,300% oversubscribed (at the minimum bid), to Sunright, which was 82% undersubscribed. The number of bids ranged from 1,128 for Eng Wah to 162,492 for Singapore Telecom. While some of the variations in participation levels would have been anticipated, there would have been some surprises.

Auctions are not the only IPO method for which there have been fluctuations in the number of participants, of course. However, the timing of sealed bid auctions and their method for determining the offer price make unanticipated variations in subscription levels more problematic than for the other two main IPO methods. With fixed price public offers, the subscription level affects a person's chance of getting shares but not her return, conditional on getting shares, since the subscription level does not affect the offer price. With book building, the underwriter observes the subscription level as well as the 'bids' and can then set the price, taking the subscription level into account. Standard sealed bid auctions force bidders to make key decisions before learning relevant information.

III.B. Evidence of Undersubscription

Many IPO auctions have been undersubscribed, when too few bidders chose to enter. IPOs may of course be undersubscribed under any method, since investors may scrutinize an offering but decide against it. However in the case of IPO auctions undersubscription may occur simply because too many investors did not consider participating in the auction. With book building, the underwriter manages the process, making it attractive for a sufficient number of investors attend the road show and consider the shares. With fixed price public offers, the shares may at least be substantially underpriced to make the issue receive investors' attention. Insufficient reward for information gathering, therefore, increases the risk of undersubscription in auctions. We offer evidence that undersubscription has occurred in practice, although existing empirical evidence is not sufficient to reliably estimate the probability of undersubscription for different IPO methods.

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[26] Multiple orders were allowed, so the number of orders might overestimate the number of bidders.

Two of the most-respected Asian telecoms, Korea Telecom and Singapore Telecom, were auctioned off in October of 1993, at a time when Asian telecom stocks were hot. The Singapore Telecom auction was heavily oversubscribed and priced far above expectations, while the Korea Telecom auction was vastly undersubscribed, receiving bids for only 10% of available shares. Given the strong reputation of Korea Telecom and the popularity of Asian telecoms at the time, this offering is a reminder that no company is so well established that investor participation in an auction is assured. In August of 2000, the Chunghwa Telecom IPO auction in Taiwan was only 72% subscribed, leaving 80.8 million shares unsold[27]. Japan Tobacco was 41% undersubscribed in 1994, and Japan Railway West was 20% undersubscribed in 1996.

Jenkinson and Mayer (1988) report that 3 out of 6 UK privatization auctions between 1982 and 1987 were undersubscribed, while one was 500% oversubscribed. The undersubscribed offerings included Britoil, which was 73% undersubscribed (i.e. bids were received for only 27% of the shares offered) and Enterprise Oil, which was 74% undersubscribed. Undersubscription also occurred for regular (non-privatization) auctions in the UK during this time period, including Argyll Foods (74% undersubscribed), Dataserv (31% undersubscribed) and VG Instruments (50% undersubscribed). The auction tranche of Sunright, the last IPO auction in Singapore in Oct. 1994, was 82% undersubscribed, even though the simultaneous public offer tranche was oversubscribed. A few months earlier in 1994, Liang Huat Aluminum's IPO auction tranche had been 38% undersubscribed, while the fixed price tranche was more than 700% oversubscribed.

These examples include both medium-sized and very large, well-known companies, which shows that being widely known does not shield an issuer from the risks of undersubscription. At the other extreme in terms of size are the French IPO auctions on the unregulated over the counter Marche Libré or Free Market, with the average auction hoping to raise less than € 1 million[28]. All 26 of these French auctions[29] in 2002-2004 were greatly undersubscribed, with mean and median subscription rates both below 20% (i.e. more than 80%

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

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

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

undersubscribed). While other IPO methods also led to undersubscription during this period, as shown in Table 4, subscription rates were dramatically higher for other methods.

An example of the extreme undersubscription of these auctions is Leon Gas, which tried to sell 30,000 shares in its December, 2003 auction but received bids for only 210 shares. Of the more than two dozen auctions in those three years, even the most successful sold fewer than half the shares (41.6%). It is possible that the extreme undersubscription of these French auctions led to the return of fixed price public offers for Free Market IPOs. It should be noted, however, that the French main market experience with auctions in the 1990s did not lead to such extreme undersubscription levels (see Derrien and Womack, 2003)

Given that many (although not all) IPO auctions have traditionally been underwritten, one might think that undersubscription is irrelevant. However the ability to buy 'insurance' does not make risk vanish, it only spreads it out, since insurance must be paid for. Moreover, the shares purchased by the underwriter in an undersubscribed offering will make their way to the market eventually. In the meantime, this 'overhang' will affect the aftermarket performance of the shares and thus possibly the company's ability to do future fundraising, as well as the ability of insiders to sell their shares later. Last, underwriting does not shield the issuer from the bad publicity surrounding an undersubscribed offer. Underwriting diversifies some of the risks of undersubscription but cannot entirely eliminate the effects.

Data on the actual number of failed offerings may sometimes be difficult to obtain, for either auctions or fixed price public offers, since underwriters have an incentive to place their own orders in an offering that is underwritten. After all, if the underwriter will be forced to buy the shares either way, why not make the offering appear successful? For IPO auctions in Israel, the Securities Authority found that many auctions that had been reported as having been strictly oversubscribed had, in fact, been undersubscribed, after adjusting for bids by the underwriter[30].

Thus, IPO auctions have been used for a wide range of issues, from small ones on France's Free Market to large privatization offerings raising $1 billion or more, such as Singapore Telecom, Argentina Telefonica, JR East or Japan Tobacco. Undersubscription has occurred for IPO auctions of all sizes.

III.C. Evidence of Return-Chasers

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[30] "Issues over subscribed due to underwriters" by Dafna Zucker and Golan Fridenfeld , Israel Business Arena, Globes (Online), August 11, 2004. A similar practice has been used in Hong Kong, for fixed price public offers.

Perhaps initially, only a limited number of sophisticated investors participate in IPO auctions based on the expectation that free riders will not be an issue. In that case. the auction clearing price may be sufficiently low to reward those investors. Sooner or later, however, apparently high returns to those participating in auctions is likely to attract more investors who are likely to be unsophisticated return-chasers. That will result in poor returns for winning bidders. As IPO auctions fail to provide reasonable returns because of high entry and resultant high auction clearing prices investors will update their priors regarding IPO auction risk and expected return, becoming less willing to participate. If issuers persist in using the method, the reduced number of bidders may eventually lead to higher initial returns, restarting the cycle. However, after observing such volatility, issuers may instead turn to another method that is perceived to be more robust, even if that alternative method leads to greater underpricing.

The available data on auctions is sparse and not easily amenable to rigorous quantitative analysis using statistical methods, since most countries that have tried IPO auctions gave up on them after a few years, leading to small samples. For example, the influential Kandel, Sarig and Wohl (1999) paper is based on only 28 IPO auctions in Israel. Moreover, data on participation levels are often unavailable. We have data on the full sample of uniform price IPO auctions done in Singapore, all 20 of them, and will attempt a quantitative characterization of that data in this section. This is albeit a bit brave, given our sample size.

The lessons from the Singapore experience are relevant for two reasons. First, Singapore is a sophisticated financial center whose banking and security markets are well regulated. One example of its technological sophistication is the fact that IPO auction bidders beginning in 1993 could place their bids through automated teller machines (ATMs), thus making those auctions as widely accessible as online internet auctions are today.

Second, Singapore's uniform price auctions were hybrids and thus were well suited to minimize free riders, since uninformed investors could participate, without specifying a price, through the simultaneous fixed price tranche. Therefore, if there is evidence of free riders including return chasers becoming an issue in hybrid uniform price auctions, they are likely to be even more of an issue in 'pure' uniform price auctions.

Figure 2 provides visual evidence of how Singapore's auctions evolved over time by plotting one month returns and subscription levels for all of Singapore's auctions, ordered chronologically. Although there were variations, the returns and participation levels for IPO

auctions fell over time. Investors would have made money on five of the first seven uniform price auctions (known as tenders) in Singapore, if they had bought at the auction strike price and sold after the shares had traded for one month. The average raw return on the first seven offerings was 11.7%, for this holding period, and the average oversubscription ratio was 4.2 (420% oversubscribed). However, the returns were negative for seven of the last eight auctions done in Singapore, with an average one-month return of -5.1% for these auctions (tenders). People noticed the poor performance, complaining that auctioned IPO shares were falling below their auction strike price on the aftermarket and joking that they must be catching a new disease called "tenderitis"[31].

While the oversubscription level for the last eight auctions was 0.7, which means that offerings were still on average 70% oversubscribed, they were substantially lower than the average of 420% oversubscription for the first 7 auctions. Two of the last five auctions were undersubscribed, including the last auction, for Sunright, which received bids for only 18% of the shares available. A similar pattern is shown in Figure 2.B, which gives one month excess returns for Main Board auctions only, relative to the All-Sing Index, a capitalization-weighted index of all stocks listed on the Stock Exchange of Singapore. The second graph shows the number of auction bids, rather than the subscription level, and the pattern is similar. The average number of bidders per auction was 48,095 for the first seven auctions[32] and 6,494 for the last eight. The results are also similar if we calculate the one month returns relative to the Straits Times Index (blue chips) or Sesdaq Index (smaller, younger companies), or if we use two month returns. It would appear that for investors who were learning and updating their priors over time, auctions became less attractive.

We argued in Section II that a high subscription rate (a large number of bids) in an auction may lead to overpricing of the auction, while a low subscription rate may lead to underpricing, due to the winner's curse. We further observed that free riders, including return-chasers, may make auctions less attractive for sophisticated investors. We examine the data in three steps to see whether there is support for these conjectures.

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

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[31] "New strategies needed for future IPOs**,** Ven Sreenivasan, Singapore Straits Times, p. 13, February 3, 1995.

$$S_{Ai} = \alpha_0 + \alpha_1 S_{Fi} + \alpha_2 r_{i,lag30d} + u_i \tag{1}$$

where

S_{Ai} is the subscription rate in the ith auction;
S_{Fi} is the subscription rate in the fixed price tranche;
$r_{i,lag30d}$ is the return that would have been obtained by buying in the $(i\text{-}2)^{nd}$ auction
and selling one month after trading begins.

For the return from a previous auction, $r_{i,lag30d}$, we use the return from 2 auctions ago because the one month return on the $(i\text{-}1)^{st}$ auction is in general not available by the time the ith auction is open for bidding[33]. We also consider the following variation of equation (1) above:

$$N_{Ai} = \alpha_0 + \alpha_1 N_{Fi} + \alpha_2 r_{i,lag30d} + u_i \tag{1'}$$

where

N_{Ai} is the number of persons bidding in the ith auction divided by the dollar value of
shares offered in the auction tranche, at the reservation price;
N_{Fi} is the number of persons bidding in the ith auction's fixed price tranche divided
by the dollar value of shares offered in the fixed price tranche.

Our conjecture is that some investors are return chasers, and that such investors tend to bid too high in auctions. In other words, return chasers are less likely to shave their bids optimally and may even attempt to free ride. However, the number of participants in an issue may also vary due to variation in the underlying demand for the stock, unrelated to the presence of return-chasing investors. Thus we use S_{Fi}, fixed price tranche orders, as a proxy for the underlying demand for the stock, to control for such variation. In Singapore, the auction and fixed price tranches occurred simultaneously, rather than sequentially as in many other countries, making fixed price tranche demand a good proxy of overall demand at the time of the auction.

The results are shown in Table 5. The coefficients for both variables have the predicted sign and are significant at the 1% level. The auction subscription rate and number of bidders are significantly positively related to our proxy for overall demand, as expected. And, after controlling for demand, the subscription rate or number of bidders is significantly positively

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[32] The average is 23,196 for the first six auctions, excluding the unusually large Singapore Telecom offering.
[33] In two cases we had to use the 30 day return on the (i-3)rd auction since the return on the (i-2)nd auction was not available when the i'th auction opened.

related to the return on the second-to-last auction, which is a sign of return-chasing. The R^2 is 60% for Equation 1 and 39% for Equation 1'. Thus, both higher underlying demand and a higher return to participating in a recent auction lead to higher participation in the current auction. Unreported regressions show that past returns and subscription rates are also significantly positively related for the fixed price tranches of auctions and for pure fixed price public offers.

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

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

where

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

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

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

The assumption is that some of the variation in the subscription rate is due to return-chasing investors who do not adequately adjust their bids for the winner's curse, or perhaps even attempt to free ride, and thus bid too high. As before, we use S_{Fi}. as a proxy for the variation in underlying demand for the stock for reasons other than the presence of return-chasing investors. The results are shown in Table 6. The auction price premium is significantly positively related, at the 1% level, to the auction subscription rate (Equation 2) or the number bidding in the auction (Equation 2')[34]. Thus we find that the clearing price in the auction tends to be higher when more bidders enter and order more shares, even after adjusting for underlying demand for the stock itself.

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[34] Note that the auction clearing price will increase with the number of bidders even when all bidders are sophisticated due to price competition among bidders.

While a higher participation rate in the auction is positively related to a higher auction clearing price, the higher price may be "rational," reflecting a higher intrinsic value of the issue over and above that reflected in the fixed price (and over and above the higher value reflected in fixed price tranche demand). Sherman (2005) models sealed bid auctions in which informed bidders are following the optimal entry and bid-shaving strategy. This model predicts that when the intrinsic value of the offering is higher, both the auction clearing price and the initial return to winning bidders will be higher.

Thus, to determine whether the relationship that we found between the auction clearing price and the participation rate is due to informed investors entering and bidding based on positive information, or to return chasers failing to shave their bids adequately, we therefore examine the relationship between the auction clearing price and the return to bidders, using the following regression:

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

where

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

The results are given in Table 7. We do not find a significant positive relation between bidder returns and the auction price premium, as would be expected if all investors were informed and bidding optimally. Instead, the auction price premium has a negative coefficient, with a t-statistic of -1.74. The evidence supports the view that high auction prices in general are associated with lower returns to bidders, as would be expected if a significant number of return-chasers are overbidding in the auctions. The conclusions do not change if we use excess returns over the Singapore stock market index instead of raw returns in the regressions.

To summarize, these findings are consistent with our story, which is that poorly informed investors (both free riders, and bidders who did not adequately shave their bids) disrupted the bidding process, and that this along with the added risk due to uncertainty about how many will participate in an auction eventually drove investors and issuers away from the auction method. Chiang, Qian and Sherman (2006) examine Taiwan's discriminatory IPO auctions and also find evidence of return-chasing, particularly among retail bidders.

IV. Auctions versus Bookbuilding: Popular Explanations

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

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

Figure 3 shows the relative auction usage patterns over time in four countries. For Singapore, Taiwan and Turkey, the main alternative method was fixed price public offers, which had been the traditional method in those countries. Auctions were first allowed in 1993 in Singapore[35] and Turkey, and in 1995 in Taiwan. In France, both auctions and fixed price public offers had been used for decades, but book building was first introduced in the 1990s, while unrestricted book building was only allowed beginning in 1999.

As can be seen from Figure 3 for the three countries in which the IPO auction method was newly introduced, auctions captured their greatest market share early on, with two-thirds or more of issuers choosing to use auctions when they were relatively new. As issuers became more familiar with the method over time, a lower proportion of them chose to use the auction method. Hence, it is hard to argue that, in these countries, the disappearance of IPO auctions was due to lack of familiarity or to an unwillingness of issuers to try a new method.

Of the four countries whose usage patterns are shown in Figure 3, France differs from the others in several ways. First, the auction method had been allowed for several decades in France. Second, a form of book building was in use during the period shown, in addition to auctions and fixed price. Last, the disappearance of auctions from the regulated exchanges seems to have been driven by a regulatory shift.

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[35]   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.

Derrien and Womack (2003) found that sequential hybrid book building was less efficient than auctions in France. Before 1999, the only form of hybrid book building that was allowed in France was a sequential hybrid, where the price must be set many days in advance, to allow time for the public to place their orders. As the modeling in Chowdhry and Sherman (1996a) demonstrates, requiring that prices be set far in advance adds risk, leading to higher levels of underpricing. Once the more modern, simultaneous hybrid book building method was allowed in France in 1999, auctions quickly vanished from the regulated exchanges[36]. The 1999 regulatory change seems to explain the timing of auctions drying up on the French regulated exchanges, although it does not explain why they were still used for several more years on the unregulated over-the-counter Free Market (Marche Libré).

One obvious question is whether issuers in these countries were truly allowed to choose freely between IPO methods. Although there were no regulatory restrictions that prevented issuers from using auctions, strong differences between the groups of issuers using different methods might imply some other sort of barrier, such as underwriter reluctance to underwrite auctions for some issuers. Therefore, in unreported analysis (available on request), we compare fixed price public offers and auctions in Singapore, Turkey and on the French Free Market based on both industry and amount of funds raised[37]. We did not find substantial differences in the size or industry patterns of auction and non-auction issues.

It is clear, in all four of the countries shown in Figure 3, that the disappearance of auctions was not due to issuers' lack of familiarity with the auction method. Similarly in Japan, issuers were forced to use auctions from 1989 to 1997. In spite of the long period during which IPOs in Japan were accomplished exclusively through auctions, the method was abandoned as soon as issuers were given the option of instead using book building.

There is not enough evidence to conclusively reject the 'lack of familiarity' argument for all countries. It may explain why auctions have not caught on in countries with limited usage, such as Germany, Australia or the US, or in countries that have never tried auctions at all. It may also explain why corporate debt and seasoned equity auctions never caught on[38],

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[36] With the exception of the two IPO auctions in 2005 that were mentioned in Section I.

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

[38] Bortolotti, Megginson and Smart (2006) show that auctions, in the form of block trades, have increased dramatically in the last decade and have become quite common around the world for seasoned equity offerings. The success of these SEO auctions fits well with our findings for IPOs, since the block trade auctions are single-unit auctions among a small group of sophisticated buyers – investment banks. The investment bank that wins the

even though there was a race between three investment banks to introduce online corporate bond auction platforms in 2000[39], and WR Hambrecht offers an online seasoned equity auction method known as OpenFollowOn[40]. But the overall IPO evidence is that issuers in many countries have been willing to experiment with both auctions and book building, and that issuers became less likely to choose auctions as they gained familiarity with the method.

IV.B. Underwriter Pressure for Using the Bookbuilding Method

Another explanation suggested by Ausubel (2002) for the failure of issuers to use IPO auctions is that investment banks have pressured issuers to use book building rather than auctions because the fees, and hence profits, are higher for book building. This argument is somewhat inconsistent – it assumes that underwriters have sufficient market power to keep book building fees artificially high, and sufficient power to force issuers to use the book building method in spite of the high fees, but that they do not have sufficient power to demand artificially high fees for auctions[41].

Regardless, this argument cannot explain the disappearance of auctions in most countries, because auctions have usually been replaced by fixed price public offers, and public offer fees are typically as low as, or even lower than, the fees for auctions. Ljungqvist, Jenkinson and Wilhelm (2003) show that average fees tend to be quite low for fixed price public offers across most countries, substantially below those for book building[42].

A third 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

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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.

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

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

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

[42] Similarly, 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 auctions. In most countries, when auctions were first used, the fees were the same for auctions as for fixed price public offers.

shares to their favored clients. This cannot explain the choice between auctions and fixed price public offers, since neither method allows the underwriter to control allocations[43].

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

Much analysis of IPOs either implicitly or explicitly assumes that issuers always prefer the offering method that leads to the lowest expected initial return, regardless of risk or other considerations[44]. There are, however, many reasons to believe that issuers care about other aspects of the process beyond just the expected initial return. An IPO is an expensive way to raise capital and is seldom worthwhile if the company's one and only goal is a one-time fundraising, particularly since the costs of being public are on-going.

An IPO opens the way to future fundraising in the public markets and establishes a market price for the company's stock. The stock price is used as a benchmark by employees, customers, suppliers and competitors, affecting employee morale as well as the company's bargaining position in various types of negotiations. Thus, an issuer benefits from establishing an accurate, sustainable long-term price, which may require a core of institutional investors that will be interested in following the company long term[45].

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 as well as the offer price and 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 may end up being ignored and stuck in the so-called Orphanage[46]. If they do not attract an institutional investor following, they will not be covered by analysts and will not be monitored closely enough to be accurately priced. This means that they will be unable to do follow-on equity offerings and will tend to trade at a substantial discount, due to their illiquidity and added risk. In order to minimize this

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

[44] See, for example, Kaneko and Pettway (2003).

[45] although, during the internet bubble, many companies seemed more focused on short term hype than on a sustainable, long term equilibrium.

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

possibility, firms may be willing to pay, through underpricing, to attract the attention of serious investors in the IPO[47]. This may explain the importance of analyst coverage found in Loughran and Ritter (2004) and Cliff and Denis (2004)[48].

This brings up the question of what objective function issuers are maximizing when choosing an IPO method. Loughran and Ritter (2004), Sherman and Titman (2002), Sherman (2005) and Chemmanur and Liu (2004) offer alternative objective functions that consider more than just maximizing proceeds. The appropriate objective function for IPO issuers is a subject in itself, and one worthy of future research. In this paper, we simply note that the evidence indicates that issuers care about more than simple expected proceeds maximization.

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

In the Singapore sample examined in Section III.C, many companies 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 (tables are available on request). We find no evidence in the Singapore data that issuer choices were driven primarily by a desire to minimize underpricing. All else being equal, however, it is likely that companies would prefer less underpricing. It therefore seems likely that the decision to avoid auctions is being driven by some other factor that more than offsets the higher apparent underpricing.

V. Six Proposals to Improve the Auction Process for IPOs

For an IPO to be successful, it is necessary to attract both sophisticated investors who will help with price discovery through costly information gathering as well investors who have the funds to invest but do not wish to spend resources on evaluating an IPO. Both types of

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[47] Underpricing as a way of inducing costly evaluation has been modeled in Sherman (1992), Chemmanur (1993), Sherman (2000), Sherman and Titman (2002) and Busaba and Chang (2003). Yung (2005) models costly evaluation by both investors and the underwriter. Cornelli and Goldreich (2001), Jenkinson and Jones (2004) and Cornelli and Goldreich (2003) offer evidence on whether or not bookbuilding performs this role in practice.

investors have to be compensated for participating in an IPO and making the issue a success. Those who contribute to price discovery must necessarily be compensated more, to make it attractive enough for them to engage in costly information gathering and valuation exercises.

The problems that arise due to the winner's curse and the presence of free riders and return-chasers, all arise due to the lack of coordination of entry in a large multi-unit auction open to large numbers of potential bidders, and to the lack of the right incentives. Uncertainty about who will bid and about which bidding strategies will be followed adds risk for both investors and issuers. Greater risk for sophisticated, informed, potentially-long-term investors will lead those investors to either shave their bids more (leading to greater underpricing) or drop out altogether, neither of which is good for the issuer/underwriter.

Solutions in general will reward both information production and steady, repeated participation in offerings, thus improving the incentives of potential bidders, lowering the proceeds risk for the issuer and producing a better process in terms of price discovery. Below, we offer some proposals on ways to improve the IPO auction process.

1. Weight bids based on many factors, not just price.

Our first proposal is to allow auction bids to be weighted on other factors, beyond simply price aggressiveness. Such more extensive auction weighting schemes have been used for many privatization auctions in Europe and Asia, as discussed in Jagannathan and Sherman (2005). For examples, in addition to favoring higher over lower bids, sellers have also announced that they would favor early, firm bids over late or tentative bids (those that can be withdrawn or changed). Such auctions have also sometimes ranked bidders based on their 'quality', in particular based on how likely they were to be long term investors (hedge funds typically ranked poorly on this factor). The weighting schemes were usually announced in advance. For example, Malaysia's 1995 Petronas Gas IPO weighted price aggressiveness most heavily, at 35%, while timing of the bid (whether it was early or late) had a 25% weight, and the quality of the investor carried a 10% weight.

By favoring early, firm bids over late bids, issuers can discourage free riding and encourage information production. Those waiting until late to bid may be hoping for rumors about the demand of others, rather than directly providing their own personal assessment of the

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

stock. On the other hand, a bidder that makes an early, firm commitment has a stronger incentive to do his own research and form a reasonable opinion about the best price.

Given the greater flexibility of a multi-factor weighting scheme, it can be used to solve many problems in a transparent, open way. Flipping could be reduced by offering a somewhat greater weight to those investors that voluntarily agreed to not sell for a set amount of time. There could be rewards for investors that had participated regularly in past auctions, thus giving investors an incentive to participate even in cold offerings in order to have a better chance to get shares in the next hot IPO. Favoring regular investors could help to stabilize participation levels, lowering the risks of participation.

Such complicated weighting schemes are similar, in some ways, to book building. The advantage of auctions with explicit weighting schemes is transparency – bidders would know what to expect before bidding, while issuers could work with their underwriters to choose the best set of weights. While such weighting schemes may seem difficult to implement, complicated weighting methods are already used in other settings. For example, large fund management companies have many different fund managers that each want a say in how trades are allocated across various brokers, while the trading desk also needs to be able to have input. Fund management companies weigh feedback from many different sources in order to allocate their trades in a way that allows fund managers to reward salespeople, analysts and strategists that have been helpful, while still allowing the trading desk to reward good trade execution. Thus, complex weighting schemes have been feasible in other settings, and would give issuers more of the flexibility of book building while retaining the transparency of an auction.

2. Use hybrids, with uninformed retail investors ordering through a fixed price tranche.

Our second proposal is to use a hybrid auction with a simultaneous fixed price tranche for retail investors (i.e. 'open pricing'). Allowing uninformed retail investors access to IPOs inevitably means substantial uncertainty over participation levels, but those fluctuations are less of a problem if the applicants do not disrupt the price-setting mechanism. Chiang, Qian and Sherman (2007) analyze institutional and retail bids in Taiwan's IPO auctions and find that institutional bidders appear to be bidding optimally, but that both large and small retail bidders are return-chasers that are not shaving their bids appropriately. Random or inappropriate bidding behavior affects all bidders. Moreover, the sheer numbers of potential retail bidders means that it is always possible for the participation level to greatly exceed the optimum.

It should be noted that the evidence of return-chasing both in this paper, for Singapore's auctions, and in Chiang, Qian and Sherman, for Taiwan's auctions, come from systems with hybrid auctions/fixed price offers. In both Singapore and Taiwan, retail investors were allowed to choose between bidding in the auction and ordering shares from the fixed price tranche (at the same or sometimes even a lower price than the auction price). As discussed earlier, such hybrids should substantially reduce the problems of free riding and the winner's curse by giving uninformed, unsophisticated investors a way to participate without disrupting the price setting process. The fact that return-chasers still spilled over into the auctions in sufficient numbers to affect the results indicates that it may be necessary to limit bidding by retail investors in the auction tranche.

Issuers may object to limiting uninformed retail investors' access to auctions, on principle. However if auctions are so risky that issuers choose not to use the method at all, then all individuals will effectively be banned from bidding. A hybrid method in which the price is set in an institutional auction in a transparent way, and in which all retail investors have an equal chance of getting shares through a retail tranche, would be more open than the traditional method in the US and yet may be more stable than a 'pure', standard auction that is open to millions of unsophisticated, inexperienced potential bidders. Limiting the number of bidders in the auction will also reduce the winner's curse, prevent free riders[49] and help reward those who help with price discovery through costly information gathering activities.

3. Allow 'dirty' auctions.

Pricing below market-clearing, a.k.a. a dirty auction, has been widespread for IPO auctions, as discussed in Section I. Biais and Faugeron-Crouzet (2002) show that it can encourage the revelation of endowed information from bidders. It also gives underwriters/issuers the ability to counteract perceived auction overpricing, either from too many free riders or from an unexpectedly large number of overall bidders. In the US, issuers for all 20 IPO auctions so far (as of July, 2007) have reserved the right to price below market clearing, but only some have actually done so. This may indicate that the option is being

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[49] Our first two proposals were originally made in Jagannathan and Sherman (2005), which also offers a third suggestion. In order to reduce free riding and encourage informed participation even in the public offer tranche, issuers should consider a method first used by German investment bank Net.IPO: make people qualify to place orders by first passing a short, multiple choice quiz, based on the Prospectus. After all, shares have to be rationed somehow. Rather than the usual lottery method or making people stand in line, the online quiz rations shares in a way that favors those that are either already familiar with the company or willing to learn about it. Net.IPO

exercised selectively to reduce the winner's curse and free rider problems, rather than consistently (as in France) to encourage and reward price discovery. Pricing below market clearing alone will not be enough – it has to be combined with a suitable allocation scheme that provides the right incentives for costly price discovery. Such an allocation scheme may involve more rationing of shares in "hot IPOs" to uninformed retail investors

4. Reject excessively high bids.

As discussed in Section II., excessively high bids may indicate free riders, and thus a policy of rejecting such bids can reduce the incentive to free ride. In the US, all IPO auction issuers have reserved the right to reject bids that the issuer and underwriter, in their sole discretion, considered to be "manipulative" or "disruptive", although they have not revealed how often, or under what circumstances, this right has been exercised.

Once again, French practice has been more transparent and uniform than that in the US. For French auctions a maximum price is set, above which all bids are rejected. This maximum is chosen only after examining the results of the auction. In some cases, the maximum has been quite low, as in Cafom's 2005 IPO auction. The minimum bid for Cafom was €11.65, the offering price was €13.50, and only bids between €13.50 and €14 were accepted, although bids had gone as high as €20. Winning bidders received around 31% of their orders. Presumably, setting a low maximum price allowed Cafom's offer price to be set well below market-clearing without even greater rationing.

5. Allow leakage of information to other investors.

This proposal could potentially reduce the winner's curse for bidders and lower risk, thus requiring them to expect less of a risk premium[50]. There is, however, a trade-off between the free rider and winner's curse problems. Allowing one bidder's information to leak to another will reduce the winner's curse but will reward free riding and reduce all investors' incentives to produce information[51]. To induce investors to scrutinize an offering, those investors need to be rewarded for their time and effort evaluating that offering. Thus, this

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claimed that their approach put more shares in the hands of long term investors.

[50] Rock (1986) shows that the uninformed may require a premium when they face a winner's curse in an IPO. Rock was modeling fixed price public offerings and had only two type of investors, fully informed and uninformed, but the intuition also applies to an investor that has some private information but does not know all that other informed investors know (i.e. it applies to independent signals). By reducing this risk for all bidders, the required underpricing may be reduced.

[51] This is why it is hard to say, theoretically, whether discriminatory or uniform price auctions are better in this

proposal is most likely to be effective if it is used in combination with the first proposal – weighting bids based on timing and firmness, to encourage independent production and reporting of information.

The most interesting example of deliberate leakage of information during an auction is the method used by Ord Minnett's eCapital, which used a hybrid of book building for institutional investors and an auction for retail investors[52]. For eCapital's online auctions to retail investors (which it called "book builds"), the updated weighted average bid price was posted online twice a day during the auction period and bidders were allowed to change their bids during the auction. The two online retail auctions done by Ord Minnett in Australia were for HCN and Chaos Music, both in November, 1999.

In Israel, two stage auctions have been used. First an institutional auction is held, after which the results are announced and then the general auction (open to everyone) is held. Bids from the first stage join the rest of the auction bids later. Those bidders can place additional bids in the second stage but cannot withdraw their first stage bids and can only place new bids at or above their previous bid price. Thus, early demand is credible and is known to all other bidders before they place their own bids. This method was introduced to give information to general bidders regarding what to bid, due to problems with single-stage sealed bid auctions.

A less transparent but more flexible approach is taken by WR Hambrecht in the US. In the Prospectuses for Clean Energy and Interactive Brokers (both OpenIPOs, lead-managed by WR Hambrecht in May 2007), investors are warned that the underwriter "may discuss general auction trends with potential investors. General auction trends may include a general description of the bidding trends or the anticipated timing of the offering." Thus the underwriter reserves the right to privately tell certain investors about the general trends in the bidding, while they still have time to change their own bids accordingly.

Although the Prospectus warnings did not appear until the Clean Energy filing, it is rumored that WR Hambrecht had been giving guidance to certain investors during the bidding process at least as far back as Traffic.com's January 2006 IPO, thus explaining why there were such concentrated clusters of bids in that auction. Traffic.com wanted to sell 7.5 million shares in its auction. It received bids for only 509,000 shares at or above $12.51 and relatively few

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setting. Discriminatory auctions reduce or eliminate the free rider problem but magnify the winner's curse.

bids from \$12.01 to \$12.49, but there were clusters of bids for more than 6 million shares at \$12.50 and more than 7 million shares at \$12.00. The clearing price was \$12.00, with winning bidders receiving about 53% of their bids.[53] Thus it appears that recent US IPO auctions have included leakage of information between investors.

One problem with any attempt at leaking information during the bidding is that bids may flood in only at the last minute. For Singapore's auctions, in which bids could be placed through Automated Teller Machines (ATMs), there were often stories about long lines for ATMs throughout the city during the last few hours of the auction. Thus, early trends may be deceiving. This presumably is why Israel had two separate, clear stages, giving institutional bidders a deadline for placing early bids in the first stage auction. With US IPO auctions, there is often some uncertainty about when the auction will end, since it generally ends quickly once the offering is declared effective by the SEC. This uncertainty may make it less likely that bidders will hold back their bids until the last possible minute, making leakage of trends more accurate. Perhaps the most transparent way to allow leakage of information would be to allow when-issued or grey market trading before the end of the auction, as in Europe for many IPOs[54].

6. Make the number of potential bidders more predictable.

The 2004 Google auction included a unique feature – anyone that wanted to participate had to obtain a unique bidder identification (ID) number in advance. The numbers were easy to obtain, at no charge, but they could not be obtained after bidding had begun. Thus there was a limit on the number of potential bidders, before bidding began. The number of unique bidder IDs assigned was not announced before the bidding, but it could have been, thus giving bidders a better idea of how much to shave their bids to adjust for the winner's curse.

This method is being used in a modified form for the Netsuite IPO auction. Netsuite filed for an IPO in June, 2007 and will be the second US IPO auction lead-managed by Credit Suisse (which co-managed the Google auction, with Morgan Stanley). In addition to being only the second US auction not lead-managed by WR Hambrecht, the Netsuite S-1 filing indicates that all institutional (but not individual) bidders will be required to obtain a unique

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[52] There has also been one hybrid book build/auction in the US, for Instinet in May, 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 \$14.50 issue price.

[53] "Open and Fair: Why Wall Street Hates Auctions", by Joe Nocera, the New York Times, March 18, 2006.

[54] Cornelli, Goldreich and Ljungqvist (2006) offer evidence that grey market trading reflects information from retail investors, and that institutional investors respond to this information in a sophisticated way. Aussenegg,

bidder ID before bidding begins. If this number is announced before bidding begins, it will reduce the winner's curse and might prevent last minute return-chasers from entering.

VI. Conclusion

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

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

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

We have shown that auctions have led to undersubscription and to extreme mispricing in practice, but it must be noted that other IPO methods have also led to withdrawn offerings and to mispricing. Thus the evidence of problems with standard auctions may, on its own, be insufficient to establish which IPO method is superior. At the very least, however, the data tell us something about which auction models best fit the existing evidence. The observed track record of IPO auctions appear consistent with costly evaluation/endogenous entry models but

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Pichler and Stomper (2005) also explore grey market trading for IPOs.

not with endowed information/full entry models, as shown in Table 2. Given that people have used the latter models to argue the superiority of the auction method, it is important to note that they do not fit the data. Moreover, the very non-existence of large, stable samples of IPO auctions, despite the fact that more than 20 countries have experimented with standard sealed bid IPO auctions, is consistent with models that predict that IPO auctions may be problematic.

We found that participation variations have been a major source of problems for IPO auctions. There is a trade-off with auctions in terms of the optimal participation level. Drawing too much unanticipated attention may mean insufficient adjustment for the winner's curse or the entrance of too many free riders, while unexpectedly 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, and the underwriter sets the price only after observing all orders. With an auction, on the other hand, bidders must place their bids before knowing how many others will enter the auction, and those who invest time and money evaluating an offering risk being squeezed out by hundreds or thousands of free riders. Without some way to screen out free riders and ensure the participation of sophisticated, long term investors, IPO auctions are highly risky for both issuers and investors.

The many goals that issuers have for IPOs may not be best achieved through standard sealed bid auctions with rigid, automatic pricing and allocation rules, but this does not mean that auctions in general cannot work in this setting. We offer several proposals – from weighting bids based on several factors rather than only one, to pricing below market clearing, to allowing retail investors to participate through a fixed price tranche – that may help issuers to develop a superior method. The optimal modified auction is likely to be different from both traditional book builds, with their lack of transparency and resulting opportunities for potential abuse, and standard sealed bid auctions, with their high risk for both investors and issuers.

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Appendices

Appendix A. Do auctions price shares accurately?

There is a popular misconception, perpetuated in part by journalists, that auctions 'in theory' lead to highly accurate prices. In SubSection II.D and Table 2, we showed that this is not true in theory, except under some extremely unrealistic assumptions. In practice, there are many examples of highly inaccurate IPO auction prices (assuming that the first day's closing price is a good estimate of the 'true' value). Some examples of large positive initial returns from IPO auctions include:

- Tenaga Nasional, Malaysia, May 1992, 34%: Malaysia's first auction was a hybrid discriminatory auction/public offer. Initial returns for winning bids ranged from 23% to 34%, even though the market-clearing price in the auction was almost 46% above the 4.50 ringgit reservation price. The initial return for the public offer was 94%.

- DDI (an affiliate of Kyocera), Japan, September 1993, 49%: Bids went as high as ¥6.02 million/share. The offer price was set at ¥3.7 million, because most successful bids were concentrated at that price. The first day's close was at ¥5.5 million.

- East Japan Railway, Japan, October 1993, 58%: JR East soared 70% above the market-clearing price the first day, only to drop back down to around the ¥370,000/share offer price within two days. Winning bids ranged from ¥352,000 to ¥623,000, so the highest bidders were still out of the money when the stock closed at ¥600,000 the first day.

- Petron, the Philippines, Sept. 1994, 63%: Hybrid discriminatory auction/public offer. The first day's closing price was 63% above the lowest winning bid, 23% above even the highest bid, 39% above the highest foreign bid and 136% above the reservation price. The fixed price tranche drew 459,133 subscribers.

- Andover.net, US, December, 1999, 252.1%: The offering was priced at $18 even though the clearing price was $24, reportedly to avoid any delay. The first day's closing price was 164% above even the auction clearing price.

- El Al, Israel, June 2003, 40%: Demand was low in the auction – they sold fewer shares than expected, all priced at the minimum bid. The shares began trading on the Tel Aviv Stock Exchange just two days later, closing up 40% the first day and up a total of 112% by the end of the second trading day.

Some examples of negative initial returns from IPO auctions are:

- Japan Telecom, September 1994, down 14.5% from the weighted average bid price of ¥5.44 million/share on the first day, and down another 10% by the end of the week: The lowest successful bid was ¥5.22 million, but the public offer price (set after the auction) was ¥4.7 million, showing that the auction bids were considered unrealistic.

The weighted average bid price gave the company a P/E of 219 times prospective earnings, in a mature telecom market.

- Japan Tobacco, October 1994, down 23.5% the first day, and it kept falling from there: The auction had been unusually enthusiastic, with a weighted average winning bid of ¥1.438 million/share for shares that institutional investors valued at no more than ¥800,000. Successful bids ranged from ¥1.362 million to ¥2.11 million. It closed the first day at ¥1.10 million, and the second day at ¥1.06 million (down more than 26%). After 2 weeks of trading, it was at ¥956,000, down 33.5%. The highest bidders lost almost 48% the first day. 41% of the shares were never sold.

- Global Securities (Global Menkul Degerler A.S.), Turkey, May 1995, down 11% the first hour: The reservation price was set at TL6,000 per share, but bids went as high as TL100,000. The auction price was set at TL9,750, a 62.5% premium. The price fell by 56.1% (giving a market-adjusted return of -60.5%) over the first three months.

Thus, there are many examples of extreme initial returns resulting from IPO auctions. These do not prove that auctions are inferior to other issue methods, since other methods have also led to large positive or negative initial returns. Nevertheless, these examples show that the pricing accuracy of the sealed bid IPO auction method should not be taken for granted.

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

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

- France: A unique, theoretically sound version of auctions co-existed with a restricted, sub-optimal form of book building (a sequential hybrid, rather than 'open pricing' which is a simultaneous hybrid) and with fixed price public offers, for several years; once the restrictions on book building were lifted, auctions dried up; during the overlap period, initial returns were lower for auctions than for sequential hybrid book building.

- Japan: Auctions and book building did not overlap in Japan, but they were used in close succession. Kutsuna and Smith (2004) found a small but statistically significant increase in initial returns under book building, and also found that a wider range of companies, including younger start-ups, were able to go public under book building.

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

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

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

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

PANEL A

		Auctions		Book Building			
	Traditional method(s)	First introduced	Apparently abandoned	First Introduced	Now dominant or gaining?	Hybrid with Fixed Price	**Main Sources**
Europe							
Austria	Fixed price			1992	**yes**	yes	Letter - Wiener Borse(Vienna Stock Exchange), 14 June 1996
Belgium		1980s	1991	1993	**yes**		News articles; Ljungqvist, Jenkinson and Wilhelm (2003)
Czech Rep.	Fixed price						E-mail, the Czech Securities Commission, 10/26/99
Denmark	Fixed price			1992	**yes**	yes	News articles
Finland	Fixed price			1993	**yes**	yes	E-mail, Financial Supervision Authority of Finland, 11/29/99; ^Letter - Mandatum & Co., 30 May 1996; www.rata.bof.fi
France	Auctions, fixed price	1960s	1999?	1993	**yes**	yes	E-mail - Listing Division, Paris Bourse SBF SA, 7/28/2000, ^Derrien and Womack (1999); Euronext website
Germany	Fixed price	only 2		1995	**yes**	yes	E-mail- BAWe(Bundesaufsichtsamt fur den Wertpapierhandl) 2/2/2000, www.bawe.de; ^E-mail - DGBank, 11/18/99
Greece	Fixed price			1994	**yes**	yes	News articles.
Hungary	Fixed price			1995	**yes**	yes	E-mail-Hungary Banking & Capital Mkt Supervision11/30/99
Ireland	Fixed price			1992		yes	E-mail, Irish Stock Exchange, 9/15/ 99
Italy	Fixed price	1980s	1986	1992	**yes**	yes	E-mail, Borsa Italiana S.p.A. 11/24/99; ^Italian Stock Exchange Commission (CONSOB) web page, www.consob.it
Luxembourg				1996	**yes**		Ljungqvist, Jenkinson and Wilhelm (2003)
Netherlands	Fixed price	1980s	1989	1994	**yes**	yes	E-mail, Stichting Toezicht Effectenverkeer (Securities Board Of The Netherlands), Oct. 1999
Norway	Fixed price			1995	**yes**	yes	E-mail - Banking, Insurance and Securities Commission of Norway, Sep. 99; ^Letter - Oslo Bors, 14 June 1996
Poland	Fixed price	1993?		1995	**yes**	yes	News articles.
Portugal	Fixed price	1987	1992	1995	**yes**	yes	E-mail, Comissão do Mercado de Valores Mobiliários (www.cmvm.pt), 11/11/99.
Spain		Only 2	1998	1993	**yes**	yes	E-mails, Bolsa de Bilbao 11/16/99; *Comisiãn Nacional Del Mercado De Valores 9/23/99, 10/18/99.
Sweden	Fixed price	1980s	1980s	1993	**yes**	yes	Letter Finansinspektionen (Financial Supervisory Authority), 12/18/1996; E-mail OM Stockholm Exchange 7/25/2000.
Switzerland	Fixed price	1980s	1980s	1995	**yes**	yes	E-mail - Switzerland Stock Exchange, 11/24/99; ^Letter - Zurcher Borse (Zurich Stock Exchange), 4 June 1996
U. K.	Fixed price	1960s	1987	1992	**yes**	yes	General sources; Brennan and Franks (1997); Levis (1990)

PANEL B

	Traditional method(s)	Auctions		Book Building			Main Sources
		First introduced	Apparently abandoned	First Introduced	Now dominant or gaining?	Hybrid with Fixed Price	
North & South America							
Argentina		1991	1992	1993	**yes**	yes	E-mail - Comisiã n Nacional De Valores 1/29/99
Barbados	Fixed price						Letter - Securities Exchange of Barbados, 8/28/97
Brazil	Fixed price	yes			**yes**	yes	E-mail, Comissãƒo de Valores Mobiliãrios 9/20/99; ^www.bndes.gov.br.; *Letter - Bolsa Do Rio, 26 Aug. 1996
Canada	Bookbuild				**yes**	yes	E-mail Com. des Valeurs Mobilières du Québec, 10/29/99
Chile					**yes**		E-mail Sup. de Valores y Seguros 10/99; Santiago SE 11/99
Mexico	Fixed price						E-mail, Bolsa Mexicana de Valores Sept. & Nov. 1999
Paraguay	Fixed price						E-mail - Comision Nacional de Valores, Oct 99
Peru	Fixed price	yes		1996	**yes**	yes	E-mail - Lima Stock Exchange, 10/20/99
U. S.	Bookbuild	1999	--		**yes**	yes	General sources
Asia/Pacific							
Australia	Fixed price	1999	1999	1992	**yes**	yes	Letter - Australian Stock Exchange, 23 April 1996
Bangladesh	Fixed price						News articles.
China	Fixed price				**yes**	yes	News articles; "The Evolution of China IPO Pricing Mechanism," Yan Gao, Manuscript CEIBS, September 2007
Hong Kong	Fixed price			1993	**yes**	yes	News articles, general sources.
India	Fixed price			1993	**yes**	yes	SEBI web page, Dec. 99;*Bombay Stock Exchange, 4/13/96; ^Assoc. of Merchant Bankers of India, 5/27/96.
Indonesia	Fixed price				**yes**	yes	Indo. Cap Mkt Supervisory Agency(BAPEPAM) 9/24/99
Japan	Fixed price	1989	1997	1997	**yes**	yes	Pettway (1999); News articles.
Korea	Fixed price	1993?			**yes**	yes	E-mail, Korea Securities Research Institute 10/26/99; ^Korea Stock Exchange fax, International Relations, April 13, 1996
Malaysia	Fixed price	1992	1994	1995	**yes**	yes	E-mail, Kuala Lumpur Stock Exchange, 1996; web page.
New Zealand	Fixed price				**yes**	yes	E-mail 10/15/99 Sec. & Exchange Commission of New Zealand; ^Fax - Cavill White Securities Ltd., 21 May 1996
Philippines	Fixed price	1994	1994		**yes**	yes	News articles.
Singapore	Fixed price	1991	1994		**yes**	yes	E-mail - Stock Exchange of Singapore, 10/11/99; web page.
Sri Lanka	Fixed price						Letter - Colombo Stock Exchange, 26 May, 1997
Taiwan	Fixed price	1995	?		**yes**		E-mail Chinese Securities Association, 11/2/99
Thailand	Fixed price				**yes**	yes	Letter - Securities and Exchange Commission, 14 May 1996;
Africa/MidEast							
Kenya	Fixed price						Fax, Capital Markets Authority, 4/3/00
Israel	Auctions, fixed price	< 1993	?	2007			e-mails - Tel Aviv Stock Exchange, Feb., Sept. and Oct. 1999
Jordan	Fixed price						E-mail, Amman Stock Exchange, 24 June, 1997; web page.
Pakistan	Fixed price			1995	no		E-mail, SEC of Pakistan, 12/01/99; ^web page - Karachi SE
South Africa	Fixed price					yes	Web page, e-mail - Johannesburg Stock Exchange, 10/99.

| Turkey | Fixed price | 1993 | 1997 | | **yes** | yes | Istanbul Stock Exchange: Email, 3/99; Fax, 17 June 1996 |

Table 2. Predictions of various models for the results of a sealed bid uniform price auction open to a large number of potential investors (high N)

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

Table 3. Participation variations for Singapore IPO auctions, 1993-1994. Most data include all 20 auctions. The number of applications is based on only 19 of the 20 IPO auctions. because the number of applications was never released for Sunright, the last auction which was heavily undersubscribed. The subscription rate is the ratio of shares applied for to shares available, so a subscription rate below one means that the offering was undersubscribed, while a subscription rate of 11 means that the offering was 1,000% (ten times) oversubscribed. Shares applied for and available are in 1,000s. Source: the Stock Exchange of Singapore.

	Mean	Median	Standard deviation	Maximum	Minimum
Subscription rate, fixed price	15.63	12.40	12.39	41.00	1.22
Subscription rate, auction	3.99	2.63	3.44	14.00	0.18
# Applications, fixed price	176,446	159,848	167,386	795,272	28,036
# Applications, auction	25,046	7,765	39,513	162,492	1,128
Shares applied for, fixed price	426,161	322,034	384,333	1,672,000	32,042
Shares applied for, auction	325,950	113,577	626,730	2,800,000	3,600

Table 4. French Marche Libre IPOs, 2002-2004. Subscription rates for 49 of 54 IPOs during 2002, 2003 and 2004. We are missing one auction (Parfex) in 2003 and four fixed price public offers in 2004. A subscription rate below 100% means that the offering was undersubscribed, while a subscription rate of 120% means that the offering was 1.2 times subscribed, or 20% oversubscribed. Source: the Euronext website.

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

Table 5. Auction subscription rate and number of bidders regressions. The dependent variable is the subscription rate in the auction for Equation 1 and the number of bidders in the auction for Equation 1'. The subscription rate or number of bidders in the fixed price tranche is used to control for overall demand for the shares. ***,**, and * denote significance at the 1, 5, and 10 percent level, respectively.

Equation 1	Coeff.	t-stat		Equation 1'	Coeff.	t-stat	
Constant	0.74	(0.85)		Constant	0.00	(0.77)	
Subscription rate in fixed price tranche	0.18	(4.27)	***	Number bidding in fixed price tranche	0.03	(3.29)	***
1 month return on next-to-last auction	14.18	(3.50)	***	1 month return on next-to-last auction	-0.001	(2.26)	***
R^2	60%			R^2	39%		

Table 6. Auction clearing price regressions. The dependent variable is the auction price premium, i.e. the percent premium of the auction clearing price over the price for the fixed price tranche. The subscription rate or number of bidders in the fixed price tranche is used to control for overall demand for the shares. ***,**, and * denote significance at the 1, 5, and 10 percent level, respectively.

Equation 2	Coeff.	t-stat		Equation 2'	Coeff.	t-stat	
Constant	0.0163	(0.12)		Constant	0.10	(0.74)	
Subscription rate in the auction	0.0769	(2.88)	***	Number bidding in the auction	313.97	(3.30)	***
Subscription rate in fixed price tranche	0.0079	(1.08)		Number bidding in fixed price tranche	15.15	(0.13)	
R^2	44%			R^2	39%		

Table 7. One month aftermarket return regressions. The dependent variable is the 30 day aftermarket return, starting from the auction price. The auction clearing price premium is the percent premium of the auction clearing price over the price for the fixed price tranche. ***,**, and * denote significance at the 1, 5, and 10 percent level, respectively.

Equation 3	Coeff.	t-stat
Constant	0.04	(1.25)
Auction clearing price, premium over fixed price	-0.10	(-1.74)
R^2	10%	

Figure 1. Distribution of simulated bids for various entry levels. Bids were generated from a normal distribution with mean = \$20 and standard deviation = \$6. There are 100 shares being sold, so the clearing price is the 101st-highest bid, shown by the dark line.

A. 120 Bidders Average Bid = \$19.81 Clearing Price = \$14.52

B. 200 Bidders Average Bid = \$19.23 Clearing Price = \$19.08

C. 500 Bidders Average Bid = \$20.05 Clearing Price = \$24.96

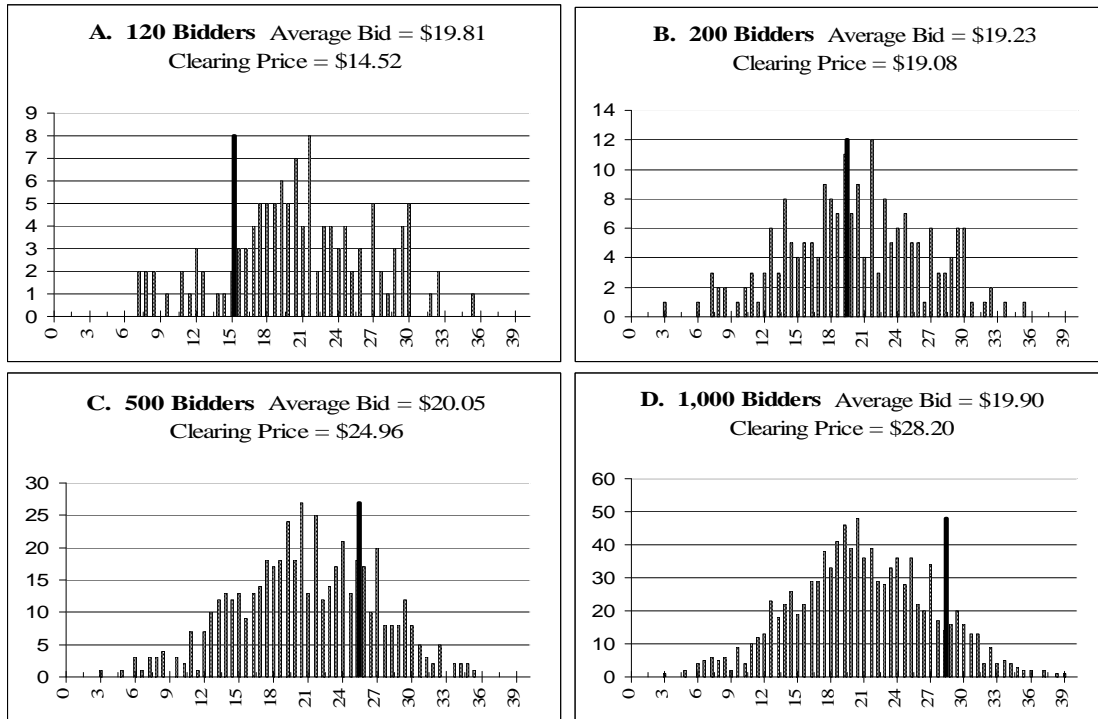D. 1,000 Bidders Average Bid = \$19.90 Clearing Price = \$28.20

Figure 2. One month buy-and-hold returns and subscription levels for Singapore auctions ordered chronologically. All 1993-1994 auctions are ordered by date. One month raw returns are the returns to winning bidders that held their shares for 30 days in the aftermarket. The 4-IPO moving average is the average return on the last 4 offers (or all previous, if less than 4). The oversubscription rate is in percent – an offering that was 60% oversubscribed received orders for 1.6 times the shares available.
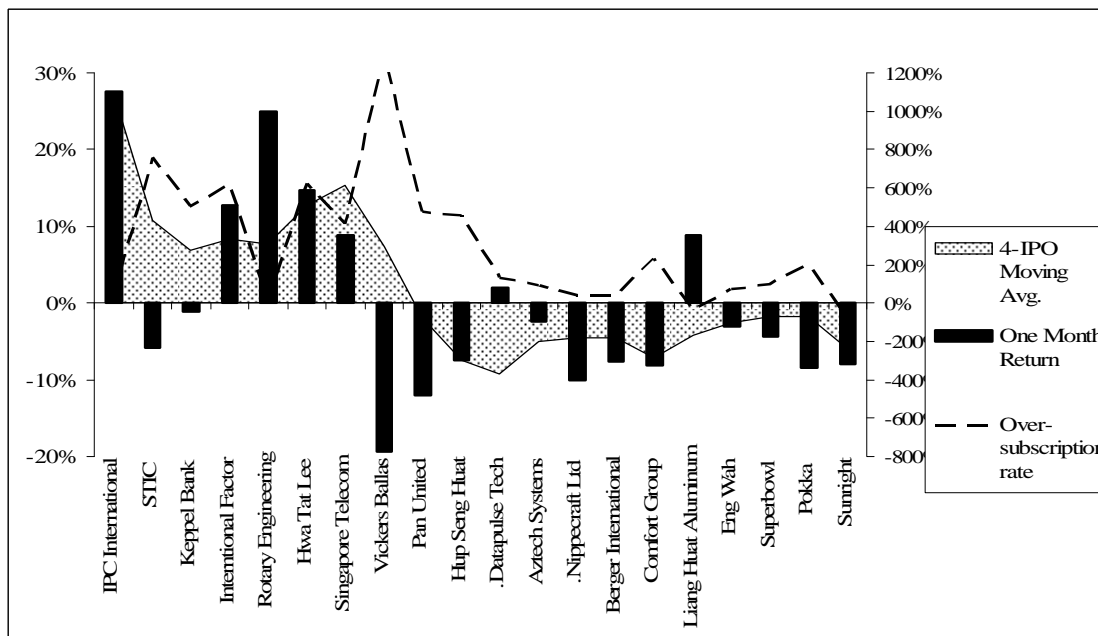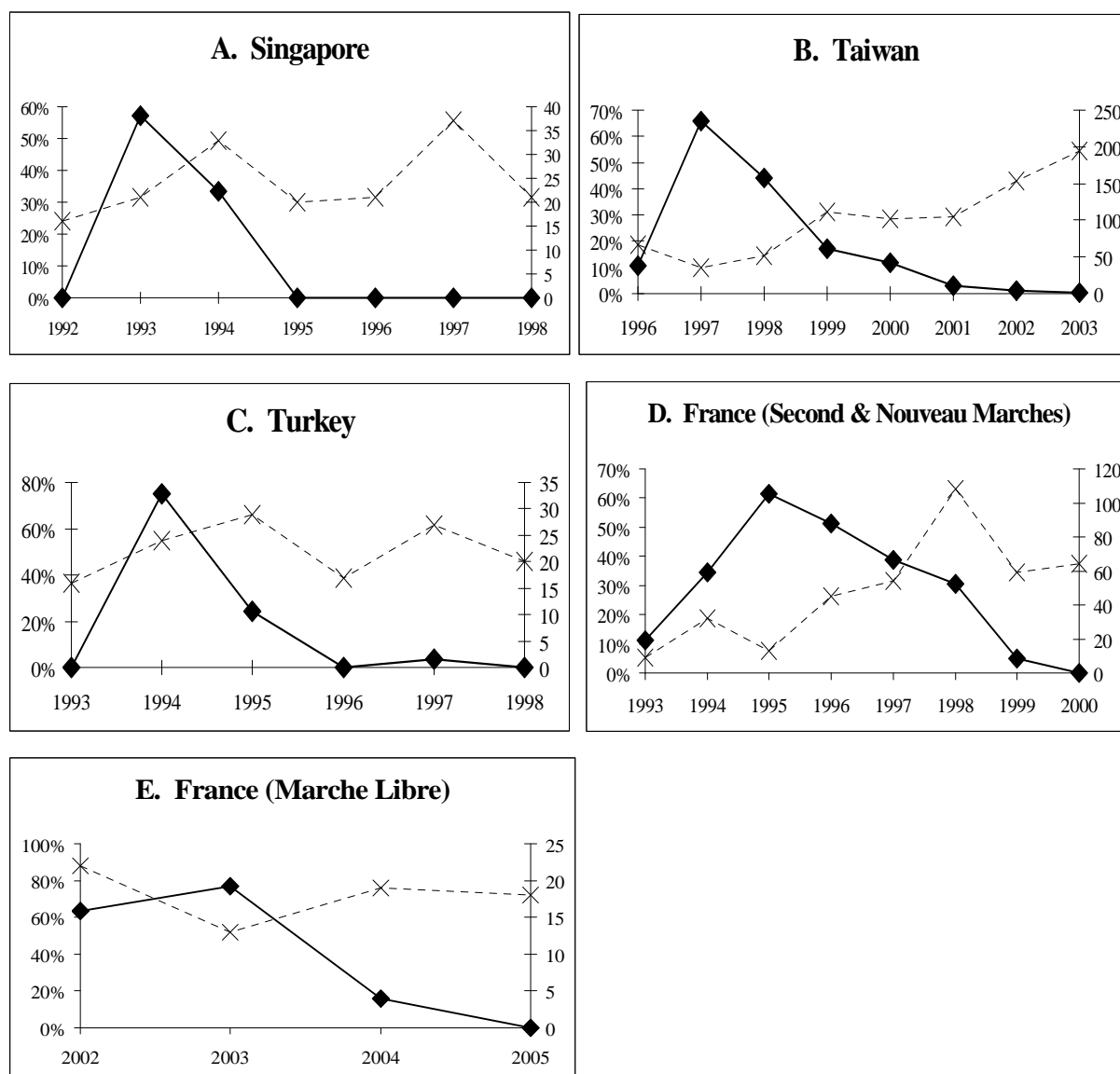
Figure 3. How auction use evolved over time in four countries. In each graph, the X's (right axis; connected by dashed lines) give the number of total IPOs per year in that country, while the diamonds (left axis; connected by solid lines) are the percentages of IPO auctions out of all IPOs.

Sources for Figure 3: A. Singapore – E-mail from the Stock Exchange of Singapore, October, 1999. B. Taiwan – The data was given to us by K.C. John Wei. See Liu, Wei and Liaw (2001) and, for 2002-2003 data, Hsu and Hung (2005). C. Turkey – E-mail from the Istanbul Stock Exchange, March, 1999. D. France Second and Nouveau Marches – From Derrien and Womack (2003) and Chahine (2001). E. France Marche Libre – Euronext website (www.Euronext.com, in IPO Archives).