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Treasury Bill Auctions: Issues and Uses

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Abstract

We review the main issues that arise in the design of treasury bill auctions and survey the relevant empirical literature. We also provide a detailed description of the actual design of these auctions in a sample of 42 industrial and developing countries.

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Summary

Academic and policy-oriented debate on the design of government securities auctions has intensified in recent years, motivated both by the desire for more cost-effective strategies to finance large stocks of government debt, and by the recognition that noncompetitive behavior may be a pervasive and costly feature of auctions of government securities around the world.

This paper reviews the main issues that arise in the design of treasury bill auctions, examining different aspects of auction design that may affect revenues from sale of government securities, such as the effect of the winner's curse on bidders' strategy and incentives to collude and corner markets. The analytical review is integrated with a survey of the relevant empirical literature. The paper's main contribution is a detailed description of the actual design of treasury bill auctions in a sample of 42 industrial and developing countries. The format of these auctions is compared with the predictions of auction theory. The authors note the striking contrast between the preference granted by the theoretical literature to uniform-price auctions, and the overwhelming prevalence of the multiple-price format among actual auctions of treasury bills around the world.

The paper finds that most treasury bill auctions tend to be of the discriminatory type, the most governments remain rather secretive in publishing auction results (except in highly aggregate form), and that governments do not appear to promote the development of organized secondary and (especially) forward markets for treasury bills. A possible explanation is that, in most countries, concerns about cornering and collusion in treasury bill auctions have tended to dominate.

The authors argue that greater effort is needed-and is likely to be forthcoming--toward extending existing models of auctions to capture actual auction of government securities more accurately. Clearer understanding of the relative incentives to noncompetitive behavior in repeated, common-value auctions of divisible objects, and clearer understanding of how auctioneers can alter such incentives by modifying auction procedures, are thought to be likely goals of future research.

I. Introduction

Auctions are used to sell government securities in a large number of countries. Many governments have begun only recently to hold security auctions, and specific auction formats tend to vary considerably internationally. Broad interest in assessing the advantage of various auction formats has emerged in recent years, however, motivated by the widespread growth of public debt during the 1980s (and hence by greater urgency for cost-effective strategies of debt financing) and by the occurrence of episodes of allegedly uncompetitive behavior in the United States and elsewhere.

In trying to develop greater understanding of the incentives faced by participants in government security auctions, and of the implications of such incentives for auction revenues, policymakers have turned to analytical research on auctions, only to uncover the absence of ready-made answers to their problems of institutional design. Indeed, despite progress made by Vickrey in the early 1960's in establishing both a taxonomy of auctions and basic revenue-equivalence results for different auction formats, most subsequent advances have been made with respect to auction formats that bear only limited resemblance to actual auctions of government securities. Few alternatives have been left to scholars and policymakers other than either to conjecture that theoretical predictions on the performance of related auctions remain approximately true for auctions of government securities, or to draw on the available (yet limited) empirical research and specific case-studies of security auctions, and conjecture about the general validity of the observed empirical regularities.

Motivated by the contrast between the practical importance of auctions of government securities and the absence of theoretical guidance on the design of these mechanisms, this study has two goals. First, it reviews the main issues arising in the design of auctions of government securities by surveying the main contributions in the literature--along similar lines of several recent reviews 1--and reviewing the main empirical results on auction performance (Sections II-IV). Second, it provides a detailed description of the institutional aspects of auctions of government securities (more specifically, of auctions of treasury bills) in a large number of countries, pointing at cross-country patterns that arise in the design of these auctions (Section V and Appendix). Our hope is that the information that we organize in this study may prove useful both for ongoing empirical research on auctions, and to policymakers in many (especially, developing) countries who face the task of implementing auctions of government securities, but lack sufficient guidance from economic theory.

II. Auctions: A Basic Taxonomy

Agricultural products, artwork, rights to exploit natural resources, and many financial assets (among which treasury securities), are commonly

1/ See, for instance, McAfee and McMillan (1987), Milgrom (1989), Reinhart (1992), Feldman and Mehra (1993), and Bikhchandani and Huang (1993).

sold through auctions rather than by over-the-counter sales with publicly announced prices. What makes auctions a more suitable vehicle for selling these goods is that sellers have only imperfect information on the value that buyers attach to these goods. Under these circumstances, they find it convenient to turn to auctions as price-discovery devices to identify the price (or prices) at which the goods can be placed at the highest possible return. While the auction literature has been minimally concerned with explaining why, in selling securities, governments appear to overwhelmingly prefer auctions to other mechanisms, it is clear that the reason for such choice must ultimately rest in the ability of auctions to convey more information about the demand curve for government securities than would be possible otherwise (e.g., by selling securities directly on the secondary market). 1/ 2/

A basic taxonomy of auctions was proposed by Vickrey (1961) and it still represents the starting point for most subsequent research on auctions. Vickrey's classification has two main dimensions. First, auctions can be distinguished according to whether successful bidders are required to pay their individual bid or, rather, the minimum price that exhausts the whole issue. Since in the case of an auction of multiple units of a divisible good (such as treasury bills), bid-price auctions give rise to multiple sale prices, we shall refer to this type of auctions as a "multiple-price" auctions. In contrast, we shall refer to auctions in which all bidders pay the minimum price that sells the auctioned object(s) as "uniform-price" auctions. Second, auctions can be distinguished according to whether bids are submitted in "sealed bid" or in public ("open outcry") form. This two-by-two classification yields four basic types of auctions, which are briefly examined below.

Subsequent research has also classified auctions according to the value that bidders attach to the objects on sale, distinguishing between the cases in which bidders attach "private" or, rather, "common" valuation to the objects on sale. 3/ In private-value auctions the valuation attached by

1/ We thank Daniel Hardy for clarifying to us this point. See Wang (1993) for a general discussion of the advantages of different allocation mechanisms, and Bikhchandani and Huang (1993) for a discussion of the different informational content of sales on the primary and secondary markets of government securities.

2/ Indeed, over-the-counter (or "tap") sales of government securities were more common in the past than they are now. In these markets, the government revises security prices infrequently, in response to changes in underlying economic conditions, and to its acquisition of information on securities' demand, gathered from buyers' behavior at the counter.

3/ The terms "correlated" or "affiliated" valuation have also been used in the literature to describe the general case of which private and common valuation are the polar cases--see Milgrom and Weber (1982a). We shall generally refer to "common-value" auctions when discussing auctions with correlated values.

each bidder to the items on sale would not be affected by his knowledge of other bidders' valuations. For instance, auctions of goods for private consumption (such as artwork not for resale) can be classified as auctions with private valuation. In contrast, auctions of goods bought for potential future resale (such as treasury bills) can be regarded as common-value auctions. In these auctions, the objective value of the item is the same for all bidders, although bidders have only imperfect knowledge of this value at the time of the auction. Bidders' behavior will therefore reflect their attempt to extract information on other bidders' assessment of the common valuation, in order to best forecast the future resale value of the good. Auctions have also been distinguished according to whether they involve the sale of a single item, such as a painting, or of multiple units of a homogeneous item, such as treasury bills. Given our interest in the institutional aspects of treasury bill auctions, we shall focus much of the following discussion on the case of common-value multiple-unit auctions.

Finally, auctions can be distinguished along other dimensions, including whether minimum bids or maximum shares to individual bidders are imposed, whether auctions take place once or repeatedly, whether bidders have symmetric preferences and similar institutional features, whether bidders are risk-neutral or risk-averse, etc. In the course of the following discussion we shall make occasional reference to these aspects of auction design, but focus on the issues that have primarily concerned scholars of government security auctions.

For the purpose of our presentation, it will be useful to recall the main trade-off faced by auction participants, which involves comparing the benefits of submitting a higher bid (which increases the probability of winning the auctioned good), weighed against the cost of doing so (that of reducing the profits from winning the auction, given by the difference between the resale price of the good and the auction price). The auction literature has focussed on a specific aspect of this trade-off that arises in the common-value case, namely: that a successful bid reveals to the bidder that he is likely to have made an above-average assessment of the resale price (or "true" value) of the good, thus raising the probability that he may incur a loss in the post-auction market. Rational bidders will discount this "winner's curse," and shade their bids downward with respect to their subjective valuation, the extent of the downward bias being a function of the specific auction format. It is the task of auctioneers to recognize these incentives and design auctions so as to maximize their revenues.

We now briefly review the main auction formats examined in the literature.

1. Multiple-price/Sealed-bid auctions

Most treasury bill auctions fall into this category, also known as "first-price" auctions when referring to the sale of a single unit, and as "discriminatory" auctions when referring to the sale of multiple units of a

single good. When auctioning a single item or unit, these auctions involve the auctioneer's screening of private bids and awarding the good to the highest bidder at the bid price (thus motivating the "first-price" label). When auctioning multiple units of a single good, these auctions involve sealed submission of quantity/price pairs, and the subsequent award of the available stock to the highest bidders, at the prices and quantities stated in their bids. Thus, the auctioneer favors bidders who submit higher bids and charges them their individual bids, similarly to a discriminating monopolist charging different prices to the highest-paying consumers in order to extract the surplus under the demand function. It is this feature that motivates the "discriminatory" label usually attached to multiple-price/sealed-bid auctions of multiple units.

2. Uniform-price/Sealed-bid auctions

Occasionally used to sell stamps and government securities, these auctions involve the auctioneer's collecting private bids and awarding the good on sale to the highest bidders at a uniform price. When a single unit is auctioned, the auction price is usually set at the second-highest bid (thus motivating the "second-price" label often attached to this auction format in the case of single-unit auctions), or at one price interval above the second-highest bid. When multiple units of a homogeneous good are auctioned (in which case these auctions are known as "competitive"), units are usually awarded to the highest bidders at one price interval above the highest unsuccessful bid. 1/

3. Multiple-price/Open-outcry auctions

In this type of auctions (often known as "Dutch," from their common use for the sale of flowers in the Netherlands), 2/ bidding takes place in real time, as bidders' either congregate in one room or interact electronically. With a single item being sold, the auctioneer begins by calling an unreasonably high price, and then progressively lowers it until a bidder accepts the current price by claiming the item. When multiple units

1/ Other pricing rules used in actual auctions include setting the common auction price at the lowest accepted bid, or somewhere between the highest and lowest successful bids (e.g., at the quantity-weighted average of the successful bids). A close relative of competitive auctions is the "Vickrey auction," a sealed-bid auction in which each successful bidder pays for his j -th unit purchased a price equal to the j -th highest rejected bid. With this auction format a winning bidder pays prices that are independent from his own bids, thus leading him to act as a price-taker. When each bidder desires a single unit, the Vickrey and the competitive formats coincide.

2/ Note that the financial press usually refers to multiple-price/sealed-bid auctions as English auctions (except in the United Kingdom, where these auctions are known as American auctions), and to single-price/sealed-bid auctions as Dutch auctions. The text follows the classification adopted in the academic literature.

are auctioned, units are progressively awarded to individual bidders (who can buy any fraction of the stock on sale at the going price), as the price keeps falling until the whole issue is sold.

4. Uniform-price/Open-outcry auctions

This auction format, often referred to as "English," is perhaps the most widely known auction format, largely because of its common use in the art world. When a single item is on sale, the auctioneer begins by calling a low reservation price, and progressively solicits higher bids until only a single bidder is left, who purchases the item at the going bid. With multiple units, this format involves collecting all quantities demanded at each price, comparing the quantity demanded with the stock on sale, and soliciting a new round of bids at a higher price if demand exceeds supply; the process continues until the quantity demanded just falls short of the whole issue; bidders at that price, and a fraction of those who just dropped off, are awarded the issue at the last price that exhausted the issue. In practice, uniform-price open-outcry auctions of multiple units are often organized as *sequences* of single-unit auctions, implemented by splitting the goods on sale into single units or lots (as in the case, for instance, of livestock in the United States and wool in Australia).

III. Strategic Aspects of Auctions and Implications for Revenue Yield

1. Revenue-equivalence results

The equivalence in terms of expected sale proceeds of the four types of auctions described above, for the case of private-value auctions of a single indivisible good, with symmetric risk-neutral bidders, and infinitesimal price increments, was initially established by Vickrey (1961). At first sight, this may appear as a surprising result: second-price auctions, in which each buyer pays a price equal to the highest rejected bid, would yield the same revenue as first-price auctions, in which winners pay the seemingly-higher amount equal to their own bid. To develop intuition for this equivalence property, first think of the case in which bidders attach different--yet publicly known--valuations to a single object on sale. Why would the bidder who values the good most ever bid his own valuation, knowing that a bid equal to (a fraction more than) the second-highest valuation would ensure him the object? It is obviously a more complicated matter when allowance is made for secrecy of individual valuations yet, if bidders form unbiased predictions of their competitors' valuation, a similar argument underlies the average equivalence between first- and second-price auctions. Note also that the strategic implications of imperfect information are drastically simplified by Vickrey's assumption that bidders' valuations are independent and private, a feature that causes the absence of winner's curse distortions. This assumption also implies the equivalence of sealed-bid and open outcry formats, as public bidding does not help bidders collect any strategically useful information. For instance, single-object Dutch auctions are closed as soon as a single bid

is posted, thus preventing the spread of more useful information with respect to their sealed-bid counterpart (i.e., first-price auctions). ^{1/} Similarly, in both English auctions and second-price auctions the bidder with the highest valuation will (on average) win the auction by tendering a bid equal to his best guess of the second-highest valuation (plus a standard price increment, typically assumed to be infinitesimal). In summary, in the standard private-value model, the auctioneer's effort to extract the surplus below the demand curve is exactly offset by a downward shift of the demand curve that results from bidders' forecast of their competitors' valuation.

Subsequent research has strived to extend Vickrey's equivalence results to less restrictive conditions. Holt (1980) and Harris and Raviv (1981), for instance, have extended the analysis to the case of risk aversion: when bidders are risk-averse, they place a premium on auction formats that present them with less uncertainty. Since in Dutch and first-price auctions bidders can at least be certain of their individual payment in case of a successful bid, they will bid more aggressively (and hence generate higher auction revenues) in these auctions than in English and second-price auctions.

A line of research more relevant for the design of Treasury auctions has explored the common-value case. The main result, in this case, is that Vickrey's revenue equivalence breaks down because of the emergence of winner's curse biases. Following earlier studies of common-value auctions (Smith (1966), Reece (1977), Wilson (1977), and Smith (1981)), for instance, Milgrom and Weber (1982a) allowed for common valuation in single-object auctions, and showed that the revenue potential of the four basic formats could be ranked according to each format's ability to mitigate the winner's curse. First, English auctions; second, second-price auctions; third, tied, first-price and Dutch auctions. In this case the auctioneer's effort to extract the surplus below the demand curve is *more than offset* by the downward shift of demand resulting from the anticipation of the winner's curse. The reason for this result is that price discrimination strengthens the winner's curse, because successful bidders are charged the full extent of their over-valuation of the "true" good's value, a feature that penalizes Dutch and first-price auctions. In contrast, in English auctions bidders can continuously update their assessment of the "true" value of the good by observing other bidders' behavior; this reduces their risk of over-valuing the good and their need to shade bids downward. The sealed-bid format of second-price auctions does not grant the same information gains. Yet, since in these auctions bidders are not required to pay their individual bids, but rather a price that incorporates to some extent other bidders' assessment of the good's value, the winner's curse is not as severe as in first-price and Dutch auctions.

^{1/} The strategic equivalence of Dutch and first-price auctions extends under conditions more general than Vickrey's; in particular, it does not depend on the private-value assumption. This property is an important ingredient of Milgrom and Weber's (1982a) analysis, discussed below.

Unfortunately, these results need not extend much beyond Milgrom and Weber's (1982a) basic assumptions. Allowing for bidders' risk aversion, for instance, already blurs the ranking: as noted above, risk aversion skews bidders' preference (and hence auction proceeds) towards multiple-price auctions, thus counteracting the effect of the winner's curse. 1/ More importantly, Milgrom and Weber's results need not apply to multiple-unit auctions, such as treasury bill auctions. 2/ In this case the main complication is that each bidder essentially tenders an entire demand schedule, rather than a single price, a feature that dramatically widens his strategic possibilities and the set of possible equilibria. 3/ Some of the strategic aspects of the multiple-object and single-object cases remain similar, and some progress has been made in modelling multiple-unit auctions in which each bidder can purchase a single unit of the good. However, it has proven difficult to develop a complete model of multiple-unit private-value auctions, despite largely side-stepping important aspects of actual auctions of government securities, including the repeated nature of these auctions, the emergence of long-term relationships among bidders, and issues relating to bidders' reputation. 4/ Much remains to be done to develop satisfactory models of auctions of government securities.

2. Collusive behavior and cornering

As general results on the revenue potential of various auction formats in the multiple-unit common-value case are not available, recent studies have focussed more on identifying special factors that may tilt the balance toward one auction format or another, with focus on the relative performance of uniform- vs. multiple-price auctions. Scholars of treasury bill auctions have been particularly interested in the contribution of different auction formats to collusive behavior and cornering, an issue brought to the forefront of the debate by recurrent episodes of allegedly non-competitive behavior in auctions of government securities in the United States and elsewhere. The controversy initially arose in the 1960's, and revolved around the suggestion to replace the multiple-price format of U.S. Treasury

1/ See Milgrom and Weber (1982a, Section 8) and Harris and Raviv (1981). Chari and Weber (1992), however, argue that risk aversion should not be much of a problem in auctions of government securities, largely because no single auction is likely to be large relative to the wealth of actual and potential participants for a realistic degree of risk aversion.

2/ See, in particular, Weber (1983), Maskin and Riley (1989), and Back and Zender (1992).

3/ In open-outcry multiple-price auctions, for instance, the first bid received need not close the auction, as it would in single-object auctions; rather, it reveals useful information on this bidder's valuation of the good on sale. This feature is likely to reduce the impact of the winner's curse in these auctions with respect to their sealed-bid counterparts.

4/ For instance, Back and Zender (1992) provide some examples of auctions with multiple-unit demands in which multiple-price auctions dominate uniform-price auctions.

auctions with the uniform-price format. Opponents of the switch argued that discriminatory auctions permitted cheaper financing of public debt, due to their ability of extracting bidders' surplus. 1/ Supporters of the switch argued that uniform-price auctions would have fostered lower cost of bid preparation, greater bidders' participation, and fewer incentives for bidders to pool and place their bids through brokers, thereby narrowing the scope for brokers to collude and corner a market. 2/

There are several ways in which non-competitive behavior can emerge in auction markets. First, a single broker or a group of brokers may attempt to form a ring with sufficient monopsonistic power so as to win the auction with a lower-than-competitive tender. Extra-profits are usually split among ring members, possibly upon allocation of the good by an internal auction. A ring may also try to gain control of the auction market in order to corner the secondary market, in which abnormal profits can be earned by acting as a discriminating monopolist. In this case, the ring's aim is to overwhelm the competition by tendering a higher-than-competitive bid in the primary market, a task which is greatly aided by the forecasts of auction prices provided by forward and resale markets. 3/ In addition to providing potential cornerers with a more accurate forecast of auction bids, forward markets also widen the scope for cornering, in that they provide a ready supply of investors who, having sold short the auctioned object on the forward market, are constrained to meet their obligations by purchasing on the secondary market, where they can be easily "squeezed" by a cornerer.

In response to the conjecture on the expanded scope for collusion in multiple-price auctions, recent literature has developed a conjecture of Mead (1967), and noted the greater ease with which collusion can be enforced in uniform-price auctions. A model of collusion in auction markets has been developed for the case of single-object auctions: profitable cartels in first-price auctions require all ring-members to tender low bids, so that individual bidders may profitably deviate from the agreement by submitting a slightly higher bid than their fellow ring-members; in contrast, second-price auctions allow the ring to police the agreement, by posting--at no

1/ See, for instance, Brimmer (1962) and Reiber (1965).

2/ See Carson (1959) and Friedman (1960, 1964). Similar arguments have been made recently by Friedman (1991) and Chari and Weber (1992).

3/ Since in this case the auctioneer sells at a higher price, it may appear that bidders' attempt to corner the market may in fact lead to higher auction revenues. The view that corners are, in fact, harmful for auction revenues rests on the conjecture that persistent non-competitive behavior will ultimately reduce investors' participation and auction revenues. Additionally, corners are viewed as inefficient, in that they promote allocation to agents other than those who attach the highest valuation to the goods on sale.

cost for the ring--a bid larger than ring-members' highest valuation. 1/ Back and Zender (1992) present a similar argument in the case of multiple-unit auctions, showing that multiple-price auctions may dominate uniform-price auctions exactly because the latter offer greater incentives to collude than the former.

In summary, although the gains from information-sharing may be greater in uniform-price auctions, enforcement of collusion is bound to be more difficult with this type of auctions. 2/ Once more, the relative performance of different auction formats is difficult to rank.

Interestingly, several studies predict that auctioneers can counteract collusion by imposing minimum auction prices that twist the collusive (monopsonistic) outcome up toward a bilateral-monopoly outcome (see Graham and Marshall (1985) for a formal treatment). On the other hand, announcing reservation prices may promote the clustering of bids around the cut-off price, thus providing a firmer reference point for potential cornerers. Buttiglione and Prati (1991) and Buttiglione and Drudi (1994) have argued informally that reserve prices may raise auction revenues by decreasing the volatility of bids (and hence uncertainty), but may reduce revenues if the auctioneer's uncertainty on the appropriate cut-off leads him to frequently truncate the lower tail of the demand function. 3/ In any case, auction theory points at a more general reason--beyond the attempt to break cartels--why sellers should impose minimum prices *strictly above* their subjective valuation of the good: a minimum price is the optimal response of a monopolistic seller who tries to extract some of the rents from bidders

1/ The formal argument, based on Milgrom (1987), goes as follows. Let all bidders attach the value v to the single object on sale. In a second-price auction, a ring would have one ring-member bid $v+\epsilon$ and all other members bid b (or less), where $b < v$. The highest bidder would win the auction at a price of b and a profit of $v-b$ (to be distributed somehow among ring-members). For a cheater to break the ring and win the auction, he would have to bid higher than $v+\epsilon$. However, he would have to pay $v+\epsilon$, which exceeds his valuation. Therefore, he would have no incentive to deviate, and the ring would stand. For a ring to make the same profit in a first-price auction, every ring-member would have to bid b or less. But then, any ring-member would gain from breaking the ring and bidding anywhere between v and b .

2/ The risk of collusion may also contribute to explain the world-wide prevalence of the sealed-bid format in treasury auctions (see Section V). Open-outcry eases collusion enforcement, in that monitoring of ring-members is easier when bids are submitted in public form (see Stigler (1964) for an early discussion and Milgrom (1987) for a more formal argument). On the other hand, the development of electronic bidding may reduce the technical cost of running open-outcry auctions interactively, thereby contributing to their diffusion when collusive behavior is not a problem.

3/ These studies also present evidence from Italian Treasury bill auctions that reserve prices may indeed lead to clustering of bids.

(see Milgrom and Weber (1982a) and McAfee and McMillan (1987) for a complete analysis). In many cases, it is appropriate to treat the auctioneer's reservation price as if it were *his bid* (see Engelbrecht-Wiggans (1983)), thus suggesting a preference for using--but not announcing--reservation prices at sealed-bid auctions of treasury bills.

3. Number of bidders

Several studies have also explored the link between the number of bidders participating in the auction and auction revenues. Clearly, greater market competition (expressed by a larger number of bidders) is likely to lead to higher auction revenues: for a ring to be successful, it must be able to control a sufficiently large share of bidders--a more difficult requirement to meet as the number of bidders participating in the auction rises. Apart from its effect on market structure, the probability that a bidder with a high valuation participates in an auction clearly rises with the number of bidders (just like the probability of observing at least one "six" increases with the number of tosses of a dice). Thus, apart from its effect on individual strategies, a higher number of bidders leads to expect a higher winning bid. By the same token, however, a larger number of bidders also reinforces the winner's curse: the winner among many bidders is likely to be further away from the consensus valuation (the mean of the distribution) than the winner among few bidders. The combination of these two effects, Wilson (1977), Reece (1978), and Milgrom (1979) have shown, is that the winning bid increases in probability towards the good's "true" value as participation in the auctions rises, even though each individual bid declines. Although this link has only been established asymptotically, or in very special cases, broad consensus has emerged in auction theory that wide auction participation should increase auction revenues. However, as the number of bidders is usually taken as exogenous with respect to the auction format, little is known on the relative incentives toward bidders' participation provided by different auction formats.

4. Information

Another prediction on which most theoretical models of auctions tend to agree is that the more information bidders have on the true value of the good, the lower will be their profits and the larger will be the auctioneer's revenue. 1/ Accordingly, it will be in the auctioneer's interest to reveal all information he has on the true value of the good. 2/

1/ See Reece (1978), Milgrom and Weber (1982a,b), Engelbrecht-Wiggans, Milgrom, and Weber (1983).

2/ An exception to this rule is provided by Milgrom and Weber (1982b): auctioneers should not reveal information that is correlated with that of the best-informed bidders, for this would increase informational asymmetry, and hence lower auction revenue.

To some extent, this may appear as a counterintuitive result: greater information reduces bidders' profits. Once again, however, the intuition for this result is rooted in the effects of the winner's curse, and in the general principle that bidders' profits at an auction reflect their *private* information, rather than *commonly available* information. Thus, greater homogeneity of information mitigates the winner's curse and increases auction revenues. To the extent that greater liquidity of secondary and forward ("when-issued") markets also contributes to spreading information symmetrically among bidders, it would be in the interest of auctioneers to promote the development of these markets in order to increase auction revenues.

Note, however, that the possibility of strategic interplay between forward, primary, and secondary markets may, under certain conditions, lead to subtle--occasionally perverse--effects on auction performance. We have already noted the possible contribution of forward and secondary markets to the promotion of collusive behavior and cornering of the market. Furthermore, if traders in the primary market recognize the role played by forward markets in revealing some of their private information, they may try to jam forward markets with distorted signals (see Bikhchandani and Huang (1992) for a discussion). For instance, a bidder with favorable information on the true value of the good may refrain from taking a long position in the forward market; in fact, he may even take a short position in order to falsely signal unfavorable information on the good's value. If the signal is successful, its sender gains an informational advantage at the auction, thereby increasing his profits and lowering auction revenues. Bikhchandani and Huang (1989) have also pointed at an important difference between investors in primary and secondary markets of treasury securities that may tilt--at the margin--preference toward uniform-price auctions with respect to their multiple-price counterpart: participants in treasury bill auctions are typically large financial institutions, generally having better information on interest rates and demand than smaller institutions and individual investors, who act only in the secondary market and may have access only to publicly known information. Under these circumstances, participants in treasury bill auctions face an incentive to tender higher bids in order to signal "good news" to uninformed investors on the true value of the security, thus marginally raising prices in the secondary market. To the extent that raising individual bids is less costly in uniform-price auctions, heterogeneity among market participants provides an additional element in favor of uniform-price auctions.

5. Allocational efficiency

Finally, we conclude our analytical survey by noting that despite the emphasis placed in the literature on the revenue comparison of different auction formats, attention has also been placed in comparing auction formats in terms of their ability to promote allocational efficiency, defined by the condition that the auctioned goods are awarded to those who value them most, while the seller obtains the maximum revenue from the auction. The textbook case of private-value auctions was examined by Vickrey (1961), who showed

that all four basic auction formats are Pareto efficient. 1/ The state of the art for common-value auctions is summarized by Maskin (1992), who shows that, in general, efficiency cannot be achieved by any of the basic auction formats, none of which can assure that the bidder with the highest valuation wins the auction. 2/ Auction formats can be ranked in terms of efficiency when the informational asymmetry among bidders is not too severe; in this case, uniform-price (or English and second-price) formats dominate multiple-price (or Dutch and first-price) formats.

IV. Empirical Evidence on Auction Performance

Empirical research on auctions has developed along several directions. One line of research has tested directly the predictions of auction theory on the revenue equivalence among the main auction formats. Results have been mixed, as one would expect given the sensitivity of the model to assumptions on the information structure, bidders' attitudes toward risk, their institutional features, the possibility of non-competitive behavior, etc. Empirical results against Vickrey's revenue-equivalence theorem, for instance, have been presented by Mead (1967), while empirical results in favor of revenue equivalence have been presented by Hansen (1985).

In comparing the revenue potential of different auction formats, scholars of treasury security auctions have focussed mainly on the relative performance of uniform-price and multiple-price auctions. The experience with U.S. Treasury auctions until the mid-1970's--which tended to confirm the presumed superiority of uniform-price auctions--was reviewed by Baker (1976). Severe data problems affected early comparison of auction formats, however, and the reliability of these findings should be discounted. Nonetheless, more recent evidence has also tended to support the prediction of greater revenue potential of uniform-price auctions. Umlauf (1993), for instance, has studied Mexican one-month Treasury bill auctions from 1986 to 1991, comparing the revenues from multiple-price auctions held until mid-1990 to the revenues from uniform-price auctions held after that date. He finds the latter format to have yielded significant more revenue than the former format, although he is unable to identify whether the revenue increase could be attributed to the lower impact of the winner's curse, or to changes in market structure triggered by the switch of format. Using data from Zambia's foreign exchange auctions from 1985 to 1987, and exploiting the switch between uniform- and multiple-price formats in these auctions, Tenorio (1993) also found uniform-price auctions to yield significantly greater revenue. In general, evidence from these studies tends to be somewhat difficult to interpret, given the variety of factors affecting auction revenues, and the resulting difficulty of attributing to a specific auction format the main cause for the observed revenue

1/ See also Harris and Raviv (1981) for a more formal treatment.

2/ See McAfee and McMillan (1987) and Feldman and Mehra (1993) for further discussion.

performance. 1/ Scholars of auctions are eagerly awaiting the results of the experiment undertaken by the U.S. Treasury since September 1992, whereby uniform-price auctions have been tentatively implemented for two-and five-years notes in lieu of the previous multiple-price format.

Another line of research has aimed at testing specific predictions of auction theory, such as the empirical significance of the winner's curse. The impact of the winner's curse has been measured by the negative spread between auction and resale market prices of the auctioned good (or, in the case of treasury bill auctions, by the yield-spread between auctioned bills and matching bills traded in the open market). Considerable evidence has been presented of significant underpricing of new debt issues with respect to matching securities in the secondary market. Cammack (1991), for instance, found mean auction prices of three-month U.S. Treasury bills from 1973 to 1984 to fall short of comparable secondary market prices by a statistically significant four basis points. 2/ Consistent with the predictions of theoretical models of common value auctions, she also finds the degree of underpricing to reflect information dispersion among bidders (measured by the variance of auction bids). Spindt and Stolz (1992) for U.S. data, Umlauf (1993) for Mexican data, and Buttiglione and Drudi (1994) for Italian data, report similar findings. Spindt and Stolz (1992) also show the extent of underpricing to decline with auction participation.

The effects of changing the number of bidders on individual and winning bids have also been explored by Gilley and Karels (1981) for oil price auctions, and by Brannman, Klein, and Weiss (1987) for a variety of other auctions. Their results are generally supportive of the prediction that increased auction participation should lower individual bids but raise expected winning bids and revenues.

Finally, several studies have examined the behavior of forward treasury bill markets, with the aim of determining their efficiency, unbiasedness, etc. Findings have typically been mixed, although a slight skew can be detected toward the view that these markets should be relatively efficient. See, for instance, Ferri, Goldstein, and Oberhelman (1985), Jacobs and Jones (1980), Poitras (1991), and Pugh (1993).

In summary, while evidence *consistent* with the predictions of theoretical models of common value auctions is abundant, taking such evidence as unambiguous confirmation of the winner's curse bias is, obviously, more problematic. In principle, underpricing may reflect risk premia or intermediation costs. Similarly, to the extent that non-

1/ Controlled laboratory experiments have also been conducted (see Smith (1992) for a survey), but no conclusive results have emerged.

2/ To put this figure in perspective, consider that Jegadeesh (1993) reports an average bid-ask spreads of about nine basis points for two-to-ten year U.S. Treasury notes from 1986 to 1991.

competitive behavior appears to be pervasive in auction markets ^{1/} (see Hendricks and Porter (1988) for offshore lease auctions, and Umlauf (1993) and Sundaresan (1992) for treasury auctions), it is problematic to interpret underpricing as direct evidence of the pricing bias caused by the winner's curse. More generally, doubt remains in the literature on the actual degree of uncertainty faced by auction participants on the true value of the security (and, hence, on the importance of the winner's curse). After all--in contrast to goods such as artwork and oil exploration rights--well developed secondary markets exist for securities of very similar maturity and risk characteristics to those auctioned in the primary market. One may conjecture that if nuisance factors such as transaction costs and risk premia could be netted out, the price bias that could be attributed to the winner's curse might be negligible.

Notwithstanding the difficulty of interpreting evidence on specific predictions of auction theory, and the lack of satisfactory models applicable to auctions of government securities, one can detect a general tendency of the theoretical and empirical literature on auctions toward the view that uniform-price auctions should, ultimately, allow the government to finance its debt issues at a lower cost. That would be the case, however, only provided that the greater incentive toward collusive behavior offered by uniform-price auctions could be inhibited, by suitable use of minimum auction prices and continued monitoring of bidders' behavior. As noted in the previous section, however, not all scholars agree on the relative incentives towards non-competitive behavior offered by different auction formats--notable disagreement being that of Friedman and of his followers. Until progress in auction theory in the next few years helps resolve these controversies, trial and error is bound to be the main strategy chosen by auction designers to achieve the goal of greater revenue and efficiency of treasury bill auctions.

V. Treasury Bill Auctions in Practice

As discussed in the previous sections, auction theory provides limited answers to many questions concerning auctions of government securities that scholars and debt managers may be most interested to ask. The theoretical debate has focussed primarily on the choice between uniform and multiple price auctions and, even in this limited field, definite answers are

^{1/} Perhaps the most celebrated example of non-competitive behavior in treasury auctions occurred in May 1991, when Salomon Brothers admitted gaining control of 94 percent of the U.S. Treasury two-year notes, in violation of the 35 percent limit set by the Treasury for each bidder. See Jegadeesh (1993) for a detailed analysis of that episode, and "Hidden Bonds: Collusion, Price-Fixing Have Long Been Rife in Treasury Market," *The Wall Street Journal*, August 19, 1991, P. A1.

still lacking. In addition, a number of aspects that may crucially affect auction results have received only limited or no attention in the literature, including:

- Who should be permitted to participate in the auctions? How could potential bidders be screened, in order to guarantee their ability to meet their commitments?
- Should central banks be allowed to participate in auctions, and under what terms?
- How frequently should auctions be held, and should securities of different maturity be auctioned with different frequency?
- How many bids should each bidder be allowed to submit, and should the amount of securities awarded to each bidder be subject to a ceiling?
- Should the treasury enjoy discretion to alter the terms of the auction after bids have been tendered? For example, should the treasury be allowed to vary *ex post* the stock of securities initially placed on sale?

Absent firm (or any) theoretical indications on many of these issues, one possibility would be to adopt a pragmatic approach by exploring international uses and patterns of actual auction and conclude, in a strict "revealed preference" mode, that how government securities auctions are organized provides the best prediction on how government securities auctions *should* be organized. We shall not take such an extreme viewpoint. After all, our sample includes a sufficiently high number of countries where government securities auctions have been implemented too recently, to ignore transitory and institutional constraints that may have led governments to select sub-optimal auction formats. Yet, the emergence of clear patterns in actual implementation of these auctions places responsibility on auction theory to offer models that predict the emergence of such patterns. As a preview of the following discussion, for instance, we note that the relative favor enjoyed by uniform-price auctions among many scholars of auctions, contrasts with the virtual monopoly enjoyed by the multiple-price format among actual auctions of government securities.

Before moving on to examining the general features of our sample, and analyze its properties in detail, a few methodological considerations ought to be noted.

First, the discussion in the rest of this paper is purely descriptive. We shall examine government securities auctions in a relatively large number of countries, but make no attempt to relate rules and institutions to auction results. Some information on the institutional aspects of auctions (spread between minimum and maximum accepted bid, average number

of participants, etc.) is provided in the country-tables presented in the Appendix. Investigation of the links between auction rules and outcomes, however, goes beyond the scope of the present paper.

Second, the analysis focusses on auctions of treasury bills, 1/ rather than of other government securities, this choice reflecting our attempt to provide international comparison across relatively homogeneous financial instruments. 2/

Finally, in this paper we identify the debt manager as "the treasury," even though, in practice, in many countries the final decision regarding the issue of treasury bills rests with the ministry of finance (which often includes a treasury department) and the central bank may be nominally charged with organizing and running the auction.

1. Sample composition

Our initial sample consisted of 77 countries (including all the G-7 countries), selected on the basis of information available at the end of 1993. 3/ As documented in Table 1, industrial countries represented about 25 percent of the sample, while developing countries and economies in transition represented respectively 53 and 22 percent of the sample. 4/ 5/

1/ In this paper, the term "treasury bill" refers to any debenture issued by the government of a country with a maturity of up to one year. In all countries surveyed (with the exception of Norway) this type of debenture is coupon-free, the return being the difference between face value and purchase price.

2/ Clearly, the line of demarcation between auctions of treasury bills and of other government securities may be occasionally artificial. Some of our countries' central banks auction certificates which, in terms of maturity and yield structure, are quite similar to treasury bills. A study of government securities auctions could surely benefit from examining these related instruments, an extension that we have chosen not to pursue at this stage.

3/ The sample included the countries for which information was more readily available. While in some cases (for example, the United States and the United Kingdom), the information was derived from official publications, in most of the cases, we relied on documents provided to the IMF by the national authorities in the context of the IMF technical assistance activity, and/or during the standard annual consultations.

4/ Unless otherwise indicated all the information reported in the rest of the paper and in Appendix I refers to the situation at the end of 1993.

5/ For simplicity, some centrally planned economy such as China have been included in the group of the economies in transition.

Table 1. Sample Composition

(Percentage of the total in parenthesis)

	Total	Industrial	Developing	Transition
Total sample	77 (100.0)	19 (24.7)	41 (53.2)	17 (22.1)
Countries with auctions	42 (100.0)	15 (35.7)	21 (50.0)	6 (14.3)
(B/A)x100	54.5	78.9	51.2	35.3

The table also shows that, at end of 1993, treasury bills were sold through auctions in 42 (or slightly more than half) of the sample countries, and that auctions were more common in industrial countries (were they were used in over three-fourths of the cases), than in developing countries (about half of the cases) and economies in transition (about one-third of the cases).

In the next sections we focus on the features of treasury bill auctions in the above 42 countries, whose composition is documented in the second row of Table 1. As not all information surveyed is available for all countries (see Appendix), the following discussion refers to sample frequencies defined over each subsample, whose size is reported in each case.

We should note from the outset that Treasury bill auctions are, from a world-wide perspective, a rather new phenomenon, its diffusion having accelerated sharply in the last few years. As documented in the Appendix, only 6 of the 42 countries included in our sample (or 14 percent of the total) were auctioning treasury bills at the beginning of the 1980s: the United States, the United Kingdom, Italy, Canada, Jamaica, and Mexico. Ten more countries introduced auctions between 1980 and 1987, raising the fraction of countries with treasury bill auctions to 38 percent, while the remaining 62 percent of the countries in our sample have introduced treasury bill auctions in the last six years. In fact, as many as 9 countries have begun to auction treasury bills in 1993 alone.

Several factors may have contributed to the rapid spread of auctions in the sale of treasury bills (and, more generally, of government securities) in the past decade. Increasingly tight constraints on central bank credit to the government have been set in the last 10 to 15 years in a number of countries, leading to a reduction of central banks' buffer role in the allocation of government securities, and the consequent need to pitch securities' prices (or yields) more in line with market demand. Sale of

treasury bills "on tap" at a posted rate (a common technique during the 1960s and 1970s; see OECD (1982)) may thus have proved too rigid as a pricing mechanism, in its shifting the adjustment from prices to quantities sold. Increasing integration of international capital markets in recent years, and the consequent greater freedom of investors to search profitable opportunities internationally, may have also exacerbated governments' need to quickly learn investors' demand for securities, thereby promoting the shift to auctions.

2. Auction techniques

Table 2 summarizes the distribution of the 42 sample countries by auction technique. Auction formats are classified by the standard distinction between uniform and multiple price auctions (including a residual column for "mixed" techniques), as well as by the criterion of whether bidders bid a discount rate, a price, or a yield.

Table 2. Auction Technique

(Percentage distribution: 42 countries)

	Uniform Price	Multiple Price	Other	Total
Discount	--	19.0	--	19.0
Price	4.8	50.0	2.4	57.2
Yield	--	23.8	--	23.8
Total	4.8	92.8	2.4	100.0

As evidenced by the last row of Table 1, price discrimination is by far the most common practice over the countries in our sample. Multiple price/yield/discount formats are used in over 90 percent of the countries, uniform price formats being adopted only in Denmark, and Nigeria. One country (Spain) uses a "lopsided" multiple price technique, in which bidders offering prices lower than the average pay their bid, while all other

bidders pay the average price. 1/ Moreover, six countries (Belgium, Tanzania, France, The Gambia, Mexico, and Italy), which had used uniform-price auctions in the past, relinquished them in favor of multiple-price auctions. There are no examples of permanent shifts from multiple- to uniform-price auctions in our sample. 2/

The classification of auction technique in terms of how bids are expressed is obviously less substantive, as the translation between price, price, yield, and discount, is a matter of simple algebra. 3/ Indeed, the prevalence of price bids among actual treasury bill auction procedures (in almost 60 percent of the countries surveyed) should be regarded as a matter of no economic significance. Nonetheless, the distinction is important for auction organization, administration, and--foremost--for empirical analysis: different countries adopt different conventions in defining contract maturities, a feature that must be taken into account when computing yields for cross-country analysis, when collecting data to assess price and yield biases between primary and secondary markets, etc. For instance, in some country the standard year used in the computation of yields is conventionally set at 360 days (Denmark, France, Sweden, United States), while other countries use the calendar year (Italy, Belgium, Finland, Spain, United Kingdom). Also, in most countries in which bids are placed in terms of yields, simple (rather than compounded) yields, are used. This convention is probably a remnant of the past, reflecting the view that derivation of treasury bills prices from compounded yields represented an unnecessary complication.

1/ This average price is computed using bid prices, rather than the prices actually paid. The aim of this format would be to allow the extraction of the full consumer surplus from those participants who bid below the average price, and of a fraction of the consumer surplus from those traders who bid above (or equal to) the average price. Naturally, the treasury's surplus-extracting effort might be frustrated by bidders' anticipation of the winner's curse (see the discussion in Sections 2 and 3).

2/ From July 1990 to the beginning of 1993 Mexico replaced uniform-price auctions with multiple-price auctions, but, subsequently, shifted back to multiple-price auctions. The United States has also experimented with uniform-price auctions for long-term securities from 1972 to 1974 period (see the discussion in Friedman (1991)) and since September 1992 for the issue of two- and five-year notes. Results for the last experiment have not yet been published.

3/ The formulas relating yield, i , discount, d , and price, P , are:

relation between price and discount: $P = 1 - d \times (n/N)$,
relation between yield and price: $i = (1/P - 1) \times (N/n)$,
relation between yield and discount: $i = [1 / (1 - d \times n/N)] \times (N/n)$,

where N is the number of days in a standard year, and n is the number of days to maturity.

3. Auction participants and deposit requirements

Table 3 provides information on the institutional features of the agents admitted to treasury bill auctions in our sample.

Table 3. Institutional status of bidders
(Cumulative percentage distribution; 42 countries)

	Own Account Only	Own Account and Customers	Total
Selected financial intermediaries ("Primary" dealers)	71.4	28.6	100.0
Financial intermediaries <u>1/</u>	64.3	19.0	83.3
All domestic legal entities	42.9	--	42.9
All domestic agents	38.1	--	38.1
All agents	28.6	--	28.6

The table summarizes the relevant rules in the 42 countries of our sample, by reporting the percentage of countries in which participation is admitted for increasingly wide categories of investors. The table also documents whether financial intermediaries can participate only on their own account, or also on behalf of customers. 2/ The rules refer to participation at so-called "competitive" terms, that is for bidders who tender price/quantity pairs. 3/ Some countries allow participation (at so-called "noncompetitive terms") of bidders who only tender quantity bids (and purchase these quantities at the average price computed on competitive

1/ In some cases, this group includes insurance companies and brokers. In Japan foreign banks can also participate in treasury bill auctions.

2/ In all countries, bids on account of other agents can be submitted only by financial intermediaries, inclusive of brokers and dealers. In a limited number of countries, even indirect participation is restricted. In Morocco, for example, only legal entities are allowed to bid through banks.

3/ Note the difference in the use of the term "competitive" when referring to the auction format (where the "competitive" label identifies a uniform-price/sealed-bid auction of multiple units), and when referring to the terms under which bids are tendered (where "competitive" bids are those for which price/quantity pairs are tendered).

bids). Noncompetitive bids are often restricted to nonbank agents (see the Appendix for further details). The table indicates that a liberal format that allows direct participation in the auctions of all agents (including individuals and foreign residents), is relatively common, being permitted in almost 30 percent of the countries surveyed; 38 percent of the countries surveyed allows participation of all domestic residents; 43 percent restricts participation to domestic legal entities (including non-financial enterprises); and a majority of the countries in our sample limits participation in treasury bill auctions to financial intermediaries.

A key issue in the design of treasury bill auctions is whether only banks should be allowed to bid directly, thereby restricting the non-bank sector to bid only through them. To the extent that the main benefit of opening auctions to non-financial agents is to increase competition, and that this benefit may be more important when the number of financial intermediaries is small, one would expect countries with a small number of financial intermediaries to follow a more liberal policy of access to treasury bill auctions. However, residents' direct participation is allowed also in countries (United States, United Kingdom, Jamaica, Spain, New Zealand) where the number of financial agents is large. Furthermore, the choice of allowing for more direct participation of small investors in treasury bill auctions also impinges on other considerations, including the difficulty of screening bids by the likelihood of delinquent behavior (ranging from the inability to meet the commitment to buy, to the attempt to recycle illicit funds), the desire to avoid an excessive number of small bids, and the scope for concentration of market power (and hence of noncompetitive behavior) in the hands of a few large intermediaries.

Cross-country differences in regulations aimed at restricting participation in Treasury auctions partly reflect cross-country differences in the severity of these problems. Almost 30 percent of the countries in our sample, for instance, have struck a compromise between tight and deregulated formats, by allowing non-financial agents to participate in treasury bill auctions, albeit only through the intermediation of primary dealers; 29 percent of the countries in our

sample have gone as far as to allow only direct bids from financial intermediaries, although only 7 percent of the countries restricted participation only to primary dealers. 1/

Many countries view restrictions on participation in auctions as only a second-best instrument to tackle the problem of bid-screening, and view minimum-bid requirements and deposit guarantees as the appropriate instruments to reduce the incidence of small or unreliable bids. Deposits guarantees are used in 66 percent of the countries where nonfinancial agents are allowed to bid directly. 2/ Guarantees are often in the form of down-payments (in cash, or in maturing government paper), or (as in the United States) of bank guarantees. 3/ In the remaining 34 percent of cases (six countries), no deposit requirement is imposed on non-financial bidders. 4/ 5/

1/ However, the number of countries in which specialized operators (known as "primary dealers") are active in the secondary market is larger. These dealers are specialized market-makers, typically identified by the commitment to post continuous buy and sell prices for bills in circulation. Some countries view these dealers' exclusive right to participate in the auctions as a compensation for this commitment. In other countries, the "compensation" includes access to central bank credit at more favorable conditions, the possibility of buying at noncompetitive terms during or after the auction, etc. Secondary-market dealers operate in about one-third of the countries surveyed, although they are much more common in industrial than in developing countries: industrial countries account for over 80 percent of the countries where secondary market dealers are present, whereas developing countries and countries in transition account for almost 90 percent of the countries without secondary-market dealers.

2/ With the exceptions indicated below, there are no deposit requirement in countries where only financial intermediaries participate in the auctions.

3/ In all but two cases, the guarantee must cover 100 percent of the bid amount. The exceptions are the United Kingdom, where the required rate of coverage is 53 percent, and Nepal and Spain (2.5 percent).

4/ In one country (New Zealand) bidders must be registered with the central bank, which sets a ceiling on the bid that can be accepted from each bidder (a small deposit requirement is needed to cover a fraction of the excess of the bid over the ceiling). In another country (Hungary), there are penalties for delayed payments.

5/ In all but two cases (Russia and Bolivia) financial intermediaries are exempted from deposit requirements, both for their own bids and for the bids submitted on their customers' behalf. However, in some cases (for example, Latvia and Slovak Republic), delayed payment is usually met with stiff penalties (such as temporary exclusion from subsequent auctions).

4. Central bank participation

The issue of whether a country's central bank should be allowed to participate in Treasury auctions is controversial. The choice involves balancing the advantage of central banks having direct influence on a key policy tool (the yield on treasury bills) against the risk that the central bank may be subject to unduly pressure from its government to tamper with the cost of financing government debt. 1/

As a matter of fact, central banks are not allowed to participate in treasury bill auctions in 59 percent of our sample. 2/ In 12 percent of our sample countries, central banks do not directly participate in the auctions, but stand ready to buy unsold amount of the bills. Only in 29 percent of the cases, central banks participate directly in the auctions. This total includes two countries (Denmark and Italy), where this possibility has been abolished as of January 1, 1994, in accord with the Maastricht Treaty of the European Union. The total includes cases in which the central bank is allowed to participate only at noncompetitive terms (Lebanon, United Kingdom), and cases in which it can participate like any other competitive bidder (Italy, Canada, The Gambia, Slovak Republic). 3/ Clearly, the first solution reflects the attempt to provide central banks with some protection against government pressure to bid at low rates. Of course, the requirement to buy at the average market price offers only partial protection, since by raising the size of its noncompetitive bid the central bank could still lower the average auction rate--see Section 5.6 for a discussion.

5. Competitive bids

We examine three features of competitive bids: (i) the admitted number of bids per bidder (34 countries); (ii) the presence of constraints on the maximum award per bidder (35 countries); (iii) the minimum admissible bid (38 countries).

In principle, a case for constraining the number of bids that each bidder can submit can be built on the need to reduce administrative costs and to ease the government's projection of auction revenues (due to the

1/ See Cottarelli (1993), Chapter III, for further discussion.

2/ This figure includes Russia and Hungary, whose central banks are only allowed to purchase, at the average auction price, a limited share of the auctioned amount.

3/ In some of the latter cases, the central bank tenders its own bid only upon observation of other participants' bids.

greater tractability of the strategic environment). 1/ In practice, constraints on the number of bids are uncommon. Seventy-six percent of our sample countries does not impose constraints. One of the remaining countries (Lebanon) imposes a very high constraint (20 bids per bidder). Only six countries have relatively tight constraints: Portugal (6 bids), Venezuela and Italy (5 bids), Slovak Republic (3 bids), and Latvia and Jordan (1 bid).

Ceilings on the maximum award per bidder have been advocated as anti-collusion or anti-cornering devices, although there is some disagreement on their usefulness. 2/ In practice, 77 percent of the countries in our sample do not apply any ceiling. Among the remaining countries, Poland and (informally) France express the ceiling in absolute terms, while four countries express the ceiling at a fixed fraction of the auctioned amount: at 60 percent in Mexico, and at about one-third in the United States, Canada, and Venezuela. The United Kingdom and Hungary use flexible ceilings. 3/

The size of the minimum accepted bid is an important factor influencing the number of bids submitted and the number of bidders. The rationale for placing a lower bound on bids is essentially that of simplifying auction procedures and reducing administrative costs. However, a binding lower bound may reduce the number of independent bidders by excluding relatively small agents and/or forcing bid-pooling, thereby promoting anti-competitive behavior. Of course, the strength of the "entry barrier" implicit in a given minimum bid will depend on several factors. For example, a minimum bid of US\$1 million may have limited impact on participation in a country where per-capita wealth is as high as in the United States, but might dramatically reduce the number of potential bidders in a developing country. Similarly, one may expect countries whose residents face fewer constraints on their ability to borrow, and are more open to foreign investors, to be less concerned with the greater incentives to non-competitive behavior associated to lower-limits on bids. Therefore, to the extent that per-capita income acts as a proxy for residents' average wealth, their access to credit, etc., the link between minimum bids admitted at treasury bills auctions and per-capita income should emerge in cross-sectional regressions. For illustrative purposes, we have conducted one such

1/ Casual evidence suggests that some governments also impose ceilings on the number of individual bids to prevent bidders from (costlessly) including unrealistically low bids which, occasionally, may turn out to be winning bids.

2/ Reinhart (1992), for instance, has suggested that quantity limits may strengthen rings, since they reduce ring-members' incentives to abandon the cartel to try to corner the secondary market individually.

3/ The U.K. Treasury reserves the discretion of refusing awards exceeding 25 percent of the auctioned amount. In Hungary the bills awarded to the same bidder can exceed 50 percent of the auctioned amount only if there is a demand shortfall at the minimum accepted price.

regression over the countries of our sample, and found the empirical link between minimum bids and per-capita income to be strong: the elasticity of minimum bids to per-capita income was estimated at a highly significant 1.16 (its standard error was 0.05), and found to explain a relatively large fraction of the cross-country variance of minimum bids ($R^2=0.52$). 1/ After excluding three outliers (countries with errors larger than twice the regression standard errors), the pattern was even more apparent (the elasticity was estimated at 1.22, with a standard error of 0.04, and R^2 of 0.73). 2/ 3/

6. Noncompetitive bids

Noncompetitive bidding, whereby bidders are allowed to purchase at the average price computed on competitive bids, is usually conceived as an instrument to spur participation in treasury bill auctions of small, uninformed, bidders. Since noncompetitive bids are typically awarded prior to competitive bids, a larger amount of noncompetitive bids leads to increase the weight of high bids over successful bids, and therefore to higher prices/lower yields at the auction.

We examine four aspects of noncompetitive bids: (i) whether competitive bids are admitted (with a sample of 40 countries); (ii) whether the share of noncompetitive bids is capped (12 countries); (iii) whether each noncompetitive bid is capped (10 countries); and (iv) whether bills can be purchased from the treasury after the auction (37 countries).

In principle, the choice between tendering a competitive or a noncompetitive bid depends on the type of information available to the bidder. Bidders whose private information is an unbiased draw from a common distribution, would like to participate at non-competitive terms in order to minimize the impact of the winner's curse. However, bidders holding privileged (i.e., biased) information on the resale value of the treasury bills would like to exploit their informational advantage by participating

1/ These figures were obtained by double-log OLS regression of the minimum bid against per-capita income, all expressed in dollar terms at end-1993 exchange rates. The regressions do not include a statistically insignificant constant term.

2/ The outliers were Lebanon, the Russian Federation, and Canada, where the minimum permitted bids were all abnormally low: US\$6 in Lebanon, US\$80 in the Russian Federation, and US\$755 in Canada.

3/ Not surprisingly, a similar correlation is apparent between the minimum *denomination* of treasury bills and per-capita income (clearly, minimum denominations are relevant only in that intermediaries typically resist their customers' request to break-up large bills into smaller denominations). A simple regression of the minimum denomination of treasury bills on per-capita income, produced an elasticity of 1.04, a standard error of 0.05, and an R^2 of 0.39. Dropping outliers (Lebanon and Morocco), yielded an elasticity of 1.05, a standard error of 0.04, and R^2 of 0.55.

at competitive terms. This mixture of incentives may explain why instances have been reported where auction participants have expressed clear preference for noncompetitive bidding (see, for instance, the U.S. experience discussed in Cammack (1991)), accompanied by instances where the opposite was true (e.g., in Italy).

In practice, a minority of our countries (40 percent) was found to accept noncompetitive bids in our sample. When noncompetitive bids are accepted, their total number varies from occasionally quite large (as high as 20,000 in the United States, or 300-350 in a country as small as Lebanon), to relatively small numbers (such as in The Gambia, Tunisia, Guyana--see the Appendix for details).

When noncompetitive bids are accepted, the issue also arises as to whether their number should be capped: the larger the share of noncompetitive bids, the thinner the share of competitive bids, and the less informative is the auction price. In the limit, the auction collapses if all bidders bid noncompetitively. Five of the twelve countries for which this information was available were found to set a ceiling on the share of noncompetitive bids. 1/

A ceiling on the size of each noncompetitive bid is sometimes enforced, probably to avoid the possible concentration of noncompetitive awards in the hands of few large noncompetitive bidders, which would penalize small bidders. 2/ This practice is followed in 5 out of the 10 countries for which this information is available. With the exception of Mexico (where the ceiling may change from auction to auction), the ceiling is fixed as part of the standing auction rules (at about US\$0.1, 0.2, 1, and 1.3 million respectively, in Hungary, Spain, United States, and Italy).

Several countries have implemented arrangements, other than noncompetitive bidding, to allow investors to buy treasury bills at the average auction price. The privilege of buying treasury bills at a price linked to the average auction price has been granted (typically at

1/ The ceiling equals 15, 30, 33, and 50 percent in Nepal, Jamaica, Honduras, and Italy, respectively. In Italy the ceiling is not operative (its introduction is allowed by the decree defining the auction rules but the authorities prefer not to use it). In some cases (e.g., in the United States) a formal ceiling is not announced, but the treasury reserves the right to reduce the share allocated to noncompetitive bids if this is needed to prevent these bids from absorbing "most or all of the public offering" (Department of Treasury, 1993, p. 419). In Lebanon, the central bank informally contacts the banking system, before announcing the auction size, in order to assess the likely stock of bids placed at noncompetitive terms.

2/ If the amount of noncompetitive bids exceeds their possible share, bills are typically awarded by prorating. Therefore, owing to a few large noncompetitive bids, the amount allocated to individual small bidders may be lower than their bid amount.

restricted terms or to limited groups of investors) in 54 percent of the countries that we surveyed. In France, for instance, post-auctions purchases are allowed only to primary dealers, only until midday of the post-auction day, and only up to 30 percent of each dealer's average award in the previous three auctions. Another example is that of The Gambia, where post-auction purchases are permitted at a fixed spread above the auction price. Interestingly, the countries where post-auction purchase of treasury bills is permitted are equally split between countries where noncompetitive bids are allowed and countries where such bids are not allowed, suggesting that the two arrangements are often seen as complements to promote participation in auctions.

7. Minimum prices and treasury discretion

We have seen in Section III that auction theory predicts that for reasons ranging from deterrence of collusive behavior to auctioneers' own informational protection, sellers may find it convenient to announce minimum prices at auctions. As a matter of fact, in 3 of the 37 countries surveyed, the treasury announces a minimum acceptable (or cut-off) price. Two countries (Italy and Mexico) announce a "cut-off rule." 1/ A more common solution, used in about three-quarters of our sample, is to exclude bids below an arbitrarily set, not announced, cut-off price. In effect, this practice is equivalent to maintaining downwards flexibility on the bills' issue, as the treasury retains the right to reduce the amount actually issued until after the bids have been tendered. 2/

Several variants of this practice are in use. Some countries (Spain, as well as Hungary for bills of certain maturities) have opted for the extreme solution of not even announcing the amount of bills to be issued. 3/ Other countries (Burundi) fix the cut-off price before collecting bids but do not announce it. Some countries maintain flexibility in the amount of bills issued only within a pre-specified fraction of the amount originally announced (Egypt), or reserve discretion over the maturity composition of the bills, but maintain the total issue constant

1/ In Italy the cut-off yield is set at the average of the first half of received bids (or to the bids covering the first half of the auctioned amount if demand exceeds supply) plus 150 basis points. In Mexico the cut-off discount is set at the average discount plus one standard deviation of the bids' distribution.

2/ In countries where the central bank acts as a residual buyer for the bills that are unsold at the cut-off price, the downwards flexibility is reflected in a reduction of the amount of bills sold to the market rather than of the amount of bills issued.

3/ The French Treasury announces a minimum and maximum auction size.

(New Zealand). In 23 percent of the countries surveyed, the treasury reserves its discretion not only of reducing the issue, but also of increasing it, if the bids received are particularly favorable. 1/

Finally, in about half of the countries (52 percent) the treasury retains its discretion of rejecting specific bids, without obligation to provide any explanation. While abuse of this discretion would undermine a basic requirement for auction efficiency--that all bidders be treated equally-- , in practice this discretion has been aimed at penalizing specific bidders for their "irregular" behavior in previous auctions, or to exclude from auctions funds of illicit or dubious source.

8. Scheduling of auctions and treasury bill maturity

We focus here on four aspects of the time table for treasury bill auctions: (i) the lag between auction announcement and auction day (31 countries); (ii) the lag between the deadline for presenting bids and the announcement of auction results (34 countries); (iii) the lag between auction date and settlement date (34 countries); and (iv) the frequency of auctions, also in regard to bills' maturity.

The lag between the date at which the auction is announced 2/ and the date at which the auction is held ranges (with the exception of Burundi) anywhere up to one week, with no recognizable pattern. 3/ However, the relative majority of countries (9 countries or 30 percent of the sample) announces the auction one week before the auction date.

The lag between the auction and the announcement of the results is typically short. In 38 percent of the countries, results are announced within three hours (and in 32 percent within two hours). In 71 percent of cases results are announced within the same day, and in all but two countries (Jordan and Pakistan) they are available within the day following the auction.

Settlement is requested for the same day of the auction only in one case (Bolivia). 4/ In 26 percent of cases settlement is scheduled for the following day, and in 50 percent of the cases settlement is requested two

1/ Increased discretion in accepting the bids facilitates treasury liquidity management, but may result in lower auction revenues, as rational bidders will counterbalance the increased uncertainty arising from discretion by lowering their bids.

2/ The announcement typically includes the auction date, an indication of the auctioned amount, and possibly other information on denomination, maturity, cut-off price, etc.

3/ In Burundi the lag is two weeks. In two countries (Kenya and Japan) the auction is held in the same day of the announcement.

4/ Same day settlement is also required in Spain in auctions restricted to primary dealers (3-6 month treasury bill auctions).

days after the auction. In most of the remaining cases settlement is required on the third day after the auction. 1/

Treasury bills are usually marketed for relatively short maturities, typically from 1 month to 1 year, with the 3-month maturity as the most common (76 percent of 38 countries). 2/ The frequency of auctions ranges typically from 1 week to a quarter, with frequencies lower than monthly being common: only 5 percent of countries uses only monthly auctions, and another 5 percent uses only quarterly auctions. Thus, 90 percent of the countries have weekly or bi-weekly auctions for at least some maturity.

As documented in Table 4, there is a clear--and intuitive--preference in many countries to auction bills of longer maturity at relatively low frequency, while shorter maturities are auctioned more frequently: 3/

Table 4. Distribution of Treasury Bill Auctions by Frequency and Maturity
(In percentage)

	Weekly	Bi-weekly	Monthly	Quarterly	Total
1 month	80.0	20.0	--	--	100.0
3 months	62.1	27.6	3.4	6.9	100.0
6 months	40.0	44.0	8.0	8.0	100.0
12 months	47.1	35.3	--	17.6	100.0

1/ Some countries adopt variable settlement lags. In France the lag is of 3 days for 3-month treasury bills and 1 week for 6-12 month bills. In the United States the lags range between 1 and 5 days.

2/ Other common maturities are 6 months (66 percent) and 12 months (45 percent). The 1-month maturity is used in 13 percent of cases, while 2- and 9-month bills are even less frequent. For simplicity, maturities are approximated here in terms of months, although in many countries they are expressed in terms of days or weeks.

3/ This is primarily explained by the need to refinance smoothly the outstanding debt stock. For example, smooth refinancing requires auctions of one month bills to be held at least monthly, auctions of three month bills to be held at least quarterly, and so on.

9. Publication of auction results

As discussed in Section 3, auction theory places considerable importance on the spread of any information the treasury may have on the value of the auctioned securities, in order to mitigate winner's curse biases. From this viewpoint, one would expect the treasury to provide at least *ex post* detailed information on auctions results, in order to reduce investors' uncertainty in future auctions about their competitors' strategy, the type of information they may have access to, etc. The drawback associated to publishing detailed information on individual bids is the greater scope for enforcing cartels, as ring-members behavior can be monitored more easily.

Most countries in our sample have chosen an intermediate strategy that involves publication of summary statistics with no publication of individual bids. In virtually all sample countries for which data were available (24 countries), published information includes the amount issued and the average yield/price. 1/ In 70 percent of cases also the cut-off price/yield is published, 2/ while information on the maximum yield (or minimum price) is released in 54 percent of cases. Information on the numbers of bids and bidders is provided in 17 percent of the countries. By far, the country that provides the most detailed information is the United States, whose treasury publishes the entire distribution of competitive bids by yield, as well as the amount of noncompetitive bids by district.

VI. Concluding Remarks

Academic and policy-oriented debate on the design of government securities auctions has intensified in recent years, motivated both by the desire for more cost-effective strategies to finance large stocks of government debt, and by the recognition that non-competitive behavior may be a pervasive and costly feature of auctions of government securities around the world. In this paper we have surveyed the issues on which such debate has focussed, and provided a detailed description of how treasury bill auctions are actually implemented in a sizable sample of countries.

We suspect that the main use for the information that we have organized in this paper may be as a reference kit for ongoing research on the performance of auctions around the world, and for policymakers faced with the task of designing such auctions and who--being unable to find sufficient guidance from auction theory--may turn to the experience of other countries as models for their domestic institutions.

1/ However, in Jordan and Honduras no information is published.

2/ In a limited number of cases the amount sold at the cut-off price/yield is also published.

Nevertheless, a comparison between theoretical predictions and actual design of treasury bill auctions may be interesting in its own respect. We noted that absent concerns on the incentives provided by different auction formats to the emergence of non-competitive behavior, theory has formulated predictions on the desirable features of many types of auctions, predictions that often have been regarded as sufficiently robust to remain applicable to the case of treasury bill auctions. Greater revenue potential of uniform-price auctions; the usefulness of cut-off prices and of the government's publication of any information it may have on the resale value of the securities; the usefulness of forward and secondary markets as information-spreading devices; and the advantage of increasing investors' participation in auctions, are the main results offered by textbook models of auctions. Most scholars of auctions would agree that these prescriptions are likely to apply to most circumstances in which non-competitive behavior is not a primary concern. However, we noted how caveats to these predictions must be attached when allowance is made for actual features of treasury bill auctions, including bidders' risk-aversion, various forms of bidders' heterogeneity, and sale of multiple units. Robust results for auction formats that incorporate these features are yet unavailable.

Furthermore, when consideration is given to the incentives to collude and corner provided by different auction formats, many of these prescriptions need not hold anymore, and may--in many circumstances--even be overturned. Thus, our finding that most treasury bill auctions tend to be of the discriminatory type, that most governments remain rather secretive in publishing auction results (except in highly aggregate form), that governments do not appear to promote the development of organized secondary and (especially) forward markets for treasury bills, can--perhaps--be rationalized by the view that in most countries concerns about cornering and collusion in treasury bill auctions have tended to dominate.

Should this view be accurate, the research and policy agenda for scholars of treasury bill auctions in the next few years would appear to be well defined. On one hand, greater effort is needed--and is likely to be forthcoming--toward extending existing models of auctions to capture actual auction of government securities more accurately. Clearer understanding of the relative incentives to non-competitive behavior in repeated, common-value auctions of divisible objects, and clearer understanding of how auctioneers can alter such incentives by modifying auction procedures, are likely to be primary ingredients of this agenda. Research aimed at more precise detection of empirical regularities, particularly with respect to the perennial alternative between multiple-price and uniform-price auctions, is likely to continue and grow, independently of progress made in theoretical research on auctions. Researchers are likely to engage in an all-out search for new data and examples, and cross-country diversity of case studies can only add to the presumption of robustness of any finding.

Country Tables

The following tables present the detailed information available on auction rules and practices in the 42 countries for which summary results are discussed in Section 5 of the main text. The tables refer, as much as possible, to the situation at end-1993, and are based on information collected by the IMF during its consultations with member countries. In addition, some official and nonofficial publications have been used. 1/

The following conventions were used in the tables:

a. The signs "... " and " -- " indicate missing information and the non-existence of the corresponding entry, respectively.

b. All data in dollars have been converted from the corresponding domestic currency values using end-1993 exchange rates, as published in the International Financial Statistics of the IMF.

c. All information on the auction schedule (for example, the lag between auction announcement and auction day) refers to working days.

d. The term "competitive bids" indicates a bid for which a price-amount pair is tendered, while "noncompetitive bid" refers to a bid for which only an amount is tendered.

1/ The interested reader may refer to the following published sources:

Bank of England, British Government Securities: The Market for Gilt-Edged Securities, London, April 1993.

Bröker, G., Government Securities and Debt Management in the 1990s", Organization for Economic Co-Operation and Development, Paris, 1993.

Fetting, K., "The Government of Canada Treasury Bill Market and its Role in Monetary Policy", Bank of Canada Review, Spring 1994.

Goldman Sachs, Guide to the Global Treasury Bill Market, "Fixed Income Bulletin", October 1993.

Martinez-Mendez, P., Spain: Government Debt Management and Monetary Policy, paper presented at the joint IMF-OECD Seminar on Government Debt Management held in Paris in June 1993.

United States, Department of Treasury, Securities and Exchange Commission, Board of Governors of the Federal Reserve System, Joint Report on the Government Securities Market, U.S. Government Printing Office, Washington D.C., January 1992.

Treasury Bill Auctions in Burundi, Japan, Norway, Jordan, and the Russian Federation

	Burundi	Japan	Norway	Jordan	Russian Federation
Auction technique					
Current	Multiple yield	Multiple price	Multiple yield	Multiple price	Multiple price
Previous	--	--	--	--	--
Admission					
Participants	Everybody is admitted, but nonbank agents must submit their bids through banks <u>1/</u>	Banks (including foreign banks' branches), credit unions, securities firms (including foreign firms' branches), insurance companies, money brokers	Security brokers, which can submit bids on account of other bidders	Deposit money banks; other agents can submit bids through banks	Primary dealers <u>6/</u> ; other agents, including individuals, can purchase through dealers; nonresidents are excluded
Deposit requirement	None	None	No, but here is a penalty on delayed payment	None	Prepayment is required
Central bank participation	Yes, as residual buyer	No	No	Yes, as residual buyer <u>4/</u>	Yes, as residual buyer up to 10 percent of the issue
Competitive bids					
Maximum number per bidder	Unconstrained	Unconstrained	Unconstrained	One	--
Maximum award	...	Unconstrained	Unconstrained	Unconstrained	Unconstrained
Minimum amount	Fbu 100,000 (US\$385)	Y 10 million (US\$89,405)	NKr 1 million (US\$133,014)	JD 1,000 (US\$704)	Rub 100,000 (US\$80)
Noncompetitive bids					
Status	Not admitted	Not admitted <u>2/</u>	Not admitted	Not admitted	Not admitted
Maximum share	--	--	--	--	--
Maximum bid	--	--	--	--	--
Minimum amount	--	--	--	--	--

Treasury Bill Auctions in Burundi, Japan Norway, Jordan, and the Russian Federation (continued)

	Burundi	Japan	Norway	Jordan	Russian Federation
Treasury discretion					
Pre-announced cut-off price/yield	Yes, although it is not announced	No	No	No	No
Flexible cut-off price/yield	No	No	No	No	No
Revision of auction size	Yes, downwards	...	Yes, downwards	Yes, downwards	Yes, downwards
Rejection of specific bids	...	...	Yes	...	No
Auction results					
Lag between auction announcement and auction day	Two weeks	One to two hours	Two days ^{3/}	None ^{5/}	One week
Lag between bids and results	...	Two to three hours	A few hours	One week	A few hours
Lag between results and settlements	...	Two to three days	Two days	Same day	One day
Published information	...	...	...	None ^{5/}	...
Typical features of an auction					
Number of competitive bidders	Only a small number of financial institutions and public enterprises participate	300	...	Three to four	15-20
Share of non-competitive bids	--	--	--	--	--
Share of non-competitive awards	--	--	--	--	--

Treasury Bill Auctions in Burundi, Japan Norway, Jordan, and the Russian Federation (continued)

	Burundi	Japan	Norway	Jordan	Russian Federation
Share of primary dealers	--	--	...	--	20-50 percent
Share of customers of primary dealers	--	--	...	--	50-80 percent
Spread on competitive bids	Some percentage points	...	...	...	20-40 percentage points
Other information					
Accounting	Physical form or book-entry	Book-entry	Book-entry	Physical form	Book-entry
Primary dealers	No	33	Yes	No	23 ^{6/}
Underwriters	No	No	No	No	No
Year of first auction	1988	1986	Mid-1980s	Late 1980s	1993
After auction subscription	None	None	...	None	No
Frequency of auctions	Fortnightly, for 1-3-6-month TBs	Twice a month for 3-6-month maturities	Every other month for 3-6-12-month maturities	Monthly on 3-month maturities	Monthly for 3-month TBs
Minimum denomination	Fbu 100,100 (US\$385)	Y 10 million (US\$89,405)	NKr 1 million (US\$133,014)	JD 1,000 (US\$704)	Rub 100,000 ^{7/} (US\$80)

^{1/} Banks are pure intermediaries and are not responsible for the bids.

^{2/} Only the Postal Service is allowed to purchase TBs at the average auction prices; the schedule of its purchases is predetermined.

^{3/} An auction calendar is announced every six months.

^{4/} The Bank of Jordan acts as an underwriter, by purchasing the whole issue. It then holds the auction and keeps the amount which is not sold.

^{5/} Information is only sent to bidders.

^{6/} At end-1993 there were 23 approved dealers, all being banks except for two brokers.

^{7/} Minimum denomination for the first treasury bill auction held on May 18, 1993.

Treasury Bill Auctions in Canada, Denmark, Finland, France, The Gambia, and Hungary

	Canada	Denmark	Finland	France	The Gambia	Hungary
Auction technique						
Current	Multiple yield	Uniform price	Multiple yield	Multiple discount	Multiple price	Multiple price
Previous	--	--	--	Uniform discount	Uniform price	--
Admission						
Participants	Only banks and investment dealers incorporated in Canada registered as "primary distributors" can bid; other agents can bid through primary distributors	Banks and stockbroking companies which are connected to the Danish Security center (the depository and settlement system)	Only market makers are allowed to participate	All institutions with a cash account with the Banque de France and a security account on the Saturne settlement system; these institutions can bid on account of other agents. <u>1/</u>	Unrestricted for residents; nonresidents are excluded	All legal entities for 1-3 month TBS; financial institutions (i.e. banks, securities firms and mutual funds) for 6-12 month auctions. <u>2/</u>
Deposit requirement	None	...	...	None	Yes, for the full amount, excluding banks	None but there are penalties for delayed payments.
Central bank participation	Yes, at competitive terms <u>13/</u>	Yes	No	No	Yes, but the bid of the central bank is determined only after other bids are opened	The central bank can buy up to 5 percent of 6-12-month TBs at the average price
Competitive bids						
Maximum number per bidder	Unconstrained	...	...	Unconstrained	Unconstrained	Unrestricted

Treasury Bill Auctions in Canada, Denmark, Finland, France, The Gambia, and Hungary (continued)

	Canada	Denmark	Finland	France	The Gambia	Hungary
Maximum award	One third of the auctioned amount	Unconstrained	...	Unconstrained (according to an informal rule bids cannot exceed FF 1 billion (USD 170 million))	Unconstrained	It can exceed 50 percent of the auction's amount only if the remaining accepted bids plus 50 percent of the auctioned amount are the lower than the auctioned amount
Minimum amount	\$1,000 (US\$755)	...	...	FF 1 million (US\$169,621)	Dalasis 5,000 (US\$524)	Ft 1 million (USD 10,287)
Noncompetitive bids						
Status	Not admitted	Not admitted	...	Not admitted	Admitted	Admitted only for 6-12 month TBS
Maximum share	--	--	...	--	...	Unconstrained
Maximum bid	--	--	...	--	...	Ft 10 million (US\$ 102,870) or 10 percent of competitive bids, whichever is lower
Minimum amount	--	--	...	--	Dalasis 5,000 (US\$524)	Unrestricted
Treasury discretion						
Pre-announced cut-off price/yield	No <u>13/</u>	No		No	No	Yes <u>15/</u>
Flexible cut-off price/yield	No	No		No	No	No

Treasury Bill Auctions in Canada, Denmark, Finland, France, The Gambia, and Hungary (continued)

	Canada	Denmark	Finland	France	The Gambia	Hungary
Revision of auction size	No	Yes, downwards		A minimum and maximum auction size is announced	No	No; however the auction size for 1-3 month TBs is announced only after bids are presented and before they are opened
Rejection of specific bids	Yes	...	...	No	No	Yes <u>14/</u>
Auction results						
Lag between auction announcement and auction day	One week	...	...	Two days	Several days	One week
Lag between bids and results	One to two hours	One to two hours	...	One hour	...	Four hours
Lag between results and settlements	Two days <u>11/</u>	Two days	Two days	Three days for 3-month TBs; one week for 6-12 month TBs	...	Variable lag (between 1 and 8 days) for 1-3-month TBs; 4 days for 6-12-month TBs
Published information	Minimum, maximum and average yield; amounts issues at next auction; allocation factor at the highest accepted yield	...	...	--	...	...
Typical features of an auction						
Number of competitive bidders	...	About 70	...	20-30	10-12	...

Treasury Bill Auctions in Canada, Denmark, Finland, France, The Gambia, and Hungary (continued)

	Canada	Denmark	Finland	France	The Gambia	Hungary
Number of non-competitive bidders	--	--	...	--	Two to three <u>3/</u>	...
Share of non-competitive awards	--	--	...	--	relatively small	Very variable; it can reach a large share of the amount issued
Share of primary dealers	...	--	...	75-85 percent	--	--
Share of customers of primary dealers	...	--	...	--	--	--
Spread on competitive bids	5-10 basis points	...	...	10-20 basis points	A few percentage points	1-3 percentage points
Other information						
Accounting	Physical form	Book-entry	Physical form	Book-entry	Mixed (book-entry, physical form)	In physical form for 1-3 month TBs; <u>4/</u> book-entry form for 6-12 month TBs
Primary dealers	Yes <u>12/</u>	No	Yes	19 primary dealers	No	No
Underwriters	No	No	No	No	No	No
Year of first auction	1934-37	1990	1991	Mid-1980s	Mid-1980s	1988
After auction subscription period	No	Yes <u>5/</u>	...	Yes, until midday of the post auction day for primary dealers (up to 30 percent of average awards in the previous three auctions) <u>6/</u>	Yes, if the auction was underscribed, at 1 percentage point below the average yield	Yes, at the average price of the latest auction

Treasury Bill Auctions in Canada, Denmark, Finland, France, The Gambia, and Hungary (continued)

	Canada	Denmark	Finland	France	The Gambia	Hungary
Frequency of auctions	Weekly for 3-6-12-month maturities <u>10/</u>	Quarterly for 3-6-9-month TBs issues are reopened every month <u>7/</u>	Weekly for TBs of 3-6-12-month maturity (mostly 12 months)	Weekly for three month TBs; fortnightly for 6-month TBs; monthly for 12-month TBs <u>8/</u>	Fortnightly on 3-6-12-month TBs	Weekly for 1 month TBs fortnightly for 3-month TBs monthly for 6-month TBs quarterly for 12-month TBs
Minimum denomination	\$1,000 (US\$755)	DKr 1 million (US\$147,645)	Fmk 5 million (US\$864,378)	F 1 million (US\$169,621)	D 5,000 (US\$524)	Ft 500,000 (US\$5,144) Ft 100,000 (US\$1,029) <u>9/</u>

- 1/ Bidders, however, do not have to disclose whether bids are made on their behalf or on the behalf of their customers.
- 2/ Banks and securities firms receive a 0.15-0.20 commission on their purchases.
- 3/ Mainly insurance companies.
- 4/ "Custodial certificates" are printed instead of printing TBs.
- 5/ Treasury bills are sold on tap by the central bank between the quarterly auctions.
- 6/ A maximum of 15 percent of an issue can be allocated in this way.
- 7/ However, bids are reopened only for series with a remaining life of at least three months.
- 8/ TBs of maturity ranging from 4 to 7 weeks are issued depending on the Treasury's cash management needs.
- 9/ The lower minimum denomination refers to 6-12-month treasury bills. The higher denomination refers to 1-3 month treasury bills.
- 10/ Treasury bills of shorter maturities (between 8 and 50 days) are issued occasionally for very large amounts on short notice (cash management bills).
- 11/ It used to be one day until November 1992.
- 12/ A subset of primary distributors (the so called "jobbers") perform the role of primary dealers.
- 13/ Through its bid and the information received from the market, the Bank of Canada influences the cut-off price, which, however, is not pre-announced.
- 14/ Participants can be penalized with the exclusion from the auctions if they break the auction rules.
- 15/ The cut-off price was not used in some of the 1993 auctions.

Treasury Bill Auctions in Ghana, New Zealand, Honduras, Bolivia, and Kenya

	Ghana	New Zealand	Honduras	Bolivia	Kenya
Auction technique					
Current	Multiple price	Multiple yield	Multiple price	Multiple discount	Multiple price
Previous	--	--	--	--	--
Admission					
Participants	All residents, however, banks can bid on account of their customers; non-residents can bid through banks <u>1/</u>	Any institution or individual can participate as long as they are registered with the central bank, at least two days before the auction. Once registered, they remain eligible to bid in subsequent auctions (at present around 100 entities are registered). Non-residents are also admitted	Everybody is admitted but only banks and other regulated financial institutions can buy in the name of third parties	Everybody is admitted except public entities <u>2/</u>	Open to everybody, including foreigners
Deposit requirement	None	None, up to a ceiling set by the central bank on each bidder; a zero interest bearing deposits, or securities in lieu of a deposit, must be lodged by the bidder for 10 percent of the amounts exceeding the ceiling	None	100 percent deposit requirement for everybody	...
Central bank participation	No	No	Yes	No	Yes, the central bank buys what is not sold
Competitive bids					
Maximum number per bidder	Unconstrained	Unconstrained	Unconstrained	Unconstrained	...

Treasury Bill Auctions in Ghana, New Zealand, Honduras, Bolivia, and Kenya (continued)

	Ghana	New Zealand	Honduras	Bolivia	Kenya
Maximum award	Unconstrained	Each bidder has a bidding limit set by the central bank based on the bidder's financial strength and market presence	Unconstrained	Unconstrained	Unconstrained
Minimum amount	Cedi 100,000 (US\$138)	SNZ 1 million (US\$558,800)	L 5,000 (US\$500)	US\$1,000 <u>3</u> /	K Sh 100,000 (US\$1,467)
Noncompetitive bids					
Status	Not admitted	Not admitted	Admitted	Not admitted	...
Maximum share	--	--	One third of total gold	--	...
Maximum bid	--	--	Unconstrained	--	...
Minimum amount	--	--	L 5,000 (US\$500)	--	...
Treasury discretion					
Pre-announced cut-off price/yield	No	No	No	No	No
Flexible cut-off price/yield	No	No	No	No	No
Revision of auction size	Yes, downwards	Yes <u>4</u> /	Yes, downwards	Yes, downwards	Yes, downwards
Rejection of specific bids	Yes	Yes	Yes	No	No
Auction results					
Lag between auction announcement and auction day	Four days	One day	Seven days	At least two days	Same day
Lag between bids and results	One day	Two hours	A few hours	Five hours	One day

Treasury Bill Auctions in Ghana, New Zealand, Honduras, Bolivia, and Kenya (continued)

	Ghana	New Zealand	Honduras	Bolivia	Kenya
Lag between results and settlements	One day	One day	Three days	Same day	Same day
Published information	Weighted average rates and amounts auctioned at the next auction	Amount sold, minimum and maximum yield for winning and nonwinning bids, average yield; number of successful and unsuccessful bids and split between bank and nonbank bids	No information is published	Amount issued, average maximum yields	Average accepted discount rate, amount issued
Typical features of an auction					
Number of competitive bidders	About 20 6/	10-15	Three-five	About 10	At least 100
Number of non-competitive bids	--	--	...	--	...
Share of non-competitive awards	--	--	Usually 33 percent	--	...
Share of primary dealers	--	--	--	--	--
Share of customers of primary dealers	--	--	--	--	--
Spread on competitive bids	Either some percentage points or zero 2/	5-10 basis points	...	--	Some percentage points
Other information					
Accounting	Book-entry	...	Book-entry	Physical form	Physical form
Primary dealers	No	No	No	No	No
Underwriters	No	No	No	No	No

Treasury Bill Auctions in Ghana, New Zealand, Honduras, Bolivia, and Kenya (continued)

	Ghana	New Zealand	Honduras	Bolivia	Kenya
Year of first auction	1989	1985	1990	1993	1990
After auction subscription period	After the auction sales are on tap at the average rate of the last auction	No	Yes, the amount not sold at the auctions is usually sold by the central bank within one to three days after the auction, at the average auction rate	Yes, without limits	Yes
Frequency of auctions	Weekly for 3-6-12-month TBs	Weekly for 3-6-12-month TBs <u>8/</u>	Irregular frequency and different maturities <u>9/</u>	Weekly on 3-month maturity	Weekly for 3-month maturity
Minimum denomination	Cedi 100,000 (US\$138)	SNZ 10,000 <u>10/</u> (US\$5,588)	L 1,000 (US\$100)	US\$100 <u>11/</u>	K Sh 100,000 (US\$1,467)

1/ Banks do not have to reveal the source of their bid.

2/ Agents can be excluded as penalty for noncomplying with auction rules or for colluding.

3/ So far only U.S. dollar denominated treasury bills have been issued.

4/ This Debt Management Office has the flexibility to "under-accept" a tranche in the auction and "over-accept" another tranche. The extent of this flexibility is limited to 50 percent of any tranche. This flexibility is adopted infrequently when unusual auction results are obtained. However, the total sum of all tranches cannot be raised.

5/ The government announces a target size for the auction but the accepted amount may be very different from the announced "target." On some occasions, all bids have been rejected.

6/ However, the number of bids is much larger (several hundred).

7/ In most cases every agent bids the same price, which is the prevailing bid price at the previous auction.

8/ In addition, "seasonal bills" of different maturity are issued irregularly to satisfy the liquidity needs.

9/ Agents can be excluded as penalty for noncomplying with auction rules or for colluding.

10/ This is the minimum amount that can be registered to the name of any party at the treasury bill register kept by the Reserve Bank of New Zealand. Transactions for multiples of NZ\$1,000 are, however, possible.

11/ So far, only U.S. dollar denominated treasury bills have been issued.

Treasury Bill Auctions in Morocco, the Slovak Republic, Spain, Sweden, Tanzania and Zambia

	Morocco	Slovak Republic	Spain	Sweden	Tanzania	Zambia
Auction technique						
Current	Multiple yield	Multiple price	"Lopsided" multiple price 1/	Multiple yield	Multiple price	Multiple price
Previous	--	--	--	--	Uniform price	--
Admission						
Participants	Financial intermediaries; those institutions can bid on account of other financial enterprises (e.g. insurance companies) and non-financial enterprises.	Commercial banks	Unrestricted, but foreign investors must place their bids through recognized dealers; 3-6 month treasury bill auctions are restricted to primary dealers	Dealers members of the Swedish National Debt Office; investors can bid through market makers	Unrestricted	Unrestricted
Deposit requirements	None	None, but penalties are possible on delayed payments	None for registered dealers; 2.5 percent for other bidders	None	None	Yes, nonbank bidders have to deposit at the central bank a banker's check
Central bank participation	No	Yes, with competitive bids 2/	No	...	No	No
Competitive bids						
Maximum number per bidder	Unconstrained	Three	Unrestricted	...	Unconstrained	Unconstrained
Maximum award	Unconstrained	Unconstrained	Unrestricted	...	Unconstrained	Unconstrained
Minimum amount	DH 3 million (US\$310,849)	Sk 1 million (US\$30,675)	Unrestricted	...	T Sh 500,000 (US\$1,042)	K 500,000 (US\$1,000)
Noncompetitive bids						
Status	Not admitted	Not admitted	Admitted	...	Not admitted	Not admitted

Treasury Bill Auctions in Morocco, the Slovak Republic, Spain, Sweden, Tanzania and Zambia (continued)

	Morocco	Slovak Republic	Spain	Sweden	Tanzania	Zambia
Maximum share	--	--	Unrestricted	...	--	--
Maximum bid	--	--	Ptas 25 million (US\$175,798)	...	--	--
Minimum amount	...	--	Unrestricted	...	—	--
Treasury discretion						
Pre-announced cut-off price/yield	Yes	No	No	...	No	No
Flexible cut-off price/yield	No	No	No	...	None	No
Revision of auction size	Yes, downwards	Yes, downwards	The auction size is not announced	...	Yes, downwards	Yes, both upwards and downwards
Rejection of specific bids	No	No	No	...	Yes	Yes
Auction results						
Lag between auction announcement and auction day	One day	At least three days	The auction calendar is announced annually; no other information is provided	Three days	One week	Four days
Lag between bids and results	One day	Two hours	Two hours	One to two hours	A few hours	A few hours
Lag between results and settlements	One day	One day	Same day for 3-6 month auctions; two days for other auctions	Two days	Two days	One working day

Treasury Bill Auctions in Morocco, the Slovak Republic, Spain, Sweden, Tanzania and Zambia (continued)

	Morocco	Slovak Republic	Spain	Sweden	Tanzania	Zambia
Published information	Amount issued, cut-off yield and amount sold at the cut-off yield	Amount allotted, minimum, maximum, average prices and yields, number of bidders and number of winning bidders	Volume of treasury bills sold (unannounced before the auction) marginal and average price; amount of noncompetitive bids	...	Minimum, maximum and average price	amount sold, maximum and minimum accepted bids, average price
Typical features of an auction						
Number of competitive bidders	Two to three	Four to five	...	12 3/4	About 200	150-200
Number of non-competitive bidders	--	--	...	...	--	--
Share of non-competitive awards	--	--	8-15 percent	...	--	--
Share of primary dealers	--	--	...	...	--	--
Share of customers of primary dealers	--	--	...	...	--	--
Spread on competitive bids	20-40 basis points	...	...	...	About 20 percentage points	10-20 percentage points
Other information						
Accounting	Book-entry	Book-entry	Book-entry	Physical form	Physical form	Physical form
Primary dealers	No	No	Yes	12 3/4	None	No
Underwriters	No	No	No	No	None	No

Treasury Bill Auctions in Morocco, the Slovak Republic, Spain, Sweden, Tanzania and Zambia (continued)

	Morocco	Slovak Republic	Spain	Sweden	Tanzania	Zambia
Year of first auction	Mid-1980s	1993 ^{4/}	1987	1982	1993	1993
After auction subscription	No	No ^{5/}	No	...	Yes, up to 10 percent of the latest auction; at the average yield	Yes, between auctions with a ceiling on purchases
Frequency of auctions	Weekly for 1-3-month TBs; monthly for 6-12-month TBs	Irregular for up to one-month TBs	Fortnightly on 3-6-12-month ^{6/} maturities	Fortnightly for 3-6-12-month maturities	Weekly on 1-3-month maturities	Weekly for 1-2-3-6-month maturities
Minimum denomination	DH 3 million (US\$310,849)	Sk 1 million (US\$) (US\$30,675)	Ptas 1 million (US\$7,032)	SKr 1 million (US\$120,431)	T Sh 500,000 (US\$1,042)	K 500,000 (US\$1,000)

^{1/} Bidders bidding for prices lower than the average pay the bid price; all other bidders pay the weighted average price (the weighted average is computed using the bid prices rather than the prices actually paid.)

^{2/} However, the National Bank of Slovakia does not bid actively. Rather it buys at the average auction yield a predetermined amount, plus any amount that remains unsold (at the marginal yield).

^{3/} Swedish National Debt Office dealers--the only agents admitted at the auctions--have to quote secondary market prices for TBs, and therefore play the role of primary dealers.

^{4/} Auctions in Czechoslovakia started in 1992.

^{5/} However, there have been occasional sales of special TBs at the latest average auction price.

^{6/} Regular auctions are held only for 12 month bills.

Treasury Bill Auctions in Pakistan, Guyana, Latvia, Portugal and Venezuela

	Pakistan	Guyana	Latvia	Portugal	Venezuela
Auction technique					
Current	Multiple price	Multiple price	Multiple discount	Multiple discount	Multiple price
Previous	--	--	--	--	--
Admission					
Participants	Banks and stock brokers, which can bid on behalf of their customers	Banks, financial institutions, trust companies, and individuals	Commercial banks; other agents can submit bids through commercial banks	Financial institutions	Commercial and savings banks, financial firms and brokers (they can submit bids on account of other customers)
Deposit requirement	None	...	None <u>1</u> /	None	None
Central bank participation	No	No	Yes	No	No
Competitive bids					
Maximum number per bidder	...	Unconstrained	One	Six	Five
Maximum award	Unconstrained	Unconstrained	Unconstrained	Unconstrained	30 percent
Minimum amount	...	G\$500 (US\$4)	LS 100,000 (US\$168,067)	Esc 1 million (US\$5,656)	Bs 10 million (US\$82,781)
Noncompetitive bids					
Status	Not admitted	Admitted <u>2</u> /	Not admitted	Not admitted	Not admitted
Maximum share	--	None	--	--	--
Maximum bid	--	None	--	--	--
Minimum amount	--	GD500 (US\$4)	--	--	--

Treasury Bill Auctions in Pakistan, Guyana, Latvia, Portugal and Venezuela (continued)

	Pakistan	Guyana	Latvia	Portugal	Venezuela
Treasury discretion					
Pre-announced cut-off price/yield	No	No	Equal to the central bank refinancing rate	No	No
Flexible cut-off price/yield	No	No	No	No	No
Revision of auction size	Yes, downwards and upwards	Yes, upwards and downwards <u>3/</u>	Yes, downwards <u>4/</u>	...	No
Rejection of specific bids	...	...	No	...	No
Auction results					
Lag between auction announcement and auction day	Five days	Five days	Five days	...	One-two days
Lag between bids and results	One-two days	One day	A few hours	One day	One-two hours
Lag between results and settlements	One-two days	Two days	Two days	Two days	Three days
Published information	Minimum, maximum and average yield; amount offered and accepted	Bids received, accepted redemption date, average discount rate	Amount sold; purchase price, commission fees	...	Amount sold, minimum average price
Typical features of an auction					
Number of competitive bidders	About 40	5-10	4-8	...	About 30
Share of non-competitive bids	--	7-10	--	--	--

Treasury Bill Auctions in Pakistan, Guyana, Latvia, Portugal and Venezuela (continued)

	Pakistan	Guyana	Latvia	Portugal	Venezuela
Share of non-competitive awards	--	15-20	--	--	--
Share of primary dealers	...	--	--	--	--
Share of customers of primary dealers	...	--	--	--	--
Spread on competitive bids	2-3 percentage points	1-2 percentage points	...	...	2-3 percentage points
Other information					
Accounting	Book-entry and physical form	5/	Book-entry	Book-entry	Physical form
Primary dealers	49	No	No	No	No
Underwriters	No	No	No	No	No
Year of first auction	1991	1991	1993	1985	1992
After auction subscription	No	Yes, for the subscribed portion of the noncompetitive allocation, and for bids not settled by competitive bidders	No	Yes, at the average auction price	No
Frequency of auctions	Fortnightly for 6-month TBs	Fortnightly for 3-6 month maturities	Irregular frequency	Fortnightly for 3-6-12 month TBs	Weekly on 3-month TBs
Minimum denomination	PRs 1,000 (US\$33)	G\$500 (US\$4)	Ls 100,000 (US\$168,067)	Esc 50,000 (US\$283)	...

1/ However, failure to pay for the bills can be penalized with exclusion from the auctions for six months.

2/ Most noncompetitive bids come from seven public banks or agencies which are given a firm allotment in each tender.

3/ The government announces a target size for the auction but the accepted amount may be very different from the announced "target." On some occasions, all bids have been rejected.

4/ The Ministry of Finance decides but does not announce the maximum discount rate that he is willing to accept.

5/ Depository system based on receipts issued by the central bank.

Treasury Bill Auctions in the Philippines, Nigeria, the Czech Republic, Jamaica, and Mexico

	Philippines	Nigeria	Czech Republic	Jamaica	Mexico
Auction technique					
Current	Multiple yield	Uniform price	Multiple price	Multiple price	Multiple discount
Previous	--	--	--	--	Uniform discount
Admission					
Participants	24 government security dealers at competitive basis; non competitive bids can be submitted by other agents	Discount houses, commercial banks, and merchant banks; they can submit bids on account of their customers	Only primary dealers at competitive terms	Unrestricted	Banks, stockbrokers, insurance companies
Deposit requirement	None for competitive bids	none	None	Nonbank bidders have to submit a banker's check for 100 percent of their bid	
Central Bank participation	No	Yes, as residual buyer	...	No	...
Competitive bids					
Maximum number per bidder	...	Unconstrained	...	Unconstrained	Unconstrained
Maximum award	...	Unconstrained	Unconstrained	Unconstrained	60 percent of quantity offered; and less than 100 times the bidder's capital base
Minimum amount	...	N 10,000 (US\$457)	...	J\$10,000	...
Noncompetitive bids					
Status	Admitted	Admitted only for public sector agencies	Admitted	Admitted	Admitted
Maximum share	...	...	Unconstrained	10 percent	Unconstrained
Maximum bid	...	...	...	Unconstrained	Pre-set at each auction
Minimum amount	...	...	...	...	...
Treasury discretion					

Treasury Bill Auctions in the Philippines, Nigeria, the Czech Republic, Jamaica, and Mexico (continued)

	Philippines	Nigeria	Czech Republic	Jamaica	Mexico
Pre-announced cut-off price/yield	...	No	...	No	No
Flexible cut-off price/yield	...	No	...	No	Yes <u>1</u> /
Revision of auction size	Upwards and downwards	Upwards and downwards	...	No	Downwards <u>2</u> /
Rejection of specific bids	...	Yes	...	Yes	Yes
Auction results					
Lag between auction announcement and auction day	At least one week	One week	...	Four days	Two days
Lag between bids and results	...	A few hours	...	Four hours	One day
Lag between results and settlements	Three days	Two days	...	One working day	One day
Published information	...	Cut-off price and amount sold to central bank and the public	...	Allotment, maximum, minimum average yield	Allotment, minimum, maximum, average yields; joint distribution of bid discounts and quantities
Typical features of an auction					
Number of competitive bidders	24	About 10	23	300-400	About 40
Number of non-competitive bidders	...	Very small	...	About 30	...
Share of non-competitive awards	...	Very small	...	About 5 percent	...

Treasury Bill Auctions in the Philippines, Nigeria, the Czech Republic, Jamaica, and Mexico (continued)

	Philippines	Nigeria	Czech Republic	Jamaica	Mexico
Share of primary dealers	...	--	...	--	--
Share of customers of primary dealers	...	--	...	--	--
Spread on competitive bids	...	70-80 basis points	...	20 basis points	20-70 basis points
Other information					
Accounting	Physical form	Book-entry	Book-entry	Physical form	Book-entry
Primary dealers	24	No	23	No	No
Underwriters	No	No	No	No	No
Year of first auction	1986 <u>3/</u>	1993	1993 <u>4/</u>	Mid-60's	1978
After auction subscription	Yes, usually for amounts not exceeding 20 percent of the auctioned amount	Yes, at the cut-off auction yield	...	No	No
Frequency of auctions	Weekly for 3-6-12-month TBs	Weekly on 3-month TBs	Fortnightly for 1-3-month TBs	Monthly for 3-6-9-12-month TBs	Weekly for 1-3-6-12-month TBs
Minimum denomination	...	N 1,000 (US\$46)	Kč 1 million (US\$33,383)	US\$10,000	...

1/ The rules of the auction require the cancellation of discounts exceeding the average (or weighted) average bid discounts plus one standard (or weighted standard) deviation of the distribution of bids.

2/ The government can cancel all or part of the competitive component of the auction; in this case non-competitive bids are awarded at a pro-announced yield.

3/ Auctions were initially introduced in the early 1980s but were discontinued in 1983.

4/ Auctions in Czechoslovakia started in 1992.

Treasury Bill Auctions in the United States, Italy, Belgium,
United Kingdom, Lebanon, Egypt, and Tunisia (continued)

Treasury Bill Auctions in the United States, Italy, Belgium,
United Kingdom, Lebanon, Egypt, and Tunisia

	U.S.A.	Italy	Belgium	U.K.	Lebanon	Egypt	Tunisia
Auction technique							
Current	Multiple discount	Multiple price	Multiple yield	Multiple price	Multiple discount	Multiple price	Multiple yield
Previous	Multiple price	Uniform price	Uniform yield	--	--	--	--
Admission							
Participants	All entities or individuals on their own account; depository institutions, brokers and dealers also on account of their customers; non residents are admitted	Banks and other credit institutions, insurance, financial companies and stockbrokers participate in competitive auctions; non residents are excluded	All residents and non residents, with the exception of residents for whom the withholding tax on income from financial assets is a definite tax	All investors, but the primary dealers account for the bulk of bids and may bid on behalf of clients	Licensed banks, financial institutions and public entities may submit competitive bids; individuals and non-residents may submit non competitive bids via banks	All entities or individuals on their own account; depository institutions, brokers and dealers also on account of their customers; non residents are admitted	Banks; noncompetitive on behalf of clients
Deposit requirement	No deposit requirement for primary dealers, depository institutions, and public institutions; for all others, a written autocharge agreement between the bidder and a depository institution is required	No	No deposit requirement on parties registered at the central bank	53 percent for individuals only	Individuals applying through their banks need to have funds in account, individuals applying through BDL pay full amount after the auction	No deposit requirement for financial institutions; all others provide a check or maturity bills	None
Central bank participation	No	Competitive <u>1</u> /	No	Noncompetitive	Noncompetitive	No	None
Competitive bids							

Treasury Bill Auctions in the United States, Italy, Belgium,
United Kingdom, Lebanon, Egypt, and Tunisia (continued)

	U.S.A.	Italy	Belgium	U.K.	Lebanon	Egypt	Tunisia
Maximum number per bidder	Unrestricted	Five	Unrestricted	Unconstrained	20	Unrestricted	Unconstrained
Maximum award	35 percent of auction size (and maximum bid used for prorating)	Unrestricted	Unrestricted	Discretionary if above 25 percent	None	Unrestricted	None
Minimum amount	\$1 million	Lit 1 billion (US\$586,854)	BF 10 million (US\$276,932)	£ 50,000 (US\$74,060)	LL 10,000 (US\$6)	LE 25,000 (US\$7,418)	D 1,000 (US\$955)
Noncompetitive bids							
Status	Admitted	Admitted	Admitted	Not admitted	Admitted	Not admitted	Admitted
Maximum share	Unconstrained	<u>2</u> /	...	--	Unconstrained	--	Unconstrained
Maximum bid	\$1 million	LIT 2 billion <u>3</u> /	...	--	Unconstrained	--	Unconstrained
Minimum amount	...	LIT 50 million	...	--	LL 50,000	--	Unconstrained
Treasury discretion							
Pre-announced cut-off price/yield	No	No	No	No	No	No	No
Flexible cut-off price/yield	No	Yes <u>4</u> /	No	No	No	No	No
Revision of auction size	No	No	Yes, downwards	Yes, downwards	Yes, upwards and downwards	Yes, both upwards and downwards up to 10 percent of the announced amount	Yes, downwards
Rejection of specific bids	Yes	No	...	No	No	Yes	No
Auction results							
Lag between auction announcement and auction day	Six days	Three days	...	One week	...	...	...

Treasury Bill Auctions in the United States, Italy, Belgium,
United Kingdom, Lebanon, Egypt, and Tunisia (continued)

	U.S.A.	Italy	Belgium	U.K.	Lebanon	Egypt	Tunisia
Lag between bids and results	One hour	A few hours	One hour	One hour	Two hours	One day	...
Lag between results and settlement	One-five days	Four days	Two days	Two days	Two or three days	One day	...
Published information	Total noncompetitive bids by district; total competitive bids per yield; information on specific bids only when exceeding 35 percent	Maximum, average and cut-off prices; number of participants and bids	...	Lowest accepted bid, percentage allotment at that price, total volume of applications, average rate of discount, and bills offered at next tender	Maximum, weighted average, and minimum yields; issued amount	Total bids and amount sold; range of interest rates bid and sold; weighted average of successful bids; number of bids and accepted bids	Issued amount, and weighted average yield
Typical features of an auction							
Number of competitive bidders	75-85	50-60	...	...	30-40	100-200	...
Number of non-competitive bids	20,000	very small	...	--	325	--	Very few
Share of non-competitive awards	20 percent	less than 1 percent	...	--	10-75 percent	--	Very small
Share of primary dealers	70 percent	--	...	Over 90 percent	--	--	--
Share of customers of primary dealers	5 percent	--	...	...	--	--	--
Spread on competitive bids	A few basis points	Up to 100 basis points	10-15 points	Very small	Up to 200 basis points	50-100 basis points	30 basis points

Treasury Bill Auctions in the United States, Italy, Belgium,
United Kingdom, Lebanon, Egypt, and Tunisia (continued)

	U.S.A.	Italy	Belgium	U.K.	Lebanon	Egypt	Tunisia
Other information							
Accounting	Book-entry	Book-entry	Book-entry	Book-entry	Book-entry	Physical form	Book-entry
Primary dealers	38	23	14	19	None	None	None
Underwriters	No	Yes	No	Yes <u>5</u> /	None	No	None
Year of first auction	1929	1962	1991	Before 1980	1992	1991	1989
After auction subscription	No	No	Yes, by primary dealers, immediately after the auction	No	Yes, at the average interest rate	No	No
Frequency of auctions	Weekly for 3- to 6-month TBs and monthly for 12-month TBs	Fortnightly on 3-6-12 month issues	Weekly for 3-month TBs and monthly for 6- to 12-month TBs	Weekly on 3- to 6-month issues <u>6</u> /	Weekly for 3-6-12-month TBs	Weekly for 3-month TBs, 1-4 weeks intervals for 6- and 12-month TBs	Weekly for 3-month TBs and less often for longer maturities
Minimum denomination	\$10,000	Lit 5 million (US\$2,934)	BF 1 million (US\$27,693)	£ 5,000 (US\$7,406)	LL 10,000 (US\$6)	LE 25,000 (US\$7,418)	D 1,000 (US\$955)

1/ As of January 1, 1994, the Bank of Italy does not participate in the auctions.

2/ The Treasury can choose between two ceilings for noncompetitive bids:

(a) a fixed limit (usually LIT 2 billion); or (b) if the bidder made a competitive bid, the amount of this bid. In the first case (which is used in practice), while there is no formal ceiling on the total amount of noncompetitive bids, their total size is very limited in practice because participation at the auctions is restricted to some groups of agents. In the second case, the maximum share of noncompetitive bids is 50 percent.

3/ The noncompetitive bid made by each individual bidder cannot exceed the amount the Treasury can set.

4/ The cut-off price corresponds to the average yield of the first half of received bids (or of total supply if demand exceeds supply) plus 150 (it used to be 100) basis points.

5/ Discount houses traditionally play the role of underwriters.

6/ The typical maturity is three months, but the Treasury Bill Act of 1877 allows any maturity up to 12 months.

Treasury Bill Auctions in Austria, Nepal, and Poland

	Austria	Nepal	Poland
Auction technique			
Current	Multiple price	Multiple discount	Multiple price
Previous	--	--	--
Admission			
Participants	Commercial banks	Open to everybody	Open to everybody, including nonresidents
Deposit requirement	None	2-5 percent of the bid amount must be deposited at the central bank	...
Central bank participation	...	...	Yes
Competitive bids			
Maximum number per bidder	Unconstrained	Unconstrained	...
Maximum award	Unconstrained	...	Z1 10 billion
Minimum amount	S 200 million (US\$16,470,200)	NRs 25,000 (US\$508)	Z1 100 million (US\$4,685)
Noncompetitive bids			
Status	Not admitted	Admitted	Admitted
Maximum share	--	15 percent	...
Maximum bid	--	...	...
Minimum amount	--	NRs 25,000 (US\$508)	...
Treasury discretion			
Pre-announced cut- off price/yield	No	No	No
Flexible cut- off price/yield	No	No	No

Treasury Bill Auctions in Austria, Nepal, and Poland (continued)

	Austria	Nepal	Poland
Revision of auction size	...	...	Yes, upwards and downwards
Rejection of specific bids	...	...	...
Auction results			
Lag between auction announcement and auction day	...	One week	One week
Lag between bids and results	...	One day	...
Lag between results and settlements	...	...	...
Published information	...	Minimum, maximum, and average yield on awarded bids; amount issued at the following auction	...
Typical features of an auction			
Number of competitive bidders	...	...	...
Share of non-competitive bids	--	...	...
Share of non-competitive awards	--	...	...
Share of primary dealers	--	...	...
Share of customers of primary dealers	--	...	...
Spread on competitive bids	A few basis points	...	...

Treasury Bill Auctions in Austria, Nepal, and Poland (continued)

	Austria	Nepal	Poland
Other information			
Accounting	Physical form	...	Physical form
Primary dealers	No	...	7
Underwriters	No	...	No
Year of first auction	1993	Early 1990s	1991
After auction subscription period	No	...	...
Frequency of auctions	Irregular on 1-3-4-9-12-month TBs	Weekly on 3-month TBs	Weekly on 1-2-3-6-9-12-month TBs
Minimum denomination	S 10 million (US\$823,520)	NRs 25,000 (US\$508)	Zl 100 million (US\$4,685)

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