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Auctions of Government Securities in India – An Analysis

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Auction methodology and its practical use have received tremendous importance in a market oriented mechanism from 1990s onwards. In this paper, we employ empirical methods to evaluate various performance parameters associated with auctions of Government of India dated securities. In this analysis we observed that Government securities auctions in India are fairly efficient as bidding dispersion is quite low with normality in pricing behaviour. The bidding behaviour analysis of Indian government securities auctions shows that bidders' pricing strategy is negatively influenced by bid size, bid cover ratio and tenor of the security. Indian bidders are reducing their bid amount for higher priced bids to minimise their 'winners-curse' in the auctions. The statistical analysis validates various standard auction features. It also establishes that the auctions help in determining most commonly perceived market-clearing borrowing rates out of well behaved bid-price distributions.

JEL Classification : D44, G10

Keywords : Government Securities Auction, Bidding Strategy.

Introduction

The Government of India issues debt securities to finance the Public Debt. Reserve Bank of India conducts the auctions of the Government securities such as auctions of Treasury Bills and fixed coupon earning dated securities, floating rate bonds, capital index bonds by following a pre-announced half-yearly calendar. Dated securities are issued by either conducting yield-based auctions for issue of new securities wherein coupon rates emerge on the basis of competitive bidding, or price-based auctions for re-issue of existing securities. With the reform process initiated in the 1990s, auctioning government securities evolved out since the first auction of dated security was conducted on June 03, 1992.

Auction is a price building process driven by a competitive bidding process, wherein the seller receives a collective assessment of prospective

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value of the asset to be sold. Modern day auctions bear out detailed empirical data on bidders' behaviour when different units of goods get allocated at accepted bid prices. The importance of periodic empirical evaluation of bidding behaviour helps reset the assumptions that go behind designing auctions, specially the traditionally evolved out complex designs like those of Treasury security auctions. As underlying raw bid-price distributions govern *a priori* the bidder's demand and information about quantum and price, an empirical understanding of the bid data in the form of panel data analysis of locally differentiated form of a variety of the empirical frequency distributions, concentration analysis of bids as also evidences of localised mean reverting bell shaped (near-normal) pricing behaviour, provide valuable insights about overall performance of the auction design[1].

The major participants in these auctions in India are the banks, insurance companies, mutual funds and primary dealers. Banks and insurance companies participate actively in the auctions to meet their statutory requirements while primary dealers participate in the auction for market making and positioning the securities for further sale in the secondary market. Auction data reveal the competitive behaviour of various investor-groups in terms of success ratios, bid shading, total amount of bonds demanded, bid amount distribution as against respective bid prices, dispersion as well as concentration of bids around multi-modal bids that could be expected within a heterogeneous cluster of bidders. Panel empirical analyses for a similar set of auctions would elucidate the bidding pattern and help evaluate the overall efficiency of the auctioning process.

Much of the auction literature deals with the relation between auction mechanism and the seller's revenue and with equilibrium bidding strategies. However, many of the theoretical results are not robust to changing assumptions when verified by doing hard empirical analyses (Milgrom, 1989). Subtleties of competitive bidding were brought to the fore because of the puzzling conclusions on winner's curse[2] drawn from the modern auction theories, which has set the age-old debate about performance of auction designs for the case of sealed-bid Treasury bill auctions in which each buyer paying a price equal to the highest rejected

bid (uniform auction) would yield more revenue to the Treasury than the auctions in which winning bidder pays the seemingly higher amount equal to his own bid (multiple-price or discriminatory price auction). Majority of empirical modelling exercises of the subsequent period, however, could not settle this theoretical puzzle. It, therefore, made a case for experimental validation of auction theories in a particular context and empirical evaluations of the theoretical predictions for a particular auctioning environment. For example, Cammack (1991) studied the bidding strategies and the information content in the US Treasury bill auctions purely on an empirical basis and brought out firm evidences towards imperfect information in the Treasury bill market, downward bias in average auction bid (bid shading[3]) and the auction prices feeding on the secondary market price behaviour implying thereby that these two markets aggregate trader's private information differently.

Early work of Hendricks and Porter (1988) and others provide important guidance about bid distribution analyses for substantiating underlying assumptions behind an auction. Over a period of time, structural approach has emerged as a positive area of research in building up econometric models of auction data, which provide critical policy inputs regarding choice of an auction design and associated issues and assumptions related to auction format[4] (Paarsch et al, 2006). Till mid-1990s, only a few empirical studies have attempted to validate theoretical models using real auction data (Laffont *et al*, 1995). With the improved estimation and simulation techniques, several rigorous statistical analyses help estimate econometric models that are closely derived from auction theories. Examples include development of empirical models to discriminate between common values and private values models in the first-price auctions, to quantify the magnitude of the winner's curse in the pure common values model[5], or say comparing the performances of open and sealed bid auctions (Athey *et al*, 2006). For example, the working paper of Hortacsu (2002) undertook one of the oldest unresolved questions in the auction literature: whether to sell treasury bills by discriminatory or uniform auction, or his recent paper (Hortacsu, 2008) on testing for common values in Canadian Treasury Bill markets. In the Indian context also, no hard evidence could be found about superiority of the uniform auctions over a comparable set of multiple price auctions (RBI Annual Report, 2002-03).

In this paper one-year auction data for 2006-07 (April-March) in respect of Government of India dated securities, which follow by and large a comparable pattern and sizes, have been analysed to capture the bid price distribution pattern so as to gain insights into institutional bidding behaviour as also overall efficiency of the auction format, design and listed methods and rules for participating in the auction.

The present paper is divided into five sections. The first section briefly describes the commonly adopted auction designs in India and abroad. A theoretical framework focussing on bidding behaviour along with literature review is presented in Section II. Performance of government securities auction with certain stylised data analyses of bidding behaviour in the recent period is presented in Section III. Then an empirical evaluation of certain quoted pricing strategy model is presented in the Section IV and the concluding observations are summarised in Section V.

Section I

Design of Government Securities Auction in India[6]

The auction procedure followed by RBI is the commonly used *multiple-price sealed-bid* auction. The bidders electronically submit sealed competitive bids specifying the price they are willing to pay for a particular amount of debt security. For dated securities auctions, investors belonging to eligible categories may also submit non-competitive bids up to a ceiling of Rs.2 crore without specifying price. These bids are accepted at the average price of bids accepted in the auction. The total amount of non-competitive bids is subtracted from the total issue-size for allocation to competitive bids. An initial ceiling of 5 per cent of issue size is kept on the total non-competitive amount but the ceiling limit is rarely touched.

Once all the bids are received during the bidding time, RBI allocates the competitive bids starting from highest price bid and moving down until entire amount is allocated. In a multiple price-auction, each successful bidder pays the price stated in his bid. In case of 'uniform price' auctions, all successful bidders pay the same price that is cut-off

price at which the market clears the issue. The method of auction is announced well in advance in the issue announcement notification.

In India, the banks and insurance companies are required to invest in government securities as per statutory reserve requirements. Main auction bidding strategy of the banks and the insurance companies is to price their bids in such a way that it is beneficial to them than buying from secondary market to meet their growing reserve requirement. Their buying demand in secondary market may increase the price in secondary market. Therefore, these bidders being long-term investor have to price their bids based on their own values of the security in longer time horizon as against the bidding strategy of other bidders like the primary dealers who acquire securities in auction mainly to sale later in the secondary market and thus their bid pricing would have valuation of shorter-term. The intermediaries like the primary dealers would like to earn quick profit by acquiring securities in the primary auctions and selling in the secondary market.

On the other hand, primary dealers have the obligation of underwriting the auction issue and get the incentive in the form of underwriting commission. Thus, the primary dealers would have of different bid pricing strategy. Moreover, on account of size (capacity) constraint, the bidding strategy of the primary dealers would be different than the banks and insurance companies. The primary dealers are smaller entities as compared to banks and insurance companies, which have higher financial capacities.

India follows the by and large universally adopted auction method with most of the auctions being multi-price (or discriminatory price) auctions. Uniform price auctions were also undertaken in the past (RBI Annual Report, 2002-03). Countries that follow regularly similar auction designs include the UK, Italy, Canada, Germany and Sweden (Keloharju M *et al,* 2005).

Even though the traditional Treasury procedures have theoretical drawbacks, it is difficult to prescribe the best way to auction government securities. The Treasury is obliged to provide easy entry into the auctions, broadening, where possible, the ownership of the public debt; and it must adhere closely to a crowded schedule of borrowing. While the

Treasury may not always get the top revenue amounts for the issuances, the prevailing auction system help the conduct of monetary policy and ensure a deep and active secondary market in government obligations.

Section II

Theoretical Backdrop[7]

Modern day fascinating world of auction theory and its application has been termed as "auction engineering" and it thrives on multiple discourses of Game Theory, experimental economics of Design Mechanism, Operation Research and Empirical Sciences like statistics, simulation and computing science. To boot, auction is being increasingly cultivated as a very effective applied tool in pricing and allocating economic good so much so that related auction methods have created "the most single exciting province of applied economics during last dozen years" (Warsh, 2006).

To have a comprehensive summary on the auction literature is a daunting task as it 'continues to grow at a prodigious, even accelerating rate' even after three decades of intensive work that started in the late 1970s and early 1980s, just when the right game-theoretic methods for studying this subject namely games of incomplete information and perfect equilibrium was becoming widely known (Maskin, 2004).

Auctions help "increase" or "augment" ('*augere*') prices of exchange of ownership of different kinds of assets in uncertain context where the buyers and sellers do not have *a priori*, precise idea on pricing (Aryal *et al*, 2007). Auctions are used by the governments to set up new assets markets namely energy sources like offshore oil and gas lease, commodities like wool and forest timber, transport infrastructure and logistics, pollution permits and spectrum for mobile-phone services as also for privatisation of national firms (Klemperer, 2004). In such a zest for market-oriented instruments of experimental economics of the new millennium, a consensus has been reached among the practitioners that the most effective way to sell government securities is through auctions (Kastl, 2008). William Vickery's (1961) classic inquiry into auctions is

considered as the foundation of the theory of auctions. This had subsequently flourished into a growing discipline to embrace new environments and new theoretical as well as empirical developments. Many practical problems in the form of testable hypotheses came up and methodologies were developed to carry out laboratory experiments and inferential procedures to validate the field data on bidding behaviour (*op cit* Paarsch *et al*, 2006). Auction theories, modified suitably by strong empirical evidences when put to practical work in the 1990s led to highly successful designs on radio spectrum auctions in the mid-1990s. Along with came many more theoretical and synthetic developments on a variety of auction designs (Milgrom, 2004).

William Vickrey established the basic taxonomy of auctions by classifying them based on the order in which prices are quoted and the way in which bids are entered. First, securities can be awarded at prices that are progressively lowered until the entire issue is sold; alternatively, the auctioneer can arrange the bids in ascending order by their price and decide on a single price that places the total issue. By the second measure, the auction can be a private affair with sealed bids opened by the auctioneer (i.e. price is not known to other bidders), or it can be conducted in real time, with participants in a single room or connected by phone/ electronic bidding in public view (i.e price is known to other bidders). This two-by-two classification yields four different types of auctions namely (i) the first-price sealed-bid auction, (ii) the second-price sealed-bid auction, (iii) the descending-price open-outcry auction and (iv) the ascending-price open-outcry auction.

Treasury auctions wield a composite design known as multiunit sealed bid auctions. Such granular single price bids bestow strategic flexibilities to each bidder so that the stipulated amount of securities notified to be issued gets determined at a cut-off issuance price based on a well spread-out demand schedule, maintaining the competitive rigour as well as transparency in the whole process. Optimality of the best price determination is premised upon the assumption that all the bidders are rational and they put their bids efficiently. Compared to other auction designs, Treasury auctions are expected to yield the highest expected

revenue (utility) to the seller, while leaving sufficient space for strategic manoeuvrability of bidding for multiple quantities of bonds as price-quantity pair. However, it is currently being debated that new auction devises like ascending-price, open bid design is superior over somewhat inefficient versions of the traditional single price bid auctions namely pay-as-bid (or discriminatory) as well as uniform price (or, non-discriminatory) auctions. While the ongoing debate on possible switching to modern day auction designs like Ausubel types dynamic auctions is evolving, it is a well accepted fact that the established markets have a liking for the traditional auction structure wherein dominant market participants would like to derive comforts from consolidated use of the current processes (Ausubel, 2004). Anecdotal recording on the institutionalisation of Treasury securities auctions also suggests that the mere prospect of greater efficiency may not necessarily effect change that requires a large number of factors to alter familiar patterns of behaviour; change sometimes also depends on following a path that facilitates learning and implementation of new patterns (Garbade, 2004). As evidenced in the case of US securities market, the Treasury successfully configured the present efficient configuration of government bond auction[8] by combining familiarity, gradualism and a willingness to improve. Successful migration to a totally changed auction or even introduction of a new financial instrument by sovereign issuer requires lot of learning, creating motivation and learning among the participants as well as resolving many practical issues.

The general framework for analysing bidder behaviour in auctions used by economists is that of game theory. The auctions can be considered as strategic games and bidding behaviour determines the price for the security auctioned and thus the revenue raised for Government. Each bidder in the auctions submits price-quantity pairs. The valuation of each bidder depends on his or her information about the security. Bidders are assumed to behave competitively and not to collude making auctions as non-cooperative game. Successful bidding in the auction involves successful guesses about other bidders' information. Bidder X wins the auction if his bid exceeds the bids of other bidders and price paid is his bid price. The decision problem bidder X faces is to strategise a set of

bids that maximises his returns. It can be shown that the equilibrium strategy is a function of the bidders own valuation and the distribution of valuation of other bidders (Krishna, 2002).

It is often argued that sealed bid descending auction has a built-in bias in slapping winner's curse on successful bidders, which is quenched totally in case of open bid ascending auctions. The debate is still unsettled as would glean from the following competing arguments. First, it is argued theoretically that there is no systematic advantage of either sealed bid (Dutch) auction over the open bid ascending (English) auctions and vice-versa. This is premised upon a set of innovative results known as *Payoff Equivalence* theorems, which were first discovered by Vickery (1961) and extended by Myerson (1981), Riley and Samuelson (1981), Milgrom and Weber (1982). It began with Vickery's surprising finding that the average revenues and payoffs are same for every auction within a very broad class. Under certain idealised conditions, changing payment rules (e.g, uniform or multiple pricing, open or closed forms) cannot affect the participants' final payoff and thus the revenue finally realised. Such results are a kind of irrelevance conclusions, which are ingenuously used in analysing relative performances of different kinds of auctions. "Practical uses of the equivalence theorems are similar to the uses of Modigliani-Miller Theorem in financial economics, and the monetary neutrality theorems in macroeconomics" (Milgrom, 2004). It means that alternative designs are sought for in complex situations where key ideal assumptions are not tenable. Otherwise, simpler designs seem to be working fine. Its veracity, however, requires to be validated based on auction performance data from time to time, as environmental factors may undergo periods of remarkable changes, coercing thereby review of the assumed auction design. Second, it is argued in the contrary that irrelevance conclusion does not hold good in real life situations in the face of persistence of different behavioural factors in case of different forms. For example, proponents of ascending auctions often argue that no bidder is willing to bid close to fair value unless pushed to do so by the open competition of the auction design. Third, sealed bid auction is liked by the auctioneer over open bid forms because latter types never result in more being paid than is absolutely necessary to win the auction,

whereas sealed bids tenders are frequently evidenced to be leaving "lots of money being left on the table". Fourth, inherent rigour of sealed bid tenders relies heavily on the fact that available pricing information is equally and efficiently utilised by the bidders and to that extent preponderance of possible bid-shading balances possible chances of winner's curse, which could be at times demand driven aggressive bidding behaviour and there is no harm in collecting the "money left on the table" out of a pay-as-bid behaviour.

Similar arguments revolve around relative merits of two alternative forms for auctioning securities, namely *multiple price* versus *uniform price* auctions. Informal arguments like government getting more money from the first scheme, rationalising thereby that each bid paying its own price, or the counterpoint in favour of the uniform price auction that bidders who collectively know that they must pay their own bid *when they win* will bid less as guided by natural 'bid shading' behaviour reduce the market-clearing price leading to lower revenues, do not settle the issue. Irrelevance property inherent in the Payoff Equivalence property entails that till the designs do not affect the allocation principles among different groups of bidders, it does not affect the total revenue or the average prices obtained by the auctioneer. Data analysis of the bidding pattern revealed not much efficiency gains of uniform auction over multiple price design in the Indian context (RBI Annual Report, 2002-03).

The auction literature also distinguishes between independent private and common value auctions following Milgrom and Weber (1982). The value of the securities auctioned is not of private nature as there is secondary market where the securities traded and a bidder has the option to try to get the security in auction at his bid price or choose to buy it from secondary market at the prevailing price. For existence of secondary market, Government securities auctions are usually considered as common value auctions. Ausubel (2004) have observed that in a common value model the 'winner's curse' is more pronounced. The more amount of the security a bidder wins, the worse news is this for him as bidder has to pay higher price for the security. Ausubel refers to this phenomenon as 'champion's plague'. Rational bidders adjust for champion's plague

by reducing their demand for any given price. In auction parlance, this is known as bid shading. Nyborg *et al* (2002) argue that intra-bidder dispersion and quantity demanded would be impacted by bidder's capacity. Wilson (1979) described a multi-unit auction model and prescribed that risk neutral bidders would submit downward sloping demand schedules and the market clearing price will be at the point where bidders demand curve intersects his residual supply curve. Back and Zender (1993) shown that all bidders pay the same price and make no profit when bidders' marginal value is constant across the bidders and the value is perfectly known. Sometimes, auction participation could also dwell upon regulatory requirement. Hortacsu (2002, 2006) have argued that the banks participate in Turkish Treasury auction to fulfil their reserve requirement. It is of special importance that marked heterogeneity among the disparate regulated institutional entities may influence their values. Distinguishing features of private value and common value items could be understood from Milgrom's (1982) treatment of oil, gas and mineral rights. Empirical models are also being developed for testing private value component in otherwise dominating features of Treasury bills.

Repo auctions are used to inject central bank funds against collateral into the banking sector. Nyborg *et al* (2005) analysed the basic bid-data of the European Central Bank's (ECB) variable Repo rate auctions. The ECB uses standard discriminatory auctions and hundreds of banks participate. The amount auctioned over the monthly reserve maintenance period is in principle exactly what banks collectively need to fulfil reserve requirements. ECB's bidder-level data study finds: (i) Bidder behaviour is different from what is documented for treasury auctions. Private information and the winner's curse seem to be relatively unimportant. (ii) Under-pricing is positively related to the difference between the inter-bank rate and the auction minimum bid rate, with the latter appearing to be a binding constraint. (iii) Bidders are more aggressive when the imbalance of awards in the previous auction is larger. (iv) Large bidders do better than small bidders.

Literature on multi-unit auctions[9] does not provide any definitive recommendations whether the ultimate goal is that of revenue

maximisation or efficiency of the allocation. So far as country practices are concerned, there is a clear preference between the two most widely used mechanisms. As per the survey on auction practices adopted for Treasury securities in 42 industrialised undertaken by IMF staff members in the second half of the 1990s, it has been recorded that 39 countries conduct discriminatory auctions and only 3 countries use a uniform price auctions. Ausubel and Cramton (2002) argued that the comparison of the uniform and discriminatory auctions, both in terms of allocation efficiency and revenue maximisation, is an empirical question. Either form could be better under different circumstances, which may be evaluated based on empirical analysis. Standard data analysis in the form of mean variance analysis, assessing bid distribution pattern as also concentration analysis across the auctions during a year having certain homogeneity regarding the environment as well as auction rules and procedures would provide certain key evaluative information. Moreover, structural econometric modelling of the auction data would statistically validate certain common hypotheses relating to general performance of the auctions in quantitative terms.

Section III

Performance Analysis of Government Securities Auctions in India

1. Empirical background

The total amount of securities raised by Government of India during the year, 2006-07 was Rs.1,62,000 crore. Of this amount Rs.16,000 crore was raised under MSS (4 auctions) while the remaining amount of Rs.1,46,000 crore was for the market borrowings of the Govt of India. Of the 37 auctions held during the year, 3 new issues were placed through yield-based auctions while the remaining 34 were reissues of existing securities conducted through price-based auctions.

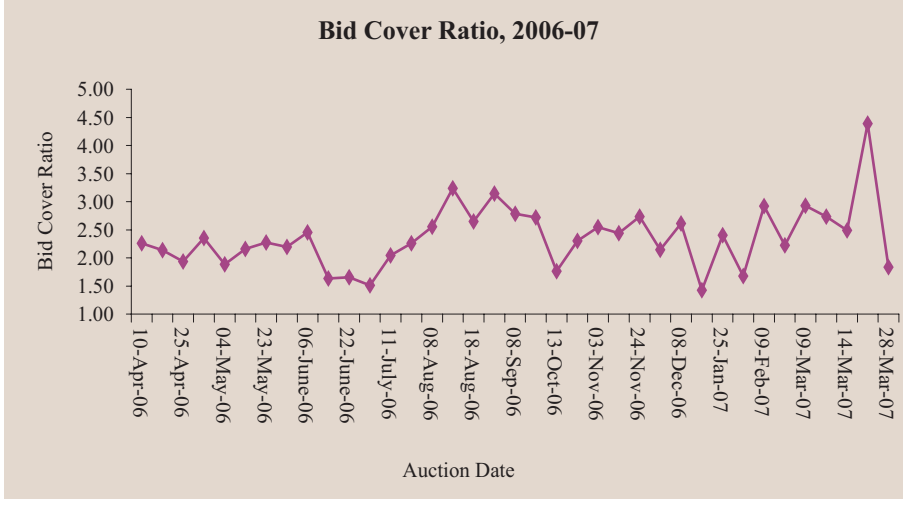
Auctions for the primary issuance were electronic sealed-bid auctions with multiple bids at different prices from market participants. An analysis of the bid-to-cover ratio and the distribution of bid price data reveal several important insights into the temporal behaviour of the overall market demand for the government securities as also pricing efficiency and concentration of bid price at the auctions conducted in 2006-07.

2. Behavioral pattern

2.1 Market demand: Demand for the government securities by the market can be measured in terms of bid-to-cover ratio (BCR) defined as total amount of bids received divided by the notified auction amount. The average BCR during 2006-07 was 2.36 as compared to 2.19 during 2005-06. Out of 37 auctions, BCR was above 3.0 in three auctions (two out of 29 auctions during 2005-06) showing higher demand compared to previous year. Maximum market demand was 4.39 times to notified amount for MSS auction of Rs.2000 held on March 22, 2007. In the overall average BCR is impacted predominantly by the liquidity scenario and the interest rate expectations. The data on BCR reveal a discernible pattern in the form of distinct quarterly cycles except a large swing witnessed in the concluding part of the study year due to a couple of market stabilization scheme (MSS) auctions.

Overall demand for government securities can be analysed in terms of (i) sectoral profile, (ii) demand-price relationship, (iii) effect of issue size, and (iv) effect of tenure of security.

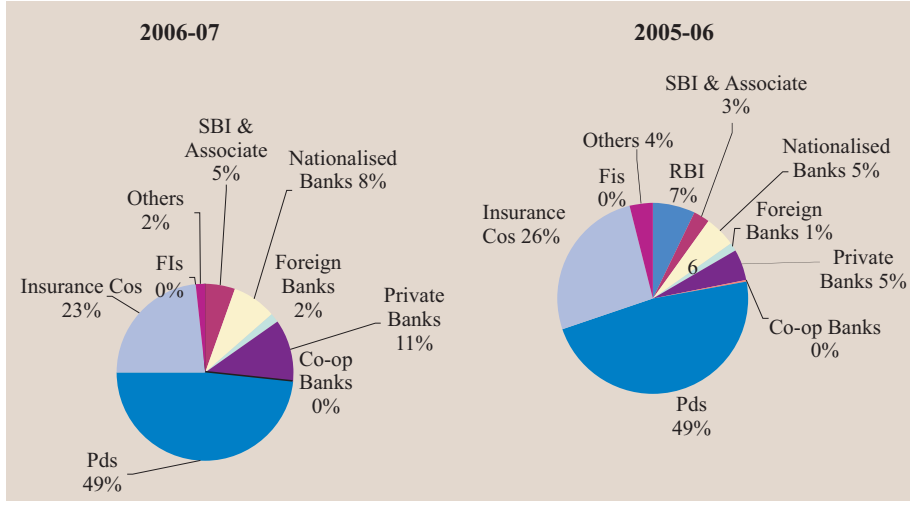
- **Sectoral profile:** The Primary Dealers have the obligation to underwrite the entire auction issue after introduction of the Fiscal Responsibility and Budget Management Act 2003 during 2006-

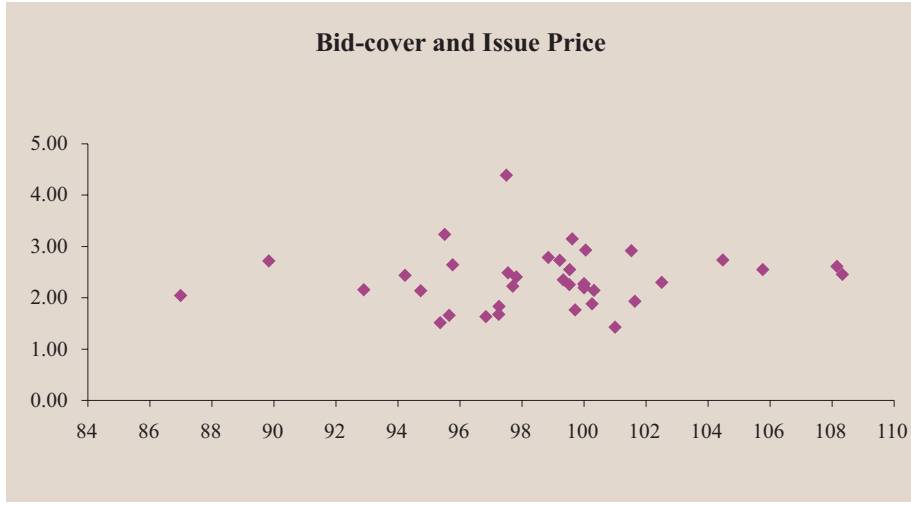


07. Hence, major portion of the issuance was subscribed by the PDs (including devolvement). The market segment-wise subscription is given below. Sectoral profile of the subscription to government securities remained by and large unchanged but for the private sector banks garnering an increased share of 11 per cent (5 per cent in 2005-06) of the overall amount of securities issued in 2006-07.

- **Demand – price relationship:** As stated above, there were 34 re-issuances of securities, thus, the price of securities being auctioned depend on the coupon of the security, higher the coupon means higher price and hence higher cash-outgo from the successful bidders. During 2006-07, the average cut-off price of the 37 auctions was Rs.98.72 compared to Rs.103.77 for the previous year. The correlation coefficient of auction demand (BCR) with cut-off price worked out to low (0.0993 for 2006-07 vis-à-vis –0.0706 for 2005-06) implying that market price and hence coupon is not a major factor for market demand. Since pricing in G Sec market in India is predominantly based on the yield-to-maturity (YTM) basis, the observation is in line with the market practice.

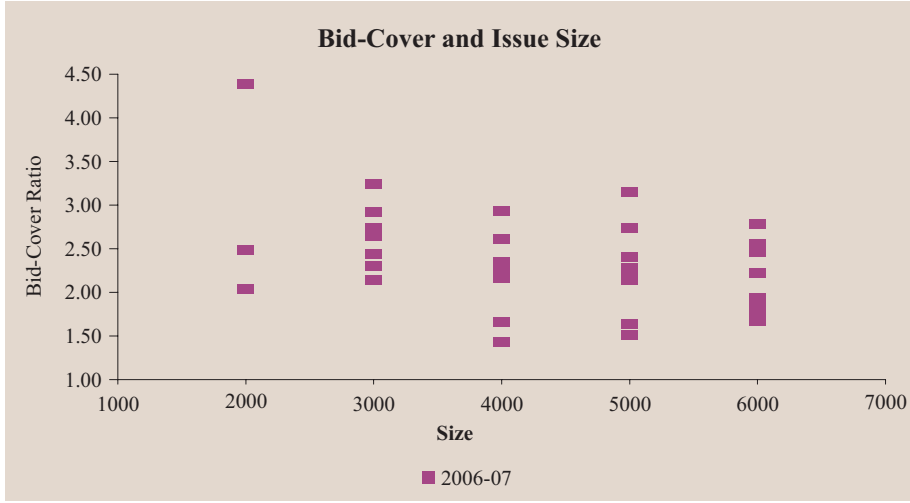
- **Demand versus Issue Size**: The average issue size of the auction was Rs.4,378 crore in 2006-07 as compared to Rs.4,233 crore in previous year. The auction size varied between Rs.2,000 crore to





Rs.6,000 crore. The Bid-to-Cover ratio showed a statistically significant inverse relationship with issue-size (correlation coefficient of –0.3968 in 2006-07 as compared to –0.2218 in 2005-06) i.e. the market demand is lower for larger issues.

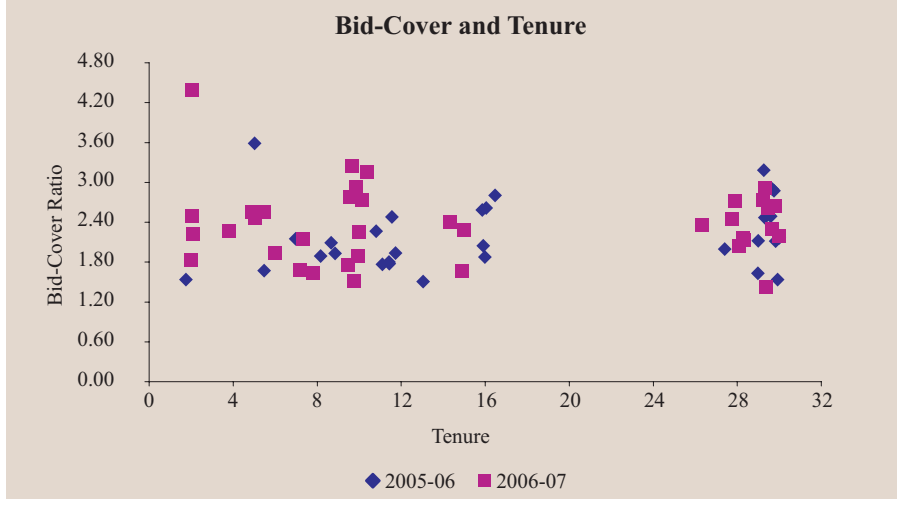
- **Demand versus Tenor**: The tenor of the securities issued during 2006-07 varied between 30 years to 2.02 years of residual maturity. The average maturity of the auction issues was 15.20 years in 2006-07 as compared to 17.63 years in 2005-06. Most of the issuance was in the range upto 16 years of residual maturity and then in the

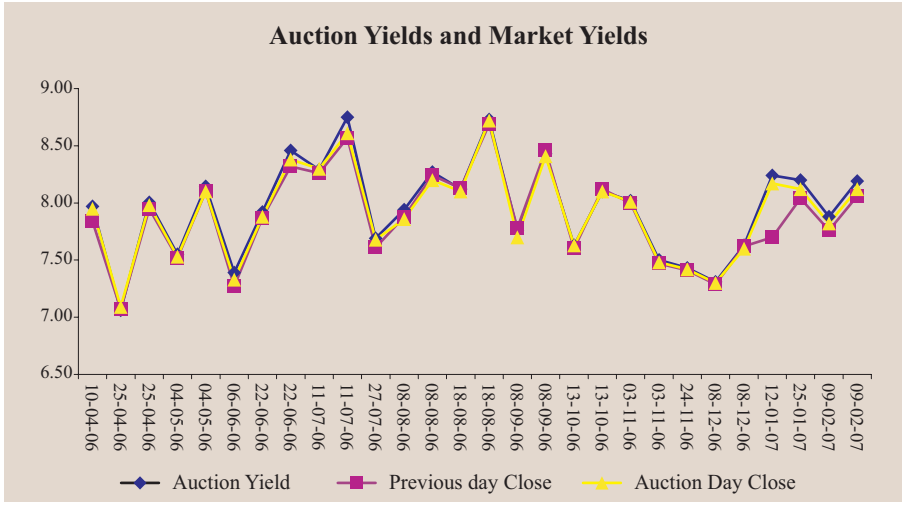


range of 28-30 years of maturity. During this period, there was no issue in the range of 16-28 years of maturity. The pattern of market demand measured in terms of bid-to-cover ratio (BCR) and residual maturity of the security auctioned is shown in the graph below. It may be observed from the data that the market demand has no over all statistical relationship with security tenor. It may appear contrary to common understanding due to segmented Indian market and the fact that shorter tenor securities (up to 10 year) accounts for about 59 per cent of the total issued amount.

2.2 Bid Pricing and Bidding Efficiency: The market pricing of primary issuance was in line with the prevailing market prices indicating the market pricing based on the sovereign yield curve. The prevailing market prices in terms of the auction day closing yield and previous day closing yield along with auction yield is presented below which indicate complete alignment of primary issuance with secondary market yields.

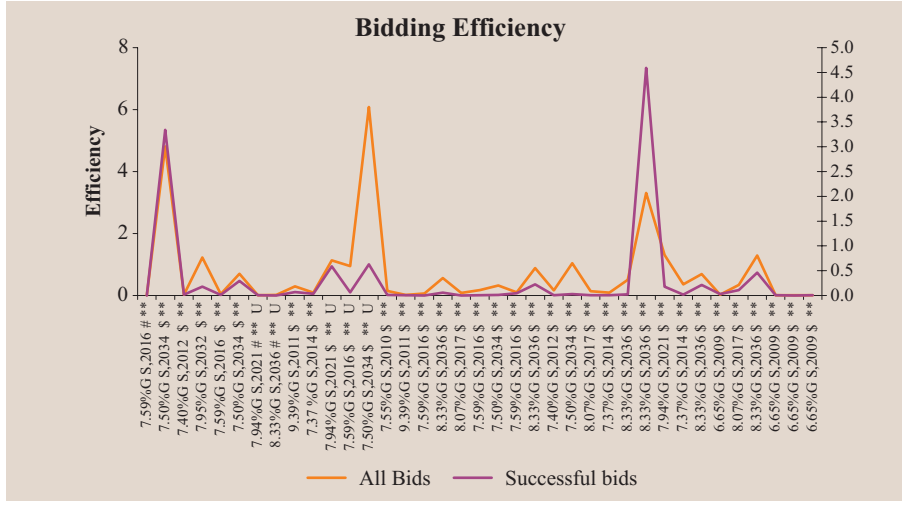
Bidding efficiency, when measured in terms of the dispersion of the bid prices around the cut-off price, requires to be weighted by the share of the amounts bid to minimise the effect of smaller size extreme bids. The lower the dispersion the more efficient is the bidding by the participants. Bidding was quite efficient (i.e. dispersion was low)





during most of the auctions except for the three longer tenure securities auction.

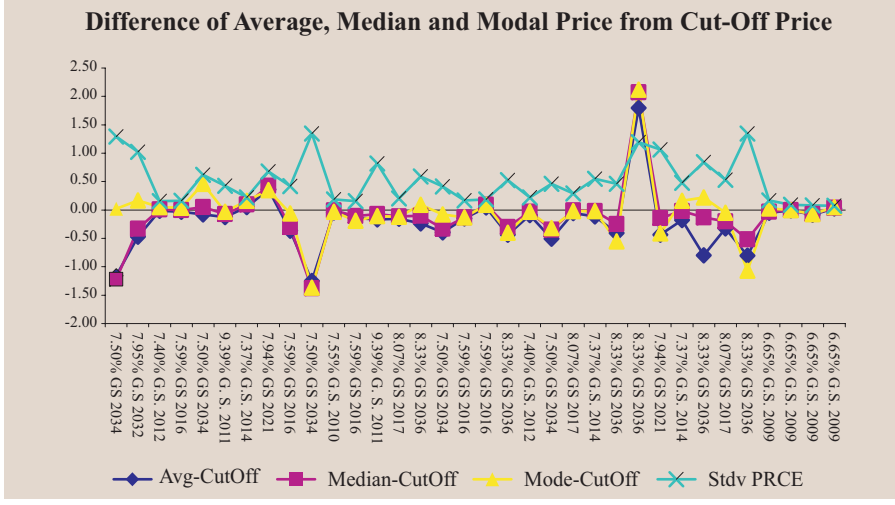
2.3 Distribution of Bid Prices: The various market price principles assume the normality in pricing behavior. The bid-prices in the primary auctions also follow the normal distribution around the centrality of the cut-off price. It may be observed that the primary auction mechanism is such that cut-off price emerges from the quantity demanded at the price and thus bid-amount determines the cut-off price among the bid-prices instead of the centrality of bid-prices.



Following chart presents the deviations of various measures of centrality of bid-prices like simple average, median and modal prices from the cut-off price. It may be observed from the chart that bid-price distribution is quite symmetrical with average, median and modal bid prices being close to each other in all the auctions. It may be noted here that average, median and modal bid-prices have been calculated without any weight to bid amount; all market participants' bid pricing is assumed to be equally likely.

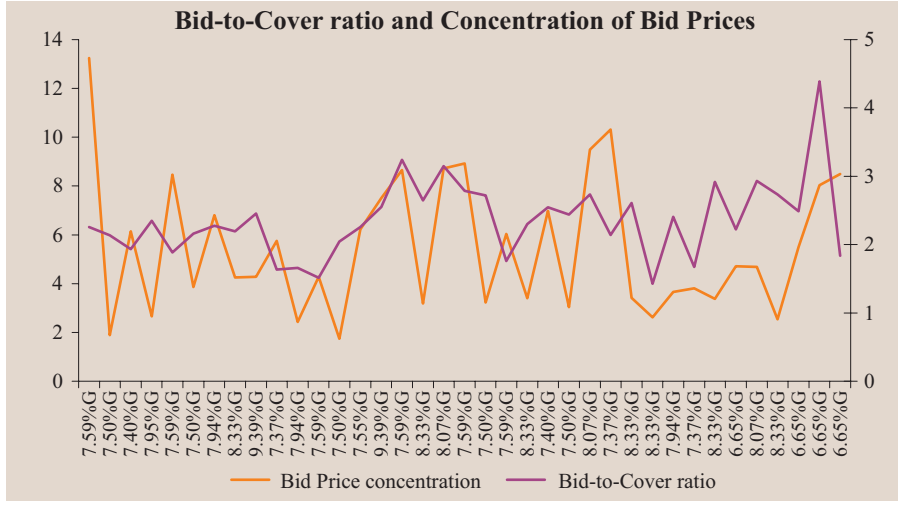
The closeness of cut-off price to the average bid-price shows the centrality of the market pricing in the auction process. This trend along with the closeness in secondary market prices reinforces the price-discovery mechanism of auction process. There were few deviations on account of devolvement (auction of 7.59%GS2016 & 7.50%GS2034) when cut-off price was higher than the central bid price. Similarly, auction of 8.33%GS2036 witnessed higher average bid price than the cut-off price as bid-cover ratio was lower at 1.43 for this issue for lower market demand and thus putting cut-off price lower than the average bid price. The skewness and kurtosis for each auction are also computed (Statement -1), which shows that the pricing behavior follows, by and large, a bell-shaped normal distribution.

2.4 Concentration of Bid Price: Concentration of bid price has



been measured by the Herfindahl index (*op cit* RBI Annual Report, 2002-03) of bid prices multiplied by the total number of bids. This is an indicator of the uniformity of market expectation. Higher the concentration of bid prices more is the uniformity of price/yield expectation of the bidders. Higher concentration around the expected cut-off price/yield is, therefore, more desirable. This measure has generally been high implying reasonable concentration of bid prices at auctions, which tallies with the observation of efficient bidding for most part of the year. Concentration of bid price has been found to be following the trend in BCR, indicating that when market demand is high market also has a reasonably uniform view on bond yields.

2.5. Investor group-wise analysis: The investors participating in the primary auctions may be categorised into 11 groups for studying the investor group-wise bidding behavior namely primary dealers, insurance companies, nationalised banks, State Bank of India and its Associates (SBI group), new private sector banks, other private sector banks, foreign banks, co-operative banks, mutual funds, other financial institutions and individuals. Of these, the last two categories of investors namely other financial institutions and individuals had participated in few auctions and thus the data analysis is confined to the major nine investor groups.

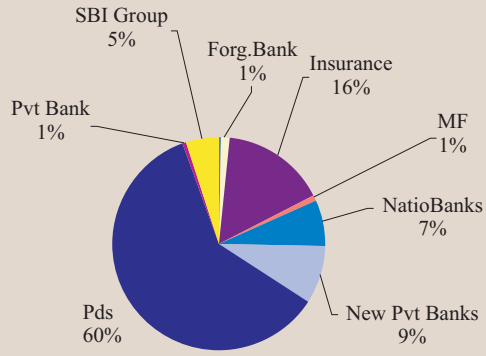


Among the Investor-Groups, the primary dealers (PDs) are required to underwrite the entire issuance (except for MSS issues), and to submit bids for the amount underwritten by each one of them. These stipulation perforce the predominance of PDs participation in the auction process. The banks and insurance companies are subject to statutory investment in G Sec. The investor-group-wise analysis has been presented on the various aspects of their participation in auctions in terms of number of bids and amount of bid submitted, and bid pricing.

(i) Auction participation: As expected, the primary dealers were ranked first with largest demand contributing to 60 per cent of the total bid amount. Banking sector contributed for 23 per cent comprising the new private sector banks (9 per cent), nationalised banks (7 per cent), SBI group (5 per cent), other private sector banks and foreign banks (1 per cent each) while the insurance companies had a share of 16 per cent of the total bid amount received in the auctions.

There is a wide variation in participation of investor-groups across the panel of the various auction issues. The insurance companies participate most aggressively in the longer tenure securities. PDs have submitted bids for larger amount in medium and short-term issues as compared with long-term issues. Banks also participated more in the medium and short-term issues. In terms of number of bids submitted in the auction, the ranking is – primary dealers (62%), banks (30%) followed

Distribution of Bid Amount



by mutual funds (4 per cent) and insurance companies (2 per cent). In all, 7,078 bids were received in the 37 auctions during the year of which 4,344 bids were submitted by primary dealers, 883 bids by nationalised banks, 597 by new private sector banks, 319 by SBI group, 267 bids by mutual funds, 153 bids by insurance companies.

(ii) Bid pricing: The bid pricing by investors is by and large guided by the yield curve; however, the individual pricing would also be influenced by the desire to get allotment in the auction. The bid pricing of investors like banks and insurance companies having statutory requirement on investment in government securities, with hold-to-maturity orientation, could be different from bid pricing of primary dealers who mainly acquires the stock in primary issues for later sale in the secondary market. In such a scenario, it is most likely that the primary dealers may be pricing their bids keeping near short-term movement of yield-curve whereas insurance companies would be pricing their bids in view of longer-term expectation of the yield-curve movement.

The investor-group-wise bid pricing behavior has been analysed for two aspects *viz.* within group variance in bid price indicating the uniformity of pricing, and difference between the cut-off price and the average bid-price in each of the auction. The investor-group-wise variance in bid prices presented in the annexed table shows the uniformity within the investors of a group giving similar considerations in bid pricing. For measuring the aggressiveness in auction biding, the average of difference from cut-off price (bid price – cut-off price) is analysed for each of the investor-group in each auction (Statement-2.). It shows clearly that the insurance companies are bidding aggressively in the longer-tenure securities' auctions having average bid price higher than the cut-off price. On the other hand, primary dealers are very competitive in their bid pricing for short and medium term securities auctions. The nationalised banks have the smallest overall difference in the auction bidding.

(iii) Success ratio**:** The aggressive bid pricing by an investor-group in the auction of security can be measured in terms of success ratio (amount allocated as percentage to bid amount). The auction-wise success ratio of various investor-groups is presented in the Statement-3.

It shows that the insurance companies have achieved a success ratio of hundred percent in nine auctions, - the highest among all the investor groups. Overall, the insurance companies have the highest success ratio indicating that their bid pricing is comparatively driven by desire to get allotment as compared with other investor groups. SBI group and the mutual funds have achieved the success ratio of hundred percent in four auctions. In terms of the overall success ratio, the ranking is: insurance companies (65 per cent), foreign banks and new private sector banks (54 per cent each), nationalised banks (50 per cent), SBI group (47 per cent), private sector banks (35 per cent), mutual funds (35 per cent), primary dealers (33per cent) and co-operative banks (23 per cent).

The primary dealers have quite lower success ratio of 33 per cent among the investor-groups because of the compulsion on bidding amount (they are required to underwrite the full amount and the bid amount can not be lower than the underwriting amount). As a result, bidding of the primary dealers in some of the auctions of longer tenure is quite negative. In twelve auctions, the primary dealers have success ratio of less than 20 per cent, of which, five auctions have success ratios even less than 10 per cent.

Section IV

Bid Pricing Strategy – Empirical Model

For understanding the bid pricing behavior of the participants in the auctions of government securities, it is important to focus on the variable 'distance of bid price from cut-off price' (i.e., bid price – cut-off price) to analyze the pricing strategy across various auctions. For this analysis, the price-based auctions have been considered.

The seminal studies of Nyborg *et al* (2002), and Hortacsu (2002, 2006) have observed the bid-shading in multiple-price auctions to minimise the 'winners-curse', i.e. bidders would like to reduce the bid size (bid amount) for prices which are more likely to get accepted. The bids above the cut-off price are accepted in the auction. Thus, bid size is one of the important variables to explain the bid pricing strategy. The next variable included in the model is market demand for the auction.

The market demand is measured in terms of bid-cover ratio for the auction. It is expected that higher market demand would induce aggressive bidding strategy of higher bid pricing. The securities auctioned are of varying maturities and it is expected that longer tenor securities would witness less aggressive pricing as longer duration securities have higher market-risk. Further, investor-group-wise behavior is also important to bid-pricing strategy as the primary dealers have the obligation of underwriting and also their role is mainly of intermediary to get securities in auction and later sale in secondary market. In order to measure the significance of market makers like primary dealers bid-pricing, a dummy variable is introduced in the model to capture the bid pricing strategy of the primary dealers. On the other hand, insurance companies have regulatory requirement for investment in the government securities for their long-term life-policies in view of India's 'population dividend'. As observed by Hortacsu (2002, 2006) in Turkish Treasury auctions, and the preliminary data analysis presented in the previous section also indicated a distinct bid-pricing strategy of ling-term investor like insurance companies in the auctions. Thus, a dummy variable is included in the model for insurance companies. Thus, the model is:

$$\text{DEVCUTOFF} = a_0 + a_1\ \text{BIDSIZE} + a_2\ \text{BIDCOVER} + a_3\ \text{TENOR}$$

$$+ a_4\ \text{DUMMYPD} + a_5\ \text{DUMMYINS}$$

where DEVCUTOFF = deviation from cut-off price (bid price – cut-off price) of the i-th bid in the j-th auction; BIDSIZE = amount bided at price in i-th bid; BIDCOVER = Bid-Cover ratio (i.e. total bid amount to the notified amount of the j-th auction; TENOR = tenure of security for which bid is placed in the j-th auction; DUMMYPD = 1 if bid belongs to a primary dealer, 0 otherwise; DUMMYINS = 1 if bid belongs to an insurance company, 0 otherwise.

The ordinary least square estimates of the regression equation is presented in Table 1 for four scenarios. The above results shows that most of the coefficients have the expected sign and are significant. The R-squared values are low but comparable for such large hetero-scedastic and multi-modal distributed discrete data. Estimates are similar to those obtained for other countries' studies (Nyborg *et al,* 2002).

As expected, the coefficient of bid size is of negative sign with statistically significant t-value. The aggressively priced bids are of lower bid size in the government securities auctions. Indian bidders are shading their bid amount for higher priced bids to minimise their winners-curse in the auctions. However, the coefficient for bid size is positive but insignificant for the auctions of very short tenor securities under MSS auctions. This observation can be interpreted as negligible 'winners-curse' due to less market risk for short-tenor securities. The short tenor securities' price would be less volatile in case of sovereign yield curve movement and thus it has opposite sign as compared to securities auctioned under normal market borrowing having larger tenor.

The bid-cover ratio representing market demand for the auctioned security is observed to have significantly negative coefficient in all types of the auctions. The bid pricing strategy of bidders in India is to have larger market demand with less aggressive pricing. The tenor of the security auctioned is also having statistically significant negative coefficient (except for the longer tenor auctions). As expected, the bidders pricing would become conservative (lower prices) with increase in the

Table 1: Estimation Results

	All Auctions	**Auctions (excl. MSS auctions)**	**Longer Tenor Auctions (tenor>20 yrs)**	**MSS Auctions of Short-tenor (tenor<3yrs)**
1	2	3	4	5
Constant	0.477 (12.08)**	0.659 (13.48)**	-3.149 (4.74)**	2.043 (5.42)**
Bid Size	-0.231x10^{-3} (2.86)**	-0.253 x10^{-3} (2.89)**	-0.585 x10^{-3} (2.90)**	0.039 x10^{-3} (0.69)
Bid cover	-0.176 (12.09)**	-0.257 (13.65)**	-1.060 (16.89)**	-0.039 (8.50)**
Tenor	-0.010 (11.90)**	-0.009 (9.07)**	0.200 (8.58)**	-0.959 (5.26)**
DummyPD	-0.132 (7.62)**	-0.151 (7.89)**	-0.452 (8.52)**	-0.013 (1.38)
DummyIns	0.247 (3.87)**	0.244 (3.63)**	0.405 (2.45)*	NA
No. of observations	6613	5958	1791	655
R-squared	0.06	0.06	0.18	0.12
F- Statistics	78.78	77.56	78.99	21.36\

(Figures in parentheses are t-statistics - ** significant at 1 % level, * significant at 5% level)

tenor of security auctioned as the fall in the market prices increases with tenor for given rise in yield curve.

For analysing the investor-group's bidding behavior, two dummy variables have been included in the model for the two dominant investor-groups namely the primary dealers (DUMMYPD) and the insurance companies (DUMMYINS). The sign of the coefficient of ' DUMMYPD' observed to be negative indicating the low pricing in bidding strategy of the primary dealers. As expected, it is statistically significant in the government borrowing auctions because the primary dealers have the underwriting obligation and consequent bidding commitments. Primary dealers are necessarily required to submit bids for the amount underwritten by them and thus low bid pricing strategy along with downward sloping bid demand is adopted to minimise their 'winners curse'. The dummy becomes insignificant in the monetary stabilization scheme (MSS) auctions where the primary dealers have no underwriting and bidding commitments. This result has an important policy implication. There are some countries where primary dealers have exclusive bidding rights. If such exclusive right is provided in India, the bidding strategy of the primary dealers would result in increased borrowing cost to the government.

On the other hand, the investor group of the insurance companies views their investments in government securities with different perspective. Insurance companies are mostly held-to-maturity investors rather than active traders of the government securities and thus their pricing strategy have to be different than the primary dealers who are mainly active traders. Accordingly, the coefficient of the dummy variable (DUMMYINS) is significantly positive. Insurance Companies have not participated in the short tenor MSS auctions.

Section V

Empirical Findings and Results - Summary and Conclusion

The market response to the primary auctions was better in 2006-07 as compared with 2005-06. The market demand reveals a discernible pattern having quarterly cycles with deviation in the concluding part of

the financial year with couple of MSS issuances. The primary dealers with underwriting obligation for entire issuance has subscribed to the major portion of issuance. The coupon rate or price of the security being auctioned is found to be insignificant factor for market demand as the market is based on yield-to-maturity and not the price.

The market demand has statistically significant inverse relationship with issue size. The residual maturity or tenor of the security being auctioned does not show any statistical relationship with market demand. This aspect could be explained in terms of complimentary demand from banking and insurance sectors for short-medium and longer maturity securities, respectively. The primary dealers act mainly as intermediary for primary issuance and not the ultimate investors.

The auction yields are in alignment with secondary market yields. Bidding was quite efficient with low dispersion and high concentration of bids around the cut-off price reflecting a fair amount of transparent market.

Investor-group-wise variance in bid prices shows the intra-group uniformity giving similar considerations in bid pricing. There is wide variation in participation of investor-groups among various auction issues. The insurance companies participate more in longer tenor securities than the short-term securities. The primary dealers had submitted bids for larger amount in the medium and short-term issues as compared with the long-term issues. Banks also participated more in the medium and short-term issues.

The bid pricing of the investors like banks and insurance companies, who are held-to-maturity type of investors with statutory requirement, found to be different from bid pricing of the primary dealers who mainly acquires the stock in primary issues for later sale in secondary market. The insurance companies are found to be bidding aggressively in the longer-tenure securities' auctions with average bid price being higher than the cut-off price.

Different investor groups show their distinct levels of aggressiveness in bid pricing as reflected in their overall success ratios: insurance

companies with 65 per cent, foreign banks and new private sector banks with 54 per cent each, nationalised banks with 50 per cent, SBI group with 47 per cent, private sector banks and mutual funds with 35 per cent each, primary dealers with 33 per cent and co-operative banks with 23 per cent.

Analysis of the bidding behavior for the Indian government securities auctions shows that generally bidders pricing strategy is negatively influenced by the bid size, bid cover ratio and tenor of the security. Indian bidders are reducing their bid amount for higher priced bids to minimise their winners-curse in the auctions. However, for the auctions of very short tenor securities under the auctions of securities issued under MSS, the coefficient is positive but insignificant unlike the other auctions. In general, the conservative bid pricing strategy increases with the tenor of security and also with the market demand. The investor-group dummy variables for the primary dealers and the insurance companies were observed to be significant with opposite signs. Primary dealers have the obligations and bidding commitment and thus adopt a conservative pricing strategy to minimise their winners curse. On the other hand, insurance companies adopt a strategy of relatively more aggressive bidding as they like to hold the securities till maturity. Statistically significant difference in bid pricing strategies of the two investor-groups in auctions in India indicates the private-value case of GoI dated securities auction unlike the commonly perceived common-value case of government securities auctions.

To condude, the present study provides an insight to the bidding strategy in the auctions of government securities in India. The large financing of the Central Government deficit is being raised through the primary auctions without the recourse to monetisation. The market response to the primary auctions of government securities has been very good and the bidding has been observed to be quite efficient. The cut-off prices emerged in the auctions were in line with the centrality of market expectations and bid pricing observed to follow normal bell shaped distribution around the cut-off prices. The diversified investor base has ensured the spread of maturity profile of government securities. Various investor-groups participating in the primary auctions have not only

ensured good demand for auctioned securities of various tenors but also imparted a fair degree of competitiveness in the auctions. The bid pricing strategies in auctions in India also confirm the bid-shading behavior of bidders to minimize their 'winners-curse' as observed in other countries. The bid-pricing strategies adopted by 'market-maker' investors *viz.* primary dealers observed to differ significantly than the pricing of buy and hold investors, *e.g.* insurance companies. The observed difference in the two pricing approaches indicates that while former follows 'common-value' case having market price movement in mind and latter follow 'private-value' case with long term price in mind.

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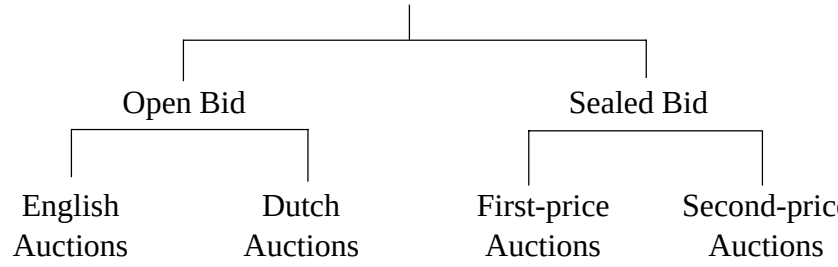
Annex

1. Auction designs and rules: There are different ways to classify auctions. There are open auctions as well as sealed-bid auctions. Besides, bid prices could be put in ascending format (e.g., auctions under hammer in the English style) or the bids are allowed to drop downwards (e.g., Holland's flower market). Experts mostly agree on four major auction types of *one-sided auctions* (bids are as per one-sided sale design, not the "asks" as in the case of double-sided market design. These are commonly termed as English, Dutch, First-Price sealed-bid, and Vickrey (uniform second-price) auctions.

Common Auction Designs



Second-price auction format, which was invented by William Vickrey (1961), does not find much real-life application, but its forms and contents are of central theoretical importance. First price auctions are commonly used for selling mineral rights and Treasury securities. English auctions (open outcry or oral bid system) are mostly used for selling art, used cars etc. and Dutch auctions are used to sell flowers in Holland. One difficulty is the lack of commonality in naming conventions. What some people call a uniform second-price auction is known in financial communities as a Dutch auction, and no end of confusion results.

The Vickrey auction and other traditional formats like single round sealed bid auction started evolving out in the early nineties, when auction theory was put to work in various challenging areas using hybrid formats combining both the traditional and newly established design like ascending bid mechanism. Ascending bid auction (English variety) helps provide the bidders with more information achieving thereby gain in efficiency over single round sealed-bid auctions, which are generally used by the central governments like the US Federal Government

especially for the sale of high-value rights such as off-shore oil and gas leases.

Initial developments in the auction theories were on modelling the auctions of a *single indivisible object* to one of several *risk- neutral bidders* with *independent* private value properties. This is the classic case where the seller holds an auction because seller's information about the possible buyers with a varied value sense is imperfect and the seller likes to extract the best possible price for the object. And the above common formats were the alternative versions of conducting the actual auction.

The common auction rules are as under:

Type	Rules
(i) English, or *ascending-price*	Seller announces reserve price or some low opening bid. Bidding increases progressively until demand falls. Winning bidder pays highest valuation. Bidder may re-assess evaluation during auction.
(ii) Dutch, or *descending-price*	Seller announces very high opening bid. Bid is lowered progressively until demand rises to match supply.
(iii) First-price, sealed bid. (Known as *discriminatory auction* in case of multiunit auctions).	Bids submitted in written form with no knowledge of bids of others. Winner pays the exact amount he bid.
(iv) Second-price, sealed bid or, *Vickrey auction*. (Known as c*ompetitive or stop-out price* auction in multi-unit auctions.	Bids submitted in written form with no knowledge of the bids of others. Winner pays the second-highest amount bid.

2. Winner's curse: Widely recognised as being that phenomenon when a "lucky" winner pays more for an item than it is worth. Auction winners

are faced with the sudden realization that their valuation of an object is higher as other participants estimated a lower market value for the item. One may appear to have won but actually end up with losing money because profits decrease (akin to Pyrrhic victory with devastating cost to the victor). The winner is the bidder who made the largest positive error in his valuation. The losers lose the item, but not any money. Anyone winning a bid against experts should wonder why the experts bid less. In auctions in which no bidder is sure of the worth of the good being auctioned, the winner is the bidder who made the highest guess. If bidders have reasonable information about the worth of the item, then the average of all the guesses is likely to be correct. The winner, however, offered the bid furthest from the actual value.Since most auctions involve at least some amount of common value, and some degree of uncertainty about that common value, the winner's curse is an important phenomenon.

In the 1950s, when the term *winner's curse* was first coined, there was no accurate method to estimate the potential value of an offshore Mexican oil field. For example, an oil field had an actual intrinsic value of $10 million, oil companies might guess its value to be anywhere from $5 million to $20 million. The company who wrongly estimated at $20 million and placed a bid at that level would win the auction, and later find that it was not worth as much. Other commonly cited instances of auctions where the winner's curse is significant are:

a. Spectrum auctions in which companies bid on licenses to use portions of the electromagnetic spectrum. Here, the uncertainty would come from, for example, estimating the value of the cell phone market in New York City.

b. IPOs, in which bidders need to estimate what the market value of a company's stock will be.

c. Pay per click advertising online, in which advertisers gain higher ranking if they bid higher amounts per click from a search engine user.

3. Winner's curse *vis-à-vis* bid shading: The **winner's curse** is a probable phenomenon that could occur in common value auctions with

incomplete information whereby the winner will tend to overpay. However, an actual overpayment will generally occur only if the winner fails to account for the winner's curse when bidding. Despite its dire-sounding name, the winner's curse does not necessarily have ill effects. Bidders have only estimates of the value of the good. If, on average, bidders are estimating correctly, the *highest* bid will tend to have been placed by someone who overestimated the good's value. This is an example of adverse selection very similar to the classic "lemons" example of Akerlof. Rational bidders will anticipate the adverse selection so that even though their information will still turn out to have been overly optimistic when they win, they do not pay too much on average. Savvy bidders avoid the winner's curse by bid shading, or placing a bid that is below their ex-ante estimation of the value of the item for sale but equal to their ex-post belief about the value of the item, given that they win the auction. The key point is that winning the auction is *bad news* about the value of the item for the winner if he/she was the most optimistic and others are correct in their average ex-post estimations. Therefore savvy bidders revise ex-ante estimations downwards to take account of this effect in multi-unit auctions.

4. Auction Format: The core of any auction design is the art of building up best price discovery mechanism. It is intrinsically linked with structuring the process of bid submission known as auction format. The common auction formats are: (i) *Live-bid auction* is just the most commonly perceived format. It is typically a public event held where bidders and spectators assemble together. (ii) *Two-bid auction* includes a written pre-auction bid followed by a live auction. The auction is then restricted event including only those bidders that submitted a pre-auction written bid. Often the bidding is further restricted to include live bidding from only the top five or three pre-auction bidders. This two-bid auction system is used most often when selling items of special value such as exceptional residential building, significant asset like a turnkey business package or systemically valued financial assets. (iii) In *on-line bid auctions*, Auction Service providers in the US have invested thousands of dollars and experimented extensively with offering and selling real estate on-line. Internet has provided significant marketing

advantages. (iv) *Sealed/ Tender Bid auction* format is used when dealing with complicated commercial sell and purchases of multi-unit/ components items like composite housing estates, large tract mineral rights transactions or Treasury securities where specific terms for the purchase are not all pre-determined by the Seller. Buyers do have room to negotiate the terms of the purchase of the property, whereas the seller is provided an opportunity to potentially receive a higher price. (v) *Open bid* format is the new avatar of live bid or the classical outcry system of price discovery mechanism. (v) *Fax bid* auction process, developed in 1997, is most often utilised in the US and Canada when dealing with very high value commercial or multi-family properties.

5. Auction's capabilities and inherent limitations: Suitability of an auction format depends on the nature of dominantly embedded value consideration for the object. Value uncertainty or more specifically, information asymmetry is a key feature of auction. In an auction, each bidder is assumed to make rational bidding based on his assessment on value consideration. Following are the two important valuation specifications:

a. **Private Value -** When an object is wanted for personal consumption and a bidder has no primary motive to resell. The bidder is motivated to pay up to a certain maximum, independent of valuations made by others. Art bought for personal pleasure is an example. A private valuation is a subjective decision. It is private in that one bidder does not know another's value. Sometimes it is possible to infer this information by observing other bidders. Private value objects have the features like: (i) No bidder knows fully other bidders' value content, each bidder keeps the full value sense strictly as private information, (ii) Knowledge of few bidders' valuation does not affect how much the object is worth to a particular bidder, (iii) It is not applicable in case the asset or the object has an active resale market. (exact value is derived only on its full consumption by any sole bidder as in the case of, say, paintings, stamps and antics).

b. Common Value - Objects acquired primarily for profitable resale in secondary markets. Individual bids not predicated only on personal

valuation but also on valuation of prospective buyers. Each bidder tries to estimate value of an object using the same measurements. Each one tries to estimate object's ultimate worth using same standard. Art bought for resale is an example. Common value objects have some specific features, namely : (i) Actual value is same but not known. (ii) Bidders have different private information about the common value. Available information, called as private signal or a view, could be an expert estimate correlated with the value that is going to emerge finally; further add on relative value estimate could be attached by individual bidders. Exact value, as it were, derived from a process with *interdependent values.* (iii) Common value is a special case of interdependent value, where the value is commonly unknown but assumed to be same for all the bidders, as if every bidder is anchored to a pure common value.

Clear classification into common value and private value components could be quite contentious and Treasury security auction occupies the centre stage for that. Real life classifications are not always based on quantitatively calibrated methods. For example, the auction of a unique work of art not for resale is prototypical private-values model whereas a Treasury auction, with each bidder guessing at the security's value at the end of the day, would idealy follow a common-values model. Historically, oil tract auctions are conducted on common value perceptions. After all the winner's curse pehnomenon, as realised to be mostly arising out of robust common value component; it came of as a quantitatively established fact in the offshore Mexican oil tract auction data. Current research on auction formats proceeds in the form of extending the theory of private value auctions and making empirically suited tailor made evaluations of the real-world auction markets, be it analysing sealedbid auctions of US Forest Service timber auctions (Athey, S *et al*, 2004) or Structural Estimation of Czech and Canadian Treasury Bill Auctions (Kastl, 2008a). In a divisible good setting, such as treasury bill auctions, bidders with private values who obtain information about rivals' bids use this information only to update their prior about the distribution of residual supply. In the model with a common value component, they also update their prior about the value of the good being auctioned. Private value case could be relevant in Treasury auction in case some bidders have to route their bids through dealers (e.g., Canadian

treasury bill market, Indian government securities market) who also submit bids on their own. For example, Hortacsu *et al* (2008) found that in the Canadian Treasury bill issuance, the null hypothesis of private values in the data for 3-months treasury bills could not be rejected; but the test rejects private values for 12-months treasury bills.

6. GOI securities auctions system: The government securities market in India has transformed into a vibrant system in the last one and a half decade. Financial reforms in the captive government securities markets commenced in the beginning of the 1990s, against the backdrop of it being portrayed as a highly controlled, sub-venting framework for administered interest rate mechanism and near static manual system of bilateral market transactions lacking price-time priority, imposing thereby counter-party credit risk in an otherwise illiquid market with bulging short-term debt in the eighties that used to be propelled by an automatic route of *ad hoc* Treasury Bills creation by the country's central bank at the behest of the government. Reforms process encompasses important developments in active policy making, strengthening institutional system, establishing dedicated clearing and settlement systems, trading expansion, diversification of market participants and instruments, consolidating transparent regulatory system, implementation of state of the art technology and enforcing enabling market legislations, rules and procedures. Some notable milestones are: (i) introduction of 'delivery-versus-payment' (DVP) system in the government securities market (1995), (ii) establishing of Primary Dealer system (1996), (iii) statutory agreement with the central government on withdrawing ad hoc Treasury Bills (1997), (iv) launching price-based auctions (1999), (v) introducing electronic Trading System (NDS) and CCIL (2002), (vi) legislation of the FRBM Act (2003), (vii) When-Issued market (2006), (viii) Short – sale permitted up to five days (2007), (ix) GS Act (2007).

Salient features of the GOI securities auction system are:

- As part of overall economic reforms, auction method of primary issuance for Government of India Securities was introduced in June 3, 1992 (RBI Bulletin Nov 1996). The first price-based auction was conducted on May 11, 1999. The RBI initiated reforms in Government

securities market has evolved primary auctions over these years. With implementation of the Fiscal Responsibility and Budget Management (FRBM) Act, 2003, the participation of RBI in the primary auction issuance has been prohibited with effect from April 1, 2006. The primary auctions in Government of India securities during 2006-07 have been subscribed completely by the market at market determined prices.

● As a part of the reform process in the primary issuance of Government Securities, a few securities were initially issued through auctions and gradually the portion of market borrowing raised through auction was increased while RBI's participation in auction with devolvement option as well as private placement with RBI declined. The primary auctions become fully market determined with withdrawal of RBI from auction with effect from April 1, 2006 on implementation of FRBM Act. The process can be observed from the gradual reduction in RBI subscriptions of market borrowings as given below:

Year	**Gross Market Borrowings (Dated securities)**	**Dated Securities raised through Auctions**	**Amount of Devolvement on Reserve Bank**
1	2	3	4
1996-97	27,911	27,911	3,698
1997-98	43,390	37,390	7,028
1998-99	83,753	53,753	8,205
1999-00	86,630	59,630	–
2000-01	1,00,183	82,183	13,151
2001-02	1,14,213	86,000	679
2002-03	1,25,000*	94,000	5,175
2003-04	1,21,500*	1,00,000	0
2004-05	80,350	80,000	847
2005-06	1,31,000	1,21,000	0
2006-07	1,46,000	1,46,000	0

* : Includes borrowings for pre-payment of external debt.

Source : RBI Annual Reports.

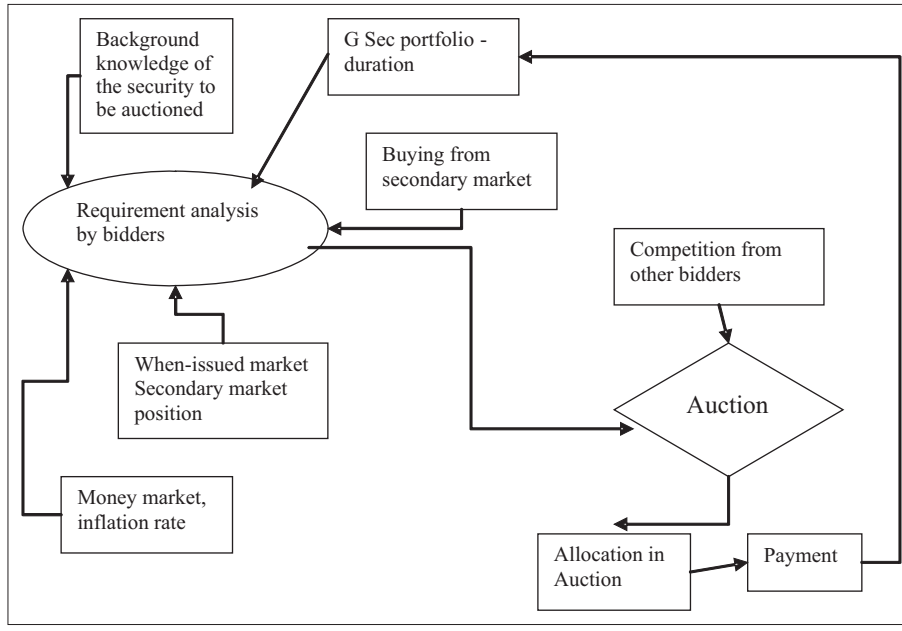
From 2006-07 onward, entire market borrowing of Government of India being raised at market-determined rate and auction analysis truly reflects the cent par cent market behaviour in auctions.

● As regards the types and mode of auction bid submission, buyers of the Government of India dated securities typically submit their sealed bids specifying quantity and price (or yield) at which they wish to purchase the quantity demanded. Initially, bid submission procedure used to be paper-based, which was moved to electronic form since 2002. Once submitted these bids are arranged from highest to the lowest price (or from lowest to highest yield) and the quantity for sale is awarded to the best bids.

● The annual Budget presented to the Parliament every year provides the total quantum of the issuance. Based on the total requirement, RBI, announces the half-yearly calendar of issuance indicating the amount, tenor (maturity bucket) of issuance. The auction calendar helps in cash flow planning of the prospective investors. The auction calendar for first half is announced in the last week of March and second half calendar is announced in last week of September. The specific issue is normally notified to the market one week before the auction date. The securities to be auctioned are traded in 'When-issued' market for the week.

● Then follows the actual conduct of auction by the RBI. Following flowchart highlights the decision-making behaviour of a bidder in the GOI securities auction.

7. Auction theories: Prior to early 1980s, the *independent private value* model was central to auction theory (cf. Steven A. Matthews Discussion Paper #1096 on "*A Technical Primer on Auction Theory: Independent Private Values*" (1995), The Centre for Mathematical Studies in Economics & Management Sciences, North-western University). Then came the most influential paper on 'A Theory of Auctions and Competitive Bidding' (Milgrom et al, 1982). Based on the theoretical analyses of the classic private value model, seven most important results of auction theories were established: (i) First-price auction is strategically equivalent to Dutch auction. (ii) Second price auction is strategically equivalent (weekly) to the English auction. (Here it is assumed that successful bidder has a dominant strategy of knowing the value of the object as opposed to stronger equivalence in case of



first-price auction as it does not require that a bidder know the value of the object). (iii) The English as well as second-price auction is Pareto optimal (at the dominant-strategy equilibrium). The winner is the bidder who values the object most highly (The maximum value he succeeds to get, as it were, known to him as a dominant strategy). (iv) In the independent private value model, all the four auction formats lead to identical expected revenues for the seller. (v) At the symmetric equilibriums of the English, Dutch, first-price and second-price auctions, the expected selling price is the same (popularly known as Revenue Equivalence result). (vi) By viewing bidder's decision problems (conditional upon fixed strategies of the other bidders) as one of choosing a probability distribution of winning and the corresponding expected pay-off and then, formulating the problem of auction design (seller's revenue maximization problem) as a constrained optimal problem, the four standard auction forms (with suitably chosen reserve prices or entry fees) are optimal for most of the common standard bid probability distributions. (vii) In the case where either the seller or the buyers are risk averse, seller will strictly prefer the Dutch (first-price) auction to the English (second-price) auction.

Auction theory, therefore, predicts that in the statistically independent private value model, the four most common auction forms lead to the same expected price.

Auction experts have analysed some of the auction's capabilities and inherent limitations, the roles of various rules, the possibilities for introducing combinatorial bidding, and some considerations in adapting the auction for sales with a revenue goal. Drawing on both traditional and new elements of auction theory, they conclude that theorists have been able to analyse proposed designs, detect biases, predict shortcomings, identify tradeoffs, and recommend solutions. But in designing real auctions there are important practical questions for which theory currently offers no answers. The "bounded rationality" constraints that limit the effectiveness of the generalised Vickrey auction have so far proved particularly resistant to simple analysis. Because of such limits to our knowledge, auction design is a kind of engineering activity. It entails practical judgments, guided by theory and all available evidence, but it also uses ad hoc methods to resolve issues about which theory is silent. As with other engineering activities, the practical difficulties of designing effective real auctions themselves inspire new theoretical analyses, which appear to be leading to new, more efficient, and more robust designs.

For example, the US Treasury's experiments with different kinds of auctions yielded inconclusive results and the broader empirical literature is also inconclusive. However, small differences in auction performance can be significant when such large amounts of money are involved, and collusion could be an issue in government securities (Klemperer, 2004). Buyer market power leading to collusion and entry deterrence is the key to auction problems, which suggests that auction design may not matter very much when there is a large number of potential bidders for whom entry to the auction is easy. It therefore calls forth for periodic empirical evaluations of the auction bid data emanating from various formats used to auction government securities even to tightly regulated entities in the financial markets.

8. U.S. Treasury auctions: The Federal Reserve issues U.S. Treasury bonds, notes, and bills in accordance with their fiscal policy. These

instruments are brought to market through a Dutch auction process where the government dealers and others bid for the particular issue. (cf. *AFTER THE TRADE IS MADE* – Processing Securities Transactions by David M. Weiss (2006), Portfolio, Penguin Group). Until recently only a special group of dealers known as government dealers could bid for these securities. The auction was a regular auction with the highest bids getting filled first. The dealers would sell the issues to their clients and to other broker/dealers for investment or for their clients. Fed has then changed its procedures and now permits qualified entities to bid for the issues directly. They also changed the auction process to a Dutch auction, where all accepted bids filled at the same price. The U.S. Treasury switched from discriminatory to uniform auctions in October 1998 after several years of experimentation

9. Multiunit auctions: Treasury auctions typically take place in a multiple price/quantity bid format in the double sense that the auctioneer puts up many units for sale and bidders also demand many units. Such format is basically different from multiunit auctions of Milgrom-Weber variety whereby bidders demand only one unit. The computation of equilibrium bidding strategies in multiunit Treasury auction is extremely difficult. Based on certain simplifying assumptions on strategic bidding behaviour, it has been established using game theory and associated quadratic optimisation techniques, that the *competitive* auctions, also known as stop-out price auctions, where bidders pay the lowest accepted bid, are technically more acceptable than its dual version of *discriminatory* auctions from the efficiency point of view (i.e., revenue maximisation principle) as it optimises *truthful bidding* and hence efficient transaction is assured. However, the simplicity aspect about strategic behaviour requires to be underscored as it is also undeniable that experienced and well-informed bidders could still achieve better performance based on their skilful bidding strategies, which may not match with the simplistic assumptions. On the other hand, stop-out bidders in the so-called competitive framework need not be so sophisticated because it is *optimal to simply bid one's true valuation*. Pareto-efficiency is always assured in a competitive auction, whereas in a discriminatory auction, it requires that all bidders have realistic expectations in a close neighbourhood of

the possible stop-out price range. Though it is claimed that *competitive* bidding is superior to discriminatory auction both in terms of efficiency and strategic simplicity, it is not prevalent in financial markets, specially in the segment of bond market, whereby more strategic flexibilities practised by technically superior bidders like Primary Dealers and Bankers seem to be eking out better gains out of discriminatory auction formats. In case of new assets market (e.g., IPOs floated by newly formed corporate) with lot of unknowns and skewed information asymmetry, however, discriminatory format ought to be inefficient in the face of the established supremacy of the generalised Vickery auction introduced by Ausubel (2004). His main contention is about winner's curse getting highly pronounced in case of *common value* item of assets if there is more than one unit for sale and bidders demand multi-units quoted at different price tags. This becomes more pronounced so if the number of bidders is sufficiently large to embrace common investors without any specialised perception about value and pricing. Common investors, being a rational agent, would always take recourse to bid shading as a cautious approach, causing thereby inefficient revenue realisation in the case of sealed bid multiunit single bid auctions. Role of specialised dealers driven auction markets like that of the bond market in circumventing the phenomenon of bid shading as well as mitigating the winner's curse, therefore, requires empirical validation about whether the dealers are successful in biding truthfully so that much needed optimality and efficiency targets are maintained.

Statement 1: Auction-wise Bid Price Distribution Statistics

Security	Cut-Off	Average	Median	Mode	Skewness	Kurtosis
7.5% GOVT STOCK2034	94.73	93.57	93.51	94.75	0.015	0.501
7.95% G.S 2032	99.33	98.86	99.00	99.50	-2.248	11.892
7.40% G.S. 2012	101.64	101.63	101.65	101.69	-0.992	1.409
7.59% GOVT.STOCK 2016	100.26	100.23	100.26	100.30	-1.409	4.353
7.5% GOVT. STOCK 2034	92.90	92.82	92.95	93.36	-0.874	0.470
9.39% G. S. 2011	108.33	108.20	108.26	108.30	-7.821	84.855
7.37% G.S. 2014	96.84	96.89	96.94	97.00	-1.984	4.504
7.94% GOVT.STOCK 2021	95.65	96.01	96.07	96.00	-1.160	2.180
7.59% GOVT.STOCK 2016	95.36	94.99	95.06	95.30	-1.412	3.194
7.5% GOVT. STOCK 2034	86.99	85.74	85.61	85.62	0.156	-0.469
7.55% G.S. 2010	99.53	99.49	99.53	99.50	-2.914	13.970
7.59% GOVT.STOCK 2016	95.51	95.37	95.40	95.32	-3.203	14.895
9.39% G. S. 2011	105.76	105.59	105.69	105.65	-10.392	110.778
8.07% GS 2017	99.62	99.47	99.51	99.50	-0.729	7.624
8.33% GOVT.STOCK 2036	95.76	95.52	95.66	95.85	-1.102	0.874
7.5% GOVT. STOCK 2034	89.83	89.44	89.50	89.75	-0.697	0.227
7.59% GOVT.STOCK 2016	98.85	98.70	98.72	98.72	-3.940	34.546
7.59% GOVT.STOCK 2016	99.71	99.76	99.80	99.80	-1.856	5.130
8.33% GOVT.STOCK 2036	102.50	102.06	102.20	102.10	-2.436	9.677
7.40% G.S. 2012	99.54	99.45	99.51	99.51	-2.741	11.818
7.5% GOVT. STOCK 2034	94.23	93.72	93.88	93.91	-1.654	3.163
8.07% GS 2017	104.47	104.42	104.46	104.45	-9.019	111.507
7.37% G.S. 2014	100.32	100.21	100.30	100.30	-13.276	197.318
8.33% GOVT.STOCK 2036	108.15	107.75	107.90	107.60	-1.391	1.831
8.33% GOVT.STOCK 2036	101.00	102.80	103.07	103.12	-0.465	-0.617
7.94% GOVT.STOCK 2021	97.81	97.37	97.67	97.40	-2.156	6.328
7.37% G.S. 2014	97.25	97.07	97.23	97.41	-2.719	8.464
8.33% GOVT.STOCK 2036	101.53	100.73	101.40	101.75	-14.531	214.285
8.07% GS 2017	100.05	99.73	99.85	100.00	-3.489	17.324
8.33% GOVT.STOCK 2036	99.22	98.42	98.70	98.15	-2.093	5.494
6.65% G.S. 2009	97.70	97.65	97.67	97.73	-0.191	-0.636
6.65% G.S. 2009	97.55	97.54	97.55	97.55	-1.868	11.300
6.65% G.S. 2009	97.49	97.41	97.42	97.42	-1.058	2.666
6.65% G.S. 2009	97.26	97.29	97.30	97.31	-0.609	0.255

Note : The above data relates to priced-based auction and large figures are due to few unusual bids in some issues only.

Statement 2: Auction-wise Average Bid-price Difference of Investor-Groups

Security Name	Co-op. Banks	Foreign Banks	Insu-rance Cos	Mutual Funds	Nation-alised Banks	New Pvt. Sec Banks	Primary Dealers	Pvt. Sect Banks	SBI Group	Issue Total
% GS 2016	0.01	0.16	-0.03	0.04	0.03	0.01	0.03	0.04		0.03
7.50% GS 2034	-0.31	-1.79	1.84	-0.08		-0.84	-1.37			-1.16
7.95% G.S 2032	-0.30	-0.57	-0.21	0.31	-0.46	0.30	-0.68	0.22	0.30	-0.47
7.40% G.S. 2012	-0.49	-0.14	-	0.12	0.03	-0.01	-0.01	-0.34	-0.03	-0.01
7.59% GS 2016	-0.20	-0.09	-0.02	-0.03	-0.08	-0.08	-0.01	0.02	0.03	-0.03
7.50% GS 2034	-1.09	-1.04	-0.19	-1.59	0.19	0.13	-1.34	0.07	-0.02	-0.92
% GS 2021	0.13		-0.07	0.11	0.03	-0.05	0.02	0.08	0.01	0.02
% GS 2036			-0.02	0.17	-0.23	0.04	0.10	0.27		0.09
9.39% G S 2011	-0.43	-0.09	0.12	-0.05	-0.03	-0.06	-0.16		-0.08	-0.13
7.37% G.S. 2014	-0.49	-0.19	0.13	0.12	0.18	0.01	0.03	0.14	0.12	0.05
7.94% GS 2021			0.61	0.09	1.04		0.28		0.40	0.32
7.59% GS 2016	-0.28	-0.02	-0.12	-0.37	-0.21	-0.43	-0.46	-0.28		-0.37
7.50% GS 2034		-0.38	-1.61			-0.46	-1.29			-1.25
7.55% G.S. 2010	-0.21	-0.05	0.09	0.05	-0.03	0.02	-0.06	-0.03		-0.04
7.59% GS 2016	-0.19	-0.07	-0.05	-0.37	-0.13	-0.11	-0.15	-0.09	-0.18	-0.14
9.39% G.S. 2011	-0.00	-0.00	-0.04	-0.06	-0.12	-0.07	-0.11	-0.16		-0.10
8.07% GS 2017	-0.42	-0.20	-0.16	-0.11	-0.12	-0.13	-0.16	-0.20	-0.17	-0.16
8.33% GS 2036	0.11	0.01	-0.00		-0.15	-0.03	-0.32		-45.38	-2.20
7.50% GS 2034	-0.29	-0.35	-0.01	-0.49	0.05	-0.60	-0.44		-0.40	-0.39
7.59% GS 2016	-0.14	-0.13	0.06	-0.15	-0.10	-0.12	-0.17	-0.12	-0.15	-0.15
7.59% GS 2016	0.03		-0.03		0.11	0.15	0.00	0.06	0.14	0.04
8.33% GS 2036	-0.46		0.46		-0.20	-1.06	-0.48		-0.09	-0.44
7.40% G.S. 2012	-0.14	0.08	0.06	-0.09	-0.04	-0.06	-0.13	0.02	-0.02	-0.09
7.50% GS 2034			-0.01	-0.73	-0.27	-21.41	-0.60	-0.45	-0.32	-1.08
8.07% GS 2017	-0.09		-7.93	-0.34	0.00	-0.00	-0.09	-0.05	0.01	-0.40
7.37% G.S. 2014	-0.09		-0.41	-0.04	-0.01	-0.27	-0.13	-0.13	-0.01	-0.12
8.33% GS 2036	-0.05		-10.69	-0.27	-0.23	-0.33	-0.46			-0.98
8.33% GS 2036	2.94		3.15		2.93	2.51	1.54	3.53		1.80
7.94% GS 2021	-2.22		0.25	0.08	0.06	-0.61	-0.55	-0.80	-0.32	-0.44
7.37% G.S. 2014	-0.25		-0.02	0.01	-0.01	-0.25	-0.23	-0.41	-0.11	-0.18
8.33% GS 2036	-1.05		-0.05	0.14	0.02	-0.03	-0.41	-1.15	-0.96	-0.35
8.07% GS 2017	-0.48	-	-0.26	-0.27	-0.27	-0.12	-0.35	-0.50	-0.27	-0.32
8.33% GS 2036			-0.18	-0.49	-0.06	-0.67	-1.10	-0.03	0.54	-0.80
6.65% G.S. 2009		-0.06		-0.25	-0.04	-0.15	-0.04	0.02	0.04	-0.05
6.65% G.S. 2009		0.00		0.01	-0.03	-0.03	-0.01	0.01	0.01	-0.01
6.65% G.S. 2009		-0.07		-0.05	-0.03	-0.06	-0.11	-0.09	-0.06	-0.08
6.65% G.S. 2009	0.03	0.08		0.12	0.08	0.04	0.02	0.01	-0.00	0.03
Grand Total	**-0.17**	**-0.14**	**-1.26**	**-0.10**	**-0.04**	**-0.23**	**-0.25**	**-0.07**	**-0.90**	**-0.26**

Statement 3: Auction-wise Success Ratio of Various Investor Groups

(per cent)

Security Name	Co-op. Banks	Foreign Banks	Insu-rance Cos	Mutual Funds	Nation-alised Banks	New Pvt. Sec Banks	Primary Dealers	Pvt. Sect Banks	SBI Group	Issue Total
% GS 2016	0.00	4.76	100.00	25.79	52.63	55.81	36.00	37.50		44.06
7.5% GS 2034	0.00	0.00	100.00	50.00		7.46	3.28			41.56
7.95% G.S 2032	33.33	11.29	68.13	100.00	11.11	52.94	14.96	100.00	84.31	42.36
7.40% G.S. 2012	0.00	66.67	46.28	100.00	81.35	66.72	45.93	0.00	59.82	51.65
7.59% GS 2016	0.00	77.67	50.00	55.56	39.73	40.85	52.79	46.41	100.00	52.82
7.5% GS 2034	0.00	0.00	99.21	0.00	56.10	57.77	14.70	60.00	52.48	46.25
% GS 2021	0.00		49.63	0.00	47.57	100.00	39.14	33.33	40.00	43.73
% GS 2036			71.43	0.00	100.00	22.22	28.07	0.00		45.55
9.39% G. S. 2011	0.00	94.12	100.00	43.48	64.63	98.58	19.31		0.00	40.66
7.37% G.S. 2014	0.00	0.00	100.00	100.00	98.68	75.00	55.15	90.00	100.00	61.18
7.94% GS 2021		100.00	66.67	100.00		40.68		100.00	60.06	
7.59% GS 2016	66.67	90.91	9.84	0.00	22.97	0.00	21.23	0.00		21.00
7.5% GS 2034	14.29	0.00			0.00	4.84			2.55	
7.55% G.S. 2010	0.00	50.00	100.00	77.52	72.08	46.28	35.93	12.57		44.07
7.59% GS 2016	0.00	19.77	76.58	0.00	3.40	0.00	11.70	31.25	0.00	30.65
9.39% G. S. 2011	50.00	81.82	0.00	25.13	0.00	18.79	44.52	0.00		39.03
8.07% GS 2017	0.00	4.00	0.00	45.45	25.06	47.08	39.34	0.00	0.00	31.66
8.33% GS 2036	82.64	58.33	49.42		16.92	67.89	25.32		2.43	37.72
7.5% GS 2034	5.56	18.18	56.25	0.00	62.24	60.63	15.43		0.00	36.64
7.59% GS 2016	8.59	18.35	100.00	0.00	59.99	53.19	17.20	0.00	0.00	35.78
7.59% GS 2016	63.64		96.92		81.98	97.34	38.57	82.35	100.00	56.55
8.33% GS 2036	0.00		100.00		12.30	0.00	0.22		0.00	43.21
7.40% G.S. 2012	14.29	100.00	50.00	8.19	34.67	58.58	30.36	66.67	58.30	39.17
7.5% GS 2034		97.09	0.00	10.99	0.00	0.56	0.00	0.00	40.89	
8.07% GS 2017	28.00		38.12	66.67	57.28	91.84	21.35	31.03	47.59	36.32
7.37% G.S. 2014	36.31		0.00	46.68	78.38	39.06	36.05	9.34	53.96	46.49
8.33% GS 2036	35.00		71.42	9.52	33.33	13.56	15.03			38.24
8.33% GS 2036	100.00		100.00		100.00	100.00	59.87	100.00		69.77
7.94% GS 2021	0.00		68.33	42.19	58.15	36.46	34.69	0.00	21.94	41.47
7.37% G.S. 2014	0.00		0.00	45.83	56.99	0.00	64.42	0.00	26.67	59.54
8.33% GS 2036	0.00		49.50	66.67	29.00	60.98	24.32	0.00	0.00	34.24
8.07% GS 2017	0.00	28.57	0.00	16.67	2.38	0.00	40.96	0.00	48.11	33.95
8.33% GS 2036		57.38	45.45	43.83	0.00	9.01	55.56	79.14	36.54	
6.65% G.S. 2009	0.00		0.00	65.19	2.50	43.75	50.00	64.55	44.98	
6.65% G.S. 2009	33.33		89.84	28.47	64.08	46.86	59.12	12.94	40.22	
6.65% G.S. 2009	10.00		0.00	29.62	34.08	24.32	0.00	4.71	22.79	
6.65% G.S. 2009	100.00	88.89		100.00	94.37	78.86	49.95	69.30	15.87	54.48
Total - Category	**22.73**	**53.44**	**64.56**	**34.77**	**50.11**	**53.43**	**32.85**	**34.88**	**47.20**	**41.90**