Repo auction formats, bidders' behaviour and money market response in India

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The treasury securities repo-auction is an important instrument for central banks in managing liquidity and sending interest rate signal to the money market. In the Indian context, the repo-auctions have been used actively in the post-reform period. The present study illustrates the money market reaction to repo-auctions and points out whether such reaction is consistent with applied auction rules. The policy implications are analysed in the light of alternative rules pertaining to discriminatory price auctions and fixed rate repos.

Introduction

The treasury securities repurchase agreement (repos) has evolved over a period as an important instrument for conducting the monetary policy by central banks. Repo auctions are undertaken with three broad objectives in view. First, repos facilitate liquidity management in the short run. Secondly, monetary authorities can transmit policy signals through repos to the money market, which has crucial influence on other segments of the financial market such as gilt-edged and foreign exchange market. Thirdly, repo operations provide liquidity and depth to the underlying treasury securities market. The reaction of money market to repo auctions, however, depends upon the market structure, liquidity conditions and auction rules encompassing the auctioner's objectives and bidders' behaviour. This paper is an attempt to study the money market reaction to repo auctions in the Indian context. The organisation of the paper is as follows.

Section I briefly discusses the theory of auctions particularly auction formats, objectives of the auctioneer and bidders behaviour constituting what is called auction rule, followed by an outline of the trends and developments in repo auctions in India during the process of financial liberalisation in the 1990s. Section II provides the analytics of auction rules and develops a framework for empirical analysis. The empirical findings are discussed in Section III, while Section IV concludes.

Section I
Treasury Auction Formats and Bidders' Behaviour

Treasury auctions play an important role in the price discovery process, especially in situations involving some degree of information and cost asymmetries in the money market. Auction designs have varying implications for the bidding behaviour of market agents. The choice of a particular auction technique by the monetary authorities is guided by the objectives of minimising the borrowing cost to the treasury, the financial market impacts of such operations and the stage of development of money market. On occasions, treasury auctions may be conducted purely with the debt management objective in view and at times, primarily as an instrument of central bank intervention in the money market.

The theoretical debate on auction practices has revolved around the choice between

alternative auction rules *viz.*, the uniform and the multiple price auctions[1]. Under first-price sealed-bid/discriminatory auction, awards are made at the highest bid prices until the supply is exhausted. A high bid lowers profit but raises the possibility of winning the auction and *vice-versa*. Thus, the bidder faces a trade-off between lowering bid relative to common valuation in order to maximise profit and the risk of lowering the probability of winning. Since all bidders have valuation about price, a high bid exposes the bidders to *winner's curse*. Price discrimination strengthens *winner's curse*, by charging the full extent of the bidder's overvaluation of true market price (Bartolini and Cottarelli, 1994). Thus, allowing for the bidders' risk aversion, it leads to downward bid shading. In other words, the bidders would have a tendency to understate the bid in comparison to their assessment of its market price (Milgrom, 1989, Feldman and Mehra, 1993, Bartolini and Cottarelli, 1994). In the second-price/uniform auction system also referred to as Dutch auction in the financial community, the bidder does not pay his bid but the second-best bid. An aggressive bidder having high probability of winning has to bid a price closer to the market rate, thus reducing the possibility of bid shading resulting from *winner's curse*. Since the successful bidders pay a uniform market clearing stop-out rate, bidders would have tendency to offer higher bids than the first-price auction bid.

Repo Auctions in India

The monetary policy of April 1992 heralded a new approach to internal debt management by switching over to auction mechanism for sale of government securities. The objectives were primarily to develop a voluntary securities market and reduce reliance on quantity variables of monetary control and activate the rate variables through government securities market. An important feature of a well-developed securities market is that the central bank should be able to buy and sell securities as part of its open market operations, depending on its assessment of liquidity in the system. The Reserve Bank has been varying its price in tandem with this objective in view.

Sale of government securities from the Reserve Bank's portfolio through repo auctions captures the liquidity impact in the short run. The Reserve Bank conducts repos auctions in Government of India securities from time to time to even out short- term liquidity fluctuations in the money market, to provide the banking system with an outlet for efficient short-term liquidity management and to optimise return on short-term surplus liquid funds. The repos auctions in government securities were introduced in December 1992. Initially the repos auctions were for a very short period of one or two days and, thereafter increased up to fourteen days. The cut-off rate generally tended to move in tandem with other short-term rates including the 91-day Treasury bill rate. The repo auctions came into prominence in 1993-94 against the backdrop of a sharp increase in the primary liquidity triggered by large capital inflows. The average value of bids accepted in this year rose to Rs. 2,729 crores. Stringent liquidity conditions stemming from decline in capi-tal inflows and sharp expansion in non-food credit during the second half of 1994-95 led to suspension of repo auctions in February 1995. As a policy response, the reverse repos facility in government dated securities was extended to Securities Trading Corporation of India (STCI) and Discount and Finance House of India (DFHI) with a view to injecting liquidity into the system. Consequently, the upward pressure on call money rates was arrested. The repos transactions were resumed in November 1996 and in the wake of continued strong pressure on liquidity at the short end of the market; repos of 3-4 days duration have been conducted on a

regular basis since January 1997. For facilitating better treasury management by participants, a system of announcing a calendar of repos auctions on a monthly basis was introduced in January 1997.

During 1992-93 (December to March) the total face value of bids accepted amounted to Rs. 68,636 crores i.e., 68 per cent of bids received at Rs. 100,994 crores. The cut-off rate ranged between 5 per cent to 19.5 per cent for duration of 1 to 2 days. The repo turnover i.e., bids accepted, increased to Rs. 98,239 crores during 1993-94 with cut-off repo rate ranging between 5.75 to 11.5 per cent for a period of 1 to 17 days. The success ratio in auctions i.e., proportion of bids accepted to bids received, remained steady at 66 per cent. During 1994-95 due to tight liquidity conditions in money market the repo transactions remained subdued with total turnover aggregating Rs. 6,428 crores. The success ratio declined substantially to 47 per cent. The repo rate varied between 5.75 to 7 per cent for a repo period mostly for 14 days. With the surge in liquidity during the second half of 1996-97, repo auctions were resumed in November 1996. Between November 1996 and March 1997, bids accepted in repo auctions ranged between Rs. 300 crore and Rs. 4194 crore, with cut-off repo rate emerging in a narrow range of 4 to 5.48 per cent for generally 3 to 4 days duration. During 1997-98, the repo auctions were actively used to manage short-term liquidity in the system. The average volume of repos outstanding stayed high on an average at Rs. 3,194 crore aggregating to about Rs. 165,000 crores. The repo rate varied between 2.9 per cent and 5 per cent between April and November 1997.

Since November 1997, the fixed rate repos system has been introduced. The turnover ranged between Rs. 3,465 crores and Rs. 10,000 crores on daily basis for a repo duration of mostly 3 days. The repo rate, initially fixed at 4.5 per cent, was gradually raised to 7 per cent by December 1997 and further to 9 per cent in January 1998 in order to bring stability in both the domestic money market and forex markets. However, as the forex market stabilised, the repo rate was brought down to 8 per cent by mid-March 1998, 6 per cent by the end of April 1998 and 5 per cent by mid-June 1998.

As an indicator of volatility, the standard deviation of call rate before auctions (on 14 days basis) was estimated at 9.22 per cent which declined to 6.64 per cent after auctions against the standard deviation of 2.51 per cent in repo rates during the discriminatory auction system[2]. In case of fixed rate repos period, the standard deviation of call rate declined sharply as compared to discriminatory auctions. The standard deviation of call rate estimated at 5.04 per cent before the repo operations declined to 3.29 per cent after repo operations. The standard deviation of repos declined to 1.40 per cent, nearly the half of its volatility in the discriminatory auction system. Thus, the switchover from discriminatory auctions to fixed rate repos has resulted in low volatility in domestic money market.

Section II
The Analytics of Repo Operations

Initially, a system of discriminatory-price auctions was introduced for repos operations in government securities. Under this system bidders submit multiple price-quantity sealed-bids. The Reserve Bank enters into repos auctions in Government of India dated securities with the

banks/financial institutions holding Subsidiary General Ledger (SGL) and current account with the Reserve Bank. The auction results are announced on the same day and the payment by the successful bidders awarded bids at or below the cut-off repo rate is made on the next day. Since November 1997, the Bank moved over to a fixed rate repos system, under which the rates are pre-announced and banks/financial institutions are required to submit bids indicating the volume of repos. The results of fixed rate repos are announced on the date of submitting the bids.

The developments since January 1998 show that the Bank Rate and repo rate are emerging as key indicators of movements of interest rates in the money and credit markets. Recently, the repos have been used as a fine tuning instrument of the money market and for transmitting signals of monetary policy. The effectiveness of repos, however, depends on the assumption that there is no unrealistic bidding behaviour by the investors which may provide unreliable information to the money market and its expected future movement. Thus, the objective has been to use an appropriate method of conducting repos operations, which persuades banks/ financial institutions to bid in conformity with actual demand. In view of this, initially a discriminatory pricing auction practice was introduced. Under such a system, the tendency on the part of the bidders to earn a positive pay-off induces them to understate the bids below their valuation, giving rise to the dilemma of going empty handed. Under discriminatory price auction, inexperienced bidders profit less than expected since they are more likely to place higher bids on account of adverse selection. This forces bidders to be conservative in their bids and discourages large market participation.

The recent move from discriminatory auction to fixed rate repo operations has the advantage of eliminating *winners' curse* and entailing equal cost to all bidders, as is the case with uniform price auction also. Under uniform price auction the bidders are awarded the bids at uniform market clearing stop out rate. The uniform price auction, however, induces the bidders to bid aggressively thus exaggerating their true valuation of the price. Fixed rate repos in government securities were introduced with the objective of attaining greater maneuverability in short-term liquidity management through absorption of surplus liquidity at such volumes as necessary to bring orderly conditions in money and foreign exchange markets. The fixed rate repos provide flexibility to monetary authorities in sending correct policy signals to the market in situations where the markets become highly volatile and behave in an erratic manner.

The Framework for Empirical Analysis

What has been the money market response to repo auctions? This issue can be examined separately for the discriminatory auction system and fixed rate system. In what follows we provide an empirical examination of this aspect in India. The first part analyses money market response to discriminatory auction system undertaken in the post-reform period i.e., December 1992 to November 1997. The second part analyses the fixed rate repos covering the period November 1997 to July 1998. The empirical literature on auctions mainly address issues relating to the bidding behaviour of various market players and the effectiveness of alternative auction formats. The empirical efforts in studying the auction formats against the backdrop of monetary and debt management policies are rather scarce in the sense that the reaction of money and debt markets to the outcome of repos auctions have been scantly explored.

In the beginning, the repo auctions were not undertaken on a regular basis i.e., daily basis As such a continuous time series data on repo auctions is not available. On the other hand, money market rates are available on a daily basis. In order to analyse the money market reaction to repo auctions, Nautz (1995 and 1997) has suggested that the data on money market need to be defined over the time domain pertaining to the repo auctions. In what follows, we draw from Nautz (1997) and present an empirical framework for analysing money market response to repo auctions.

Let repo auctions are undertaken in the time period t when bids are asked by the central bank. The results of the repo auctions are usually published on the next day i.e., t+1. The results of repo auctions shall be reflected in the money market on the day t+1. The money market absorbs the information content resulting from the spread (∂r) between the repo rate rate ($r_{r)}$ and money market rate ($r_{c)}$ prevailing on the auction day. The changes in money market (∂r_c) between the rate prevailing on the day before and the day after the auction day will react to the information content of spread ∂r i.e., (r_r-r_c). If money market is efficient and well integrated, the response of ∂r_c to spread ∂r shall be close to unity. In this context, information content of repo auctions fully caputres the market participant's expectations about the state of the economy, particularly the liquidity condition.

$$\partial\, {}^{r}c = a + b\,({}^{r}r - {}^{r}c) \qquad (1)$$

Further, it has been argued that the reaction of money market to repo auctions could not be symmetrical at high and low rates. The theoretical line of argument on asymmetrical response owing to the original work of Wilson (1977) has guided several empirical works including Hendricks and Porter (1988). It is the degree of this asymmetry in the adjustment of money market to high and low Repo rates which reflects the maturity of markets. The reaction of money market could then be formalised as

$$\partial\, {}^{r}c = a + {}^{b}{}_{H}({}^{r}r - {}^{r}c)_H + b_L\,({}^{r}r - {}^{r}c)_L \qquad (2)$$

If $b_H = b_{L,}$ then money market reaction is symmetrical, other- wise, it is asymmetrical. The high and low repo rates are defined on the basis of median rate giving rise to the following formulation.

$$(r_r - r_c)_H = (r_r - r_c) \geq \text{median}\ (r_r - r_c)$$
$$= 0, \text{otherwise}$$

and

$$(r_r - r_c)_L = (r_r - r_c) < \text{median}\ (r_r - r_c)$$
$$= 0, \text{otherwise}$$

In essence, the asymmetrical response model such as equation 2 implies that the reaction of money market depends on its preceding deviation from the long run equilibrium path that can be distinguished between high and low repo rates. In terms of continuous time series characterisation, the equation 1 is an error correction model and equation 2 a non-symmetrical

error correction model of Granger and Lee (1989) type. However, for the error correction model to be valid, r_r and r_c should be integrated of order one i.e.,I(1) series and (r_r - r_c) stationary i.e., I(0) series.

Another important information available from repo auctions relates to the concentration of bidders influencing the behaviour of the money market. Usually, the share of successful bidders i.e., the proportion of bids accepted to bids received in value terms, denoted as BS, is considered in such cases. The share of a successful bidder has several implications. First, a high value of such an indicator reflects the convergence of expectations of the auctioneer as well as the bidders. Second, as the bidders have a natural tendency to exaggerate (understate) the bids, the proportion of successful bids indicates to what extent the central bank would agree with market expectation. Thus, the coefficient of successful bids would have negative sign indicating some correction that central bank desires over the expectation about the money market movement.

Section III
Money Market Reaction to Discriminatory - Price Auction

The most sensitive money market rate in India is the daily call rate (i.e. inter-bank borrowing/lending rate). The repo auctions in Government of India securities are conducted by the Reserve Bank through sealed-bid discriminatory-price auctions. In repos auctions, while the Bundesbank and Federal Reserve Bank buy securities from credit institutions on the condition that the seller simultaneously repurchases the securities forward, the Reserve Bank sells securities with the undertaking to repurchase at a specified date in the future. However, reverse-repos operations are carried out with Primary Dealers (PDs) to facilitate liquidity in the system.

The observed auction rules and money market behaviour suggest that in case of discriminatory-price auction money market rates react particularly strongly to a relatively high repo rate. This inference is drawn from the observed behaviour of markets in developed money markets where the term repos implies purchase of securities by the central bank i.e., operations involving supply of liquidity to the system. Since the repo operations in our case mainly involve selling operations, under a discriminatory price auction regime, the bidders will exhibit a tendency to bid for a higher repo rate than the true valuations about the market price with inherent motive to minimise relative loss from winning the auction.

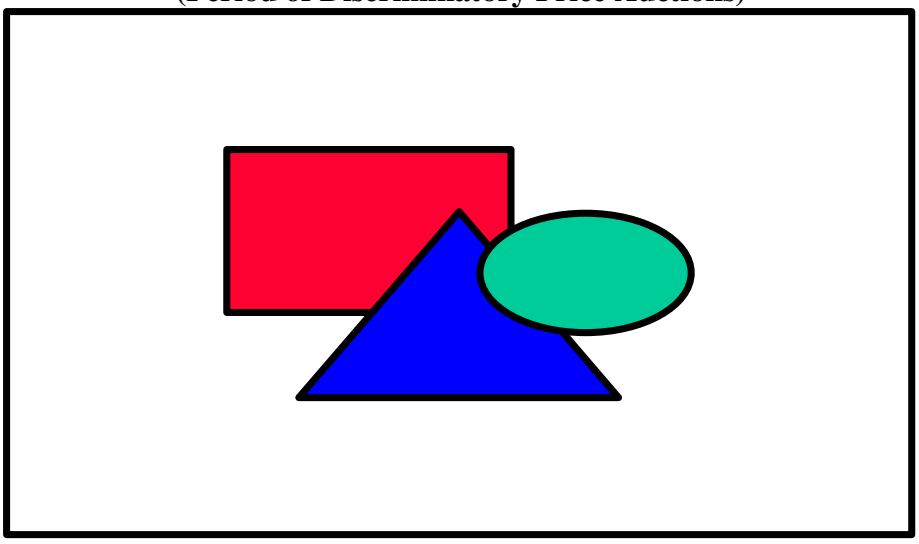
The movements of repo rate and call money rate are depicted in Graph 1 and the proportion of successful bids in Graph 2. The plots of these two variables indicate the tendency of their strong co-movement. The movement of repo rate, call rate and foreign exchange market as represented by three months forward premia is depicted in Graph 3. The graph indicates a high degree of co-movement in the rates and repo rate providing a floor to the call money rate and forward premia. Table 1 reports the results of unit root test. The unit root tests were conducted in terms of ADF(1) regression model and the test statistics reported were arrived after correcting for heteroscedasticity variance. The call money rate and repo rate have unit roots and their difference (∂r) is stationary, thus indicating the existence of long run relationship between the two variables.

Table 1 : Unit Root Test

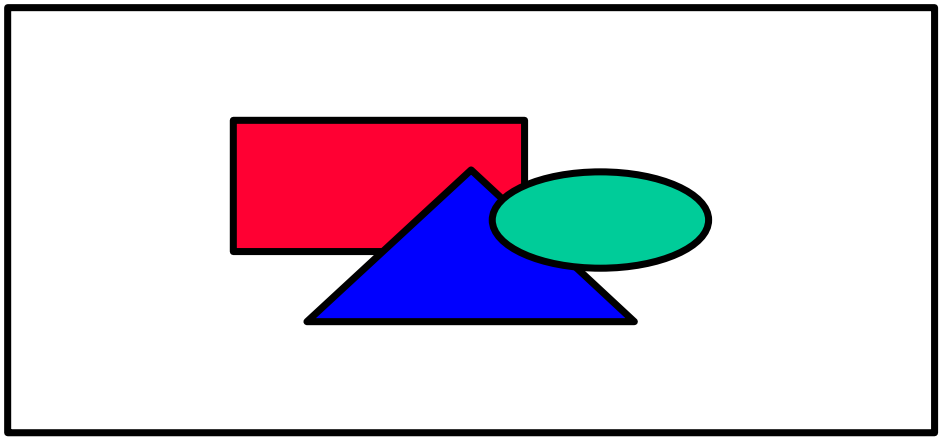
Variable	ADF (1)
Call Rate (r_c)	-2.37(-2.86)
Repo Rate(r_r)	-0.83(-2.86)
∂r_c	-3.96(-2.88)
$\partial r = (r_r - r_c)$	-3.55(-2.88)

Figures in the bracket indicate 95% critical value

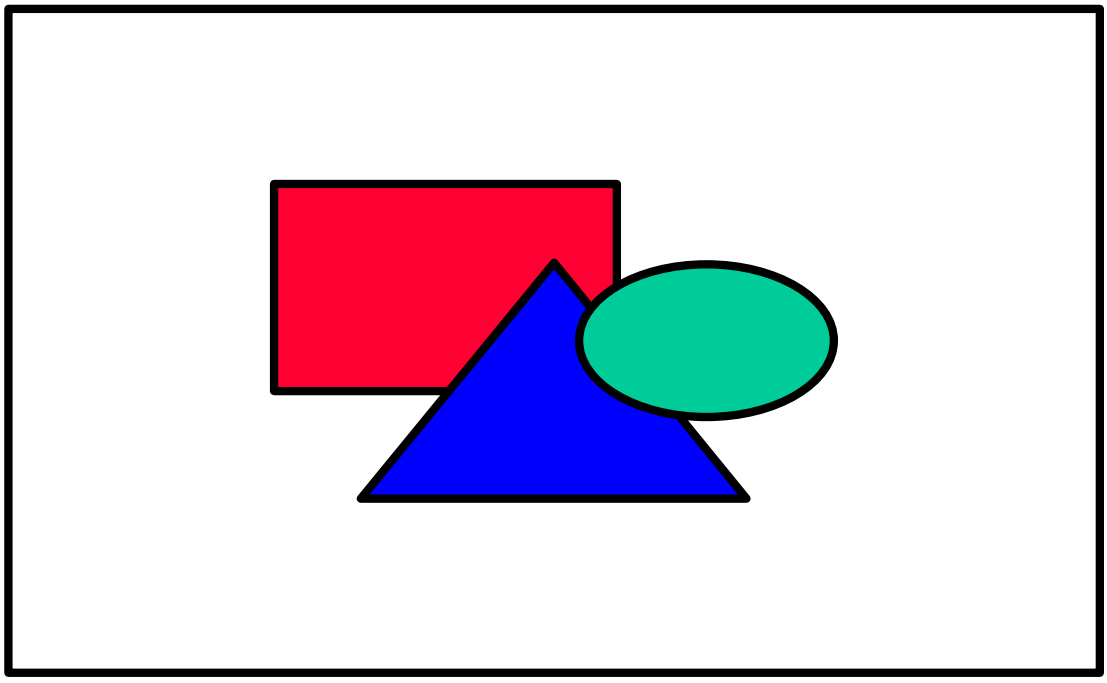
Graph 1 : Movement in Repo Rate and Call Money Rate
(Period of Discriminatory Price Auctions)



Graph 2 : Proportion of Successful Bids
(Period of Discriminatory Price Auctions)



Graph 3 : Movement of Call Money Rate, Repo Rate and Forward Premia (3 months) in Forex Market



The empirical estimates of symmetric and asymmetric models corresponding to equations

1 and 2, respectively, are presented in Table 2. In general, the coefficients have correct signs and they are significant at 5 per cent level[3]. The coefficient of BS (proportion of successful bids) variable is more or less same in magnitude in both the models and has negative sign as expected, indicating some degree of correction over market expectation. In the symmetric model, the estimated coefficient of (∂r) term is high at 0.79. Although it seems close to unity, the Wald test of unity restriction on this coefficient, yielding X^2 statistic at 8.83 rejects such hypothesis at 5 per cent level of significance. In case of asymmetric model, the coefficient of high repo rate $(\partial r)_H$ i.e., 0.66 is about 50 per cent lower than the low rate $(\partial r)_L$ at 0.97. Interestingly, the joint hypothesis in terms of linear restriction that both the coefficients are not different from one another i.e., H0: $a_H = a_L = a$ could not be rejected as the estimated X^2 statistics at 2.24 turned insignificant at 5 per cent level. On the contrary, a non-linear restriction i.e., the percentage difference between the two could be zero $[((a_H / a_L)-1) = 0]$ could be rejected at 7 per cent level of significance. Similarly, the unit restriction on the coefficients was also rejected. The results enumerated above provide the basis for the following observations on the money market.

The response of the money market to repos auction is high although it is not complete in a strict statistical sense. The estimates from non-symmetric error correction model do not show a significant difference between the adjustment parameters, suggesting weak asymmetry in money market response to high and low repo rates. Notwithstanding this, it is observed that the call rates adjust freely to low repo rate i.e. $(\partial r)_L$, thus confirming the theoretical hypothesis on discriminatory auction formats. The presence of very weak asymmetry in the reaction of money market to repo rates explains the inability of money market to react differentially to rate variations. There may be several explanations underlying such a phenomenon. Money market in India has grown only in the post-reform period. The market still lacks adequate depth and market players do not usually react differently to relatively high and low repo rates unlike the case with developed money markets.

Table 2: Money Market Reaction to Discriminatory Repos Auctions

Dependent Variable: ∂r_c		
Regressors	OLS Symmetric	OLS Asymmetric
Constant	1.422 (2.81)	1.826 (3.20)
BS	-0.021 (-3.11)	-0.022 (-3.29)
$(\partial r) = a$	0.79 (11.4)	
$(\partial r)_H = a_H$		0.659 (5.82)
$(\partial r)_L = a_L$		0.969 (7.10)
R^2/DW	0.54, 1.50	0.57, 2.08
U(-1)		
Ho:a = 1	8.83	

Ho : $a_H = a_L = a$	2.24**
Ho : $a_H = a_L = 1$	11.18
Ho : $((a_H/a_L)-1) = 0$	3.30*

Note : * Significant at 10 per cent level of significance.
** Not significant.
The remaining coefficients are significant at 5 per cent level of significance.

Money Market Reaction to Fixed Rate Repos

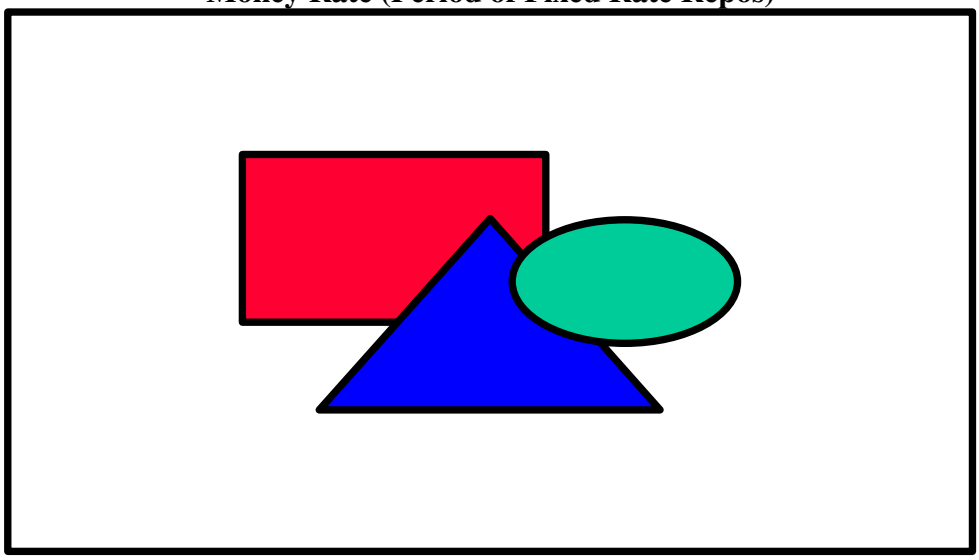
Repos operations initially developed as instruments to absorb excess liquidity have emerged as a major instrument of monetary control. It is also used as a signaling mechanism for short-term interest rates. In a major policy switch, the Reserve Bank moved over to fixed rate repos on November 29, 1997. Since then repos of varying maturities have been conducted along with periodical revision in repo rates to absorb liquidity from the system. Fixed rate repos could have certain implications for the market behaviour. Unlike the auction mechanism, it may imply some loss of information regarding the perception of the bidders on price and liquidity conditions. Since under the fixed rate repos the rates are pre-announced, the bidders submit tenders on quantity only. At the empirical level, an attempt has been made to measure the reaction of money market to fixed rate repos and the effectiveness of repos in transmitting interest rate signal to the short end of the money market i.e., the inter-bank call market.

The data on the fixed rate repo auctions are available almost on a daily basis. Unlike the discriminatory auctions, the analysis of fixed rate repo auctions can be carried out on a continuos time basis as the repo auctions are conducted on day-to-day basis. The sample data covers the period from November to July 1998, representing 156 sample points. On the first trial, the sample did not reveal much information on the money market adjustment to repo rates[4]. There are instances of the call rate substantially deviating from the repo rate during this period (Graph 4). The reason was that the proportion of bids accepted was much lower for a period of about 2 months (Graph 5). However, from March 1998 to July 1998, the call rate has closely followed the repo rate. Thus, for dealing with this problem the sample period has been broken at March 1998, yielding a sample of 87 observations up to July 1998 for the empirical exercise[5].

The empirical estimates of symmetric and asymmetric models on the money market response to fixed rate repo auctions are shown in Table 3. In the case of symmetric model, the coefficient (∂r) term turned out to be positive (0.59) and statistically significant at 5 per cent level. However, the unity restriction on the coefficient can be rejected as the estimated X^2 statistic at 3.55 is highly significant at 5 per cent level. The coefficient of successful bidders turned out to be marginally negative (0.01) but significant at 5 per cent level.

The results in case of asymmetric models are quite interesting. The estimated coefficient of high repo rate $(\partial r)_H$ at 1.70 is about 5 times larger than the coefficient of low repo rate $(\partial r)_L$ at 0.37. The joint hypothesis that $a_H = a_L$ can be rejected as the estimated X^2 statistic at 6.05 is highly significant. Similarly, the difference between these coefficients in percentage term is not zero[6].

Graph 4: Daily Movement of Repo Rate and Call Money Rate (Period of Fixed Rate Repos)



Graph 5: Proportion of Bids Accepted to Bids Received (Period of Fixed Rate Repos)

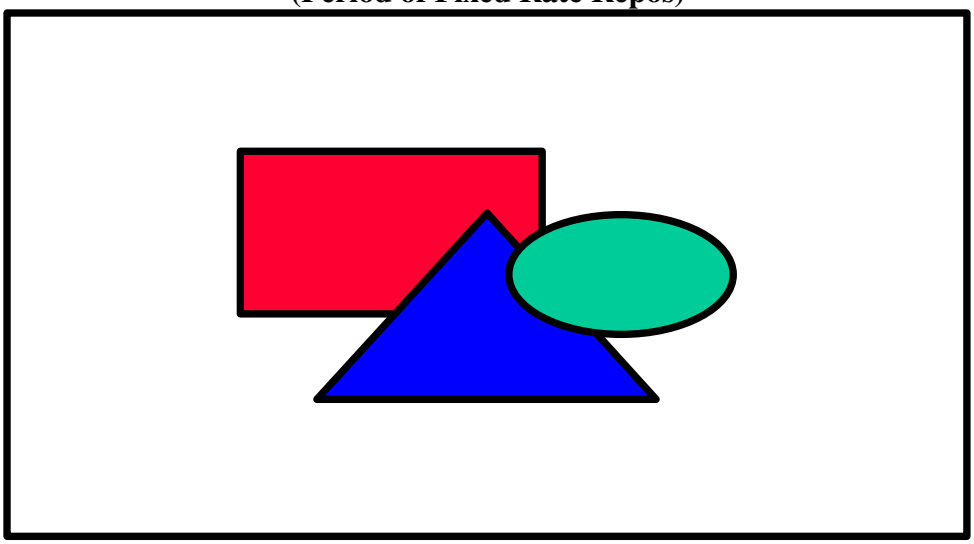


Table 3 : Money Market and Fixed Rate Repos

Dependent Variable: ∂r_c		
Regressors	OLS Symmetric	OLS Asymmetric
Constant	0.6235 (3.88)	0.2602 (1.42)**
BS	-0.0135 (-3.54)	-0.0122 (-3.37)

$(\partial r) = a$	0.5924 (6.04)	
$(\partial r)_H = a_H$		1.7006 (5.12)
$(\partial r)_L = a_L$		0.3723 (3.30)
R^2/DW	0.36, 2.08	0.43, 2.18
U(-1)		
Ho:a = 1	17.26	
H0 : $a_H = a_L = a$		6.05
H0 : $a_H = a_L = {}_1$		15.82
H0 : $((a_H/a_L)^{-}1) = 0$		12.09

The results of the sub-sample provide useful insights for understanding the money market behaviour. A high degree of asymmetry is reflected in adjustment of call money rates to relatively high and low repo rates. Surprisingly this sort of behaviour is also exhibited in the case of discriminatory-price auctions in developed and matured markets. A possible explanation is as follows. Under such a system, the behaviour of bidders is reflected on the changes in bids tendered in response to pre-announced rates. Since the central bank is offering a flat rate, which is pre-announced, the possibility of *winners' curse* is completely eliminated. In this situation, expectations play an important role. As evident from the striking differences between adjustment parameters, money market reacts strongly to any upward revision in repo rates. Introducing an additional variable on proportion of successful bids demonstrates the fair degree of convergence between the perception of the auctioneer and the market players. A significant parameter on bidding substantiates the effectiveness of policy signals.

Section IV
Conclusion

The study analysed the response of the money market to repo auctions in India. The study demonstrates that under discriminatory price repo auctions, call money rates respond significantly to both low and high repo rates, abstracting from the strict theoretical auction hypotheses. The results also reveal that the money market rates adjust to both a relatively low and high repo rate; the degree of adjustment being higher in case of the former than the latter. The lack of high degree of asymmetry as evidenced in well developed money markets could arise from various market imperfections. The empirical experiment with the fixed rate repo system also reveals a robust relationship between repo and money market rates. In this case, there is a high degree of asymmetry in the response of money market to high and low repo rates. This could indicate the effectiveness of repo system as a signaling mechanism for the money market rates. The results suggest that fixed rate repos provided a floor rate for money market and proved effective in stabilising the money market rates around this level in comparison to discriminatory price auctions.

The present study was confined to analysis of money market response to one-way repo operations. However, the reverse repo operations involving liquidity support to the system may shed additional lights on the behaviour of market agents, which has not been investigated in the

study due to lack of adequate information.

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Notes

1. Milgrom (1989) provides a detailed theoretical discussion on several aspects of auction formats and bidders behaviour. Other issues in this debate are discussed in Cammack (1991) and Reinhart (1992).

2. An analysis on volatility of repo rates and call money rates in the Indian money market is also provided by Kanagasabapathy (1994).

3. Although the regression model could involve some degree of auto-correlation of residuals, it was not very high for the first order autocorrelation coefficient was low at 0.22. Since the Durbin-Watson statistics is reasonably high (1.50) and the data are discrete series, the problem could be safely ignored.

4. The regression model based on the entire sample including 156 data points yielded low estimates on the coefficient of the (∂r) term at 0.21 and R^2 at 0.19 i.e., 2 times lower than estimates based on the 87 sample observations.

5. The rates r_r and r_c for the sample period of fixed rate repos had unit roots indicated by the estimated ADF(1) test statistic at -1.55 and -1.36, respectively.

6. The median of (∂r) in fixed rate repo case turned negative at -0.10. However, even after classifying the high and low rates on the basis of 90 per cent trimmed mean with a positive estimate could lead to very marginal changes in the estimated coefficients with the sign remaining unchanged as compared to estimates based on median rate.

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