

BONN ECON DISCUSSION PAPERS

Discussion Paper 10/2003

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by

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June 2003



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Overbidding in Fixed Rate Tenders – An Empirical Assessment of Alternative Explanations*

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June 3, 2003

Abstract

This paper investigates various theories explaining banks' overbidding in the fixed rate tenders of the European Central Bank (ECB). Using auction data from both the Bundesbank and the ECB, we show that none of the theories can on its own explain the observed overbidding. This implies that the proposed new rules by the ECB, aimed at neutralizing interest rate expectations, would not eliminate overbidding if the rationing rule in the fixed rate tenders remains unchanged.

JEL- classification numbers: E52, D44.

Keywords: Overbidding, repo auctions, monetary policy instruments of the European Central Bank.

*Financial support by the Deutsche Forschungsgemeinschaft (DFG) through OE-198/2/1 and NA-31020102 is gratefully acknowledged.

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1 Introduction

During the first 18 months of the Euro, the European Central Bank (ECB) used *fixed rate tenders* in its main refinancing operations to allocate liquidity to the banking sector. In a fixed rate tender, the interest rate is pre-announced by the central bank, and banks simply indicate how much refinancing they would like to receive at that rate. When total bids exceed the intended allotment, banks are rationed proportionally to their bids according to a uniform allotment ratio.

The fixed rate tender procedure was abandoned by the ECB in June 2000 due to an escalating overbidding problem. Banks increasingly exaggerated their demand for reserves until finally banks bid on average more than 100 times their actual demand. The overbidding severely hampered the ECB's liquidity management and it was also costly and risky for banks (see e.g. Bindseil, 2003 and Nautz and Oechssler, 2003). The reasons for the observed overbidding are still under dispute. Thus, in this paper we try to assess the empirical relevance of various proposed explanations for the overbidding phenomenon. For this purpose, we use data from the ECB's fixed rate tenders as well as data from the Bundesbank which employed fixed rate tenders from 1996 to 1998.

In June 2000, the ECB switched to a variable rate tender format, a standard multi-unit auction augmented by a minimum bid rate. Using variable rate tenders entails a partial loss of control of the central bank over short term interest rates which explains why the ECB has still a marked preference for the fixed rate tender format, see e.g. ECB (2000, p.37). Moreover, recent modifications of the ECB's operational framework are apparently designed to allow a return of the fixed rate tender format. Therefore, the question of what contributed to banks' overbidding in fixed rate tenders is still an important one.

Three theoretical explanations for the overbidding problem have been discussed in the literature. The first explanation, 'the rate hike hypothesis', is advanced by the ECB itself and states that overbidding was solely caused by interest rate hike expectations, see ECB (2000) and Bindseil (2003). Clearly, if banks expect increasing repo rates within the reserve maintenance period, bidding in the current repo auction is particularly attractive and

leads banks to exaggerate their demand.¹ According to the ECB, there is nothing wrong with fixed rate tenders in times when interest rates are expected to remain constant. In the ECB's recently announced 'measures to improve the efficiency of the operational framework', the role of interest rate expectations for banks' bidding is mitigated by the commitment that rate changes will not occur during a maintenance period, see ECB (2003, p78).² According to the rate hike hypothesis, the implementation of these measures allows the return to the fixed rate tender format since both, the under- and the overbidding problem should be completely solved.

There is clear evidence, partly based on individual bidding data, that interest rate expectations are an important determinant of banks' bidding behavior, see Breitung and Nautz (2001). Yet, interest rate hike expectations did not prevail for the entire period in which fixed rate tenders were employed. In particular, the Bundesbank observed overbidding in its fixed rate tenders from 1996 until 1998 when interest rates remained more or less constant.³ This already indicates that rate hike expectations might not be the whole story. In this case, the ECB's new operational framework mitigates but cannot solve the overbidding problem inherent to the fixed rate tender format.

The second explanation, the 'tight liquidity hypothesis', is due to Ayuso and Repullo (2003). They argue that the ECB kept liquidity too tight such that the resulting spread between the interbank rate and the repo rate was too large. Risk neutral banks therefore overbid in order to profit by arbitrage from this interest rate differential. In fact, during the fixed rate tender period the average spread was about 8 basis points which might be well above the so-called natural spread stirred by different collateral requirements. Following the tight liquidity hypothesis, avoiding rate hike expectations is not sufficient for preventing banks from overbidding. A further necessary con-

¹Analogously, when interest rates are expected to decrease, banks *underbid*, i.e. they tend to refrain from bidding. Since bids have been constraint by a minimum bid rate, underbidding also occurred in the ECB's variable rate tenders, see Bindseil (2003) and Linzert et al. (2003).

²The new measures can be summarized as follows: Starting in 2004, the maintenance period will be defined by the meetings of the Governing councils. Rate changes will only occur at those meetings. Moreover, the maturity of repos will be shortened from two to one week. As a result, rate changes will not occur anymore *during* the maintenance period.

³See Bindseil (2003) for a comprehensive review on the overbidding experience of other central banks.

dition for banks to bid seriously is a 'neutral' liquidity management by the ECB which guarantees that the spread is *on average* at its natural level.

Finally, the third explanation may be entitled the 'rationing hypothesis'. It claims that there can be overbidding in fixed rate tenders even if rates are not expected to increase and even if the spread between the repo and the interbank rate is on average at its natural level. Nyborg and Strebulaev (2001) show that banks may overbid in response to the risk of being squeezed after the auction. In fact, banks typically submit higher bids at the last auction of the reserve maintenance period, see e.g. Nyborg et al. (2002).⁴ Based on the model in Nautz and Oechssler (2003), Ehrhart (2000,2001) shows that overbidding can occur even if there is only a probability that banks are rationed and do not receive their full demand. Therefore, in contrast to the 'tight liquidity hypothesis', banks overbid even if the spread between the repo and the interbank rate is *on average* at its natural level. The 'rationing hypothesis' is complemented by an adaptive learning process (Nautz and Oechssler, 2003) that explains why banks *increasingly* overbid. Understanding the dynamics of overbidding is of particular importance because the main problem of the fixed rate tender procedure was not constant overbidding but increasing overbidding which resulted in an explosion of bids.

In order to evaluate the empirical relevance of these hypotheses, we investigate the determinants of total bids and allotments in the fixed rate tenders of the ECB and the Bundesbank. We find that none of the three theories alone can explain the empirical performance of the fixed rate tenders. To account for rate hike expectations, we include the spread between the one month interest rate and the biweekly repo rate. We also include the difference between the overnight rate and the repo rate to account for the 'tight liquidity hypothesis'. While those variables prove to be important, other factors still matter. In particular, we find that the lagged allotment ratio is significant as well as a linear time trend, both of which are compatible with an adaptive learning process. This suggests a more fundamental problem with fixed rate tenders that cannot be alleviated by the proposed measures of the ECB (2003) since they aim only to exclude rate hike expectations as source of the overbidding.

The closest reference to our paper is Ayuso and Repullo (2001) who

⁴In the same vein, Scalia and Ordine (2002) found evidence against a winner's curse effect and concluded that banks might bid too aggressively in a repo auction because the concern is the risk of losing, not winning.

restrict attention to the rate hike and the tight-liquidity hypotheses. They estimate bid functions for the fixed rate tenders of the ECB and find support only for the latter. The current paper investigates the empirical relevance of all three competing explanations for the overbidding phenomenon and uses auction data from both, the Bundesbank and the ECB. Moreover, advancing on previous studies on banks' bidding behavior, our analysis explicitly accounts for the interplay between bidders and the central bank's allotment policy by estimating a system including both, bids and allotments as endogenous variables.

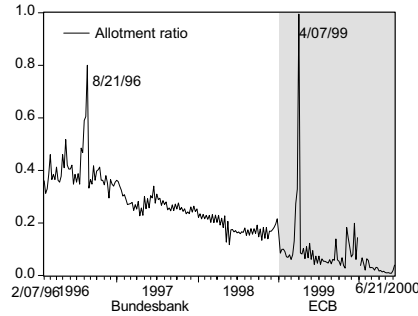
The remainder of the paper is organized as follows. In the next section, we review the overbidding experience of the Bundesbank and the ECB and introduce the explaining variables used in our regressions. In Section 3 we present the empirical results for the Bundesbank's and the ECB's auction data. Some concluding remarks are offered in Section 4.

2 The overbidding phenomenon

In a fixed rate tender the central bank sets the repo rate, and banks simply bid the amount of refinancing they wish to obtain at that rate. Having collected all bids, the central bank decides upon the repo volume, i.e. the total allotment A , and each bank gets the same quota (allotment ratio) $Q = \min(1, A/B)$ of its bid, where B is the sum of all bids.

Figure 1 shows the allotment ratios of the weekly fixed rate tenders performed by the Bundesbank (since February 1996) and the ECB (until June 2000). Note that the German experience with overbidding should be helpful for the ECB, simply because a major part of the repo volume is usually allocated to German banks, compare Breitung and Nautz (2001). On average, the Bundesbank allotted only 30% of the bids; in the Eurosystem the average allotment ratio (6.1%) was even lower.

Figure 1: Allotment ratios in fixed rate tenders



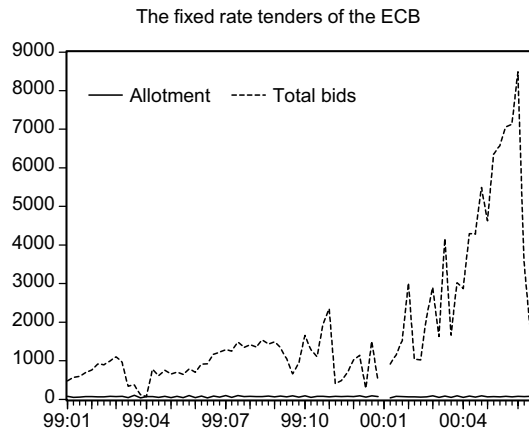
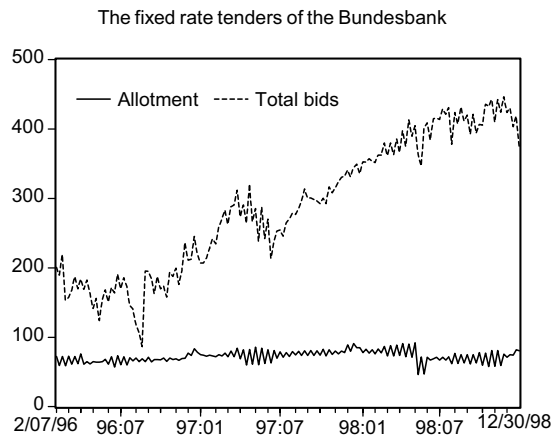
Notes: The allotment ratio is the ratio of total allotments and total bids. 4/07/99 and 8/21/96 correspond to auctions immediately before the central banks announced a cut in the repo rate. The shaded area indicates the new Eurosystem. Source: Monthly Bulletins of the Bundesbank, Tab.VI.5, and of the ECB, Tab.I.3.

What is particularly noticeable is the dramatic decline of the allotment ratio over time. The ratio started 1996 above 40%, declined to about 15% at the end of 1998 and reached in May 2000 an all-time low of 0.87%. Figure 2 reveals that the downward trend in the ratio is solely due to increasing bids and not to more restrictive allotments. Obviously banks tried to circumvent the rationing of the central bank by *increasingly* exaggerating their bids. Every theory that deals with fixed rate tenders must be able to explain this feature.

In the following, we will investigate the three competing explanations for the overbidding phenomenon using auction data from both, the Bundesbank and the ECB. In contrast to Ayuso and Repullo (2001) and Breitung and Nautz (2001), our analysis of banks' bidding explicitly accounts for the interplay between the bidders and the allotment policy of the central bank. To that aim, we estimate a system having both, total bids and total allotments as endogenous variables. Before we present the results, we introduce the explanatory variables and discuss their predicted influence.

Rate change expectations are an important factor to understand banks'

Figure 2: Bids and allotments in fixed rate tenders

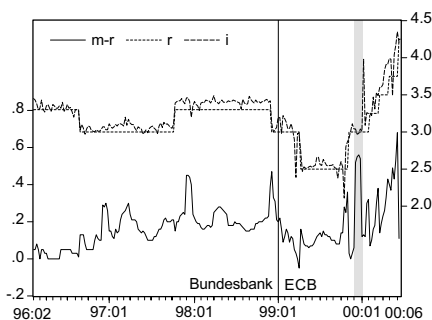


Notes: The Figure shows total bids and allotments in the fixed rate tenders of the Bundesbank (in DM) and the ECB. Data source: Monthly Bulletin of the ECB and Deutsche Bundesbank.

bidding behavior and a variable capturing interest rate expectations has to be included in any analysis of bidder behavior in repo auctions. For example, both peaks in Figure 1 (August 21, 1996 and April 7, 1999) are due to banks' *underbidding*, i.e. banks anticipated upcoming interest rate cuts and thus refrained from bidding. In line with the expectations theory of the term structure of interest rates, we use the term spread ($m - r$) between the one month interest rate, m , and the biweekly repo rate, r , as a proxy for the prevailing interest rate expectations. Thus, negative values of $m - r$ indicate that the repo rate is expected to decrease while large positive values point to rate hike expectations. Note, however, that the increase of the one-month rate in December 1999 is solely due to the Y2K-effect and does not reflect rate change expectations, compare Figure 3.

In line with Gaspar et al. (2001), Figure 3 illustrates that the repo rate changes of the Bundesbank and the ECB typically had been anticipated by the market. According to the 'rate hike hypothesis' advanced by the ECB, rate hike expectations are the only relevant explanation for banks' overbidding and the failure of the fixed rate tender format.

Figure 3: Interest rates in Germany and in the Eurosystem



Notes: The Figure shows the repo rate (r), the overnight rate (i), and the spread between the one month rate ($m - r$) valid at the bidding day of the auction. The shaded area indicates the increase of the one month rate due to the Year 2000 effect.

Following the ‘tight liquidity hypothesis’ of Ayuso and Repullo (2001, 2003), rate hike expectations are only part of the overbidding story. According to their model, the spread between the interbank overnight rate and the repo rate ($i - r$) is the predominant factor for banks’ bidding behavior. Thus, we include this spread as well in the regressions.

Finally, the rationing hypothesis in combination with the adaptive learning process of Nautz and Oechssler (2003) implies that past bids and allotments matter for the bidding behavior of banks. A simplified version of this process works as follows. Banks with true demand for reserves D^i are supposed to assume myopically that the allotment quota remains unchanged from the previous period. As a best reply to the anticipated rationing, bank i bids $1/Q_{t-1}$ times its true demand, $B_t^i = D^i/Q_{t-1}$. Summing over all banks yields

$$B_t := \sum_i B_t^i = \frac{\sum_i D^i}{Q_{t-1}} = \frac{\sum_i D^i}{A} B_{t-1}. \quad (1)$$

This difference equation explodes if the sum of true demands for reserves exceeds the allotment of the central bank (by however small amount). In other words, the rationing hypothesis implies that total bids B_t increase exponentially. If the bid equation is written in logs, this should be reflected in an additional linear time trend.

3 Empirical results

The empirical analysis of the overbidding phenomenon is based on the following system describing the determinants of banks’ bidding and the central bank’s allotment policy. The endogenous variables are the log of total bids submitted in a fixed rate tender b_t and the log of the central bank’s total allotment a_t .

$$a_t = c + \tau t + \sum_{j=1}^2 \alpha_j a_{t-j} + \sum_{j=0}^2 \beta_j b_{t-j} + \sum_{j=0}^1 \rho_j \Delta r_{t-j} + \gamma_i (i - r)_t + \gamma_m (m - r)_t + \delta x_t + \varepsilon_t \quad (2)$$

$$b_t = c' + \tau' t + \sum_{j=1}^2 \alpha'_j a_{t-j} + \sum_{j=1}^2 \beta'_j b_{t-j} + \sum_{j=0}^1 \rho'_j \Delta r_{t-j} + \gamma'_i (i - r)_t + \gamma'_m (m - r)_t + \delta' x_t + \varepsilon'_t \quad (3)$$

The allotment equation contains contemporaneous total bids as an explaining variable because the bids are known to the central bank when the allot-

ment is determined. The system will therefore be estimated by three-stage least squares (TSLS) for both samples (Bundesbank and ECB).

The equations of the system contain lags up to order two. Higher lag orders turn out not to be significant, presumably because the maintenance period of required reserves is one month. Recall that $i - r [m - r]$ denotes the spread between the overnight rate i [the one-month rate m] valid at the bidding day of the fixed rate tender and the repo rate r . In line with the 'tight liquidity' and the 'rate hike hypothesis', these variables account for the impact of opportunity cost and rate expectations for banks bidding and the central bank's allotment decision. The 'rationing hypothesis' which predicts that exploding bids are inherent to the fixed rate tender format implies a significant linear time trend t in the bid equation (see equation (1)). To allow for possible liquidity effects, we include the (lagged) change of the repo rate Δr into the set of explaining variables. Finally, x is a vector of further variables which captures specific features of the Bundesbank's and the ECB's data.

Under normal circumstances, total allotments of the Bundesbank and the ECB increased slightly over time due to monetary expansion. However, in May 1998 the Bundesbank transferred its profit to the German government and sterilized the resulting increase in reserves by reducing the available repo volume, see Figure 2. For the Bundesbank data, x therefore consists of the step-dummy *profit* which is one after 5/13/1998 and zero otherwise. For the ECB, the variables in x account for the Year 2000 (Y2K) effect. In particular, the increase of the one-month rate in December 1999 is due to Y2K and does not reflect rate change expectations, see Figure 3. x therefore consists of the dummy variable *Y2K* which is one in December 1999 and zero otherwise. Following Ayuso and Repullo (2001) and Breitung and Nautz (2001), we avoid the distorting effect of *Y2K* on the variable measuring the rate expectations by including $(1 - Y2K)(m - r)$, not $m - r$, into the regressions.

The Bundesbank employed fixed rate tenders in its main refinancing operations from February 1996 until the end of 1998, which gives us 152 observations. The ECB conducted fixed rate tenders from 1999 until June 2000 which gives us 75 observations. Table 1 summarizes the results.

Let us first look at the equations explaining the central bank's supply of repos. The general impression is that the allotment policies of the Bundes-

Table 1: Bid and allotment functions for fixed rate tenders

	Bundesbank Feb 1996 -1998		ECB 1999 - June 2000	
	a_t	b_t	a_t	b_t
$trend \times 10^{-2}$	0.125 (2.36)	0.267 (4.06)	-1.303 (0.10)	0.765 (2.41)
a_{t-1}	-0.275 (3.56)	-0.341 (3.04)	-0.516 (4.30)	-0.368 (1.51)
a_{t-2}	0.629 (11.65)	0.068 (0.12)	0.231 (2.12)	-0.082 (0.34)
b_t	-0.068 (0.43)		-0.043 (0.33)	
b_{t-1}	-0.027 (0.29)	0.518 (6.27)	0.029 (0.38)	0.333 (2.48)
b_{t-2}	0.023 (0.48)	0.175 (2.18)	0.042 (0.62)	0.292 (2.33)
Δr_t	0.137 (1.10)	-0.529 (2.84)	-0.200 (0.60)	-1.807 (3.37)
Δr_{t-1}	-0.033 (0.36)	-0.061 (0.33)	0.102 (0.32)	-1.014 (1.59)
$(i - r)_t$	0.073 (0.62)	0.546 (3.39)	-0.013 (0.10)	0.435 (1.73)
$(1 - Y2K_t)(m - r)_t$	0.355 (4.96)	0.228 (1.85)	0.179 (0.55)	1.763 (3.40)
<i>constant</i>	7.996 (5.02)	7.246 (3.24)	5.172 (5.55)	4.032 (2.36)
<i>profit</i> _t	-0.465 (10.27)	0.070 (0.80)		
<i>profit</i> _{t-1}	0.081 (1.05)	-0.235 (1.74)		
<i>profit</i> _{t-2}	0.279 (4.92)	0.207 (2.23)		
$Y2K_t$			0.005 (0.04)	0.481 (1.73)
$Y2K_{t-1}$			0.575 (3.42)	-0.292 (0.81)
$Y2K_{t-2}$			-0.497 (3.70)	-0.253 (0.88)
\bar{R}^2	0.858	0.942	0.468	0.836
Sample size	152	152	75	75

Notes: The Table shows the estimated bid (b_t) and allotment (a_t) functions for the fixed rate tenders of the Bundesbank (columns 2-3) and the ECB (columns 4-5), compare Eq. (2) and (3). t -values are in parentheses. m , i and r denote the one-month, overnight and the repo rate, resp. *profit* is a step-dummy accounting for the transfer of Bundesbank profits to the Government, $Y2K$ is one in december 1999 and zero otherwise. The systems are estimated by TSLS using two lags of all predetermined variables as instruments.

bank and the ECB appear to be very similar. For both central banks, the current allotment strongly depends on the allotment two weeks ago. This indicates that repos were used on a revolving basis, i.e. banks repay maturing repos using new repo credit. In contrast, neither lagged nor current bids have a significant influence on the central banks' allotment. Apparently, submitted bids contained no valuable information for the Bundesbank's and the ECB's liquidity management. The central banks' supply of repo credit is also unaffected by repo rate changes (Δr) or the spread between the overnight rate and the repo rate ($i - r$). Regarding the supply of repos, the only notable difference between the Bundesbank and the ECB concerns the impact of rate expectations ($m - r$) which are significant for the Bundesbank but not for the ECB. In this sense, the Bundesbank had been more active in its allotment policy than the ECB. The estimated coefficient reveals that the Bundesbank supplied reserves more generously whenever the term spread indicated that interest rates are expected to increase.

We now turn to the equations explaining the bidding behavior of banks. The estimated bid functions for the repo auctions of the ECB show that rate expectations have a strong influence on banks' bidding. The coefficient of the term spread ($m - r$) is highly significant and plausibly signed, i.e. total bids increase in times of rate hike expectations. The importance of rate expectations for banks' bidding is also reflected in the significant impact of Δr . Compared with the results obtained for the ECB, the impact of rate expectations on banks' bidding is rather weak in the Bundesbank auctions. Yet this weak effect might be due to the specific sample period where rate expectations did not play an important role. In fact, from 1996 to 1998 bids steadily increased but the German repo rate remained more or less constant.

The significant influence of rate expectations on banks' bidding behavior is in contrast to earlier findings by Ayuso and Repullo (2001, Table 5). They estimated a bid function for the ECB's fixed rate tenders of the following form.

$$b_t - b_{t-2} = -a_{t-2} + c + \gamma'_1(i - r)_t + \gamma'_2(m - r)_t + \varepsilon_t \quad (4)$$

Note that this specification neglects the significant influence of Δr_t and the linear time trend.⁵ Moreover, it severely restricts the dynamic structure

⁵In Ayuso and Repullo (2001), i denotes the one-week Euribor rate instead of the overnight rate Eonia used in our analysis. However, this choice does not affect the results in a significant way.

of the bidding process. Compared with the more general bid equation (2), equation (4) assumes that $\alpha'_1 = \beta'_1 = 0$ as well as $\beta'_2 = -\alpha'_2 = 1$. These parameter restrictions can be tested and are strongly rejected by the data.

The results presented in Table 1 provide also some support for the tight-liquidity hypothesis. In particular for the Bundesbank, the highly significant coefficient of the spread $i - r$ indicates that banks compare the repo rate with the cost of alternative refinancing opportunities before they submit the bids. As expected, the larger the spread, the larger the submitted bid volume.

However, neither the rate hike nor the tight-liquidity variables are sufficient to explain why banks overbid. The highly significant time trend in both bid functions demonstrates that the upward trend in the bids is not only due to interest rate effects. In line with the rationing hypothesis, total bids increase over time independent of prevailing rate expectations and the allotment policy of the central bank. The estimated long-term trends $[\tau(1 - \beta'_1 - \beta'_2)]$ imply a weekly increase in the bids of about 2% for the ECB and 0.87% for the Bundesbank auctions. Note that bids in the Bundesbank auctions may have increased less dramatically because in the Bundesbank auctions the complete bid, not only the allotment, had to be collateralized by the bidders.

The results indicate that past allotments have a negative effect on bids, which shows that banks increased their bids if the allotment in the preceding repo auction was low. In fact, the estimated coefficients of lagged allotments and bids suggest an intuitive response of bidders to observed auction outcomes, which is in line with the adaptive process (1). For both central banks, the parameter restrictions $\alpha'_1 = -\beta'_1$ and $\alpha'_2 = -\beta'_2$ are not rejected by the data: the p -values of the corresponding Wald tests are 0.186 for the Bundesbank and 0.535 for the ECB. Thus, banks increased their bids excessively because past allotment ratios were low. Due to this overbidding, the allotment ratio of the next auction was even lower which in turn reinforced banks' overbidding.

4 Conclusions

The literature on the bidder behavior in the repo auctions of the ECB offers three different theories that try to explain why banks overbid in fixed rate tenders. First, according to the 'rate hike hypothesis' advanced by the ECB, overbidding is due entirely to expectations of banks that the repo rate may increase during the reserve maintenance period. Since reserves obtained during the maintenance period are perfect substitutes, it obviously pays to increase one's demand just before the expected interest rate hike. Second, the 'tight liquidity' hypothesis claims that the ECB kept liquidity too tight such that the spread between the interbank rate and the repo rate exceeds its natural level. Banks therefore overbid in order to profit by arbitrage from this interest rate differential. Third, various models support the 'rationing hypothesis' which predicts that banks overbid in fixed rate tenders even if interest rates are expected to be constant and the spread is on average on its natural level.

In a recent announcement, the ECB (2003) explains a plan to reorganize its operational framework of monetary policy. In line with the rate hike hypothesis, all these measures are designed to stop the under- and overbidding problem by mitigating the role of rate expectations on banks' bidding. In particular, rate changes will not occur anymore during a maintenance period.

If the rate hike hypothesis could fully account for the observed overbidding, this plan should work. However, using data from the Bundesbank and the ECB, we find that bids submitted in fixed rate tenders increase exponentially even if one controls for rate expectations, the liquidity position of the money market, and the allotment policy of the central bank. The empirical evidence presented in this paper suggests that the ECB's new measures to improve the efficiency of the operational framework would not eliminate overbidding if the rationing rule in the fixed rate tenders remains unchanged.

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