WHY DID THE BANKS OVERBID? AN EMPIRICAL MODEL OF THE FIXED RATE TENDERS OF THE EUROPEAN CENTRAL BANK

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Abstract

This paper tests two hypotheses for the overbidding behavior of the banks in the fixed rate tenders conducted by the European Central Bank (ECB) from January 1999 until June 2000. One hypothesis attributes the overbidding to the expectations of a future tightening of monetary policy, while the other attributes it to the liquidity allotment decisions of the ECB. The model is estimated with individual bidding data of the Spanish banks, and also with aggregate bidding data of all Spanish banks and all banks in the euro area. The empirical results provide support for the second hypothesis.

Keywords: European Central Bank, open market operations, money auctions, bidding behavior.

JEL Classification: E52, E58, D44.

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1 Introduction

The monetary policy instruments used by the European Central Bank (ECB)[1] are (i) minimum required reserves, (ii) open market operations, and (iii) standing facilities. The minimum reserves help to ensure that the euro area banking system has an aggregate liquidity deficit which is covered by two main types of open market operations: the main refinancing operations and the longer-term refinancing operations. The former (latter) are liquidity providing collateralized transactions with a weekly (monthly) frequency and a maturity of two weeks (three months). The banks can also obtain or place overnight liquidity at the marginal lending and deposit standing facilities.

The refinancing operations can be conducted via fixed rate or variable rate tenders. In fixed rate tenders the ECB announces an interest rate and the banks bid the amount of liquidity they want to borrow at this rate. If the aggregate amount bid exceeds the amount of liquidity that the ECB wants to provide, each bank receives a pro-rata share of this liquidity. In variable rate tenders the banks bid the amounts they want to borrow and the interest rates they are willing to pay. In this case, bids with successively lower interest rates are accepted until the total liquidity to be allotted is exhausted.

From the beginning of the Monetary Union in January 1999 until June 2000 the main refinancing operations were conducted as fixed rate tenders. A striking feature of these tenders was the very high degree of overbidding by the banks. Figure 1 depicts the total amount bid and the liquidity allotted by the ECB in the 76 tenders that took place during this period. From the beginning, the difference between bids and allotments was high, and it increased dramatically over time. To give an idea of the quantities involved, in May and June 2000 the banks were bidding on average an amount that was more than eight times the size of the consolidated balance sheet of the Eurosystem. Given this situation, the ECB decided to switch to variable rate tenders, noting in its press release of 8 June 2000 that the decision was "...a response to the severe overbidding which has developed in the context of the current fixed rate

[1] Strictly speaking we should refer to the monetary policy of the Eurosystem, which comprises the ECB and the national central banks of the countries that have adopted the euro. However since the Eurosystem has no legal personality and is governed by the decision-making bodies of the ECB, with a slight abuse of terminology, in this paper we will simply use the latter term.

tender procedure."

[Figure 1]

Two main hypotheses have been proposed to explain the overbidding. The first one relies on market expectations of future interest rate increases: "The strong rise in bids in the first half of 2000 was due to the fact that, during most of this period, there were market expectations of interest rate hikes and short-term money market rates were significantly above the main refinancing rate." (ECB, 2000, pp. 37-38). The second one explains the overbidding by the existence of a positive spread between short-term money market rates and the main refinancing rate resulting from the allotment decisions of the ECB. Thus, in the *expectations hypothesis* the banks overbid because of the expectation of a future tightening of monetary policy, while in the *tight-liquidity hypothesis* they did it because of a contemporaneous restriction in the supply of liquidity.

A rationale for the tight-liquidity hypothesis is given in Ayuso and Repullo (2000). They construct a theoretical model in which a large number of banks can obtain liquidity from a fixed rate tender conducted by a central bank or in an interbank market. The central bank decides on the quantity allotted in the tender in order to minimize the expected value of a loss function that depends on the quadratic difference between the interbank rate and a target rate that characterizes the stance of monetary policy. Ayuso and Repullo show that when the central bank is more concerned about interbank rates below the target than about interbank rates above the target (i.e. when its loss function is asymmetric), it supplies less liquidity than that required to keep the expected interbank rate equal to the target rate. This opens a spread between these two rates, and generates a profit opportunity for the banks that is increasing in the quantity allotted, so they have an incentive to overbid.[2]

The purpose of this paper is to construct an empirical model to test the ability of these two hypotheses to account for bidding behavior of the banks in the fixed rate tenders of the ECB. In the model each bank computes a desired allotment that depends on the bank's characteristics and it is also an increasing function of two

[2] Moreover, they use interest rate data for the period January 1999 - June 2000 to estimate the asymmetry parameter of the loss function of the ECB, showing that it is significantly different from zero.

interest rate spreads: the difference between the one-week Euribor and the tender rate, and the difference between the one-month Euribor and the tender rate.[3] The latter captures the bank's incentive to front load its liquidity demand over the monthly maintenance period of the reserve requirement when tender rates are expected to rise, while the former captures the incentive to borrow from the central bank when the tender rate is below the short-term interbank rate. Given its desired allotment, each bank then computes the amount that is going to bid by dividing its desired allotment by the expected allotment ratio (the ratio between the allotted amount and the total amount bid), which is assumed to be a function of the allotment ratio in previous tenders. From here we derive an individual bidding equation that is a function of the previous allotment ratios and the two interest rate spreads. Finally, by adding the bids of the individual banks we get an aggregate bidding equation that is a function of the same variables.

It is important to note that in the presence of a reserve requirement with an averaging provision, expectations about future interest rate increases are likely to have a positive impact on very short-term interbank rates.[4] However, by introducing both spreads in the equation we estimate the effect of each spread after controlling for the other. So the coefficient of the one-month spread measures the pure effect of these expectations without any indirect effect via the short-term spread. Similarly, the coefficient of the one-week spread rates measures the effect of the short-term profit opportunities for a given level of the one-month spread.

The model is estimated with individual bidding data of the Spanish banks, and also with aggregate bidding data of all Spanish banks and all banks in the euro area. The results show that for both the individual and the aggregate equations the coefficient of the spread between the one-week Euribor and the tender rate is much larger than the coefficient of the spread between the one-month Euribor and the tender rate. Moreover, only the first one is statistically significant. Hence we conclude that the explanation of the banks' overbidding lies in the positive spread between short-term interbank rates and the tender rate. Although this spread may have been affected

[3] Euribor is the rate at which a prime bank is willing to lend funds in euro to another prime bank, and is computed as the average of the daily offer rates of a representative panel of prime banks.

[4] The averaging provision means that bank reserves held on any day of the maintenance period are perfect substitutes for the purpose of satisfying the requirement. As noted by Campbell (1987) and Hamilton (1996) among others, this implies that overnight rates should follow a martingale.

by expectations of future interest rate increases, we think that the most plausible interpretation of the results is that the aversion of the ECB to seeing interbank rates fall below the tender rate led it to be overly cautious in its allotment decisions, and this opened a profit opportunity that the banks tried to seize by overbidding.

This paper is closely related to Nautz and Oechssler (1999), and Breitung and Nautz (2001). The first paper estimates aggregate bidding equations for the fixed rate tenders conducted by the Bundesbank from February 1996 until December 1998, showing that overbidding occurred even at times when interest rates were not expected to increase. Breitung and Nautz (2001) estimate individual bidding equations for the German banks during the period January - November 1999, and aggregate bidding equations for all banks in the euro area during the period January 1999 - June 2000. The difference between their approach and ours will be discussed in detail below.

The paper is organized as follows. Section 2 presents our model of banks' bidding in fixed rate tenders. Section 3 describes the data used in the analysis. Section 4 presents the empirical results for both individual and aggregate data. Section 5 concludes.

2 The Model

Consider a model with n banks and a central bank. In each week t the central bank conducts a fixed rate tender in which the banks can get liquidity for two weeks at an interest rate r_t. In this tender bank $i = 1, ..., n$ bids an amount B_{it}, and receives an allotment

$$A_{it} = a_t B_{it}, \tag{1}$$

where

$$a_t = \frac{A_t}{B_t} \tag{2}$$

is the ratio between the liquidity A_t provided by the central bank and the total amount bid $B_t = \sum_{i=1}^{n} B_{it}$. In week t there is also an interbank market where the banks can obtain (or place) liquidity for one week or one month at rates w_t and m_t, respectively. Finally, the banks are subject to a lagged reserve requirement, so they have to hold over a monthly maintenance period an average level of reserves equal to a fraction of the reserve base computed at the end of the previous month.

Given a vector X_t of market variables observed prior to the tender, bank i first computes a desired allotment A^*_{it} for the tender of week t. We assume that

$$A^*_{it} = Z_{it} f(X_t), \tag{3}$$

where Z_{it} is a scale variable that depends on some bank's characteristics (like size, type of business, required reserves, collateral, etc.). Bank i then computes the amount B_{it} that is going to bid by dividing its desired allotment A^*_{it} by the expected allotment ratio $E(a_t)$, that is

$$B_{it} = \frac{A^*_{it}}{E(a_t)}. \tag{4}$$

Thus when the allotment ratio is expected to be small, the bank will try to achieve its desired allotment by scaling up the size of its bid.

Substituting (3) into (4) yields the following expression for the bid of bank i in the tender of week t

$$B_{it} = \frac{Z_{it} f(X_t)}{E(a_t)}. \tag{5}$$

Aggregating the individual bids gives the aggregate bid

$$B_t = \frac{Z_t f(X_t)}{E(a_t)}, \tag{6}$$

where $Z_t = \sum_{i=1}^{n} Z_{it}$ is the sum of the individual scale variables.

In order to get an empirical model we need to specify (i) the empirical counterparts of the individual and the aggregate scale variables Z_{it} and Z_t, (ii) the determinants of the expected allotment ratio $E(a_t)$, (iii) the variables in the vector of market variables X_t, and (iv) the functional form of f.

Starting with the individual scale variable Z_{it}, we consider two possible specifications, namely $Z_{it} = K_i$ and $Z_{it} = K_i R_{it}$, where K_i is a constant parameter that depends on the identity of the bank, and R_{it} is the level of required reserves of bank i for the maintenance period corresponding to week t. We also choose two specifications for the aggregate scale variable Z_t, namely $Z_t = KR_t$, and $Z_t = KA_{t-2}$, where K is a constant parameter, R_t is the aggregate level of required reserves for the maintenance period corresponding to week t, and A_{t-2} is the total amount allotted in the tender of week $t-2$. Choosing A_{t-2} is justified by the fact that the central bank is lending with a maturity of two weeks, so there is a high positive correlation between A_{t-2} and A_t.[5]

For the expected allotment ratio $E(a_t)$ we simply assume that

$$E(a_t) = a_{t-2}. \tag{7}$$

This is again justified by the two-week cycles in the main refinancing operations of the ECB.[6]

The vector of market variables X_t comprises two interest rate spreads: $w_t - r_t$ and $m_t - r_t$. The latter captures the incentives to front load the liquidity demand over the maintenance period when the tender rate is expected to rise, while the former captures the profits that banks can make by borrowing from the central bank at a rate r_t and placing these funds in the interbank market at a rate w_t.

Finally, we assume that

$$f(w_t - r_t, m_t - r_t) = \exp\left[\alpha_1(w_t - r_t - \gamma_1) + \alpha_2(m_t - r_t - \gamma_2)\right], \tag{8}$$

with $\alpha_1 \geq 0$ and $\alpha_2 \geq 0$, so the bids are increasing and convex in the two interest rate spreads. Moreover when $w_t - r_t = \gamma_1$ and $m_t - r_t = \gamma_2$ we have $f(\gamma_1, \gamma_2) = 1$, which implies $B_{it} = Z_{it}/E(a_t)$. For the empirical analysis we write (8) as follows

$$f(w_t - r_t, m_t - r_t) = \exp\left[\alpha_0 + \alpha_1(w_t - r_t) + \alpha_2(m_t - r_t)\right], \tag{9}$$

where $\alpha_0 = -(\alpha_1\gamma_1 + \alpha_2\gamma_2)$.

Substituting (7) and (9) into (5), and taking logs, gives the following individual bidding equation

$$\log B_{it} = \log Z_{it} - \log a_{t-2} + \alpha_0 + \alpha_1(w_t - r_t) + \alpha_2(m_t - r_t) + u_{it}, \tag{10}$$

where u_{it} is an error term.[7] However this equation cannot be estimated directly, because many banks in our sample bid zero in some weeks. To take care of this fact

[5] For the period January 1999 - June 2000 this correlation was .59. The correlation between A_t and A_{t-1} was $-.67$.

[6] An alternative specification that takes into account the observed declining trend in the allotment ratio would be $E(a_t) = \delta a_{t-2}$, with $\delta < 1$. But given the form of bidding equation (5), the effect of δ could be incorporated in the scale variable Z_{it}, so this is equivalent to (7).

[7] Note that the constant parameter K_i in the scale variable Z_{it} will be estimated as an individual fixed effect $\alpha_{0i} = \alpha_0 + \log K_i$.

we follow two alternative strategies. First, we estimate by non-linear least squares the corresponding exponential equation

$$B_{it} = \frac{Z_{it}}{a_{t-2}} \exp\left[\alpha_0 + \alpha_1(w_t - r_t) + \alpha_2(m_t - r_t)\right] + v_{it}, \tag{11}$$

where v_{it} is another error term. Second, we use the fact that there is a minimum bid amount of EUR 1 million to specify the following Tobit equation

$$B_{it} = \begin{cases} B_{it}^*, & \text{if } B_{it}^* \geq 1 \\ 0, & \text{otherwise} \end{cases} \tag{12}$$

where $\log B_{it}^*$ is given by the right-hand-side of (10). Thus in the Tobit model, equation (10) is interpreted as the log of the desired amount of bidding. Desired and observed bids coincide for values above the minimum, while zero bids correspond to desired bids below the minimum.[8]

Next substituting (7) and (9) into (6), and taking logs, gives the following aggregate bidding equation

$$\log B_t = \log Z_t - \log a_{t-2} + \alpha_0 + \alpha_1(w_t - r_t) + \alpha_2(m_t - r_t) + u_t, \tag{13}$$

where u_t is an error term. It should be noted that when $Z_t = KA_{t-2}$, this equation can be written as

$$\Delta_2 \log B_t = -\log a_{t-2} + \alpha_0' + \alpha_1(w_t - r_t) + \alpha_2(m_t - r_t) + u_t, \tag{14}$$

where $\Delta_2 \log B_t = \log B_t - \log B_{t-2}$ is the two-week (log) rate of growth of the aggregate bids, and $\alpha_0' = \alpha_0 + \log K$.

The individual and the aggregate bidding equations are estimated with, respectively, individual bidding data of the Spanish banks, and aggregate bidding data of all Spanish banks and all banks in the euro area. Before presenting the results, the following section describes the characteristics of the data.

[8] In our sample no bank bids the minimum amount, so there is no need to consider a more complicated model in which banks with desired bids below the minimum prefer to bid the minimum rather than zero.

3 Data

The explanatory variables in the bidding equations are two interest rate spreads. The first one, $w_t - r_t$, is computed as the difference between the one-week Euribor and the tender rate.[9] The second spread, $m_t - r_t$, is computed as the difference between the one-month Euribor and the tender rate. Since the main refinancing operations are announced on Mondays, and the counterparties may submit their bids until 9.30 am of the following day, their information sets cannot contain variables observable after this hour, so we have chosen the Euribor rates corresponding to the Mondays of each week. Figure 2 shows the behavior of the two interest rate spreads. Both spreads moved in line over the sample period, except in December 1999 when the one-month Euribor shoot up as a result of the year 2000 (Y2K) effect.

[Figure 2]

To construct the dependent variable in the aggregate bidding equation (13) we need two variables that are easy to obtain, namely the total amount bid B_t, and the total amount allotted A_t in each tender. To obtain the third one, the level of required reserves R_t, we have to associate each tender with a particular maintenance period of the reserve requirement. The criterion that we have used is choose the maintenance period that has the largest overlap with the two-week duration of the corresponding refinancing operation.[10] In the case of the aggregate bidding of the Spanish banks we obtained in a similar manner the total amount bid B_{St}, the total amount allotted A_{St}, and the level of required reserves R_{St}.

The descriptive statistics of the aggregate variables used in the empirical analysis are summarized in Table 1. The average two-week (log) rate of growth of the aggregate bids of the banks in the euro area was 4.3% during the period January 1999 - June 2000, with a minimum of -171% and a maximum of 221%. The average spread between the one-week Euribor and the tender rate was 11 basis points, with a minimum of 6

[9] In principle, it would have been desirable to match the maturity of both rates (recall that the tender rate is a two-week rate), but the market for two-week deposits is not active enough to offer reliable interest rates.

[10] Since the monthly maintenance period ends on the 23rd calendar day of each month, the value of R_t for the tenders conducted from (before) the 16th calendar day is the reserve base at the end of the last (second to last) month. For additional information on the operation of the minimum reserve system see ECB (2000b, Chapter 7).

and a maximum of 43, and the average spread between the one-month Euribor and the tender rate was 18 basis points, with a minimum of 5 and a maximum of 58. The behavior of the two-week (log) rate of growth of the aggregate bids of all Spanish banks was very highly correlated with that of all banks in the euro area. Anticipating the results in the following section, the correlation of both rates of growth of bids with the weekly spread is higher than the correlation with the monthly spread.

[Table 1]

In their empirical analysis of the overbidding phenomenon, Breitung and Nautz (2001) use the spread between the overnight rate (Eonia) and the tender rate instead of the spread between the one-week Euribor and the tender rate. However, if we are trying to capture the profits that the banks can make by borrowing at the ECB tender and placing these funds in the interbank market we think that using Euribor is better than using Eonia for two reasons. First, differences in maturity relative to the main refinancing operations: for the one-week Euribor the difference is one week, while for Eonia it is almost two weeks. Second, differences in credit risk relative to the main refinancing operations: although the main refinancing operations are collateralized while both Euribor and Eonia are interest rates on unsecured deposits, the credit risk of the former is probably smaller than that of the latter because Euribor is computed as the rate at which a prime bank is willing to lend funds to another prime bank, while Eonia is an effective overnight interest rate. There is also a third and more important reason for preferring Euribor, namely the fact that the behavior of Eonia is typically very unstable in the last days of the maintenance period of the reserve requirement, so when these days coincide with the day in which the banks prepare their bids it is a bad predictor of the overnight rates over the next two weeks.

To construct the dependent variable in the individual bidding equation (10) we need for each tender t the amount bid B_{it}, and the level of required reserves R_{it} of each bank i. To compute the latter we have used the criterion explained above to associate each tender with a particular maintenance period of the reserve requirement. In the case of bank mergers we have aggregated both bids and reserves backwards, as if there were a single institution from January 1999. Finally, since there are many institutions that bid zero in most weeks, we have restricted attention to Spanish banks that have participated in a minimum number of tenders. In particular, we have constructed two samples. The first one comprises 51 banks that have bid positive amounts in at least one third of the tenders (25 out of 76), while the second comprises 34 banks that have submitted positive bids in at least one half of the tenders (38 out of 76).

4 Results

In this section we first present the results on the determinants of the bidding behavior of the Spanish banks in the 76 fixed rate tenders conducted by the ECB between January 1999 and June 2000, and then we look at the results for the aggregate bidding of all Spanish banks and all banks in the euro area. We discuss to what extent the results provide support to the two hypotheses presented above. Finally, we discuss the difference between our results and those in Breitung and Nautz (2001).

The non-linear least squares estimation of the exponential bidding equation (11) is shown in Table 2. The first two columns present the results for an specification in which the scale variable Z_{it} is a constant K_i for each bank i (which, as noted in Section 2, is estimated as an individual fixed effect). The last two columns show the results for the case where the scale variable Z_{it} is the product of a constant K_i times the required reserves R_{it} of bank i for the corresponding maintenance period. In all cases, the point estimates and the standard errors (robust to heteroskedasticity) of the coefficients of the spreads $w_t - r_t$ and $m_t - r_t$ are reported.

[Table 2]

The results in Table 2 do not depend on the specification of the scale variable or on the selection of the sample of banks. The coefficient of the spread between the one-week Euribor and the tender rate is positive, with a significance level around 3%. On the other hand, the coefficient of the spread between the one-month Euribor and the tender rate is not significantly different from zero. Hence the evidence from the behavior of the Spanish banks is that, once we control for the spread between the one-week Euribor and the tender rate, expectations about future interest rate changes do not have any effect on their bidding.

Table 3 presents the results for the Tobit model (12). Since there is evidence of heroskedasticity, we have estimated an individual Tobit model for each bank, and then computed the average of the estimated coefficients.[11] The qualitative results are similar to those in Table 2, although now the coefficients of the two spreads are much larger in absolute value.

[Table 3]

The estimation of the aggregate bidding equation (13) for all Spanish banks is shown in Table 4. In this and all subsequent tables we report standard errors robust to autocorrelation, as well as the Q-statistics of serial correlation of orders 1 and 4. The results, especially for the second specification of the scale variable Z_{St}, are in line with those obtained in Tables 2 and 3. Again, it appears that the main explanatory variable for the bidding behavior of the Spanish banks is the spread between the one-week Euribor and the tender rate.

[Table 4]

Table 5 shows the estimation of the aggregate bidding equation (13) for all banks in the euro area. The results for both specifications of the scale variable Z_t are very similar. The coefficient of the spread between the one-week Euribor and the tender rate is positive, with a significance level around 1%, while the coefficient of the spread between the one-month Euribor and the tender rate is positive, but it is not significantly different from zero. Moreover, the first coefficient is significantly larger than the second.[12]

[Table 5]

The previous results are robust to restricting the sample to 1999, when interest rates were more stable than in the period January - June 2000,[13] eliminating the

[11] Taking averages is justified when the slope coefficients may be different across banks.

[12] The one-sided test of the hypothesis that the coefficient of the first spread is greater than the coefficient of the second (i.e. that $\alpha_1 - \alpha_2 > 0$) has a p-value of .07 in the equation with $Z_t = KR_t$, and a p-value of .04 in the equation with $Z_t = KA_{t-2}$.

[13] In this period the tender rate was raised four times, while in 1999 there were only two interest changes of opposite sign.

tenders of December 2000, when the one-month Euribor was distorted by the Y2K effect, or taking the one-week Euribor for the day of settlement of the tender (Wednesdays), and instrumenting the corresponding spread, in order to better approximate the profits that could be made by borrowing from the ECB and placing the funds in the interbank market. Hence we conclude that the bidding behavior of the European banks in the fixed rate tenders conducted by the ECB until June 2000 is basically explained by the spread between very short-term interbank rates and the tender rate.

To close this section we briefly comment on the difference between our results and those of Breitung and Nautz (2001), who estimate individual bidding equations for the German banks during the period January - November 1999, and aggregate bidding equations for all the banks in the euro area during the period January 1999 - June 2000. They include as explanatory variables the spread between the overnight rate (Eonia) and the tender rate, $d_t - r_t$, the spread between the one-month Euribor and the tender rate, $m_t - r_t$, the change in the tender rate, Δr_t, and a time trend.[14] Their results show that the coefficient of the spread between the one-month Euribor and the tender rate is much larger and statistically more significant than the coefficient of the spread between Eonia and the tender rate. However, we think that these results may be biased for two reasons. First, we have already mentioned that using Eonia is problematic when the relevant day for the tender coincides with the last days of the maintenance period of the reserve requirement. Second, the change in the tender rate is likely to capture an effect that should be attributed to the spread between Eonia and the tender rate, namely that there is less overbidding on a tender in which the rate is increased: in such days Δr_t is positive and $d_t - r_t$ is likely to go down (because the probability of another increase in the tender rate within the current maintenance period is small). Moreover, even with these two potential handicaps, in their regressions the spread between Eonia and the tender rate has a positive and statistically significant coefficient, thus implying that interest rate expectations do not suffice to explain the overbidding.

[14]There are other significant differences between their equations and ours. In particular, they use as explanatory variables of the log of the aggregate (individual) bids two lags of the aggregate (individual) bids as well as two lags of the log of the aggregate (individual) allotments. This implies that they restrict the sample for the individual equations to banks that bid positive amounts in three consecutive tenders.

5 Conclusion

We have tested two hypotheses that have been put forward to explain the overbidding behavior of the banks in the fixed rate tenders conducted by the ECB from January 1999 until June 2000. The expectations hypothesis attributes the overbidding to the expectations of a future tightening of monetary policy that led the banks to increase their current demand for liquidity in order to reduce the cost of holding reserves over the maintenance period of the reserve requirement. On the other hand, the tight-liquidity hypothesis explains the overbidding by the fact that the ECB kept interbank rates above the tender rate, which generated a profit opportunity for the banks that was increasing in the quantity bid. Our empirical analysis uses two interest rate spreads as explanatory variables: the spread between the one-week Euribor, and the tender rate and the spread between the one-month Euribor and the tender rate. The results show that once we control for the first spread, the effect of the second is small and statistically not different from zero. Hence the evidence supports the view that the reluctance of the ECB to let interbank rates fall below the tender rate played a crucial role in explaining why the banks overbid.

The main policy implication of our results is the following. To the extent that overbidding is considered to be a problem, the ECB should decide the quantity allotted in fixed rate tenders in order to keep the one-week Euribor rate close to the tender rate,[15] instead of computing the allotments from the analysis of the behavior of the autonomous liquidity creation and absorption factors. However, in the presence of expectations of interest rate changes this alternative policy would probably introduce large variability in the sequence of allotments, which may also be regarded as undesirable. Whether these problems are solved by using variable rate tenders is an interesting topic for future research.

[15] The policy of keeping interbank rates close to the tender rate has been called by Bindseil and Mercier (1999) the "golden rule" of fixed rate tender allotment decisions.

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Table 1

Descriptive statistics of the aggregate variables

	Mean	Standard deviation	Correlation with $\Delta_2 \log B_t$	$\Delta_2 \log B_{St}$	$w_t - r_t$	$m_t - r_t$
$\Delta_2 \log B_t$	4.3%	68.9%	1	.91	.45	.31
$\Delta_2 \log B_{St}$	6.7%	70.9%		1	.43	.26
$w_t - r_t$	11.2 bp	9.5 bp			1	.62
$m_t - r_t$	17.8 bp	14.5 bp				1

Table 2

Non-linear least squares estimation of the individual exponential bidding equation for the Spanish banks

Dependent variable: B_{it}

	$Z_{it} = K_i$		$Z_{it} = K_i R_{it}$	
	$n = 34$	$n = 51$	$n = 34$	$n = 51$
$w_t - r_t$	3.05	3.04	3.15	3.14
(s.e.)	(1.39)	(1.38)	(1.40)	(1.40)
$m_t - r_t$	$-.76$	$-.74$	$-.89$	$-.87$
(s.e.)	(1.11)	(1.10)	(1.12)	(1.12)
R^2	.77	.78	.77	.77
$n \times T$	$2,516$	$3,774$	$2,516$	$3,774$

Standard errors are robust to heteroskedasticity.

Table 3

Average Tobit estimation of the individual
log-linear bidding equations for the Spanish banks

Dependent variable: $\log B_{it}$

	$Z_{it} = K_i$		$Z_{it} = K_i R_{it}$	
	$n = 34$	$n = 51$	$n = 34$	$n = 51$
$w_t - r_t$	5.75	8.47	5.64	8.41
(s.e.)	(1.17)	(1.08)	(1.17)	(1.08)
$m_t - r_t$	-1.62	-3.10	-1.77	-3.26
(s.e.)	(.89)	(.89)	(.89)	(.90)
$n \times T$	$2,516$	$3,774$	$2,516$	$3,774$

Table 4

OLS estimation of the aggregate log-linear
bidding equation for all Spanish banks

Dependent variable: $\log B_{St}$

	$Z_{St} = KR_{St}$	$Z_{St} = KA_{S,t-2}$
$w_t - r_t$	1.84	3.30
(s.e.)	(1.05)	(1.05)
$m_t - r_t$	1.17	$-.10$
(s.e.)	(.71)	(.71)
R^2	.54	.54
$Q(1)$	2.65	4.83
$Q(4)$	3.12	8.07
T	74	74

Q(i) is the LM test of residual autocorrelation up to order i.
Standard errors are robust to autocorrelation.

Table 5

OLS estimation of the aggregate log-linear
bidding equation for all banks in the euro area

Dependent variable: $\log B_t$

	$Z_t = KR_t$	$Z_t = KA_{t-2}$
$w_t - r_t$	2.78	3.06
(s.e.)	(1.03)	(1.05)
$m_t - r_t$	.50	.21
(s.e.)	(.69)	(.71)
R^2	.51	.50
$Q(1)$	4.40	6.57
$Q(4)$	4.66	7.68
T	74	74

Q(i) is the LM test of residual autocorrelation up to order i.
Standard errors are robust to autocorrelation.

Figure 1
Total bids and allotments
(January 1999 - June 2000)

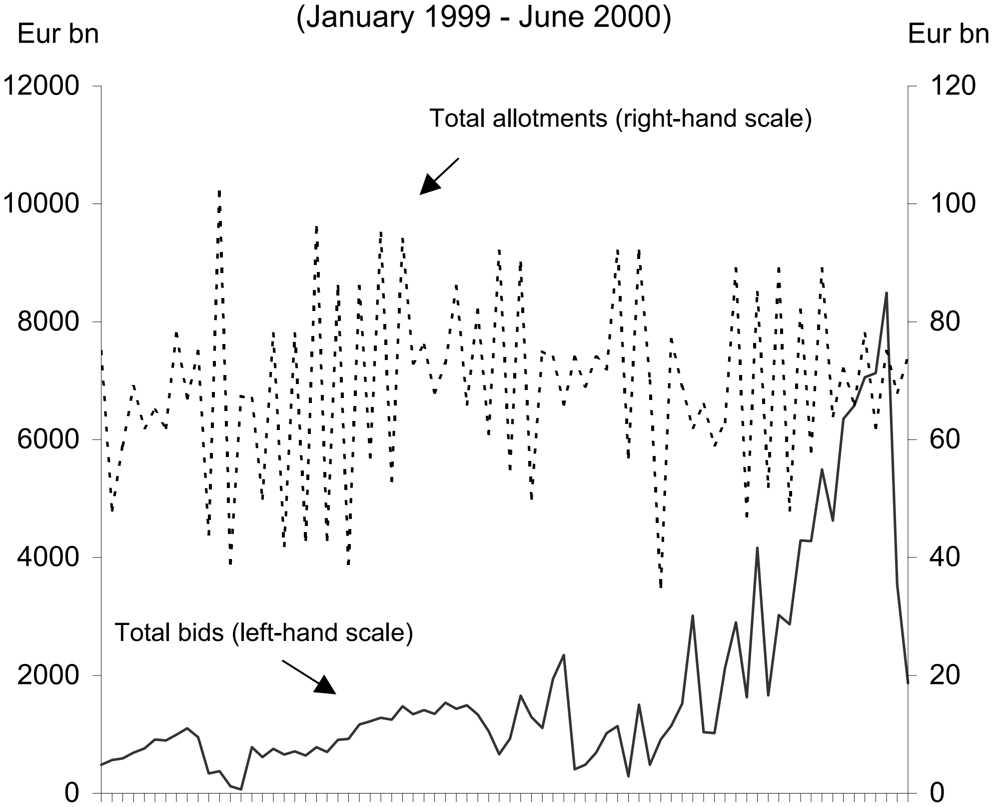

Figure 2
Interest rate spreads
(January 1999 - June 2000)