The impact of the operational framework reform on the link between bidding behaviour and market conditions.

Abstract:

This paper studies the nature of the link between market conditions (as illustrated by short-term deposit and EONIA swap rates) and the bidding strategies of banks involved in the Eurosystem refinancing operations. The dataset starts with the first variable rates MRO and covers the recent changes in the operational framework. Bidders' behaviour is summarised by the aggregated weighted average rate of bids and the standard deviation of bids around this average bid rate. Market conditions are gauged through the recourse to a large set of interest rates data (EONIA, OIS swap, Euribor, Eurepo etc.) and other indicators (volatility, accumulated reserves surplus, calendar effects, etc).

The econometric analysis shows that most of variance of the aggregated bidding behaviour can be explained by the evolution of the swap rate and calendar regularities. The second empirical evidence unveiled by the regressions is the structural change staged by the bidding behaviour in December 2003, ahead of the modification of the operational framework. We show that the weighted average rate of bids has moved downward closer to the minimum bid rate since this date, so much so that the model produces biased outcomes for the last twelve months of the sample. The stability tests indicate that one can not reject the hypothesis of structural change in the behaviours of bidders. Although the operational framework has certainly contributed to this change in the bidding behaviour, the study shows that this structural shift has taken place three months ahead of the new framework implementation. This result can be explained by the combination of a temporary factor (the lagged effect of a punctual ECB's allotment policy) and by structural evolutions (the decrease in risk premiums under the new framework).

VERY PRELIMINARY

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Florent Lecinq

Banque de France
Market Operations Division.

I/ Introduction

Since June 2000, the main refinancing operations (MROs) of the Eurosystem have been conducted *via* a variable rate tender procedure. These operations provide the bulk of refinancing to the banking sector, thereby enabling the credit institutions to satisfy their liquidity needs. The minimum rate of the MRO is the key interest rate of the Eurosystem, therefore MROs play a crucial role in steering the overnight interest rate.

As MROs are a variable rate auctions, a bid is an amount associated with a rate. The counterparties of the Eurosystem can submit up to 10 bids for different levels of interest rate at or above the minimum rate. Then the ECB allots a certain amount beginning to satisfy the bids submitted for the highest rates. Therefore the cost of the refinancing for the banking system as a whole can be slightly different from the minimum rate. This actual cost of the liquidity depends on the ECB's allotment size policy, together with the bidding behaviour of the banking sector.

The liquidity available for the banking sector as a whole depends entirely on the amount of refinancing granted by the Eurosystem via its various open market operations, but from the point of view of an individual bank, the liquidity can be obtained either by participating in the ECB's operations or by borrowing directly in the money market. Therefore, there is a strong link between the banks bidding behaviour and the market conditions in the money market. This paper aims to study the exact nature of this arbitrage.

Section one provides details about the alternative source of refinancing for banks; section two reviews the theoretical effect of the different variables which could explain the bidding behaviour; section three introduces the dataset whereas section four investigates a simple econometric analysis. Section five documents the possible explanations of the results.

I/ The alternative sources of refinancing for an individual bank.

A bank can meet its liquidity needs by many ways.

First, it has the possibility to borrow liquidity via the Eurosystem operations (main refinancing operation and long term refinancing operation). In this case, the maturity of the transaction is respectively one week and three months[1]. The cost of refinancing is slightly uncertain since it depends on the bidding behaviour of the other banks and the transaction needs to be collateralized.

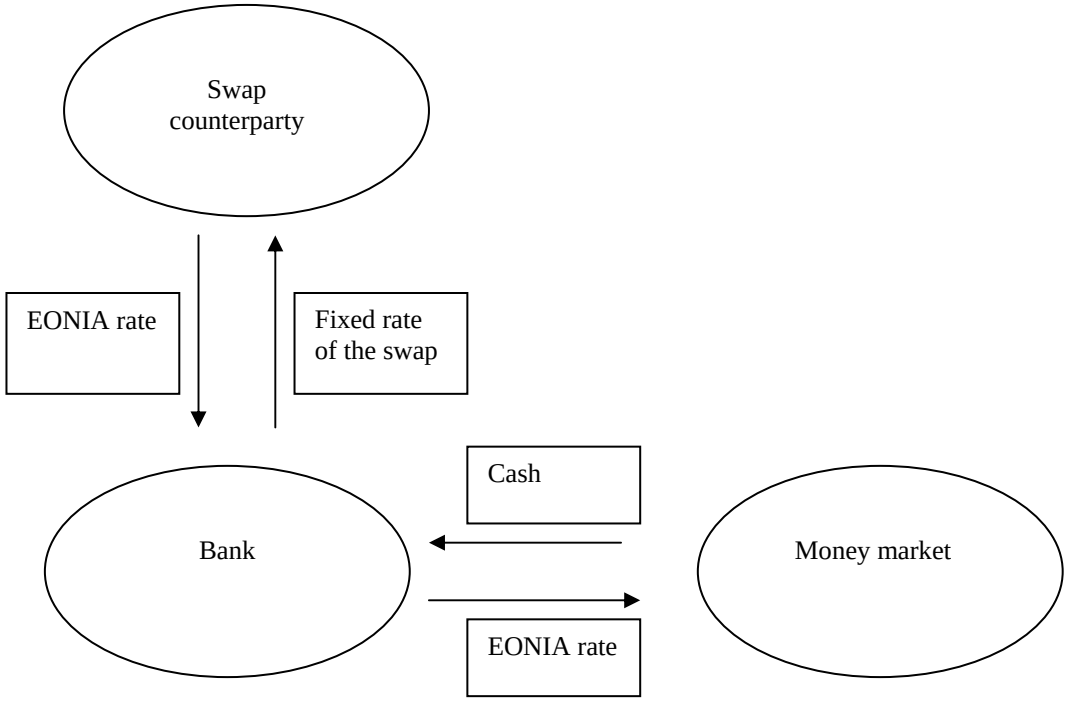
Second, a bank can borrow the liquidity directly in the cash market in the very short term market (overnight tom/next) or in the medium term (Euribor one, two or three months). The cost of the funding is certain and depends on the maturity and the spread paid by the borrower which remunerates the counterparty risk borne by the lender. Of course, the quality of the matching with the bank's liquidity needs depends on the maturity of the transaction: the liquidity needs are uncertain for long horizons whereas the daily needs are more correctly estimated by treasurers.

Third, the counterparties can decide to use the repo market. In this case, the cost of refinancing is lower than for a non-secured borrowing but the bank must accept to sell a bond for the length of the transaction. The repo market is liquid for a range of maturity between overnight and three months.

The fourth and last strategy of refinancing is to conclude a swap in the overnight index swap (OIS swap) in order to hedge a rolling funding in the overnight market. The OIS swap

[1] Before the reform of the operational framework in march 2003, the maturity of the MRO was 2 weeks.

contract enables two counterparties to exchange a fixed rate against the EONIA rate (a variable one) for a period of one or two weeks. The most liquid segment is the two weeks maturity. The basic hedging operation is the following:



Using an OIS swap contract, banks can very easily roll a daily refinancing in the market at a rate determined in advance.

II/ The banks' expected bidding behaviour.

This section describes the theoretical impact of a set of variables which is likely to modify the bidding behaviour of banks involved in the Eurosystem's auctions. The econometric analysis (section four) will then give evidence of how these effects are relevant from a quantitative point of view.

- The cost of alternative sources of funding.

Banks can decide to refinance themselves in the cash market, the repo market or the swap market depending of the current and expected interest rate level in these markets. Therefore, the different money market rates and the weighted average rate of bidding are likely to be closely correlated. It is especially the case for the OIS swap rate which provides a simple and direct arbitrage opportunity. In a perfect market, the fixed rate of the OIS swap should represent the expected average level of the EONIA for the length of the contract. It is clear that the ex-post average EONIA rate over one or two weeks is the rate which balances the cost of getting the liquidity via the tender and the cost of rolling an overnight borrowing.

- The liquidity imbalances.

The credit institutions in the euro area must hold a minimum amount of cash on a specific account in order to fulfil their reserve requirements. Since this obligation is assessed on average over a maintenance period, the banks have the opportunity to let their current accounts decrease in case of liquidity shocks. Nevertheless, certain banks make a limited use of this averaging possibility because they need high working balances or because of internal operational rules. Therefore one might think that the aggressiveness of bidding should be related to the accumulated liquidity surplus or shortage.

- The expected change in interest rate.

Before the March 2003 reform of the operational framework, a change in the minimum rate of the MRO could occur within a maintenance period. Accordingly, banks were encouraged to take advantage of this situation by moving forward or backward the fulfilment of their reserves requirements in case of rate hike or cut. Of course such expectations could steepen or flatten the short term rate curve, thereby changing the relative cost of the funding sources (Euribor, OIS swap, EONIA)

- The calendar effects.

It is well known that the window dressing activities have a significant impact on the dynamic of the overnight rate. The turn of the year usually sees an increase in the EONIA. This phenomenon also occurs to a lesser extent at the end of quarters and at the end of months. It makes the ECB's refinancing more attractive ahead of these dates; as a consequence, the bids are more aggressive when the maturity of the tender is later than these critical dates. One might also imagine that the last tender of each period could be bidden more aggressively because the reserve requirements constraint becomes binding at the end of the maintenance period.

- The volatility

The volatility of the EONIA rate is mainly due to the calendar effects but the "unusual" volatility which doesn't reflect the calendar events entails an uncertainty about the expected cost of refinancing of the strategies based on the rolling of an overnight borrowing. Therefore, one might think that the volatility is likely to boost the price of the "cost certainty"[2] associated with the central banks tenders. In other words: an increase in the maturity of the refinancing transaction is a simple way to insure against the volatility risk.

[2] The cost of the liquidity in the auction procedure is not completely certain because the individual weighted average rate and the marginal rate depend on the behaviours of the other bidders. Nevertheless, this uncertainty is much less relevant than the uncertainty about the future levels of the EONNIA rate in the case of a "rolling strategy".

III/ The data used.

♦ Bidding behaviour.

The bidding behaviour of credit institutions involved in the Eurosystem's tenders are studied from a global point of view by calculating the average weighted rate of bids and the standard deviation of those bids around the average bid.

The weighted average rate (WAR) of bids is the first moment of the distribution of bids. It is calculated as follows:

For each rate i, an amount A_i is asked by the bidders,

$$WAR = \frac{\sum_i A_i R_i}{\sum_i A_i}$$

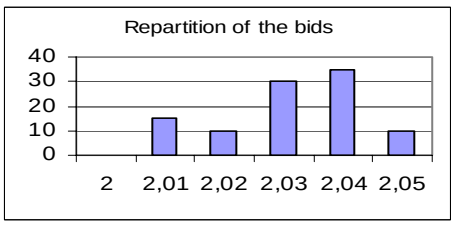
The standard deviation of bids is the second moment of the distribution:

$$SD = \frac{\sqrt{\sum_i (R_i - WAR)^2 A_i}}{\sum_i A_i}$$

Ex1 : Distribution of the aggregated bids : an example.

Rates	2	2,01	2,02	2,03	2,04	2,05	2,06	2,07
Amounts	0	15	10	30	35	10	0	0

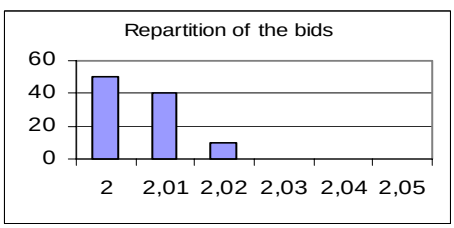
WAR in level	2,0315
WAR in spread	0,0315
SD	0,0119



Ex2 : Distribution of the aggregated bids : a second example.

Rates	2	2,01	2,02	2,03	2,04	2,05	2,06	2,07
Amounts	50	40	10	0	0	0	0	0

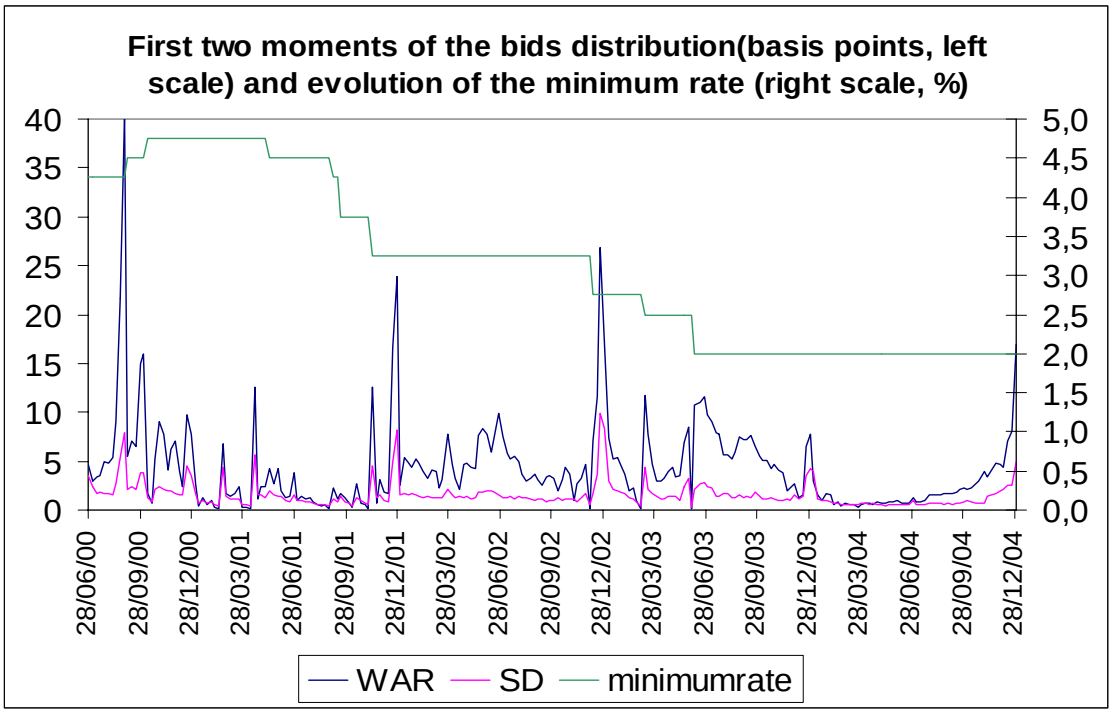
WAR in level	2,0060
WAR in spread	0,0060
SD	0,0066



The rate used to deflate the WAR is the minimum rate of the main refinancing operation.

The dataset starts with the first variable rates MRO in June 2000 till August 2004, thus covering the recent changes in the operational framework.
In order to ease the comparisons across time, we express the WAR in term of spread from the minimum rate.

Chart 1



Descriptive statistics of the series.

	WAR (spread in bp)	SD (in bp)
Mean	4,403	1,617
SD	4,764	1,370
Max	40,214	9,931
Min	0,073	0,347

Of course, the WAR and the dispersion of bids are closely correlated. We did not study the skewness and the kurtosis of the distribution because these statistics are sensitive to non-typical bids in terms of rate (very high rate for a very small amount) and their interpretation is less straightforward.
The chart 1 clearly shows that the WAR is mainly driven by calendar effects. The largest two peaks occurred at the end of the year 2001 and 2002. The other peaks in the WAR took place either in case of interest rate hike expectations or immediately after a rate cut. The former is simply the pricing of the likelihood of an increase in the minimum rate ahead the maturing of the operation[3]. The latter took place just after some falls in the minimum rate. In this case, the EONIA rate and the WAR can sometimes gradually decrease after the rate cut with a small lag of one or two weeks. As a consequence, the spread between the WAR and the minimum rate might soar just after a rate cut because the spread is calculated using a lower minimum rate and the lowering of the minimum rate offsets the decrease in the WAR.

[3] Those increases in WAR occurred over the year 2000.

As regards the absolute level of the average bid, data highlights a spread of 1.3 basis point between the OIS swap rate and the WAR. On average the spread between the WAR and the average rate of the successful bids is equal to 0.9 basis point, meaning that the actual cost of funding in the auction is slightly below the midpoint of the OIS swap (0.6 bp). This result is consistent with the basic outcome of the theoretical literature about the auction mechanism, namely the presence of underpricing in primary markets.[4] We can nevertheless point out that the underpricing is very modest in the case of the MRO.

- **Market data**

We used a wide range of market interest rates in order to assess market conditions. The interest rates introduced in the sample are the EONIA, the OIS Swap (7 and 15 days), the Euribor one month, and the Eurepo. For the sake of convenience, all the rates are expressed in spread from the minimum rate, except the Euribor which is introduced in difference from the OIS swap rate (Euriborswap variable). As regards the OIS swap, we created a dummy equal to zero if the spread two weeks OIS minus the minimum rate is negative and we multiply this dummy by the OIS swap in order to catch in case of rate cut expectations the possible asymmetry effect of the OIS swap.

The rates are considered the day of the announcement of the tender (usually on Monday). Although the counterparties have the possibility to submit bids until 9:30 a.m. on the calibration day of the MRO (usually on Tuesday), we think it is preferable to use data the day of the announcement because the final market rates of the calibration day are completely unknown when the treasurers submit their bids early in the morning.

We also included in the dataset historic volatility indicators (OIS swap on 7 and 15 days, the EONIA rate, the Euribor one month). We calculated the volatility over 5 business days, given that the tenders are weekly.

- **Calendar regularities.**

Since the window dressing activities modify the market rates and the bidding behaviour, we introduced in the dataset dummies variables in order to take into account the calendar effects for:

-the last two tenders of the year;
-the last tender of each month;
-the last tender of each maintenance period.

- **Liquidity conditions.**

Several variables are included in the dataset in order to sum up the liquidity conditions. The following indicators are defined:

-the theoretical daily reserve surplus: number of days since the beginning of the maintenance period multiplied by the estimation of the daily level of excess reserves. This indicator is a raw estimation of how high the reserves surplus should be, for any day within the maintenance period;

-the liquidity situation indicator is the accumulated daily reserves surplus minus the theoretical one.

We also added into the dataset the accumulated daily surplus.

[4] For further details on this issue: see Nyborg, Rydqvist and Sundaresan 2002.

Given that the liquidity conditions are especially relevant at the end of the maintenance period, we created a second set of variables which is equal to the first one multiplied by a dummy variable equal to zero except for the last tender of each maintenance period. This new set of liquidity condition variables takes into account the growing importance of the liquidity situation within the period since the variables equal zero except for the last tender of each maintenance period.

IV/ The regression analysis.

Estimate a regression enables us to assess the impact of each variable on the spread between the weighted average rate of bids and the minimum rate.
By estimating a linear relation between the weighted average rate of bids and the variables described above we need to deal with two difficulties: the collinearities between explanatory variables and the non-linearity due to the presence of a minimum rate.

As regards the fist issue, there is a strong correlation between the OIS swap rate and the Euribor one month (0.8). Moreover, correlations between the swap rate, the calendar events and the liquidity situation are also significant. These difficulties have been addressed by the use of new variables uncorrelated with the swap rate. Information included in the Euribor rate has been taking into account by considering the spread between the OIS swap and the Euribor (euribor_swap). Furthermore, the regression between the swap rate and the other variables (calendar events and the liquidity situation) has been carried out in order to get a swap series uncorrelated with the other explanatory variables. Indeed, the residuals of this regression represent information included in the swap series which is not correlated with the remaining variables of the dataset (see annex for further details).

As regards the non-linear response of the weighted average rate to the market rates, we decided to implement a simple dichotomy between "normal" situations i.e. when the swap rate is above the minimum rate and situations when an underbidding can occur i.e. when the swap rate is below the minimum rate.

Comments on the outcomes of the regression

The regression provides the following outcomes.

Ceteris paribus, impact of the following variables on the weighted average rate of bids

	Impact on the spread WAR minus minimum rate in bp
Increase in the swap rate by 1 bp when it is negative	0.763
Increase in the swap rate by 1 bp when it is negative	0.287
Increase in the swap between the 1 month euribor and the 2-week swap by 1 bp	0.062
Increase in the accumulated reserve surplus by 1 billion	-0.021
Increase in the volatility of the swap rate by 1 bp	0.304
Last tender of the year	9.932
Penultimate tender of the year	9.517
Last tender of the month[5]	1.699
Last tender of the maintenance period	1.433
Constant term	2.128

[5] The effects of the calendar variables are cumulative, for instance the impact of the last tender of the year is equal to 9.15 +1.69 = 10.84 bp.

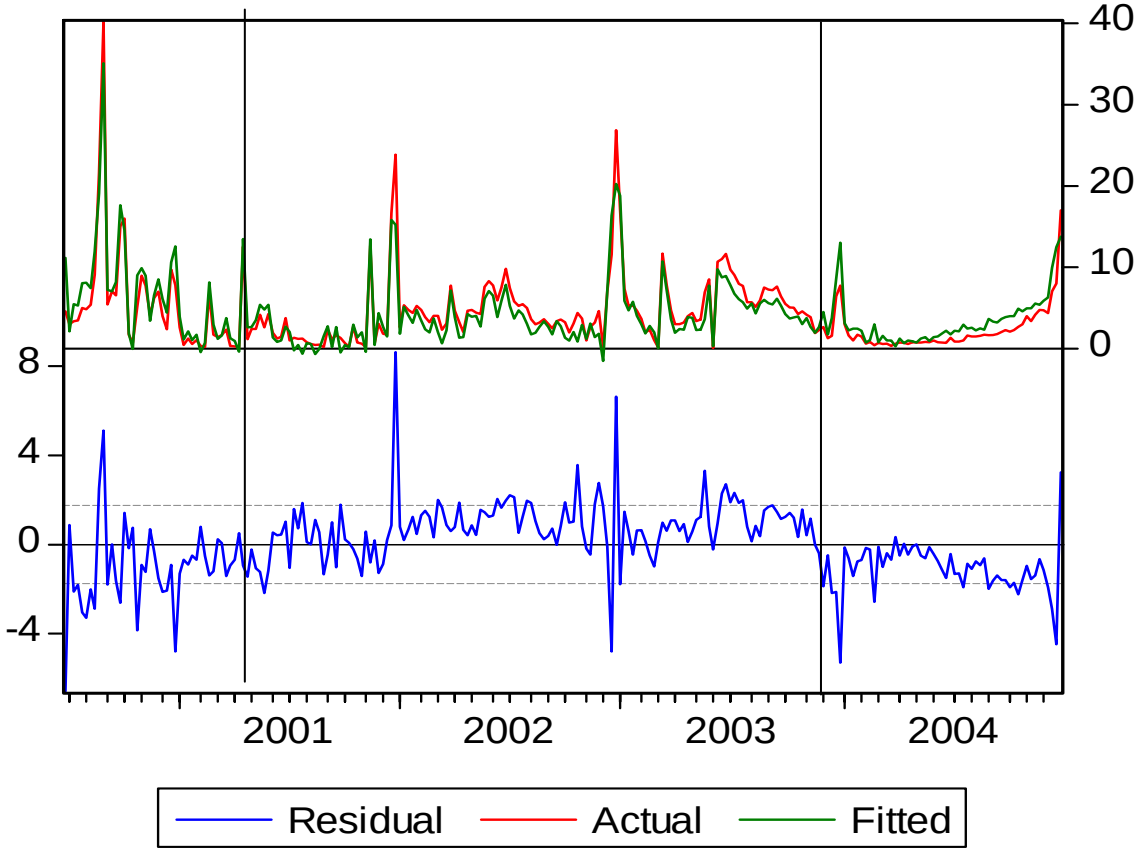
The regression illustrates the fact that the bidding behaviour is mainly driven by the swap rate market. Thus, an increase in the OIS swap rate of one basis point leads to a rise in the WAR by 0.76 basis point. This parameter is slightly higher than in Nyborg, Bindseil and Strebulaev (2002) since they found that an increase in the swap rate by 1 basis point led to a rise in the WAR by 0.72 basis point[6]. When the swap rate is negative, its effect on the WAR is lower due to the presence of a floor (the minimum rate). This asymmetry comes from the presence of the minimum rate which reins in the shade of the bids in case of rate cut expectation.
The interest rate expectations are almost fully incorporate into the swap rate since the effect of the spread between the one month Euribor and the swap rate has a very low impact (0.06) on the WAR. Moreover, the significance of the coefficient is not robust to the introduction of the repo rate in the regression.[7]
The volatility of the swap plays a light but significant role. This result is consistent with the idea of a risk premium linked to volatility included in weighted average rate. When volatility increases, the choice of having recourse to the market for satisfying liquidity needs becomes riskier, as a consequence, banks respond to this growing uncertainty about the expected cost of refinancing on the market by raising the aggressiveness of their bids.
As regards the effect of the calendar events, the outcomes illustrate the relevance of the window dressing behaviours in the understanding of the fluctuations of the WAR. The significance of the variable which takes into account the effect of the last tender of the maintenance period indicates that there is a kind of insurance premium which is paid by the bank to get higher liquidity volumes to fulfill their reserve requirements more easily during the last days of the maintenance periods.

The stability of the regression.

As regards the stability of the regression, the analyze of the recursive coefficient shows that the main coefficients of the model are quite stable except the intercept which has a bell shape, being increasing on the first part of the sample before gradually going down. The correlogram of the residuals confirm the presence of a significant autocorrelation since the first order autocorrelation coefficient is equal to 0.34. The model estimated on the whole sample systematically overestimates the WAR at the beginning and at the end of the sample. Rather than using econometrics methods to tackle this autocorrelation problem we have thought that one should interpret this autocorrelation as a clue indicating that some structural breaks could have occurred during the period.

[6] However our methodology is slightly different since we split the swap series depending on the sign of the swap spread. If we do not split the swap series the swap coefficient is equal to 0.63. This discrepancy with the estimation of Nyborg, Bindseil and Strebulaev can also be explained by the use of a different time sample.
[7] The repo rate plays an important role in the determination of the bidding behaviour, unfortunately data about the Eurepo rate has been available only since March 2002. It obliges us either to shorten the sample or to renounce using these series. We chose not to use the repo variable, in order to use the whole sample and ease the comparisons between time samples. See annex 5 for further a regression using the repo variable.

Chart 2: Spread between the WAR and the minimum rate



A Chow test has been carried out so as to confirm the presence of structural changes in the bidding behaviour. We used the Chow statistic in order to determine the best breaking points. We found that the first break took place just after the end of the interest rate expectation period, namely around March-April 2001, whereas the second breaking point occurred in November 2003. As a consequence, three new regressions have been estimated on the three sub-samples.

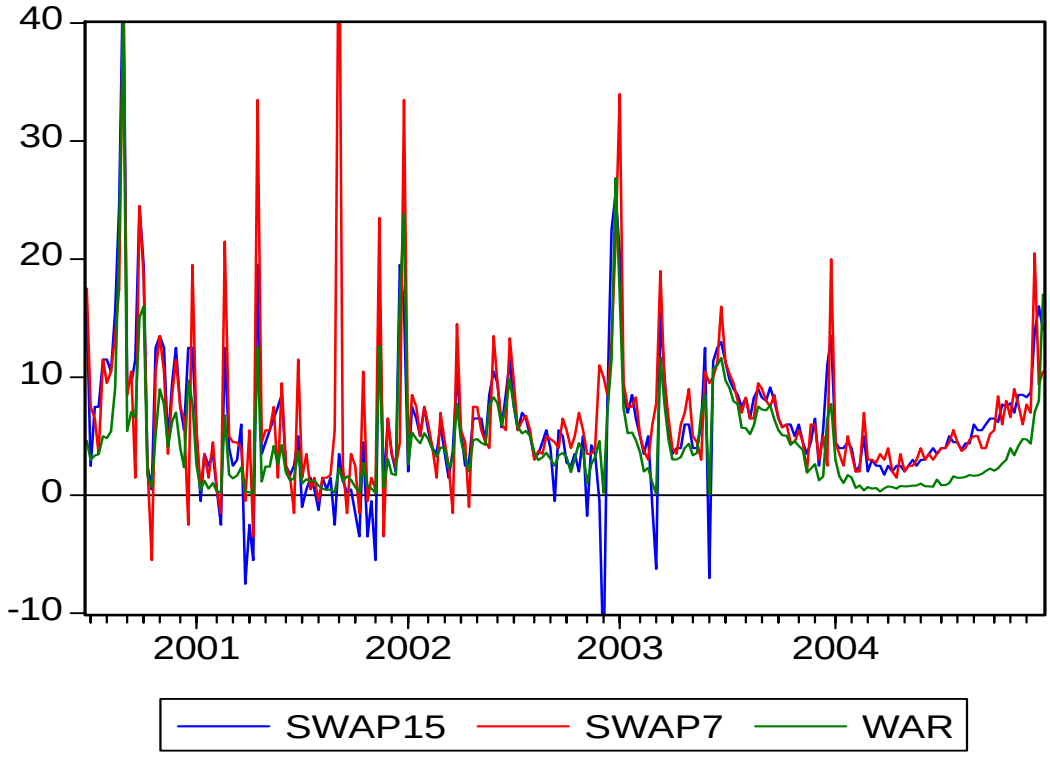
Coefficients of the explanatory variables for the three sub-sample.

	June00–Dec04	June00-April01	May01-Nov03	Dec 03- Dec 04
OIS_POS	0.763 ***	0.84 ***	0.705 ***	0.527 ***
OIS_NEG	0.287 ***	0.162 **	0.328 ***	NA
EURIBORSWAP	0.062 **	0.096	0.061 ***	0.167 **
RESERVE	-0.021 ***	-0.02 ***	-0.026 ***	-0.007
VOLSWAP	0.304 ***	0.491 **	0.105	0.317 ***
LAST_YEAR	9.932 ***	8.467 ***	12.574 ***	10.214 ***
LAST_YEAR1	9.517 ***	9.037 ***	14.057 ***	6.834 ***
LASTMONTH	1.699 ***	0.09	1.495 ***	1.755 ***
LASTTENDER	1.433 ***	1.973 ***	0.898 ***	1.172 ***
C	2.128 ***	0.275	3.496 ***	0.608
Adjusted R-squared	0.85	0.94	0.90	0.87
First order autocorrelation	0.34	0.03	0.11	-0.08

NB: *** indicates that the coefficient is significant with an alpha threshold of 1 %; ** indicates that the coefficient is significant with an alpha threshold of 5 %.

The main feature of the last period is a strong decrease in the values of the swap coefficient (from 0.70 to 0.52) and the intercept (from 3.49 to 0.6). It is important to underline that the decrease in the influence of the 2-week swap is not the consequence of a switch of the attention of the market participants from the 2-week to the 1-week swap because the 2-week swap is still more closely correlated with the WAR than with the 1-week swap.

Chat 3: A break in the relation between the swap rates and the WAR in 2004.

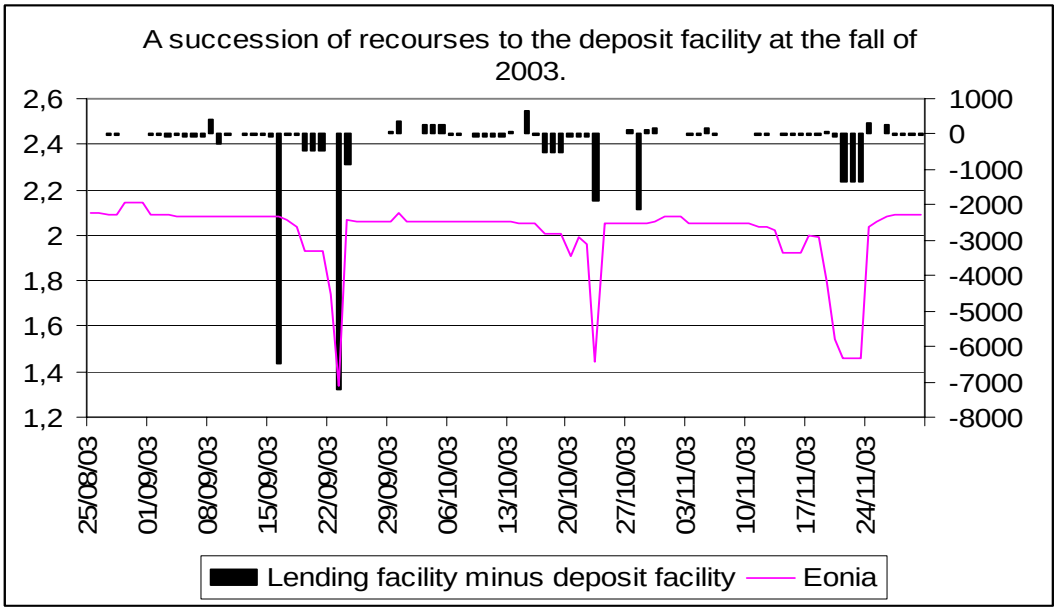


Moreover, the coefficient taking into account the impact of the reserves requirement fulfilment becomes non-significant for this period.
This leads us to interpret those outcomes as the consequence of a sharp reduction in the aggressiveness of the biding behaviour.

V/ Explanations of the results.

We identified a serious shift in the bidding behaviour around the end of November 2003. Ceteris paribus this modification results in a decrease in the aggressiveness of the bidding behaviour by at least one basis point.
This evolution is likely to be explained by the conjunction of two factors, the first one was temporary whereas the second one is structural.

♦ **The consequence of the ECB's policy allotment at the fall of 2003 on the bidding behaviour between December 2003 and February 2004.**



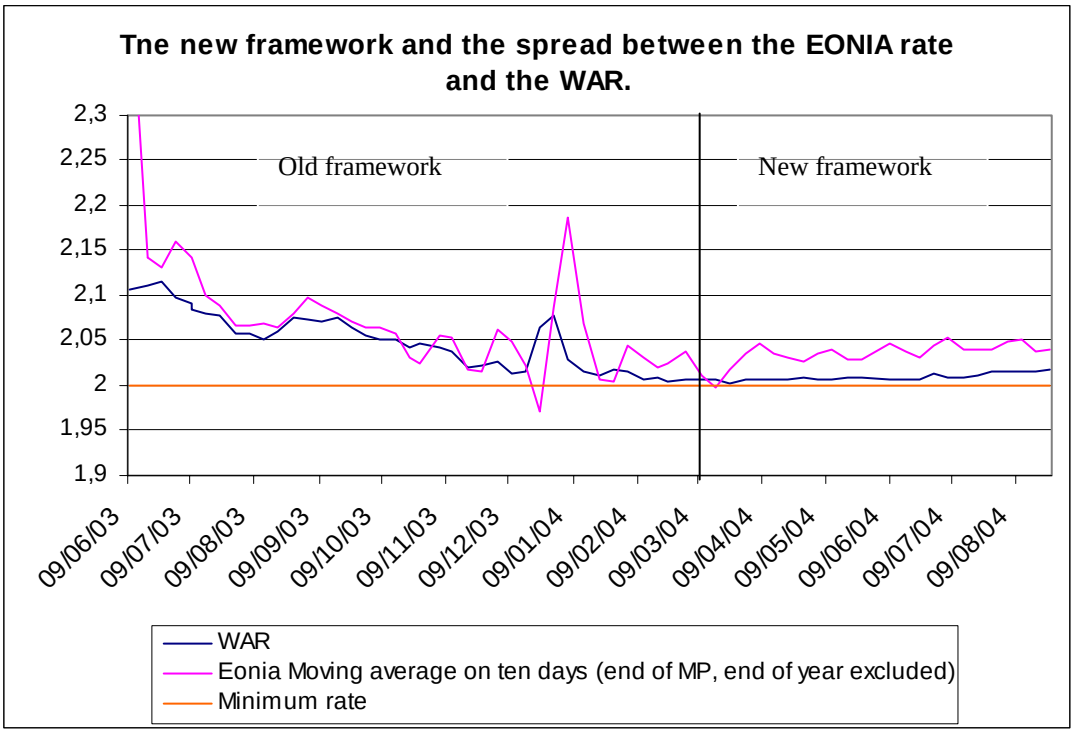
The period between July 2003 and November 2003 was featured by high level of the Eonia over the whole length of the different maintenance periods. The spread between the Eonia and the minimum rate was comprised between 5 to 10 bp. In order to cope with this situation the ECB decided to allot more liquidity than the amounts strictly needed by the level of autonomous factors. As a consequence, the skew introduced in the calibration of the MROs and some autonomous factors forecasting errors led to several decreases in the overnight rate at the end of the maintenance periods in September, October and November.

Experience taught us that the money market is sometimes backward looking, therefore, the ECB's loose policy might had been taking into account by the treasurers with a lag. This phenomenon could explain the modification of their bidding behaviour at the end of November 2003 till the modification of the operational framework despite the fact that the ECB's policy became again strictly neutral during this period.

♦ **The change in the operational framework.**

The change of the operational framework provided three modifications:
- the shortening of the MRO maturity from two weeks to one week;
- the length of the maintenance periods has become variable in order to avoid having variations of the minimum rate during a single maintenance period;

- the communication policy toward the market has been amended, in order to make the assessment of the liquidity conditions easier for the market participants.



There is no obvious link between the implementation of those reforms and the modification of the bidding behaviour described in the previous paragraph. Nevertheless the analysis of the data and informal discussions with treasurers incite us to put forward the following hypothesis.

♦ The shortening of the MRO maturity could have prompted the bidders to increase the level of their opportunistic bids. Indeed, under the new framework, the shortage of liquidity implied by a non-successful bidding strategy (a too low weighted average rate) is limited to one week, therefore the risk associated with an aggressive strategy could appear lower. This effect is likely to be very low for banks which have a cheap access to the liquidity in the money market because of their reputation and their corresponding low counterparty risk, but for banks for whom the various funding sources are not close substitutes, the length of the liquidity shortage due to a too aggressive bid could influence the average rate of bids.

♦ Following the modification of the maintenance period dates, the uncertainty regarding the evolution of the minimum rate till the end of the period fell sharply. This reduction of uncertainty could also contribute to significantly lower the average bid. Indeed in the previous operational framework, even a very low likelihood of minimum rate change could modify the WAR of bids by one or two basis points.

♦ The new communication policy has also reduced the doubts regarding the actual stance of the allotment policy. Indeed, in the previous framework, complicated calculations were necessary to compute the benchmark allotment and therefore to assess the stance of the

allotment policy. The poor accuracy of the calculations carried out by counterparties and the lack of information regarding some important parameters necessary to compute the exact level of the benchmark allotment (such as the level excess reserves for instance) led to serious discrepancies between the various estimations of the benchmark allotment by the banks[8]. This uncertainty (whatever real or exaggerated) about the ECB's behaviours entailed an uncertainty regarding the Eonia rate dynamic and therefore the pricing of a risk premium was included in the WAR of bids. Under the new framework, this uncertainty has been dramatically reduced because the level of the benchmark allotment is explicitly published on the wire services.

- At the same time, the volatility of the Eonia rate has fallen since March 2004, especially at the beginning of each maintenance period.

All days except the last four business days of each maintenance period

New framework (till Oct)	EONIA - minimum rate (in bp)
MEAN	5,5
SD	17,0
Root mean square spread	17,9

Jan 2002 –March 2003	EONIA - minimum rate (in bp)
MEAN	8,2
SD	24,8
Root mean square spread	26,1

Last four business days of each mp only.

Jan 2002 –March 2003	EONIA - minimum rate
MEAN	1,5
SD	25,0
Root mean square spread	25,0

New framework (till Oct)	EONIA - minimum rate
MEAN	11,8
SD	22,4
Root mean square spread	25,3

This decrease in the volatility should theoretically incite the treasurers to bid at a lower WAR since the volatility risk premium implicitly included in the price of a one-week-maturity financing should consequently be reduced.

Conclusion.

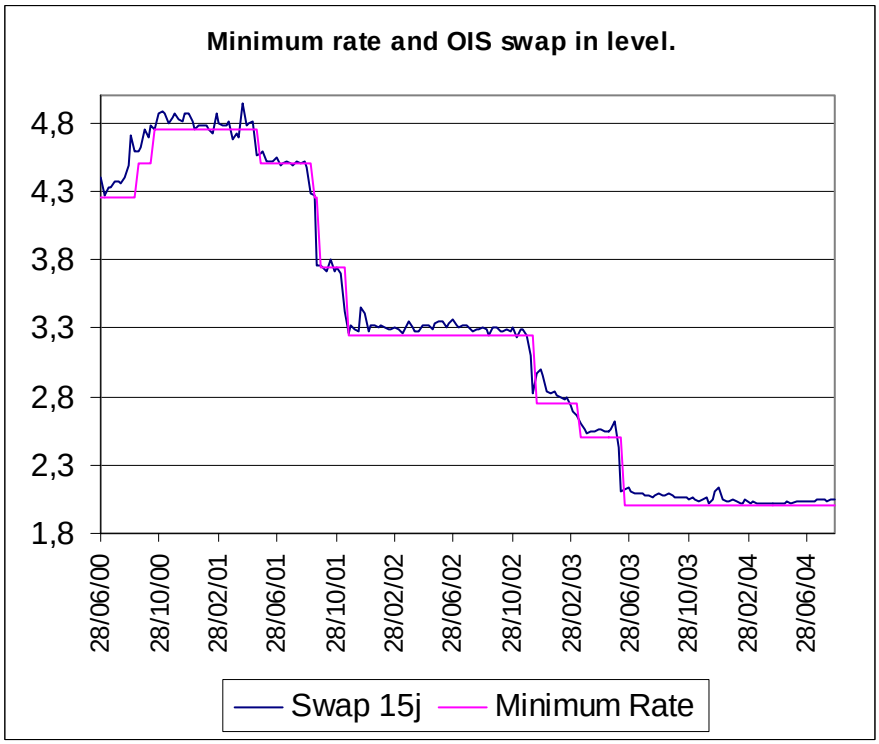
In this paper, we have tried to highlight the links between the bidding behaviour of the counterparties to the main refinancing operations of the Eurosystem and the level of the market rates in the money market. We find that the OIS swap rate play a strong but asymmetric role in the determination of the weighted average rate of the bids. We also point

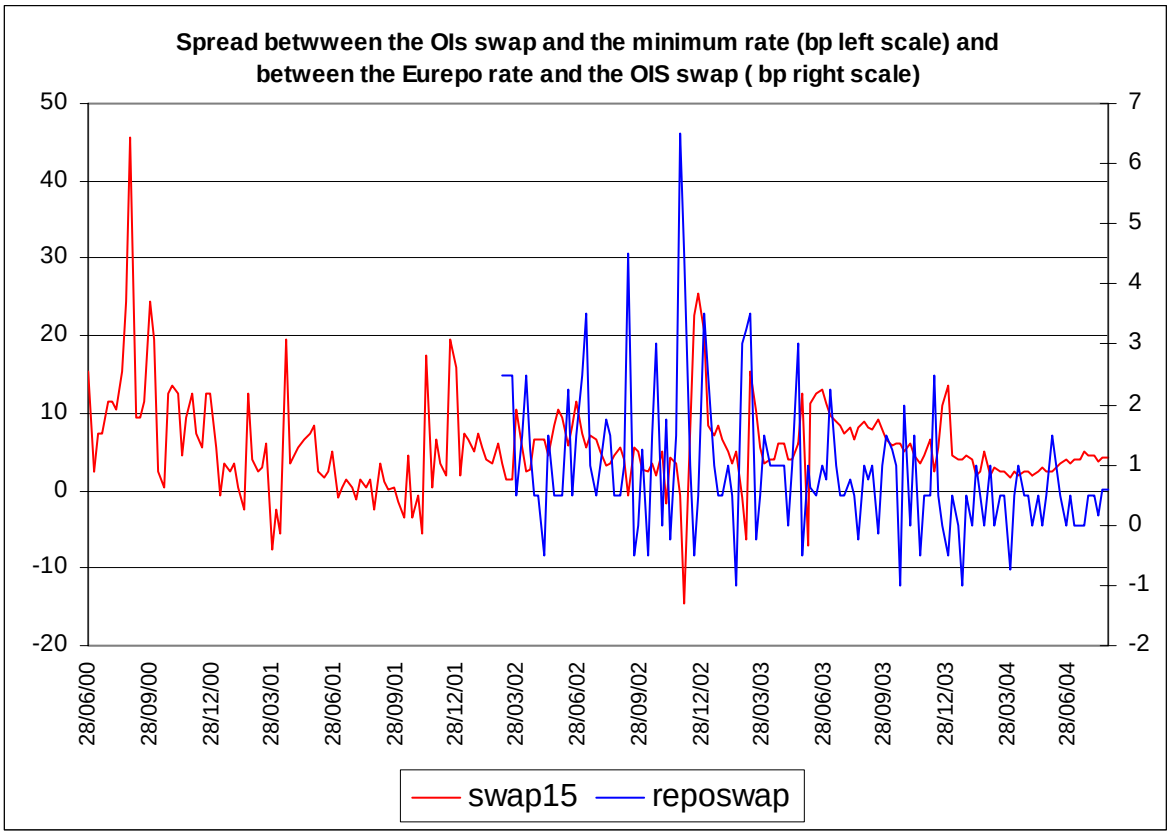
[8] The money market watch reported some differences which could reach three or four € billions between the main banks.

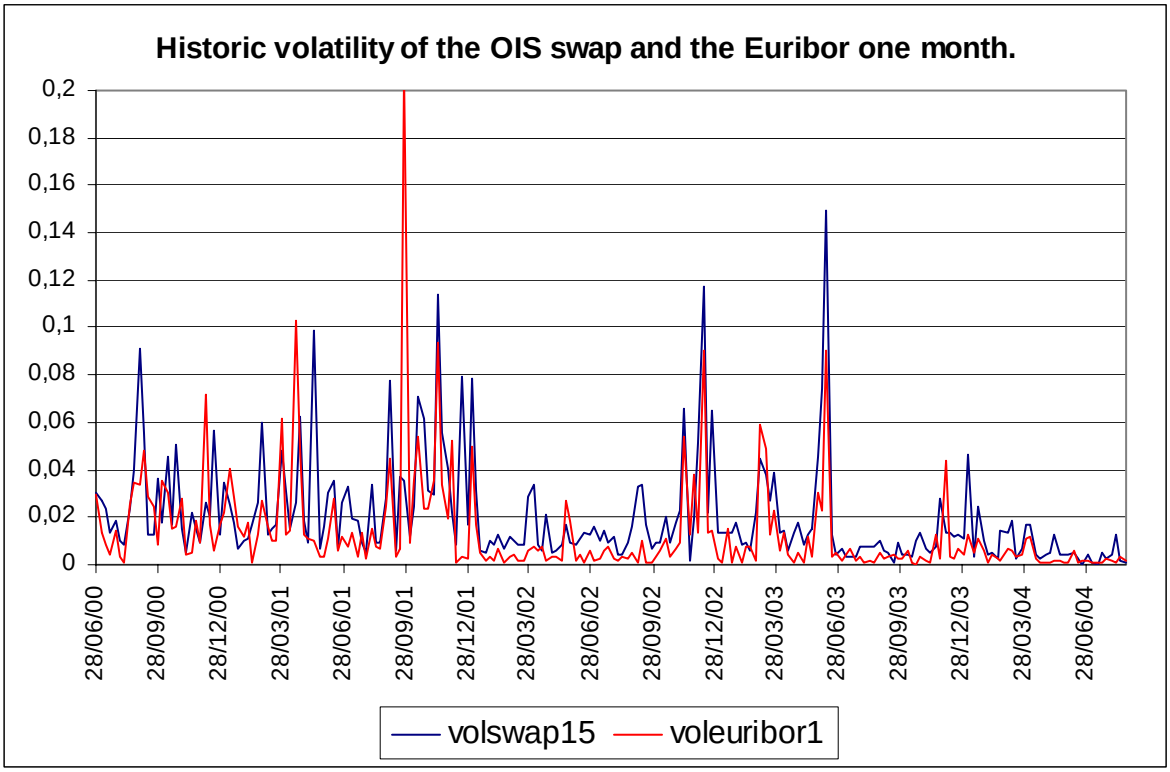
out the fact that ceteris paribus the banks have lowered their bidding rate since the end of November 2003 but one can reckon that the implementation of the new operational framework in March 2004 and the ECB's allotment policy at the end of 2003 are likely to be reasonable explanations for this evolution.

Annex 1

The dataset






Historic volatility of the OIS swap and the Euribor one month.
0,2
0,18
0,16
0,14
0,12
0,1
0,08
0,06
0,04
0,02
0
28/06/00
28/09/00
28/12/00
28/03/01
28/06/01
28/09/01
28/12/01
28/03/02
28/06/02
28/09/02
28/12/02
28/03/03
28/06/03
28/09/03
28/12/03
28/03/04
28/06/04
volswap15
voleuribor1

Annex 2

Preliminary regression

In order to get an OIS swap variable completely uncorrelated with the other explanatory variables, we estimated a preliminary regression between the 2-week swap and the explanatory variables. The residuals of this equation represent the interest rate expectation not related to the other variables.

Dependent Variable: SWAP15
Method: Least Squares
Sample: 6/28/2000 12/29/2004
Included observations: 236

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAST_YEAR	7.751791	2.565110	3.022012	0.0028
LAST_YEAR1	11.18298	2.549983	4.385512	0.0000
LASTMONTH	2.415454	0.913098	2.645338	0.0087
LASTTENDER	1.847192	0.890513	2.074300	0.0392
RESERVE	-0.029874	0.011348	-2.632646	0.0090
C	4.249207	0.600027	7.081695	0.0000
VOLSWAP15	22.14294	17.70518	1.250647	0.2123

R-squared	0.200375	Mean dependent var	5.922288
Adjusted R-squared	0.179424	S.D. dependent var	5.969389
S.E. of regression	5.407411	Akaike info criterion	6.242630
Sum squared resid	6695.983	Schwarz criterion	6.345371
Log likelihood	-729.6304	F-statistic	9.564012
Durbin-Watson stat	0.966049	Prob(F-statistic)	0.000000

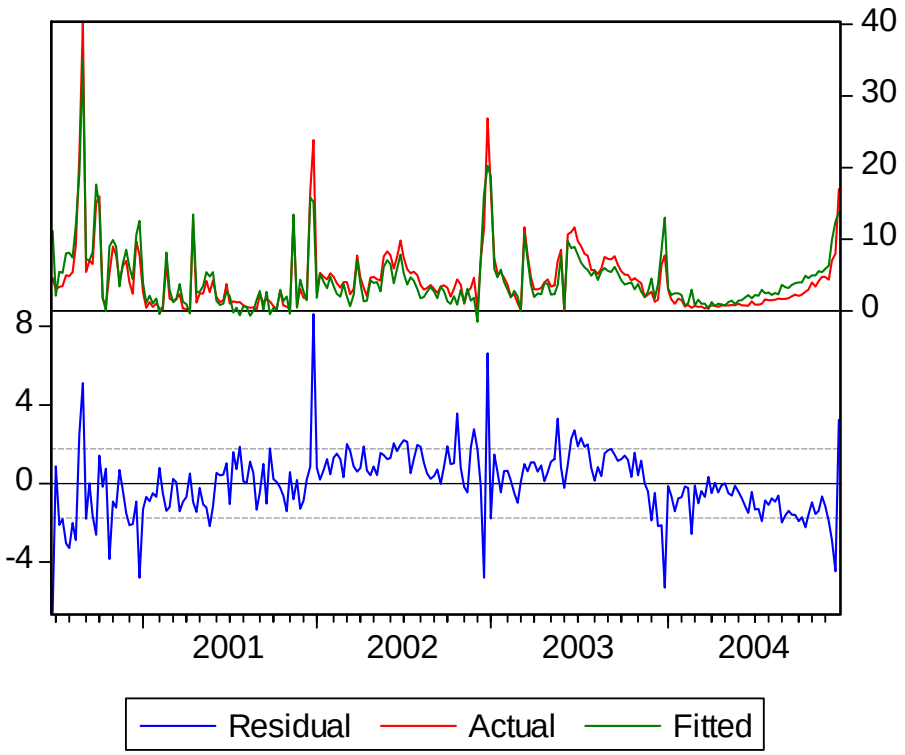
Annex 3
Details about the different regressions.

Whole sample: period June 2000 –December 2004.

Dependent Variable: WAR
Method: Least Squares
Sample: 6/28/2000 12/29/2004
Included observations: 236
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIS_POS	0.763430	0.047400	16.10602	0.0000
OIS_NEG	0.287207	0.037365	7.686561	0.0000
EURIBORSWAP	0.061850	0.024104	2.565961	0.0109
RESERVE	-0.020796	0.003081	-6.749047	0.0000
VOLSWAP	0.304034	0.055836	5.445140	0.0000
LAST_YEAR	9.932228	2.399533	4.139234	0.0000
LAST_YEAR1	9.516578	1.828202	5.205430	0.0000
LASTMONTH	1.698721	0.283753	5.986616	0.0000
LASTTENDER	1.432744	0.299364	4.785952	0.0000
C	2.127698	0.287756	7.394108	0.0000

R-squared	0.863996	Mean dependent var	4.328108
Adjusted R-squared	0.858580	S.D. dependent var	4.664148
S.E. of regression	1.753991	Akaike info criterion	4.003113
Sum squared resid	695.2852	Schwarz criterion	4.149886
Log likelihood	-462.3674	F-statistic	159.5245
Durbin-Watson stat	1.269617	Prob(F-statistic)	0.000000


40
30
20
10
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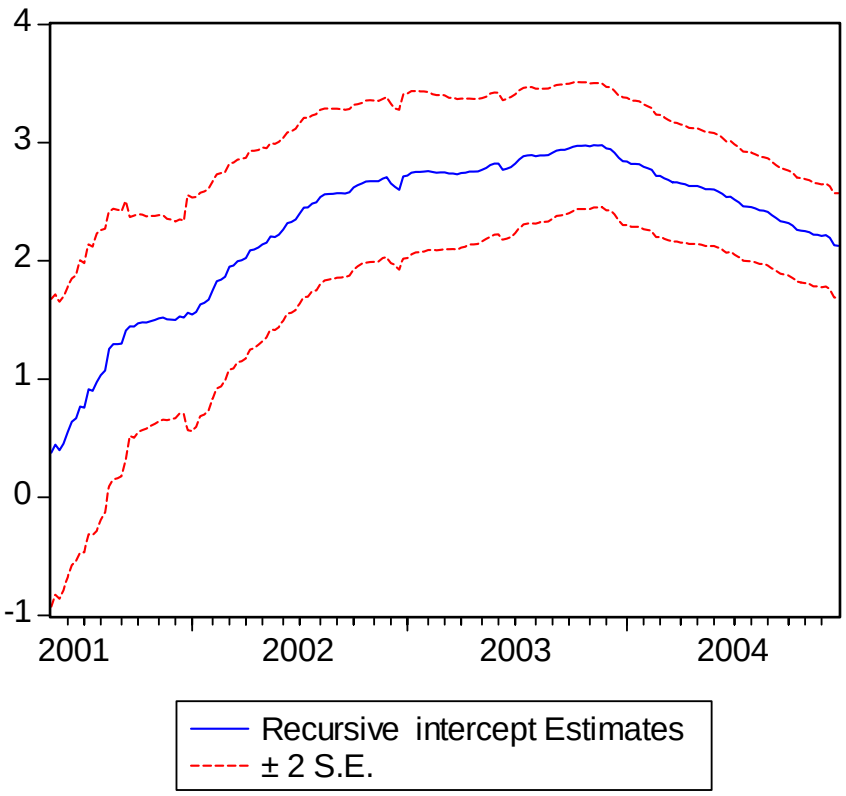
8
4
0
-4
2001
2002
2003
2004
Residual
Actual
Fitted

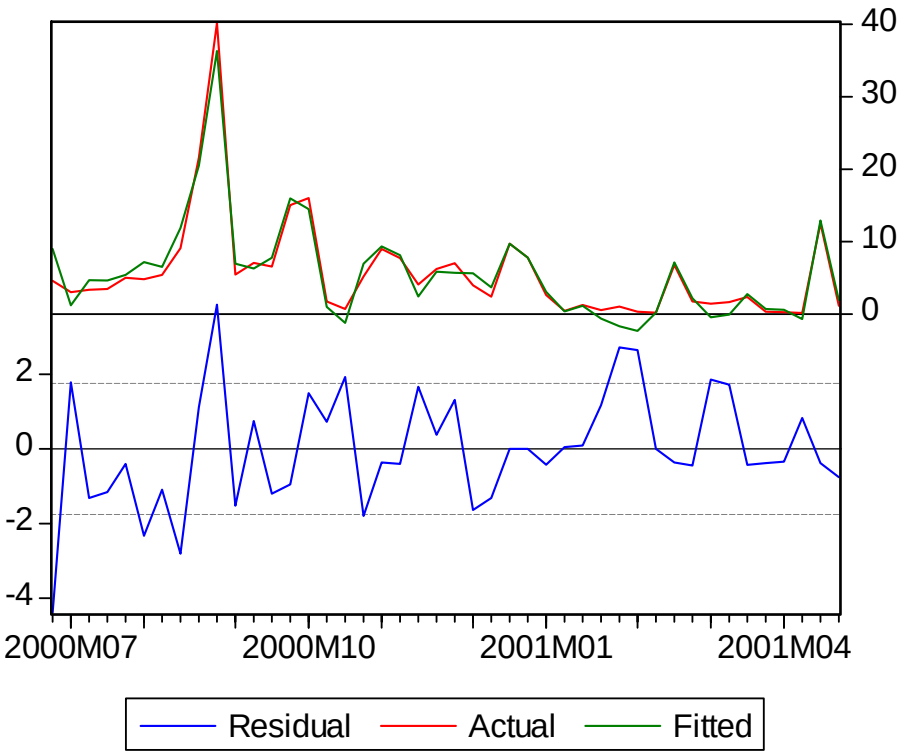

4
3
2
1
0
-1
2001
2002
2003
2004
Recursive intercept Estimates
± 2 S.E.

Period June 2000-April 2001

Dependent Variable: WAR
Method: Least Squares
Sample: 6/28/2000 4/25/2001
Included observations: 44
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIS_POS	0.840299	0.061129	13.74621	0.0000
OIS_NEG	0.161740	0.061293	2.638800	0.0125
EURIBORSWAP	0.096414	0.062893	1.532978	0.1345
RESERVE	-0.019659	0.006930	-2.836867	0.0076
VOLSWAP	0.491429	0.186738	2.631653	0.0127
LAST_YEAR	8.467250	1.263282	6.702583	0.0000
LAST_YEAR1	9.037325	0.833097	10.84787	0.0000
LASTMONTH	0.090266	0.950277	0.094990	0.9249
LASTTENDER	1.973303	0.698796	2.823860	0.0079
C	0.275201	0.955313	0.288074	0.7750

R-squared	0.950998	Mean dependent var	5.707159
Adjusted R-squared	0.938027	S.D. dependent var	7.071571
S.E. of regression	1.760417	Akaike info criterion	4.165694
Sum squared resid	105.3683	Schwarz criterion	4.571192
Log likelihood	-81.64527	F-statistic	73.31734
Durbin-Watson stat	1.736851	Prob(F-statistic)	0.000000

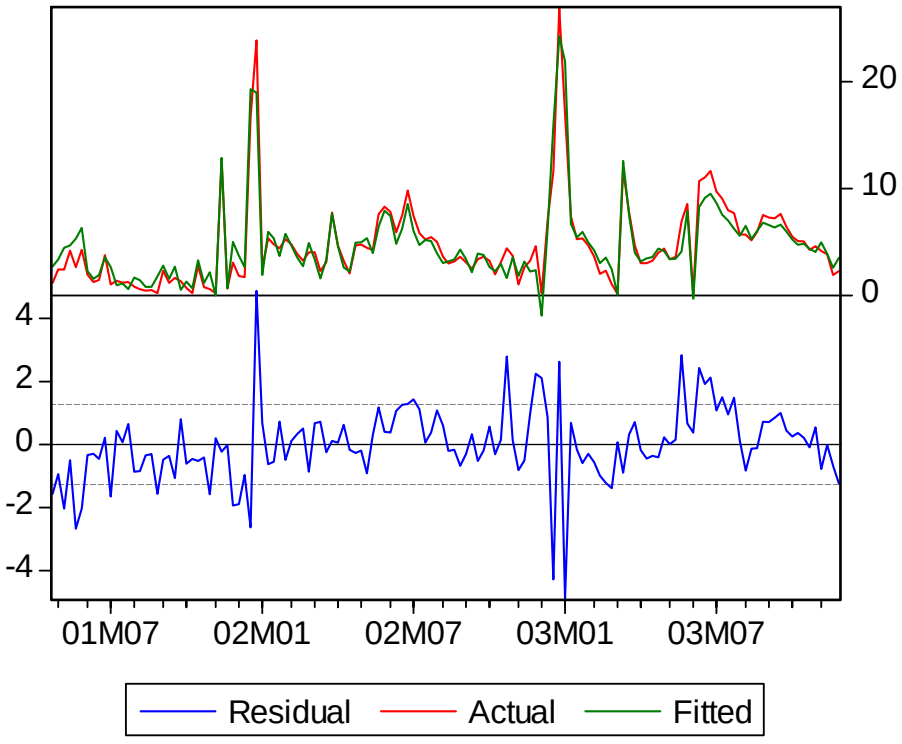

40
30
20
10
0
2
0
-2
-4
2000M07
2000M10
2001M01
2001M04
Residual
Actual
Fitted

Period May 2001-November 2003

Dependent Variable: WAR
Method: Least Squares
Sample: 4/25/2001 11/26/2003
Included observations: 136
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIS_POS	0.705138	0.073242	9.627455	0.0000
OIS_NEG	0.327936	0.051122	6.414719	0.0000
EURIBORSWAP	0.061170	0.021793	2.806847	0.0058
RESERVE	-0.025528	0.003109	-8.210086	0.0000
VOLSWAP	0.104816	0.057993	1.807400	0.0731
LAST_YEAR	12.57350	3.553082	3.538758	0.0006
LAST_YEAR1	14.05676	2.335203	6.019503	0.0000
LASTMONTH	1.494569	0.195688	7.637524	0.0000
LASTTENDER	0.897526	0.336052	2.670793	0.0086
C	3.495839	0.171997	20.32503	0.0000

R-squared	0.909097	Mean dependent var	4.707158
Adjusted R-squared	0.902604	S.D. dependent var	4.059590
S.E. of regression	1.266933	Akaike info criterion	3.381762
Sum squared resid	202.2452	Schwarz criterion	3.595928
Log likelihood	-219.9598	F-statistic	140.0097
Durbin-Watson stat	1.752881	Prob(F-statistic)	0.000000

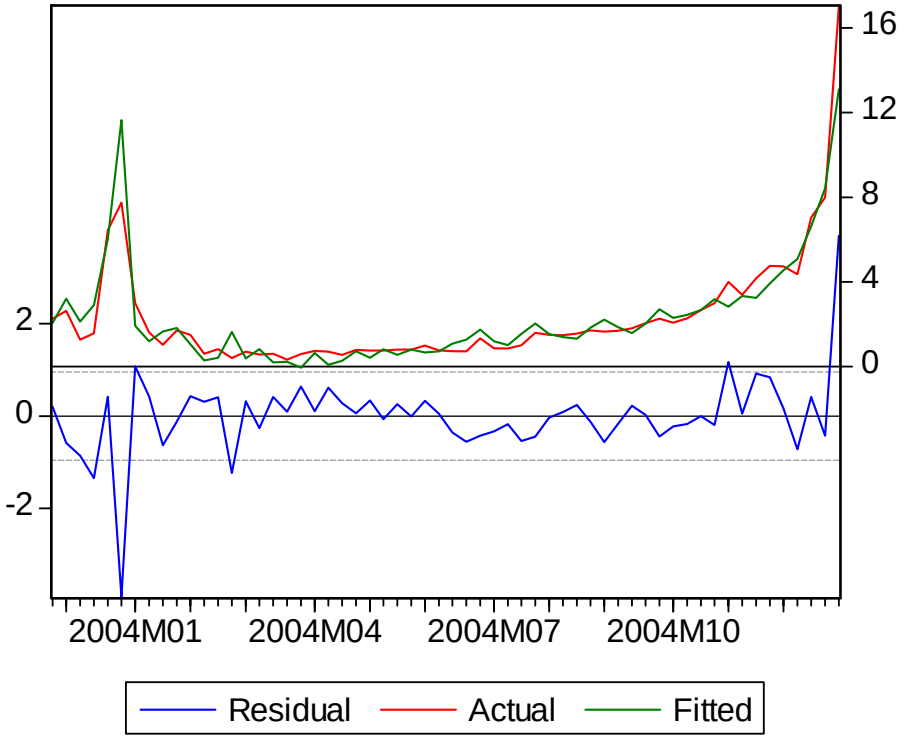


Period December 2003-December 2004

Dependent Variable: WAR
Method: Least Squares
Sample: 11/26/2003 12/29/2004
Included observations: 58
Newey-West HAC Standard Errors & Covariance (lag truncation=3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIS_POS	0.527337	0.038264	13.78150	0.0000
EURIBORSWAP	0.166740	0.076227	2.187409	0.0335
RESERVE	-0.006840	0.008807	-0.776654	0.4411
VOLSWAP	0.317226	0.101691	3.119528	0.0030
LAST_YEAR	10.21423	3.109608	3.284732	0.0019
LAST_YEAR1	6.834326	0.346754	19.70944	0.0000
LASTMONTH	1.755192	0.148056	11.85490	0.0000
LASTTENDER	1.172235	0.225463	5.199245	0.0000
C	0.608488	0.316166	1.924586	0.0601

R-squared	0.891069	Mean dependent var	2.302892
Adjusted R-squared	0.873284	S.D. dependent var	2.682990
S.E. of regression	0.955068	Akaike info criterion	2.887653
Sum squared resid	44.69555	Schwarz criterion	3.207377
Log likelihood	-74.74193	F-statistic	50.10329
Durbin-Watson stat	1.895692	Prob(F-statistic)	0.000000



Annex 5
Introduction of the repo rate in the explanatory variables.

The repo series is the 2-week Eurepo. It begins in June 2002. The variable reposwap is the spread between the Eurepo rate and the 2-week OIS swap. This variable has a positive mean because the Eurepo rate is a bid rate whereas the OIS swap is a mid-point price. The bid-ask spread makes the reposwap a positive variable although the repo rate is of course below the swap rate on average. Nevertheless this complication doesn't preclude us from interpreting the coefficient as the effect of an increase in the repo rate by one bp, other things being equals.

Dependent Variable: WAR
Method: Least Squares
Sample (adjusted): 3/06/2002 12/29/2004
Included observat: 148 after adjustments
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIS_POS	0.826853	0.070769	11.68380	0.0000
OIS_NEG	0.468872	0.053521	8.760591	0.0000
REPOSWAP	0.831309	0.085328	9.742464	0.0000
RESERVE	-0.015263	0.002303	-6.626981	0.0000
VOLSWAP	0.378647	0.040626	9.320304	0.0000
LAST_YEAR	8.193200	2.585744	3.168605	0.0019
LAST_YEAR1	9.784691	2.204554	4.438400	0.0000
LASTMONTH	1.962432	0.203356	9.650243	0.0000
LASTTENDER	1.678932	0.329290	5.098645	0.0000
C	1.817494	0.200601	9.060222	0.0000

R-squared	0.881438	Mean dependent var	4.245386
Adjusted R-squared	0.873706	S.D. dependent var	3.675236
S.E. of regression	1.306103	Akaike info criterion	3.437149
Sum squared resid	235.4148	Schwarz criterion	3.639663
Log likelihood	-244.3490	F-statistic	113.9941
Durbin-Watson stat	1.805985	Prob(F-statistic)	0.000000

The coefficient of the reposwap is very high since an increase in the repo rate leads to an increase in the WAR by 0.83%. This result is not surprising because the repo market is a natural source of secure funding for the Eurosystem counterparties, therefore it seems natural that the evolutions of the repo rate influence the bidding behaviour.

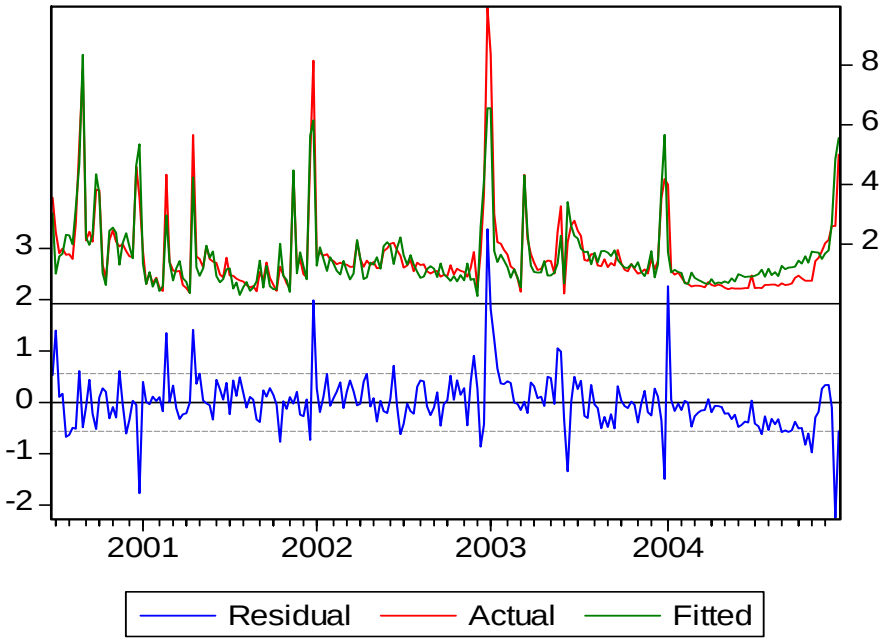
Annex 6
Regressions of the standard deviation of bids.

Given the high correlation between the mean and the standard deviation of the average bid, the regression is very similar to the regression fitted for estimate the WAR.

Dependent Variable: SD
Method: Least Squares
Sample: 6/28/2000 12/29/2004
Included observations: 236
Newey-West HAC Standard Error& Covariance (lag truncation=4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIS_POS	0.159574	0.011034	14.46261	0.0000
OIS_NEG	0.073436	0.010814	6.790758	0.0000
RESERVE	-0.009212	0.001504	-6.125113	0.0000
EURIBORSWAP	0.018581	0.008183	2.270616	0.0241
VOLSWAP	0.101648	0.025609	3.969255	0.0001
LAST_YEAR	4.229602	0.742637	5.695386	0.0000
LAST_YEAR1	3.624592	0.886132	4.090352	0.0001
LASTMONTH	0.312934	0.063539	4.925090	0.0000
LASTTENDER	0.388569	0.100282	3.874761	0.0001
C	0.964110	0.081597	11.81547	0.0000

R-squared	0.828972	Mean dependent var	1.581774
Adjusted R-squared	0.822161	S.D. dependent var	1.332382
S.E. of regression	0.561878	Akaike info criterion	1.726384
Sum squared resid	71.34968	Schwarz criterion	1.873156
Log likelihood	-193.7133	F-statistic	121.7136
Durbin-Watson stat	1.519196	Prob(F-statistic)	0.000000


8
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-1
-2
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2002
2003
2004
Residual
Actual
Fitted