THE EUROSYSTEM'S MONETARY POLICY OPERATIONAL FRAMEWORK: FIRST EXPERIENCE WITH THE CHANGES OF MARCH 2004

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1 Introduction

This paper gives a brief overview on the Eurosystem's[2] operational framework for monetary policy and its performance since its inception six years ago. The operational framework has overall proved very robust and has catered for an efficient transmission of the monetary policy stance. A particular attention is given to the changes to the Eurosystem's monetary policy operational framework that were introduced in March 2004, with a view to provide an assessment of the experience under the new framework until December 2004.

The paper is organised as follows. Section 2 describes the main components of the Eurosystem's operational framework and briefly reviews the framework's performance since its inception. Section 3 reviews the major episodes of unbalanced bidding and explains the changes to the operational framework that were decided in January 2003 and became effective as of March 2004. Section 4 reviews the experience gained so far with the new operational framework by comparing the developments in the period March 2004-December 2004 (i.e. the experience under the new monetary policy operational framework) to the time of the old framework (mostly focussing on the period since June 2000, when the variable rate tender regime was started). Section 5 concludes.

2 The main components of the Eurosystem's operational framework for monetary policy and its general performance since its inception

2.1 The main components of the Eurosystem's operational framework for monetary policy

It is generally useful to distinguish the ECB's monetary policy strategy from the Eurosystem's operational framework. The former describes how the relevant information on the economy is organised to provide a foundation for monetary policy decisions, the outcome of which is a certain level of short-term interest rates that is considered adequate in terms of the ECB's objective of achieving price stability. In order to achieve this objective, the ECB has at its disposal a set of monetary policy instruments and procedures.[3] This set forms the operational framework for monetary policy, which is used by the ECB to steer the short-term market interest rates. The desired level of interest rates is signalled to the financial markets through the rates of the main refinancing operations and the standing facilities. So far, the former has been either the minimum bid rate of variable rate tenders or the rate applied to fixed rate tenders.

The main components of the Eurosystem's monetary policy operational framework are the open market operations, the standing facilities, and the minimum reserve system.

Open market operations play an important role in the monetary policy of the Eurosystem for the purposes of steering interest rates, managing the liquidity situation in the market and signalling the stance of monetary policy. While in principle more types of instruments are available to the Eurosystem, recourse

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2 For the sake of simplicity, the terms "ECB" and "Eurosystem" are used interchangeably throughout this paper.

3 See also "The implementation of monetary policy in the euro area - General documentation on Eurosystem monetary policy instruments and procedures", February 2004 and The Monetary Policy of the ECB, 2004.

is made at present to main refinancing operations (MROs), to longer-term refinancing operations (LTROs), and to fine-tuning operations (FTOs):

- MROs are regular liquidity-providing reverse transactions with a weekly frequency. Until March 2004, MROs had a maturity of two weeks, so that two operations of this type were outstanding at any point in time. Since March 2004, the maturity has been reduced to one week. MROs are the most important open market operations, signalling the stance of monetary policy, playing a key role in the steering of interest rates and managing the liquidity situation in the market. They provide the bulk of refinancing to the financial sector. A broad range of monetary policy counterparties can participate to MROs.
- LTROs are liquidity-providing reverse transactions with a monthly frequency and a maturity of normally three months. In these operations, the Eurosystem does not, as a rule, intend to send signals to the market and therefore normally acts as a rate taker.
- FTOs are executed on an *ad hoc* basis with the aim of managing the liquidity situation in the market and steering interest rates, in particular in order to smooth the effects on interest rates caused by unexpected liquidity fluctuations in the market. FTOs are primarily executed as reverse transactions, but can also take other forms.

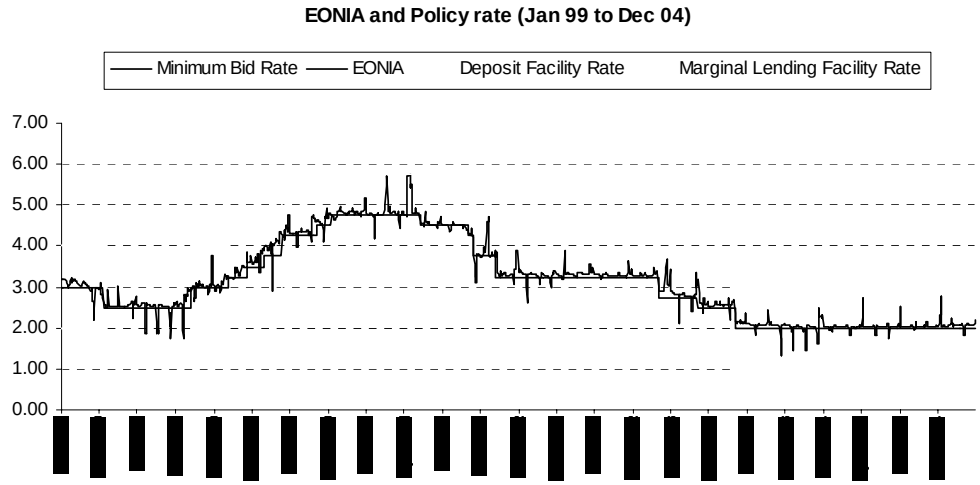
Standing facilities aim to provide and absorb overnight liquidity, signal the general stance of monetary policy and bound overnight market interest rates. Two standing facilities are available to eligible counterparties on their own initiative, subject to their fulfilment of certain operational access conditions. Counterparties can use the *marginal lending facility* to obtain overnight liquidity from the national central banks against eligible assets. The interest rate on the marginal lending facility normally provides a ceiling for the overnight market interest rate. Furthermore, counterparties can use the *deposit facility* to make overnight deposits with the national central banks. The interest rate on the deposit facility normally provides a floor for the overnight market interest rate.

Finally, the Eurosystem's minimum reserve system applies to credit institutions in the euro area and primarily pursues the aims of stabilising money market interest rates and creating or enlarging a structural liquidity shortage. The reserve requirement of each institution is determined in relation to elements of its balance sheet. In order to pursue the aim of stabilising interest rates, the Eurosystem's minimum reserve system enables credit institutions to make use of so-called "averaging provisions". Compliance with the reserve requirement is determined on the basis of the institutions' *average* daily reserve holdings over the maintenance period. Institutions' holdings of required reserves are remunerated at the rate of the Eurosystem's main refinancing operations (fixed rate of the operation until June 2000, marginal rate of the variable rate tender after June 2000). From January 1999 until February 2004, the reserve maintenance period lasted one month, always starting on the 24th calendar day of each month and ending on the 23rd calendar day of the following month (also regardless of whether these days were TARGET operating days or not).

2.2 The framework's general performance since its inception

The main objective of the Eurosystem's operational framework for monetary policy is the steering of short term interest rates. Specific emphasis is put on the overnight rate, the starting point of the yield curve. In Chart 1, the graph of the EONIA and the ECB policy rate (the fixed rate in fixed rate tenders or the minimum bid rate in variable rate tenders) reveals that the overnight rate has tracked the ECB policy rate rather closely within the corridor formed by the rates applied on the standing facilities (deposit facility and marginal lending facility). In this regard, the framework has had considerable success.

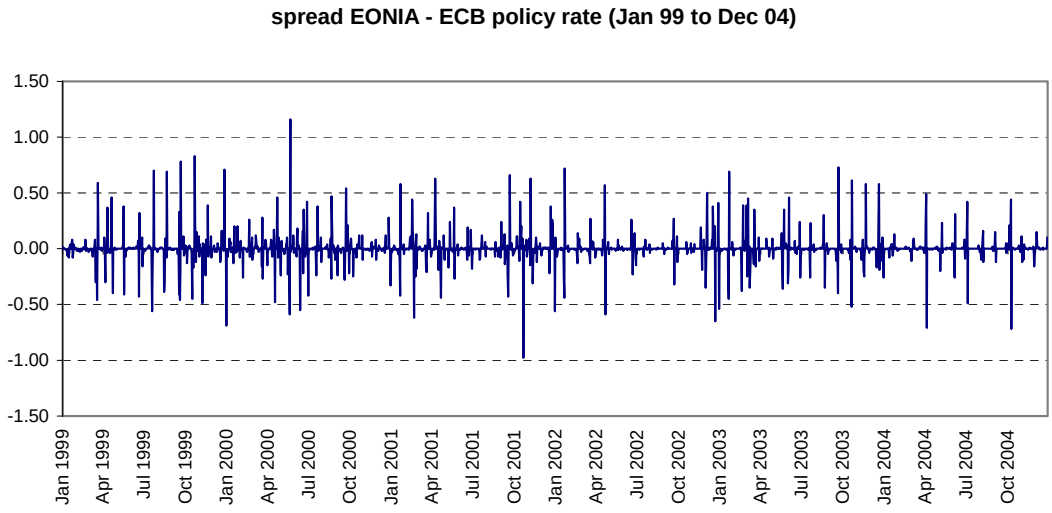
Chart 1: EONIA and ECB policy rate, 1999-2004



Source: ECB.

As is visible from Chart 2, occasional spikes occurred at the end of the maintenance period. However, this feature was not unexpected.

Chart 2: The spread between the EONIA and the ECB policy rate, 1999-2004



Source: ECB.

The volatility of the EONIA can be described for example, by the standard deviation of the spread between the EONIA and the ECB policy rate (EONIA spread), which stood at 18 basis points from 1999

until December 2004. Another measure of EONIA volatility is the standard deviation of the daily changes in the EONIA spread which was 12 basis points. It appears overall that during each reserve maintenance period, the EONIA remained quite stable.

The volatility of the EONIA is mainly attributable to two factors: first, events of unstable bidding behaviour by counterparties, and, second, end of reserve maintenance period volatility, when credit institutions have to adjust the level of their reserve holdings. This volatility has never spilled-over to longer maturities and was therefore not of relevance for the transmission of monetary policy through the economy.

In sum, the Eurosystem's framework for monetary policy implementation has generally been assessed positively since the launch of the euro in 1999. The volatility of short-term money market rates has, on average, been low in the euro area in comparison with European national money markets prior to January 1999. This is also true by international standards. The low degree of volatility has been fostered by the use of averaging provisions by the minimum reserve system, with little need for the ECB to conduct fine-tuning operations. Moreover, credit institutions have had only limited recourse to the standing facilities, indicating that the money market has been working efficiently. The small and fairly stable spread between the ECB's main refinancing rate and the short-term money market rates has also demonstrated the ECB's ability to closely steer short-term interest rates in line with its intentions.

Also, the operational framework has been robust when faced with exceptional challenges, like Y2K, the transition to the millennium year 2000, the terrorist attacks of 11 September 2001 or the euro cash changeover in January 2002.

Still, some strains emerged when high expectations of changes in the key ECB interest rates translated into unstable bidding by credit institutions in the MROs, namely episodes of "overbidding" and of "underbidding". The occurrence of overbidding was eliminated when the ECB Governing Council decided, in June 2000, to switch from the fixed rate tender to variable rate tenders. Subsequently, however, the problem of underbidding led the ECB Governing Council in January 2003 to decide on changes to the operational framework that became effective from March 2004. The next section reviews these events.

3 Measures to improve the monetary policy operational framework[4]

3.1 Episodes of unstable bidding under the old framework

A central bank's monetary policy operational framework is likely to affect short-term interest rates and credit institutions' bidding behaviour. Within the euro area, between mid-1999 and 2003, the Eurosystem witnessed several episodes of unstable bidding behaviour from credit institutions in periods of imminent expectations of interest rate changes. Such unstable bidding is composed of two types of instability, namely episodes of "overbidding" and of "underbidding".

[4] See also the article "Changes the the Eurosystem's operational framework for monetary policy", published in the ECB Monthly Bulletin in August 2003.

Overbidding refers to the phenomenon of credit institutions submitting high and even continuously increasing bids to MROs, such that the ratio between allotment and bid amounts falls to very low levels. Overbidding occurred under the regime of fixed rate tenders, when there were expectations of an imminent interest rate hike by the ECB. Due to such expectations of an increase in interest rates, the short-term money market rates stood at a level clearly above the fixed tender rate.

Several episodes of overbidding occurred in particular in the second half of 1999 and the first half of 2000, when the Eurosystem conducted the MROs through a fixed rate tender procedure in an environment of strong expectations of interest rate increases. Over that period, the allotment ratio fell to extremely low levels, dropping to as low as 0.87% on 31 May 2000. In addition to a general downward trend, this allotment ratio was volatile, implying that it was difficult for participants in the MROs to predict the amount of liquidity they would actually receive. During the overbidding period, when the corresponding market rates tended to be above the fixed tender rate, credit institutions faced difficulties in forecasting precisely the rather volatile allotment ratio and, accordingly, the risk of receiving significantly more or less liquidity in the tender than desired. Furthermore, some credit institutions felt uncomfortable to bid for amounts that exceeded the collateral they had available.

As these issues could not be addressed under a fixed rate tender system, the ECB changed the tender procedure and adopted in June 2000 the variable rate tender procedure with a minimum bid rate. The minimum bid rate in the variable rate tender plays the key role of signalling the monetary policy stance, a role which was previously performed by the rate in fixed rate tenders. This change successfully eliminated overbidding episodes.

However, under the variable rate tender regime, occasional episodes of underbidding occurred. Underbidding refers to the situation in which credit institutions submit an aggregate amount of bids which is less than the one needed to allow for a smooth fulfilment of reserve requirements in the period until the next MRO is conducted. Its consequence is that the ECB can not allot its benchmark allotment amount.

The Eurosystem has experienced nine episodes of underbidding in the “old” operational framework, eight of these occurring under the regime of variable rate tenders with a minimum bid rate in place since June 2000.[5] In all but one episode, the underbidding occurred in an environment of strong expectations of an imminent reduction in the key ECB rates, of which eventually five materialised. On several occasions, underbidding in one MRO was followed by allotments in the remaining MROs of the reserve maintenance period that did not allow credit institutions to compensate fully for the under-fulfilment of reserve requirements during the week after the underbidding occurred. In this context, credit institutions faced the risk of running short of liquidity at the end of the maintenance period and, as a consequence, had to take recourse to the marginal lending facility. All cases triggered significant temporary volatility in the short-term money market rates.

Overall, underbidding typically resulted in tight liquidity conditions in the euro money market and probably also affected market uncertainty about the liquidity conditions that would prevail over the

[5] The underbidding episodes under the variable rate tender regime in the old framework are presented in Annex 1.

remainder of the maintenance period. Shorter-term interest rates were driven up and volatility of the overnight interest rates rose. Moreover, in situations where the key ECB rates were actually reduced, the temporary upward movement of the overnight rate associated with underbidding created a source of noise, at least temporarily, in the signalling of the monetary policy stance.

3.2 The rationale for changes to the monetary policy operational framework

When considering implementing some reforms to its operational framework, the ECB drew experience from the delicate situation for liquidity management arising in case of underbidding, as the ECB found itself in the following trade-off situation. On the one hand, any shortfall in liquidity created by interest rate speculation on the side of counterparties could not immediately be compensated for, as incentives for bidding "smoothly" over the maintenance period needed to be preserved. On the other hand, the resulting temporary volatility in money market rates was undesirable. Overall, all the episodes of unstable bidding showed that no instrument was easily available to the Eurosystem to prevent these occasional tensions. Indeed, the occasional occurrence of unstable bidding behaviour by counterparties, and the related volatility in short-term money market rates were endogenous features of the "old" operational framework.

The possibility of changes in the key ECB rates *during* the reserve maintenance period, which affected short-term interest rates and credit institutions' bidding behaviour in MROs, was mainly due to the following elements of the old framework:

- The reserve maintenance period starting on the 24th calendar day of each month and ending on the 23rd calendar day of the subsequent month;
- The two-week maturity of the weekly MROs.

The definition of reserve maintenance periods that prevailed at that time implied that changes in the key ECB interest rate could occur in the course of a maintenance period. Indeed, the assessment by the Governing Council of the monetary policy stance did not coincide with the start of the maintenance period.[6] If the Governing Council decided to change the MRO minimum bid rate and the rates applied on the standing facilities, the new rates would come into force immediately, i.e. they were applied already at the next MRO being announced and to the standing facilities on the following day. As a consequence, rate change expectations within the prevailing reserve maintenance period implied that overnight interest rates may have deviated from the rates used by the ECB to signal its monetary policy stance, even if neutral liquidity conditions were expected for the end of the reserve maintenance period. The resulting spreads between the ECB's main refinancing rate and the corresponding money market rates, therefore, gave credit institutions incentives for excessive bidding in case of rate increase expectations or disincentives to participate in the MROs in case of rate cut expectations.

Moreover, the two-week maturity of the weekly MROs implied that at least the last MRO of each reserve maintenance period overlapped with the subsequent period. Therefore, expectations of an interest rate change to take place in the subsequent reserve maintenance period could also destabilise bidding at the

[6] As of 8 November 2001, the ECB Governing Council had decided that it would, as a rule, assess the stance of the ECB's monetary policy and change interest rates only at its first meeting of each month, which is usually the first Thursday.

end of the prevailing maintenance period. In conclusion, these features of the old operational framework made the expectations of a change in the key ECB interest rates occurring within one or even two maintenance periods particularly relevant for credit institutions' bidding in MROs.

In order to neutralise the impact of interest rate change speculation within a maintenance period, the ECB, therefore, considered to change the timing of the reserve maintenance period, and to shorten the maturity of the MROs, as described below.

3.3 The decided changes

The changes

On 23 January 2003, the ECB Governing Council decided on the following two measures to improve the efficiency of the operational framework for monetary policy, also taking into account the feedback received from a public consultation[7, 8]:

- The timing of the reserve maintenance period was changed so that it always starts on the settlement day of the MRO following the Governing Council meeting at which the monthly assessment of the monetary policy stance is pre-scheduled. Furthermore, as a rule, the implementation of changes to the standing facility rates should be aligned with the start of the new reserve maintenance period.
- The maturity of the MROs was shortened from two weeks to one week.

Given the technical and legal preparatory work - by counterparties and by the Eurosystem - required for the implementation of these measures, they were scheduled to come into effect in March 2004. In this respect, the Eurosystem implemented the necessary changes to the minimum reserve regulation and the regulation on consolidated balance sheet, and to the calendars of the tender operations, of the maintenance period, and of the freezing of minimum reserves. Furthermore, in order to minimise disruption to the timetable of LTROs, the link between the maintenance period and LTRO allotment days was discontinued. In the old framework, LTROs were allotted on the first Wednesday of each reserve maintenance period. From February 2004 onwards, LTROs were normally allotted on the last Wednesday before the end of the month.

A transitional reserve maintenance period, from 24 January 2004 to 9 March 2004, phased in the new monetary policy operational framework.

In sum, the following positive features were attributed to the changes that were decided for the Eurosystem's monetary policy operational framework. The measures were expected to help remove expectations of interest rate changes during any particular maintenance period, given that changes in the

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[7] On 7 October 2002, the ECB launched a public consultation that was addressed to all credit institutions in the euro area and to banking and financial market associations. The Eurosystem received a strong response to this public consultation, highly representative of the euro area banking community. Comments were received from 17 banking and financial market associations (five pan-European associations and 12 national associations representing eight countries). There were also 42 replies from individual credit institutions, including both large EONIA panel banks and small institutions.

[8] In addition to the above mentioned two measures, the ECB also asked the market participants whether to suspend the longer-term refinancing operations. However, since these operations appear to continue to serve the liquidity management needs of the Eurosystem's counterparties, they were not suspended.

ECB's key interest rates would only apply, in general, to the forthcoming reserve maintenance period and that liquidity conditions would no longer spill over from one reserve maintenance period to the next. Consequently, within a maintenance period, the overnight rate would normally no longer be affected by rate change expectations. Hence, the overnight rate would, due to the generally neutral liquidity management policy of the ECB, tend to remain close to the minimum bid rate. This was expected to eventually prevent speculative considerations from disrupting the bidding behaviour of credit institutions in MROs and, moreover, support the signalling of the monetary policy stance provided by the minimum bid rate in the MROs. [9]

Additional communication

In addition to these changes to the operational framework, the ECB decided to systematically provide its forecast of the average autonomous factors and its calculation of the benchmark allotment amount on each day it announces or allots an MRO with a view to eliminating misperceptions in the market as to whether or not the allotment decisions in MROs targeted balanced liquidity conditions.[10] Previously, the ECB only published its forecast of the average autonomous factors on MRO announcement days, on the basis of which the market could calculate a proxy of the benchmark allotment. The additional information now made explicitly clear to the market whether or not the ECB's allotment decisions in MROs aim at balanced liquidity conditions. Prior to this, when credit institutions observed a deviation between the MRO allotment amount and the benchmark amount that they had calculated, there was uncertainty as to whether the deviation was actually due to the ECB deliberately pursuing a non-neutral liquidity target, or whether it was simply due to updates of the autonomous factors forecast, which were not published at that time. This had occasionally led to misinterpretations of the ECB's allotment decisions.

The risks associated with the changes

Concerning the risks associated with these changes, it was noted that the change in the timing of the maintenance period would imply a more variable length of the reserve maintenance periods.

More importantly, the shortening of the maturity of the MRO would imply an increased turnover of central bank refinancing. All other things equal, the allotment amounts of the MROs would double. It was not excluded that some credit institutions could face difficulties to adjust their bids to the higher weekly turnover in MROs, especially with regards to the collateral.

Furthermore, since the last MRO of the maintenance period would always be allotted eight days before the end of the maintenance period (i.e. a period longer than the on average around half a week in the old framework), there could be a higher probability of the accumulation of large aggregate liquidity imbalances at the end of the period, leading to greater volatility in interest rates. In this respect, it should however also be stressed that the Italian tax collection,[11] which has typically been a significant source of

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[9] It is noted that also in the new operational framework, "technical" underbidding may in principle still occur, i.e. for reasons other than expectations of interest rate changes. This means essentially stochastic factors, such as technical failures at an individual bank or the "co-ordination" problem, which can also affect the total bid amount.

[10] The published benchmark allotment is rounded to EUR 500 million.

[11] Italian government deposits are the most fluctuating autonomous factor, with a large impact of the monthly tax collection by the government.

unexpected fluctuations in autonomous factors, would in the new framework occur before the last MRO of the maintenance period. Anyway, fine-tuning operations would always be available to the ECB to cope with unbalanced liquidity conditions.

Whether these risks have materialised is assessed in the following section that reviews the first experience with the new framework.

4 First experience with the new monetary policy operational framework

This section describes the experience with the changes to the Eurosystem's monetary policy operational framework that became effective in March 2004.[12] It reviews in turn the interest rate conditions in the overnight euro money market, the bidding behaviour of counterparties in the MROs as well as the tender outcomes, and the ECB's liquidity management.

4.1 Interest rate conditions in the overnight euro money market

Evolution of the spread between the EONIA and the minimum bid rate ("overnight spread")

Conditions in the overnight market, when assessed from the point of view of EONIA developments, became remarkably stable when the March 2004 changes came into force. Leaving aside EONIA developments on the very last day of each maintenance period, the overnight spread became significantly lower and stable after March 2004. As shown in Chart 1, money markets enjoyed about half a year of very low interest rates, with an EONIA hovering some 2-4 basis points above the minimum bid rate on normal days.[13]

At the end of the Summer 2004, however, the EONIA started to experience end-of-period deviations from the minimum bid rate which gradually intensified and changed in nature over time. By the end of 2004, the usual final day interest rate spikes started to spill over to several days prior to the end of the maintenance periods. The overnight spread started to widen earlier than the last couple of days of the maintenance period, thereby potentially affecting bidding behaviour in all MROs within the maintenance period and contaminating other money market maturities and segments (e.g. derivatives).

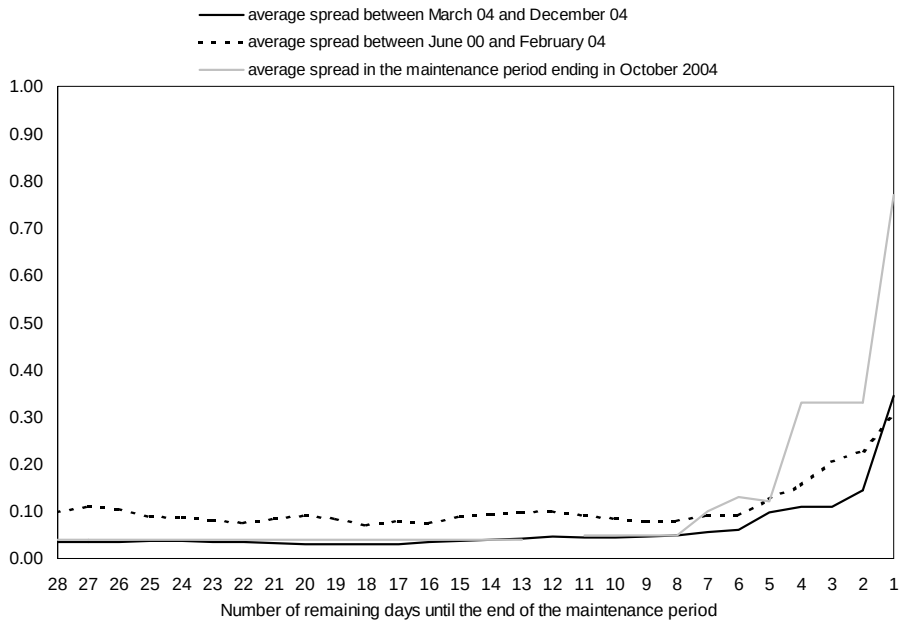
Chart 3 shows the overnight spreads that have prevailed on average on each successive day of a period. A first average is computed for the "pre-March 2004" sample, i.e. June 2000-February 2004. A second average is shown for the maintenance periods since March 2004.[14]

[12] The period covered in this section ends in December 2004.

[13] .e. excluding the last day of the maintenance period, or days affected by specific factors such as end-of-month or quarter effects.

[14] The maintenance period ending on October 2004 has also been singled-out in Chart 3. It is commented further below.

Chart 3: Spread between the EONIA and the minimum bid rate ("overnight spread") within a maintenance period[15]



Source: ECB, percentages, daily data.

Chart 3 suggests that, except for the last day of the maintenance period, the average overnight spread has *declined* under the new framework all along the maintenance period, including during the days between the last MRO and the end of the maintenance period. However, this evidence should be treated with due caution given that the sample covering the new framework represents only few observations and is probably affected by the fact that three maintenance periods ended with a fine-tuning operation aiming at rebalancing liquidity conditions.

Volatility of the overnight rate

In parallel to the increase in the overnight spread observed during the last quarter of 2004, developments in the volatility of the overnight rate also seemed to have changed.

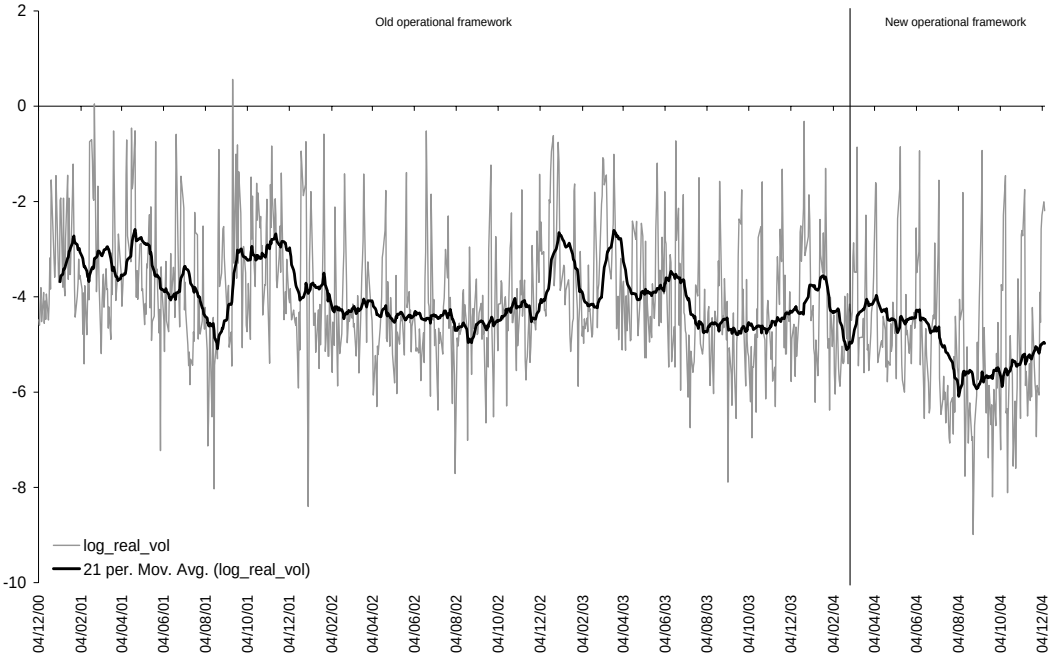
These changes started with the maintenance period ending on 11 October 2004, as can be seen also from the atypically high overnight spread observed at the end of that period (singled-out in Chart 3). Regarding

[15] In the data used to construct Chart 4, end-of-month peaks have been removed from the series to facilitate the comparison between samples.

volatility developments, unusual intra-day movements of the overnight rate have been observed towards the end of the maintenance periods ending on 11 October, 8 November and 7 December 2004.

However, overall the volatility of the overnight rate remained low in the new framework. An analysis of the daily evolution of the realised volatility of the overnight interest rate, defined as the sum of high-frequency intra-daily squared returns[1] is shown in Chart 4, which displays the log realised volatility of the intra-day overnight rate and its moving average over 21 business days, i.e. around one month.[16] Overall, the realised volatility of the overnight interest rate follows a downward trend, which was more pronounced after the launch of the new operational framework in March 2004. Volatility was lower on average after March 2004. After August 2004 volatility increased again albeit from a low level, and still remains below the levels reached under the old framework.

Chart 4: Log of the realised volatility of the overnight interest rate



Source: Reuters, ECB's calculations, 5-minutes intraday data, 4 December 2000-7 December 2004.

Nevertheless, evidence on the overnight spread as well as on the evolution of the intra-day overnight rate volatility suggests that overnight rate developments can be split in two distinct "phases" under the new framework: an initial period of quiet market conditions with low levels of spreads which prevailed until the end of the Summer 2004, and a sequence of consecutive maintenance periods with heightened interest rate volatility and increases in overnight spreads. In response to these money market developments, fine-tuning operations have been carried out on the last day of the maintenance period, with a view to offsetting large expected liquidity imbalances. The fine-tuning episodes are reviewed in section 4.3 below.

Have the effects of interest rate expectations been eliminated?

The March 2004 changes have been designed to eliminate the adverse effects of interest rate expectations on the counterparties' demand for liquidity within the reserve maintenance period. Having neutralised the effects of interest rate expectations on the path of liquidity demand within each maintenance period, it was thought that banks would have no (or fewer) incentives to front - or backload reserves, thereby also stabilising the flows being traded in the secondary euro money market.

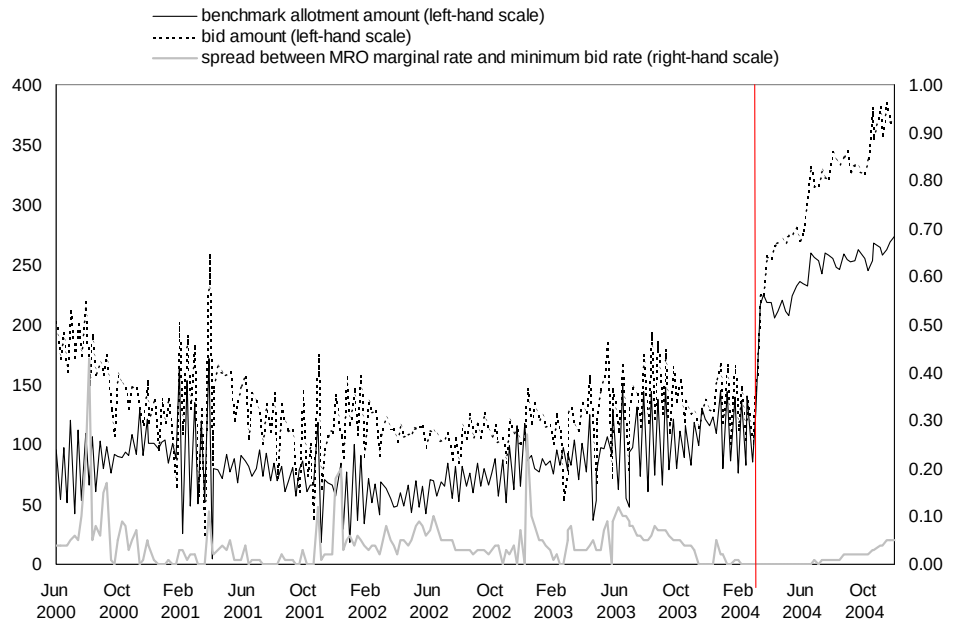
At the current stage, it is fair to say that the answer to this question remains uncertain. If indeed liquidity volumes demanded at regular MROs have not behaved abnormally since March 2004 – in particular no underbidding episode took place in relation to interest rate expectations - all MROs took place in an environment of an unchanged monetary policy stance where the minimum bid rate has been kept constant at 2% by the Governing Council of the ECB. During this time, interest rate expectations also remained broadly flat across maintenance periods. However, in the very last months of the period under review, banks may have started to show an aversion towards liquidity uncertainty, which could have possibly led to renewed frontloading.

4.2 Bidding behaviour of counterparties in the MROs and tender outcomes

This section compares the bidding behaviour of counterparties in MROs and the tender outcomes before and after the changes to the framework were implemented in March 2004.

Benchmark allotment amount and total bid amount

Chart 5: Benchmark allotment and total bid amount



Source: ECB, weekly data (left-hand scale: EUR billion; right-hand scale: percentages).

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[16] This analysis has been conducted by Alain Durré and Stefano Nardelli, ECB, DG Economics. The (log) realised volatility of the overnight interest rate is defined as follows: $\ln(RV_d) = \ln(\Sigma_h\, r^2_{d,h})$, where $r^2_{d,h} = ({}_d r_{h+1} - {}_d r_h)^2$ is the 5-minute return for the 5-minute interval h ($h \in [9{:}00, ..., 17{:}55]$) on a particular day d.

Chart 5 reveals a significant change in the behaviour of the total bid amount in comparison to the benchmark allotment. [The rest of the paragraph should be redrafted] The ratio total bid amount / benchmark allotment (a proxy for the bid-to-cover ratio at the ECB's MROs) has been on a declining trend between the inception of variable rate tenders with minimum bid rate in June 2000 and the implementation of the changes in March 2004 (represented by the vertical red line in the Chart). Within this period, the liquidity deficit gradually broadened, reflecting a strong increase in the demand for banknotes since the beginning of 2002. By contrast, since March 2004, total bids gradually diverged away from the benchmark allotment amount.

After March 2004, when the size of MRO allotments sharply increased, bid amounts quickly adapted to the new average scale of benchmark amounts. Gradually, the total MRO bid amount even increased to levels steadily above the allotment amount, and it stood in December 2004 at an all-time high of around EUR 400 billion. Only one case of "technical underbidding" occurred during the transition on 23 March 2004, when the total amount of bids fell short of the benchmark amount by EUR 5 billion.

Overall, the gradual divergence between the bid and allotment amounts suggests that the higher turnover of collateral implied by the shortening of the MRO maturity has, to date, not caused any major difficulty associated with collateral constraints.

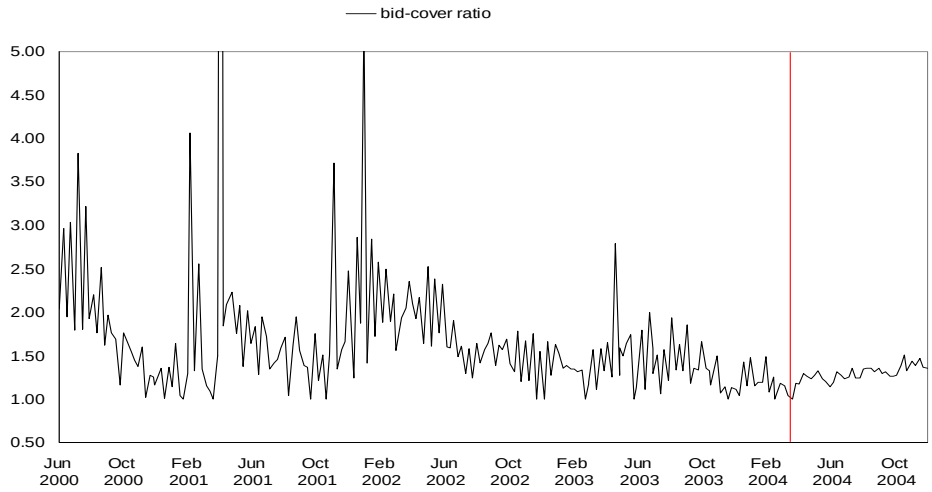
Did the smoother allotment path help counterparties to bid?

The introduction of symmetric and non-overlapping MROs with one-week maturity reduced the imbalance between the size of consecutive MROs (see also Chart 5). Before the March 2004 changes, the average weekly change in the benchmark allotment had an absolute value of ca. EUR 33 billion. By December 2004, this figure had been reduced to EUR 7 billion. This smoother path of liquidity provision can be attributed to the fact that the MRO maturity is now always aligned with the horizon of the liquidity target on which the benchmark allotment is based – i.e. the day before the settlement of the next MRO.[17]

Intuitively, it should be the case that the reduced short-term fluctuations in the benchmark allotment amount contribute to a stabilisation of credit institutions' bidding in MROs. As shown in Chart 6, the bid-to-cover ratio, has been quite volatile under the "old" framework. Between January 2000 and February 2004, the average weekly change in the bid-to-cover ratio was 0.65. It decreased to 0.06 in the period since March 2004, suggesting that the risk of misalignment between the scale of bids and the allotment size has diminished under the new framework.

[17] Prior to March 2004, the two-week maturity of the MROs was always longer than the horizon of the liquidity target. Therefore, the relationship between the volumes of the two outstanding MROs turned-out to be complex and occasionally led to sharp fluctuations across weekly benchmark allotments.

Chart 6: Bid-to-cover ratio at the ECB's MROs



Source: ECB, weekly data.

The evolution of tender rates and the "tender spread"

To some extent, developments in the overnight spread described above mirror those of the so-called "tender spread", defined as the spread between the marginal rate prevailing at MRO tenders and the minimum bid rate. The tender spread remained remarkably small and stable between March and June 2004 (zero basis point), following which it started to gradually increase to 7 basis points by mid-December 2004.[18]

One may put forward the following factors behind the gradual increase in the tender spread in the most recent period. First, there may have been an increase in banks' preferences for frontloading reserve holdings, as a reaction to higher (first perceived, and then actual), end-of-period uncertainty. Second, banks may have developed – wrongly - the perception of a tightening bias in the ECB's liquidity management. These perceptions may be due to the fact that the first fine-tuning intervention conducted by the ECB under the new framework happened to be a liquidity absorbing operation. However, there does not seem to be strong empirical support to the perceptions of asymmetric ECB preferences. Indeed, these perceptions were not well founded.

4.3 The ECB's liquidity management: early responses and challenges ahead

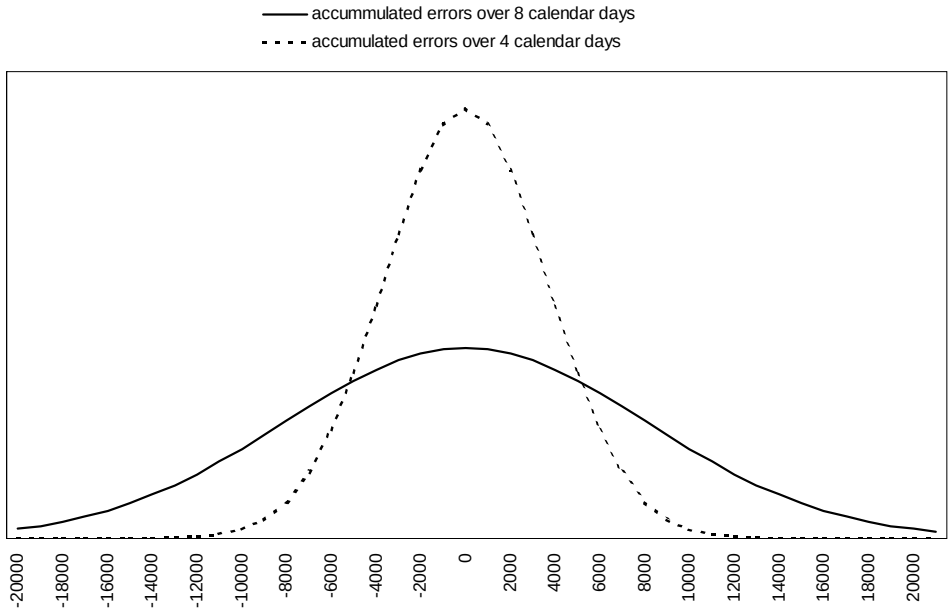
The higher end-of-period uncertainty that has prevailed towards the end of 2004 under the new framework stems from the increased likelihood of large liquidity imbalances accumulated after the allotment of the last MRO of a reserve maintenance period. These potentially large end-of-period imbalances are related to the fact that under the new framework, the allotment of the last MRO always

[18] Note that the observed widening of the tender spread is not inconsistent with the fact that the total bid amount has accelerated relative to the rate of growth of the benchmark allotment, leading to the increased bid-to-cover ratio presented in Chart 6.

takes place eight days ahead of the last day of the reserve maintenance period. By contrast, in the previous framework, the last allotment took place between two and eight days (and given the frequency, four on average) before the end of the period. All other things equal, this has increased the volatility of the overnight rate in the last week of the maintenance period.

The distribution of accumulated autonomous factor errors after the last MRO has therefore widened. Chart 7 compares the distribution of errors accumulated after the last MRO of the maintenance period, under the old and new framework respectively. Each distribution corresponds to an accumulation over four (the average horizon under the old framework) and eight (the current horizon) days.

Chart 7: Distribution of accumulated autonomous factor forecast errors



Source: ECB, EUR billion, daily data, 8 January – 8 December 2004.

The two distributions presented in Chart 7 measure the precision with which last MRO allotments of the maintenance period can be calibrated. The standard deviation of the accumulated autonomous factor forecast error over eight calendar days is normally around EUR 7 billion, while it stays around EUR 3 billion over four working calendar days. All in all, higher uncertainty about end-of-period liquidity imbalances may imply wider and earlier fluctuations of the overnight rate away from the minimum bid rate after the last MRO allotment of the maintenance period. The potential for higher overnight rate volatility may also be amplified by the increased transparency in the publication of both autonomous factors forecasts and the benchmark allotment, which make it easier for counterparties to follow the path of liquidity imbalances in "real time".

Money markets needed to be monitored very closely in order to detect any unexpected development associated with the implementation of the changes to the operational framework. In response to the higher end-of-period uncertainty and its effect on money market developments, fine-tuning operations on the last day of the maintenance period have been carried-out at three occasions after the changes to the operational framework became effective.[19] Indeed, large expected liquidity imbalances that resulted from changes in the Eurosystem's forecast of autonomous factors needed to be offset.[20]

All three fine-tuning operations conducted in 2004 after the changes were carried out irrespective of the sign of the liquidity imbalance: on 11 May and 7 December 2004, liquidity-absorbing fine-tuning operations were conducted, while on 8 November 2004 a liquidity-providing fine-tuning operation was carried out. The operations restored balanced liquidity conditions at the end of the maintenance period. Indeed, from the moment the possible recourse to a fine-tuning operation was announced by the ECB one day before the end of the period, the overnight rate stabilised at a level closer to the minimum bid rate.

When taking the decision to conduct a fine-tuning operation on 8 November, a liquidity imbalance of EUR 6.5 billion was expected, which was less than what had been expected at the end of some previous maintenance periods when the ECB did not conduct fine-tuning operations. This reflects the fact that the ECB, possibly taking into account its first experience with the new framework and its preference for smooth money market conditions throughout the maintenance period, acted in a way that addressed more effectively liquidity imbalances at the end of the reserve maintenance periods. This way to address such liquidity imbalances has evolved gradually and may have benefited from experience in successive maintenance periods. Before the changes to the framework were implemented in March 2004, the end-of-period liquidity imbalances and the resulting volatility in the overnight rate were normally rather moderate, and the ECB never carried out a fine-tuning operation after the last MRO allotment in response to them. This was consistent with the idea that some volatility in the overnight rate at the end of the maintenance period can enhance credit institutions' incentives to bid in MROs, as they seek to reduce their interest rate risk. Owing to the initial concerns expressed by some credit institutions that the higher collateral turnover brought about by the shorter MRO maturity could increase the risk of underbidding, it was considered important not to reduce incentives to bid.

As the analysis of bidding behaviour in the previous section suggests, it turned out that both bid amounts and bid rates showed that incentives to bid steadily increased after the changes to the framework. Therefore, there seems to be little, if any, need to enhance incentives to bid by allowing excessive volatility in the overnight rate at the end of the period. In addition, some tentative evidence has emerged that such volatility, which can reach elevated levels (as seen in October 2004), can be somewhat disruptive to interbank money market liquidity and to the smooth operation of the associated derivative markets. Hence, on several occasions in the autumn of 2004 the ECB address more effectively liquidity imbalances at the end of the maintenance period via fine-tuning operations.

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[19] As of 31 December 2004. On 18 January 2005, the last day of the maintenance period, another liquidity providing fine tuning operation was conducted to rebalance liquidity conditions in the euro money market.

[20] On several occasions, forecasts had, for example, to be corrected due to unforeseen developments in banknotes in circulation.

5 Conclusion

This paper reviewed the overall performance of the Eurosystem's operational framework for monetary policy since its inception, addressing in particular the changes to the framework that were implemented in March 2004 as well as the experience gained so far with the adapted framework.

Overall, although the new framework had not, as of December 2004, been directly tested against expectations of interest rate changes, its seems pretty immune to unstable bidding behaviour and tender developments of the kind experienced before the changes, namely the episodes of underbidding (as well as of overbidding under the fixed rate tender regime).

The paper shows that the transition to the new regime proved smooth and conducive to stable money market conditions and appropriate tender developments at MROs. Counterparties quickly adapted to the increased allotment amounts in the weekly MROs, thereby dispelling fears that collateral constraints may become an issue. In this respect, the main goal of the changes implemented in March 2004, namely preventing bidding behaviour in the MROs from being destabilised by expectations of interest rate changes, has so far proven successful.

The stable bidding behaviour has also been accompanied by an overall narrowing of the spread between the interbank overnight rate and the minimum bid rate during the maintenance period. In addition, it led to an overall decline in the volatility of the overnight interest rates.

The new framework, however, showed to be vulnerable to the increased scope for end-of-period liquidity imbalances brought about by errors in forecasting autonomous factors in the last week of each maintenance period. Indeed, the reaction of the overnight rate to these imbalances has been amplified, bringing about undue intra-day interest rate volatility and widening the spreads between the minimum bid rate on one side, and tender, overnight, and other short-term money market rates on the other side, towards the end of the maintenance period.

As a result, the ECB countered liquidity imbalances at the end of the reserve maintenance period more effectively via fine-tuning operations conducted on the last day of the maintenance period. These fine-tuning operations contributed to contain the average volatility of the overnight rate.

ANNEX 1: MAIN EPISODES OF UNDERBIDDING UNDER THE "OLD" FRAMEWORK[21]

In the following, the main episodes of underbidding experiences by the Eurosystem in the old operational framework are described.

In the underbidding episode of **13 February 2001**, the overnight rate crept upwards as a result of a shortage of bids by counterparties in the MRO allotted on that day. Although the ECB satisfied all the bids, the operation fell short of the neutral liquidity allotment by around €23 billion as a considerable number of counterparties had expected that overnight rates would drop below the market rates in the days to come and therefore reckoned that borrowing from the market would be cheaper than from the ECB. Although the ECB allotted a record amount in the subsequent MRO, it did not cover the full liquidity needs. This implied for the credit institutions a substantial recourse to the marginal lending facility at the end of the maintenance period.

After the bids had fallen short by €28 billion of the intended allotment volume in the MRO conducted on 10 April 2001, the spread between the overnight and the minimum bid rate increased substantially, since most market participants did not expect the ECB to step in to restore normal liquidity conditions before the end of the maintenance period. The recourse to the marginal lending facility was, after the previous underbidding episode, the second highest ever.

The underbidding episode of **9 October 2001** took place in an environment of expectations of a reduction of the key ECB interest rates. As the liquidity deficit that consequently accumulated in the following week was only partially offset by the relatively high allotment in the subsequent MRO, credit institutions had to take substantial recourse to the marginal lending facility in order to fulfil their reserve requirements. Until the end of the maintenance period, the overnight rate was driven substantially upward towards the marginal lending facility rate.

In the episode of **6 November 2001**, despite the underbidding, the credit institutions did not have to resort to the marginal lending facility in order to fulfil their reserve requirements, mainly due to the allotment amounts in the remainder of the maintenance period and other liquidity factors. The overnight rate, which had edged upwards on the day of the announcement of the underbid MRO, returned closer to the minimum bid rate level a few days later.

The underbidding episode of **3 December 2002** should be analysed in conjunction with the episode of 17 December 2002, as they both impacted on liquidity conditions in the same reserve maintenance period. While the episode of 3 December 2002 took place in an environment of expectations of interest rate reductions and resulted in a fairly marginal underbidding amount, the one on 17 December 2002 appeared atypical as it did not seem to be related to expectations of reductions in the key ECB interest rates. Indeed, the spread between the two-week swap rate and the tender rate was positive at the time of bid submission. Anecdotal evidence suggests that underbidding on 17 December 2002 was related to the reluctance of credit institutions to participate in an MRO with maturity on 31 December 2002, which was

[21] Most of these cases are described in the article "Changes to the Eurosystem's operational framework for monetary policy", ECB Monthly Bulletin, August 2003, p. 41-54.

considered to be a particularly unattractive day for the settlement of the tender. This episode was even more special as it occurred in the last MRO of the maintenance period, implying that the related liquidity deficit could not be offset before the end of the maintenance period, unless the ECB conducted a liquidity-providing fine-tuning operation. Actually, on this specific occasion, the ECB conducted a fine-tuning operation on the settlement day of the underbid MRO with a view to reducing the liquidity shortage. The allotment amount reflected a balance between the ECB's aim to restore normal liquidity conditions, while at the same time preserving incentives for credit institutions to bid sufficiently in MROs.

In the underbidding episode of **3 March 2003**, very large reserve deficits accumulated after the announcement of underbidding of the size of €42 billion. The overnight rate remained above the former minimum bid rate, even after the expected decrease in interest rates had materialised. In order to facilitate liquidity management without generating a considerable difference between the sizes of the two outstanding MROs, the ECB decided the following week to conduct an additional MRO with a maturity of one week in parallel to the regular MRO. As a result, liquidity conditions were perceived as satisfactory and credit institutions only had to take a small net recourse to the marginal lending facility.

Finally, the last case of underbidding in the old operational framework occurred on **3 June 2003**. Again, underbidding took place in an environment of strong expectations of interest rate decreases. As, however, underbidding turned out to be less significant than initially expected, overnight rates fell after the tender result was announced. Apart from the very end of the maintenance period, the overnight rate presented a pattern similar to that observed in the underbidding episode of 3 December 2002.