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LIQUIDITY MANAGEMENT UNDER MARKET TURMOIL: EXPERIENCE OF THE EUROPEAN CENTRAL BANK IN THE FIRST YEAR OF THE 2007-2008 FINANCIAL MARKET CRISIS

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ABSTRACT:

The ECB managed the tensions in money markets arising from the 2007/08 financial market turmoil through a combination of automatic stabilisers and an active liquidity policy. This paper argues that the design of the ECB’s operational framework turned out to be crucial for its crisis management, and evaluates different liquidity policies employed by the ECB. The ECB was able to control the overnight interest rate close to the desired level, even if at the cost of higher volatility. However, its influence on longer-term money market rates was limited.

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1 Introduction

This paper analyses the crisis management tools and policies of the European Central Bank (ECB) during the first year of the 2007-2008 financial market turmoil. The turmoil exposed widespread market failures in various segments of the money and credit markets. By turning to the open market operations of the Eurosystem, many banks in the euro area avoided credit rationing, which prevented that a sudden funding liquidity crisis escalated into a generalised solvency problem and the emergence of a systemic financial crisis. Given the source of the disturbance - global retrenchment by investors from exposure to credit risk transfer and related instruments and institutions – individual, targeted liquidity assistance was not feasible, at least in the early stages of the turmoil.

We argue that the prevention of a systemic crisis was supported by automatic adjustment mechanisms embedded in the operational framework of the Eurosystem, which were also supported by (and allowed) an active liquidity management and communications policy by the ECB. Until August 2008, it has not been necessary to make any significant changes to the operational framework of the Eurosystem in order to be able to respond to the market turmoil.

Five features of the operational framework of the Eurosystem seem to have been crucial in crisis management, having played a role as *automatic stabilisers*: (i) the (large) *number of counterparties* that have direct access to the Eurosystem's intra-day credit, overnight standing facilities and open market operations; (ii) the characteristics of the *minimum reserve requirement* (sizable, remunerated, with averaging provision); (iii) the *collateral framework* (acceptance of a broad range of collateral including non-marketable securities); (iv) the availability of an automatic *lending facility* with no significant stigma attached to it; (v) the *large volumes* of its refinancing operations.

Liquidity management policy played an additional important role in managing the crisis: the ECB used a flexible allotment policy in its main refinancing operations (MROs) and changed the maturity structure of its refinancing by increasing the relative weight of its regular longer-term refinancing operations (LTROs) and by adding other, special longer-term refinancing operations (SLTROs); fine-tuning operations (FTOs) were carried out more frequently and have been used to mop-up liquidity provided in MROs and LTROs and fixed rate tender procedures with full allotment have been used when markets conditions were severely strained. In addition, at the turn of the year 2007, the ECB joined the Bank of England, the U.S. Federal Reserve and other central banks in an unprecedented international co-operation in the field of liquidity management.

The remainder of the paper is organised as follows. In Section 2 we present a simple model of the overnight interbank market in order to explain the ECB's liquidity management under calm market conditions and set the ground for the analysis of the turmoil period. Section 3 introduces the ECB's crisis management tools and policies covering automatic stabilisers (3.1), fixed rate tenders with full allotment (3.2), the separation principle and liquidity draining fine-tuning operations (3.3), frontloading (3.4), asymmetric narrow corridor (3.5) and other measures (3.6). Section 4 makes a preliminary assessment of the effectiveness of the crisis management by the ECB. Conclusions and open issues are presented at the end.[2]

2 ECB liquidity management under normal market conditions

As a rule the Governing Council (GC) of the European Central Bank (ECB) decides the level of the key policy interest rates at its monthly policy meeting (held every month). The main policy rate is the minimum bid rate (MBR) in the ECB's weekly Main Refinancing Operations (MROs). These are liquidity providing repo operations conducted as variable rate tenders, subject to the minimum bid rate[3], in which the ECB determines the total amount that is allotted to counterparties, while banks submit bid schedules expressing the price they are willing to pay for liquidity in these operations.

The other two policy rates apply to the standing facilities. Counterparties may at any time, and in unlimited amounts, either deposit funds overnight with the Eurosystem at the deposit facility, which are remunerated at i^d, or borrow funds overnight from the marginal lending facility at a rate i^l. Thus, banks can obtain central

[2] For a comprehensive description of the events and policies see ECB (2007) and ECB (2008).

[3] The ECB also conducts longer-term refinancing operations of 3-months maturity (LTROs), to which no minimum bid rate applies. For further information on the main features of the operational framework of the Eurosystem see ECB (2006).

bank liquidity, either in the open market operations or via the marginal lending facility, both against collateral.

The rates on the two standing facilities set a corridor around the minimum bid rate, which effectively bounds movements in the overnight interest rate therefore dampening its volatility. Since April 1999, the GC of the ECB has set the interest rate corridor in a symmetric manner, with a width of ±100 basis points around the minimum bid rate. The volatility of the overnight interest rate is proportional to the width of the corridor. Narrow corridors are preferable from the perspective of reducing interest rate volatility. However, a too narrow corridor may hamper market activity also in the unsecured segment of the overnight interbank market. The optimal width should strike a balance between these considerations. Moreover, with unlimited access to the lending facility, the narrower the gap between the lending facility rate and the market rate, the higher the risk of inducing moral hazard behaviour as it would offer as an ill-devised (e.g. no penalty) permanent lender of last resort facility.

The choice, by the ECB, of the allotment amounts provided in the main refinancing operations follows a relatively simple rule (referred to as benchmark allotment).[4] We illustrate the main issues using a stylised 2-day reserve maintenance period *à la Poole* (see Poole, 1968). For a more general formalisation, taking into account the institutional features of the euro area the reader is referred to Gaspar, Pérez-Quirós and Rodríguez-Mendizábal (2007), Pérez-Quirós and Rodríguez-Mendizábal (2006), and Välimäki (2003).

2.1 Last day of the reserve maintenance period

In this section, we formalize interest rate behaviour in the overnight interbank market in a stylized model of a two-day reserve maintenance period (RMP). Assume that there are two days in the reserve maintenance period ($t = T\text{-}1$ and T). The maintenance period starts with an MRO whereby the ECB refinances the banking system with 2-day maturity funds. On the last day the ECB conducts an FTO (one-day maturity) to compensate for the forecast error of aggregate liquidity needs made on day $T\text{-}1$. Under normal market conditions, the interest rate in the overnight interbank

[4] For details on ECB's liquidity management and calculation of the benchmark allotment see ECB (2002).

market on the last day of the reserve maintenance period (day T), i_T, is determined, to a close approximation by the following equation:

$$i_T = p_T^{DF} i^d + p_T^{MLF} i^l \qquad (1)$$

where: i^d and i^l refer to the rates of the standing facilities; and p_T^{DF} and p_T^{MLF} are, respectively, the probability of a liquidity surplus and of a deficit on the last day of the reserve maintenance period, in which case counterparties would need to make use of either the deposit facility (DF) or the marginal lending facility (MLF), respectively. Equation (1) states that the overnight interest rate is a weighted average of the rates of the two standing facilities. Note that this equation is derived from the individual demand for reserves by banks and aggregating considering a representative bank so that (1) holds for the market as such.

The reasoning behind this relationship is the following: banks must fulfil their reserve requirements on average: the constraint imposed by the minimum reserve requirement becomes binding only at the end of the reserve maintenance period. On the last day, banks know that if they hold excess funds on their central bank account, these will be remunerated at i^d, while if they have a deficit, they will be charged the rate i^l. The ECB tries to adjust the liquidity supply to the banking sector so that the aggregate recourse to either facility is equally likely and therefore equal to one-half ($p_T^{DF} = p_T^{MLF} = 0.5$). In this case:

$$i_T = \frac{i^d + i^l}{2} = i_{mbr} \qquad (2)$$

where: i_{mbr} denotes the minimum bid rate.[5] In order to achieve this outcome, the ECB usually supplies the amount of liquidity that allows banks to fulfil their reserve requirements smoothly over time. This defines the *benchmark allotment*. If the ECB's forecast errors of aggregate liquidity needs are unbiased, the overnight rate on the last day in the reserve maintenance period should be, to a close approximation, determined by (2). In what follows we will assume that the ECB has credibly

[5] Even under ideal circumstances, this equation is only an approximation, as the interest rates in question have different characteristics. In particular, (1) the minimum bid rate refers to one-week operations, while the other rates refer to overnight transactions; (2) the market rate referred to is usually an unsecured rate, while ECB loans are collateralized.

committed to ensuring (2) and, therefore, this condition also holds in (unconditional) expectation, $E(i_T) = i_{mbr}$.

Figure 1: Money market equilibrium on the last day of the maintenance period

Figure 1 illustrates equilibrium in the overnight interbank market on the last day in the reserve maintenance period. D_T is the (inverse) aggregate demand for liquidity and S_T is the supply of liquidity. For simplicity the demand schedule is drawn with linear segments, which is correct only around the equilibrium point (R, i_T). The slope of the inverse demand schedule captures uncertainty about idiosyncratic (i.e. bank specific) liquidity shocks. Higher uncertainty implies flatter (inverse) demand schedules. To simplify the presentation, the vertical portion of the aggregate supply schedule is set at the average daily reserve requirement level, therefore assuming that the other factors that generate liquidity demand (i.e. banknotes) have mean zero. The underlying total outstanding allotment is 2R.

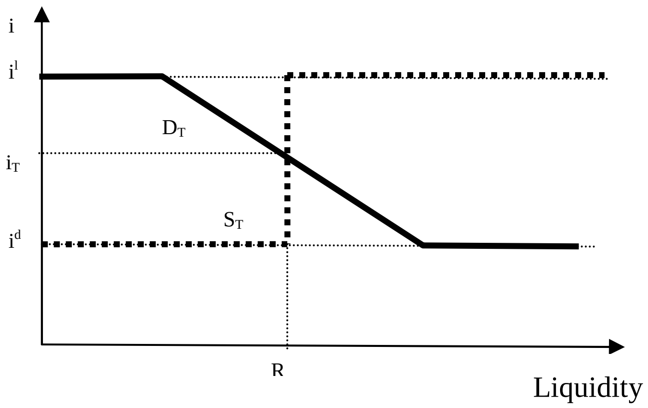
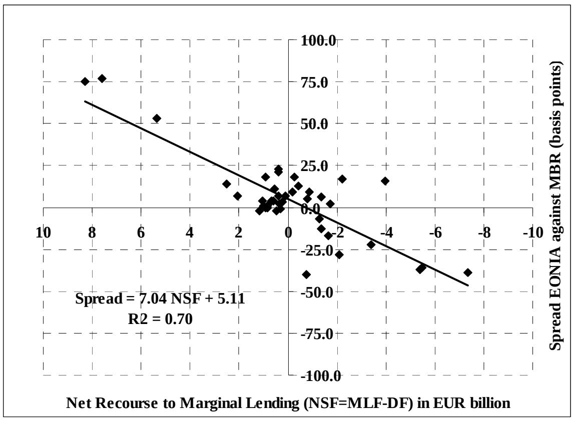


Figure 2: EONIA spread and liquidity conditions on the last day of the RMP

Figure 2 plots the EONIA[6] spread over the MBR against the aggregate liquidity conditions on the last day of each reserve maintenance period (RMP) between Mar. 2004 and July 2008. Aggregate liquidity conditions are measured by the net recourse to marginal lending (NSF). According to the estimated relation between the EONIA spread and the liquidity conditions, when the RMP ends perfectly balanced EONIA is set at about 5 basis points above the minimum bid rate. For each EUR 1 billion of liquidity shortage (NSF>0) the predicted spread is approximately 12 basis points (7 + 5).



Notes: the scale in the x-axis is in reverse order. MLF is the recourse to the marginal lending facility; DF is the recourse to the deposit facility; NSF = MLF-DF is the net recourse to marginal lending. Benchmark allotment targets NSF=0.

[6] EONIA is an effective overnight rate computed as a weighted average of all overnight unsecured lending transactions in the interbank market, initiated, within the euro area, by a panel of banks.

2.2 *Before the last day of the reserve maintenance period*

On the first day of the 2-day reserve maintenance period, equilibrium in the overnight interbank market is slightly more complicated. The reason is that early in the maintenance period banks can postpone the accumulation of reserves until the last day, which gives them an option for how much to hold in their account at the central bank. The only constraint that applies early in the reserve maintenance period is that overnight overdrafts are not allowed. Given that marginal lending from the central bank is costly, banks try to manage their current accounts at a level that keeps the likelihood of an overdraft close to zero. On the other hand, banks try to avoid an early fulfilment of the reserve requirement - avoid being *locked-in* – as any surplus will be remunerated at a penalty rate i^d. For example, by keeping daily current accounts close to their daily minimum reserve requirements, banks can simultaneously avoid overdrafts and keep the probability of being locked-in low until close to the end of the RMP. Under these assumptions, the equilibrium interest rate on the first day of a 2-day reserve maintenance period is given by:

$$i_{T-1} = p_{T-1}^{DF} i^d + p_{T-1}^{MLF} i^l + [1 - p_{T-1}^{DF} - p_{T-1}^{MLF}] E(i_T) \tag{3}$$

Equation (3) states that the equilibrium overnight rate on day *T-1* is a weighted average of the rates of the standing facilities and of the expected rate on the last day of the reserve maintenance period. To better understand equation (3) note that, under normal market conditions, p_{T-1}^{DF} and p_{T-1}^{MLF} are small given: i) the large size of the reserve requirement in the euro area; ii) the benchmark allotment policy of the ECB; and iii) the smooth reserve requirement fulfilment path followed by banks.[7] Thus, to a close approximation, equation (3) simplifies to $i_{T-1}=E[i_T]$. The left hand side of this simplified equilibrium condition is the benefit for the representative bank of postponing by one day the accumulation of one unit of reserves (as the bank can lend the unit to other banks earning i_{T-1}); the right hand side is the expected cost of accumulating one unit of reserves tomorrow (e.g. borrowing one unit from other banks). In equilibrium the marginal benefit equals the marginal cost of overnight funds, which is exactly what equation (3) describes.

[7] On the reserve fulfilment path of euro area credit institutions see Cassola (2008).

Equation (3) also applies, as a good approximation, to maintenance periods that have longer durations, leading to the so-called *martingale hypothesis*. According to this hypothesis, interest rates throughout the reserve maintenance period should equal its expected value for the last day, i.e. $i_t=E[i_T]$ for all $t<T$. This holds because due to the reserve averaging provision of reserve requirements, banks are essentially indifferent between holding liquidity on different days in the reserve maintenance period, and therefore will not be willing to pay higher rates (or accept lower rates) in the interbank market than the expected one.[8]

Summarising, under normal market conditions, the overnight interest rate can be steered close to the minimum bid rate as long as it is firmly anchored on the last day of the reserve maintenance period via an appropriate liquidity supply policy. Note that an important hypothesis underlying the model illustrated in Figure 1 and expressed by Equations (1) to (3) is the absence of market frictions (i.e. market segmentation, asymmetric information, transaction costs, etc.) whereby any bank with a liquidity surplus will be willing to lend it to any other bank with a liquidity need. The interbank market perfectly redistributes liquidity across banks so that the ECB can concentrate on ensuring balanced aggregate liquidity conditions and a smooth flow of refinancing to the banking system over time. The following sections will discuss why and how the ECB's liquidity policy had to be adjusted during the market turmoil. In what follows, however, we still abstract from asymmetric information effects on the overnight interbank market and the potential market breakdown that it may cause.

[8] Since the March 2004 reform of the operational framework of the Eurosystem, key policy rate changes are implemented, as a rule, from the start of the reserve maintenance period. This has reduced significantly the impact of expectations of changes in policy rates on the demand for liquidity within the reserve maintenance period.

Figure 3: Money market model on the penultimate day of the maintenance period

Figure 3 illustrates equilibrium in the overnight interbank market on the first day of a 2-day reserve maintenance period. D_{T-1} refers to the (inverse) aggregate demand for liquidity and S_{T-1} refers to the supply of liquidity. For simplicity the demand schedule is drawn with linear segments. Also to simplify the presentation the vertical portion of the aggregate supply schedule is set at R, the daily average reserve requirement. The inverse demand schedule is flat at (R, $E(i_T)$) which implies that aggregate liquidity supply shocks (unless very large) do not have any impact on the overnight interest rate. This is the 'buffering function' resulting from the averaging possibility.

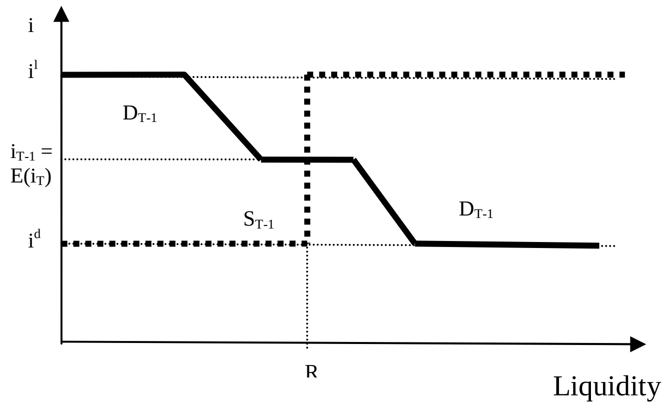
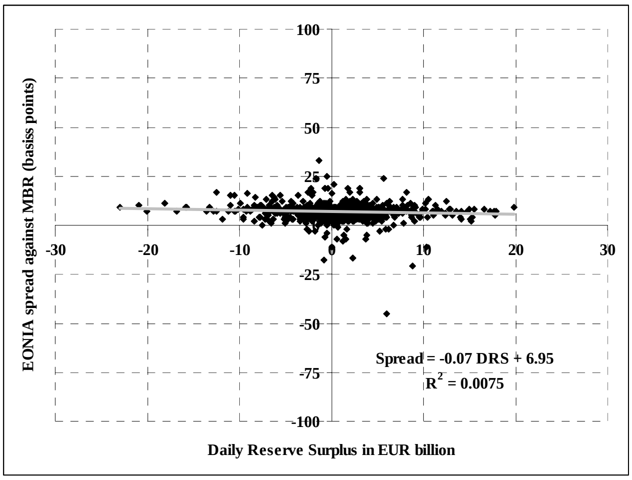


Figure 4: EONIA spread and liquidity conditions during the RMP

Figure 4 plots the EONIA spread over the MBR against the aggregate liquidity conditions on all but the last two business days of each reserve maintenance period (RMP) between March 2004 and July 2007. Aggregate liquidity conditions are measured by the daily reserve surplus (DRS). According to the estimated relation between the EONIA spread and the liquidity conditions, EONIA is set 7 basis points above the minimum bid rate, irrespective of the daily liquidity conditions.



Notes: Daily Reserve Surplus (DRS) is defined as the difference between the daily current accounts of credit institutions with the Eurosystem and their daily average minimum reserve requirement.

3 ECB liquidity management under turbulent market conditions

3.1 Automatic stabilisers

Four features of the operational framework of the Eurosystem can be considered as *automatic stabilisers* in the context of crisis management: (i) the (large) *number of counterparties* that have direct access to the Eurosystem's intra-day credit, overnight standing facilities and *regular* open market operations; (ii) the characteristics of the *minimum reserve requirement* (sizable, remunerated, with averaging provision); (iii) the *collateral framework* (acceptance of a broad range of collateral including non-marketable securities); (iv) the availability of an automatic *lending facility* with only limited stigma attached to it.

Counterparties and size of operations

A very large *number of credit institutions* interact directly with the Eurosystem. About 2,000 credit institutions registered in the euro area have access to the marginal lending facility of the Eurosystem, and just over 1,700 can participate in the regular refinancing operations of the ECB which are large in volume (making up to around 30% of Eurosystem's total assets); 130 are eligible to participate in the fine-tuning operations. The fact that the main credit and refinancing facilities of the Eurosystem are accessible to such a large number of institutions supported confidence in the ability of the banking system to prevent a spiralling liquidity crisis, therefore contributing to avoid bank runs and limit contagion (due to either asymmetric information or overlapping claims).

Reserve requirements

The sizable *reserve requirement* that banks have to fulfil in the euro area coupled with the averaging provision, provide an immediate liquidity buffer for the banking system during the early stages of any market turmoil; moreover the sizable reserve requirement has allowed the implementation of a liquidity policy (frontloading, see section 3.2.3) which, to some extent, has contributed to reducing the funding liquidity risk of banks.

The fact that reserve requirements are remunerated at the marginal rate of the main refinancing operations of the ECB, which is a result of banks' bidding behaviour, makes current accounts with the Eurosystem (up to the minimum reserve level) a very attractive asset for banks to hold, in terms of risk-return characteristics, as it is a highly liquid, risk-free asset with a return higher than the return on the risk-free rate. The downside is that a sizable reserve requirement may put banks under additional pressure to get refinancing given the penalties attached to non-fulfilment.

Eligible assets

The *collateral framework* of the Eurosystem, with its broad range of eligible assets encompassing asset backed securities, credit claims, and non-marketable assets, allows banks to get funding from the Eurosystem without undue constraints. This became even more relevant during the turmoil, also because the ECB did not enforce stricter risk control measures during the period under review.[9] The downside is that, over time, central bank refinancing may become increasingly collateralized with illiquid assets, which raises complex issues for risk management and market functioning.

The above mentioned four characteristics of the operational framework interacted in a virtuous manner enhancing financial stability: the sizable reserve requirement and volume of operations, the large number of counterparties and the broad range of collateral implied that financial assets that had suddenly become illiquid in private markets (*market liquidity risk*) could still be used as collateral with the Eurosystem, thereby significantly adding to market liquidity whilst at the same time reducing *funding liquidity* needs of, and risk for credit institutions.

Marginal lending facility

Under market turmoil the lending facility plays the role of an automatic Lender of Last Resort facility (LLR), which fulfils the *Bagehot principle*: unlimited lending to solvent, illiquid institutions, at a penalty rate and against collateral. However, the marginal lending facility of the Eurosystem was conceived to be used only sporadically and not to provide regular refinancing to the banking system or to replace National Central Banks, domestic supervisory entities and fiscal authorities in their tasks related to the Lender of Last Resort function.

[9] Risk control measures have been refined in September 2008 in the context of the bi-annual review. However, implementation is scheduled for February 2009.

When the market turmoil began, the *marginal lending facility* of the Eurosystem had *no stigma* attached to its use. In fact, credit institutions in the euro area have been accustomed to using the marginal lending facility since January 1999. Recourses to marginal lending during the maintenance period can usually be explained by imperfect monitoring of current accounts by individual credit institutions (customer order flows, payments and securities settlement systems problems, human errors, operational failures, etc.). These recourses have had a very low frequency and have been, in general, for small amounts. The most significant usage tends to occur on the last day of the reserve maintenance period and, to a large extent, is related to the aggregate liquidity imbalance caused by the inevitable errors made by the Eurosystem in forecasting the daily aggregate liquidity needs of the banking system.

The Eurosystem publishes on a daily basis the recourses to the standing facilities, in the context of the release of other information about daily liquidity conditions (e.g. consolidated balance sheet of the Eurosystem). However, the names of the credit institutions involved are not disclosed by the ECB or the Eurosystem. Still, it cannot be excluded that, under market turmoil, some stigma may emerge in case large and recurrent recourses to marginal lending occur namely because they could trigger market rumours about which institution(s) has (had) been involved.

3.2 Liquidity management

Before the turmoil, the ECB provided the bulk of its refinancing to the banking system via its weekly MROs (70%; one-week maturity), which were complemented with a monthly LTRO (30%; three-month maturity). After February 2005, the ECB started conducting, on a frequent basis, a fine-tuning operation on the last day of the reserve maintenance period. Before the turmoil, the ECB's open market operations had a relatively low frequency and the stabilisation of the overnight interest rate was mainly achieved through the averaging mechanism as explained in Section 2. In this Section we review why and how ECB's liquidity policy has changed after August 2007.

3.2.1 Fixed rate tenders with full allotment

Liquidity management policy has played an important role in crisis management: fine-tuning operations (FTOs) have been carried out more frequently and fixed rate tender procedures with full allotment were applied when market conditions were perceived as severely strained. This was clearly the case on 9 August 2007.

Figure 5 gives a graphical interpretation of the events that occurred on 9 August 2007 in the euro interbank market for overnight funds. In our simplified framework the shock occurred on the first day of the 2-day reserve maintenance period. Ex-ante demand for liquidity by banks (e.g. before the turmoil) is represented by the bold step-wise function (D_0). As explained in Section 2.2 early in the maintenance period, under calm market conditions, the (inverse) demand function is highly interest-elastic (flat) at the expected future overnight rate (and around the daily reserve requirement level). The supply of funds by the ECB (S_0) was the benchmark amount - which, for simplicity, is set equal to the daily reserve requirement (R). The ex-ante equilibrium overnight interest rate was at the middle of the interest rate corridor.

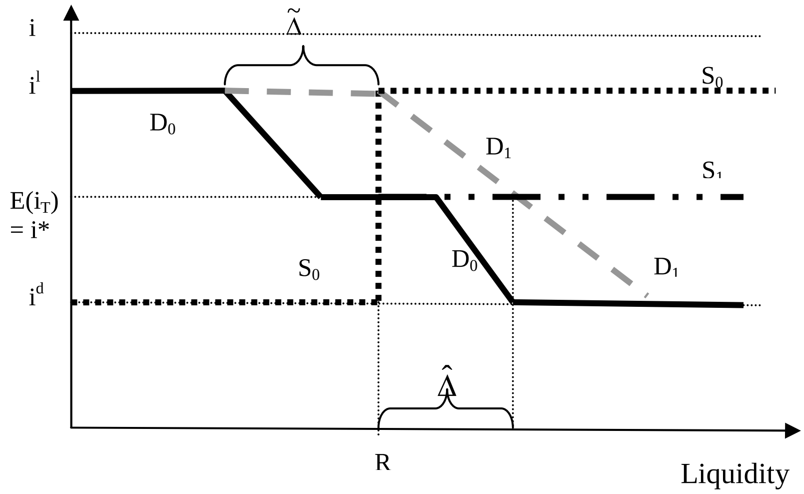
Our interpretation of the 9 August 2007 events is that a *funding liquidity shock*[10] affected the demand for reserves by banks in two different ways: (i) a parallel rightward shift; and (ii) a reduction in the elasticity of the (inverse) demand schedule (i.e. a steeper curve without a flat segment). The former movement captures the idea that the sub-prime crisis was perceived by banks as implying an increase in the likelihood of a large (aggregate) liquidity draining shock; the latter movement captures the idea of an increase in the idiosyncratic component of liquidity uncertainty. As a consequence banks set (stricter) targets for their daily current accounts, with the result that the averaging mechanism weakened and "liquidity effects" emerged on the first day of the reserve maintenance period (the flat part of the demand curve vanished). Graphically, the shock is represented by the parallel shift in the demand curve from D_0 to D_1, where $\tilde{\Delta}$ is the (highly uncertain) increase in the demand for reserves.

On 9 August 2007, the ECB allotted liquidity via an FTO with a fixed rate tender (FRT) procedure with full allotment (FA). This is represented in Figure 5 by an infinitely elastic supply function, S_1. This procedure allowed the ECB to get an

[10] The ultimate source of the funding liquidity shock was (arguably) asymmetric information and the fear of credit rationing and also anxiety about credit lines/support commitments towards special purpose vehicles and about the realization and/or rolling-over of securitization programmes.

estimate of the additional liquidity demand by banks (a measure of the liquidity shock), represented by the bid amount $\hat{\Delta}$ as R was already in the market.

Figure 5: Fixed rate tender with full allotment on 9 August 2007



In the model, the immediate impact of the turmoil was an increase in banks' expected recourses to the marginal lending facility. From Equation (3) it can be seen that an increase in the probability of taking recourse to the marginal lending facility on day *T-1*, $\tilde{p}_{T-1}^{MLF} > p_{T-1}^{MLF}$, immediately translates into: i) higher market overnight rate on day *T-1*, and ii) weakening of the anchoring provided by the expected overnight rate $E(i_T)$, even if the liquidity shock is perceived as transitory. Equation (4) shows the equilibrium condition in the overnight interbank market before the fine-tuning operation:

$$i_{T-1} = \tilde{p}_{T-1}^{MLF} i^l + [1 - \tilde{p}_{T-1}^{MLF}].E(i_T) > i_{MBR} \tag{4}$$

where, for simplicity, we have assumed that the unusual market conditions imply $p_{T-1}^{DF} = 0$.[11] The provision of temporary liquidity by the ECB can influence market rates by reducing banks' expected recourse to the marginal lending facility and thus bring down overnight rates by accommodating the perceived sudden increase in liquidity demand. The equilibrium in the interbank market after the fine-tuning operation will be discussed in the following section.

[11] In the limit, $i_{T-1} = i$.

3.2.2 The separation principle

The fine-tuning operation conducted as fixed rate tender with full allotment left the banking sector with a large daily reserve surplus. The surplus had to be drained over the remaining days of the reserve maintenance period because otherwise the overnight rate would fall sharply towards the deposit facility rate level, compromising the signalling of the monetary policy stance. Given *the separation principle* between monetary policy stance and implementation, this could not be allowed unless the Governing Council (GC) of the ECB decided to change the policy stance, which was not the case.

According to the separation principle, the assessment of the monetary policy stance and related decision by the GC of the ECB on the minimum bid rate and on the rates on standing facilities, are separated from the day-to-day liquidity management - a task whose responsibility is delegated to the Executive Board of the ECB.

Figure 6 gives a graphical interpretation of the problem using the 2-day RMP model. It portrays the expected liquidity situation in the inter-bank market on the last day of the reserve maintenance period (day *T*) should the ECB not drain the surplus created by the fixed rate tender fine-tuning operation with full allotment. This would leave a liquidity surplus in the banking sector and, with high likelihood, would lead to an aggregate recourse to the deposit facility on the last day of the RMP, $\tilde{p}_T^{DF} > p_T^{DF}$. Demand for liquidity by banks on the last day of the reserve maintenance period is represented by the bold step-wise function (D_0). Given that only the reserve requirement (R) is remunerated (in the example at the policy rate in the mid-point of the interest rate corridor), any excess reserves in the central bank account $\hat{\Delta}$ would be remunerated at the deposit facility rate of the ECB (i^d). This would likely change day *T-1* and day *T* money market expectations about the overnight interest rate, which would then start falling towards the level of the deposit facility rate. Equation (5) and equation (6) are the equilibrium conditions in the overnight interbank market on day *T-1*, after the fine-tuning operation, if the additional liquidity is not drained on the last day:

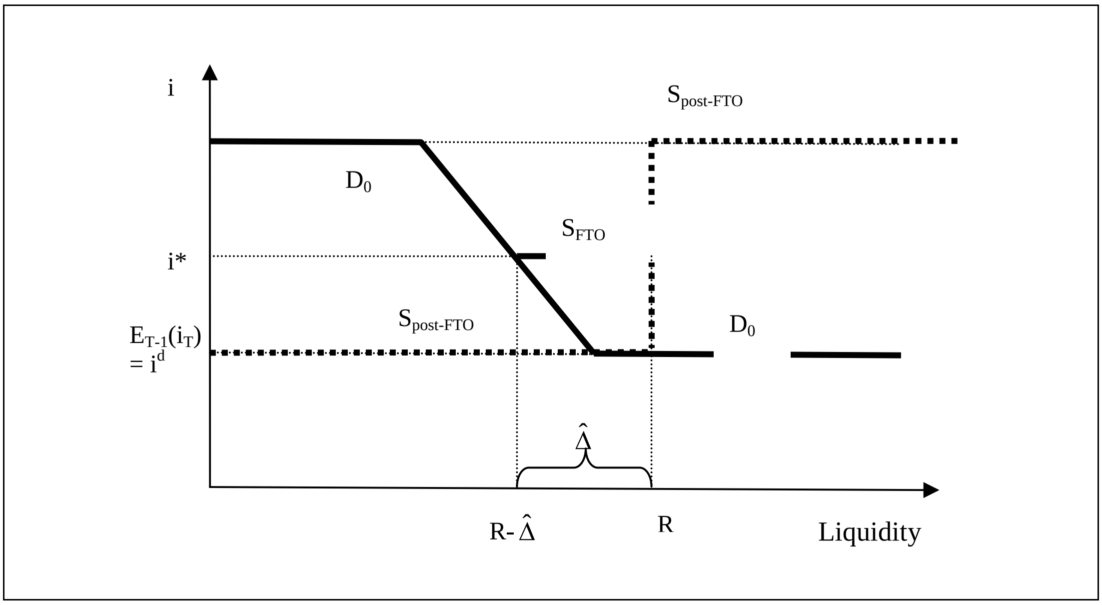
$$i_{T-1} = \tilde{p}_{T-1}^{MLF} i^l + \tilde{p}_{T-1}^{DF} i^d + [1 - \tilde{p}_{T-1}^{MLF} - \tilde{p}_{T-1}^{DF}].E_{T-1}(i_T) \qquad (5)$$

$$E_{T-1}(i_T) = E_{T-1}(\tilde{p}_T^{DF})i^d \approx i^d \qquad (6)$$

where: $E_{T-1}(i_T)$ denotes expectation of i_T conditional on information available at time T-1.

To avoid a significant drop in interest rates towards the deposit rate, the ECB had to drain the liquidity surplus from the market.[12] However, because a sudden drain (on day T-1) could create volatility in the money market, the ECB decided to stretch the adjustment of liquidity conditions over the remainder of the maintenance period. In the 2-day model the liquidity surplus is drained on day T rather then on day T-1. Given that equilibrium in the overnight market with $i_T = i_{mbr}$ is achieved when total liquidity supply (L_t) is such that, $R + \hat{\Delta} + R - FTO = 2R$, the fine-tuning operation must be calibrated to drain the surplus, $FTO_T = \hat{\Delta}$. It is worth noting that the size of the reserve requirement puts a limit to the feasibility of the policy with unchanged policy rates as $\hat{\Delta}$ cannot be so large as to imply negative current accounts with the central bank after the FTO. In that case the central bank would not be able to prevent a drop in the overnight interest rate and the separation principle would probably not be feasible.

Figure 6: Liquidity drain on last day of reserve maintenance period



[12] The ECB also took care of communicating its intentions in all extraordinary allotments.

3.2.3 Frontloading

Against the experience of one full reserve maintenance period with the market turmoil, in the following reserve maintenance periods the ECB initiated a frontloading liquidity management policy. The frontloading policy consists in allotting significantly above benchmark at the beginning of the reserve maintenance period, and gradually reducing the surplus until the end of the reserve maintenance period. On the last day of each period, a liquidity draining fine-tuning operation is carried out, mopping-up the remaining surplus and therefore generating expectations of an overnight rate, on the last day, close to the minimum bid rate. It should be emphasised again that due to the separation principle, frontloading aims at creating a temporary surplus in the market, not a permanent one. That is, on average, the supply of liquidity to the banking system is the same as before the turmoil – i.e. just enough for banks to fulfil their reserve requirements – only the timing of the provision is changed.

During turmoil times, the market interest rate is, in principle, still influenced by expected liquidity conditions on the last day of the maintenance period (as in equations (1) and (2)). However, several changes should be introduced into the equations. First, credit rationing, market segmentation, and liquidity hoarding imply – throughout the maintenance period – a higher probability of recourses to the marginal lending facility. Second, in times of rapidly changing asset valuations, there is an increasing risk that access to the marginal lending facility might be restricted, either because of lack of sufficient collateral or because of a rating downgrade. The latter is captured by introducing an extra term in the overnight interbank market equilibrium conditions $p_T^{NOCOL} > 0$. Should these circumstances materialise, banks would be forced to resort to more expensive liquidity (at a higher rate i^h). Without a frontloading policy, short-term interest rates would then roughly obey the following equations:

$$i_{T-1} = \tilde{p}_{T-1}^{MLF} i^l + [1 - \tilde{p}_{T-1}^{MLF}] E_{T-1}(i_T) \qquad (6)$$

$$E_{T-1}(i_T) = E_{T-1}(\tilde{p}_T^{MLF}) i^l + E_{T-1}(p_T^{NOCOL}) i^h > i_{mbr} \qquad (7)$$

where: $\tilde{p}_t^{MLF} > p_t^{MLF}$, for $t=T-1,T$ and $p_T^{NOCOL} > 0$, $p^{DF}{}_T=0$, and $i^h > i^l$. We assume, for simplicity, that the downgrade and/or the collateral shortage affects market rates only through expectations for day T (i.e. we assume that banks know/reveal their current state early in the morning). Again, our analysis is based on the assumption that there is a representative bank. In this case, the two equations govern the aggregate demand of the banking sector.[13]

The frontloading policy of the ECB counteracts the upward pressure on the overnight interest rate in two ways: on the one hand, by allowing for some early accumulation of central bank reserves, it reduces the probability (and volumes) that banks may need to borrow in the unsecured market at a very high rate, should they run out of collateral or face a downgrade. On the other hand, frontloading increases the probability that banks fulfil their reserve requirements early in the maintenance period and, as a consequence, increase the probability of 'locking-in', i.e. that banks may have to deposit excess funds at the deposit facility at rate i^d. Both mechanisms contribute to reducing the short term interest rate via increasing $E_{T-1}(p_T^{DF})$ and by decreasing $E_{T-1}(p_T^{NOCOL})$. With the frontloading policy, short-term interest rates become determined by the following equations:

$$i_{T-1} = \tilde{p}_{T-1}^{MLF} i^l + \hat{p}_{T-1}^{DF} i^d + [1 - \tilde{p}_{T-1}^{MLF} - \hat{p}_{T-1}^{DF}] E_{T-1}(i_T) \qquad (8)$$

$$E_{T-1}(i_T) = E_{T-1}(\tilde{p}_T^{MLF}) i^l + E_{T-1}(\hat{p}_T^{DF}) i^d + E_{T-1}(p_T^{NOCOL}) i^h \qquad (9)$$

where: $\hat{p}_{T-1}^{DF} > p_{T-1}^{DF}$ and we assumed that frontloading reduces but cannot eliminate completely the other term, $E_{T-1}(p_T^{NOCOL}) \neq 0$. The main challenge to the frontloading policy is to calibrate the allotment such that in Equation (9):

$$E_{T-1}(i_T) = E_{T-1}(\tilde{p}_T^{MLF}) i^l + E_{T-1}(\hat{p}_T^{DF}) i^d + E_{T-1}(p_T^{NOCOL}) i^h = i_{mbr}.$$

This can be achieved (at least in the model) through the combination of an allotment on day *T-1* above *2R* (*R* each day) and a liquidity draining operation on day *T*. Note that with frontloading, the link between the current and the expected future overnight rates is weakened as in equation (8) the term between the squared brackets is smaller than 1. The martingale hypothesis no longer applies and daily liquidity shocks start having an impact on the overnight interest rate. Moreover, given that $\hat{p}_{T-1}^{DF} < \hat{p}_T^{DF}$, as the probability of being locked-in, which can be substantially different from zero with frontloading, generally increases in the course of a maintenance

[13] In the limit, $i_{T-1} = i^l$.

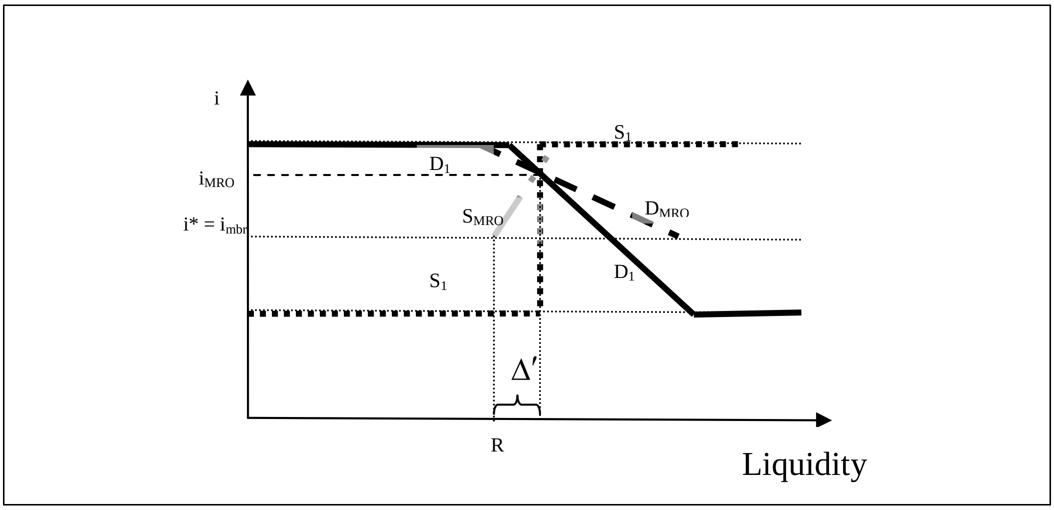
period, with frontloading the overnight rate is expected to decline over the course of the maintenance period which, in the 2-day RMP model implies $i_{T-1} > E_{T-1}(i_T) = i_T = i_{mbr}$. This again shows that the martingale hypothesis is not valid under turmoil.

Figure 7 illustrates how the frontloading policy works. Demand for liquidity by banks is represented by the bold step-wise function (D_1). During the turmoil the demand for reserves by banks, on day *T-1*, shifted rightwards and became less elastic (see Figure 1). Demand at the MRO is represented by the curve D_{MRO}. It is a downward sloping bid curve rather than a pre-turmoil (almost) flat curve. After the turmoil the allotment policy consists of providing liquidity above the benchmark ($R+\Delta'$). The supply at the tender is represented by S_{MRO}, demand at the tender is represented by D_{MRO} and the minimum bid rate by i_{mbr}. After the tender, supply in the overnight market is represented by S_1. On day T the ECB conducts an FTO and drains the surplus $2\Delta'$ from the market. Note again that the size of the reserve requirement puts a limit to the feasibility (and effectiveness) of the frontloading policy as $2\Delta'$ cannot be so large as to imply negative current accounts with the central bank on day T.

From equations (8) and (9) and the above discussion we may conclude that in the model, MRO tender rates, under turmoil, become elevated through the expectation effect of a downgrade and the increased probability of marginal lending:

$$i_{MRO} = (½)(i_{T-1} + E_{T-1}(i_T)) > i_{mbr}.$$

Figure 7: Frontloading



Under market turmoil a positive spread emerged between the MRO tender rate and the policy rate. However, and contrary to the prediction of the 2-day RMP model, the overnight interest rate during the turmoil has been consistently below tender rates throughout the reserve maintenance period. In this regard, two points are worth noting. First, the situation described in Figure 7 could not represent equilibrium in normal market conditions as banks would not bid up the MRO rate; and most probably would also not bid for an amount much larger than the reserve requirement. Second, the surplus allotted by the ECB does not fully accommodate the increased demand for reserves ($\Delta' < \tilde{\Delta}$) and, as a consequence, the marginal price of liquidity rises, though by less than without the allotment above benchmark.

What kinds of banks are willing to bid up the MRO rate? What elements have implied a spread between the overnight inter-bank market and the marginal MRO rate?

To answer these questions it is useful to think of the inter-bank market as being populated by two types of banks, let's call them *ostracised* banks and *sound* banks. *Sound* banks are those with a large pool of liquid collateral (e.g. government bonds), not dependent on wholesale funding (securitization), without committed back-up credit lines (to special investment vehicles, etc.), and without off-balance sheet exposures. Sound banks have, say, AAA credit rating. Actually, these banks may not even need to participate in the MROs (or LTROs) and instead may rely on the private repo market and / or overnight borrowing to meet their reserve requirement needs. *Ostracised* banks are those with a small pool of liquid collateral, heavily dependent on wholesale funding (securitization), with committed back-up credit lines (to special investment vehicles, etc.), and/or large off-balance sheet exposures. *Ostracised banks* must have at least A- credit rating to be eligible to ECB operations. The ostracised banks will be eager to participate in the MROs (and other operations) in order to buy insurance against credit default, downgrade, unexpected drawing from back-up lines or in order to prevent a "run" on the bank by investors and/or depositors. They typically will get funding from the ECB using rather illiquid collateral (i.e. loans, ABS, RMBS). However, as *ostracised* banks receive more reserves from the central bank than they need to fulfil their reserve requirements they lend to the sound banks in the overnight inter-bank market. In fact, because the alternative for the ostracised banks is to use the deposit facility of the ECB at a penalty rate (100 basis points below the minimum bid rate), they will likely lend to the sound banks at a rate close to the (risk free) policy rate. Moreover, ostracised banks would prefer to frontload while sound banks would be willing to backload their fulfilment of the reserve requirement waiting for softer rates as they do not face the risk of being downgraded.

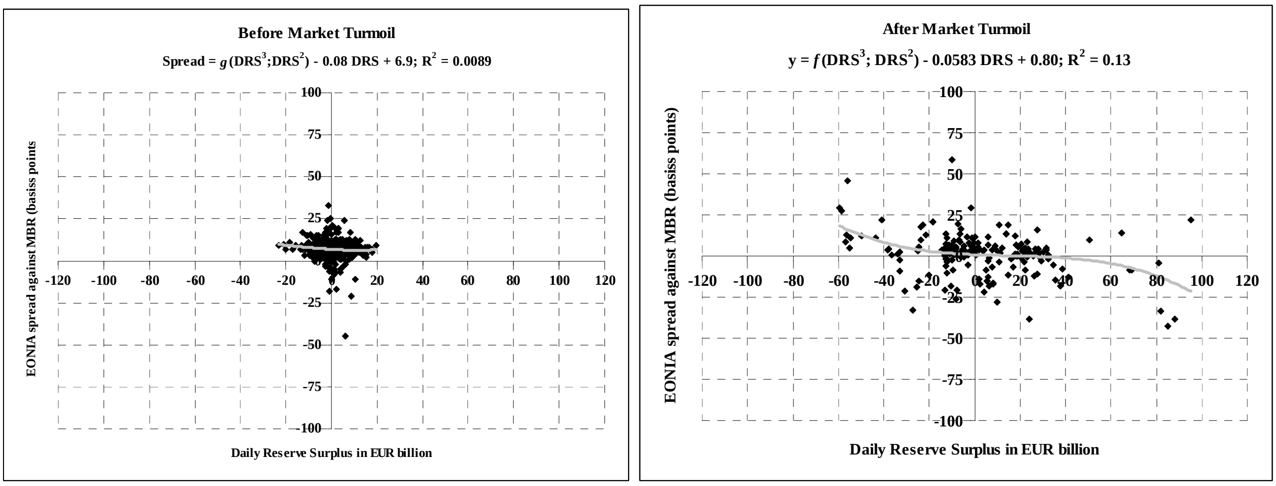
This situation would represent a "*separating*" *equilibrium* with *market segmentation*: sound banks borrowing in the inter-bank market (or in the private repo market using high quality collateral) and ostracised banks borrowing in the MROs and LTROs. This works like an insurance mechanism whereby ostracised banks pay sound banks and the Eurosystem the difference between the MRO rate (which is the remuneration of R for all banks and is the cost of R only for ostracised banks) and the overnight rate (which is the cost of R only for sound banks). In the process the Eurosystem applies risk mitigation measures (hair cuts, among other measures). A more realistic and complex model of the overnight interbank market would be needed to fully incorporate liquidity provision by the central bank under asymmetric information and credit rationing. To our best knowledge, however, such a model does not exist.[14]

With some variation and adaptation, the frontloading model has been applied since the first maintenance period with financial turmoil. In spite of the success of the frontloading policy in aligning the overnight interest rate with the minimum bid rate in the first month of the turmoil, it became clear that liquidity policy alone could not solve the underlying, asset valuation uncertainties and credit-risk problems, which were the main causes underlying the funding crisis. In the maintenance periods ending in November and December, the ECB took forceful control of the overnight rate. This will be discussed in the next section.

[14] In a different setup, Heider et al. (2008) provide a model of asymmetric information in the interbank market which explains the benefit of intermediation by the central bank.

Figure 8: EONIA spread and daily liquidity conditions before and after August 2007

Figure 8 compares the EONIA spread over the MBR against the DRS on all but the last two days of each RMP between March 2004 and July 2007 (LHS) and between August 2007 and June 2008 (RHS). Almost all observations before the turmoil are contained inside the square, DRS = ± EUR 20 billion, Spread = ± 25 bps. After the turmoil, the EONIA spread became sensitive (albeit in a non-linear manner) to daily liquidity conditions. Most observations after August 2007 are spread through the rectangle, DRS = EUR -60 and +90 billion, Spread = ± 50 bps.



Note: see Figure 4 for further information on the definition of the variables.

3.2.4 *Narrow corridor with large surplus*

Towards the end of the year 2007, renewed money market tensions revealed that banks were struggling to ensure funding liquidity. Under such extreme circumstances, the frontloading policy was not likely to be strong enough to tie down the overnight interest rate close to the minimum bid rate. In terms of the 2-day model in equation (9), the probability of having a shortage of funds, $E_{T-1}(p_T^{MLF}) + E_{T-1}(p_T^{NOCOL})$, was simply too high.

The ECB managed liquidity in this period in an innovative way. First, the maturity of the MRO that covered the Christmas period was extended to two weeks, so that also the year-end was covered. Second, the ECB announced that all bids submitted at or above a certain rate (4.21%, the marginal rate of the previous MRO) would be served in full. Third, following this operation, the ECB offered to drain some of the liquidity provided by a series of liquidity-absorbing fine-tuning operations at the minimum bid rate.

Even if not stated explicitly, combining a fixed rate tender with full allotment (even if at a rate above the minimum bid rate) with (daily) liquidity draining fine-tuning operations is very similar to setting a (synthetic) narrow interest rate corridor. The “narrow corridor policy” differs from the pure frontloading policy. While frontloading affects the probabilities of having a liquidity surplus or shortage and thus affect the expected recourse to the standing facilities, a narrow corridor (or the mimicking of such a corridor) affects the overnight rate directly. In the 2-day maintenance period model, a narrow corridor policy results in an overnight rate very close to the policy rate level:

$$i_{T-1} = i_{mbr} \tag{10}$$

$$E_{T-1}(i_T) = i_{mbr} \tag{11}$$

This result is driven from banks’ bidding at the fixed rate, full allotment tender the amount that allows complete hedging of the funding liquidity risk associated with a potential downgrade in period *T* (provided that sufficient collateral is available). In fact, in our simplified 2-period model, a very large bid with $\hat{\Delta} = R$, ensures (endogenously) that both on day *T-1* and on day *T*, banks start the day with 2*R* on their current accounts (guaranteeing the fulfilment of the reserve requirement). In that case, banks will be willing to offer to the ECB, at the daily fine-tuning operation, an amount $\hat{\Delta} = R$. In equation (8) and in equation (9) the large allotment will lead to a very high usage of the synthesized deposit facility, $\hat{p}_{T-1}^{DF} = \hat{p}_{T}^{DF} = 1$. The downward pressure of the liquidity provision is counterbalanced by the liquidity drain at the policy rate i_{mbr}.

Note that when the martingale property is weakened, a narrow corridor has the advantage of influencing rates on each day directly, without relying solely on effects stemming from liquidity conditions on the last day of the maintenance period. Thus, the synthetic narrow corridor seems most adequate to steer overnight rates in times of extreme market conditions, albeit with the downside of some potential volatility in market conditions if the liquidity providing (draining) operations are overbid (underbid).

3.2.5 Lengthening the maturity structure of refinancing and the TAF

The GC of the ECB decided to lengthen the overall maturity structure of refinancing by increasing the volumes of the regular LTROs and by introducing Special LTROs with 3- and 6-month maturities. This was achieved by reducing the volume allotted at the weekly MROs such that the total refinancing remained unchanged. These measures were aimed at addressing the drying up of money market activity at longer maturities. They were not designed to steer longer-term money market interest rates, even if they were expected to bring some relief to money market conditions. As a side-effect, the operational risk involved in rolling-over, every week, most of the refinancing provided to banking system was mitigated. MRO volumes have been reduced to about 40% of total refinancing, from 70%, and therefore no longer provide the bulk of liquidity to the market.

On 12 December 2007 it was announced that the Bank of Canada, the Bank of England, the ECB, the Federal Reserve, and the Swiss National Bank would take exceptional measures designed to address elevated pressures in short-term funding markets. The Governing Council of the ECB decided to take joint action with the U.S. Federal Reserve by offering US dollar funding to Eurosystem counterparties. Note that US-dollar provision by the ECB to banks in the euro area does not have any direct impact on liquidity conditions in the euro money market. However, to the extent that some borrowing pressure in the MROs or in the euro overnight inter-bank market was related to frictions in the US dollar money market and the foreign exchange swap market, direct provision of US dollar to euro area banks might have contributed to easing funding pressure also in euro.

4 An overall assessment of the liquidity policy

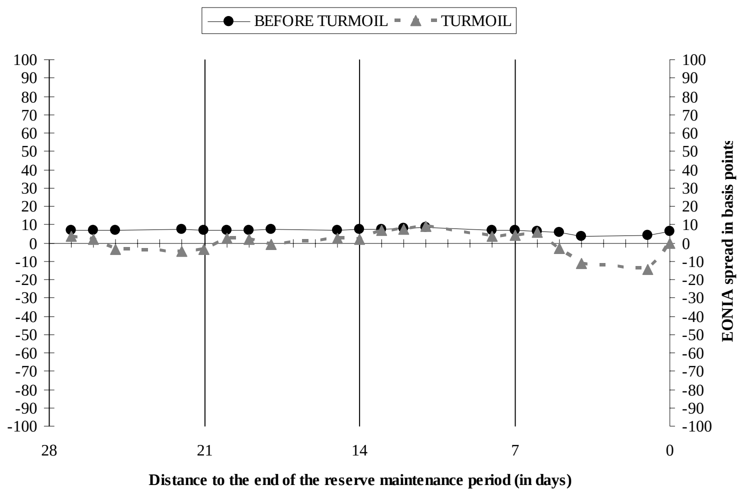
In this section we draw the main lessons that can be extracted from the ECB's experience during the first year of the financial turmoil and highlight some problem areas. The limits of liquidity policy for dealing with the underlying causes of the turmoil are discussed at the end of the section. Our conclusions are fully in line with the policy recommendations in CFGS (2008).

Short-term interest rates before and during the turmoil

Figure 9 shows the average EONIA spread on each day in the reserve maintenance period (0 is the last day). The scale of the chart corresponds to the ± 100 basis points interest rate corridor set by the standing facility rates around the policy rate. In the chart the daily average spread during the turmoil (August 2007 – June 2008) is compared to the daily average spread before the turmoil (March 2004 – July 2007).

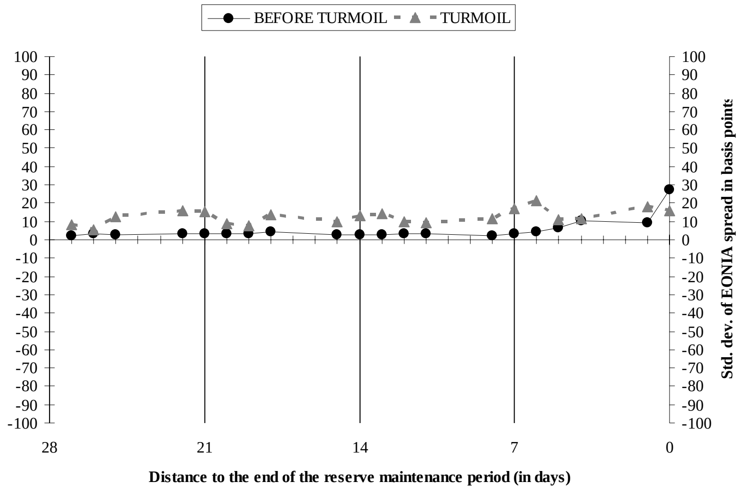
Before the turmoil EONIA was virtually fixed at 7 basis points above the policy rate throughout most of the reserve maintenance period, except during the last week when EONIA displayed a smooth U-shape pattern as the overnight rate softened a bit ahead of the last weekend of the reserve maintenance period to increase again until the last day of the reserve maintenance period. During the turmoil EONIA fluctuated around the policy rate with a more pronounced U-shape pattern after the last MRO of the reserve maintenance period. The frontloading policy appears to have achieved, on average, a reduction in the EONIA spread – virtually eliminating its "natural spread" against the policy rate.

Figure 9: EONIA spread and interest rate corridor



Lowering the EONIA spread has been achieved at the cost of an increase in its volatility. Figure 10 shows the standard deviation of the EONIA spread on each day in the reserve maintenance period. Before the turmoil EONIA was very stable during most of the reserve maintenance period, displaying increasing volatility towards the end of the maintenance period and in particular on the last day. During the turmoil EONIA showed higher volatility throughout the entire maintenance period suggesting some erosion in the efficacy of the averaging mechanism. Whether the increase in volatility was due to the frontloading policy itself (e.g. large deviation from smooth accumulation of reserves) or to the underling factors (e.g. market segmentation, liquidity hoarding and credit rationing) is an open issue.

Figure 10: Standard deviation of EONIA spread



The frontloading policy generates volatility in daily aggregate liquidity conditions. Figure 11 shows the daily reserve surplus (DRS defined as the current accounts of banks minus the daily average minimum reserve requirement) on each day of the reserve maintenance period. Before the turmoil the surplus was very stable and small throughout the reserve maintenance period. During the turmoil a large surplus has been built during the first week of the reserve maintenance period (€ 20 billion/day); this has been achieved by MRO allotments (and fine-tuning operations) significantly above benchmark. Banks have been willing to bid for such large amounts. The burden of reducing the surplus then has fallen on the last two weeks of the maintenance period (€ -10 billion/day). Moreover, one-day fine-tuning operations on the last day of the maintenance period have been draining on average about €30 to €40 billion.

Figure 11: Daily reserve surplus

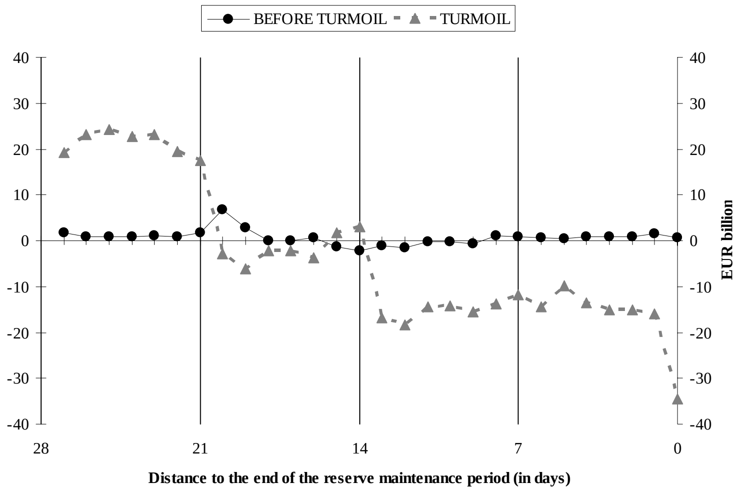
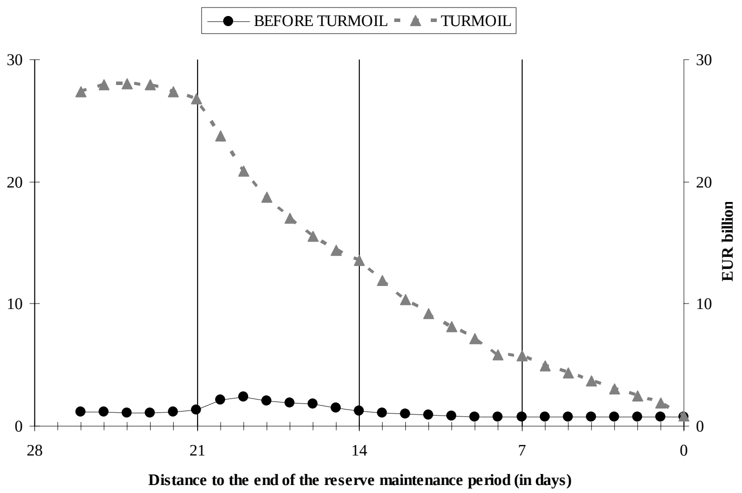


Figure 12 shows the average daily reserve surplus on each day in the maintenance period: the average on the last day, after the turmoil, is undistinguishable from the average before the turmoil. This illustrates that the ECB has not increased the supply of reserves; it has merely shifted the time-path of its liquidity provision within each maintenance period.

Figure 12: Average daily reserve surplus



The large size and variations in the daily reserve surplus documented above seem to be correlated with the level and volatility in the EONIA spread, suggesting the emergence of liquidity effects on a daily basis. Whether those liquidity effects are related to the frontloading policy or are due to other distortions in the functioning of the inter-bank market during the turmoil (i.e. market segmentation, liquidity hoarding and credit rationing) is an open issue.

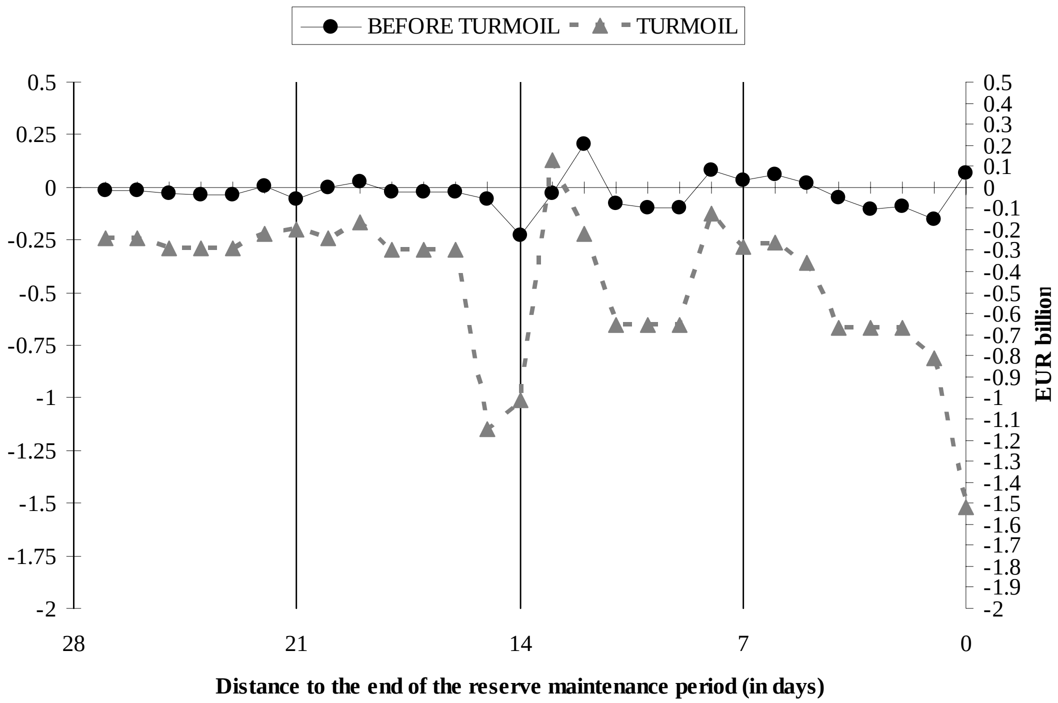
To summarize, the liquidity policy pursued during the first year of the turmoil was able to keep short-term interest rates at levels close to the policy rate and thus managed to counteract the effect of the turmoil on the overnight segment of the money market. However, the EONIA displayed a higher level of day-to-day volatility.

Recourse to standing facilities

Figure 13 shows the net recourse to the standing facilities (marginal lending – deposit facility) of the Eurosystem on each day of the reserve maintenance period. A negative value means a liquidity drain (cash is deposited with the Eurosystem) and a positive value means a liquidity injection (a credit from the Eurosystem). As expected in a regime with averaging and high reserve requirements, the net recourse is negligible under normal market conditions (an exception is that some net usage is observed between observations 8 and 14, coinciding with end-of-month days). Before the turmoil there was almost zero net recourse and a small positive recourse on the last day (€ 0.1 billion). During the turmoil the picture has changed significantly. A net recourse to the deposit facility has emerged which seems persistent, throughout the reserve maintenance period, with higher volatility around end-of-month days. The net recourse increases rapidly (in absolute terms) during the last week of the maintenance period ending with a net recourse to the deposit facility of about € 1.5 billion. The net recourse is mainly due to an increase in the recourse to the deposit facility rather then a decline in marginal lending.

Figure 13: Net recourse to standing facilities

(Lending minus deposit)



The rapid increase in the deposit facility that occurs on average towards the end of the maintenance period is consistent with the expected impact of the frontloading policy - some banks after the turmoil fulfil their reserve requirements before the last day of the maintenance period. These banks can no longer buffer out daily shocks to their liquidity position, and need to deposit all their reserves at the deposit facility. The persistent and steady recourse at around € 0.25 billion since the first day of the maintenance period and during most of the time is however difficult to explain with the frontloading policy. Two explanations, not mutually exclusive, seem plausible.

First, banks may be applying, under the turmoil, stricter lending limits in the overnight inter-bank market. The remaining cash is then parked with the Eurosystem – which plays the role of a risk-free counterparty without lending limits. Still, to the extent that banks get refinancing from the ECB, depositing with the Eurosystem implies (at least) a penalty of 100 basis points. That banks are willing to bid up tender rates reveals high degree of funding risk (aversion or premium) and / or market segmentation. In fact, this is equivalent to some form of liquidity hoarding by banks.

Second, instead of frontloading the fulfilment of the reserve requirement (reducing the daily reserve deficiency) banks instead could keep their reserve deficiency on a trajectory which is closer to a smooth fulfilment path – using the deposit facility to control for deviations from the smooth path, rather than inter-bank lending. This allows banks to keep their current accounts at higher levels without being locked-in and thus reducing the probability of marginal lending. However, this is rational for banks only if there is some stigma attached to, or asymmetry perceived in the cost of marginal lending versus deposit facility. In fact, under symmetry and no stigma "locking-in" and drawing from the marginal lending whenever needed whilst keeping the current account at zero, should be equivalent to not "locking-in", take recourse to the deposit facility and reduce marginal lending to (close to) zero.

Limits to the current frontloading policy

In spite of the success in steering the overnight interest rate close to 4% for more than one year, longer-term unsecured money market rates remained elevated and volatile. Figure 14 shows the spreads between EURIBOR deposits and EONIA swap rates for one-week, one-month and three month maturities. These spreads measure a mix of funding liquidity risk, market risk, counterparty risk and risk aversion and/or uncertainty. Before the turmoil, those spreads were small and stable, with an essentially flat term structure. During the turmoil spreads widened sharply and a positively sloped term structure of spreads emerged. In the process, also MRO and LTRO tender rates remained elevated and volatile (see Figure 15 and Figure 16) mimicking developments in the EURIBOR-EONIA swap spreads in terms of size and volatility.

Quite clearly the OIS spreads and the MRO and LTRO tender spreads have not abated in spite of ECB intervention, suggesting that underlying the apparent resilience of funding liquidity risk there has been a persistent concern among investors about the quality of the assets of the banks. The two aspects appear intertwined throughout the August 2007 – June 2008 period.

Figure 14: Spreads between EURIBOR and EONIA Swap rates

(Daily data: 15/03/2005 – 10/06/2008)

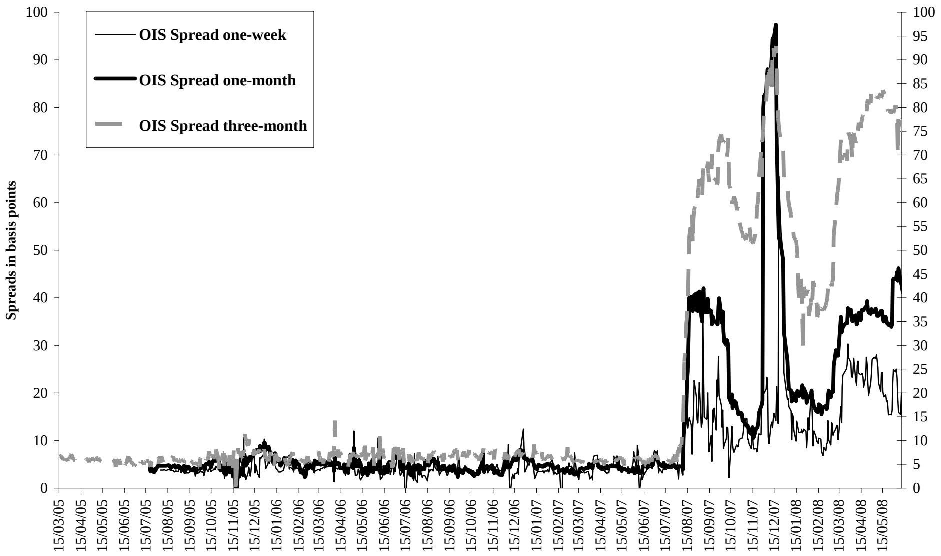


Figure 15: MRO spreads

(Daily data: 15/03/2005 – 10/06/2008)

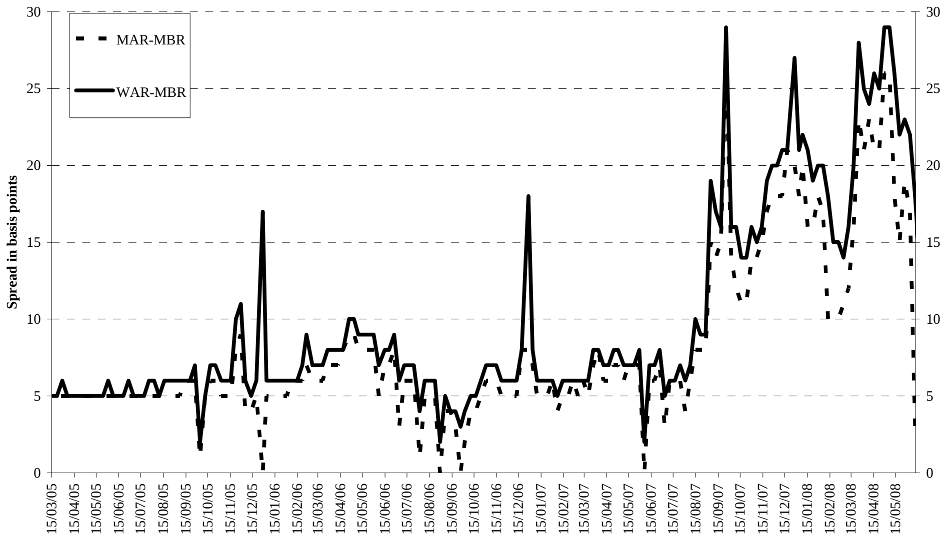
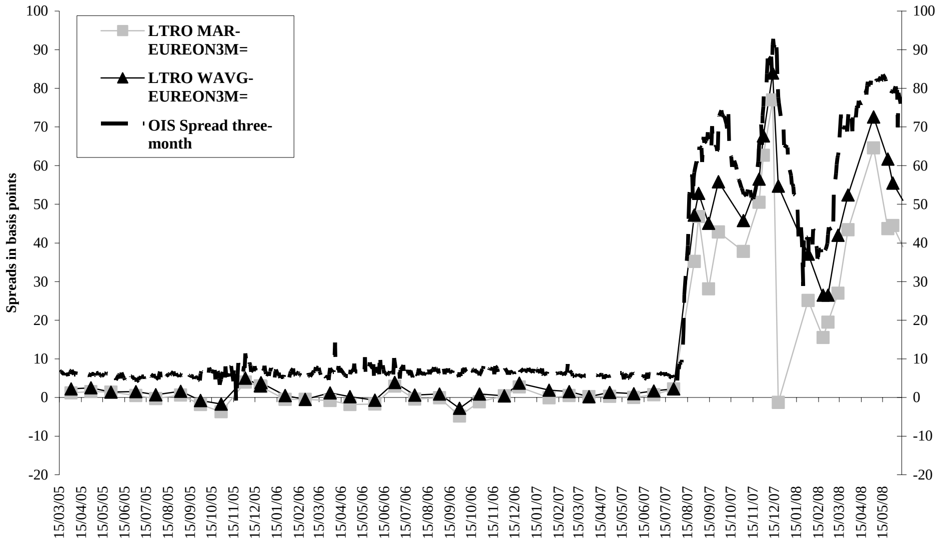


Figure 16: LTRO spreads

(Daily data: 15/03/2005 – 10/06/2008)



5 Conclusions and open issues

The ECB's operational framework has, at least during the first year, proven to be resilient to the ongoing financial turmoil. Several features that are special to the Eurosystem were particularly helpful: first, in times of market segmentation and very restricted interbank lending, the large number of counterparties to the Eurosystem was particularly important. Second, even in times of rapid changes in asset valuations and break-down of entire market segments, the broad range of collateral ensured that banks were not restricted to take part in central bank operations by their available assets.

The ECB's liquidity management during the turmoil has gone through several stages. The first phase (after an initial adaptation period), which is also the current one, is characterized by frontloading, in which the central bank changes the time path of its liquidity supply so that banks build up reserves early in the maintenance period. We have argued that the frontloading policy affects short-term market interest rates by influencing the probabilities of having to take recourse to the ECB's standing facilities and by mitigating the funding liquidity risk associated with a downgrade (or collateral shortage) towards the end of the maintenance period. Over the year-end period ECB's liquidity policy effectively put a floor and a ceiling to short-term rates in a way that is similar to implementing a narrow interest rate corridor.

On top of these actions, the ECB participated in the Term Auction Facility (US dollar auctions) together with other major central banks and lengthened the maturity structure of its refinancing operations. These measures had also an indirect impact on conditions in the overnight money market and, thus, contributed further to the stabilization of money market conditions.

Given the ongoing and deepening tensions in global financial markets, the Eurosystem's operational framework will continue to be under pressure. In spite of the success of the liquidity policy in aligning the overnight interest rate with the minimum bid rate, it seems clear that liquidity policy alone can not solve the underlying asset valuation uncertainties and credit-risk problems, which are the main causes underlying the funding liquidity crisis.

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