

Economic Policy
Fiftieth Panel Meeting
Hosted by the Universiteit van Tilburg
Tilburg, 23-24 October 2009

Monetary Policy In Exceptional Times

Michele Lenza, Huw Pill and Lucrezia Reichlin

The organisers would like to thank the Universiteit van Tilburg for their support.
The views expressed in this paper are those of the author(s) and not those of the funding organization(s).

MONETARY POLICY IN EXCEPTIONAL TIMES

Michele Lenza, Huw Pill and Lucrezia Reichlin¹

05 October 2009

PRELIMINARY VERSION: NOT FOR ATTRIBUTION OR QUOTATION

Abstract: *This paper describes the response to the financial crisis by three central banks: Bank of England (BoE), European Central Bank (ECB) and the Federal Reserve (Fed) and focus on so-called “non standard” monetary policy measures. We propose an empirical exercise aiming at quantifying that part of these policies which have affected the spread between the policy rate and the money market rate.*

1. Introduction

This paper describes monetary policy responses to the financial crisis from the emergence of the early symptoms of the crisis in the summer of 2007 to date. We focus on three major central banks: the European Central Bank (ECB), the Bank of England (BoE) and the Federal Reserve (Fed).

Since the response has implied major changes to the conduct of monetary policy and the role of central banks in the financial system, we focus on those actions that have been labelled “non-standard monetary policy measures”. We first characterize them at a conceptual level and then provide a description of their evolution over the period considered (August 2007 to now). The narrative is divided in two periods: before and after the collapse of Lehman Bros. The innovations introduced after Lehman’s failure eroded the distinction between liquidity management and monetary policy, creating new challenges for the communication of monetary policy.

Our story highlights similarities and differences in the monetary policy of the three institutions and concludes that, while there were differences that should be attributed to the heterogeneity of the financial systems and variation in starting points, overall the similarities across the responses of the three central banks were more significant than the differences.

The paper also proposes an empirical exercise which aims at quantifying the effect of the non-standard policies on the macroeconomy, including loans and monetary variables. The exercise is based on three vector autoregression (VAR) models (one for each country). These models each include between thirty and forty variables characterizing the real, nominal and financial sectors. For the euro area, the VAR is the same as in Giannone, et al. (2009). For the US and the UK, similar models have been designed. In all three cases, the problem arising from the large dimensionality of the model is dealt with by Bayesian shrinkage, as in Giannone, et al. (2009).

¹ Lenza and Pill: European Central Bank; Reichlin: London Business School. The views expressed in this paper are those of the authors and do not necessarily reflect those of the ECB or Eurosystem.

The empirical exercise is limited in scope since it focuses only on that part of non-standard policies which have affected the spread between the policy rate and the effective money market rate. Since, during a period of financial market stress, the policy rate alone can no longer summarise the monetary policy stance adequately, as significant wedges appear between that rate and the rates that matter for lending and borrowing in the economy, central banks have tried to affect spreads, for a given level of policy rate. We ask what has been the quantitative significance of the compression of the relevant spreads at the macroeconomic level.

The paper is organized as follows. The next section suggests a characterization of the new measures, section three provides the narrative and section four describes and reports the results of the empirical exercise. Section five concludes.

2. Characterizing non-standard measures

The response of central banks to the events taking place in financial markets since August 2007 has been characterized by recourse to “non-standard monetary policy measures” as well as substantial interest rate cuts. These non-standard measures largely relate to modifications in the implementation of monetary policy and have implied major changes in the role played by central banks as financial intermediaries, market makers and “lenders of last resort”. In turn, these changes have added to the complexity surrounding the signalling and communication of the stance of monetary policy on the basis of the level of key interest rates.

In what follows we make an attempt to characterize the non-standard measures. We distinguish three dimensions: (a) the immediate impact of these measures on the central bank balance sheet; (b) the choice of counterparties for the non-standard transactions, which has implications for whether non-standard measures aim at replacing or re-activating private market activity; and (c) whether the actions reflected attempt to re-establish or enhance conventional channels of monetary transmission or exploit channels typically neglected as the scope to ease through lowering interest rates was circumscribed by the approach of a lower bound.

(a) Impact on balance sheet

A “textbook view” distinguishes between, on the one hand, “quantitative easing” and, on the other hand, “qualitative easing” (or “credit policy” (Goodfriend, 2009)) in the following way.

Quantitative easing involves an expansion of the central bank balance sheet – and, in particular, an expansion of the monetary base – which does *not* change the composition of its asset side. In other words the holdings of “conventional assets” held by the central bank in normal times are simply increased, without changing the portfolio shares of the various assets in a substantial way. Of course, in assessing whether this criterion is met, one has to come to a view regarding which asset characteristics are most relevant: the issuer, the credit quality (or rating), the maturity, etc. On the

liability side, given that banknotes are provided perfectly elastically and are thus demand determined, the increase in the monetary base is reflected in an accumulation of central bank reserves (see **Figure 1**).

The converse is true for pure qualitative easing. In that case, the overall size of the central bank balance sheet is left unchanged, but the composition of asset holdings is changed such that “unconventional assets” are introduced at the expense of conventional assets. (Again, what constitute unconventional assets will depend on what asset characteristics are deemed most relevant.)

(b) *Choice of counterparties: Replacing or re-activating the market*

Policy measures may be non-standard not only because of the transactions conducted, but also because of the counterparties chosen for those transactions. Conceptually, central banks have to choose whether to deal only with their regular counterparties, or to open their operations to others. Traditionally, central banks have dealt solely with banks, on the basis that these are regulated institutions central to the payments system and credit creation, but the set of counterparties has been widened as a response to the crisis. As we will see in next Section the three central banks have taken different decisions in this respect.

The difference reflects a key conceptual choice in the design of non-standard measures: whether they aim at, on the one hand, replacing or by-passing a market that is blocked or impaired or, on the other hand, re-activating private activity in that market.

As we will see, many of the interventions undertaken from August 2007 onwards offered central bank intermediation of bank-to-bank transactions at a time when the interbank money market had frozen. This is an example of replacing private market activity. Given the centrality of the money market to the transmission of monetary policy, it has been recognized at least since Bagehot that central banks have little alternative but to offer these intermediation services at times when “panic” precludes interbank transactions. In providing such intermediation, however, central banks recognize that they are potentially crowding out market activity, creating various forms of dependency on central bank intermediation and thus complicating eventual normalization.

Looking beyond the money market, the scope for variation in central bank responses widens. For example, to the extent that non-standard measures are designed to support the credit creation process (and thus real activity which depends upon it), one can envisage central banks:

- (i) working *through* the banking system (and thus supporting loan supply), an example of attempts to *revive* private activity;
- (ii) supporting the functioning of private credit markets (e.g. by acting as a *de facto* market maker), which allows scope for the non-financial sector to *by-pass* an impaired banking system by substituting into capital market-based forms of external finance; or

- (iii) providing credit *directly* to the non-financial sector, which can be seen as an attempt to replace the malfunctioning financial sector.

(c) *The role of the lower bound on nominal rates*

Another conceptual distinction in the design of non-standard monetary policy measures is the role played by considerations related to the lower bound on nominal interest rates. At the start of the financial turmoil in August 2007, the level of short-term interest rates in all three jurisdictions was well away from the lower bound. Although monetary policy is naturally forward-looking, it is unlikely that lower bound considerations were central to the design of policy at that stage, yet a variety of non-standard liquidity measures were nonetheless introduced. By contrast, by spring 2009, short-term rates had reached very low levels and lower bound issues were to the fore.

We can distinguish between two forms of non-standard measures on a conceptual basis. The first is measures designed to improve the effectiveness of conventional monetary policy actions (i.e., changes in interest rates) which can therefore be considered *complements* to interest rate cuts. Many of the measures taken after the emergence of money market tensions in August 2007 – notably the support to the functioning of the money market – can be seen in this light. Indeed, the impact of these measures has often been summarized by analyzing their impact on the money market spreads since the containment / stabilization of these spreads ensured that monetary policy decisions steering the overnight rate were transmitted to market rates of more relevance to the financing and spending decisions of firms and households.

Another set of measures, on the other hand, is taken to implement a further easing of financing conditions once the scope for conventional easing has run out, i.e. when nominal short-term interest rates have reached their lower bound. By their nature, such measures are at least *potential substitutes* for conventional monetary policy.

As it will appear in our narrative, non-standard measures were not always easily classifiable in terms of whether they aimed to complement or to substitute for conventional interest rate cuts. By its nature, this situation has impaired the clarity with which central banks have been able to communicate the monetary policy stance, which in the current environment can no longer be captured solely by the level of a very short-term interest rate, such as the EONIA in the euro area.

3. Narrative

In describing the conduct of monetary policy and the introduction of non-standard measures during the financial crisis, it is useful to distinguish between two periods: before and after the failure of Lehman Bros. in September 2008.

Up to Lehman's demise, non-standard measures represented variations on "qualitative easing" (as defined in the previous section). By contrast, after the failure of Lehman, central bank balance sheets

expanded strongly (while the asset side composition continued to evolve), implying a combination of both quantitative and qualitative easing. In turn, these developments had implications for the signalling of the monetary policy stance and the transmission of monetary policy.

The remainder of this section describes the evolution of non-standard central bank policy measures over these two periods. It identifies a number of similarities and differences in the implementation of non-standard measures across the three central banks surveyed.

3.i Turmoil: August 2007 – September 2008

Following a prolonged period of strong loan growth, rising asset prices and narrowing credit spreads, financial turmoil first became apparent in mid-2007. Initially confined to markets for asset-backed securities in the US, by early 2008 market tension had become widespread. In particular, in August 2007 significant tensions emerged in the money markets. In the US, UK and euro area, spreads between secured and unsecured money markets rates rose to unprecedented levels (see **Figure 2**), while interbank transactions volumes fell to low levels at term maturities.

The causes of these tensions have been widely discussed elsewhere.² We do not repeat them here. Rather, we simply stress that central banks were confronted with a seizing-up of the inter-bank money market (especially at term maturities) and the emergence of very large spreads between, on the one hand, unsecured interbank deposit rates and, on the other, secured and swap rates. Uncertain of the availability of short-term financing in the money market, banks demand for central bank liquidity rose significantly.

Central banks responded to these developments by refining their liquidity management techniques (i.e. their choice of the instruments and procedures to be employed in the context of monetary policy operations). While superficially the actions taken during the period between August 2007 and September 2008 appear quite diverse (as reflected in the more detailed description of the measures taken by individual central banks presented below), in practice a number of common themes exist.

In particular, during this pre-Lehman period all central banks kept their liquidity management measures distinct from those taken regarding the monetary policy stance,³ in two specific senses. First, innovations in liquidity management were *not* intended to lead to a deviation of very short-term interest rates (notably the overnight money market rate) from the key policy rate. Second, the liquidity operations undertaken were *not* intended to increase the outstanding stock of monetary liabilities on

² e.g. Gorton (2008).

³ At the ECB, this distinction was elevated to the status of a “*separation principle*” (see Stark, 2008). Maintaining the distinction between monetary policy and liquidity operations was particularly important in the ECB’s case, since the need to address upside risks to inflation (possible second round effects stemming from the very high level of oil prices then observed) required a *tightening* of the monetary policy stance, even though liquidity operations were characterized as supportive.

the central banks' balance sheets.⁴ Given these elements, it remained possible to continue to characterize the monetary policy stance largely in terms of the level of very short-term interest rates (as in normal times). Of course, policy decisions regarding the stance had to take into account money market conditions and their impact on the level and volatility of money market rates (which represent important links in the chain of monetary policy transmission). But such decisions could be taken distinctly from liquidity management decisions

If liquidity operations were not intended to change the monetary policy stance, then what was their role? In large part, innovations in the operational procedures of the central banks between August 2007 and September 2008 were designed to achieve two inter-related objectives: first, to support interbank intermediation in the money market; and second, to introduce the necessary liquidity into bank balance sheets, which were becoming “blocked” by the accumulation of illiquid assets, notably asset-backed securities. Across the three jurisdictions, these objectives required that the central bank could offer a sufficiently large volume of liquidity to a sufficiently large number of counterparties so that transactions –which, in normal times, had been settled between banks directly in the money market – could now be settled across the central bank balance sheet. And they had to offer a facility that allowed banks which had to refinance illiquid assets to do so, thereby avoiding a “fire sale” of these illiquid assets that would further erode bank capital and destabilise markets.

Despite the common objectives of the non-standard measures, the details of central bank responses with respect to liquidity management appear to vary substantially.

The ECB was in the vanguard of acting to address the initial emergence of money market tensions. It conducted a number of large fine tuning operations (FTOs) in early August to contain the rise in money market spreads. Subsequently, it changed the timing of liquidity provision within the reserve maintenance period (thereby accommodating banks' demand for so-called “frontloading” of reserve accumulation⁵) and lengthened the maturity of its outstanding operations (increasing the volumes allotted in its longer-term refinancing operations (LTROs) at the expense of allotments in the main refinancing operations (MROs), while leaving the total volume of outstanding operations unchanged).

The BoE was initially more hesitant in employing liquidity operations, but – following the run on Northern Rock in mid-September 2007 – it subsequently also adopted a more active approach to liquidity management. Like the ECB (albeit from a different starting point), the BoE increased the

⁴ A small exception emerges here with regard to the BoE since – due to specific technical details of its operational framework (viz. the voluntary and flexible level of reserves required in the maintenance period and the “reserve band” at the end of the maintenance period) – it was possible for the reserves to expand somewhat without a significant impact on the level of overnight market rates.

⁵ In normal times, the ECB's allotment decisions at its regular weekly refinancing operations implied a smooth accumulation of reserves by banks over the maintenance period. Following the emergence of market tensions, banks wished to “frontload” their reserve accumulation (i.e. to hold more reserves than the amount required on average at the start of the maintenance period and less at the end), in part to avoid being short at the end of the maintenance period.

average maturity of its outstanding operations. It also widened the range of collateral eligible for its longer-term repo operations to include (highly rated) asset-backed securities (ABS), thereby mimicking the very broad definition of eligible collateral adopted by the ECB from the outset. In April 2008, the BoE introduced a new facility – the so-called special liquidity scheme (SLS) – that allowed banks to swap some of the illiquid assets on their balance sheets (notably ABS) for liquid Treasury bills for a period of up to three years.

With the exception of this asset swap scheme, most of the measures adopted by the ECB and BoE involved the use of instruments or procedures that were foreseen in these central banks' existing operational framework. By contrast, the FED – in addition to providing additional liquidity through its regular operations and lengthening the maturity of loans granted at the deposit window – introduced a set of new facilities. First and most importantly, in December 2007 the FED created the term auction facility (TAF) to provide liquidity through repo operations to a much broader set of counterparties and against a much wider set of collateral than had previously been the case in its regular open market operations. In March 2008 – at the time when Bear Stearns faced financing difficulties and was ultimately taken over by JP Morgan – the FED also established the primary dealer credit facility (PDCF), creating a standing credit facility for institutions outset the set of depository institutions eligible for borrowing at the discount window, and the term securities lending facility (TSLF) which allows primary dealers to borrow liquid Treasury securities from the FED against the collateral of illiquid assets held on their balance sheets, notably ABS.

How can one explain the diversity of measures adopted in the face of the initial emergence of money market tensions, despite the common objectives of such non-standard measures? A crucial part of the explanation is the difference in starting conditions. For example, even prior to the crisis, the ECB was conducting large regular refinancing operations – allotments in its weekly main refinancing operation (MRO) were around EUR 300bn. By contrast, the FED's regular refinancing operations were much smaller (in the region of USD 30bn), since the bulk of the counterpart to the note issue was in the form of outright holdings of Treasury securities. Similarly, the ECB had always had a very wide set of eligible counterparts (approaching 2000 credit institutions had the facility to bid at the weekly operations, of which around 300 regularly did so), whereas at the FED only a small number of primary dealers (around 20) were able to bid at its daily tenders. And, in part because of the legacy of the diverse set of collateral systems inherited from the pre-Monetary Union period, a very broad range of assets – notably including asset-backed securities – were eligible as collateral in Eurosystem operations, whereas collateral for the FED's regular operations was much more limited (largely to Treasuries and government agency bonds).

Relatively modest innovations within the ECB's existing framework were therefore seen as sufficient to manage the money market tensions, whereas more substantial changes were required in the US. Indeed, in many respects the introduction of the TAF can be understood as an attempt to mimic the

possibilities for central bank intermediation and refinancing offered by the ECB's regular operations. It gave anonymous access to liquidity to a very large number of counterparties (all depository institutions that had access to the FED's primary credit facility or "discount window") against a very broad range of collateral. The anonymous character of obtaining liquidity through the TAF was crucial, at a time when fear of the "stigma" associated with recourse to standing facilities in a market subject to informational asymmetries and adverse selection was high.

Moreover, the asset swap schemes introduced in the US and UK allowed illiquid assets to be taken off bank balance sheets and replaced by liquid securities that could be used as collateral in interbank transactions. Since the ECB accepted a large number of such assets as collateral in its own operations, there was little need for such asset swaps. Support for the view that the various and apparently diverse measures introduced by the three central banks were similar in substance in the obvious co-movement of money market spreads during the August 2007 – September 2008 period (shown in **Figure 2**).

While the refinements to liquidity management described above were the main measures taken to address the initial emergence of money market tensions, two further measures are worthy of note. First, in order to ensure a smoother distribution of US dollar liquidity to European and Asian banks, the introduction of the TAF was accompanied by the establishment of foreign exchange swaps among the leading central banks. The proceeds of these swaps were then provided to non-US resident banks.⁶ Second, in a number of cases central banks had to undertake further exceptional measures to support specific financial institutions in difficulty. Of special note is the case of Bear Stearns, which – after facing serious financing difficulties – was taken over by JP Morgan in March 2008. In facilitating this take over, the FED provided financing to a special purpose vehicle that assumed the problem assets on the Bear Stearns balance sheet.

The success of this broad set of liquidity measures in containing the rise in money market interest rate spreads is illustrated in **Figure 2**. A number of studies have attempted to estimate the impact of liquidity measures using econometric event studies.⁷ While the relative importance of liquidity and credit risk remains uncertain, the available studies suggest that the significant measures taken by central banks from August 2007 onwards did serve to contain the tensions in the market. Nonetheless – as reflected most visibly in the Bear Stearns case mentioned above – underlying problems in the financial sector persisted, with weak balance sheets, a need for capital replenishment and uncertainties surrounding the value and liquidity of "toxic assets" to the fore. While the functioning of the money market appeared to have improved somewhat as a consequence of central bank actions, risks in the financial sector remained significant.

⁶ For example, on the basis of dollars obtained through a swap with the FED, the ECB offered dollar liquidity to its own European counterparties against its regular collateral in dollar tender operations.

⁷ See Taylor and Williams (2008), McAndrews, et al. (2008), Wu (2008) and Christensen, et al. (2009).

3.ii Crisis: September 2008 onwards

These underlying weaknesses became manifest with the failure of Lehman Bros. in mid-September 2008. Whether this was simply the trigger for events that were anyway inevitable given the weakness of the banking system or a more important causal factor in its own right is difficult to ascertain (and likely to remain so). Suffice to say that, following the failure of Lehman, financial tensions intensified significantly.

One symptom of the panic then gripping financial markets was the further substantial rise in money market interest rate spreads, to levels not seen even at the height of the post-August 2007 tensions. At their peak following Lehman's collapse, the spread between unsecured deposit rates (EURIBOR) and secured rates (EUREPO) at the three-month maturity approached 200 basis points in the euro area – the equivalent spreads were even higher in the US and UK (see **Figure 2**).⁸

Central bank action following these events has to be understood as one part of a broader response by the policy authorities. Given the solvency issues that arose in many financial institutions, the fiscal authorities also needed to be mobilized to stabilize the financial sector. The passage of the troubled asset relief programme (TARP) in the US and the commitment of significant fiscal resources to support the banking system in Europe were important steps in early October 2008. Specific examples are the bail out of AIG in the US, the rescues of Fortis and Dexia banking groups by European governments and the restructuring of the UK banking sector with the merger of leading players brokered by the government. Fiscal stimulus to support demand was also significant on both sides of the Atlantic.

Here we consider the central banks' response. Interest rates were also cut significantly in the face of financial panic. On the 8 October 2008, the ECB, FED and BoE (in conjunction with other leading central banks) embarked on a coordinated 50 basis point cut in their key policy rates (see **Figure 3**). Although the pace of subsequent cuts varied somewhat, by the spring of 2009 very short-term money market rates in all three jurisdictions were close to zero (even if the changes in key policy rates exhibited somewhat more heterogeneity, for reasons to be explained). And as market rates reached such very low levels, consideration of the possible implications of a lower bound on nominal interest rates increasingly entered policy discussions.

Our focus remains the effects of non-standard measures (rather than changes in key policy rates). After describing the non-standard measures taken by the three central banks, we demonstrate: first, that their impact on the size and composition of the central bank balance sheets was more similar across the three jurisdictions than has been typically suggested by observers thus far; second, that differences in the actions taken by central banks reflected, to a large extent, differences in financial structure across countries, with implications for whether they could operate effectively with

⁸ These spreads form one basis for the empirical exercise conducted in Section 5.

traditional counterparties or needed to innovate in that regard; and third, that the measures introduced additional complexities into the characterisation of the monetary policy stance, in turn creating potential complications for central bank communication and signalling.

All three central banks undertook unprecedented actions with regard to the size and composition of their balance sheets. Initially, the motivation for such measures followed that which had underpinned the interventions after August 2007, namely to support market functioning through increasing central bank intermediation and to balance sheet pressures on financial institutions. Only the scale of such activities increased. As market activity froze, it became imperative to help banks manage the illiquid assets on their balance sheets: not only did such assets threaten the extension of new credit, their forced disposal would have created a “fire sale” adding to the downward pressure on asset prices that was already reducing available private collateral and eroding bank capital. Subsequently, as the level of interest rates fell, in some cases the motivation for such balance sheet actions was shifted to and / or augmented by a switch to quantitative monetary policy measures, as the scope for conventional interest rate easing diminished.

Against this background, how do the actual measures introduced (as summarized in **Figures 6, 7 and 9**) match up to the text book definitions provided in Section 2? As already recognised, prior to the Lehman failure the liquidity measures employed closely resemble text book qualitative easing: no aggregate expansion of the balance sheet, but rather change in the composition of its asset side. By contrast, from September 2008 onwards, the non-standard measures employed by the three central banks are no longer easily characterized as either one text book case or the other. First, the measures taken embodied *both* changes in the composition of the asset side *and* an overall expansion of the balance sheet. While the means varied across central banks, the outcome was one where elements of quantitative and qualitative easing were employed (even if the rhetorical emphasis placed on the two elements varied across jurisdictions and over time). Second, on the liability side a number of elements were introduced that were not envisaged in the text book framework, such as the increase of government deposits at the central bank. And third, on the asset side the nature of unconventional operations varied from the relatively modest step of simply increasing the maturity of repo operations in the case of the ECB to purchasing novel private assets (such as ABS) at the FED.

What is striking about the balance sheet evolution of these three central banks is that, despite significant differences in rhetoric and operational technique, there are obvious broad similarities. In particular, the timing of the balance sheet expansion is coincident; the nature of liability expansion – with a focus on accumulation of remunerated reserves – is very similar; and, although the specific nature of assets accumulated varied in line with the structure of the financial system, the increase in “unconventional” assets at the expense of conventional assets is common.

This notwithstanding, significant differences have emerged with regard to the magnitude of *changes* in central bank balance sheets across countries, especially after the failure of Lehman Bros. For example, the total size of the FED and BoE balance sheets have more than doubled since September 2008, whereas that of the Eurosystem has increased by a more modest 60% (see **Figure 8**). Yet such differences give a misleading impression of variation in central bank actions, since they neglect the variation in starting points. Given the much larger initial size of the Eurosystem balance sheet, the increase needed to absorb the increased demand for central bank intermediation was smaller. **Figure 8** demonstrates that the size of central bank balance sheets (relative to GDP) was relatively similar after the response to Lehman's demise.

If the impact on the size and composition of central banks' balance sheets was similar, greater diversity was demonstrated with regard to the mode of implementation and, in particular, the choice of counterparty. The ECB continued to operate largely via the banking sector, overwhelmingly in the form of repo operations. Even the relatively modest outright purchases of securities made by the Eurosystem were intended to improve bank funding conditions by reactivating the covered bond market. By contrast, the FED undertook a very large volume of outright purchases of Treasury and asset-backed securities from a broader range of market counterparties, including non-banks. The BoE also engaged in significant outright purchases (strictly speaking, as an agent of HM Treasury) from a broad range of market counterparties going beyond banks. Indeed, the BoE attempted to target gilt purchases from the non-financial private sector.

Two broad explanations of these different approaches can be offered (corresponding to issues raised in Section 2 above): first, differences in financial market structure, which influenced decisions on whether the banking system should be supported or by-passed by the non-standard measures; and second, attitudes towards whether quantitative measures were needed to alleviate concerns about the effectiveness of monetary policy as the lower bound on nominal interest rates approached.

As regards the role of financial structure, given the overwhelming importance of banks as providers of external financing to firms and households in the euro area, the ECB had little alternative to work through the banking system and thus continue to operate largely via its regular counterparties. By contrast, the market-centred financial system in the United States implies that banks are a less important source of external funds and thus that working solely through the banking system – which was itself impaired – risked failing to ensure a flow of credit to the broader non-financial sector. As a consequence, the FED set out to by-pass the banks, circumventing its conventional counterparties.

Moreover, the unbundling of the various components of loan making process had proceeded much further in the United States than in the euro area. By implication, direct interventions in financial markets by the FED – such as the purchase of residential mortgage backed securities (RMBS) – were required to bridge the institutional “gap” that had emerged between the origination of loans, their

initial financing and their ultimate securitization and sale in the market. The equivalent euro area transactions remained internalised within a single financial institution that both originated, financed and (when possible) securitized the underlying mortgage loans. Recourse to Eurosystem operations by conventional counterparties, where RMBS remained eligible collateral (including that created by “retained securitization” as described above), was therefore sufficient to prevent a complete freezing of the credit creation process. By contrast, in the US the FED was forced to undertake a much greater “market making” role, so as to ensure that the links in this intermediation chain remained intact. Such details of the intermediation process thus influenced the design of non-standard measures as much as the overall structure of the financial system.

Turning to questions related to the lower bound, to the extent that non-standard measures were seen as a substitute for interest rate cuts as a lower bound on nominal rates approached, then central banks (most volubly the BoE) emphasised the desirability of purchasing assets from non-bank counterparties. Through such measures, the impact of quantitative measures on private portfolio choices (and thus on asset prices and spending) could work more effectively, since the danger that the liquidity injected would simply be held passively in the banking system would be reduced. At the time of writing, the success of such an approach remains open to question.

By their nature, these non-standard measures increased the complexity of communicating the monetary policy stance. Precisely because of their novelty, a new mode of communication was required – even if the specifics varied from one central bank to another, depending on the details of the measures introduced – and this required some learning from both sides.

Against this background, the remainder of this sub-section offers a more detailed description of the actions of the three central banks following the failure of Lehman Bros., with an emphasis on the euro area.

Euro area

Soon after the coordinated interest rate cut on 8 October, the ECB announced several important innovations in its operational procedures. First and foremost, it adopted a fixed rate / full allotment (FRFA) tender procedure in its regular monetary policy operations. Through so doing, it forewent the ability to determine the quantity of liquidity provided to the market by deferring that decision to its counterparties. By providing certainty on the availability of central bank liquidity (with regards to both quantity and price), this measure helped to stabilise the banking sector at a time of high stress. Second, the ECB expanded its list of eligible collateral, to include securities (other than ABS) rated BBB or higher, while also further lengthening the average maturity of its outstanding operations. Taken together, these measures considerably expanded the scope for central bank intermediation to substitute for a money market subject to severe disruption. Moreover, bank counterparties to the Eurosystem operations were able to refinance parts of their balance sheets on a rotating basis at the

central bank.⁹ In the extremely difficult market conditions that followed the failure of Lehman Bros., there can be little doubt that this facility provided significant comfort and support to the banking sector and thus, particularly given the bank-centric nature of the financial system, to financial stability in the euro area.

Reflecting the need for such intermediation in the environment then prevailing, demand for central bank liquidity at these FRFA tenders was substantial. Participation at the tenders by eligible counterparts also increased, to around 1000 at its peak. Indeed, demand was so large that it exceeded the aggregate liquidity needs of the banking sector consistent with the fulfilment of reserve requirements over the maintenance period as a whole. The ECB chose to reabsorb the liquidity in excess of that required to fulfil minimum reserves through recourse to the deposit facility, rather than conducting FTOs. As a result, holdings at the deposit facility – and thus the monetary base, defined as the sum of currency in circulation and reserves held at the central bank (including at the deposit facility) – increased substantially (see **Figure 4**).

Given the strength of counterparty demand and the decision not to reabsorb excess liquidity via FTOs, a chronic situation of ample liquidity emerged in the euro money market (see **Figure 4**). As a result, the overnight money market interest rate (EONIA) moved systematically away from the MRO rate (which hitherto had been seen as the ECB’s key “policy rate”) and fell towards the rate on the deposit facility (see **Figure 5**). As such, the MRO rate became a less effective summary of the monetary policy stance, as the emergence of spreads in the money market rendered it a less effective basis for assessing market rates and the starting point of the transmission mechanism.

When the FRFA procedure was introduced, the ECB also reduced the width of its interest rate corridor (defined by the rates on the marginal lending facility and deposit facility) to ± 50 basis points from its normal ± 100 basis points, in an effort to avoid too great a fall in the overnight rates and maintain the MRO rate as a meaningful signal of the monetary policy stance. However, in January 2009, having experienced a fall in activity in the overnight money market that was associated with this narrower corridor,¹⁰ the ECB decided to re-widen the interest rate corridor to ± 100 basis points and thereby to accept a significant departure of the overnight market rate from the MRO rate.¹¹ Over time, the ECB’s official communication reflected that the MRO rate was no longer an adequate indicator of the monetary policy stance and that, in the exceptional times being faced, the stance was

⁹ One particular feature of this more general phenomenon was so-called “retained securitization”, whereby banks transformed loans on their own balance sheet into ABS via related SPVs, and then held the resulting security to use as collateral in the Eurosystem operations. Mortgage loans, for example, could thus be refinanced at the ECB.

¹⁰ In principle, a narrower corridor implicitly made intermediation over the central bank balance sheet cheaper relative to market intermediation (the corridor was akin to the ‘bid / ask’ spread in private markets).

¹¹ On reducing the MRO rate by 25 basis points to 1% in May 2009, the ECB left the deposit rate at 0.25%, thereby again narrowing the corridor, this time to ± 75 basis points (as the marginal lending rate was simultaneously reduced by 50 basis points).

better understood in terms of the level of market rates at various maturities. Indeed, with the EONIA persistently below the MRO rate, money market rates of all types and at all maturities adjusted downwards. Thus the specific liquidity measures introduced by the ECB exerted a clear effect on the level of short-term interest rates – and thus the monetary policy stance – from autumn 2008 onwards.

In May 2009, the ECB announced that it would undertake three repo operations with a one-year maturity, further extending its support of banks' credit creation. These operations were also conducted using a FRFA procedure and the attractiveness of this facility resulted in a very large demand (and allotment) (slightly less than EUR 450bn). The substantial quantity of liquidity provided maintained the downward pressure on EONIA, which fluctuated 60 – 70 basis points *below* the MRO rate rather than at a spread of 3-10 basis points above the MRO rate characteristic of normal times.¹² Moreover, the long maturity of the fixed rate operation was interpreted by some as a signal of future interest rate intentions (and thus an attempt to “flatten the yield curve” and loosen overall financing conditions while holding very short-term rates unchanged), even if the ECB as at pains to make clear that it would never pre-commit to a path of future interest rates.

In concert with the announcement of these one-year operations, the ECB also announced that it would purchase EUR 60bn of bank covered bonds over the course of the subsequent year. The size of these purchases was modest, both in relation to the overall size of the covered bond market and the size of the ECB's own balance sheet. The stated purpose of the covered bond purchase programme was to act as a catalyst for the recovery of the private transactions in the market, rather than act as a replacement for such transactions. Its approach thus differed from that adopted in the money market, where ECB interventions aimed at offering the possibility of central bank intermediation to replace private transactions that were no longer taking place. Moreover, covered bond purchases were viewed as part of a consistent strategy associated with the other measures described above, which focused on easing bank funding conditions and promoting credit creation through the banking system rather than trying to by-pass it. By the end of September 2009, covered bond purchases totalled around EUR 12bn. Despite this modest amount, these purchases appear to have exerted a positive influence on primary market issuance and narrowed credit spreads in the specific market segment, even if secondary market trading remains low by normal standards.

Finally, in response to the Lehman failure, the ECB (and other central banks, including the BoE) re-opened swap lines with the FED and again provided US dollars to its counterparties against regular Eurosystem collateral. These operations also adopted a FRFA tender procedure.

Taken together, these measures have been labelled the ECB's “enhanced credit support”.¹³ Their impact on the ECB's balance sheet is shown in **Figure 6**. A number of points are noteworthy: (1)

¹² These spreads form another basis of the empirical exercise conducted in Section 5.

¹³ See, for example, the description of the ECB measures offered in Trichet (2009).

balance sheet expansion in excess of the trend increase in banknotes only started after the failure of Lehman; (2) on the liabilities side, balance sheet expansion was largely reflected in recourse to the deposit facility; (3) on the asset side, expansion of the balance sheet was largely associated with longer-term refinancing operations; and (4) the magnitude of outright purchases is negligible.

United States

In the US, the FED also moved to expand its balance sheet significantly after the failure of Lehman Bros. On the liability side, balance sheet expansion was reflected in an increase in both deposits held by the US treasury at the FED and bank reserves. As part of the TARP legislation, the FED was endowed with the power to pay interest on bank reserves (thereby mimicking ECB practice since the start of Monetary Union), which allowed the accumulation of reserves to take place without market interest rates departing substantially from the Fed Funds rate target set by the FOMC. However, because significant players in the overnight market did not have access to this remunerated deposit facility, in practice it proved difficult to stabilize the dollar overnight rate. Indeed, the FED ultimately decided to announce a target band of 0 – 0.25% for the Fed Funds rate (even with reserves offering a return of 0.25%), reflecting its difficulty in steering the rate closely in this environment.

On the asset side, following Lehman's demise the FED undertook large outright purchases of a variety of securities. A whole series of facilities were introduced to support various segments of the financial market and specific institutional sectors. In particular, significant purchases of GSE debt and ABS were made, in an attempt to stabilize these markets and prevent the seizing up of credit creation.

This process of direct intervention in specific financial markets was labelled "credit easing". It was seen as a natural continuation of the policies pursued by the FED prior to the Lehman failure, which also involved a reconfiguration of the asset side of the FED's balance sheet as non-conventional assets (e.g. TAF loans) replaced conventional assets (Treasury securities). The intensification of financial market tensions in September 2008 simply became larger in scale and thus implied an expansion of the overall balance sheet in order to accommodate the larger required asset purchases. This approach was distinguished from the "quantitative easing" pursued by Japan at the turn of the century, which had focused on expanding the liability side of the Bank of Japan's balance sheet and was seen by many observers having been relatively ineffective.¹⁴

However, by March 2009 – as market conditions reached their nadir – the FED prepared to combine the "credit easing" approach of targeted (even if large) market interventions described above with a broader attempt to expand its balance sheet. A large asset purchase scheme was initiated, which will imply the purchase of USD 1.75tr of assets (USD 1.25tr of agency debt, USD 300bn of Treasuries and USD 200bn of other assets) outright by the end of the first quarter of 2010. These volumes are without

¹⁴ See Bernanke (2009), where this distinction was emphasised.

historical precedent and dwarf the increases in the Eurosystem’s balance sheet (and still more the outright purchases made by the ECB, which are tiny in comparison). However, when judging these policies in a comparative perspective, it is important to keep in mind that the Eurosystem’s balance sheet was initially much larger. Both at current market exchange rates and in relation to GDP, the FED and ECB balance sheets are broadly at comparable magnitudes in levels, despite the much larger increase seen in the US over the past year (see **Figure 8**).

Also appearing on the asset side of the FED’s balance sheet are the swaps with other central banks, already discussed above. It should also be mentioned that, as in the Bear Stearns case, the FED was closely involved in a number of “rescue schemes” for specific financial institutions. For example, it provided loans to facilitate rescue of AIG (an insurance company) immediately after Lehman’s failure. These actions – most of which were indemnified by the US Treasury – resulted in the creation of a number of other “off balance sheet vehicles” that were financed by the FED.

United Kingdom

The evolution of the BoE balance sheet demonstrates a number of similar features. Again, balance sheet expansion only starts in earnest after the failure of Lehman (see **Figure 9**). On the liability side, it largely reflects an increase in recourse to the deposit facility, which is remunerated in the same manner as that of the ECB. On the asset side, the BoE initially also followed an approach which emphasized longer-term repos, but from early 2009 it started to undertake large asset purchases. In order to protect the BoE from the financial risks associated with such balance sheet expansion, these purchases were undertaken by an off balance sheet vehicle with government guarantees that was financed by loans from the BoE. These latter measures were labelled “quantitative easing”; relative to the ECB and FED, after the introduction of its asset purchase facility, the BoE placed more emphasis on the expansion of the liability side of its balance sheet, rather than the composition and size of the asset side.¹⁵

Summing up

In an attempt to summarise the many detailed points described above, **Figure 10** offers a comparison across the ECB, FED and BoE over six dimensions: balance sheet size relative to GDP and bank credit; size of refinancing operations; maturity of refinancing operations; size of reserve holdings; number of counterparties; and breadth of collateral eligible for repo operations with the central bank.¹⁶ It shows the evolution of these characteristics over three phases: prior to the emergence of turmoil;

¹⁵ See Bean (2009) for a more complete discussion.

¹⁶ Of course, the choice of these six indicators is, to some extent, arbitrary. Moreover, given the specificities associated with the design of the operational framework for monetary policy in the three jurisdictions, identifying a common indicator across countries requires a certain element of judgement. While such considerations naturally influence the appearance of Figure 10, the conclusions drawn are robust.

between the onset of money market tensions and the failure of Lehman Bros.; and after the failure of Lehman.

On the basis of the evolution of the six characteristics over these phases, **Figure 10** makes two important points. First, much of the apparent “activism” of the FED in the initial turmoil phase (relative to the actions of the ECB and, to a lesser extent, the BoE) represent efforts to expand their facilities in the direction of those already in place elsewhere. Second, the broadening and deepening of non-standard measures after the failure of Lehman Bros. led to broadly comparable outturns – at least on the basis of these six indicators – across all three countries.

While we thus see important similarities in the responses of central banks to the turmoil, we also see differences. These arise from two sources: variation in financial structures (both at an aggregate level and on specifics related to the securitisation process); and (especially from spring 2009 on wards) variation in the importance attached to lower bound issues. This latter issue remains open and will remain to as long as the evolution of the economic outlook – and, in particular, the magnitude of deflationary risks – is uncertain.

Regardless of the specific non-standard measures taken, their novel character has raised new challenges for central bank communication. In particular, the maintenance of a clear distinction between, on the one hand, the monetary policy stance (as signalled by evolution of a single “key policy rate”) and the tools and instruments of monetary policy implementation and liquidity management have been eroded. Refining the framework for communication remains an important challenge for all three central banks considered in this paper. Given the crucial importance of guiding expectations in the conduct of monetary policy and the associated benefits to a rules-based approach, the ability to signal clear intentions in this new and complex environment is key.

4. Transmission mechanisms

Having described and characterized non-standard monetary policy measures, it is natural at this point to ask whether they have mattered and whether we can recognize any cross-country differences in their impact.

Non-standard measures affect interest rates through three channels:

- (i) First, they may influence the level of very short-term interest rates (notably the overnight rate) directly, through liquidity effects. In other words, to the extent that they involve the injection of ample central bank liquidity into the market, non-standard measures can open up a spread between the key “policy rate” (e.g. MRO rate in the ECB context) and the market rate that forms the basis for pricing financial instruments (EONIA).
- (ii) Second, non-standard measures may contain and / or reduce the spreads that emerged in the money market, thereby further reducing the level of market interest rates (such as the EURIBOR

or LIBOR, which form the basis for many private credit contracts) and stimulating spending. Efforts to offer central bank intermediation to support interbank transactions would work in this direction and – as shown in **Figure 1** – appear to have been relatively successful.

(iii) Third, non-standard may serve to manage expectations of the path of future monetary policy decisions and thus affect the slope of the money market yield curve.

This is clearly an incomplete list of the possible ways in which non-standard measures can support the economy, but a complete evaluation goes beyond what can be done at this stage.

In what follows we focus on the effect on the economy of interest rate spreads. From the perspective of our analysis, this component of the non-standard measures should act on the economy in the same way as an interest rate change in normal times. By affecting spreads, central banks affect the financing conditions facing firms in a similar manner to a change in the stance of monetary policy in normal times: in our models, this acts as a standard monetary policy shock to the macroeconomy.

Our exercise consists in estimating counterfactual paths of the variables of interest under two alternative scenarios: a no policy scenario where the spread between the policy rate and 3-month LIBOR is kept constant at the level observed in October 2008 (the peak of the crisis), and a policy scenario where that spread is reduced by policy intervention.

The exercises are conducted on the basis of a Bayesian monthly vector auto regression (VAR) model for the three countries, each containing standard macroeconomic variables and some details on money and credit variables. This model has been first developed for the euro area by Giannone et al (2009). Here we have implemented it for the USA and the UK as well. Details of the definition of variables, the estimation method and the technical aspects of the counterfactual exercise can be found in the appendix.

Euro Area

To implement our empirical analysis of non-standard measures in the euro area, we estimate the model until 2007, i.e. until before the introduction of these measures. On the basis of the estimated parameters and from November 2008, we construct two conditional forecasts for the variables of interest, where we condition on, respectively, a policy and a no policy scenario. The difference between these two conditional forecasts is our estimate of the effect of the policy measures on these variables.

As explained in the previous section, as a response to the increased tension in the financial market following Lehman's collapse, the ECB, by adopting a FRFA tender procedure and thereby creating conditions of ample liquidity, kept the EONIA close to the lower bound of the corridor (deposit rate) (as shown in **Figure 5**). While in normal times the spread between the MRO and the EONIA is small and positive, after Lehman, the spread therefore became large and negative: approximately 65 bps. We have also shown how the non-standard measures appear to have reduced the spread between the

EURIBOR and OIS rates in the money market, reflecting central bank intermediation of interbank transactions as the market froze. The aim of the exercise is to study the impact of these changes.

Let us explain the exercise in more detail.

For the no policy scenario we assume that, between November 2008 and August 2009, the spread between the 3-month EURIBOR and the policy rate (MRO) remains at the stressed level of October 2008 and that the spread between the EONIA and the MRO remains, as in pre Lehman historical experience, positive and small. Since the EONIA time series for a sufficiently long sample is not available, we implement this counterfactual by adding the positive (historical) EONIA-MRO spread to the EURIBOR. We then compute the conditional expectation of the variable of interest given the parameter of the models, past observations of all variables and the path of the counterfactual EURIBOR-MRO spread. For the policy scenario, expectations are computed conditioning on the observed value of the EURIBOR-MRO spread. The effect of policy on the variables of interest is the difference between the policy and the non policy conditional expectations.

To implement the no policy scenario we also have to control for effects arising from any flattening of the money market yield curve. To this end, we need to compute the slope of the yield curve that would have prevailed without non standard monetary policies. This is done by estimating the VAR until 2007 (standard monetary policy sample) and forecasting the 3-month EURIBOR for 3, 6 and 9 months ahead from November 2008 (expected rates under standard policy). This counterfactual expected rate is then compared with actual expected rates computed using the forward rates implied by the Overnight Index Swaps (OIS). The effect of non-standard measures on the 12 months EURIBOR is computed as the difference between actual expected policy and expected standard policy. The no policy scenario for the 12 months EURIBOR is the 12 months EURIBOR plus the effect of non standard measures.

Figure 11 reports the policy and no policy path for the 3 month and 12 month EURIBOR [*to be inserted*].

The charts in **Figure 12** illustrate results for M1, M3, three categories of loans, inflation, unemployment and industrial production. The charts report the size of the effect (the solid line) and the size of the effect normalized by the standard deviation of the variable (the dashed line). The effect is on the year-on-year growth rates of the variables except for unemployment where we consider the rate.

The results reveal a sizeable positive effect on M1, consumer loans and loans for housing purchases. The effect on M3 is negligible, while the effect on loans to non-financial corporations is delayed. Our estimate of the size of policy based on differences in counterfactual paths cannot be interpreted as an impulse response function since the paths are influenced by other shocks than the policy one. However, it is interesting to note that our results are in line with those found by Giannone et al. (2009)

on the effect of monetary policy shocks in normal times and the cyclical characteristics of the variables studied here. Those authors show that monetary policy shocks affects loans to non-financial corporations with a delay and that, while loans to non-financial corporations lag the business cycle, consumer loans and loans for housing purposes are coincident. They also show that, while there is a liquidity effect on M1, we don't have it on M3 and that M1 is pro-cyclical while M3 is a-cyclical and not well captured by the model.

Turning to unemployment and industrial production, we can identify a delayed effect on both unemployment and industrial production, again in line with results in Giannone et al. (2009). As expected, results on inflation are not interpretable since this variable is not well captured by the model (see Giannone et al., 2009).

USA

To be added

The United Kingdom

To be added

5. Concluding remarks

This paper describes the monetary policy response to the financial crisis by the European Central Bank, the Bank of England and the Federal Reserve, with a focus on the non-standard measures implemented. We also study the effect on key macroeconomic variables, loans and monetary aggregates of the compression of the spread between the policy rate and EURIBOR / LIBOR which resulted from these non-standard monetary policies.

Our main conclusions can be summarized as follows. First, although there are some differences in the responses of the three institutions, in our view the similarities across the three central banks are more significant, especially once the implications of variation in financial structure are recognised. Second, policies implemented after Lehman's collapse have eroded the distinction between liquidity management and monetary policy, thereby creating new challenges for central bank communication. Finally, we have shown that (for the moment for the euro area only) these non-standard policies, by affecting spreads between policy and market rates, had exerted a significant effect on the macroeconomy, which is qualitatively similar to a monetary policy shock in normal times.

References

- Bean, C. (2009). Speech given at the Cutlers' Feast, Cutlers' Hall, Sheffield, May, <http://www.bankofengland.co.uk/publications/speeches/speaker.htm#bean>
- Bernanke, B.S. (2009). "The Crisis and the Policy Response", Stamp Lecture, London School of Economics, January 2009, <http://www.federalreserve.gov/newsevents/speech/bernanke20090113a.htm>.
- Bernanke, B.S. (1983). "Non-monetary effects of the financial crisis in the propagation of the Great Depression," *American Economic Review* 73(3), pp. 257-76.
- Christensen, J., J. Lopez and G. Rudebusch (2009). "Do central bank liquidity operations affect interbank lending rates?" FRB San Francisco.
- Friedman, M., and A.J. Schwartz (1963). A Monetary History of the United States, 1867-1960, Princeton, NJ: Princeton University Press.
- Giannone, D., M. Lenza and L. Reichlin (2009). "Money, credit, monetary policy and the business cycle in the euro area," presented at the ECB workshop on monetary policy transmission, September 2009.
- Goodfriend, M. (2009). "Central banking in the credit turmoil: An assessment of Federal Reserve practice," paper prepared for Bank of Japan conference, May 2009.
- Gorton, G.B. (2008). "The Panic of 2007," in Maintaining stability in a changing financial system, FRB Kansas City.
- Heider, F., M. Hoerova and C. Holthausen (2009). "Liquidity hoarding and interbank market spreads: The role of counterparty risk", ECB working paper *forthcoming*.
- Manna, M., H. Pill and G. Quirós (2001). "The operational framework of the Eurosystem in the context of the ECB's monetary policy strategy," *International Finance* 4(1), pp. 65-99.
- McAndrews, J., A. Sarkar, and Z. Wang (2008). "The effects of the Term Auction Facility on the London Interbank Offered Rate," Federal Reserve Bank of New York staff report no. 355.
- Stark, J. (2008). "Monetary policy during the financial turmoil: What have we learned?" *The ECB and its Watchers X*, http://www.ecb.europa.eu/press/key/date/2008/html/sp080905_1.en.html.
- Taylor, J. and J. Williams (2009). "A black swan in the money market," *American Economic Journal: Macroeconomics* 1(1), pp. 58-83.
- Trichet, J-C. (2009). "The ECB's enhanced credit support". Keynote address at the University of Munich / IFO symposium, <http://www.ecb.europa.eu/press/key/date/2009/html/sp090713.en.html>.
- Wu, T. (2008). "On the effectiveness of the Federal Reserve's new liquidity facilities," Federal Reserve Bank of Dallas working paper 0808.

Figure 1: Quantitative versus qualitative easing – Textbook view

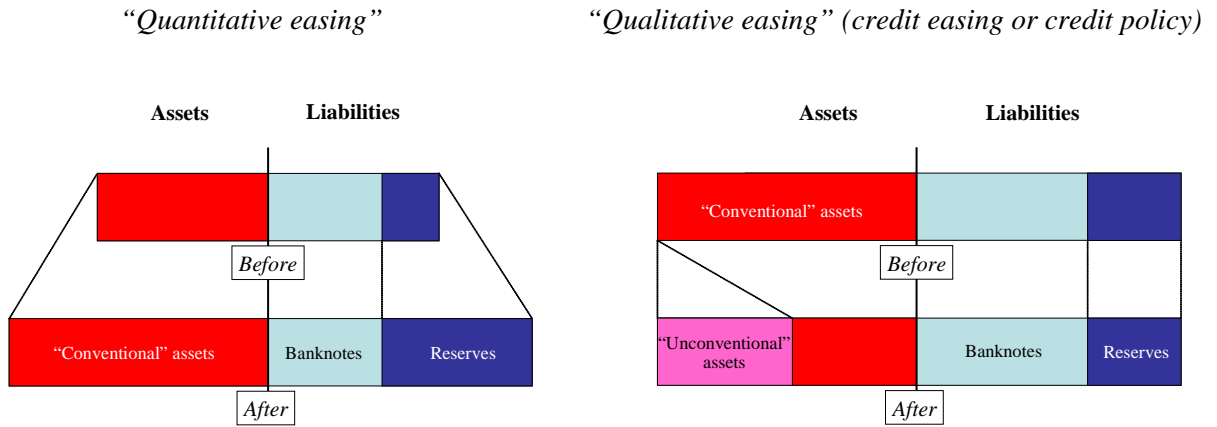
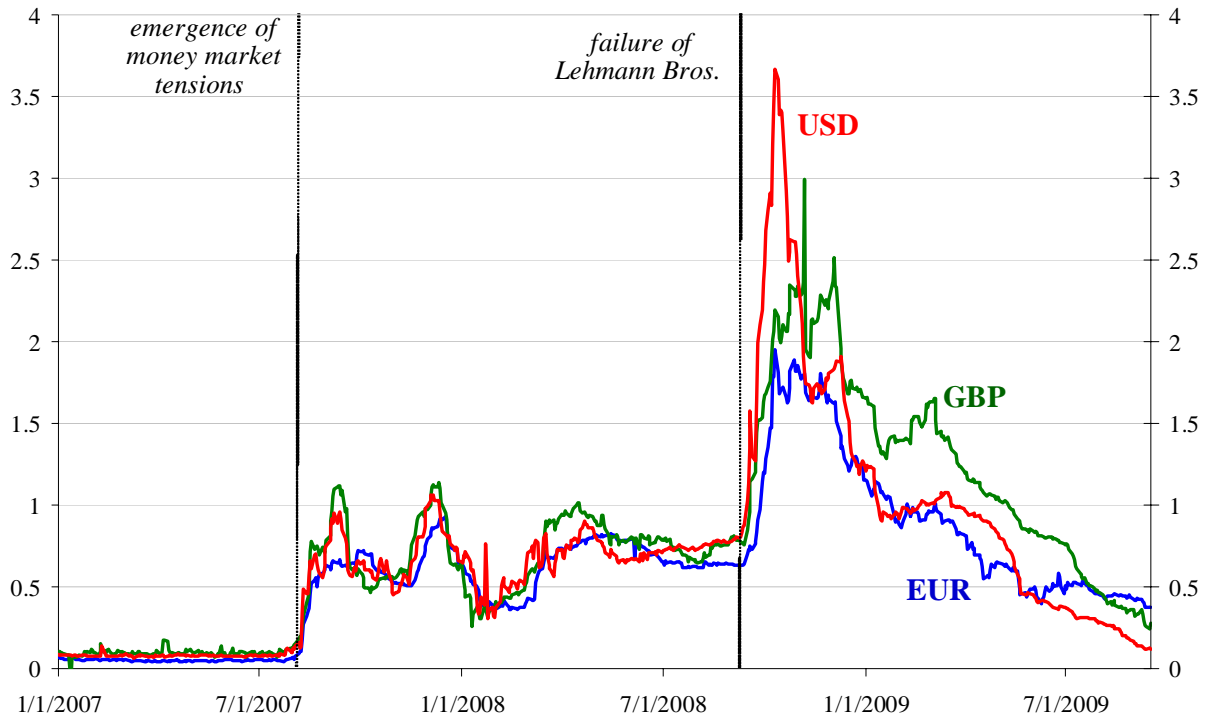


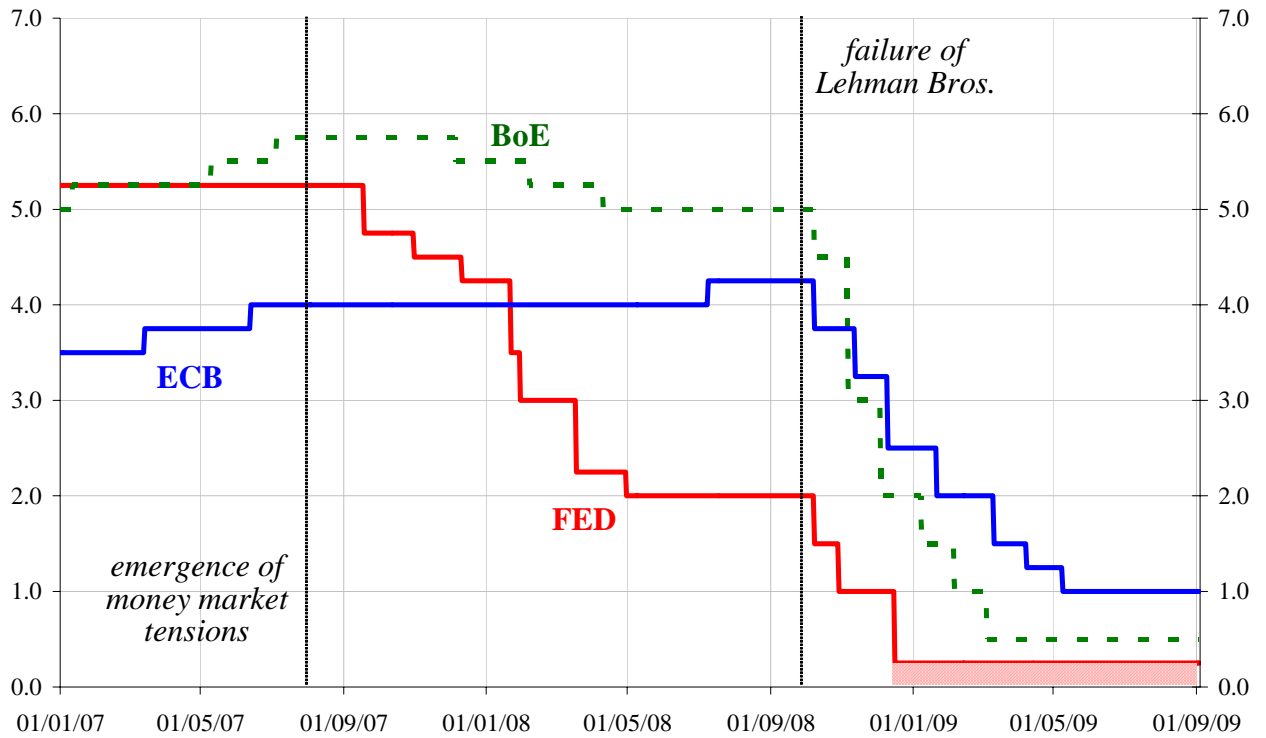
Figure 2: Spread between interbank deposit and OIS rates at 3-month maturity
percentage points



Note: The euro spread (labeled EUR) represents the difference between the 3-month EURIBOR fixing and the 3-month overnight interest swap (OIS) rate. For the US dollar (USD) and British pound (GBP), the interbank deposit rate used is the 3-month LIBOR fixing.

Source: ECB

Figure 3: Evolution of key policy rates
percent per annum



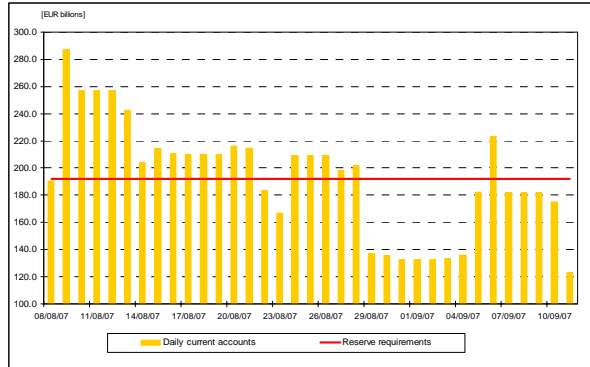
Note: Since 16 December 2008, the FED has expressed its target for the Fed Funds rate in the form of a range, from 0 – 0.25%.

Sources: ECB, Federal Reserve, Bank of England

Figure 4: Monetary policy operations: Current account holdings over maintenance period
EUR billions

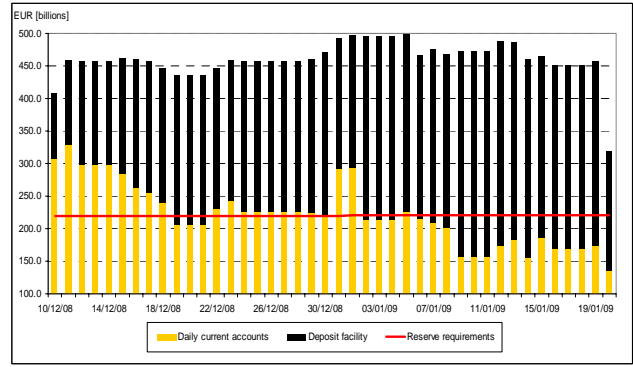
“Front-loading” – crisis pre-Lehman

Maintenance period ending 8 September 2007



“Ample liquidity” – post-Lehman

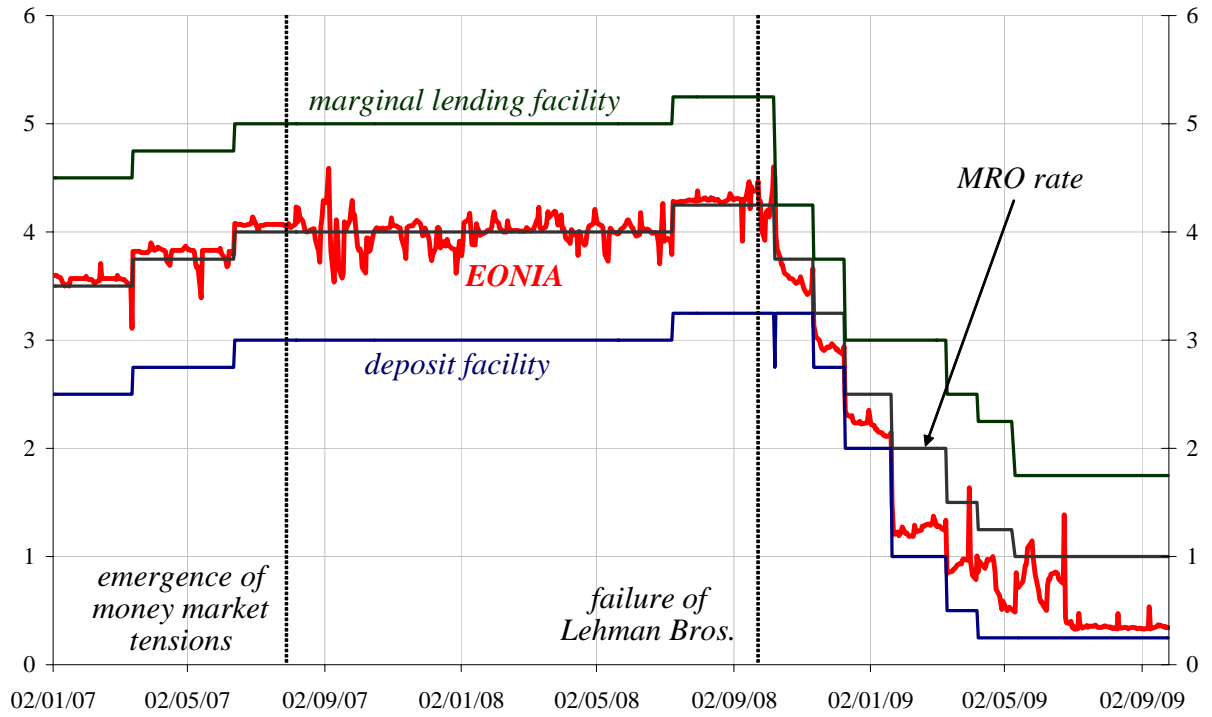
Maintenance period ending 12 December 2008



Note: The red line represents the level of reserves to be held on average over the reserve maintenance period to satisfy the reserve requirement. The yellow bars represent the actual holdings of central bank reserves on each day of the maintenance period. The black bars represent recourse to the deposit facility on each day of the maintenance period.

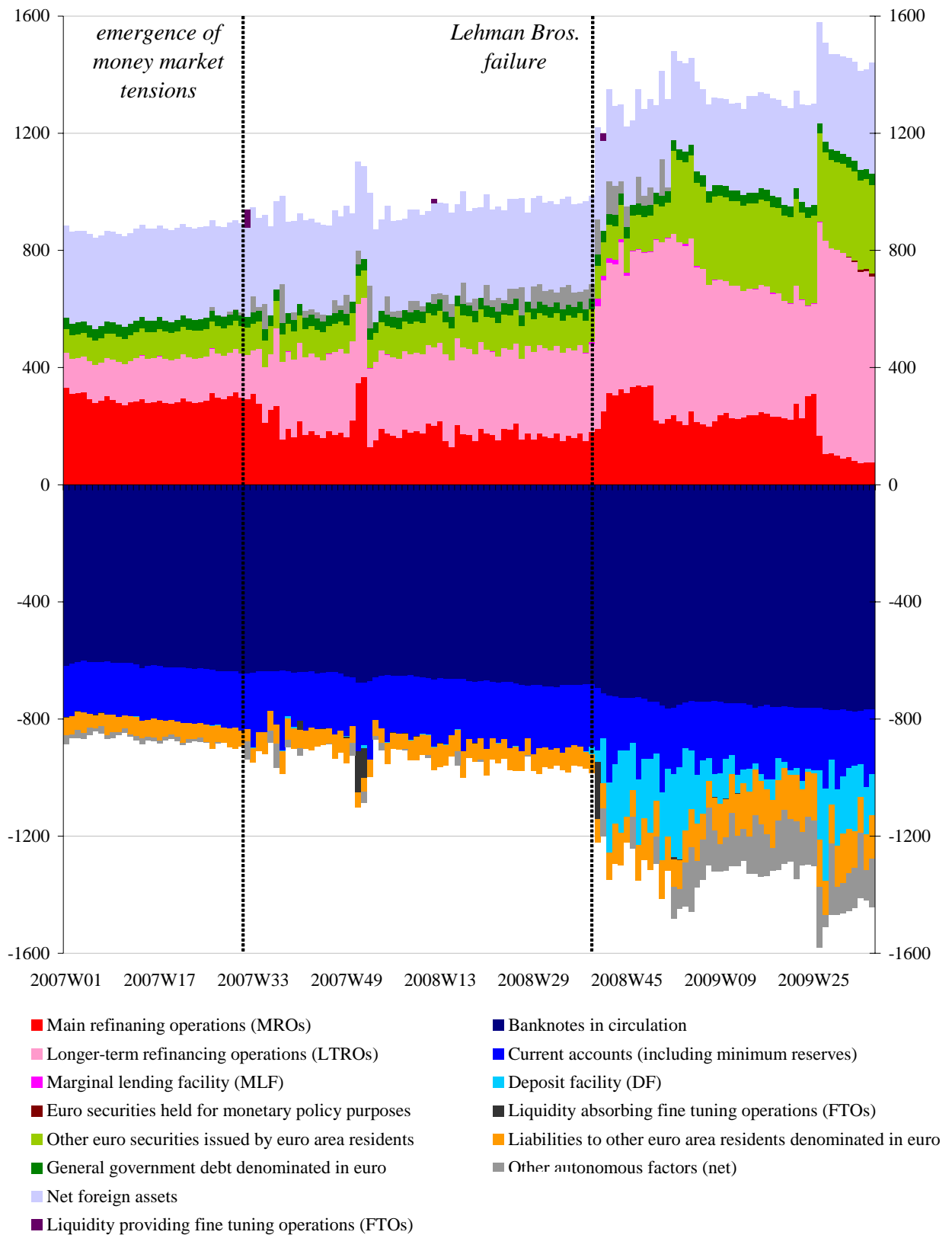
Source: ECB

Figure 5: Evolution of the EONIA relative to the ECB key interest rates
percent per annum



Note: The MRO rate refers to the minimum bid rate until 9 October 2008 and the fixed MRO rate thereafter.
Source: ECB

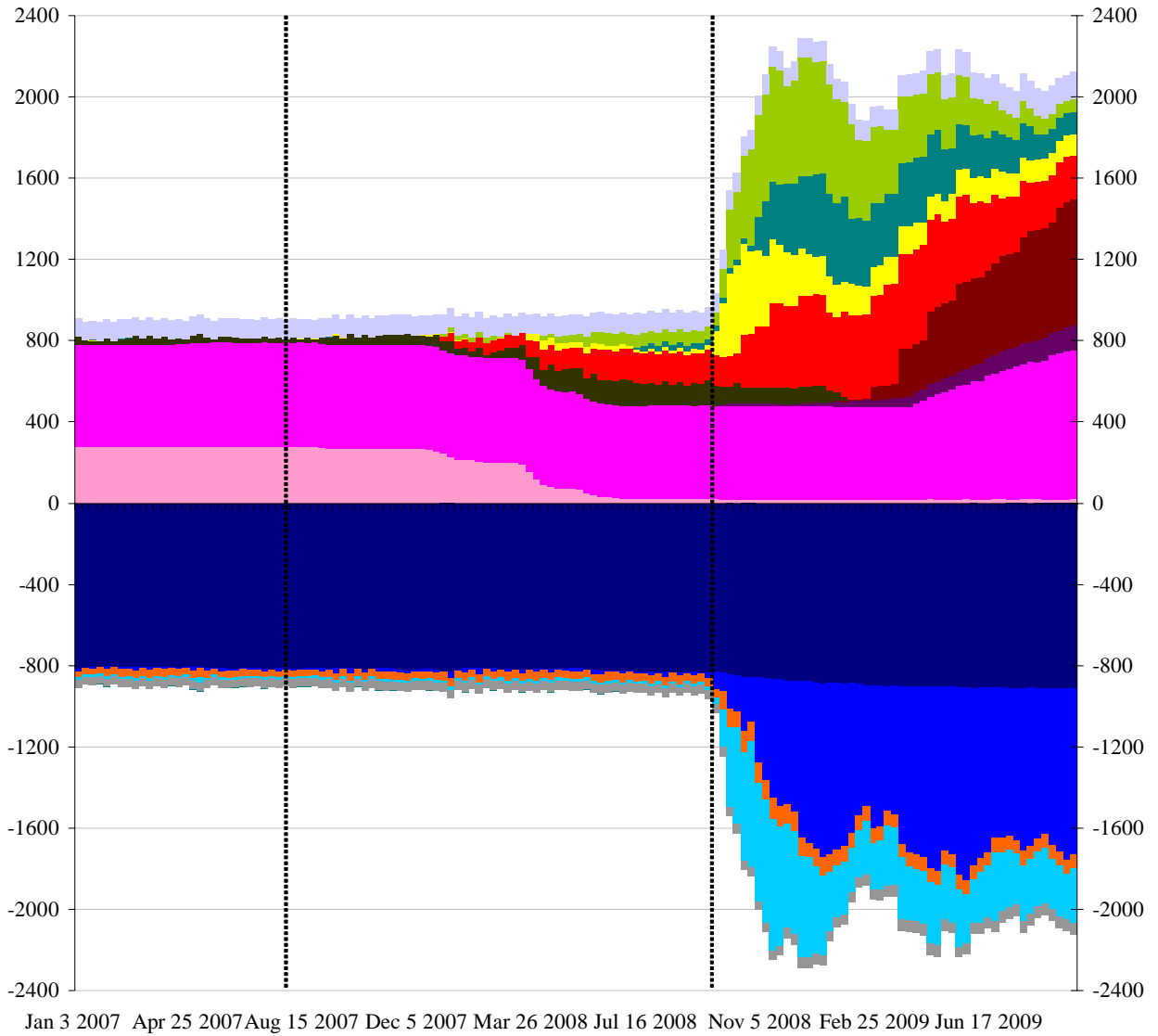
Figure 6: Evolution of the Eurosystem balance sheet
EUR billions



Source: ECB

Figure 7: Evolution of the Federal Reserve balance sheet

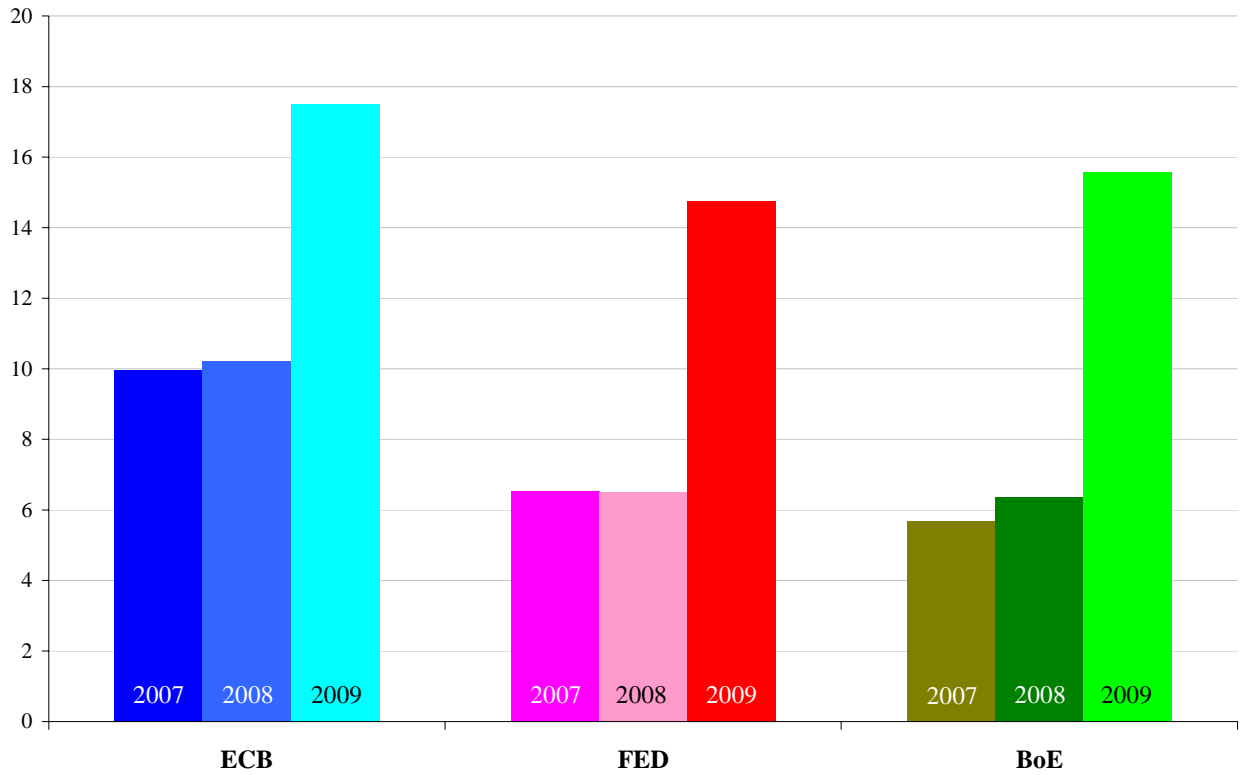
USD billions



- | | |
|---|---|
| <ul style="list-style-type: none"> ■ US Treasury bills ■ US Treasury coupons ■ Agency debt ■ MBS ■ Repurchase agreements ■ TAF ■ other loans ■ other facilities ■ Swaps ■ other assets (incl gold / SDRs and treasury currency) | <ul style="list-style-type: none"> ■ currency in circulation ■ reserve balances ■ reverse repos ■ deposits other than reserve balances (incl. Treasury deposits) ■ Other liabilities and capital |
|---|---|

Source: Federal Reserve

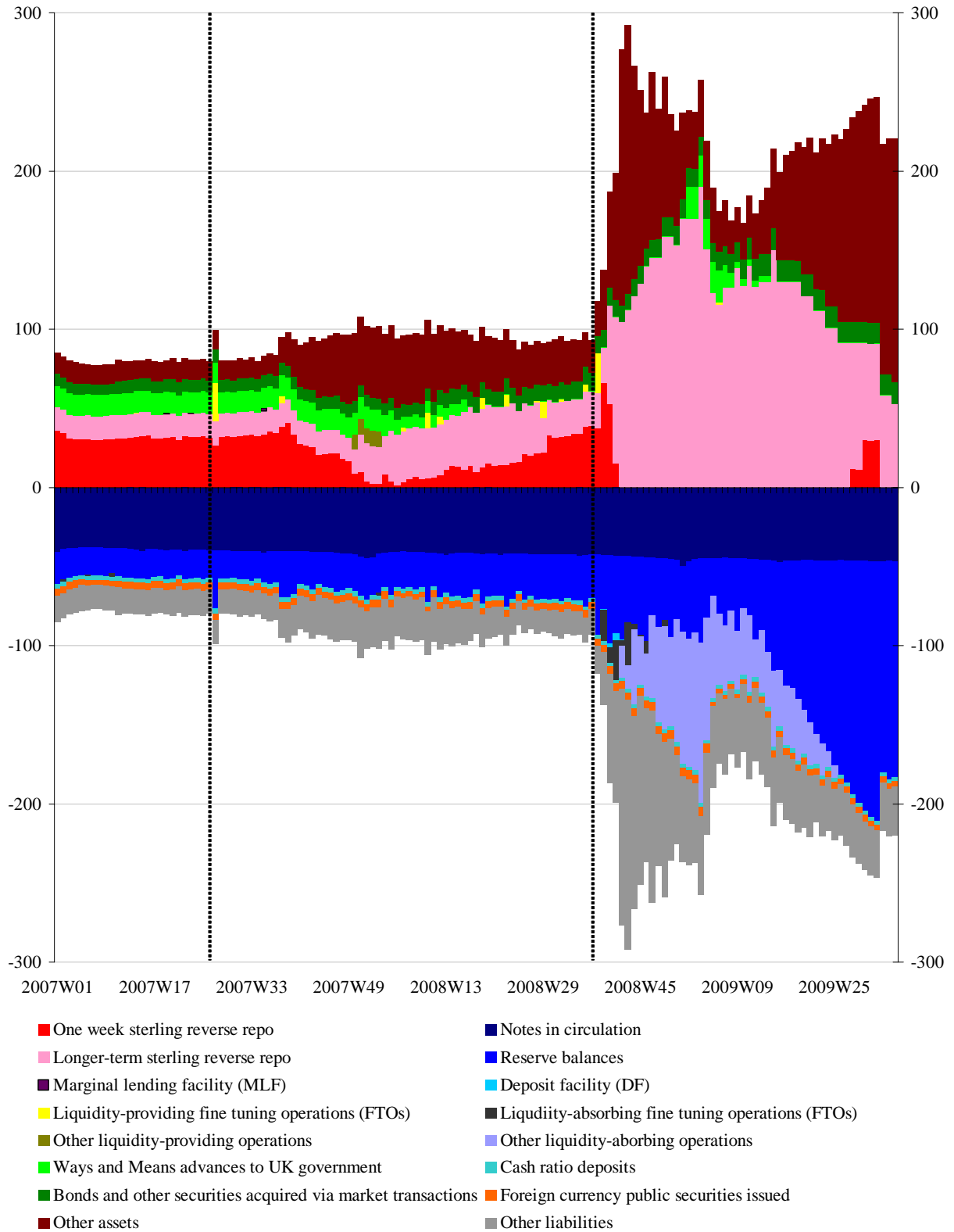
Figure 8: Central bank balance sheets relative to GDP
%



Note: The data shown refer to end-June. The measure of balance sheet size relative to GDP is total assets on the central bank balance sheet to nominal GDP.

Sources: ECB, Federal Reserve, Bank of England

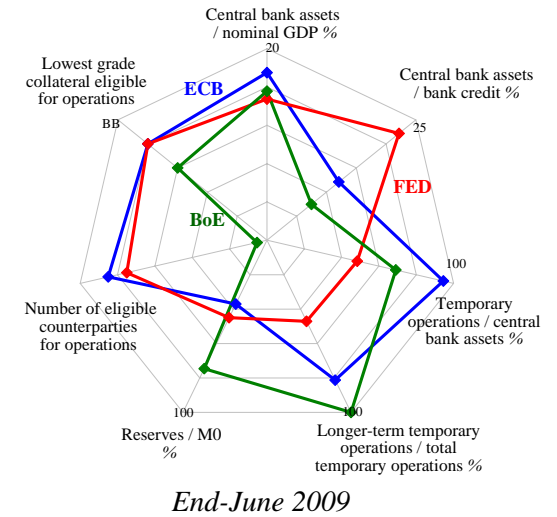
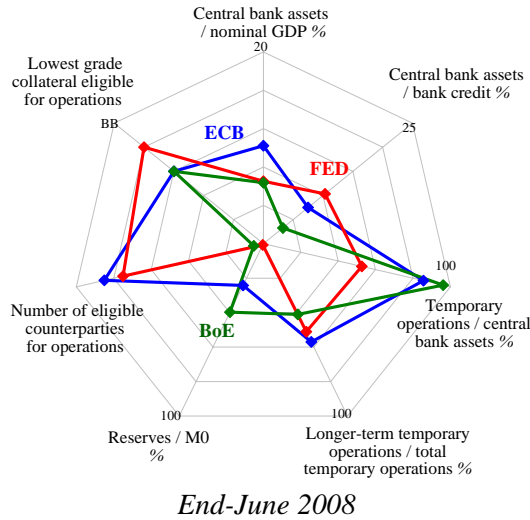
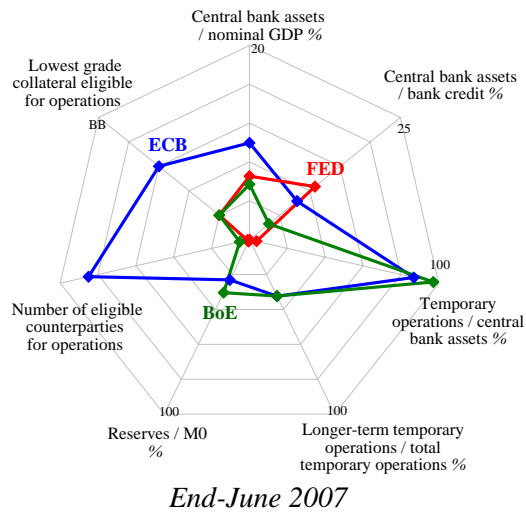
Figure 9: Evolution of the Bank of England balance sheet
GBP billions



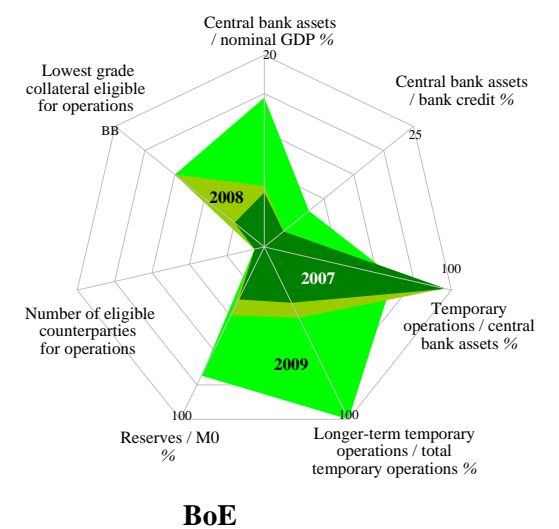
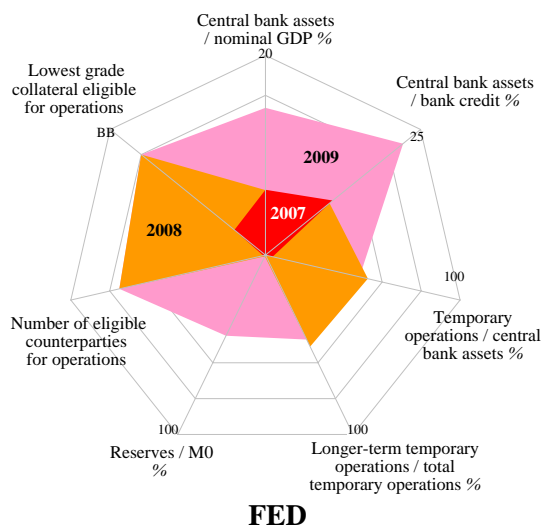
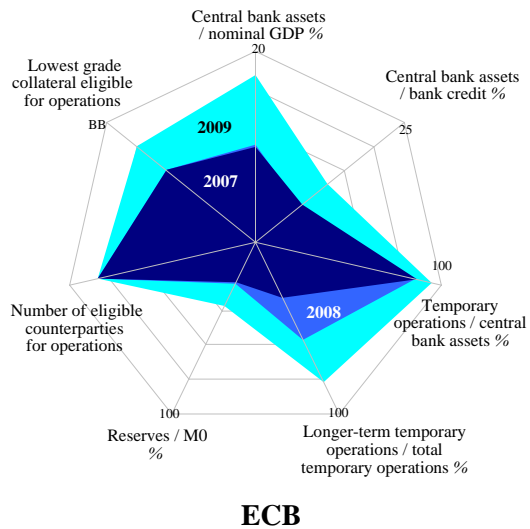
Source: Bank of England

Figure 10: Comparing central bank balance sheets across countries and over time

A: Comparison across countries over time



B: Comparison over time across countries

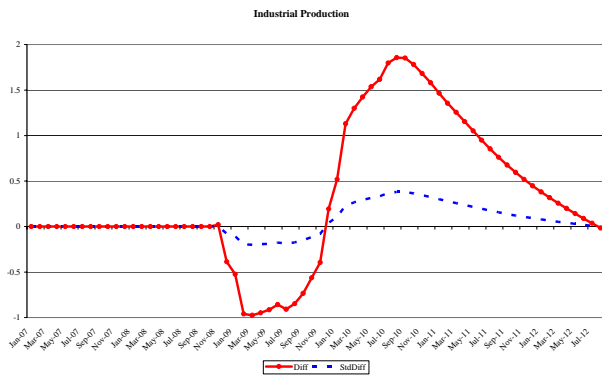


Note: Data on number of counterparties for the UK refers to number of banks that can become eligible (and neglects possible non-bank counterparts active in money market).
Sources: ECB, Federal Reserve, Bank of England

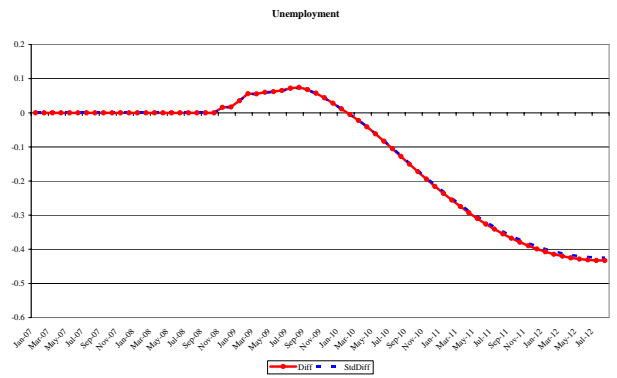
Figure 11: Path of EURIBOR 3-month rate in policy and non-policy scenarios
percentage points

[to be added]

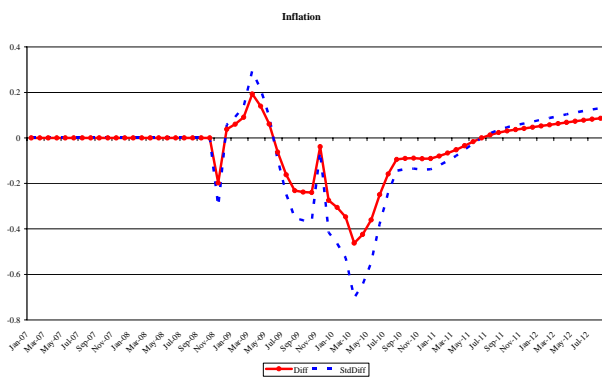
Figure 12: Effect of non-standard measures (difference between policy and non-policy scenarios)
percentage points



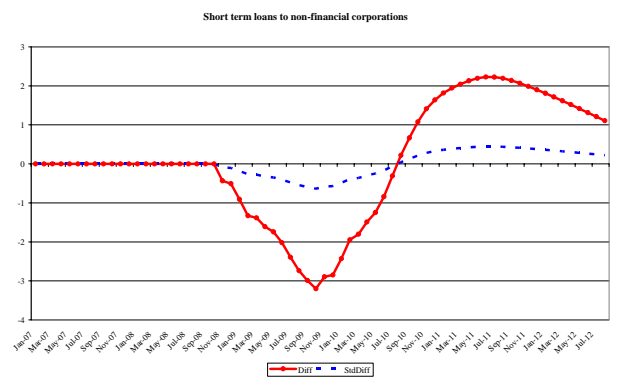
Industrial production



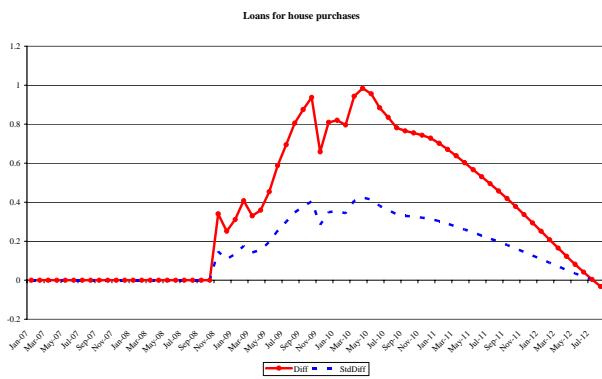
Unemployment



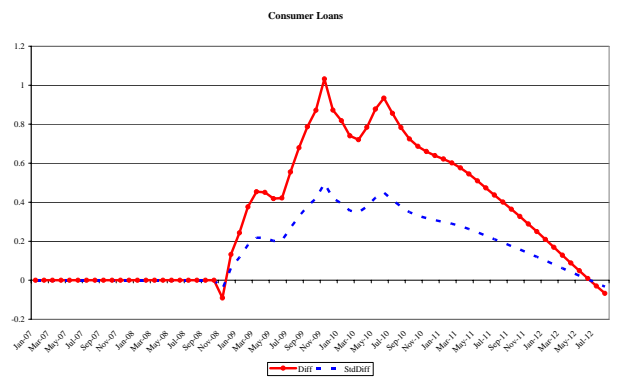
HICP inflation



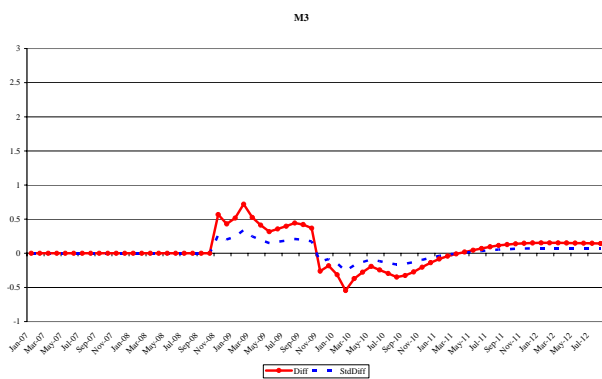
Short-term loans to non-financial corporations



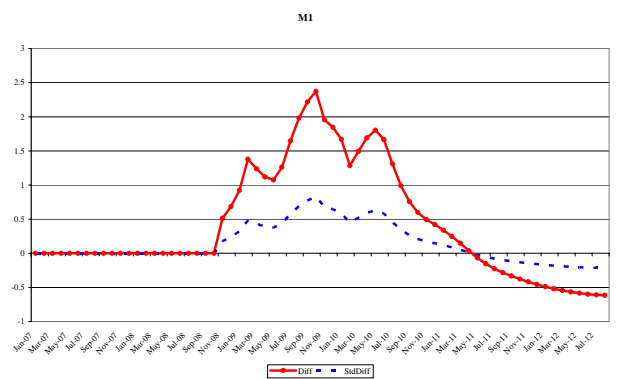
Loans for house purchase



Consumer loans



Broad money M3



Narrow money M1

A. Appendix

Description of the VAR