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# THE MONETARY MECHANICS OF THE CRISIS

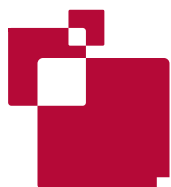
JÜRGEN VON HAGEN

## Highlights

- In response to the financial and economic crisis, central banks, unlike in the 1930s, have created enormous amounts of money.
- There are fears that this will lead to inflation, but it is base money (the central bank's liabilities) that has expanded; total monetary aggregates have not. By contrast, in the 1930s, base money remained stable and monetary aggregates dropped.
- The reason for this is that in a crisis the relationship between the base money and monetary aggregates is altered. The money multiplier drops. It is therefore necessary to create more base money so that monetary aggregates remain stable.
- This is what central banks have done in the current crisis – and rightly so. They have learned the lessons of the Great Depression.
- This framework helps understand differences across countries. The crisis affected the euro area money and credit supply process much less than the US and the UK. Therefore, the European Central Bank was right to respond to the crisis with a less expansionary monetary policy than the Bank of England and the Federal Reserve. However, stabilising the money supply may not have been enough to stabilise the supply of credit.

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# THE MONETARY MECHANICS OF THE CRISIS

JÜRGEN VON HAGEN, AUGUST 2009

## INTRODUCTION

September 2008 marked the beginning of the deepest financial crisis to hit the industrialised countries since the late 1920s. Entire segments of the financial markets disappeared. The events immediately following the collapse of Lehman Brothers and in the following weeks and months has been documented widely on the basis of data for interest rates and spreads indicating the loss of investors' and bankers' confidence in financial institutions. It has also been pointed out that the major central banks, the Federal Reserve of the US ('the Fed'), the Bank of England and the European Central Bank (ECB), reacted to the crisis by expanding their balance sheets in unprecedented ways, although there are marked differences between the reactions of the three. This massive creation of liquidity by the central banks has spurred fears of high inflation rates<sup>1</sup>.

In this paper, we take a look at the *monetary mechanics* of the crisis. That is, we take a look at the money and credit supply processes in the US, the UK, and the euro area to trace the events and developments in terms of the structure of and developments in the balance sheets of the banking sector and the central banks. Money supply data is complementary to the interest rate data previous studies have focused on<sup>2</sup>. It reflects the reactions of non-banks, banks, and central banks to the crisis in terms of their holdings of cash and central bank reserves, deposits, interbank credit, and credit supply. While previous studies of the 'unconventional monetary policy reactions' have considered the developments in

the central bank balance sheets since September 2008 (see eg. Meier, 2009), the monetary data can link these developments to the money and credit supply.

After a brief explanation of the money and credit supply processes in section 2, we begin, in section 3, with an illustration of what happened in the US during the 1929 crisis and in the 1930s. This provides an interesting reference point for the most recent developments in the US, the UK, and the euro area. In section 4, we then analyse the monetary mechanics of the crisis in the US, the UK, and the euro area. Section 5 ends with some policy conclusions.

## 2 THE MONEY AND CREDIT SUPPLY PROCESS REVISITED

'Money' is an aggregate of cash and various types of deposits offered by commercial banks and held by the non-bank public. Banks create deposits in the process of supplying credit to the non-financial sectors of the economy. An important part of the banks' business is liquidity management, ie. making sure that they are able to meet their customers' demand for withdrawals of deposits, be it to obtain cash or to make payments to other banks. They do this by holding deposits with the central bank (called 'reserves') and by trading such deposits among each other on the interbank market. The central bank creates cash and the reserves held by the banking sector by purchasing assets (open market operations), lending to financial institutions, or intervening in the foreign exchange market. Thus, the supply of

1. See eg. McCullagh (2009) and the discussion in Meier (2009).

2. See eg. Taylor (2008) and Barth *et al* (2009), as well as numerous comments in the recent reports of the European Central Bank, the Federal Reserve Board, and the Bank of England.

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*'September 2008 marked the beginning of the deepest financial crisis to hit industrialised countries since the late 1920s. Entire segments of the financial markets disappeared. Central banks reacted to the crisis by expanding their balance sheets in unprecedented ways.'*

money is the product of the financial behaviour of three economic sectors: the central bank, the banking sector, and the non-bank sector, mainly private households and firms.

This interaction between the three sectors is conveniently summarised in the *money multiplier* model of the money supply process<sup>3</sup>. It starts with a simplified exposition of the balance sheets of the three sectors. The first is the central bank's balance sheet, which can be simplified and summarised as:

$$NFA + S + REF + OA = CP + R = B \quad [1]$$

Here, NFA stands for net foreign assets, S for the central bank's portfolio of government and other securities acquired in open-market operations, and REF is central bank lending to financial institutions, eg. through discount window loans, repurchase agreements, etc. OA stands for all other assets (net). CP is the amount of cash held by the non-bank public, and R the amount of reserves with the central bank (deposits and vault cash) held by financial institutions. The sum of these two, B, is called the *monetary base*. Thus, the left hand side of equation [1] shows how the central bank creates base money, while the middle part shows how the private sector uses it.

Next, we have the aggregate banking sector's balance sheet, summarised as

$$L + R + S^B + OAB = D + T + REF \quad [2]$$

Here, L is the amount of bank credit supplied to non-banks, S<sup>B</sup> the banks' holdings of government and other securities, OAB, are other assets of the banking sector (net), while D stands for checkable deposits and T for all other types of deposits. Finally, we have the non-banks' (households and non-financial firms) balance sheet

$$CP + S^P + D + T = L + NW \quad [3]$$

Here, S<sup>P</sup> stands for the non-banks' portfolio of securities, and NW is the non-banking sector's net worth.

The narrow money supply (M1=CP+D) is an aggregate of cash held by non-banks and checkable deposits, while the broad money supply (M2=CP+D+T) adds other types of deposits as well. Which definition of the money supply is most useful for a given economy depends on its payments habits, the portfolio behaviour of its non-bank sector and other institutional determinants.

Looking at the balance sheets immediately reveals that the money supply is determined by the interaction of all three sectors. The money multiplier model summarises this interaction by separating it into the monetary base, B, and the money multiplier, m1 or m2, where the former proximately indicates the central bank's behaviour and the multiplier proximately indicates the banks' and non-banks' behaviour<sup>4</sup>. Thus, the money supply M1 is

$$M1 = \frac{1+k}{k+r} (NFA + S + REF + OA) = m1B. \quad [4]$$

where k=CP/D indicates how much cash non-banks wish to hold relative to deposits, and r=R/D indicates how much reserves with the central bank banks wish to hold relative to checkable deposits. Similarly, the money supply M2 is

$$M2 = \frac{1+k+t}{k+r} (NFA + S + REF) = m2B. \quad [5]$$

where t=T/D indicates the ratio in which non-banks hold other deposits to checkable deposits.

In the context of a financial crisis, we can interpret changes in the cash coefficient, k, as an indicator of changes in the non-banks' confidence in the banking sector. If non-banks fear that the banks might become illiquid or insolvent, they will convert their deposits into cash, and the cash coefficient will rise. Similarly, we can interpret changes in the reserves coefficient as an indicator of changes in the confidence banks have in other banks during times of crisis. From the point of view of an individual bank, borrowing central bank deposits from and lending such deposits to other banks is the main alternative to borrowing from the central bank (REF) or holding reserves at the

3. See Karl Brunner and Alan H. Meltzer [1981] for a classical exposition of the model see Al Burger [1971].

4. The separation is only an approximate one because all three sectors interact in equilibrium and, therefore, all magnitudes in the process are interdependent.

central bank. Furthermore, an individual bank fearing that the interbank market might not be liquid in the near future, has an incentive to hold on to its reserves with the central bank rather than lending them to other institutions, in order to avoid the risk of not being able to find a bank that will lend it central bank money in the future. Thus, when banks lose confidence in the financial soundness of other banks, they will tend to hold more reserves relative to deposits, and  $r$  will rise. The same applies when a bank fears it might be regarded with suspicion by other banks.

The structure of the multiplier model implies that the money supply contracts when either  $k$  or  $r$  or both increase. Therefore, a financial crisis is likely to trigger an endogenous contraction of the money multiplier and, *ceteris paribus*, the supply of money. This is an important channel of transmission of the crisis into the macro economy.

Finally, the total supply of loans from the banking sector is

$$L = \frac{1 + k + rf - r - s^b}{r + k} B = cB. \quad [6]$$

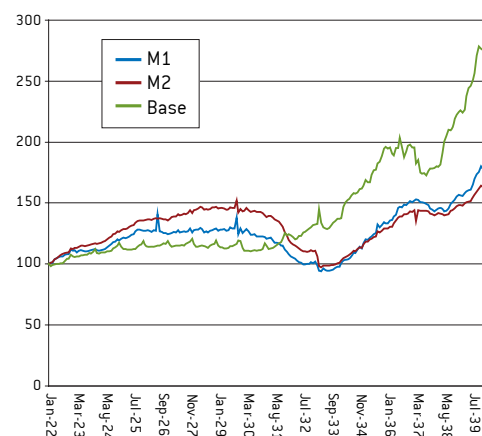
Where  $rf = \text{REF}/D$  is the ratio of central bank loans taken by the banking sector to deposits,  $s^b = S^b/D$ , and  $c$  is the bank loan multiplier. Equation [6] shows that the money and the credit supply processes interact. In particular, an increase in the cash and the reserves coefficients will lead to a contraction of the credit supply.

### 3 THE US CRISIS OF 1929 REVISITED

We can apply this framework to the US in the 1920s and 1930s<sup>5</sup>. The following figures use data from Friedman and Schwartz [1970]. Figure 1 shows the evolution of the money stocks M1 and M2 together with the monetary base during the 1920s and 1930s. To facilitate comparison with the current crisis, all three are normalised at their January 1922 values. The figure illustrates the argument Friedman and Schwartz [1963] made about the monetary causes of the Great Depression. The money supply M2 collapsed by

about one third between October 1929 and the March 1933. This was the result of the stock market crisis in October 1929, and a series of banking crises in October 1930, March 1931, and March 1933, the latter being accompanied by a banking panic. A further wave of bank runs occurred between October 1931 and January 1932, which was triggered by the UK's departure from the Gold Standard and the subsequent speculative attacks on the US dollar. The monetary base remained essentially flat until early 1932, indicating that the Fed did not take appropriate action to offset the monetary contraction, which then caused the contraction in real GDP and employment. Only in April 1932 did the Fed embark on a programme of large-scale open market purchases, raising the monetary base by six percent by September.

Figure 1: Money stocks and base money in the US during the Great Depression (Jan 1922=100)



Source: Friedman and Schwartz [1963].

Figure 2 shows the behaviour of the money multipliers during the same episode, also normalised at their January 1922 values for better comparability with more recent developments. Two things are noteworthy. First, the M2 multiplier contracts by about 50 percent from peak to trough. Thus, the monetary contraction was primarily a result of the dramatic changes in the banks' and non-banks' balance sheet behaviour.

Figure 3 shows where this dramatic collapse of

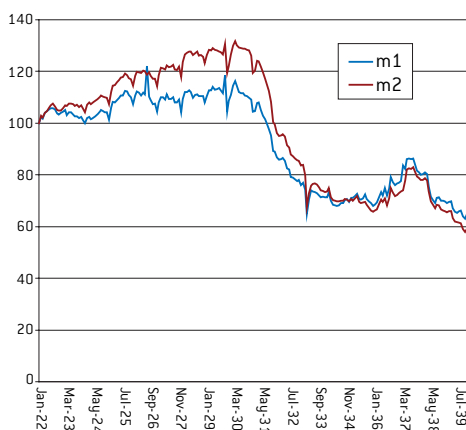
5. See Friedman and Schwartz [1963] for a much more extensive analysis along the same lines.

*'A financial crisis can lead to a large, endogenous contraction in the money supply if not counteracted by the central bank. It may take a long time before the multipliers recover and the money supply process returns to a normal phase.'*

the money multipliers comes from. There are two contributing factors. The first is a massive increase in the cash coefficient, reflecting the public's run on the banks for fear of losing their deposits. Between the summer of 1929 and the banking crisis in early 1933, the cash coefficient rose from 16 percent to 40 percent. By August 1935, it had come back to 21 percent and remained at that level for the rest of the decade. In contrast, the reserves ratio reacted much less to the incipient financial crisis. Between June 1929 and June 1932 it remained between 7.2 and 9.0 percent. In the banking crises of late 1932 and March 1933, however, it increased sharply and peaked at 17 percent in late 1935. After a brief decline in 1936 and the first half of 1937, it even climbed to 20 percent by late 1939.

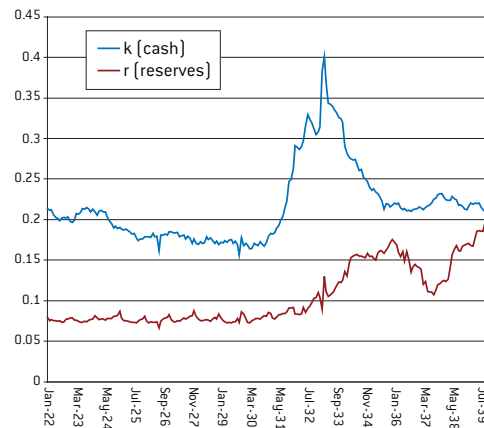
These figures thus carry two important messages. First, a financial crisis can lead to a large, endogenous contraction in the money supply if not counteracted by the central bank. Second, it may take a long time before the multipliers recover and the money supply process returns to a normal phase.

**Figure 2: Money multipliers in the US during the Great Depression (Jan 1922=100)**



Source: Friedman and Schwartz [1963].

**Figure 3: Cash and reserves coefficients in the US during the Great Depression**



Source: Friedman and Schwartz [1963].

#### 4 THE MONEY SUPPLY PROCESS IN 2008-09

With this background in mind, we now turn to the developments of the last year. All data used in the following graphs comes from the Federal Reserve Bank of St. Louis website. Figure 4 shows the US money supplies M1 and M2 and the monetary base over the past decade. Until September 2008, all three follow constant trends. After September 2008, the monetary base almost doubled, slightly declined, but then continued to increase during the first half of 2009. The largest part of this huge expansion was achieved through an increase in the Fed's portfolio of securities and an increase in Fed lending to commercial banks, S and REF in terms of equation (1) above, in what has become known as 'unconventional monetary policy'. It is unconventional in the sense that it was not part of the Fed's conventional strategy of targeting the fed funds rate and that it involved the purchase of assets the Fed had not acquired before. It is conventional, however, in that the effect is simply an expansion of base money [see Disyatat, 2009]. In contrast, the evolution of the money supply M2 seems practically unaffected by the crisis. M1 increased by about 20 percent in late

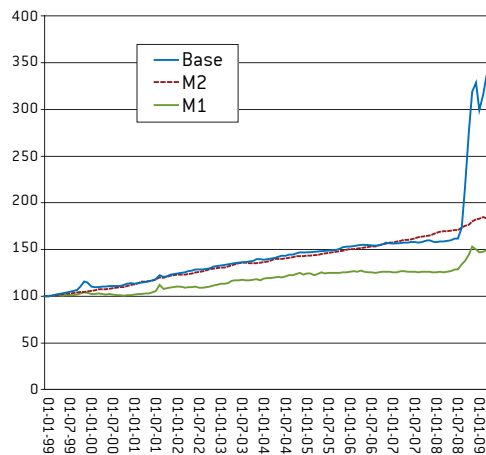
1. This section comes from Santos [2008].

2. See Enderveen *et al.* [2002] for a review of this literature.

2008, reflecting some substitution of non-M1 deposits into M1. However, it flattens soon afterwards.

4.1 THE US

Figure 4: M1, M2 and monetary base in the US, January 1999-May 2009 (Jan 1999=100)

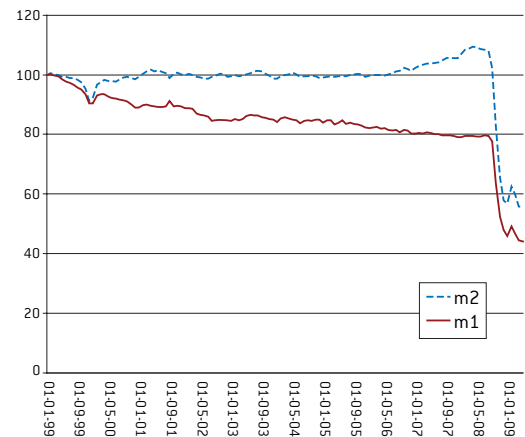


Source: Federal Reserve Bank of St. Louis.

Consider now Figure 5, which shows the evolution of the money multipliers in the US during the crisis. The most interesting observation is that the m2 multiplier declines by about 50 percent following September 2008. That is, the effect of the crisis on bank and non-bank portfolio behaviour as summarised by the money multiplier is almost exactly the same as in the late 1920s. However, this time, the action is in the monetary base and the money supply (M2) stays on trend as before the crisis. Obviously, the Fed managed to counteract the effects of the crisis on the money supply. If Friedman and Schwartz are right in their judgement that what turned the economic developments of the late 1920s from a serious recession into the Great Depression was the huge monetary contraction, the conclusion here is that the Fed stopped a Great Depression emerging from the 2008 crisis. Obviously, this does not preclude the possibility of a severe recession following the crisis, as we have witnessed so far. But it does

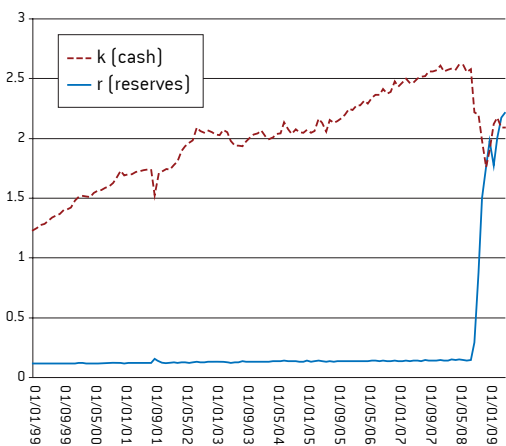
indicate that, in contrast to the crisis of 1929, the Fed has made a substantial effort to avert a contraction of the magnitude of the Great Depression.

Figure 5: Money multipliers in the US, January 1999-May 2009 (Jan 1999=100)



Source: Federal Reserve Bank of St. Louis.

Figure 6: Cash and reserves coefficients in the US, Jan 1999-May 2009



Source: Federal Reserve Bank of St. Louis.

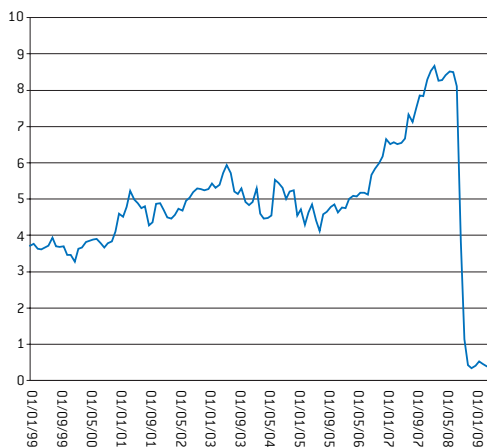
Figure 6 shows the cash and the reserves coefficients during the same period of time. Two observations are interesting. First, the cash coefficient trends are upwards before the crisis, probably reflecting the export of US cash to other

*'The Fed has managed to counteract the effects of the crisis on the money supply, and has stopped a Great Depression emerging from the 2008 crisis.'*

countries, which has nothing to do with the underlying monetary developments in the US. As the crisis hits, the cash coefficient declines, primarily reflecting an increase in non-banks' holdings of (insured) checkable deposits at the expense of (non-insured) other deposits. Comparing figures 6 and 3 illustrates the extent to which effective deposit insurance protects the money supply from collapsing endogenously in a moments of crisis.

Second, the reserves coefficient jumps to unprecedented levels after the collapse of Lehman Brothers. This increase reflects the breakdown of normal interbank trading which began already in August 2007, a result of the fact that banks shied away from lending to other banks<sup>6</sup>.

**Figure 7: Ratio of interbank lending to total bank reserves in the US, Jan 1999-May 2009**



Source: Federal Reserve Bank of St. Louis.

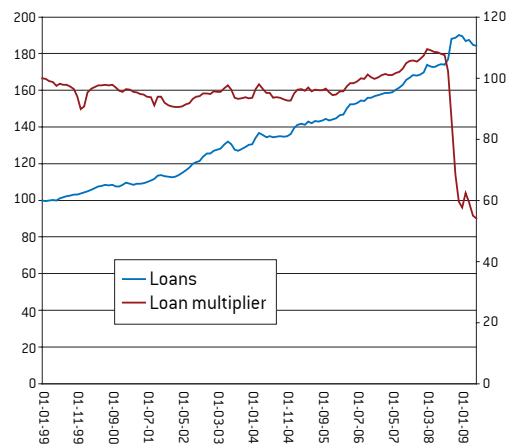
Figure 7 illustrates the same point by showing the ratio of interbank lending among US commercial banks to total reserves held by US commercial banks at Federal Reserve Banks, a measure of the banks' tendency to obtain liquidity in the interbank market rather than from the Fed. It shows how the interbank market already stagnated starting from January 2008 and then collapsed at the end of the year. Since the start of 2009, it has bottomed out without showing a recovery, yet. The implication is that the Fed has largely replaced interbank borrowing and lending as the mechanisms for liquidity management of

US banks. Its 'unconventional' monetary policy instruments have served to replace financial markets that vanished as a result of the crisis.

The main factor driving the dynamics of the crisis in 2008 was thus different from that in 1929. Then, it was largely the collapse in the public's confidence in the banking system. This time, it was largely the collapse in the banks' confidence in the soundness of other banks that triggered the reaction of the money multiplier.

Figure 8 shows the evolution of bank loans and the bank loan multiplier for US commercial banks. At the onset of the crisis, loan supply actually increased, a result of the fact that many companies called on unused credit lines<sup>7</sup>.

**Figure 8: Loan supply and loan multiplier in the US, Jan 1999-May 2009**



Source: Federal Reserve Bank of St. Louis.

At the same time, however, the credit multiplier dropped by almost one half, and it continued to fall in the early months of 2009. As a result, credit supply has been contracting since early 2009. Although the Fed has stabilised the money supply, credit supply seems to become scarcer as time goes on.

#### 4.2 THE UK

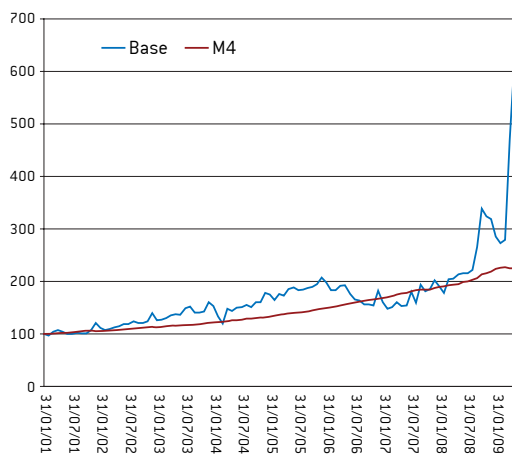
Next, we turn to the crisis in the UK. The following data are taken from the Bank of England. Figure 9 shows the development of the money stock M4,

6. See Gorton (2008) for an excellent analysis of the interbank market crisis in the US after August 2007.

7. See Ivashina and Scharfstein (2008), who document the evolution of bank lending during the crisis.

the Bank of England's preferred indicator of broad money together with the monetary base since 2001, both normalised to the level in January 2001. Compared with M2, M4 includes an even broader range of bank deposits with long maturities. As in the US, the monetary base, which had already grown by 21 percent between March and September 2008, expanded strongly in September and October 2008, the total increase being 57 percent. In the months immediately following this expansion, however, the Bank of England contracted the base by 24 percent, much more than the Fed did in late 2008. Between late February and late May 2009, the base expanded by another 134 percent. The total expansion over the entire episode was by 188 percent. As in the US, this was largely the result of 'unconventional monetary policy'. Meanwhile, the growth of the money stock at first accelerated slightly, but then flattened out from the beginning of 2009.

Figure 9: Monetary base and M4, UK, January 2001-May 2009 (Jan 2001=100)

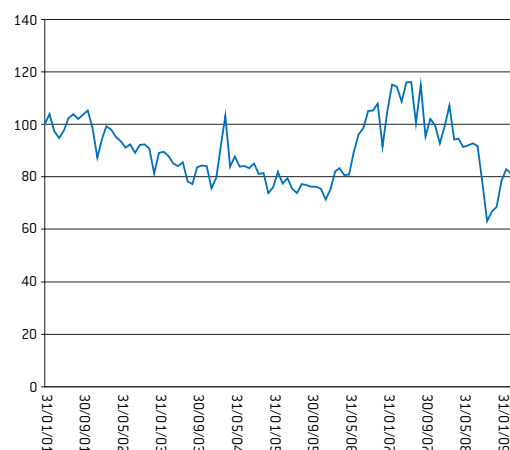


Source: Bank of England.

Figure 10 shows the corresponding movements in the money multiplier, normalised to its value in January 2001. In contrast to the US, where the broad money multiplier was increasing before the crisis, the m4 multiplier in the UK had been already on a downward trend since August 2007. Figure 11 shows that this was due to a gradual increase in the banking system's inclination to hold central bank reserves. During the crisis that started in September 2008, the reserves ratio

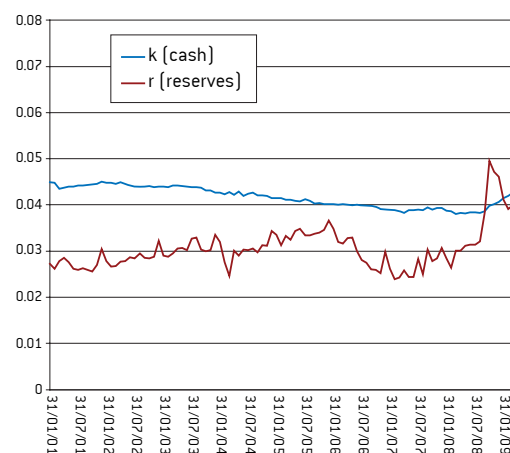
increased sharply, as it did in the US. In the UK, however, the cash coefficient increased, too, showing that non-banks had a higher preference for cash. This reflects the non-bank public's growing distrust of the banking system. This became most visible in the run on Northern Rock and other institutions, and is probably due to the less-comprehensive deposit insurance in the UK compared to the US and the euro area<sup>8</sup>. Altogether, the money multiplier contracted by 61 percent between September 2008 and May 2009.

Figure 10: m4 multiplier, UK, January 2001-May 2009 (Jan 2001=100)



Source: Bank of England.

Figure 11: Cash and reserve coefficients, UK, Jan 2001-May 2009



Source: Bank of England.

Figure 12 presents an indicator of the performance of the interbank market in the UK,

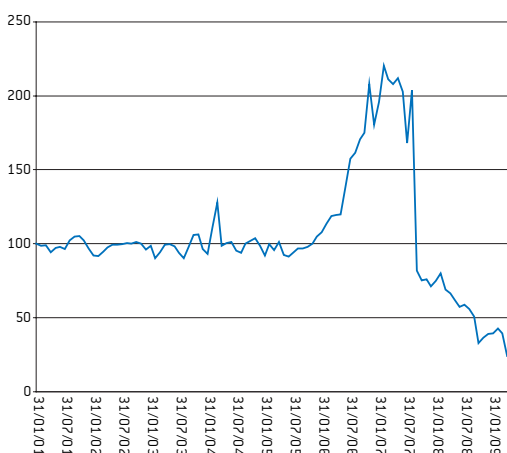
8. At the beginning of the crisis, UK bank deposits were insured at 100 percent for the first £2000, and 90 percent for amounts up to £35,000. In the US, the Federal Deposit Insurance company, FDIC, provided insurance of 100 percent for bank deposits of up to \$100,000 per depositor.



namely the ratio of GBP-denominated interbank deposits to banks' central bank reserves. After hovering around a normal level for several years, the ratio increases sharply in the booming financial market environment between 2005 and mid-2007. For about a year, it seemed to have settled at a level twice as large as before, but it declined sharply already in August 2007, when the first signs of financial market tensions occurred. This indicates that banks in the London money market started losing confidence in other financial institutions already a year earlier than in the US. The September 2008 crisis brought about further decreases in the ratio of interbank deposits to reserves.

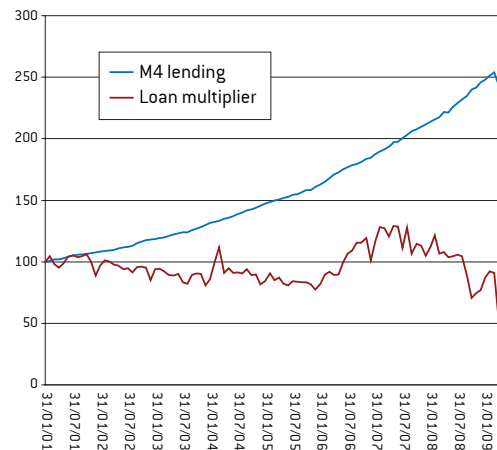
Finally, figure 13 shows the development of credit supply in the UK. It indicates that the credit multiplier, too, increased substantially during the financial market boom, but contracted after August 2007. The Lehman Brothers crisis first caused an increase in lending by banks and the multiplier similar to the US. As the crisis progressed, however, the multiplier fell sharply. While this contraction was offset by the increase in the monetary base until the spring of 2009, credit supply began to decline in April.

**Figure 12: ratio of interbank deposits to total bank reserves, January 2001-May 2009 (Jan 2001=100)**



Source: Bank of England.

**Figure 13: Credit supply in the UK, January 2001-May 2009 (Jan 2001=100)**



Source: Bank of England.

#### 4.3 EURO AREA

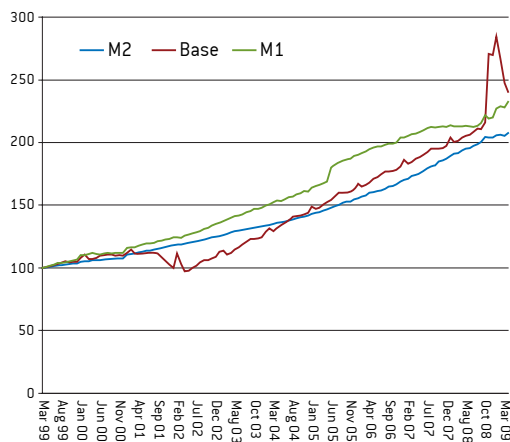
We now turn to the monetary developments in the euro area. Figure 14 shows the money stocks M1 and M2 and the monetary base, all normalised at their March 1999 values. All three show rather steady trends right up to the September 2008 crisis. During the crisis, the ECB's monetary base first increased by about 25 percent and then by another five percent. Thus, the total expansion was much less pronounced than in the US or the UK. The base actually began to come down again already in February 2009. By May 2009, it had reached pretty much the level that would have been implied by its pre-crisis trend.

The supply of broad money remained largely unaffected by the crisis, while the money stock M1 began to accelerate as a result of the crisis. Figure 15 shows the corresponding development of the two money multipliers. Both dropped by about 20 percent during the September 2008 crisis, but recovered soon afterwards. Figure 16 indicates that the cash coefficient in the euro area, which had been on an upwards trend for several years, probably because of growing cash holdings outside the monetary union, only moved very slightly during the crisis. The reserves coefficient jumped up more dramatically, but came back almost to its old level by May 2009. As in the US, the ratio of interbank loans to reserves

fell dramatically at the onset of the crisis (Figure 17). Although it recovered during the first part of 2009, it was still about one third below its original level in May. Figure 18, finally, shows that the credit multiplier dropped due to the crisis and recovered somewhat since then. However, total bank lending to private non-banks has been stagnating since the beginning of 2009.

The picture for the euro area, then, is significantly different from that for the US and the UK. Judging from the perspective of the money supply process, the financial crisis seems to have affected the banking sector in the euro area much less than in the two other economies. This indicates that the ECB's much more moderate reaction was indeed justified. While critics have argued that the ECB did not do enough to contain the crisis and the dangers of deflation, the monetary indicators suggest that an expansion of the monetary base of the same scale as the US would have created serious risks of inflation. In addition, the data indicate that the euro area dealt with the financial crisis much more quickly than the US and the UK.. This suggests that the ECB should also be first in returning to a more normal monetary policy position.

**Figure 14: Money stocks and monetary base, euro area, Mar 1999-May 2009 (Mar 1999=100)**



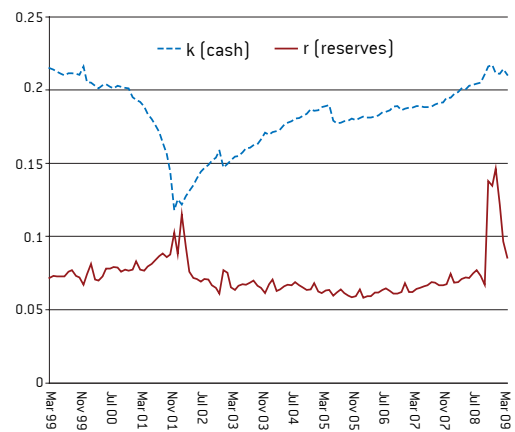
Source: ECB.

**Figure 15: Money multipliers, euro area, Mar 1999-April 2009 (Mar 1999=100)**



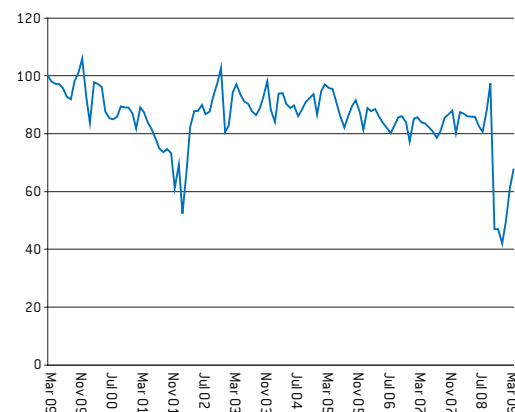
Source: ECB.

**Figure 16: Cash and reserves coefficient, euro area, Mar 1999-Apr 2009**



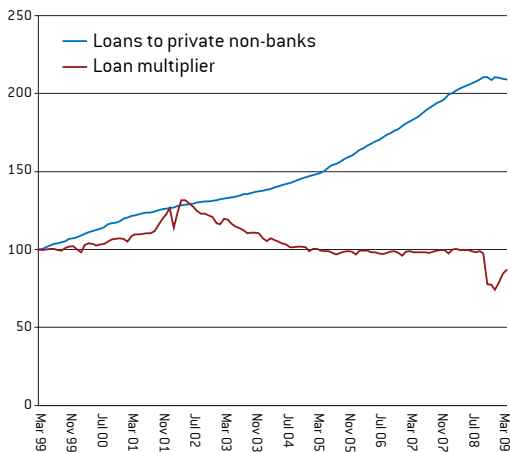
Source: ECB.

**Figure 17: Ratio of interbank lending to total bank reserves, euro area, Mar 1999-Apr 2009 (Mar 1999=100)**



Source: ECB.

Figure 18: Bank lending, euro area, Mar 1999-  
Apr 2009 (Mar 1999=100)



Source: ECB.

## 5 CONCLUSIONS

We have reviewed the monetary mechanics of the financial crisis that was triggered by the collapse of Lehman Brothers in September 2008. The crisis resembles to a remarkable degree to post-1929 crisis in the US, in terms of the behaviour of the money multipliers. However the loss of confidence among banks and, with it, the disappearance of a large part of the interbank market was the decisive factor in the current crisis, while it was the loss of non-banks' confidence in the banking sector that was decisive in the Great Depression. Comparing the US and the UK indicates the stabilising influence that comprehensive deposit insurance has in a crisis<sup>9</sup>. The data show that the crisis affected the banking sectors in the US and

the UK much more strongly than in the euro area.

Central banks in the US, the UK and the euro area reacted to the crisis in the appropriate way, providing ample liquidity that offset the draining of liquidity implied by the vanishing of large parts of the interbank market. As a result, the money supply remained largely unaffected by the crisis. Comparing this crisis with the post-1929 crisis suggests that the central banks this time round managed to prevent the three economies from going into a deep depression caused by an excessive monetary contraction.

The challenge for monetary policy is now to make sure that the large amounts of liquidity provided by the central banks will not turn into a large monetary overhang that would cause a bout of inflation. As confidence returns in the financial sector and more normal patterns of balance sheet behaviour are restored, the central banks will have to undo the expansion of their balance sheets. They will have to watch money stocks and the money multipliers and their components closely in order to implement appropriate policy. In this regard, an important insight from the multiplier model of the money supply is that the money stock depends on the size of the monetary base but not on its composition. Thus, the fact that the Bank of England and the Fed have reverted to unconventional measures to increase the base does not impose constraints on their ability to control the money supply and inflation in the future.

9. Note, however, that other empirical evidence suggests that the availability of deposit increases the likelihood that a banking crisis will occur; see Ho and von Hagen (2007).

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