Financial crisis and quantitative easing: can broad money tell us anything?

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Abstract
When Bank of England (and the Federal Reserve Board) introduced their quantitative easing (QE) operations they emphasised the effects on money and credit, but much of their empirical research on the effects of QE focuses on long-term interest rates. We use a flow of funds matrix with an independent central bank to show the implications of QE and other monetary developments, and argue that the financial crisis, the fiscal expansion and QE are likely to have constituted major exogenous shocks to money and credit in the UK which could not be digested immediately by the usual adjustment mechanisms. We present regressions of a reduced form model which considers the growth of nominal spending as determined by the growth of nominal money and other variables. These results suggest that money was not important during the Great Moderation but has had a much larger role in the period of the crisis and QE. We then use these estimates to illustrate the effects of the financial crisis and QE. We conclude that it would be useful to incorporate money and/or credit in wider macroeconometric models of the UK economy.

Keywords: monetary policy, quantitative easing, financial crisis, monetary growth.

JEL: E5, E65

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The original announcement of the decision to start quantitative easing (QE) in the UK put it in the context of “the aim of boosting the supply of money and credit and thus raising the rate of growth of nominal spending”. In the US, the equivalent announcement presented it as a decision “to help improve conditions in private credit markets”.¹ Policymakers in each country were also surely well aware of the argument (set out in Friedman and Schwartz, 1960) that the money supply had been allowed to fall too far in the early 1930s (von Hagen, 2009).

However, the first substantial pieces of research to come out of the Bank of England (BoE) and the Federal Reserve Board (Fed) focused on the effect of large scale asset purchases on long term bond yields, and made almost no reference to money or credit. Gagnon, Raskin, Remache and Sack (2010) used event study and time-series analysis and found that yields on US long term Treasury bonds fell in response to large scale asset purchases by 50-100 basis points (in the event study) or 38-82 bps (in the time-series analysis). Joyce, Lasaosa, Stevens and Tong (2010) also used event study and time-series analysis, and found falls in yields on UK gilts of 50-100 bps. Only later did the Bank of England publish articles or papers examining either the effects of QE on broad money or the effects of QE on nominal spending or real economic activity (Bridges, Rossiter and Thomas, 2011; Joyce et al, 2011; Kapetanios, et al., 2012; Bridges and Thomas, 2012).

This paper seeks to investigate whether the growth of broad money might be able to help us to understand the nature of the financial crisis and the effects of QE. In a sense, it takes its cue from Goodhart (2007, see also 2010), who argued that the neglect of money in the dominant New Keynesian and Dynamic Stochastic General Equilibrium...
models (Woodford, 2003) – based on assumptions about money demand stability and money supply endogeneity – had been taken too far. The quantity of credit has also recently been emphasised by Driffield and Miller (2011), who have used the model of Kiyotaki and Moore (2008) to argue that the fall in that quantity was a key factor in the crisis.2

In the next section we use the once well-known flow of funds framework to discuss the mechanics of financial crisis, fiscal expansion and QE. In section 2 we look at the relevant data for the UK over the last 3-4 years. In section 3 we report the results of a simple reduced-form regression of the relationship between nominal spending growth and nominal money growth using interacted dummies for the crisis period. In sections 4 and 5 we illustrate the striking results of that regression by using appropriate counterfactuals to consider what they imply, first for the contribution of the financial crisis to the path of spending in 2008-9, and then for the contribution of (the first round of) QE in 2009-10. Section 6 concludes by arguing that this investigation should be taken further by the introduction of monetary and/or credit aggregates in some form into existing large-scale macroeconometric models of the UK.

1 The mechanics of crisis and quantitative easing

Here we present a simple analysis of the ‘mechanics’ of financial crisis and QE in terms of a flow of funds matrix (Table 1) of the kind which used to be included in undergraduate macro textbooks (e.g. Artis and Lewis, 1991; Cobham, 1998) but is not familiar to the younger generation of macro researchers.
In Table 1 the columns represent different sectors of the economy: government, central bank, foreign, private non-financial (firms and households), and private financial (banks); while the rows represent first the financial deficit (net borrowing) of each sector (from the national income accounts) and then the changes in assets (positive) and in liabilities (negative) for each financial claim, e.g. deposits, government securities. Thus the columns show the balance sheet constraints for each sector, while the rows show the supply = demand conditions for each claim: each column and each row must sum to zero. This simple presentation makes several important simplifications. For example, the central bank and the private financial sector are assumed to have no (physical) investment or saving (out of income); government securities are held only by domestic agents; non-financial corporate equity and bonds are issued and held within the private non-financial sector (so they are not visible); and contingent liabilities (derivatives) are not shown because they are off balance sheet. Moreover, what the table shows is essentially identities rather than behaviour. However, this framework is useful because it obliges us to think through the ramifications of any change: a change in one sector’s acquisition of a financial claim must involve some offsetting change in that column and in that row, and typically some further changes as well.

[Table 1 near here, circa 1/2 of page]

The identities in the table can be manipulated (and this was often the main purpose of the exercise in the past) so as to derive the counterparts to broad money growth:

$$\Delta M_s = D E F - \Delta G D_{nf} + \Delta A - \Delta N D L + \Delta R E S$$

where $M_s$ is broad money supply, $D E F$ is the government’s budget deficit, $G D_{nf}$ is the amount of government debt held by the private non-financial sector, $A$ is banks’
lending (advances) to the private non-financial sector, NDL is banks’ non-deposit liabilities (mainly equity issued by the banks) and RES is the central bank (CB)’s foreign exchange reserves. This is broadly the credit counterparts to monetary growth as identified, for example, in Table A3.2 of the Bank of England’s Bankstats. But the flow of funds as a whole goes beyond that insofar as it represents the balance sheet constraints of the non-bank sectors as well.

We now consider through this framework the proximate effects of a number of exogenous changes, as summarised in table 2; the changes discussed are restricted to simple cases where there are ‘single-factor’ offsets, and the analysis focuses on first-round effects and ignores subsequent portfolio adjustments (many of which take place within the private non-financial sector). The first three rows of Table 2 are clear enough, but the later rows deserve some comments.

Row 4 treats the case of a conventional fiscal expansion financed by a bond issue: there is an increase in the government’s budget deficit G-T to which we assume there is a corresponding fall in the private sector’s deficit I-S (and no change in the current account X-Z), together with an issue of bonds by the government. In this simple case the private non-financial sector ‘spends’ the additional resources from its increased savings/reduced investment on buying the new government bonds. There is no change in H or Ms.
Row 5 considers a ‘pure’ financial crisis in which banks cut their lending to the private non-financial sector. For both sectors the reduction in bank lending is balanced by a reduction in deposits. The result is that H is unchanged but Ms falls.

Row 6 is for ‘pure’ quantitative easing: the CB goes into the market and buys government bonds from the private non-financial sector. By the time the CB’s cheque has passed through the payments system, this brings about an increase in both the deposits of the private non-financial sector and the reserves of the commercial banks. For the CB the rise in its assets (increased bond holdings) is balanced by the rise in its liabilities in the form of banks’ reserves, for the banks the rise in their assets (reserves) is balanced by a rise in their deposit liabilities, and for the private non-financial sector the fall in bond holdings is balanced by a rise in another asset, their bank deposits. The result is that H and Ms both rise.

Row 7 combines a financial crisis/fall in bank lending (as in row 5) with a fiscal expansion (as in row 4) of the same magnitude. The private non-financial sector ends up with more bonds (to the extent of the fall in its financial deficit), less loans and less deposits. The result, which is the sum of the results for rows 4 and 5, is that H is unchanged but Ms falls.

Row 8 combines the financial crisis with QE (as in row 6) of the same magnitude: here banks’ lending falls but the CB steps in to buy government bonds to the same amount, and its purchase of bonds from the private non-financial sector offsets the impact of the fall in banks’ lending on the private non-financial sector’s bank deposits. For the banks there is a fall in one asset (loans) offset by a rise in another (reserves at
the CB). The overall effect (the sum of the effects in rows 5 and 6) is that H rises but Ms is unchanged.

Finally, row 9 combines fiscal expansion with QE of the same magnitude. Here the government issues bonds to cover its increased budget deficit, and these bonds are in effect bought by the private non-financial sector (the independent CB is not allowed to participate in the primary government debt market) but then sold immediately to the CB. Thus the private non-financial sector, which has a reduced financial deficit (corresponding to the increased government budget deficit) ends up with a rise in its deposits, while for the banks the increase in deposit liabilities is balanced by a rise in reserves at the CB. In total (combining the results of rows 4 and 6), Ms rises (because deposits rise) and H rises (because banks’ reserves rise). This is, in effect, the standard case of a monetary-financed fiscal expansion.

The key point to take from this discussion is that QE raises the money supply, either absolutely (rows 6 and 9) or relative to what would have happened otherwise (row 8). In section 4 we also make use of the results that banks’ issues of new equity tend to reduce money (row 2), while banks’ acquisitions of government debt tend to increase it (row 3).

2 Monetary growth in the UK 2007-10

It would be useful to fill in the actual numbers for a full flow of funds matrix in recent years to examine the evolution of the various aggregates in the UK. But once we move from the simple framework above to the specificities of the UK the matrix becomes much more complicated, because of the role of foreign financial institutions,
the larger number of financial claims and the deep international integration of the UK
financial sector (foreign sector purchases of government bonds, domestic banks’
operations in foreign currency, and so on). However, we can provide numbers for
various aggregates and for the basic credit counterparts so as to highlight the major
developments in financial flows since 2007.7

Figure 1 shows the trend decline in the velocity of broad money (measured as
quarterly nominal GDP divided by M4ex – M4 excluding intermediate OFCs, the
Bank’s preferred measure of broad money), which was then reversed from 2009 Q2.
The lines for nominal income and broad money growth (since four quarters before)
make clear that the last part of the decline reflected a faster fall of nominal income
than of broad money from mid-2008, while the reversal of the decline reflected the
rebound of nominal income growth; broad money growth on this four quarter basis
did not go negative, and began to rise again after 2010 Q1. Figure 1 also includes real
GDP growth, which is below that of nominal income but moves closely with it,
especially over the crisis period.

[Figure 1 near here, c. 1/3 of page]

Table 3 shows calendar year growth rates for M4ex and its main counterparts (as
percentage of outstanding M4ex), in the nearest UK-specific form to the basic
equation given in section 1:8

\[
\Delta M4ex = \Delta M4ex \text{ lending to the private sector} \\
+ \text{ public sector net cash requirement (PSNCR)} \\
- \text{ net private sector purchases of public sector debt} \\
- \text{ public sector external and all other FX transactions}
\]
- $\Delta$ in MFIs’ net non-deposit liabilities

\[\Delta\]

+ $\Delta$ in MFIs’ external and all other FX transactions

+ $\Delta$ lending (net of deposits) to intermediate OFCs

where the second, third and fourth items on the right hand side can be combined in the ‘public sector contribution’ to monetary growth. The latter is also referred to as net sterling lending to the public sector by monetary financial institutions (MFIs), where MFIs include the Bank of England so that this includes asset purchases under QE. An alternative perspective on these developments is provided by Figure 2, which shows the four quarter changes in M4ex and the main credit counterparts from 2004 to 2010 (all as percentages of M4ex). Three particular points stand out from the table and the figure. First, the changes in both M4ex and M4ex lending had been around 7% and 10% respectively between 2000 and 2004, and then around 10% and 12-15% in 2005 and 2006, but both fell strongly in 2008 and 2009 to below 2%; M4lending growth then went negative for a while, but M4ex growth (on the four quarter basis) remained positive but very low. Secondly, the PSNCR (the public sector’s financial deficit) rose from around 3-4% in the mid-2000s to 7% in 2009 and 13% in 2009. Thirdly, the public sector contribution which had fluctuated around zero rose to nearly 14% of M4ex in 2009. Within that aggregate, the Bank of England’s cumulative gilt purchases under the Asset Purchase Facility reached in January 2010 the scheduled £200bn, equivalent to nearly 13% of M4ex in March 2009 and nearly 14% of nominal GDP in 2008. There is also a sharp fluctuation, in opposite directions, in MFIs’ externals in 2008 and 2009; this appears to be related to some one-off movement around the turn of the 2008/9 year which is also reflected in an unusually large change in (sterling) non-deposit liabilities in 2008 Q4. Over-all, it is clear that the sharp fall in broad money growth in the crisis was associated with a sharp fall in lending to the
private sector; and the sharp rise in 2009-10 in the public sector’s contribution was associated with the rise in the budget deficit, on the one hand, and with QE on the other. At the same time MFIs’ externals and the change in non-deposit liabilities fluctuated more widely than usual over the crisis and QE period.

[Table 3 near here, probably a whole page in landscape, but half a page in portrait if possible; Figure 2 also near here, this may need to be a whole page in landscape, but half a page in portrait if it is still clear enough]

The penultimate row in the table shows the numbers available (for M4 rather than M4ex) for the twelve months from March 2009 to February 2010, which covers the period of QE. Here the MFIs’ externals are much smaller and, more importantly, it is clear that the public sector contribution to monetary growth is very large while monetary growth is limited by the negative impact of the large change in non-deposit liabilities (this issue is taken up below in section 5). The final row shows the data for the counterparts from July 2009 (when monthly data first become available) to January 2010: again it is clear that the public sector contribution is very large (but is offset by a large change in non-deposit liabilities).

Figure 3 shows the financial surpluses/deficits of different sectors. In the early years the foreign sector has a consistent surplus (i.e. there is a current account deficit) and that continues with little change over 2008, 2009 and 2010. On the other hand the general government’s deficit increases in 2008 and even more strongly in 2009, and falls slightly in 2010. The private sector has corresponding movements in its financial surplus; disaggregated data make clear that the main changes arise in the household
sector, whose surplus increased very strongly in 2009, while non-financial and financial corporations experienced a rise and a fall respectively in 2010.

[Figures 3 and 4 near here, c. 1/3 of a page together]

Finally, Figure 4 shows new issuance by private non-financial corporations (quarterly and over the four preceding quarters). The series fluctuates widely but it is clear that there were exceptional levels of issuance in 2009-10.

The fiscal expansion, the financial crisis (in terms of its impact on bank lending) and QE are all substantial changes to the counterparts of broad money growth over 2008-10. The fiscal expansion clearly originates outside the monetary sphere, in the combination of the financial crisis, the sharp cyclical downturn and the discretionary measures taken to mitigate the recession by the Labour government. The financial crisis, with the problems of bad debts, on the one hand, and the freezing of the interbank market, on the other, led to a very sharp fall in bank lending: the careful examination by Bell and Young (2010) of the balance between credit supply side factors and loan demand factors finds that credit supply effects were dominant, that is banks were deciding to lend less. And QE itself was the result of a policy decision taken by the MPC (in coordination with the government) in the light of the crisis and the recession. These changes are not, therefore, the automatic response of the monetary system to the shocks affecting it, they were the result of specific decisions taken by specific agents (who could have taken different decisions). In that sense these changes can be regarded as exogenous to the monetary system. Moreover, they are substantial enough not to be washed away in the short term through the usual
adjustment mechanisms that allow monetary growth in more tranquil periods to be reasonably viewed as endogenous.

This suggests that it would be useful to investigate whether we can use broad money directly (in a reduced form equation) to analyse the course of UK GDP over the crisis. If a clear relationship is found this might make it possible to get a better grip of what would have happened to nominal spending first in the absence of the financial crisis, and then in the absence of QE, by simulating the effects of different levels of monetary growth. First, however, we examine the relationship between nominal spending growth and broad money growth.

3 The relationship between nominal spending growth and broad money growth

In this section we investigate whether it is possible to explain the four-quarter growth rate of nominal GDP (the growth since four quarters before) on the basis of the four quarter growth rate of nominal money and other variables. We use four quarter growth rates in order to concentrate on ‘medium term’ effects and to abstract from short run noise. Given that there is no obvious up-to-date reduced-form (or structural) model that we can pluck off the shelf to analyse this relationship, we approach it as follows. First, we draw on the forward-looking Taylor rule literature in choosing as regressors the variables typically used to forecast inflation and the output gap in standard GMM estimations (see, for example, Clarida, Gali and Gertler, 1998), together with the nominal money growth rate. Second, we use the automatic econometric model selection procedure within PC-Give (formerly known as PC-GETS) to select the variables and the lags.
The measure of broad money is the Bank of England’s recently introduced preferred measure, M4 excluding intermediate OFCs. This measure is only available since 1997 Q4, so we use the four-quarter growth rate of M4 as broad money growth before 1998 Q4. Figure 1 above shows the four quarter growth rates of nominal GDP and nominal money on this basis, together with the corresponding growth rate for real GDP. The independent variables we consider are lagged nominal GDP growth, the annual growth rate of the world commodity price index, Bank Rate and nominal money growth. We consider up to 4 lags of each variable.13

Since, as set out in the previous section, there is a suspicion that money may have been subject to extraordinary supply-side shocks in the last few years which might have changed the underlying relationships, we estimate this equation with interacted dummy variables for M4 growth and Bank rate: the dummy is defined as zero up to 2007 Q2 and 1 thereafter, and it is interacted with each of the four lags of these two variables.

The results of the regression are reported in the first column of Table 4. For the period as a whole, the automatic selection programme in PC-Give selects only the lagged dependent variable (lagged one period), nominal money growth (lagged three periods) with a rather small but significant coefficient, and commodity price inflation (lagged three periods), but not Bank Rate. However, the interacted dummy variables covering only the period from 2007 Q3 turn out to be very important: money growth (lagged two periods) has a significant coefficient of 0.70, and Bank Rate (lagged four periods) has a significant coefficient of -1.49. This coefficient on monetary growth is less than
the 1 that might be expected from a simple quantity theory model (with constant velocity), but given the medium rather than long-term focus of the analysis it is impressively large. The coefficient on lagged Bank Rate is also strikingly high: it implies that a rise of 1% in Bank Rate leads in four quarters to a 1.49% fall in the rate of nominal GDP growth. The lags – given that money growth is since four quarters before – are broadly consistent with a priori expectations and, in the case of Bank Rate, with the Bank of England’s BEQM model.

[Table 4 near here, c. 1/2 of page]

The exercise is repeated in equation [2] for real GDP growth against real M4 growth. The latter is calculated using the GDP deflator, so the conversion is the same as for nominal GDP, but the other variables – commodity price inflation and Bank Rate – are unchanged between the regressions. The results are broadly the same. Here a second term in GDP growth (lagged four periods) is significant, and Bank Rate has a small but significant negative coefficient for the period as a whole. For the later period the interacted variables for money growth and Bank Rate both have smaller (than in [1]) but still highly significant coefficients.

These results were obtained from a naïve reduced form single-equation regression, which does not consider directly, for example, variables representing world economic activity or domestic fiscal policy and in which the lagged dependent variable is very important. However, the fact that the same broad pattern of results – small roles for Bank rate and money growth in the 1994-2007 period, but negative and significant coefficients on Bank rate and positive and significant coefficients on money growth in the later period – is found if real GDP growth is taken as the dependent variable with
real money growth as the regressor, or even if real GDP growth is made dependent on nominal money growth,\textsuperscript{14} suggests that the finding is robust.

Overall, these results are consistent with the proposition that money has a significant role in explaining nominal spending growth in the periods which include the crisis and QE, but little such role in the tranquil pre-crisis period; and they are consistent with Goodhart’s (2007) argument that money may sometimes provide no additional useful information beyond that provided by inflation, output and interest rates, but in other periods money might tell us more, so that in general it should be monitored rather than ignored. In the next two sections we use the results of regression [1] to illustrate the magnitude of the impact monetary developments might have had on the economy, first for the downturn in bank lending in the crisis period of 2007-8 and then for the QE period of 2009-10.

4 The effect on nominal income of the collapse of bank lending

We have already referred to the work of Bell and Young (2010), which found that there were significant supply-side factors in the downturn of bank lending to the private non-financial sector during the crisis. On that basis we suggest that an appropriate counterfactual A for what would have happened if there had been no financial crisis is that (nominal) M4ex lending would have continued through 2008 to 2009 Q4 at a ‘normal’ rate. Given that the evolution of M4ex over this period was dominated by and very close to that of M4ex lending (see Figure 1), we make this operational by simply assuming that the four quarter growth rate of M4ex does not fall below its average of 6.48% in 1998-2004 (which omits the period of faster growth in 2005-7). Thus on counterfactual A M4ex growth in 2008 Q1 is at the historical rate
of 8.3% and in the following seven quarters it is 6.48%, as against the historical
values of 6.6, 4.3, 3.7, 4.4, 3.1, 1.9, 1.0 and 0.8%. The actual and counterfactual paths
for the four quarter growth rate of nominal money are shown in Figure 5. We then use
the coefficient estimates from regression [1], the predicted values of the lagged
growth rate, the counterfactual values for money growth and the actual values of
commodity price inflation and Bank Rate, to calculate what the nominal GDP growth
rate would have been under the counterfactual rate of money growth.

Table 5 gives the definition of the counterfactual and Figure 6 shows the actual path
of the growth rate, and that predicted under counterfactual A (with the actual values
of the independent variables up to 2008 Q1). It suggests that nominal spending growth
would have been much higher if bank lending had not collapsed in the way that it did
during the financial crisis: growth falls to a low of only -1.8% in the first half of 2009,
as opposed to the actual trough of -5.5%, and by the end of 2009 it is picking up
strongly. The high rates of growth reached in 2010 also reflect the cuts in Bank Rate
in 2008 Q4 and 2009 Q1 (which might not have been needed if the financial crisis had
not occurred). For this reason amongst others the counterfactual should be regarded as
suggestive rather than a precise estimate.

5 The effect on nominal income of QE

We now turn to assess the impact of quantitative easing on nominal GDP growth,
given the occurrence of the financial crisis, by constructing a counterfactual path for
monetary growth. Given the complexity of the issue and the various offsets to QE
which have been identified by Bridges et al. (2011) (see also Bridges and Thomas, 2012), we construct three different counterfactuals (see also Table 5 above). First, if there were no offsets to QE at all, then M4ex in the absence of QE would have been lower by the cumulative amount of the asset purchases: in this counterfactual B money growth falls much faster than the historical series, turning negative in 2009 Q2, reaching -11.6% in 2009 Q3 but then returning towards the historical series as QE begins to fall out of the four quarter interval during 2010.

Second, there is an important offset highlighted by Bridges et al. (2011): the effect of ‘banking sector stabilisation’ in the form of (a) banks’ issuance of new equity and bonds which raises their non-deposit liabilities and reduces their deposits (see row 2 in Table 2), and (b) banks’ acquisition of additional public sector debt in order to improve their liquidity ratios, which increases their deposits (see row 3 of Table 2). It is likely that some banking sector stabilisation of these kinds would have occurred in the absence of QE, since banks needed to improve their capital ratios after the revelation of large housing-related bad debts. But it could be argued that the stabilisation was facilitated by QE: QE meant that ‘other financial corporations’ (OFCs), notably pension funds and life assurance companies, which had sold their gilts to the BoE now had extra resources to invest, and this may have encouraged banks to issue new paper. We therefore construct a counterfactual C under which nominal money was lower by the amount of the ‘excess’ lending by MFIs to the public sector (which includes both QE and commercial banks’ purchases of gilts), net of the ‘excess’ increase in MFIs’ non-deposit liabilities, where the excess is the deviation from the respective averages for 1997 Q4 to 2007 Q4.
Third, Bridges et al. (2011) have also raised the issue of private non-financial corporate issuance. Here the argument is that PNFCs may have been issuing more equity and bonds over the QE period because OFCs were willing to buy, as with bank issuance, but this might reduce the PNFCs’ demand for credit and hence their borrowing from banks, in which case the stock of M4ex lending and M4ex itself would be lower by the (cumulative) amount of PNFC issuance. We therefore construct a final counterfactual D by adding to the nominal M4ex implied by counterfactual C the amount of PNFC issuance from 2009 Q2 in excess of the average issuance from 2003 Q1 to 2008 Q4 (the period for which the data are available on the Bank’s website).

The paths of nominal money growth under these counterfactuals are shown in Figure 7. Counterfactual B implies the largest effect from QE, counterfactual C a smaller effect and counterfactual D an even smaller effect. As stated above there is evidence that the fall in bank lending was more of a supply-side phenomenon. To the extent that the fall was supply-driven then additional PNFC issuance would be providing firms with additional resources without reducing the amount of firms’ borrowings from the banks, so the size of the offset would be smaller. It is also arguable that much of the banking sector stabilisation would have taken place, necessarily, even in the absence of QE. So while counterfactual D can be regarded as the lower bound (and it is close to the lower bound suggested by Bridges et al., 2011), it seems likely that the ‘true’ counterfactual would involve a somewhat larger fall in nominal money growth, somewhere between counterfactuals B and D. It should also be noted that there is a sharp jump in nominal money in 2010 Q1 under counterfactuals C and D. This is the result of an exceptionally large rise in banks’ non-deposit liabilities in that
quarter, followed by a fall in 2010 Q2, and of the fact that the assumptions defining
the counterfactuals are taken to hold beyond the end of QE (in January 2010). This
means that for these two counterfactuals more weight should probably be attached to
the results for 2009 than for the later quarters.

[Figures 7 and 8 near here, c. 1/3 of page]

These counterfactuals are then used to find what the nominal GDP growth rate would
have been in the absence of QE, as understood in each case. Figure 8 shows the actual
path and those predicted under counterfactuals B, C and D. In each case the difference
between the actual and the counterfactual paths of nominal GDP can be interpreted as
a (rough and suggestive) estimate of the effect of QE under the relevant assumptions.
On counterfactual B, that is if no QE was undertaken and there were no offsets to it,
growth falls heavily to a trough of -13.8% in 2010 Q3, before turning up. On
counterfactuals C and D, where there are assumed to be varying offsets, growth
improves from 2009 Q3 but becomes positive only in 2010 Q3 and 2010 Q4
respectively, whereas actual (and predicted) nominal spending growth rose above zero
in 2010 Q1. The implication is that in the absence of QE nominal spending growth
would have been considerably weaker for longer. In other words QE did indeed have
a significant impact on nominal spending and hence economic activity in the UK.

A recent article in the Bank’s Quarterly Bulletin (Joyce et al. 2011) has reported a
number of estimates of the peak effect of QE on real GDP and CPI inflation taken
from ongoing research at the Bank: the range for GDP is 1.5-2%, and that for CPI
inflation is 0.75-1.5%. If we take the sum of these to be a reasonable estimate of the
change in nominal GDP, this comes to around 3%. In Figure 10, the difference in the
four quarter nominal GDP growth rates as of 2010 Q1 (the QE period) between the predicted rate and the rate on counterfactual D (which implies the smallest impact of QE) is also of the order of 3%, while the differences with counterfactuals C and B are around 4.8% and 10.6%. On the other hand, our corresponding estimates of the peak effects are 4.6 and 7.2% for the four quarters to 2010 Q2 on counterfactuals D and C, and 18.2% for 2010 Q3 on counterfactual B. Thus our estimates for the effect of QE are typically a little higher than those reported by the Bank, particularly if the ‘true’ counterfactual is agreed to be somewhere between B and D, as argued above.

6 Conclusions

Formal announcements of the introduction of quantitative easing emphasised the intended impact on money and credit and hence on nominal spending, but the main empirical research published by the leading QE-undertaking central banks focuses instead on the effects of QE on long-term interest rates rather than money or credit. In this paper we have tried to see whether there is a direct connection between nominal spending growth and monetary growth, which we argue is very likely to have been significantly affected by the financial crisis and quantitative easing. Our approach can be thought of as covering the range of possible transmission mechanisms, as set out in e.g. Benford et al. (2009), and connecting money with the object of ultimate interest, nominal spending, rather than say long-term interest rates. The results we have obtained should be treated as tentative, since they have been derived using a simple ad hoc reduced form equation rather than a more comprehensive model, and since we can only give a range of counterfactuals on different assumptions. Nevertheless, they suggest strongly that changes in money have had a considerable impact on the economy in the last few years, and a much greater impact than in the pre-crisis period.
This is consistent with the idea that in tranquil times money may not embody significant additional information, but that in other periods changes in banks’ behaviour may affect money, credit, nominal spending and the real economy. Moreover, they imply that QE has indeed had a major impact on the UK economy, and a somewhat larger impact on our analysis than that reported by the Bank of England.

For this period at least broad money would indeed appear to tell us something, enough to suggest that more research would be appropriate. We do not think further insights can be gained by working on simple reduced form models, but we suggest that operators of large macroeconometric models of the UK economy, notably the Bank of England, should experiment with the inclusion of monetary and credit variables in their models. The Bank’s (published) monitoring of money and credit could also be deepened.15
Notes


2 Another paper which calls for the re-integration of money into macro modelling is Chadha, Corrado and Holly (2008): we are grateful to a referee for drawing this to our attention.

3 In contrast to earlier versions of the matrix, here the government and central bank are treated separately, in the light of the modern focus on central bank independence and the need to locate QE within that context.

4 To derive this, write each of the private non-financial column, the financial deficit row and the overseas column as equations:

\[(I-S)+\Delta D+\Delta NDL+\Delta C+\Delta GD_{nf} = \Delta A + K\]  \([A]\)

\[\text{DEF} + (X-Z) + (I-S) = 0\]  \([B]\)

\[(X-Z) + K = \Delta \text{RES}\]  \([C]\)

then substitute for I-S in \([A]\) from \([B]\), and for X-Z from \([C]\) and use the definition \(\Delta M_s = \Delta D + \Delta C\).
This view of the credit counterparts to broad money growth goes back to the changes in monetary statistics made in the UK in the late 1960s. See Goodhart (1989, part 6) and Cobham (1991).

In the discussion that follows we talk of rises or falls in assets and liabilities, but strictly the changes are rises or falls in the flows into assets and liabilities, i.e. changes relative to whatever else is happening.

The monetary data are from the Bank of England’s interactive statistical database, and GDP and financial deficit data from the Office of National Statistics.

We are grateful to Ross Meader at the Bank of England for explanation of some of the details of the credit counterparts of M4ex. See also Kirkham and Davies (2011).

We are grateful to Jonathan Bridges and Ryland Thomas at the Bank of England for clarification on this point.

Monthly data (seasonally adjusted or otherwise) are available for M4ex and M4ex lending only from July 2009. We use twelve months rather than the eleven over which QE took place and non-seasonally adjusted data because the basic counterparts relationship does not hold for the seasonally adjusted data.

More precisely they conclude that “the evidence discussed in this article suggests a significant role for a persistent tightening in the supply of credit, independent of changes in credit quality and Bank Rate… Credit demand is also likely to have weakened during the recession…” (Bell and Young, 2010: 319). See also the study by Aiyar (2011) on the transmission of shocks to banks’ external funding through to their domestic UK lending. Gambacorta and Marques-Ibanez (2001) find for a large sample of EU and US banks that bank-specific characteristics such as banks’ Tier 1 capital ratios affected their behaviour in the face of the crisis.
This also means that for the monetary data, where the seasonal adjustment procedures are still under discussion (Hussain and Maitland-Smith, 2010; Gilhooly and Hussain, 2010), we can reasonably use non-adjusted data.

We also experimented with US and euro area output gaps, but this did not produce satisfactory results.

In this case there is a significant positive coefficient on Bank Rate for the overall period, but this is more than offset by significant negative values on the interacted dummy variables for Bank Rate (lagged two and four periods), and there is a significant positive coefficient on nominal money of 0.56.

It is noticeable that the ECB’s *Monthly Bulletin*, for example, contains a more substantial analysis of money and credit than the Bank of England’s *Inflation Report*, while the Bank of England also has no parallel to the large-scale macroeconometric model of Giannone et al. (2009), which provides the basis for their (2011) estimates of the effect of the ECB’s non-standard policy measures.
References


Table 1: Simplified flow of funds matrix

<table>
<thead>
<tr>
<th></th>
<th>government</th>
<th>central bank</th>
<th>overseas</th>
<th>private non-fin</th>
<th>private financial</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) fin def</td>
<td>G-T</td>
<td>X-Z</td>
<td>I-S</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2) deposits</td>
<td>∆D</td>
<td></td>
<td></td>
<td>-∆D</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3) non-deposit</td>
<td>-∆H</td>
<td>∆NDL</td>
<td></td>
<td>-∆NDL</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>liabilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) high-powered</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>money</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) government</td>
<td>-∆GD</td>
<td>∆GD&lt;sub&gt;cb&lt;/sub&gt;</td>
<td>∆GD&lt;sub&gt;nf&lt;/sub&gt;</td>
<td>∆GD&lt;sub&gt;f&lt;/sub&gt;</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>securities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) CB lending</td>
<td>∆CBL</td>
<td></td>
<td></td>
<td>-∆CBL</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>to banks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7) domestic</td>
<td>-∆A</td>
<td>∆A</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>lending</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) foreign</td>
<td>∆RES</td>
<td>K-∆RES</td>
<td>-K</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>lending</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes: G-T, X-Z (Z for imports) and I-S are the standard sectoral financial deficits as in the national income accounts; D and NDL are bank deposits and bank non-deposit liabilities respectively; H, C and R are high-powered money, notes and coin in circulation and banks’ reserves at the central bank; GD, GD<sub>cb</sub>, GD<sub>nf</sub> and GD<sub>f</sub> are the stock of government debt (securities) in existence, and the amounts held by the central bank, private non-financial and private financial sectors respectively; CBL is short term lending from central bank to commercial banks, i.e. ‘money market assistance’; A is bank lending (advances); K is capital inflows, and RES is the foreign exchange reserves. The change in high-powered money is equal to the change in notes and coin in circulation (∆C) plus the change in banks’ reserves at the central bank (AR). The change in broad money is equal to the change in notes and coin in circulation (∆C) plus the change in deposits (AD).
<table>
<thead>
<tr>
<th>Table 2: Effects on the flow of funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exogenous change</td>
</tr>
<tr>
<td>standard CB refinancing of banks: increase in CBL</td>
</tr>
<tr>
<td>issuance of new equity and bonds by banks, bought by private non-financial sector</td>
</tr>
<tr>
<td>banks buy government bonds (to improve own liquidity) from private non-financial sector</td>
</tr>
<tr>
<td>fiscal expansion (with equivalent fall in private sector financial deficit) financed by bond issue bought by private non-financial sector</td>
</tr>
<tr>
<td>‘pure’ financial crisis: banks reduce their lending</td>
</tr>
<tr>
<td>‘pure’ QE: CB purchases government bonds from private non-financial sector</td>
</tr>
<tr>
<td>financial crisis plus fiscal expansion financed by bond issue bought by private non-financial sector</td>
</tr>
<tr>
<td>financial crisis plus QE: bank lending falls but CB buys more bonds to same extent</td>
</tr>
<tr>
<td>fiscal expansion plus QE: government issues new bonds which are then purchased by CB</td>
</tr>
</tbody>
</table>
Table 3: Changes in M4ex and counterparts (as percentage of outstanding M4ex)

<table>
<thead>
<tr>
<th>Year</th>
<th>ΔM4ex Lending</th>
<th>Public Sector Net Cash Requirement</th>
<th>Private Sector Purchases of Public Sector Debt (-)</th>
<th>Public Sector External and All Other FX Transactions</th>
<th>Public Sector Contribution</th>
<th>ΔMFIs’ External and All Other FX Transactions</th>
<th>Δ in Net Non-deposit Liabilities (-)</th>
<th>Net Lending to Intermediate OFCs</th>
<th>ΔM4ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>12.84</td>
<td>-4.60</td>
<td>1.64</td>
<td>0.45</td>
<td>-2.54</td>
<td>0.90</td>
<td>-3.88</td>
<td>0.48</td>
<td>7.91</td>
</tr>
<tr>
<td>2001</td>
<td>8.87</td>
<td>-0.23</td>
<td>0.81</td>
<td>0.45</td>
<td>1.02</td>
<td>-2.50</td>
<td>-1.25</td>
<td>0.13</td>
<td>6.28</td>
</tr>
<tr>
<td>2002</td>
<td>10.12</td>
<td>1.97</td>
<td>-0.97</td>
<td>0.26</td>
<td>1.26</td>
<td>-2.74</td>
<td>-2.74</td>
<td>0.93</td>
<td>6.83</td>
</tr>
<tr>
<td>2003</td>
<td>11.72</td>
<td>3.79</td>
<td>-3.14</td>
<td>-1.37</td>
<td>-0.72</td>
<td>-2.77</td>
<td>-2.08</td>
<td>0.46</td>
<td>6.60</td>
</tr>
<tr>
<td>2004</td>
<td>12.41</td>
<td>4.00</td>
<td>-3.09</td>
<td>-0.24</td>
<td>0.67</td>
<td>0.41</td>
<td>-6.42</td>
<td>0.38</td>
<td>7.41</td>
</tr>
<tr>
<td>2005</td>
<td>12.37</td>
<td>3.67</td>
<td>-1.02</td>
<td>-2.74</td>
<td>-0.08</td>
<td>2.99</td>
<td>-3.54</td>
<td>-1.87</td>
<td>9.87</td>
</tr>
<tr>
<td>2006</td>
<td>15.50</td>
<td>2.73</td>
<td>-1.69</td>
<td>-2.70</td>
<td>-1.66</td>
<td>-0.07</td>
<td>-2.41</td>
<td>-1.31</td>
<td>10.06</td>
</tr>
<tr>
<td>2007</td>
<td>8.98</td>
<td>2.40</td>
<td>-0.07</td>
<td>-2.93</td>
<td>-0.61</td>
<td>-2.73</td>
<td>-0.68</td>
<td>5.42</td>
<td>10.37</td>
</tr>
<tr>
<td>2008</td>
<td>1.97</td>
<td>7.19</td>
<td>-3.75</td>
<td>-2.65</td>
<td>0.80</td>
<td>9.93</td>
<td>-13.74</td>
<td>4.72</td>
<td>3.70</td>
</tr>
<tr>
<td>2009</td>
<td>-0.42</td>
<td>12.94</td>
<td>1.91</td>
<td>-1.16</td>
<td>13.68</td>
<td>-10.92</td>
<td>-0.08</td>
<td>-1.31</td>
<td>0.95</td>
</tr>
<tr>
<td>2010</td>
<td>-1.07</td>
<td>10.17</td>
<td>-2.34</td>
<td>-5.09</td>
<td>2.74</td>
<td>3.21</td>
<td>-3.71</td>
<td>1.48</td>
<td>2.65</td>
</tr>
<tr>
<td>2011</td>
<td>2.00</td>
<td>7.62</td>
<td>-1.26</td>
<td>-2.02</td>
<td>4.34</td>
<td>-0.12</td>
<td>-5.07</td>
<td>0.10</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Mar09-Feb10*  | n.a.            | (2.15)                     | 13.20                                         | 1.82                                          | -0.84                      | 14.18                                         | -0.66                           | -10.67                           | n.a.   |

Jul09-Feb10** | -1.05          | 8.19                          | 2.01                                          | -2.01                                         | 8.19                       | 2.08                                          | -8.75                           | -1.16                            | -0.69  |

Notes: MFIs are monetary and financial institutions (essentially banks, building societies and the Bank of England); relationship between columns: 5 = 2 + 3 + 4; 9 = 1 + 5 + 6 + 7 + 8; * numbers in brackets in this row refer to M4 and M4 lending, because M4ex and M4ex lending are available on a monthly basis only from July 2009, and all numbers in this row are percentages of M4ex outstanding at end-2008 Q4; ** July 2009 to February 2010 only, data not seasonally adjusted, and all numbers are percentages of M4ex outstanding end-2008 Q4.
Table 4: PC-Give autometrics estimation
Dependent variable: nominal GDP growth / real GDP growth
Sample period: 1994 Q1 to 2010 Q4

<table>
<thead>
<tr>
<th></th>
<th>[1]: nominal</th>
<th>[2]: real</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.29*</td>
<td>1.31**</td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
<td>0.13</td>
</tr>
<tr>
<td>GDP growth (-1)</td>
<td>0.51**</td>
<td>(-1)</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>0.79**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>GDP growth (-4)</td>
<td></td>
<td>-0.21**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.03)</td>
</tr>
<tr>
<td>M4 growth (-3)</td>
<td>0.07*</td>
<td>0.07*</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Bank Rate (-3)</td>
<td></td>
<td>-0.01**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.004)</td>
</tr>
<tr>
<td>commodity price inflation (-2)</td>
<td></td>
<td>-0.01**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.003)</td>
</tr>
<tr>
<td>commodity price inflation (-3)</td>
<td>-0.01**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td></td>
</tr>
<tr>
<td>M4 growth (-2)*dum</td>
<td>0.70**</td>
<td>0.47**</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Bank Rate (-4)*dum</td>
<td>-1.49**</td>
<td>-0.74**</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.94</td>
<td>0.97</td>
</tr>
</tbody>
</table>

AR 1-5 test: F(5,57) 0.83090 [0.5331] 0.98108 [0.4373]
ARCH 1-4 test: F(4,60) 0.85417 [0.4967] 0.28612 [0.8859]
Normality test: Chi²(2(2)) 1.6718 [0.4335] 2.2232 [0.3290]
Hetero test: F(10,57) 2.5113 [0.0141]* 0.49697 [0.8850]
Hetero-X test: F(20,47) 1.5412 [0.1118] 0.57136 [0.9130]
RESET23 test: F(2,60) 1.5422 [0.2223] 1.6169 [0.2070]
AR 1-5 test: F(5,57) 0.83090 [0.5331] 0.98108 [0.4373]

Notes: growth of GDP or money is growth since four quarters before; equation [1] has nominal GDP growth as the dependent variable and nominal M4ex growth among the independent variables, equation [2] has real GDP growth as the dependent variable and real M4 growth among the independent variables; standard errors are in brackets; ** significant at the 1% confidence level; * significant at the 5% confidence level.
<table>
<thead>
<tr>
<th>Purpose of Counterfactual</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A to identify broad money growth in absence of financial crisis-induced cut in bank lending</td>
<td>Broad money growth does not fall below its average for 1998Q4 to 2004Q2, i.e. 6.48%</td>
</tr>
<tr>
<td>B to identify broad money growth in absence of quantitative easing</td>
<td>Broad money level set equal to actual minus cumulative asset purchases under APF</td>
</tr>
<tr>
<td>C to identify broad money growth in absence of QE but taking account of offsets from (a) rise in non-deposit liabilities (⇒ Ms↓) and (b) banks’ purchases of public sector debt (⇒ Ms↑)</td>
<td>Broad money set equal to actual plus excess of change in MFIs’ net sterling assets (over average for 1997Q4-2007Q4) minus excess of MFIs’ lending to public sector (over average for 1997Q4-2007Q4)</td>
</tr>
<tr>
<td>D to identify broad money growth in absence of QE but taking account of offsets from (a) rise in non-deposit liabilities (⇒ Ms↓), (b) banks’ purchases of public sector debt (⇒ Ms↑) and (c) increased issuance by PNFCs (⇒ bank lending↓ and Ms↓)</td>
<td>Broad money set as in counterfactual C plus excess of PNFCs’ issuance (over average for 2003Q1-2008Q4)</td>
</tr>
</tbody>
</table>

Note: the offsets are calculated from 2009 Q1 to the end of 2010, except for that for the non-deposit liabilities which starts in 2009 Q2 (because there are very high and largely offsetting variations in that series for 2008 Q4 and 2009 Q1, and given that QE started only in March 2009 it is unlikely that significant QE-related issuance by banks occurred in 2009 Q1).
Figure 1: Velocity, nominal income growth and broad money growth
Figure 2: Four quarter changes in M4ex and counterparts (% of M4ex)

Source: data from Bank of England interactive statistical database
Figure 3: Financial surpluses/deficits by sector (% of GDP)

Source: ONS website

Figure 4: Issuance by private non-financial corporations

Source: BoE.
Figure 5: Monetary growth under counterfactual A

Figure 6: Nominal GDP growth under counterfactual A
Figure 7: Money growth under counterfactuals B, C and D

Figure 8: Nominal GDP growth under counterfactuals B, C and D