Money and Banking in a Realistic Macro-Model

Peter Howells
University of the West of England

1. Introduction

In the last few years there has been a long overdue recognition that the treatment of money in mainstream macroeconomics has been fundamentally erroneous. In the real world, the money supply is not exogenously determined by administrative decision of central banks and monetary 'shocks' do not take the form of a disequilibrium between supply and demand working their way out through real balance effects. In practice, central banks set a nominal rate of interest at which they are willing to make reserves available to the banking system and what happens to the money supply is the outcome of a complex interaction between banks and non-bank agents involving the (income-related) demand for credit and the (portfolio-related) demand for monetary assets. This process cannot be captured by an *LM* curve, derived from a fixed money supply.

Attempts to develop a 'macroeconomics without an LM curve' are now various starting, implicitly, with Clarida *et al* (1999) and more explicitly with Romer (2000). Walsh (2002) took the task forward by developing a framework which avoided the pitfalls of *LM* and also facilitated a discussion of inflation targeting – reflecting the contemporary trend in policy design. More recently we have seen a new framework for the teaching of monetary economics developed by Bofinger, Mayer and Wollmershäuser [BMW] (2005) and by Carlin and Soskice [CS](2005) who have since incorporated it in an intermediate level textbook (2006).

As part of a larger picture, these developments are often presented as part of the 'new consensus macroeconomics' [NCM], the idea of 'consensus' originating, presumably, in its combining the ability of monetary policy to influence real variables (after Keynes) in the short-run with the neutrality of money (after the 'classics') in the long-run. As a representation of the fundamental ideas of Keynes, this 'consensus' is unlikely to appeal to many Keynesian scholars who would question the long-run independence of output and monetary policy (see for example Fontana and Palacio-Vera, 2005; Arestis and Sawyer, 2005, Lavoie, 2006). However, the recognition that the money supply is endogenously determined and that the role of central

banks is limited to setting a short-term rate of interest should be a matter of at least limited satisfaction in post-Keynesian circles.

In this paper, in section 2, we review the latest suggestions for dispensing with the *LM* curve, focusing primarily on the (quite similar) BMW (2005) and CS (2005 and 2006) approaches. The novelty, however, lies in section 3 with the further development of these models in such a way that incorporates the behaviour of the banking sector. In section 4 we 'test' the legitimacy of this development by showing how the effects of a shock emerging from the macro part of the model can be traced through the banking sector where it produces perfectly sensible outcomes. The same section also provides a test of the model (reversing direction) by showing how the effect of a recent disturbance originating in the banking sector, the alarm over sub-prime lending, can be incorporated in the banking sector of the model and followed through to the macro part where again they show sensible results. Section 5 concludes.

2. Dispensing with the *LM* curve.

Criticisms of the *LM* curve, and attempts to provide something better are not new. Firstly, the *IS/LM* model as a whole has attracted criticisms for many years. For example, Hicks (1980) himself drew attention to the problems of combining a stock equilibrium (the LM curve) with a flow equilibrium (the *IS* curve) as well as the model's contradictory demand for a real and nominal interest rate while Moggridge (1976) warned students that the model downplayed dramatically Keynes's emphasis upon uncertainty – as regards the returns from capital spending and the demand for money – by incorporating them into apparently stable *IS* and *LM* functions respectively. Its survival as the centrepiece of intermediate macroeconomics for so long is testimony to its versatility: it captures a very large number of simultaneous relationships in a very compact way. There are few aspects of macroeconomic policy that cannot be explored using the model. Ironically, the way in which central banks actually behave is one of these.

As regards the *LM* curve specifically, its assumption of a fixed money supply was never going to be acceptable to economists who felt that the money supply was to any degree endogenously determined. Leaving aside the more distant monetary controversies such as the debate over the 'Great Inflation' of fifteenth century Europe[1] and the issues between the 'bullionist' and 'banking' schools in nineteenth century Britain, both of which involve views

[1] For a summary of *very* early allusions to money's exogeneity/endogeity see Arestis and Howells (2002).

on the endogeneity/exogeneity of money, it has been the so-called post-Keynesian school that has been most vociferous in its rejection of the central bank's willingness/ability to determine the path of any monetary aggregate, even the monetary base. In these circles, therefore, there has been an implicit rejection of the *LM* curve since Davidson and Weintraub (1973) and an increasingly explicit rejection as the project gathered momentum through Kaldor (1982), Rousseas (1986), Moore (1988), Palley (1991) and many others.[2]

In spite of this, attempts to construct a tractable model, for teaching purposes, which incorporates an endogenous money supply have not hitherto been successful. In fact, diagrammatic representations of an endogenous money supply have verged on the chaotic. For the most part, this is the result of starting from the same interest-money space that is used to represent a fixed money supply and a downward-sloping money demand curve from which the *LM* curve was derived. It is understandable that critics wished to confront the orthodoxy as directly and simply as possible and therefore the temptation to turn the money supply curve through ninety degrees and claim that the money supply was completely elastic at the rate of interest of the central bank's choosing (now represented by the intercept on the vertical axis), was irresistible. Indeed, it lay behind the title of Basil Moore's treatise published in 1988.[3] Unfortunately, however intuitively appealing, it was misleading. That framework was intended to show the behaviour of stock demand and supply, while the endogeneity of money was concerned with *flows.* Even worse, there was confusion as to whether this was a money supply or credit supply curve. Those who described the behaviour of endogenous money in interest-money space by reference to a *money supply* curve include Lavoie, 1985, p.71; Kaldor, 1982, p.24, 1983 p.22; Moore, 1988, p.263 and 1989, p.66; Rousseas, 1986, p.85 Wray, 1990, pp.166-7. Others, e.g. Palley, 1991, p.398; Dow 1993, 1994 and Dow and Earl, 1982, p.140 refer to it as a *credit* or *loan supply* curve. Lavoie, on a later occasion (1994, p.12) covers all possibilities by referring to it as a '...credit *or* money supply curve...' (our emphasis). Many of these problems were highlighted in Arestis and Howells (1996). Be that as it may, the idea that turning the (stock) money supply curve through ninety degrees could yield a useful comparison with the orthodox view caught on.

[2] How it was that the *LM* curve survived for so long in the face of this academic onslaught and the repeated statements of central bankers that the money supply is endogenous should yield an interesting research topic for future students of the philosophy of social science.

[3] Moore (1988) *Horizontalists and Verticalists: The macroeconomics of credit money* (Cambridge: Cambridge U P)

What all this shows is that the initial decision to tell the story of endogenous money supply creation within an orthodox framework led to a good deal of confusion. As we shall see in the rest of this section, a more satisfactory approach was to start from a completely different position.

From a monetary point of view the weaknesses of the *IS/LM* model are well-known. Amongst other things, it postulates:

- The money supply is fixed exogenously by the central bank
- The policy instrument is the monetary base
- In the absence of policy intervention the money supply is fixed
- Policy interventions are transmitted to the real economy through real balance effects
- The rate of interest is determined by the interaction of the demand for money and the exogenously determined supply.

All of these are so patently misleading as to make *IS/LM* a thoroughly unsuitable pedagogic device for students who are alert to what actually happens as widely reported by the media (and on increasingly helpful central bank websites).

Furthermore, things get worse when *IS/LM* is combined with an *AD/AS* framework which links aggregate demand to output and the *price level*, when current debates in macroeconomics require a link between demand, output and the rate of inflation. In 2000, David Romer courageously suggested dispensing with the *LM* curve altogether.

By way of alternative, he proposed (Romer, 2000) an *IS-MP-IA*[4] model, central to which is the replacement of the *LM* curve with a rate of interest imposed by the central bank, represented by a horizontal line, designated appropriately the *M*(onetary) *P*(olicy) curve. Further developments allowed him to re-introduce the *IS* curve and to derive an aggregate demand curve in output/*inflation* space.[5]

Given its simplicity and its avoidance of the basic defects of the *LM* curve, it is perhaps surprising that the Romer model was not more widely adopted. By comparison with later developments, the model says little about the supply side of the economy and there is little detail about the basis of policy decisions (or 'monetary rules'). Both may be seen as drawbacks but only in comparison with subsequent developments. For monetary specialists, however, what was more discouraging was the account that Romer gave of the way in which the policy rate was set. Firstly, Romer presents the decision to use the interest rate as a *choice*, to which the alternative could presumably still be direct control of the monetary base. In a section on

[4] Standing for *I=S*/Monetary Policy/Inflation Adjustment

[5] The term 'aggregate demand' needs to be interpreted with some care. The *AD* curve in Romer is derived from, and is totally contingent upon, the reaction of the central bank to (e.g.) inflation. It is not an alternative route to what is conventionally described as an *AD* curve which is derived from fundamental, structural, features of the economy.

'The Money Market' Romer gives an explanation of how the central bank imposes its chosen rate '…by injecting or draining high-powered money…' (p.162). In so far as the focus is on high-powered (rather than broader measures of) money, this is correct. But when it comes to explaining how operations on the monetary base influence the policy rate, we switch to changes in the quantity of broad money and real balance effects. A change in reserves causes a change in broad money and by '…the standard experiment of the central bank increasing the money supply when the money market is in equilibrium…the supply of real balances now exceeds the demand…' (p.163). This description is a long way from the reality recognised by economists working with central banks. This is, by contrast, that central banks have little choice but to set a rate of interest and that they do this by adjusting the price at which they refinance past borrowings of reserves and banks then convert that cost of reserves to a market rate of interest (relevant to the *IS* curve, for example) by a variable mark up. It also understates the extent to which Woodford and other members of the 'new consensus' have moved in recognising the hegemony of the interest rate instrument:

> It is often supposed that the key to understanding the effects of monetary policy on inflation must always be the quantity theory of money... It may then be concluded that what matters about *any* monetary policy is the implied path of the money supply... From such a perspective, it might seem that a clearer understanding of the consequences of a central bank's actions would be facilitated by an explicit focus on what evolution of the money supply the bank intends to bring about – that is by monetary targeting... The present study aims to show that the basic premise of such a criticism is incorrect. One of the primary goals ... of this book is the development of a theoretical framework in which the consequences of alternative interest-rate rules can be analyzed, *which does not require that they first be translated into equivalent rules for the evolution of the money supply'*. (Woodford, 2003, p.48. Second emphasis added).[6]

Since Romer, Bofinger, Mayer and Wollmerhäuser (BMW) (2006) have developed a more comprehensive framework 'for teaching monetary economics' – more comprehensive in the sense that it is more explicit about the supply side and introduces monetary policy rules (e.g. after Taylor), and central bank credibility. More interesting in many ways are the attempts to 'apply' these models, in the sense of incorporating them into mainstream macro teaching. As we have noted already, there are precious few such but Carlin and Soskice (2006) is a notable example.

[6] If a topical illustration of the independent supremacy of the rate of interest were needed, it can be found in the behaviour of central banks in the face of the sub-prime lending crisis (discussed further below). On 11/12 August 2007, the *Financial Times* reported 'Central banks have been forced to inject massive doses of liquidity in excess of $100bn into overnight lending markets, in an effort to ensure that the interest rates they set are reflected in real-time borrowing....The Fed is protecting an interest rate of 5.25 per cent, the ECB a rate of 4 per cent and the BoJ an overnight target of 0.5 per cent.' (p.3)

The C-S book is doubly interesting since it represents one of the first attempts to introduce a more realistic treatment of money into a mainstream textbook. This requires the treatment to provide not just a sensible framework for the discussion of money and policy but also to be consistent with the modelling of the external sector and economic growth and a wide range of topics covered later in the book. It is also interesting because it starts from a position which embraces more wholeheartedly the essence of the new consensus. There is no reference to central banks controlling stocks of narrow (or broad) money with a view to targeting interest rates. In this sense the 'rejection' of the *LM* curve is more complete than it is in Romer. In Carlin and Soskice, the interest rate is set as part of a Taylor-*type* rule, and in so far as a mechanism for setting such a rate is required it is consistent with the Woodford (2003) view expressed above.

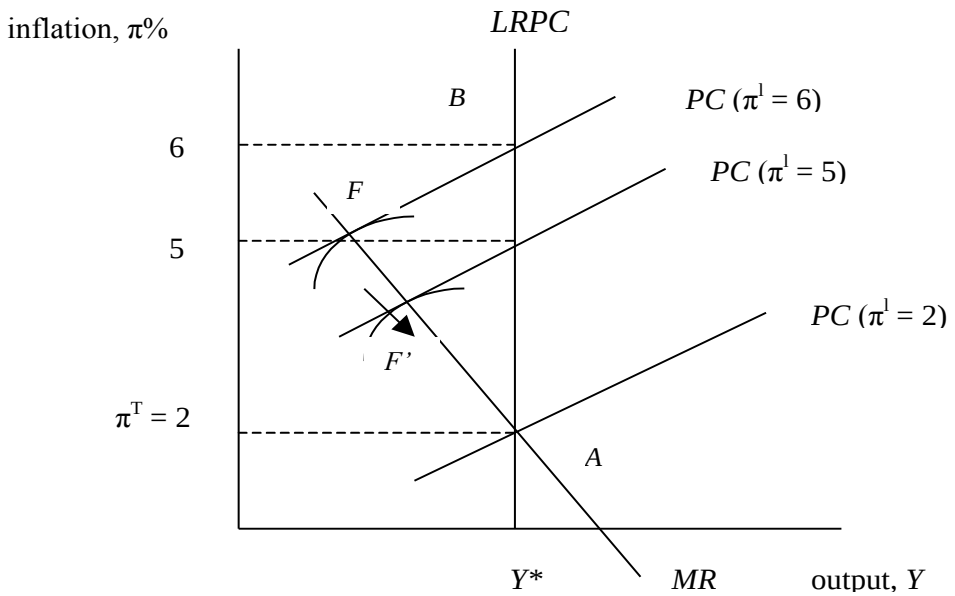
The basic model in Carlin and Soskice is developed over pages 81-87. It consists of three equations and is described as the *IS-PC-MR* model. As with Romer (and BMW), the *IS* curve remains but Romer's 'inflation adjustment' is replaced by an 'inertia-augmented Phillips curve'. 'Inertia-augmented' is preferred to the more usual 'expectations-augmented' since the latter relies for its upward slope on expectational errors which CS regard as implausible. The inertia derives from a combination of Calvo pricing and monopolistic competition (so everyone 'knows' what the rate of inflation is but institutional realities prevent it from being incorporated everywhere instantaneously. Finally, 'monetary policy' is modelled more explicitly as a 'monetary rule'. (Notice that it is a *monetary policy* rule and not an *interest rate* rule at this stage).

The starting point is figure 1 in which the central bank is assumed to have an inflation target of 2 per cent. Initially, the economy is in equilibrium at *A*, with inflation running at that level. Output is at its 'natural' level (on a long-run vertical Phillips curve) so there is no output gap to put positive (or negative) pressure on inflation. An inflation shock is introduced which moves the economy to *B* at which inflation is 6 per cent. In order to return to target, the central bank raises the real interest rate[7] and pushes output below its natural level and we move down the short-run Phillips curve (drawn for $\pi^1 = 6$) to the point labelled *F*. Notice that *F* is selected because the central bank is at a point tangential to the best available indifference curve at that combination of output and inflation. The indifference curve represents the output/inflation trade-off (the degree of inflation aversion) for that particular central bank. (A more inflation

[7] Carlin and Soskice (p.84) make the same point as Romer, that the central bank strictly speaking sets the *nominal* interest rate but does so with a view to achieving a *real* interest rate. Since it reviews the setting of this rate at regular, short, intervals, and the behaviour of inflation is a major factor in the decision, it is reasonable to see it as setting a real rate.

averse central bank would have a different indifference map and would move the economy to a point on PC ($\pi^l = 6$) to the left of *F*).[8] As the inflation rate falls to 5 per cent, the short-run PC shifts down to ($\pi^l = 5$). The central bank can then lower the real interest rate, allowing output to rise, so the economy moves to *F'* and by this process (described as following a monetary rule) the central bank steers the economy back to equilibrium at *A.*

Figure 1

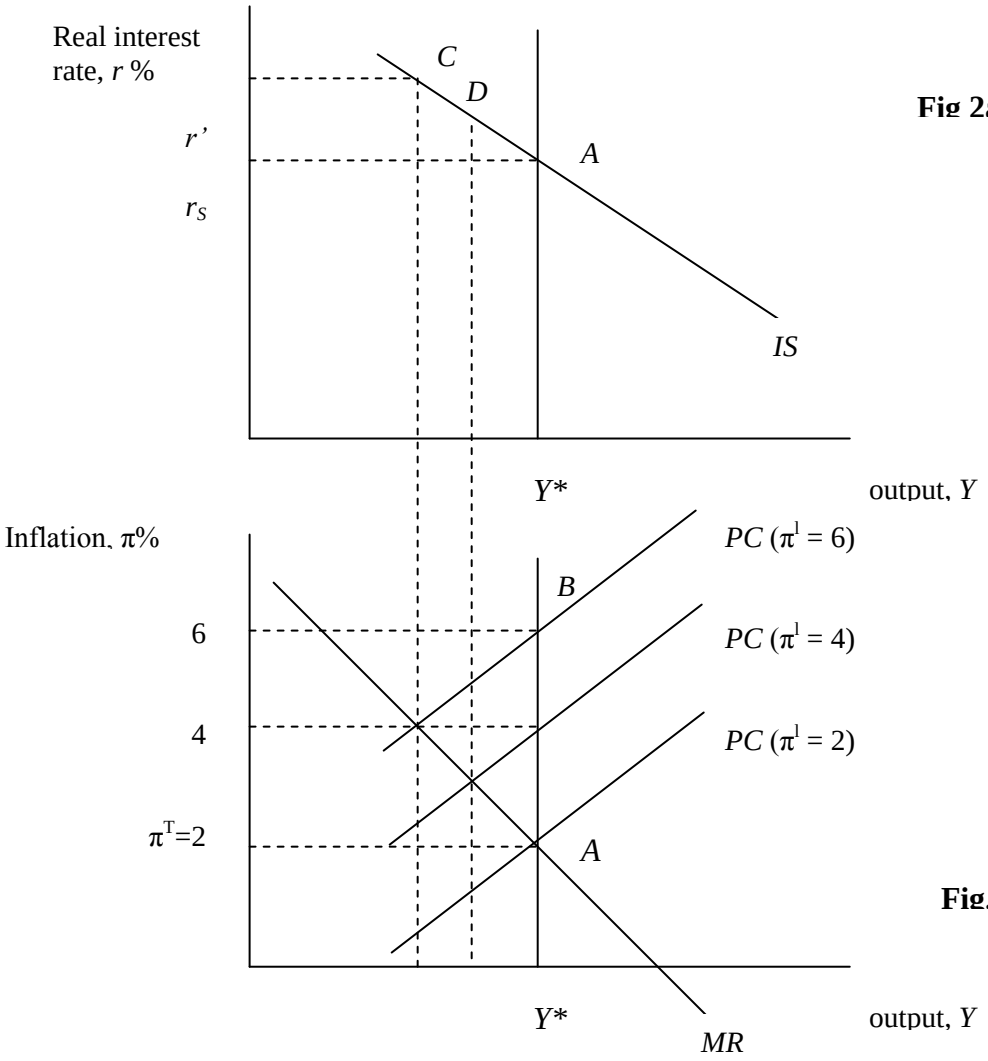


The next step is to introduce the *IS* curve and the real rate of interest. This is done in the upper part of figure 2. To begin with the economy is in equilibrium, shown in both panels by the point *A.* Notice that in the upper panel, this includes a real rate of interest identified as r_s (a 'stabilising' rate of interest which maintains a zero output gap). In the lower part, we then have a replay of figure 1. There is an inflation shock which takes the economy from equilibrium at *A* to a rate of inflation of 6 per cent (at *B*). In figure 2a, the central bank now raises the real rate of interest (to *r'*) which has the effect of moving us up the *IS* curve to *C* at which the level of output is reduced. (In the lower panel we move down the *PC* $\pi^l = 6$ curve to a point at which the reduction in demand pressure lowers inflation to 4 per cent). As inertia is overcome, contracts embrace 4 per cent and the Phillips curve shifts down to *PC* ($\pi^l = 4$), the real rate is reduced allowing some expansion of output. We are now at point *D* on the *IS* curve

[8] The indifference curves in figure 1 are segments of a series of concentric rings centred on *A.* If the central bank's loss function gives equal weight to inflation and output, the rings will be perfect circles. If the central bank puts more weight on inflation, the rings will be ellipsoid (stretched) in the horizontal plane. Hence greater inflation aversion on the part of the central bank would create a tangent 'further down' the *PC.*

but since we are still to the left of *Y** inflation continues to fall. This allows a further reduction in the real interest rate when inflation comes back to target at 2 per cent.

Figure 2



The dynamics are essentially the same as Romer. There is an *implicit* aggregate demand curve (the *MR* curve), with inflation on the vertical axis, which is *made* downward-sloping by virtue of the central bank's reaction to inflation. But in Carlin and Soskice the dynamics are spelt out in more detail and the reaction function of the central bank (here the 'monetary rule') is clearer and if we are interested in the banking sector, this detail is welcome. The big difference comes, however, when we look at later pages where Carlin and Soskice discuss 'How the *MR* relates to the *LM* curve' (pp.92-3). The first point they make is that the choice of model (*MR* or *LM*) must depend upon the nature of the monetary regime. 'If the central bank is using an *interest-rate based monetary rule* ...the correct model is the 3-equation model with the

MR. This is often called an inflation-targeting regime' (p.92).[9] Of course, they recognise that there is at any time a stock of monetary assets in existence and that these must be held by the non-bank private sector (since that is how money is defined). In that sense there is a permanent equilibrium between the demand for money and its supply. In an inflation targeting model one can *imagine* an *LM* curve if one so chooses: '...it goes through the intersection of the *IS* curve and the interest rate set by the central bank but *it plays no role in fixing the position of the economy in terms of output, inflation or the interest rate'* (p.93. Emphasis added). In a footnote they add '...in a world in which the central bank sets the interest rate, the causality goes from $i \rightarrow L \rightarrow M \rightarrow H$ (where '*L*' is the demand for money) whereas in the traditional *LM* model the causality is reversed from: $H \rightarrow M \rightarrow i$, where *H* is high powered money'.[10]

In figures 1 and 2, we have a scheme which incorporates many of the features of a mainstream macromodel wherein the Phillips curve is vertical in the long-run but monetary policy can cause deviations from the equilibrium level of output because the realities of price-setting ensure a continuous lagged adjustment to the current rate of inflation. Furthermore, it incorporates much of the emerging consensus about modern monetary regimes and the way in which monetary policy is conducted. For example, the central bank sets interest rates and the money supply is endogenously determined. The rate of interest for this purpose is whatever rate is relevant to the central bank's refinancing of bank reserves (a very short-term repo rate in most regimes) and while it is only the nominal rate that the central bank can control directly this rate is set and revised at short intervals in order to produce the real rate required to adjust or maintain the rate of inflation.

3. Introducing the monetary sector

We commented earlier that dissatisfaction with the incorporation of money into simple macromodels has a long history. This dissatisfaction was founded in most cases in the

[9] There are echoes here of the point made by Chick (1983, ch.9) where she argues that the reversal of causality in the savings-investment nexus proposed by Keynes should not be seen as the triumph of correct theory over error but as a change in theory which was required by state of evolution of the banking system.

[10] In other words, the model assumes a permanent equilibrium between the demand for and supply of money. This has its antecedent in the 'flow of funds' approach to the analysis of money supply determination which was popular in the UK in the 1970s and 1980s. The flow of funds identity explained the change in *money supply* in terms of the sum of additional *bank lending*. This was based upon the banks' balance sheet identity in which loans must equal deposits but it side-stepped the issue that the deposits newly-created by loans had to be willingly held. As Cuthbertson (1985, p.173) commented at the time 'There is an implicit demand for money in the model but only *in equilibrium.*' (Emphasis in original). The same issue was briefly controversial in the post-Keynesian literature where it was a cornerstone of monetary analysis that 'loans create deposits'. The debate between Goodhart (1989, 1991), Moore (1991a, 1991b, 1995, 1997) and Howells (1995, 1997) explored the question of why the preferences of deficit units for loans should coincide with the portfolio preferences of money holders. Consequently, post-Keynesian economists would recognise (and endorse) the $i \rightarrow L \rightarrow M \rightarrow H$ sequence in CS immediately, except that they would view '*L'* as the demand for *loans* rather than the demand for money.

unrealistic nature of bank behaviour which they assumed. Consequently, many of the attempts, pre-Romer, to devise a more realistic approach started by looking at the banking sector. Most of these we know were unsuccessful because they still tried to analyse the monetary consequences of bank decisions within the conventional framework of interest-money space.

We begin with a summary of the system we are trying to model. In a paraphrase of Goodhart (2002):

- The central bank determines the short-term interest rate in the light of whatever reaction function it is following;
- The official rate determines interbank rates on which banks mark-up the cost of loans;
- At such rates, the private sector determines the volume of borrowing from the banking system;
- Banks then adjust their relative interest rates and balance sheets to meet the credit demands;
- Step 4 determines the money stock and its components as well as the desired level of reserves;
- In order to sustain the level of interest rates, the central bank engages in repo deals to satisfy banks' requirement for reserves.

Figure 3

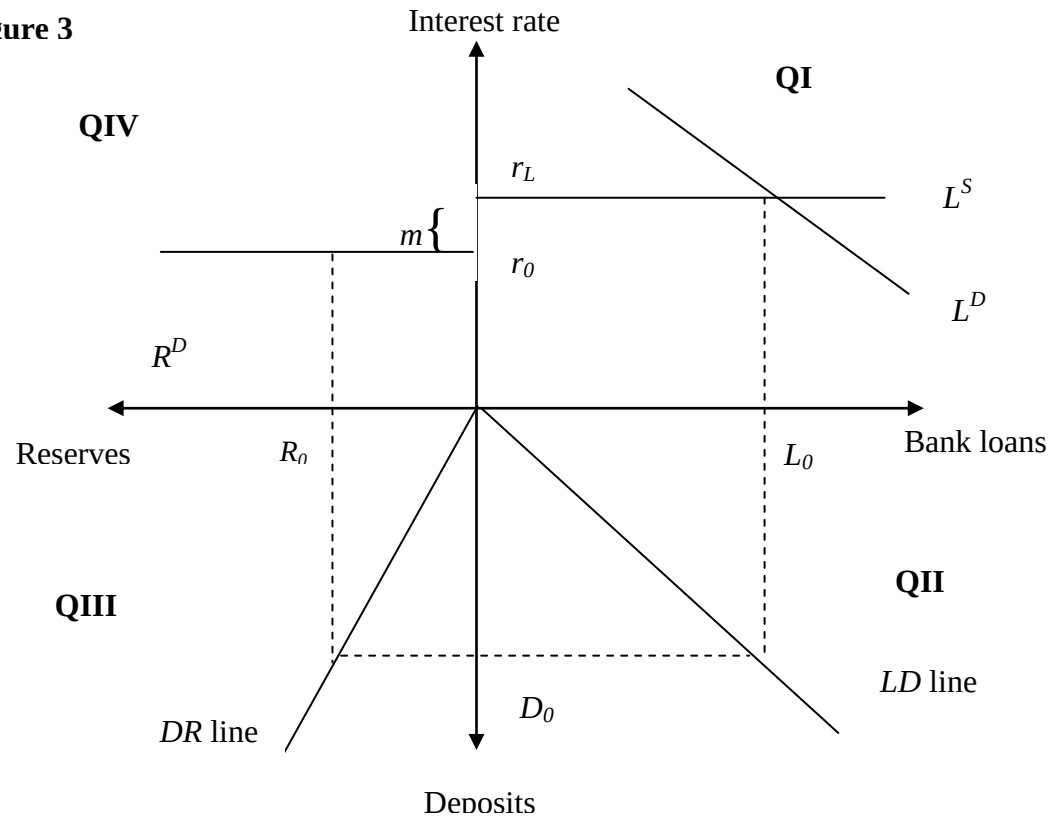


Figure 3, based on Fontana (2003, 2006), embraces these requirements in four quadrants.

In QI the central bank sets an official rate of interest, r_0.

$$r_0 = \overline{r_0} \qquad [1]$$

This official rate determines the level of interbank rates on which banks determine their loan rates by a series of risk-related mark ups. We make two simplifications. The first is that interbank rates are conventionally related to the official rate so that the mark-ups are effectively mark-ups on the official rate. The second is that we can represent the range of mark-ups by a single, weighted average, rate. This is shown as *m.*

$$r_L = r_0 + m \qquad [2]$$

In QII banks supply whatever volume of new loans is demanded by creditworthy clients at the loan rate r_L. Notice that the loan supply curve, L^S, denotes flows, consistent with what we have said about the flow of funds being positive at the going rate of interest. This is further confirmed by the downward-sloping loan demand curve, L^D, showing that the effect of a change in the official rate is to alter the *rate of growth* of money and credit. At r_0, loans are expanding at the demand-determined rate L_0.

$$L^S = L^D \qquad [3]$$

$$L_D = f(\underset{+}{\Delta \ln P}, \underset{+}{\Delta \ln Y}, \underset{-}{r_L}) \qquad [4]$$

QIII represents the banks' balance sheet constraint (so the *L=D* line passes through the origin at 45^o). In practice, of course, 'deposits' has to be understood to include the bank's net worth while 'loans' includes holdings of money market investments, securities etc. At r_0 the growth of loans is creating deposits at the rate D_0.

$$L^S = L^D = L_0 = D_0 \qquad [5]$$

The DR line in QIV shows the demand for reserves. The angle to the deposits axis is determined by the reserve ratio. In most developed banking systems this angle will be very narrow, but we have exaggerated it for the purpose of clarity.

$$DR = \frac{R}{D} \; D \qquad [6]$$

In a system, like the UK, where reserve ratios are prudential rather than mandatory, the *DR* line will rotate with changes in banks' desire for liquidity. Even in a mandatory system, the curve may rotate provided that we understand it to represent total (ie required + excess) reserves. Thus one of the model's strengths is that can show changes in banks' liquidity

preferences either induced by changes in central bank operating procedures (as in the UK in April 2006),[11] or as an autonomous response to changed market conditions (see section 5).

Finally, in QI again we see the central bank's willingness to allow the expansion of reserves at whatever rate (here R0) is required by the banking system, given developments in QII-QIV.

$$R_0 = \frac{R}{D}(D_0) \qquad [7]$$

$$R_S = R_D \qquad [8]$$

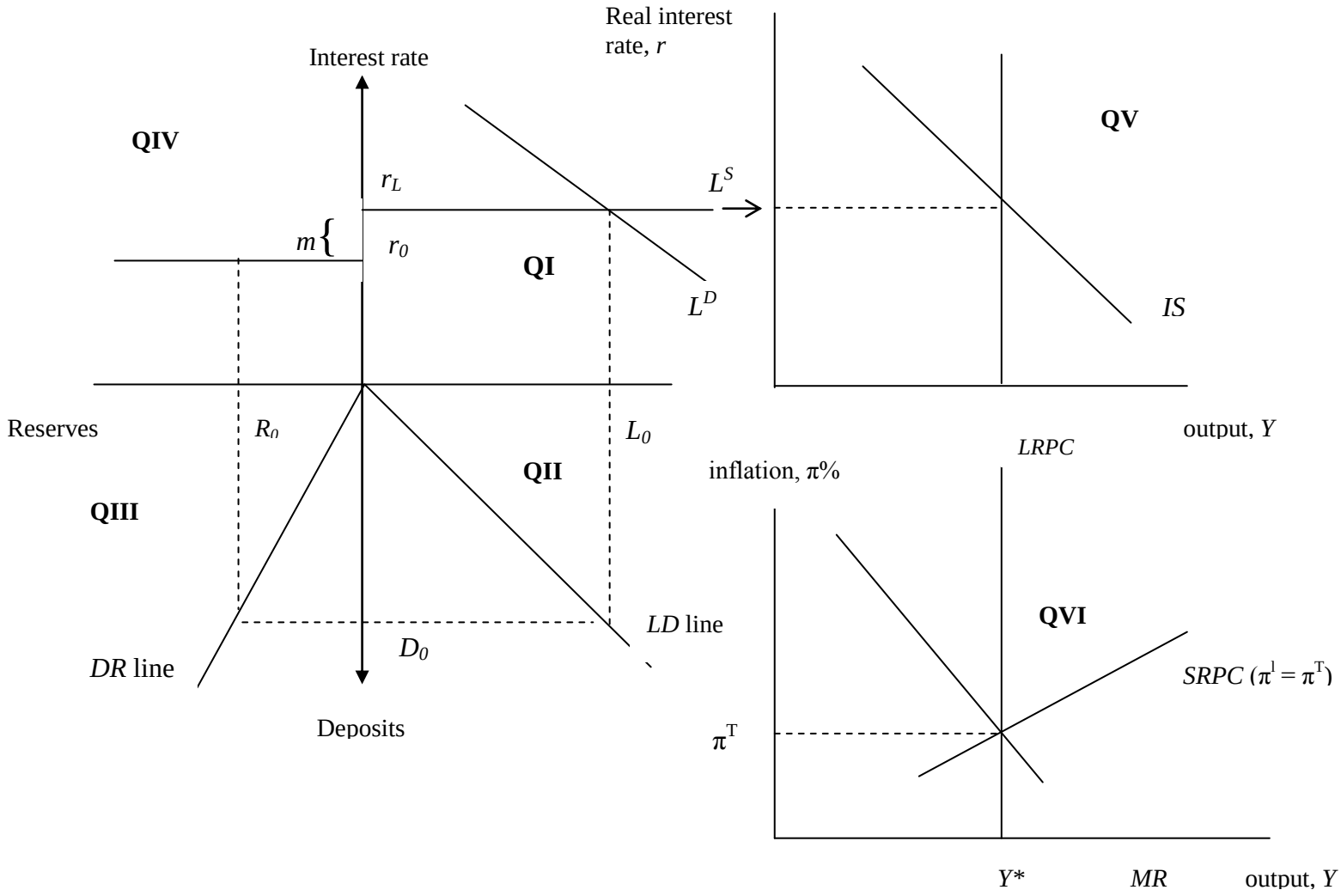
How do we combine this with the analysis of Carlin and Soskice (or BMW) in figure 2? The key lies in QI. Recall that the rate of interest in QI is the official rate, r_0, (usually a repo rate) plus a mark-up, *m*, set by commercial banks. We have already agreed that r_0 can reasonably interpreted as a real rate of interest. This is what is required by the *IS* curve.[12] All that we have done in QI is add a mark-up in order to convert r_0 into a loan rate, r_L. Since the *IS* curve represents an equilibrium between investment and saving, there should be no objection to showing changes in equilibrium output to be dependent upon changes in the loan rate. This is directly relevant to investment spending and while one may object that the rate paid to savers is different, this objection could be made to any single rate of interest on the vertical axis. We are bound at accept that *any* single rate is a proxy for a spread term.[13] In figure 4, therefore, we show (in QI-QIV) a banking system in flow equilibrium (loans and deposits are expanding at a rate which satisfies all agents at the current level of interest rates and banks can find the appropriate supply of reserves to support this expansion. This sounds like a reasonable description of how the banking/monetary sector behaves in normal circumstances. At the same time, the rate of interest set by the central bank is consistent with its inflation target. Output is at its 'natural rate', *Y**, (the output gap is zero).

[11] See Bank of England, *The Framework for the Bank of England's Operations in the Sterling Money Markets* (the 'Red Book') February, 2007.

[12] As we noted above, it was a widespread criticism of the *IS/LM* model that while the behaviour summarised in the *IS* curve required a real rate, the relationships in the *LM* curve depended upon a nominal rate.

[13] Although the *LM* curve was traditionally drawn for a single rate of interest (usually the bond rate), this was strictly correct only if money's own rate was zero. Strictly, the rate should have been a spread term incorporating the rate on money and the rate on non-money substitutes.

Figure 4



Joining up six quadrants to show a static equilibrium is all very well, however. The more interesting question is whether, if we introduce a shock at some point, the model traces out a plausible set of adjustments in the banking system (QI-QIV) *and* in the real economy (QV-QVI). In the next section we look firstly at how a shock in the real economy reacts upon the banking sector and then (in reverse) at how a disturbance in the banking sector affects the real economy.

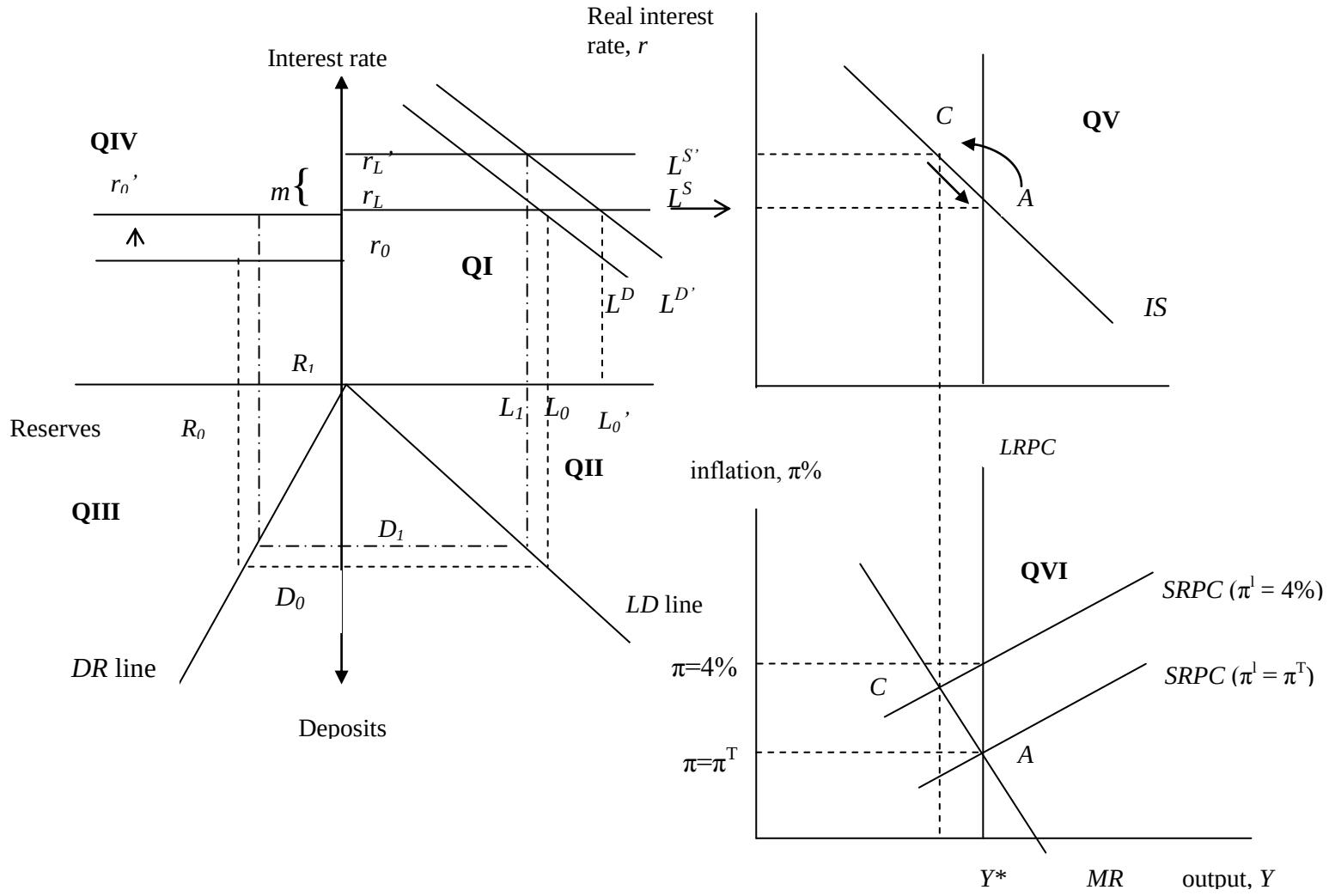
4. Introducing some disturbances

For our first illustration we begin with a disturbance in the real sector since this allows us to use the case already featured in figure 2: there is an inflationary shock which doubles the rate of inflation from the target of 2 per cent to 4 per cent. This requires the central bank to raise the

rate of interest, reducing the level of demand and output, until the rate of inflation begins to fall, when the central bank can begin to reduce the rate of interest until inflation and output return to their target levels.

The implications for the banking sector can be seen in figure 5.

Figure 5



We being with the official rate at r_0, giving a loan rate of r_L. New lending, dependent on nominal output, is forthcoming at L_0, giving a monetary expansion of D_0 (QII) which is accommodated by the central bank (QIV). The inflationary shock, causing an increase in *nominal* income pushes the loan demand curve out to $L^{D'}$. Without policy intervention, loans and deposits would grow more rapidly (at L_0' and D_0' – not shown) and would support the higher inflation rate. However, an inflation targeting central bank will raise the policy rate (to r_0' in figure 5. With a constant mark up, market rates increase by the same amount (from r_L to r_L'). The demand for new loans is reduced (to L_1), the rate of monetary expansion is reduced

and banks requirement for new reserves also fall. (At r_L' the connections are shown by the dash/dot lines).

In the real economy (QV) the rise in interest rate reduces the level of output (from *A* to *C*). As inflation begins to fall (QVI) two things happen. The central bank begins to lower the official rate (to return eventually to r_0) and market rates begin a return towards r_L - the loan curve shifts downward. Also, the loan demand curve shifts to the left, reflecting the reduction in nominal income. Eventually, the intersection of L^S and L^D converges on its original position and monetary conditions return to those consistent with Y^* and π^T. This seems a reasonable representation of how we think the monetary system performs under an inflationary shock followed by a deflationary policy. Initially, loans and deposits expand more rapidly as a result of the inflationary pressure. When the central bank raises the policy rate, there is a tightening of monetary conditions involving the rate of expansion of loans and deposits and the level of interest rates.

We turn our attention now to a shock of a different kind. This originates in the banking system itself and we take the recent case of a so-called 'credit-crunch' induced by anxieties over sub-prime lending. If we are to judge the model's ability to represent these developments successfully we need to be clear on the main features of this episode. The following paragraph describes the key events as they developed from mid-August through October 2007.

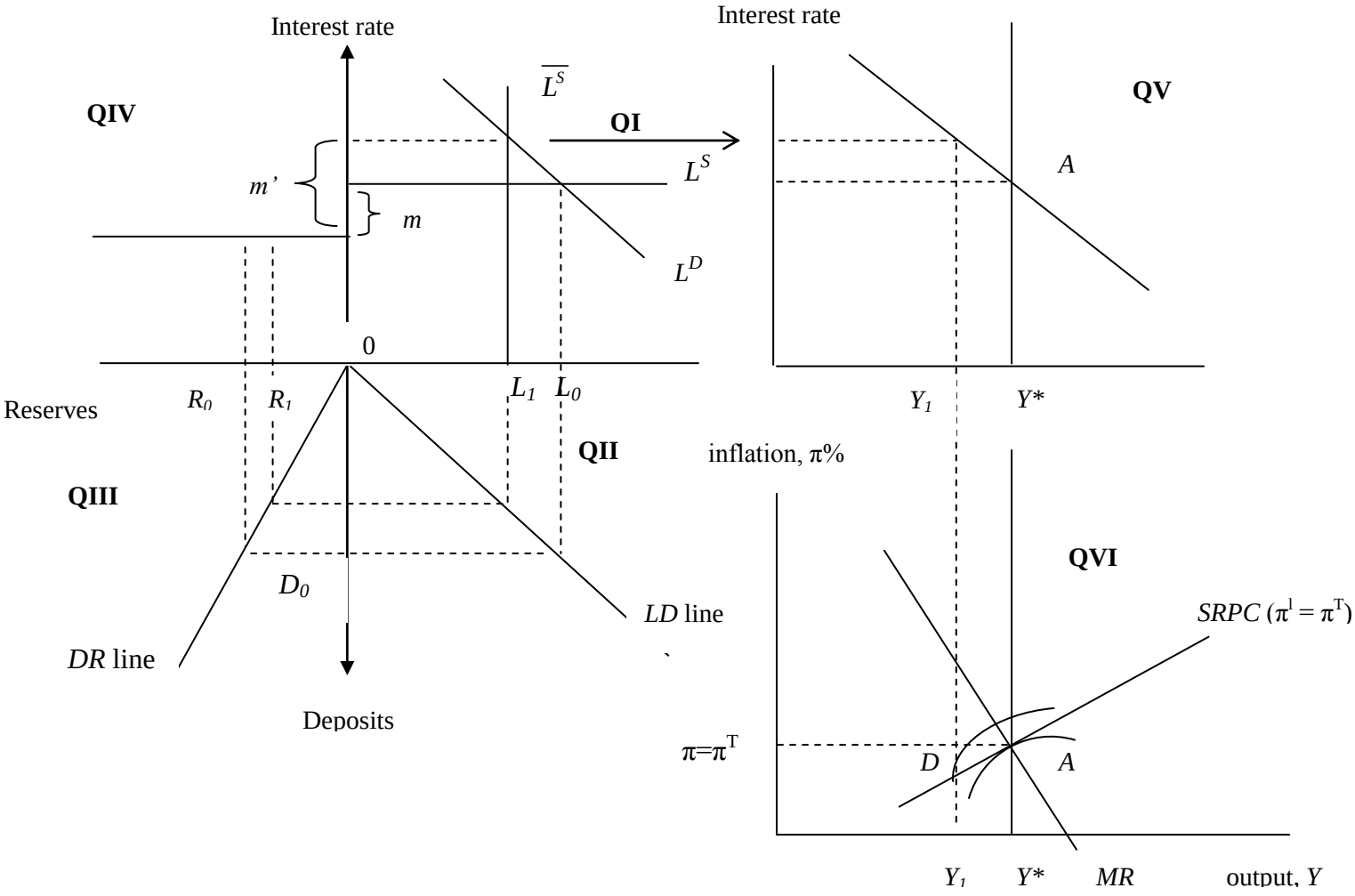
Banks have built up a substantial portfolio of lending to so-called 'sub-prime' borrowers. In some cases these loans had been securitised and sold on to various types of 'special vehicles' and hedge funds, in some cases lending to these SPVs and hedge funds themselves. A downturn in the US housing market calls the value of some of this lending into question. However, compared with housing market recessions in the past, there are two novel problems. The first is that the securitisation obscures the ownership of the loans and thus the *distribution* of the associated risk; the second is that the *extent* of the risk is unknown because many of the collateralised debt obligations (CDOs) are never traded.

The results, which we shall try to represent in the model, are:

- the market for CDOs collapses
- banks cannot securitise further loans
- banks become nervous about their own liquidity position
- they are unwilling to lend to each other since they don't know the risk exposure of the counterparty

- the market rate (ie LIBOR, FIBOR, Fed Funds) premium over the official rate jumps by as much as 100 basis points
- central banks become concerned about likely effects on the real economy
- some central banks (eg the Fed) reduce the official rate; others (the ECB and, eventually, the Bank of England) widen the range of securities that they are prepared to accept from banks in exchange for liquidity.

Figure 6 shows this dramatic change in monetary conditions as well as the possible effects on the real economy that caused such anxiety.



Our starting point is in QI where, in contrast to their willingness to lend on demand at the official rate plus the conventional mark-up, banks are now restricting their lending to $\overline{L^S}$. This is because, hitherto, they have been accustomed to securitising a fraction of their new lending. For simplicity in the diagram, we shall suppose that the securitised fraction is shown by the distance $L_1 - L_0$. Now that the market for securitised loans has collapsed, all lending

must be taken on to the asset side of the balance sheet in the form of conventional loans and we are assuming that the desired fraction of total lending that banks wanted to hold as conventional loans is shown by 0-L_1. In practice, the rate of interest charged by banks is a mark-up on LIBOR. Conventionally, that mark up is such that we can show the mark-up over the official rate as *m.* However, in the new circumstances, the conventional relationship between LIBOR and the official rate is broken (the spread has widened) so that when we express the mark-up in relation to the official rate it is now *m'*. The cost of loans has risen.

With credit and money now growing more slowly, banks' need for additional reserves is reduced and in the diagram we show this at R_1. However, it would be a simple task to show banks reacting to the crisis by wishing to increase their liquidity. In such a case, we would rotate the *DR* line clockwise. If we rotated by the critical amount we could show banks wanting to acquire additional reserves at the original rate (R_0) – thereby increasing their reserve ratios.

As regards the real economy, we can show the effect that commentators (and central banks) were fearing. This is that the restricted flow and increased cost of credit is deflationary. It threatens to push us up the *IS* curve and down the *SRPC* curve (to *D*) increasing the output gap to Y^*-Y_1. Notice that the policy maker is now on an inferior indifference curve and will seek to move the economy to the preferred curve and the position *A.* In order to do this, they seek to move the loan market back to its original position where the flow of new credit is restored to L_0 and the cost comes down to the level intended by policy. Different central banks adopted different expedients. The Bank of England (eventually) and the ECB (more readily) focused on broadening the range of securities that they would accept as collateral for lending. The range was never extended to include those backed by sub-prime mortgages but the willingness to accept a wider range of top quality securities could be seen as a way of trying to revive the market for CDOs and, in the diagram (QI), trying to reduce the gap $L_1 - L_0$. The Federal Reserve's response, by contrast, was to lower the official interest rate by 50bp. In the diagram (QIV) this is shown by a lowering of the official rate. Even with the larger spread between LIBOR and official rates (i.e. *m'* given), loan rates should fall.

5. Conclusion

For many years, simple models of the macroeconomy and of the role of monetary policy within it have been based on the fundamentally incorrect principle that the money supply is exogenously determined and that the policy instrument available to the central bank is the monetary base. From this stemmed the adoption of the *IS/LM* model wherein policy was shown

by shifts of the *LM* curve and explained by reference to real balance effects. Policy-makers themselves, and their advisers, have known for years that this is quite misleading.

Fortunately, the last few years have seen the emergence of a widespread consensus about monetary policy works and the desire to represent this accurately within a reasonably simple model has led to the replacement of the *LM* curve and its replacement by various devices all of which recognise that the rate of interest is a policy instrument set by the central bank.

Starting from this position, we have shown in this paper how the setting of that rate of interest affects not just the macroeconomy (the subject of the IS/PC/MR model) but also the banking or monetary sector. Using a simple 4-quadrant diagram we have shown how monetary policy works in normal circumstances and where the central bank needs to respond to inflationary shocks. We have also shown that it can capture the current situation where bank lending is inhibited by fears of default in the sub-prime market and where policy-makers fear for the effects of this credit squeeze on the real economy.

References

Arestis P and Howells P G A (1996)`Theoretical Reflections on Endogenous Money: The Problem with "Convenience Lending"', Cambridge Journal of Economics, 20(5), 539-551

Arestis P and Howells P G A (2002), 'The 1520-1640 "Great Inflation": an early case of controversy in money', Journal of Post Keynesian Economics, 24 (2)

Arestis P and M C Sawyer (2005), ' Can Monetary Policy Affect the Real Economy?', Levy Economics Institute Working Paper, no, 355.

Bofinger P, Mayer E and Wollmerhäuser T (2006) 'The BMW Model: a new framework for teaching monetary economics', *Journal of Economic Education*, 37 (1), 98-117

Carlin W and Soskice D (2005) 'The 3-Equation New Keynesian Model – a graphical exposition, *Contributions to Macroeconomics* 5 (1), 1-27

Carlin W and Soskice D (2006) *Macroeconomics: Imperfections, Institutions and Policies* (Oxford: Oxford U.P.)

Clarida R, Calli J and Gertler M (1999) 'The science of monetary policy: a new Keynesian perspective', *Journal of Economic Literature*, 37, 1661-1707

Cuthbertson K (1985) *The Supply and Demand for Money* (Oxford: Blackwell)

Davidson P and Weintraub S (1973) 'Money as Cause and Effect', *Economic Journal*, 83, (332) 1117-32.

Dow S C (1993) 'Methodology and the analysis of a monetary economy', in S C Dow *Money and the Economic Process* (Aldershot: Edward Elgar)

Dow S C (1996) `Horizontalism: a critique', *Cambridge Journal of Economics*, 20, 497-508

Dow S C and Earl P E (1982) *Money Matters: A Keynesian approach to monetary economics* (Oxford: Martin Robertson)

Fontana G (2003) 'Post Keynesian Approaches to Endogenous Money: a time framework explanation', *Review of Political Economy*, 15 (3), 291-314

Fontana G (2006) 'Telling better stories in macroeconomic textbooks: monetary policy, endogenous money and aggregate demand', in M Setterfield (ed) *Complexity, Endogenous Money and Macroeconomic Theory: Essays in honour of Basil J Moore* (Cheltenham: Edward Elgar)

Fontana G and A Palacio-Vera (2005) 'Are Long-run Price Stability and Short-run Output Stabilization All that Monetary Policy Can Aim For?' Levy Economics Institute Working Paper, no, 430.

Goodhart C A E (1989) `Has Moore become too horizontal?' *Journal of Post Keynesian Economics*, vol. 12(1) pp. 29-34

Goodhart C A E (1991) `Is the concept of an equilibrium demand for money meaningful?' *Journal of Post Keynesian Economics*, vol. 14(1), pp. 134-36

Hicks J R (1980) "IS-LM: An explanation", *Journal of Post Keynesian Economics*, Vol. 3 (2), p.139-54.

Howells P G A (1995), `The Demand for Endogenous Money', *Journal of Post Keynesian Economics* 18(1), Fall 1995, 89-106

Howells P G A (1997) 'The Demand for Endogenous Money: A rejoinder', *Journal of Post Keynesian Economics* vol. 19 (3) pp.429-35.

Kaldor N (1982) *The Scourge of Monetarism* (Oxford: Oxford U P)

Kaldor N (1983) `Keynesian Economics after Fifty Years' in D Worswick and J Trevithick (eds) *Keynes and the Modern World*, Cambridge: Cambridge U P

Lavoie M (1985) 'The Post Keynesian theory of endogenous money: a reply', *Journal of Economic Issues*, 19 (3) 843-8

Lavoie M (1994) `Horizontalism, Liquidity Preference and the Principle of Increasing Risk' University of Ottawa, mimeo.

Lavoie M (2006) 'A Post-Keynesian Amendment to the New Consensus on Monetary Policy', *Metroeconomica*, 57 (2), 165-92.

Moggridge D (1976) *Keynes* (London: Fontana), appendix.

Moore, B J, *Horizontalists and Verticalists*, (Cambridge: Cambridge U P, 1988)

Moore B J (1991a) `Money supply endogeneity', *Journal of Post Keynesian Economics* vol. 13(3), pp. 404-13

Moore B J (1991b) `Has the demand for money been mislaid?', *Journal of Post Keynesian Economics*, vol. 14(1), pp. 125-133

Moore B J (1997) 'Reconciliation of the supply and demand for endogenous money', *Journal of Post Keynesian Economics* vol. 19 (3) pp.423-28

Palley T I (1991) 'The Endogenous Money Supply: Consensus and Disagreement', *Journal of Post Keynesian Economics*, 13, 397-403.

Romer D (2000) ‘Keynesian Macroeconomics without the LM curve’, *Journal of Economic Perspectives*, 2 (14), 149-69

Rousseas S (1986) *Post Keynesian Monetary Economics* (New York: M E Sharpe).

Woodford M (2003) *Interest and Prices: Foundations of a Theory of Monetary Policy* (Princeton: Princeton U P)

Wray L R (1990) *Money and Credit in Capitalist Economies: the endogenous money approach* (Aldershot: Edward Elgar).