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『Routes of Money Endogeneity: A Heuristic Comparison』

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Routes of Money Endogeneity:
A Heuristic Comparison

Abstact

The paper sets up an analytical framework which is based on simplified balance sheets of the banking, the non-banking private and the government sectors, in order to identify four primary routes through which money can be generated endogenously and to discuss their characteristics. These routes approximate, if not precisely correspond to, the Post Keynesian accommodationist and structuralist views, the New Keynesian credit view ("bank lending channel"), and a hybrid one. (JEL E12, E51)

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1. Introduction

It is well known that there are broadly two approaches to the endogeneity of money within the Post Keynesian group: Accommodationist and Structuralist (to be abbreviated respectively as PK-A and PK-S; see e.g. Pollin, 1991). It is equally well known that the New Keynesian "credit view" also provides a view of money in which the stock of money is endogenous, that is, determined in response to the state of private sector economic activity (see, e.g., Blinder and Stiglitz, 1983; Bernanke and Blinder, 1988; Bernanke and Gertler, 1995).[1]

This paper proposes to provide a heuristic typology of the routes through which the stock of money is determined endogenously. *Four* routes will be identified. Two of them approximate the views of the two Post Keynesian approaches and one the view of the New Keynesian approach. The remaining one is a hybrid; the reason to consider it is to indicate a limit of the route associated with the New Keynesian view. This said, however, we wish to emphasize that we do not reckon the routes identified in the following pages as precise representations of the views of any particular approaches or individuals; they are intended merely as approximations in the first degree, and the role of these first approximations is to identify some primary routes through which money can be generated endogenously. The reality may be entertained by the simultaneous operation of more than one among the four identified routes and also other possible routes. And, indeed, there is no *a priori* reason why a particular theoretical approach

[1] The credit view is contrasted to the "money view" of the more traditional exogenous-money approach. Both views are related the transmission mechanism of the supply of reserves. The credit view identifies two transmission mechanisms: the "bank lending channel" and the "balance sheet channel" (see, e.g. Blinder and Stiglitz, 1983). The view considered in the present paper is closer to the bank lending channel contained, for example, in Bernanke and Blinder (1988). For an excellent review of the credit view in the context of money endogeneity, see Rochon (1999); for various Post Keynesian attitudes toward New Keynesian economics in general, see Rotheim (1998).

should not take some eclectic position. This is why we emphasize the *heuristic* aspect of our presentation.

2. A methodological remark

The heuristic aspect of our presentation is also based on the methodology it takes. We wish foremost to identify a *causality* leading to, and the *essentiality* of that causality for, the endogeneity of money.

To do so, we *in the first approximation* take the supposedly causal elements as completely exogenous (that is, given at an arbitrary, *positive level*) (the Group *A* variables). On the basis of this first approximation, we attempt to solve an equation system which represents the relevant relationships among the relevant variables. If the equation system solves without any internal contradiction, this is taken as confirming the *causal priority* of those elements which have been supposed to be completely exogenous.

If a variable taken as exogenous in the first approximation is set at zero, but if the model still solves for other variables with consistency and economic meaningfulness, then the variable in question is deemed *non-essential*. By contrast, if the setting of a variable at zero makes the model collapse or produce a trivial (such as all-zero) or economically meaningless (such as negative-value) solution, then the variable concerned is deemed *essential*. A variable that is both essential and causal is said to have an *underlying causal priority*.

If a variable *must*, for the solvability of the system, be expressed as a function of a given form with some endogenous variables as arguments of the function, then this variable is *semi-causal*. The values of these variables are determined endogenously but a change in their functional forms will have a causal effect. The semi-causal variables are *essential* in the sense that they cannot be arbitrarily set at zero.

Variables that are determined completely endogenously are *non-causal*. Non-causal variables can be classified into two groups. The first group consists of those which cannot be omitted from the model without damaging the significance of the model; these endogenous variables are *essential* (they cannot be set arbitrarily at zero). Those which can be omitted—this is equivalent to setting their values at zero—are *non-*

essential; a non-essential and non-causal variable can be termed an *inessential* variable. There is another kind of inessential variables: those *causal* variables which affect, *directly and indirectly*, only inessential endogenous variables.[2]

Following the above classification, a variable can be (*i*) essential and causal (having an underlying causal priority), (*ii*) essential and semi-causal, (*iii*) essential but non-causal, (*iv*) causal but non-essential, and (*v*) inessential (non-essential and non-causal). Table 1 summarizes the classification of variables. Different routes to money endogeneity are characterized by different sets of *essential* (*causal/semi-causal/non-causal)* variables.

<Table 1 here>

After the first approximation, one can modify some or all of the Group *A* variables as functions of some of endogenous variables as well as of some other variables in Group *A* (call the Group *A* variables modified to functional forms the Group *A*' variables). It is at this stage that relevant behavioral aspects are taken into consideration, reflecting the relationships existing in the reality and figured out in economy theory; these relationships are represented by the forms and arguments of the functions. It is also at this stage that the model represents particular *economic* views; in contrast, in the stage of first approximation, the model has mainly *formal* significance.[3]

The Group A' variables and semi-causal variables have some similarity. Both are expressed in functional forms, and since the forms of functions are exogenously imposed upon the model, they constitute *independent* equations of a proposed system. Also, the values of both are determined endogenously. Thus these two kinds of variables have some degree of exogeneity as well as some degree of endogeneity. But it is important, from the formal point of view, to have in mind that the Group A' variables could have been set at an arbitrary level (as belonging to Group A) whereas semi-causal variables cannot.

The typology in the following pages shall stop at the first approximation. By doing so we may be neglecting some important aspects of the reality. However, it will help

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[2] For an example of such an inessential (exogenous) variable, see footnote 11 below.

[3] This implies that comparative statics, if to have economic meaning, should be carried out only after a full specification of the Group *A*' variables.

identify the underlying causality. It goes without saying that more realistic research should go beyond this stage: once the underlying causality is identified, a researcher should investigate and introduce functional relationships to analyze the more realistic relationships among the various variables. Our typology is concerned more with the *formal* than with the economic properties of the various routes of money endogeneity.

3. The framework

We consider the economy consisting of three sectors: the Bank Sector (the B sector), the Non-Bank Private Sector (the NB sector) and the Government Sector (the G sector). The NB sector includes both households and firms; the G sector integrates the Treasury and the central bank.

The balance sheets of the three sectors, in their simplified forms, can be represented by the following accounting identities (where the superscripts *S* and *D* stand respectively for supply and demand):

(1) the B sector: $(1+i)L^S + (1+j)B^D + R^D = D^S + (1+t)F^S$;

(2) the NB sector: $D^D + (1+t)F^D = (1+i)L^D + Z$;

(3) the G sector: $Z = (1+j)B^S + R^S$.

The B-sector assets consist of the supply of loans to the NB sector (L^S) plus interest thereupon at the rate of *i*, the holding of government bonds (B^D) plus interest thereupon at the rate of *j*, and the demand for reserves (R^D); the liabilities consist of the supply of deposits (D^S) (we assume that banks do not pay interest on deposits) and the supply of bank-issued financial assets (F^S, typified by the certificates of deposits, CDs) plus interest thereupon at the rate of *t*. Deposits and CDs are demanded by the NB sector only, the stocks of which (D^D and F^D) plus interest on the holding of CDs constitute the assets of the NB sector; the liabilities of the NB sector consist of the demand for loans (granted by the B sector) (L^D) plus interest thereupon and the net wealth (*Z*). The net wealth of the NB sector is the national debt incurred by the G sector. The G sector spends on outlays every period and the source of financing the outlays is taxes. If outlays exceed taxes, this budget deficit is financed by an additional issue of

either bonds or reserves or both. The liabilities of the G sector are the stock of bonds (B^S) plus interest thereupon and the stock of reserves (R^S); thus, the asset of the G sector is the accumulated budget deficits (primary deficits plus interest), and this constitutes the net wealth of the NB sector. If in accumulatively net terms the G sector is in deficit (resp., surplus, balanced) budget, the NB net wealth is correspondingly positive (resp. negative, zero).

The demand for reserves is

(4) $$R^D = (r_1 D^S + r_2 F^S) + E \,.$$

The required reserve ratios for deposits and CDs are respectively r_1 and r_2 ($1 > r_1 > r_2 \geq 0$); in addition to the reserves required for the supply of deposits and CDs, banks can hold excess reserves (*E*). Excess reserves are like a type of financial assets for which the required reserve ratio is unity. From (1) and (4), one has

$$(1+i)L^S + (1+j)B^D + E = \left[(1-r_1)D^S + (1-r_2)F^S\right] + tF^S \,;$$

the term in the brackets on the right hand side stands for the non-reserved parts of deposits and CDs. Following Bernanke and Blinder (1988), we shall relate the demand for excess reserves to the sum of non-reserved parts of deposits and CDs at a proportion *e* to the non-reserved parts of deposits and CDs:

(5) $$E = e[(1-r_1)D^S + (1-r_2)F^S] \,.$$

The supply of reserves by the central bank comes along different routes, as we shall discuss later.

The decision on the supply of loans is envisaged similarly:

(6) $$L^S = a[(1-r_1)D^S + (1-r_2)F^S] \,.$$

Proportions *e* and *a* represent the *asset management* decisions of banks. We shall treat the market for government bonds as a residual market: when the markets for loans, reserves, deposits and CDs are simultaneously in equilibrium, the set of the accounting identities (1) to (3) entails equilibrium in the market for bonds. The demand for loans is construed differently in different approaches.

(Narrow) money consists solely of bank deposits; we abstract from cash and coins.

Then the supply of and the demand for deposits (narrow money) are respectively represented by the following equations:

(7) $D^S = mR^S$

(8) $D^D = D(\overset{-}{i}, \overset{-}{j}, \overset{-}{t}, \overset{+}{\bar{y}})$

The sign over a variable represents the sign of the first derivative of the function with respect to that variable. Banks supply deposits (D^S) in relation to the supply of reserves (R^S). The causality between D^S and R^S is different for different approaches, and indeed this is one of the dividing lines of the four routes to money endogeneity we consider. The NB sector demands deposits (D^D) from the familiar motives for demanding money (transactions, precautionary and speculative); the demand for deposits is adversely affected by the rates of interest on bonds, bonds and CDs but positively by the real income; we do not consider the determination of the real income, so that we take it as exogenously given at the level of $\bar{y}$.[4]

The demand for CDs comes from the NB sector, and one can reasonably express it as

(9) $F^D = hD^D \;\; ; \quad h = h(\overset{+}{t})$

The liability portfolio of the NB sector consists of deposits and CDs, and the demand for CDs is expressed as a proportion (*h*) of the demand for deposits. This proportion is an increasing function of the rate of interest on CDs (*t*). The supply of CDs is made by banks; one can express the decision of banks in this regard by the following:

(10) $F^S = fD^S$

The proportion *f* can be a decision (exogenous) variable for the B sector or an endogenous variable to be determined to balance the portfolio of the sector. As it reflects the portfolio of the liabilities of the B sector, it stands for *liability management*

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[4] One can determine the real income endogenously by introducing the IS relation (which represents the equilibrium condition for the goods market) such as $y = y(\overset{-}{i}, \overset{-}{j}, \overset{-}{t})$; see Bernanke and Blinder (1988).

of the B sector.

Up to now, we have listed the relationships common to all the systems of equations we are going to consider. Four systems—named Systems I, II, III and IV—will be differentiated in reference to four aspects.[5] The first aspect of the difference is related to the supply of reserves. In Systems I, III and IV, it is exogenously set by the central bank:

(11) $R^S = \bar{R}$

By contrast, System II regards the supply of reserves to be fully accommodative to the demand for it.

The second is regarding the proportion *e*, which represents the decision of the B sector on excess reserves. Systems II and III take it as fully exogenous:

(12a) $e = \bar{e}$

whilst System IV takes it to be fully endogenous. System I is unique in that there *e must* be presented in a functional form. The usual form is a decreasing function of the loan rate of interest: a higher rate of interest on loans means a larger profit accruing from the lending and banks will wish to switch their holding of assets from excess reserves to loans:

(12b) $e = e(\overset{-}{i})$

The third is associated with the demand for loans. In Systems II, III and IV, the demand for loans can be set as

(13a) $L^D = \bar{L}$

whilst in System I, it *must* be expressed in a functional form such as

(13b) $L^D = L(\overset{-}{i}, \overset{+}{y})$

We have three kinds of the rates of interest—on loans (*i*), bonds (*j*) and CDs (*t*).

[5] We refrain from associating the respective systems to particular existing economic approaches. However, the reader may be allowed to think that System I corresponds to a New Keynesian approach (in particular, that presented in Bernanke and Blinder, 1988), System II to PK-A, and System III to PK-S, whilst System IV is a hybrid of them.

The rates of interest on bonds and on CDs are endogenously determined in all the four systems. But they differ regarding the loan rate of interest—the fourth aspect of the difference. In System I, the rate of interest on loans is completely endogenous. By contrast, it is "exogenous" in all the other systems. A remark is in order about the "exogeneity" of the loan rate of interest. It is well known that there have been intense debates between PK-A and PK-S on the behavior of the loan rate of interest. In both PK-A and PK-S, it is expressed as the sum of the base rate (i_B), exogenously set by the central bank, and a mark-up (α), decided upon by private banks. In PK-A, the mark-up is insensitive to the quantity of loans demanded, whereas in PK-S it is an increasing function of the size of loans in accordance with the Kaleckian "principle of increasing risk": $\alpha = \alpha(L^D), \alpha' > 0$. The "interest rate rule" in the recent mainstream New Consensus position (see, e.g., Romer, 1999; Taylor, 1998) can be taken as following a similar line, despite the apparent difference: the base rate of interest is, rather than exogenously given, a function of the "output gap": $\bar{y} - y^f$ where y^f is the level of potential real income. But it will turn out that, in all these three systems, the loan rate of interest is an "essential-causal" not "semi-causal" variable from the *formal* point of view: it belongs to Group *A*', that is, it is a functional generalization of a Group *A* variable with the purpose of containing a particular economic view. Thus the following different formulations (14a), (14b) and (14c) are variations on the theme of an "exogenous" loan rate of interest. As we are concerned more with the formal than the economic aspects of the systems, we assume that in all of Systems II, III and IV the loan rate of interest is given as in (14a):[6]

(14a) $i = i_B + \bar{\alpha} \equiv \bar{i}$

(14b) $i = i_B + \alpha(\overset{+}{L^D})$

(14c) $i = \beta(\overset{+}{\bar{y} - y^f}) + \alpha(\overset{+}{L^D})$

We have five markets—for loans, bonds, reserves, deposits and CDs. The overall

[6] The reader who feels uneasy with this practice is free to adopt any of the reasonable, "flexible" "interest rate rules" such as (14b) and (14c).

equilibrium requires equilibrium in each market, which in turn requires equality between the quantity supplied and the quantity demanded of the relevant variable. Since the balance sheet identities (1) to (3) implies the overall equilibrium, the state of equilibrium in one of the five markets is guaranteed when equilibrium prevails in the other four markets. We have taken the bond market as the residual one.

(15) the loan market equilibrium: $L^D = L^S$

(16) the reserve market equilibrium: $R^D = R^S$

(17) the CD market equilibrium: $F^D = F^S$

(18) the money market equilibrium: $D^D = D^S$

Table 2 summarizes the formal differences among the four systems regarding the supply of reserves (R^S), the determination of excess reserves (*e*), the demand for loans (L^D) and the loan rate of interest (*i*). In addition to these variables, two more variables—the asset management decision of the B sector regarding the supply of loans (*a*) and the liability management decision (*f*)—will be treated as the key variables whose characteristics we wish to identify in the respective systems. The four different routes to money endogeneity will be characterized on the basis of which classification of variables (discussed in Section II) they will respectively belong to.

<Table 2 here>

4. The typology

The four routes to money endogeneity that we shall identify will be called, respectively, *SAME* (Supply-driven Asset Management Endogneity), *DBME* (Demand-driven Base-Money Endogeneity), *DLME* (Demand-driven Liability Management Endogeneity) and *DAME* (Demand-driven Asset Management Endogeneity). In all the systems, the required reserve ratios for deposits and CDs are set exogenously, of course, by the central bank.

(A) SAME (Supply-driven Asset Management Endogeneity)

We solve the system consisting of equations (11), (12b) and (13b) in addition to the common part. The variables representing the other portfolio decisions of the B sector (*a*

and f) are exogenously given; this exogeneity reflects the discretionary aspect of the decisions. The various rates of interest are all determined fully endogenously. With $r \equiv r_1 + r_2 f$, one get the following results (the equilibrium values are marked with an asterisk):

(A-1) $R^* = \bar{R}$

(A-2) $D^* = \left[\dfrac{1}{r + e^*(1 + f - r)} \right] \bar{R}$

(A-3) $m^* \equiv \dfrac{D^*}{R^*} = \left[\dfrac{1}{r + e^*(1 + f - r)} \right]$

(A-4) $L^* = a(1 + f - r)D^S = a \left[\dfrac{1 + f - r}{r + e^*(1 + f - r)} \right] \bar{R}$

(A-5) $\mu^* \equiv \dfrac{D^* + F^*}{R^*} = (1 + f)m^*$

(A-6) $$\left.\begin{array}{l} e = e(i) \\ h(t) = f \\ L^* = L^D(i, \bar{y}) \\ D^* = D^D(i, j, t, \bar{y}) \end{array}\right\} \Rightarrow \left\{\begin{array}{l} e^* = e(i^*) \\ t^* = h^{-1}(f) \\ i^* = i(L^*, \bar{y}) \\ j^* = i(t^*, \bar{y}, L^*, D^*) \end{array}\right.$$

(A-1) states that the equilibrium level of reserves is the same as the exogenously set supply of reserves. (A-2) and (A-3) are variations on the theme of the traditional "money multiplier" model; the difference is an additional term $e^*(1 + f - r)$—and this makes all the difference, as shall be discussed presently. Note that the asset management decision regarding the supply of loans (a) is not involved at all with the money multiplier; however, naturally, this decision plays a role in determining the equilibrium level of loans, as is shown in (A-4). The ratio μ between $D + F$ and R—the "broad money multiplier"—behaves similarly to its counterpart for narrow money, as (A-5) shows.

Let us find out the characteristics of the key variables. In accordance with (12b), the equilibrium value of e is determined *endogenously* as a function of the loan rate of interest, which is also determined endogenously. The (narrow or broad) money

multiplier is endogenously determined, and accordingly the stock of (narrow and broad) money is endogenously determined. The route of money endogeneity in the present system is the asset management decision by the B sector on excess reserves. For this result asset management regarding excess reserves must be semi-causal: *e* must be given in a functional form such as (12b). The crucial importance of *e* is ascertained by two considerations. First, suppose that *e* = 0 (even though this cannot be *a priori* postulated) and see the system reduced the familiar money-multiplier case of exogenous money. Second, consider the case where $r_1 = r_2 = 0$; this case, which means that reserves consist solely of excess reserves, is perfectly compatible with the working of the system.

By contrast, asset management regarding the supply of loans (*a*) does not play a direct role in determining narrow or broad money. It is involved instead in determining loans and thereby the loan rate of interest; this means that it has an indirect effect on the stock of money. Now consider *f*. Set *f* at zero and one will see that this does not affect the normal working of the system; hence, liability management is nonessentially causal along this route of money endogeneity.

(A-2) indicates that the primary element which determines the stock of money is exogenously given reserves. If reserves are set at zero, then the system collapses (becomes trivial with all variables being zero); hence, reserves are an essential and causal variable. By contrast, the loan demand cannot be completely exogenous. If it is postulated to be exogenous, the system cannot determine the loan rate of interest; and if so, the very route of money endogeneity—the endogenous determination of the money ratio, which is based on the endogenous decision on asset management, which in turn relies upon the endogenous determination of the loan rate of interest—will crumble down. In this sense the loan demand is semi-causal. (A-6) shows that simultaneous equilibrium in the CD, the loan and the money markets determines the various rates of interest.[7]

The causality in this system runs in the following direction:

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[7] Bernanke and Blinder combine the loan market and the goods market equilibrium conditions (represented by the IS relationship referred to in footnote 4) to call the resulting relation $y = y(i(L^*, j, y), j) = y(j, y; r, f, e, \bar{R})$ the *CC (Credit–Commodity) Curve*. It interacts with the LM curve, $D^* = D(i, j, t, y)$, to determine the rates of interest and income.

(A-7) $R^S \rightarrow D^S \rightarrow L^S \rightarrow L^D$ (where $\rightarrow$ means "causes")

The supply of reserves constitutes the primary constraint on the supply of loans, and thus on the level of economic activity. The causality is not so different from the usual exogenous-money case; the only difference required for money endogeneity is the semi-causal intervention of asset management regarding excess reserves.[8] This type of money endogeneity is "*supply-driven, asset management endogeneity*" (SAME).

Figure 1 depicts the working of the SAME system.[9]

<Figure 1 here>

The NW panel describes the supply of reserves. The given reserves are represented by the vertical line in the R-i_B space, where i_B denotes the base rate (or the discount rate): the discount rate is set by the central bank at a certain level (one can consider the case where reserves are a function of the discount rate; however, this is not crucial). The SW panel depicts the reserves market, in the D-R space. The demand for reserves, represented by the solid line, comes from the required reserves on deposits and CDs and also from the demand for excess reserves; the slope of the line is r_1 but its position is to be determined endogenously (i.e., F and E are to be determined endogenously). The resulting, equilibrium loci of intersection between the supply of and the demand for reserves are represented by the dotted line: the narrow money multiplier relationship. The SE panel in the D-L space is for the loan market. The supply of loans, described by the solid line, results from asset management by banks: banks supply a portion a of the non-reserved assets as loans. The slope of the line is $a(1-r_1)$, but its position adjusts to the size of deposits which is determined by the narrow money multiplier relationship in the reserve market; the eventual equilibrium relationship between D and L is

[8] Thus, SAME is quite similar to the textbook case where the base money includes cash in addition to deposits and thus the money multiplier contains the cash-deposits ratio (c), which is then conceived as a function of the rate of interest. The subtle difference in the meaning of money endogeneity between this case and Post Keynesian positions is discussed, e.g., in Howells (1995). The limit of SAME as a route of money endogeneity is brought to relief when we consider a hybrid route, System IV (DAME), below.

[9] Palley (1996) and Fontana (2004) use similar figures as our Figures 1 to 3, with the axes representing the same variables. But the detail of our figures is different from theirs.

represented by the dotted line. Thus, the supply of loans (L^S) is determined in relation to the quantity of narrow money (*D*), which is in turn determined by the supply of reserves (R^S). Now, the demand for loans is a function of the loan rate of interest, and it is pictured as a down-sloping line in the NE panel of the *L-i* space. What is determined here is the rate of interest in correspondence to the level of loan supply. The resulting *i* must be, of course, higher than the base rate i_B. The arrows indicate the direction of causality: it is unidirectional—the affair begins with the supply of reserves, passes through money (narrow and broad) and then the supply of loans, and finally ends with the demand for loans.

(B) DBME (Demand-driven Base-Money Endogeneity)

The second system consists of equations (12a), (13a) and (14a) in addition to the common part. The discretionary aspect of the portfolio decisions of the B sector is represented by the exogeneity of all the three proportions standing for those decisions. The main characteristic of the system is found in the demand for loans:

(B-1) $$L^D = \bar{L}$$

Solving for deposits,

(B-2) $$D^* = \left[\frac{1}{a(1+f-r)}\right]\bar{L}$$

Deposits are determined mainly in reference to the demand for loans; the central bank policy represented by *r* (which contains r_1 and r_2), the asset (loan) management (*a*) and the liability management (*f*) of the B sector are also involved. Note that neither the supply of reserves (R^S) nor asset management regarding excess reserves (*e*) plays any role in determining the stock of money. This is the result in stark contrast with the case (A-2) of SAME. Setting $\bar{L}$ at zero will produce a trivial result, which means that the demand for loans is an essential and causal variable along this route. The same is true of asset management regarding the supply of loans. In contrast, liability management is nonessential, for setting *f* at zero does not at all disturb the working of the system.

The system determines the quantity of reserves endogenously:

(B-3) $$R^* = \left[r + e(1+f-r)\right]D^* = \left[\frac{r+e(1+f-r)}{a(1+f-r)}\right]\bar{L}$$

Reserves are determined primarily by deposits and thus by the loan demand. The causality runs from loan demand to money to reserves. This "reverse causality" is the main characteristic of this route, especially in comparison with SAME or the usual exogenous-money-multiplier case. The decisions by private banks regarding the portfolios of assets and liabilities also have an influence on reserves. This result confirms the essentiality or otherwise that we have just above checked of these variables.

One has

(B-4) $$m^{*-1} = r + e(1+f-r)$$

(B-5) $$\mu^{*-1} = \frac{r+e(1+f-r)}{(1+f)}$$

As the causality runs from money to reserves, it would be more appropriate to consider the inverses of m^* and μ^* and to call them the "(narrow or broad) money divisor." The money divisors are determined in reference to the required reserve ratios and the portfolio decisions of banks. Note that neither the supply nor the demand aspect of loans is involved at all in determining the money divisors. One can check that neither *e* nor *f* is essential for the money divisors. Still, the decisions of the B sector are crucial for the money divisors: the case where $r_1 = r_2 = 0$ (the case where the central bank does not require any reserves) leaves intact the normal working of the system.

Equilibrium in the CD and the deposit markets determines the rates of interest on CDs and on bonds.

(B-6) $$\left.\begin{array}{l} h(t) = f \\ D^* = D(\bar{i}, j, t, \bar{y}) \end{array}\right\} \Rightarrow \left\{\begin{array}{l} t^* = h^{-1}(f) \\ j^* = j(\bar{i}, t^*, D^*, \bar{y}) \end{array}\right.$$

In this approach, the causality runs in the following sequence:

(B-7) $$L^D \rightarrow L^S \rightarrow D^S \rightarrow R^S$$

The essential and causal variables are those related to the demand for and the supply of loans, and the supply of reserves is fully accommodative. In contrast, liability

management, asset management regarding excess reserves and the required reserve ratios play nonessential-causal roles. This type of money endogeneity is "*demand-driven, base-money endogeneity*" (DBME), and stands in the opposite to the traditional money-multiplier case of exogenous money (and also to SAME).

Figure 2 below explains the DBME type of money endogeneity in a diagrammatical way.

<Figure 2 here>

We start from the NE panel where the demand for loans is represented as exogenously given (independently of the rate of interest on loans). $\bar{i}$ is the rate of interest on loans which is given as the sum of the base rate (i_B) and a constant markup. In the SE panel, the demand for loans and the supply of loans equalize to bring about equilibrium in the loan market. The supply of loans is shown as the solid line in the *D-L* space; it shifts to reflect changes in *F*, and the resulting equilibrium loci are shown as the dotted line; given the demand for loans, the amount of deposits (narrow money) is determined. The SW panel is a *D-R* space, where the demand for reserves is represented by the solid line. Corresponding to the deposits which are determined in reference to loans, the demand for loans is determined. As the demand for reserves in the *D-R* space shifts to reflect changes in *F* and *E*, one can trace the point where reserves match changing deposits. The result is the dotted line, which shows that reserves are determined as a portion $[r + e(1 + f - r)]$ of deposits. The NW panel shows what happens to the supply of reserves. As far as the discount rate is given regardless of the amount of reserves, the supply of loans will be represented as a horizontal line. One will notice that the causality is unidirectional as in SAME but the direction is reversed: the arrow start from the demand for loans, goes through the supply of loans and money (narrow and broad), and finally ends with the supply of reserves.

(C) DLME (Demand-driven Liability Management Endogeneity)

The third route of money endogenity, which shall call "*demand-driven liability management*" (DLME), is represented by the system that consists of (11), (12a), (13a) and (14a) in addition to the common part. Since we now have four more independent relationships (rather than three, as in the previous systems), one of the three portfolio

proportions that were previously taken as exogenous should be determined endogenously. DLME is characterized by the endogenous determination of the liability management variable, *f*: the B sector adjusts the proportion between deposits and CDs to meet the requirement of reserves arising from their discretionary decisions on the assets (loans and bonds).

Thus,

(C-1) $R^S = \bar{R}$

(C-2) $L^D = \bar{L}$

The given supply of reserves and demand for loans must be matched by the demand for reserves and the supply of loans, respectively, and results in the equilibrium levels of *D* and *F* in the following way:

(C-3) $$D^* = \left(\frac{1-r_2}{r_1-r_2}\right)\bar{R} - \left[\frac{r_2+e(1-r_2)}{a(r_1-r_2)}\right]\bar{L}$$

(C-4) $$F^* = -\left(\frac{1-r_1}{r_1-r_2}\right)\bar{R} + \left[\frac{r_1+e(1-r_1)}{a(r_1-r_2)}\right]\bar{L}$$

(C-5) $$D^* + F^* = \bar{R} + \left(\frac{1-e}{a}\right)\bar{L}$$

(C-6) $$f^* = \frac{F^*}{D^*} = \frac{-a(1-r_1)\bar{R} + \left[r_1+e(1-r_1)\right]\bar{L}}{a(1-r_2)\bar{R} - \left[r_2+e(1-r_2)\right]\bar{L}}$$

Deposits and CDs are determined primarily in simultaneous reference to the supply of reserves ($\bar{R}$) and the demand for loans ($\bar{L}$). If $\bar{R} = 0$, then $D^* < 0$; if $\bar{L} = 0$, then $F^* < 0$; since both cases are economically meaningless, the supply of reserves and the demand for loans are essential and causal in this system. The required reserve ratios and the asset management variables are also involved; however, even if e = 0, the working of the system is not affected a jot; in other words, asset management regarding excess reserves is nonessential. In contrast, both the policy of the central bank regarding the reserve ratios and the decision of the B sector on the supply of loans prove essential and causal: if either $r_1 = r_2 = 0$ or $a = 0$, the equation system cannot be solved.

Given the supply of reserves, the supply of deposits (narrow money) decreases as loans increase, as is shown in (C-3); by contrast, the supply of CDs moves in the same direction as loans, as in (C-4). This reflects the working of liability management by banks: as loans increase, the initial effect would be an increase in deposits, but deposits should observe a higher reserve ratio so that banks reduce the supply of deposits and increase the supply of CDs. (C-5) shows that the net effect (broad money) is positive with loans. One can carry out similar analysis as for changes in reserves, given loans. Also, from (C-6), one can demonstrate that the ratio between *F* and *D* decreases with reserves and increases with loans. The liability management decision of banks is an essential-non-causal variable, for it must be endogenously adjusted to meet the requirement of reserves.

Now, the ratio that (narrow or broad) money bears to reserves is determined in a quite different way from SAME or DBME.

(C-7) $$m^* = \left(\frac{1-r_2}{r_1-r_2}\right) - \left[\frac{r_2+e(1-r_2)}{a(r_1-r_2)}\right]\left(\frac{\bar{L}}{\bar{R}}\right)$$

(C-8) $$\mu^* = 1 + \left(\frac{1-e}{a}\right)\left(\frac{\bar{L}}{\bar{R}}\right)$$

These ratios are affected by the given quantity supplied of reserves and the given quantity demanded of loans (more precisely, the ratio between them), apart from the various decisions related to required reserve ratios and asset management. Still, since the supply of reserves is exogenously given and the stock of money is endogenously determined in (partial) relation to it, it would be appropriate to call them the “money multipliers.” The result that the money multipliers are affected by the ratio between the absolute levels of reserves and loans indicates that they will tend to be *unstable*; in the previous systems, the money multipliers or divisors are exclusively determined by the policy variables and the portfolio decision proportions, which can be regarded as relatively more stable over time than the ratio between two variables that are given independently from each other. It is also notable that the broad money multiplier is independent of, whilst the narrow money multiplier is dependent upon, the required reserve ratios. That the two money multipliers behave differently is also interesting. The

narrow money multiplier increases, *ceteris paribus*, as the supply of reserves increases or as the loan demand decreases. By contrast, the broad money multiplier increases as the supply of reserves decreases or as loan demand increases. Of course, this reflects the effect of liability management by banks.

The determination of the various rates of interest is similar to DBME:[10]

$$\text{(C-9)} \quad \left.\begin{array}{l} i^* = \bar{i} \\ h(t) = f \\ D^* = D(i, j, t, \bar{y}) \end{array}\right\} \Rightarrow \left\{\begin{array}{l} i^* = \bar{i} \\ t^* = h^{-1}(f) = g(a, e, r_1, r_2, \bar{R}, \bar{L}) \\ j^* = j(\bar{i}, t^*, D^*, \bar{y}) \end{array}\right.$$

The significance of DLME lies, as has been emphasized in the literature on PK-S, in the result that an increase (decrease) in reserves may not bring about a concomitant increase (decrease) in money (narrow or broad), in contrast with the usual setting of exogenous money supply. Taking the total differentials of (C-3) and (C-4) with $dD^* = 0$, and of (C-5) with $dD^* + dF^* = 0$, one gets, respectively,

$$\text{(C-10)} \quad \left.\frac{d\bar{L}}{d\bar{R}}\right|_{dD=0} = \frac{a(1-r_2)}{r_2 + e(1-r_2)} > 0$$

$$\text{(C-11)} \quad \left.\frac{dF^*}{d\bar{R}}\right|_{dD=0} = \frac{r_1 - r_2}{r_2 + e(1-r_2)} > 0$$

$$\text{(C-12)} \quad \left.\frac{d\bar{L}}{d\bar{R}}\right|_{dD+dF=0} = -\left(\frac{a}{1-e}\right) < 0$$

If loans change in the *same* direction as reserves by $a(1-r_2)[r_2 + e(1-r_2)]^{-1}$ times the change in reserves, there will be no change in narrow money; equivalently, a change in CDs in the *same* direction as reserves by $(r_1 - r_2)[r_2 + e(1-r_2)]^{-1}$ times the change in reserves will nullify the impact of the change in reserves on the stock of narrow money. In contrast, the stock of broad money will be kept constant if loans change in the *opposite* direction to reserves by $a(1-e)^{-1}$ times the change in reserves. The reason lies, of course, in the working of liability management.

By a similar token, reserves do not put a constraint on the supply of loans.

[10] The same characteristic holds even if the loan rate of interest is determined "endogenously" in such a way as (14b) or (14c).

Liability management intervenes to offset the attempted constraint by R^S on L^S. From (C-3) and (C-4) one gets the following result:

(C-13) $$\left.\frac{dD^*}{d\bar{R}}\right|_{d\bar{L}=0} = \frac{1-r_2}{r_1-r_2} > 0$$

(C-14) $$\left.\frac{dF^*}{d\bar{R}}\right|_{d\bar{L}=0} = -\left(\frac{1-r_1}{r_1-r_2}\right) < 0$$

If the central bank decreases the supply of reserves, banks operate their liability management: they will decrease the supply of deposits by $(1-r_2)(r_1-r_2)^{-1}$ times the change in reserves and increase the issue of CDs by $(1-r_1)(r_1-r_2)^{-1}$ times, in order to balance the supply of loans to the given demand for loans. Since $r_1 > r_2$, this balance is achieved by an increase in CDs by a smaller amount than the decrease in deposits.

The causality of this system runs as follows:

(C-10) $$\left.\begin{matrix} R^S \\ L^D \end{matrix}\right\} \rightarrow (D^S, F^S, m)$$

That is, the amounts of deposits and CDs are adjusted (through liability management) to reconcile the two exogenously given, essential-causal variables—the supply of reserves and the demand for loans.

The working of this route is pictured in Figure 3.

<Figure 3 here>

The supply of reserves and the demand for loans are respectively represented by the vertical lines in the NW and NE panels. Simultaneous equilibrium in the reserve market and the loan market yields the dotted lines in the SW and the SE panels (the two lines represent the same relationship among L^D, R^S and D^*). In contrast to the previous two systems, these lines will change its position if there is a change in the demand for loans (in SW) or in the supply of reserves (in SE). Equilibrium in the two markets ensures that the resulting deposits and CDs are such that the demand for reserves and the supply of loans are appropriate. The directions of the arrows indicate that there are two origins of causality and that they are reconciled through changes in deposits and

CDs, that is, liability management.

(D) DAME (Demand-driven Asset Management Endogeneity)

This route is a slight modification of SAME, which will however produce some surprising results. We have seen that in SAME, asset management regarding excess reserves must have the semi-causal characteristic for money endogeneity: it must be given as a function of some rate(s) of interest, so that its *value* is determined endogenously. Now, we shall make it non-causal and essential; that is, overall equilibrium is brought about mainly by the fully endogenous adjustment of *e*. Since a variable which previously provided an independent (causal) relationship for the system becomes fully endogenous (non-causal), one of the variables which were non-causal *must* now stand in as an independent (causal) relationship. The obvious candidate is the loan rate of interest; thus, the loan rate of interest is now considered in one of the ways of (14a), (14b) and (14c). But, then, the demand for loans need not be semi-casual as in SAME, for the loan rate of interest is now an independent variable (recall that the reason why the demand for loans must be semi-causal in SAME is to determine the loan rate of interest endogenously); it follows that the form (13b) is now merely a functional generalization of the Group *A* form of the demand for loans. This will allow us, in the first approximation, to take the demand for loans as a Group *A* variable, as in DBME; that is, as given at an arbitrary level. Then, actually, since both the supply of reserves and the demand for loans are now taken as exogenous, the system becomes similar to DLME:

(D-1) $R^* = \bar{R}$

(D-2) $L^* = \bar{L}$

It is different from DLME in one important aspect: the burden of full adjustment falls on asset management regarding excess reserves rather than on liability management. With this difference, however, the results are rather surprising. One will have

(D-3) $$D^* = \left[\frac{1}{a(1+f-r)} \right] \bar{L}$$

(D-4) $$F^* = \left[\frac{f}{a(1+f-r)}\right]\bar{L}$$

(D-5) $$e^* = a\left(\frac{\bar{R}}{\bar{L}}\right) - \left(\frac{r}{1+f-r}\right) \;;\; E^* = \bar{R} - \left[\frac{r}{a(1+f-r)}\right]\bar{L}$$

(C-6) $$m^* = \left[\frac{1}{a(1+f-r)}\right]\left(\frac{\bar{L}}{\bar{R}}\right);\; \mu^* = \left[\frac{f}{a(1+f-r)}\right]\left(\frac{\bar{L}}{\bar{R}}\right)$$

The stock of money (narrow or broad) is determined in precisely the same way as in DBME—in independence of the supply of reserves—despite the fact that the supply of reserves is exogenously controlled as in DLME. In contrast, the behavior of the money multipliers is similar to that in DLME, rather than the money divisor in DBME, despite the result that the stock of money is independent of the supply of reserves: the money multipliers are dependent on the ratio between loans and reserves, so they tend to be unstable. However, in this system, the economic significance of the money multipliers can be put in doubt precisely because there is no causal connection, in either direction, between the stock of money and the supply of reserves. Liability management plays a nonessential role in determining any of these variables, as in DBME. By contrast, the asset management decision regarding the supply of loans is essential as in all the other demand-driven routes; this is natural since the demand for loans is an essential-causal variable and the supply of loans must be matched to it.

The causality in this system can be represented as follows:

(D-7) $$\left.\begin{array}{l} L^D \rightarrow (D^S, F^S) \\ R^S \end{array}\right\} \rightarrow (E, m)$$

The supply of reserves and the demand for loans operate separately from each other. These two essential-causal variables are reconciled by the full adjustment of the asset management decision regarding excess reserves. Hence, the name of "*demand-driven asset management endogeneity*" (DAME).

Figure 4 illustrates the working of DAME.

<Figure 4 here>

As in DLME, the NW and NE panels respectively shows the two essential-causal variables: the supply of reserves and the demand for loans. In the SE panel, the stock of money is determined in reference to the demand for loans but in independence of the supply of reserves. The SW panel shows how excess reserves are endogenously determined: the line representing the relationship between the equilibrium quantities of reserves and deposits has an exogenous slope (r) whilst the R-intercept (E) adjusts to match the given supply of reserves and the equilibrium quantity of deposits. The meeting of the arrows, which start from two places, is successfully arranged by the adjustment of excess reserves.[11]

5. Conclusion

Using a common analytical framework, we have identified four routes of money endogeneity. The first is supply-driven asset management endogeneity (SAME). The primary essential-causal element is the exogenous supply of reserves; different supplies of reserves require banks to match them by adjusting deposits, CDs and excess reserves. In SAME, it is the adjustment of excess reserves by banks, in response to changes in the loan rate of interest, that makes money (deposits) determined endogenously. The second is demand-driven base-money endogeneity (DBME). The primary essential-causal element here is the demand for loans; reserves are adjusted to match the demand for reserves generated from the given demand for loans. Asset management regarding the supply of loans is also essentially causal here, but asset management regarding excess reserves is nonessentially causal. For the third type of money endogeneity—demand-driven liability management endogeneity (DLME)—asset management regarding excess

[11] The recent neo-chartalist view of money generation (e.g. Wray, 2004) can be treated as a variation of DLME or DAME. Instead of (C-1), the behavior of the G sector is represented by the exogeneity of the national debt: $Z = \bar{Z}$. One will see a much more complicated determination of the key variables; however, for one thing, one will see the determination of money (narrow or broad) in reference to the national debt (and the demand for loans), whether as a variation of DLME or as a variation of DAME. The reader may also wonder what will happen if we make non-causal the asset management variable regarding the supply of loans (a), rather than f (DLME) or e (DAME); that is, if the supply of loans are fully accommodative of the demand for loans. Then we shall be back to the case of exogenous money! Indeed, in this case, loans will become *inessential*: the demand for, and the supply of, loans will be involved solely in determining the quantity of loans and nothing else.

reserves continues to be nonessentially causal. However, the asset management decision on the supply of loans and the liability management decision are both essential and causal, as well as the supply of reserves and the demand for loans. The most salient characteristic of this route of money endogeneity is that an attempt by the central bank to control the private sector by means of the supply of reserves can be offset by the liability management of banks and that the (narrow or broad) money multipliers, being directly affected by the ratio between the supply of reserves and the demand for loans, are unstable. The fourth route is demand-driven asset management endogeneity (DAME), asset management taking the form of adjusting excess reserves fully (that is, not only in response to changes in the loan rate of interest): excess reserve management is a non-causally essential variable. This route shows a mixture of features of DBME and DLME: the stock of money is primarily determined by the demand for loans just as in DBME, whilst the money multipliers show instability just as in DLME. Liability management is nonessentially causal here. Table 3 summarizes the characteristics of the key variables for the respective routes of money endogeneity.

<Table 3 here>

Intended as a heuristic typology, the four routes identified in the present paper are nothing more than rough approximations to those discussed in some well-known approaches (New Keynesian, Post Keynesian Accommodationist and Post Keynesian Structuralist) and, of course, to the reality. But as a heuristic, the typology will enhance our understanding of the various outstanding channels, and their differing characteristics, through which the stock of money is generated in response to the economic activity of the private sector.

References

Bernanke, B. S. and Blinder, A., “Credit, money and aggregate demand”, *American Economic Review, Papers and Proceedings*, 1988, 78, 435-39.

Bernanke, B. S. and Gertler, M., “Inside the black box: the credit channel of money policy transmission,” *Journal of Economic Perspectives*, 1995, 9(4), 27-48

Blinder, A. and Stiglitz, J., “Money, credit constraints, and economic activity,” *American Economic Review*, 1983, 73(2), 297-302.

Fontana, G. “Rethinking endogenous money: a constructive interpretation of the debate between horizontalists and structuralists”, *Metroeconomica*, 2004, 55(4), 367-385.

Howells, P., “Endogenous Money,” *International Papers in Political Economy*, 1995, 2(2): 1-41

Palley, T. *Post Keynesian Economics: Debt, Distribution and Macro Economy*, 1996, Macmillan, London.

Pollin, R. “Two Theories of Money Supply Endogeneity: Some Empirical Evidence.” *Journal of Post Keynesian Economics*, 1991, 13(3), 366-96.

Rochon, L.-P. *Credit, Money and Production*, Cheltenham, Edward Elger. 1999.

Romer, D., “Keynesian Macroeconomics Without the LM Curve,” *Journal of Economic Perspectives*, 1999, 14, 149-169.

Rotheim, R. (ed.), *New Keynesian Economics/Post Keynesian Alternatives*, 1998, London, Routledge.

Taylor, R., “Teaching Modern Macroeconomics at the Principles Level,” *American Economic Review*, 1998, 88: 90-94.

Wray, R. (ed.) *Credit and State Theories of Money: The Contributions of A. Mitchell Innes*, 2004, Cheltenham: Edward Elgar.

Tables

Table 1: *the causality and essentiality of variables*

	essential	non-essential
causal	– can be set at an arbitrarily positive level – if set at zero, the collapse of the system	(1) – can be set at an arbitrarily positive level – even if set at zero, no collapse of the system (2) (inessential) – directly and indirectly affects inessential non-causal variables only
semi-causal	– must be expressed as a function of a given form for the integrity of the system	
non-causal	– fully endogenous – cannot be omitted	(inessential) – fully endogenous – can be omitted

Table 2: *Main differences among the four systems*

	I	**II**	**III**	**IV**
the supply of reserves	$R^S = \overline{R}$	endogenous	$R^S = \overline{R}$	$R^S = \overline{R}$
excess reserves	$e = e(i)$	$e = \overline{e}$	$e = \overline{e}$	endogenous
the demand for loans	$L^D = L(\overset{-}{i}, \overset{+}{y})$	$L^D = \overline{L}$	$L^D = \overline{L}$	$L^D = \overline{L}$
the loan rate of interest	endogenous	$i = \overline{i}$	$i = \overline{i}$	$i = \overline{i}$
liability management	$f = \overline{f}$	$f = \overline{f}$	endogenous	$f = \overline{f}$

Table 3: *The characteristics of the key variables*

	SAME	DBME	DLME	DAME
essential and causal	R^S, e	L^D, a, i	R^S, L^D, a, i	R^S, L^D, a, i
essential and semi-causal	L^D			
essential and non-causal	i	R^S	f	e
nonessential	f, a	f, e	e	f

Figures

Figure 1: *SAME*

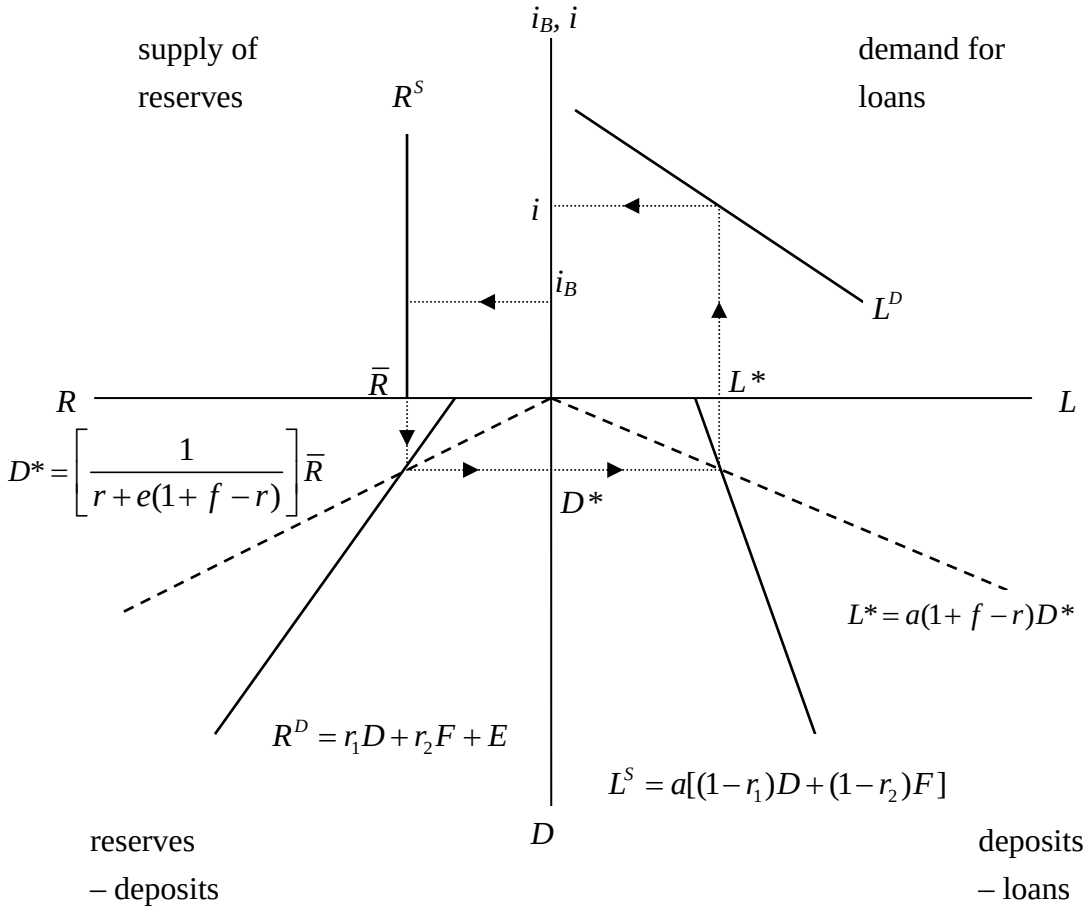

Figure 2: *DMBE*

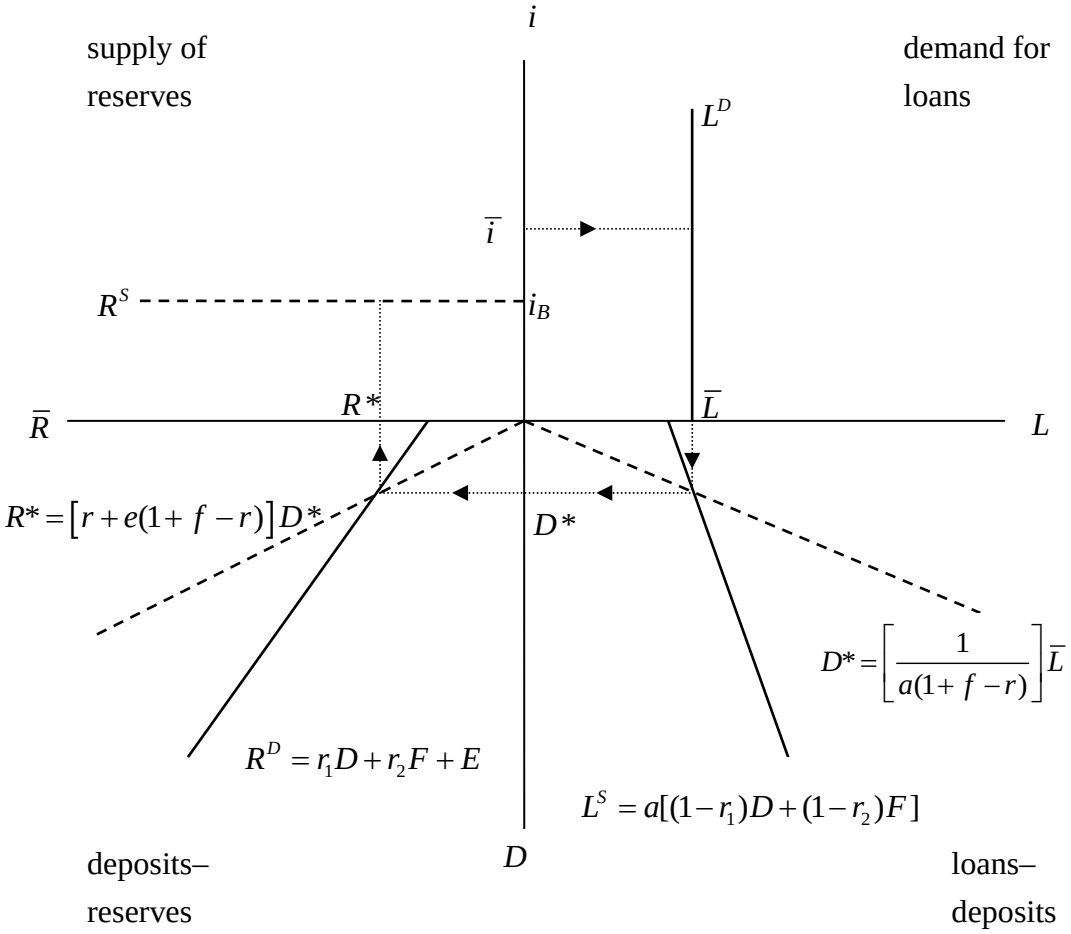

Figure 3: *DLME*

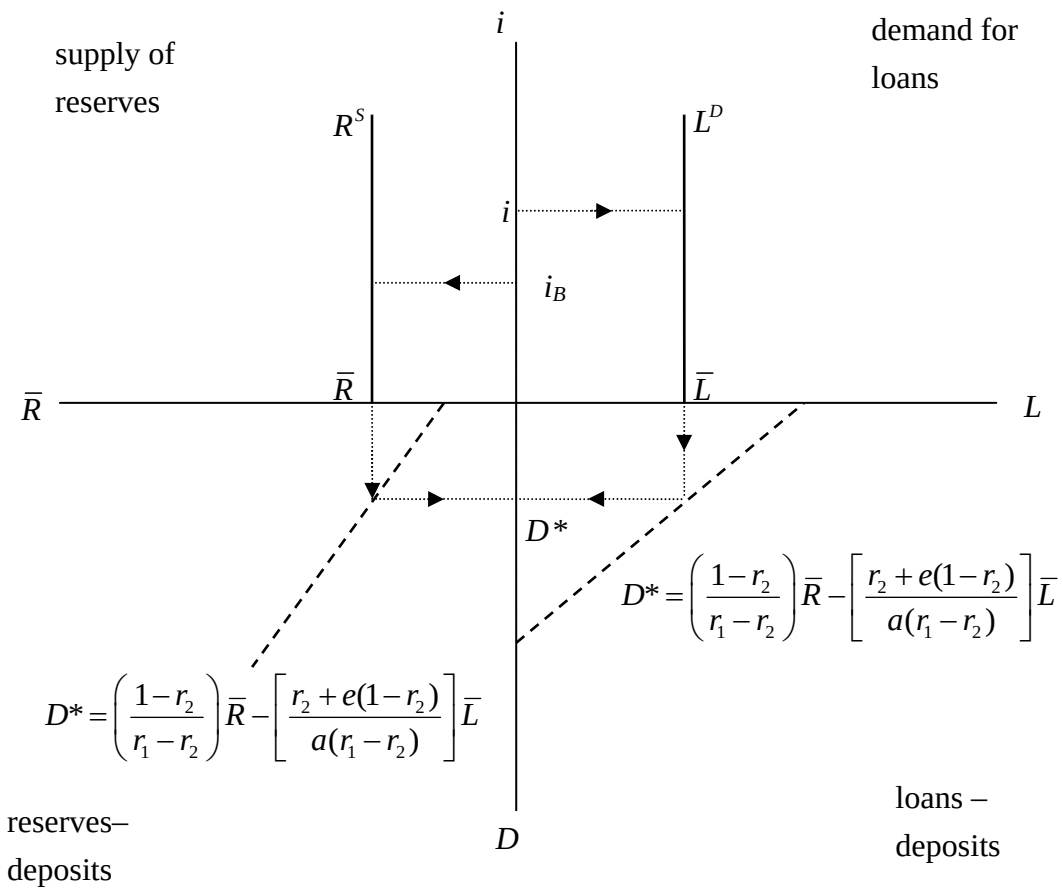

Figure 4: *DAME*