Endogenous interest rate with accommodative money supply and liquidity preference

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Prepared for the International Post-Keynesian Conference “Money, crises and Capitalism”, Grenoble, 10-12 december 2015

This version fixes two typos page 7 (see the erratum page 12)

Abstract

The paper offers theoretical discussion and modelling showing that -in accordance to the post Keynesian approach to endogenous money- the credit-worthy demand for loans determines the supply of loans at the prevailing interest rate, while -in accordance with Keynes’s liquidity preference theory- the rate of interest is endogenously determined as to equalize the demand and supply of liquidity-money in terms of stocks. As a consequence, the mark-up reflected in the spread between the central bank refinancing interest rate and the market interest rate is endogenously determined by the total demand and supply of liquidity-money. The paper also argues that, while the central bank effectively controls the base interest rate, additional conditions are required to control the liquidity-money market interest rate, owing to the conventional nature of the rate of interest Keynes pointed out.

JEL Classifications: E40, E43, E44, E5

Keywords: Accommodationism, Credit-money, Endogenous money, Horizontalism, Interest rate, Liquidity preference, Monetary policy, Structuralism, Verticalism

Introduction

The paper distinguishes between the flow of credit money and the stock of money as a liquid asset. It proposes an analytical framework which explicitly accounts for both the credit-money market and the liquidity-money market. This allows to demonstrate that there is no essential contradiction between the post Keynesian approach to endogenous money and Keynes's liquidity preference theory. The paper offers theoretical discussion and modelling showing that -in accordance to the post Keynesian approach to endogenous money- the credit-worthy demand for loans determines the supply of loans at the prevailing interest rate, while -in accordance with Keynes’s liquidity preference theory- the rate of interest is endogenously determined as to equalize the demand and supply of liquidity-money in terms of stocks. As a consequence, the mark-up reflected in the spread between the central bank refinancing interest rate and the market interest rate is endogenously determined by the total demand and supply of liquidity-money. The paper also argues that, while the central bank effectively

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controls the base interest rate, additional conditions are required to control the liquidity-money market interest rate, owing to the conventional nature of the rate of interest Keynes pointed out.

To start with, the credit market is depicted (section 1) where money is endogenously supplied through the flow of credit, given the rate of interest on bank loans. Then the market for liquidity-money is considered (section 2), where the total supply of money is not simply the additional quantity of money resulting from current credit operations (flow), but the total stock of money resulting from the present and past loans and repayments. The rate of interest (hence the mark-up reflected by the spread with respect to the central bank refinancing rate) is determined by the liquidity-money market clearing condition (section 3). The policy problem raised with respect to the conventional nature of the rate of interest is discussed in section 5. Section 6 concludes.

1. Credit market and the flow of credit-money

This section focuses on the credit-worthy demand for bank-loans which endogenously determines the banks supply, so that the market clears spontaneously whatever the level of the rate of interest.[1]

Credit-worthy demand for loans

Let's suppose that the credit-worthy demand for credit (C_d) at any point in time, that is, the demand for loans meeting the banks definition of credit-worthiness at that time, is an increasing function of the aggregate output firms have decided to produce at that time (Y) and a decreasing function of the rate of interest (r).

$C_d = L_0(Y,r)$, $L_{0Y}'>0$, $L_{0r}'<0$

Since aggregate output is a positive function of the marginal propensity to consume (c), of the aggregate autonomous demand (A), of the long-term expectations that feed the inducement to invest (E), and a negative function of the rate of interest (r), it follows that the credit-worthy demand curve is negatively sloped in the locus (r,C_d):

$Y(r,c,E,A)$, $Y_r' < 0$, $Y_C' > 0$, $Y_E' > 0$, $Y'_A > 0$ ==> $dC_d/dr = L_{0Y}'dY/dr + L_{0r}' < 0$

Supply of bank loans

In a competitive modern banking system, banks accommodate the credit-worthy demand for loans at the prevailing rate of interest. Since this behavior holds whatever the interest rate, we have:

$C_s \equiv C_d(r,c,E,A)$, $\forall$ r

So that:

$dC_s/dr = dC_d/dr < 0$

It turns out that the loan-supply curve at a point in time (C_s) is not horizontal nor positively sloped, for it is the same curve as the demand for loans at that time, that is, a decreasing function of the rate

1 'The' rate of interest in this paper refers broadly to the price paid by borrowers to lenders for all kind of contracts (whatever the maturity, risk...). As banks and non-bank lenders compete with one another, it is assumed that 'the' rate of interest rates applies to both the bank and non-bank loans.

of interest (figure 1). The higher the interest rate, the lower the demand for loans, and the lower the credit supply.

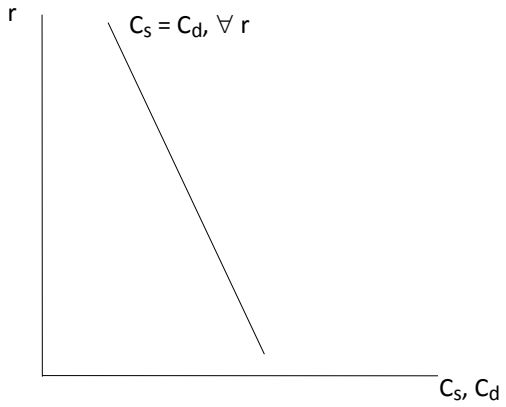

Figure 1. Negatively sloped credit supply and demand at a point in time

Observe that the decreasing credit-money supply does not alter the reasoning in terms of full accommodation of the credit-worthy demand for loans, which is so much central to endogenous money theory. It only shows, contrasting with the widespread opinion, that full accommodation of the credit-worthy demand for bank loans does not entail a horizontal nor a positively sloped supply curve at a point in time.

2. Liquidity-money market and the total stock of money

Bank loans create the deposits that feed the existing stock of money continuously, meanwhile loan repayments tend to reduce it. Therefore, the flow of deposits created at point in time is only one part of the existing stock of money at that time, which also contrasts with the treatment received in the literature (see for an example Palley 2013, Dow 2006, p 46-47, and the 'horizontalist' models in Fontana and Setterfield 2009, pp 146-148, Howells 2009, pp 178-179, or Lavoie 2014, p 251).This section shows that, while full accommodation of the credit-worthy demand for bank loans makes it impossible that the supply and demand differ from one another, this does not hold in the liquidity-money market where money is considered a liquid asset competing with non-money assets in agent's portfolio.

Money supply

The quantity of money in existence at a point in time, which is the total money supply at that time, is not merely the difference between the flows of money injected and withdrawn into and from circulation at that time, it is the difference between the sum of the past and present injections and the sum of the past and present withdrawals, including the central bank operations in markets. Therefore, the money supply at a point in time is a stock that may differ considerably from the deposits resulting from the net flow of credit money injected through credit operations and loan repayments at that time.[2]

2. 'Circuitists' use to think within a production period in such a way that –under normal conditions- the money injected through the financing of productive operations is withdrawn at the end of the period when firms repay the loans to the banks (reflux). In this paper, it is admitted that the banks also provide finance for long-term investments that are not supposed to be repaid at the end of a single production period. Hence at any point in time (for example, at the end of a single production-

Although the total quantity of money is not the same as the flow of credit-money supplied, it is not independent, however, for additional deposits resulting from bank-loan operations influence continually the stock of money. As a result, the total quantity of money (M_s, in bold in figure 2) is a decreasing function of the rate of interest at any point in time, for it is geometrically the sum of the previously created money and of the current flow at any point in time.

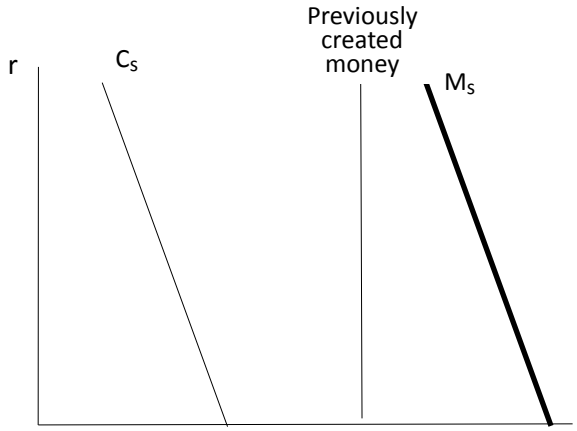

Figure 2. Total money supply at a point in time

Formally, the total money supply is the sum of the previously created money M_0 (net of repayments, including current repayments) and of the current credit supply:[3]

$M_s = M_0 + C_s = M_0 + L_0(Y,r)$

It follows that the total supply of money is a decreasing function of the rate of interest, the slope of which is the same as the slope of the credit-supply curve:

$M_{sr}' = L_{0Y}'dY/dr + L_{0r}' = C_{sr}' < 0$

Demand for liquidity-money

The demand for money at a point in time includes a demand for 'active' balances related to transactions (including planned transactions in the case of the Keynes 'finance motive'), and a demand for precautionary and speculative 'inactive' balances.[4] The demand for money at a point in time (stock) therefore is a broader notion compared with the demand for deposits resulting from the demand for credit at that time (flow).

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period), the quantity of money in circulation depends on the difference between the current and past bank loans and the current and past loan repayments (it also depends, of course, of the central bank operations in markets).

3 For convenience, it is assumed that M_0 also reflects the central banks current injections/withdrawals of money through market interventions.

4. "The demand for liquidity can be divided between what we may call the active demand which depends on the actual and planned scales of activity, and the inactive demand which depends on the state of confidence of the inactive holder of claims and assets' (Keynes 1937, p 665). The 'finance motive' is a motive for holding money in the 'interval between planning and execution' of an investment (Keynes 1937, p 665).

The transaction demand for money involves both the credit-worthy demand for additional bank-loans (L_0), since bank-loans are underwritten with the aim of doing transactions, and the part of "L_1" which comes under the transaction motive (referring to Keynes's notation in the *General Theory*). The total demand for money therefore is:

$M_d = L_0(Y,r) + L_1(Y) + L_2(r),\ L_{1Y}' > 0,\ L_{2r}' < 0$

It is worth noting that the relationships involved in L_1 (precaution and transaction motive) and L_2 (speculation motive) depend on the state of the liquidity preference and, therefore, are subject to potential shifts. Furthermore, the demand for money at a point in time is a decreasing curve the slope of which is flatter than the slope of M_s:

$dM_d/dr = L_{0Y}'dY/dr + L_{0r}' + L_{1Y}'dY/dr + L_{2r}' < dM_s/dr = dC_s/dr = dC_d/dr = L_{0Y}'dY/dr + L_{0r}'$

This is because a higher rate of interest makes the total demand for money lower through a lower L_0 (demand for additional loans), but also through lower L_1 and L_2, while it only impacts on the total money supply through the lower supply of additional loans. In other words, a lower rate of interest impacts on M_s through a higher demand for loans only, while it makes the total demand for money higher because of the transaction-motive (including those transactions financed by additional bank loans), the precaution-motive and the speculation-motive.

Liquidity market equilibrium

As a result of having a different slope, the total money demand and the total money supply curves intersect each other for some level of the rate of interest. Hence, for values of the rate of interest below the intersection of the demand and supply curves, competitive forces would push the rate of interest upward, as demanders would compete with one another because of the lack of liquidity. On the contrary, for values of the rate of interest above the intersection, competitive forces would push down the rate of interest. As a result, competitive forces tend to equalize the demand and supply for liquidity at any point in time:

$M_0 + L_0(Y,r) = L_0(Y,r) + L_1(Y) + L_2(r)$

Which simplifies as:

$M_0 = L_1(Y) + L_2(r)$

It transpires therefore that, although banks fully accommodate the credit-worthy demand for credit-money, the liquidity-money market equilibrium condition is the same as in *The General Theory*. This is because the effect of the supply and demand for bank loans on the total supply and demand for money offset each other whatever the rate of interest. This shows formally that full accommodation of the credit-worthy demand for loans and Keynes's liquidity preference theory are complementary.

3. Endogenous mark-up and interest rate

Given the difference between the flow of credit-money and the stock of previously created money, if the bank-loans interest rate was determined by a given mark-up to the central bank refinancing interest rate, as often assumed in 'horizontalist' models (see for example Lavoie 2014, pp 251-256,

Palley 2013, p 412, or Fontana and Setterfield 2009, p 146), this would not ensure that the total supply of money would be equal to the total demand for money at that interest rate. As a result, the rate of interest would hardly remain unchanged in case of a discrepancy between the supply and demand: if the quantity of money was higher than the quantity demanded, holders would depart with excess money by accepting a lower reward from banks or bond issuers for their liquidities, and conversely, if the quantity of money was lower than the quantity demanded, bond issuers would accept to pay a higher interest rate to get the desired liquidity, which would allow banks to rise the bank-loans interest rate as well (figure 3).[5]

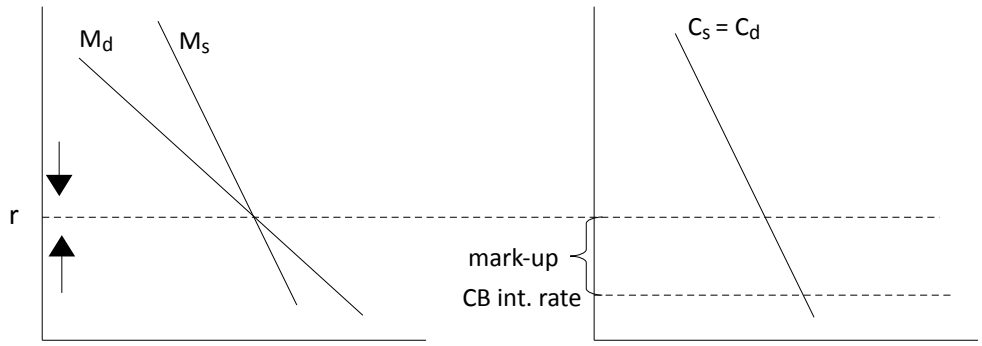

Figure 3. Endogenous interest rate and banks mark-up

Although credit-worthy demand is fully accommodated, the market rate of interest is determined by the relative scarcity of liquidity-money. Competitive forces adjust the market rate of interest continuously as to equalize the total demand and supply of liquidity-money.

Equilibrium interest rate

To account for interactions between the rate of interest and the level of output involved in L_1 and L_2, it is helpful to express the output level as a decreasing function of the rate of interest, in accordance with the goods market equilibrium condition:

$$Y = (A - b_0 r)/s$$

where A represents both the autonomous demand and the effect of long-term expectations on aggregate investment, b_0 measures the sensitivity of aggregate investment with respect to the rate of interest, s is the marginal propensity to save.

5. This line of reasoning holds subject to the provision that the quantity of money is higher than the quantity demanded ex ante. In the special case where some mechanism prevents "automatically" such an ex ante discrepancy, there would be no change in the rate of interest of course (see Peter Howells 1995). The "reflux mechanism" has been understood initially as a proportionate repayment of bank loans when the quantity of money demanded is lower than the quantity of money held, which ensures that the total demand and supply of money are made equal with no change in the rate of interest. But this is a special case. The author is grateful to Louis Philippe Rochon for mentioning the issue of the *Cambridge Journal of Economics* where Philip Arestis and Peter Howells's (1999), in an answer to Lavoie's paper (1999) published in the same volume, stated both theoretically and empirically that a partial "reflux" and an adjustment of the interest rate should not be considered mutually exclusive.

Hence, the money demand function becomes:

$M_d = a_0 [(A - b_0 r)]/s – a'_0 r + a_1 [(A – b_0 r)]/s + Z - b_1 r$

where

$a_0 [(A - b_0 r)]/s – a'_0 r = L_0(Y,r)$

$a_1 [(A - b_0 r)]/s = L_1(Y)$

$Z – b_1 r = L_2(r)$

Z is a component of the money demand which may shift according to the subjective views about the future. To ensure that L_2 is never negative, it is assumed that: $Z \geq b_1 r, \forall r \geq 0$

The money supply function accordingly becomes:

$M_s = M_0 + a_0 [(A - b_0 r)]/s – a'_0 r$

where

$a_0 [(A - b_0 r)]/s – a'_0 r = C_s = C_d = L_0(Y,r)$

The equilibrium interest rate is solution of $M_d = M_s$:

$r = [a_1 A/s + Z – M_0] / (a_1 b_0/s + b_1)$

Thus, in accordance with the *General Theory*, the market equilibrium interest rate is a positive function of A and Z, and a decreasing function of M_0. Observe that, for a given M_0 (but of course M_0 may change if the central bank so decides; further discussed in section 5), a demand stimulus involves an additional supply of credit money at the prevailing interest rate (full accommodation of the shift in the credit-worthy demand for credit $L_0(Y,r)$), but nevertheless, the rate of interest increases as a result of the additional demand for money related to $L_1(Y)$:

$dr/dA = 1 / (b_0 + b_1 s/a_1) > 0$

The higher a_1, the higher dr/dA.

As Keynes pointed out (Keynes 1937, p 667): "Just as an increase in actual activity must (as I have always explained) raise the rate of interest unless either the banks or the rest of the public become more willing to release cash, so (as I now add) an increase in planned activity must have a similar, superimposed influence". Thus, the widespread view that there is no 'eviction effect' in an endogenous-money framework does not necessarily hold insofar as the rate of interest must equalize the total demand and supply of money, not just the additional credit-money demand and supply. Of course the central bank may intervene to prevent such an outcome, but it may not (for example, if it worries about price stability, or about capital outflows and currency reserves or exchange rate stability in an open economy), so that an 'eviction effect' is possible.

Endogenous mark-up
Assuming the rate of interest cannot be lower than the refinancing interest rate plus some minimum mark-up (noted x) amounts to the following condition:

$r \geq r_{ref} + x > 0 \Leftrightarrow [(a_1 A/s + Z - M_0] / (a_1 b_0/s + b_1) \geq r_{ref} + x > 0$

which supposes

$M_0 \leq a_1 A/s + Z - (r_{ref} + x)(a_1 b_0/s + b_1)$

This condition ensures that $r \geq r_{ref} + x$ in any circumstance ($r_{ref} + x$ may be interpreted as the base rate). It involves the variables of the two sides of the liquidity-money market, plus the central bank refinancing rate of interest. It can be assumed to hold because the liquidity preference (here captured by Z) tends to raise as r is closer to the minimum rate lenders are prepared to accept (Keynes 1936, p 202-203), and because the central bank could always, if needed, adjust r_{ref} and/or M_0 as to ensure $r \geq r_{ref} + x$.[6]

Given this interest rate (and mark-up) lower bound, the effective mark-up can be determined as:

$r - r_{ref} = (a_1 A/s + Z - M_0) / (a_1 b_0/s + b_1) - r_{ref}$

or alternatively, in terms of the spread with respect to the base rate:

$r - (r_{ref} + x) = (a_1 A/s + Z - M_0) / (a_1 b_0/s + b_1) - (r_{ref} + x)$

The banks mark-up appears to be a complex function of the parameters and variables that represent the money market conditions. Within the mentioned limit imposed by the central bank to the difference between r and r_{ref}, the mark-up depends negatively on the previously created money (including central bank's market interventions), positively on the state of the liquidity preference, and positively on the level of the autonomous expenditures and long-term expectations.

4. Market convention and the equilibrium interest rate

Although the supply of bank-loans spontaneously accommodates any increase in the flow of credit-worthy demand for loans, the total money supply does not accommodate spontaneously the increases in the money demand that do not involve additional demands for bank loans; it depends on whether the central bank compensates or not for such increases by buying assets in the markets.

At a point in time, central banks have the power of increasing the total quantity of money much beyond the additional flow of credit-money by buying public and private debts in the markets. This amounts to a shift in the M_s curve with no change in the C_s curve (figure 4).

6 This assumes that, by means of market interventions, reserve requirement and other policy instruments, the monetary authority always can make the quantity of liquidity-money scarce enough to get a higher interest rate if it wants so. However, because of the interest rate lower bound and of the related behaviour of Z, it would be imprudent to assume, conversely, that the central bank can always obtain a decrease in the rate of interest if it wants (assuming $r > r_{ref} + x$).

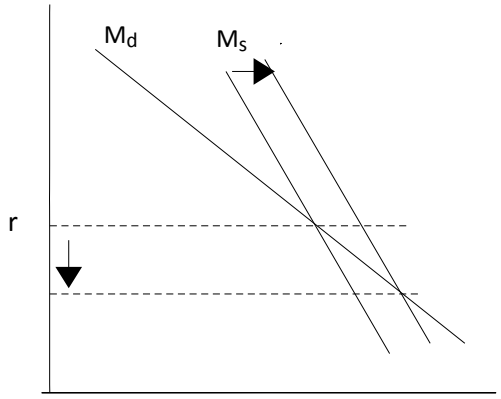

Figure 4. An increase in the money supply with no change in the supply of bank-loans

This may be aimed at reducing the market rate of interest, but as Keynes pointed out, it may not be sufficient, for it only operates on the total supply of money, whereas the long-term rate of interest also depends on the liquidity preference function. Keynes indeed pointed out that the market interest rate is a convention in the sense that the actual interest rate, as determined by the interplay of the total supply and demand for money, cannot depart lastingly from the level expected to hold (Keynes 1936, pp 203-204). This is because, when the central bank increases the total money supply, the market rate of interest only decreases if the prevailing opinion is that the market rate of interest is in effect going to decrease and asset prices to increase, for otherwise, investors would start selling bonds or borrowing from banks to become more liquid as soon as the market rate of interest started decreasing below the expected figure (noted r_c). This would increase the money demand along with the money supply in such a way that the rate of interest eventually would not change, or would only decrease temporarily (figure 5).

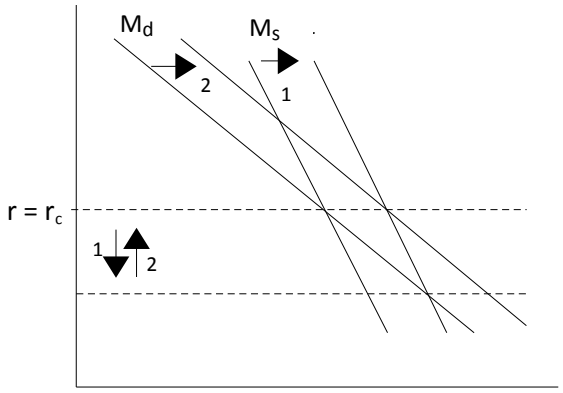

Figure 5. An illustration of the strength of the market convention

Authorities therefore can only control the long-term interest rate provided they get to change the market conventional views regarding the interest rate, which supposes to influence the liquidity preference function as to have it crossing the money-supply curve at the targeted rate. Setting the refinancing rate of interest and/or buying debts from the market (moving M_s) may be necessary for that purpose, but it may not be sufficient.

This view has been challenged by Marc Lavoie for long:

> "… the market cannot continuously short-circuit monetary policy. If monetary authorities are sufficiently insistent and consistent, a shift in interest rate differentials can only be temporary. Summoning Keynes's authority, it could be said that the convention established in the prevailing spread 'will not be always unduly resistant to a modest measure of persistence and consistency of purpose by the monetary authority (vii, p. 204). In the case where long term rates would be high relative to short rates, financial operators would come to realize that substantial profits can be made by borrowing short and lending long." (Lavoie 1996, p 295, see also Lavoie 2014, p 233).

Hopefully Lavoie is right that the central bank refinancing interest rate anchors the conventional interest rate at its target level eventually. But observe that 'In the case where long term rates would be high relative to short rates', financial operators would only 'realize that substantial profits can be made by borrowing short and lending long' provided the 'long-term' rate of interest is expected to decrease effectively, that is, provided the central bank's target is expected to hold eventually, which is not warranted.[7] Keynes (1936, pp 205-206) actually argued that the conventional rate of interest would be more effectively influenced through open-market operations than through single bank rate for short-term bills:

> "Perhaps a complex offer by the central bank to buy and sell at stated prices gilt-edged bonds of all maturities, in place of the single bank rate for short-term bills, is the most important practical improvement which can be made in the technique of monetary management." (Keynes, 1936, p 206)

He also pointed out several "limitations on the ability of the monetary authority to establish any given complex of rates of interest for debts of different terms and risks" (see Keynes 1936, pp 207-208).

Formally, if the central bank wants the rate of interest be not too high, it may not be sufficient to set r_{ref} even at zero and increase M_0, for the liquidity preference may increase accordingly in such a way that the rate of interest stands at the conventional value. This can be expressed formally by an increase in Z when M_0 increases. It amounts to a shift in $L_{2,}$ as investors think that an interest rate decrease would increase the risk of an increase in the rate of interest and of a loss in the value of bonds. To control the market interest rate effectively, the authorities must convince the investors that the rate of interest will effectively decrease, so that investors have no incentive to sell bonds when the market interest rate starts decreasing (Z does not shift upward when M_0 shifts).

5. Conclusion

The paper offers a clarified presentation of the post-Keynesian theory of endogenous money which proves to be complementary to the Keynes liquidity preference theory.

It argues that, whilst at any point in time banks accommodate the credit-worthy demand for loans whatever the rate of interest (provided a sufficient mark-up is allowed for), the total money supply, of which the current additional amount of loans is only one part, does not match the total demand for

7. The above quotation of Keynes is not a definite statement; it is a hope, as attested by the beginning of the sentence: "Such comfort as we can fairly take from more encouraging reflections must be drawn from the hope that, precisely because the convention is not rooted in secure knowledge, it will not be always unduly resistant…". (Keynes, 1936, p 204)

money automatically. Hence competitive forces tend to adjust the rate of interest to equalize the total demand and supply of money. The mark-up, as reflected by the spread between the central bank refinancing interest rate and the market equilibrium interest rate, is endogenously determined by the total demand and supply of money, given the central bank refinancing rate.

In this framework the rate of interest is only influenced by the interplay of the existing quantity of money and the liquidity preference function, as depicted in *The General Theory*. At a point in time, it does not depend on the current credit market conditions. This is because the effect of the supply and demand for bank loans on the total supply and demand for money offset each other whatever the rate of interest, with the result that they do not influence the equilibrium interest rate. This shows formally that the statement that banks fully accommodate the credit-worthy demand for loans whatever the rate of interest and the Keynes's liquidity preference theory are complementary.

Regarding the central bank capacity to control the rate of interest, it turns out that, although the central bank controls the base rate and may issue or withdraw money discretionarily by buying or selling public and private securities in the markets to increase or decrease the total supply of money, this may not be sufficient to control the rate of interest effectively. This is because the market interest rate depends on both the supply and the demand side of the market for money/liquidity, so that the authorities can only control it to the extent that they are capable of influencing the liquidity preference function as well as the total supply of money.

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Erratum

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1. In the original version a_0' was replaced with a_0 in several occurrences. This version replaces the second a_0 with a_0' in the relevant equations, as follows:

$$M_d = a_0 [(A - b_0 r)]/ s - a_0' r + a_1 [(A - b_0 r)] / s + Z - b_1 r$$

$$a_0 [(A - b_0 r)] / s - a_0' r = L_0 (Y, r)$$

$$M_s = M_0 + a_0 [(A - b_0 r)] / s - a_0' r$$

$$a_0 [(A - b_0 r)] / s - a_0' r = C_s = C_d = L_0 (Y, r)$$

2. This version replaces A with 1 in the right hand side of the relevant equation, as follows:

$$dr / dA = 1 / (b_0 + b_1 s / a_1) > 0$$