Money and Walras' Law in the General Theory of Market Disequilibrium*

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I. Introduction

Robert Clower's insightful paper, "The Keynesian Counter-revolution: A Theoretical Appraisal," and Axel Leijonhufvud's iconoclastic work, *On Keynesian Economics and the Economics of Keynes,* have led to a renewed interest in the theoretical foundations of macroeconomic analysis. As a result a general theory of disequilibrium behavior has been developed as exemplified by the works of Barro and Grossman, Grossman, and Tucker. That the disequilibrium approach to economic analysis is a most promising innovation is beyond question. At the same time, however, a disquieting consensus with regard to the nature and relevance of the demand for money in the disequilibrium model appears to be emerging. Tucker and Grossman have argued that the demand for money is arbitrary and ambiguous within this context. On this point Grossman has stated:

> . . . the structure of a monetary economy implies that the excess demand for money, money being the medium of exchange, can have no direct influence upon the formation of prices. Consequently, we can define the effective excess demand for money arbitrarily.

This line of reasoning is further supported by Tucker:

> . . . in the presence of significant and shifting market disequilibrium the demand for money is an ambiguous and arbitrary (and hence treacherous) concept, and this severely limits its usefulness for studying short run phenomena. (Tucker, 1971, p. 57)

The inability to handle the demand for money within the context of market disequilibrium is symptomatic of a fundamental misunderstanding of the formal structure of the disequilibrium model. In particular, what is at issue is the relevance of Walras' Law. That this is the case is made explicit by Tucker:[1]

> Walras' law is no more than a matter of definition: it is either true or false by definition

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[1]Tucker asserts that the basis for the alleged ambiguity of money demand in his analysis is related to his interpretation of the meaning of ex ante demand functions. The notion of ex ante and ex post relationships can be ambiguous in itself. This is particularly true when used outside the context of the savings-investment relationship. This particular aspect of Tucker's analysis is not considered in this paper except to observe that he defines "the individual's [ex ante], demand for money to be the money balance he desires to be holding at the end of the trading day." (Tucker, 1971, p. 64) If we define the individual's other ex ante demands similarly (e.g. the individuals' ex ante demand for consumer goods as the quantity of consumer goods that he desires to have purchased by the end of the trading day) the criticism of money demand that Tucker has made in this regard also applies to the other demands in his model. For a further discussion of the general problem of ex ante and ex post relationships see Blackford.

depending on which measure of the demand for money one takes. (Tucker, 1971, p. 69)

Throughout the discussion Tucker makes it clear that Walras' law is taken to be a significant factor in determining the appropriate "measure" of money demand. For example,

> The money demand function can be useful . . . as a means of obtaining the excess demand for one of the other commodities through Walras' law (and this requires that one use the effective measure of money demand, for which Walras' law is valid). (Tucker, 1971, p. 69)

It will be shown below that these two statements are inaccurate, but for the moment, let us turn to Grossman's formulation of the problem.

In his discussion of the demand for money, Grossman attempts to formulate the problem in terms of the "structure of a market economy in which money serves as a medium of exchange" (Grossman, p. 944). That this is not the basic issue, however, is indicated by his explicit reference to Leijonhufvud: "in this type of model, as Leijonhufvud (1968, p. 88) has pointed out, the specification of the effective excess demand for money is ambiguous." (Grossman, p. 951) If we examine this reference to Leijonhufvud, we find that he is discussing the relevance of Walras' law to the theory of unemployment disequilibrium.

The notion that the demand for money is ambiguous or that it can be arbitrarily defined in such a way as to make Walras' law hold is quite disturbing. After all, if the concept of money demand is ambiguous or arbitrary, it would appear that all of the monetary theory is equally ambiguous or arbitrary. This is a most unsatisfactory state of affairs. It is the purpose of this paper to show that the demand for money is well defined in the general theory of market disequilibrium and to clarify the role of money and Walras' law within this context. In the following section a choice-theoretic derivation of the familiar Keynesian model of unemployment disequilibrium is briefly outlined. This derivation is based upon a straight forward application of Clower's dual decision hypothesis. In Section III the relationship between the demand for money and Walras' law is examined within the context of the Keynesian model of unemployment disequilibrium specified in section II. It is demonstrated that the demand for money is not ambiguous and cannot be arbitrarily defined in such a way as to make Walras' law hold. In Section IV an analytic justification for the assumption that the excess demand for money cannot directly affect prices is given. It is demonstrated that the structure of constraints in the disequilibrium model implies the excess demand for money is always equal to zero.

II. A Choice-Theoretic Keynesian Model

In his discussion of the Keynesian model Clower argued that the actual choice of an individual decision-making unit to buy or sell a particular quantity in a given market is constrained by the units' ability to carry out its planned transactions in other markets, as well as by the vector of prices and state of technology with which the unit is confronted. Specifically, he argued that the quantity of consumer goods a household attempts to purchase in the market is determined not only by the price which it must pay for these goods and the wage at which it can sell its labor services, but also by the quantity of labor services the household is able to sell. Presumably a labor market constraint on the quantity of labor that can be sold will have an effect upon the quantity of consumer goods the household will be willing and able to purchase. Once this presumption is recognized, it is necessary to assume that the choices of an individual in one market are determined by the individual's ability to carry out his desired transactions in other markets. This assumption is the essence of Clower's dual decision hypothesis.

If this hypothesis is to provide a choice-theoretic basis for the familiar Keynesian model, however, Clower's model must be extended to include a monetary sector and to provide explicitly for saving and investment behavior. This extension can be accomplished by introducing real balances and real bonds into the utility function in the manner suggested by Patinkin.

For the purpose of this paper, the Keynesian model with rigid wages and an excess supply of labor is specified within a two sector economy[2] (households and firms) with four goods: real-balances (M), real-bonds (B), labor (L), and output (Y) where output consists of both consumption (C) and investment (I) goods. In this economy the general budget constraint faced by the representative household may be written as

$$(B_0 - B)/r + (M_0 - M) + WL + b + q - C = 0, \tag{1}$$

where W is the real wage; B_0 and M_0 are initial holdings of real bonds and real balances; r is the rate of interest; q is real profit income, and b is real interest income. Since there exists an excess supply of labor in the Keynesian model, the representative household's effective demands are derived by maximizing utility subject to (1) and

$$L = \bar{L}, \tag{2}$$

where $\bar{L}$ is the quantity of labor the household can sell and is less than the quantity offered for sale. The behavioral equations implied by this maximization may be written as

$$C^d = C^d(Y, r, B_0, M_0) \tag{3}$$

$$B^d = B^d(Y, r, B_0, M_0) \tag{4}$$

$$M^d = M^d(Y, r, B_0, M_0), \tag{5}$$

where

$$Y = W\bar{L} + b + q. \tag{6}$$

Following Clower (pp. 288-89) and Grossman (p. 951) the household's effective supply of labor is obtained by maximizing utility subject to (1) alone, to obtain

$$L^s = L^s(W, r, B_0, M_0, b, q). \tag{7}$$

Equations (3)-(5) can be referred to as effective demands and (7) as an effective supply in the sense that these equations predict a consistent set of choices made by the household as recorded in the market when the quantity of labor that can be sold is restricted: C^d represents the quantity of consumer goods the household chooses to buy and is equal to actual purchases, because we are only considering a market constraint on the quantity of labor that can be sold and not on the quantity of consumer goods that can be purchased; B^d and M^d represent the real quantities of bonds and money that the household chooses to hold and are equal to end of period holdings, and L^s represents the quantity of labor services that the household offers for sale and is greater than the quantity actually sold because of the labor market constraint.

The representative firm's supply of output, demand for labor, and demand for investment goods can be derived by maximizing the present value of expected future income subject to the production function and various restrictions on costs of adjustment.[3] The behavioral equations implied by this maximization may be written as

[2] The economy envisioned is essentially that described by Tucker (1971) except that the role of government is ignored and, for ease of exposition, it is assumed that firms do not hold money. All bonds are consoles which pay one dollar per year. All profits are paid out to households on a predetermined basis. There are no banks in the system, and households are assumed to hold fiat money, the stock of which is exogenously determined. Since we will use the expedient of a representative firm and household, all micro functions and variables will be viewed as aggregate functions and variables without a change in notation. The price level enters the model in that all real variables are taken to be equal to their nominal value divided by the price of output. The assumption that firms do not hold money is made for ease of exposition and notational convincing only; none of the conclusions of this study depends upon this assumption.

[3] See Eisner and Strotz, and Lucas.

$$Y^s = Y^s(W) \quad (8)$$

$$L^d = L^d(W) \quad (9)$$

$$I^d = I^d(W, r). \quad (10)$$

Given (8)-(10) and the assumption that all income received by firms is paid out to households, the supply of real bonds made available by the firm is completely defined by its budget constraint:

$$(B^s - B_0)/r + Y^s - WL^d - b - q - I^d = 0. \quad (11)$$

By noting that $Y^s = WL^d + b + q$, (11) can be reduced to

$$B^s = rI^d + B_0 = B^s(r, W, B_0), \quad (12)$$

where B_0 denotes the initial stock of real bonds issued by the firm and in the aggregate is equal to the stock of real bonds held by households.

Having specified the above behavioral equations and definitions, we are now in a position to examine the formal structure of the Keynesian model. For the purpose of this paper this structure may be viewed as a set of five equations,

$$Y = C^d(Y, r, B_0, M_0) + I^d(r, W) \quad (13)$$

$$M_0 = M^d(Y, r, B_0, M_0) \quad (14)$$

$$B^s(r, W, B_0) = B^d(Y, r, B_0, M_0) \quad (15)$$

$$Y^s(W) = C^d(Y, r, B_0, M_0) + I^d(r, W) \quad (16)$$

$$L = L^d(W), \quad (17)$$

which, when used in conjunction with the exogenously determined money wage, can be used to solve for four unknowns: the rate of interest, price of output, and the level of output and employment. These five equations denote the equilibrium conditions for the Keynesian model: (13) and (14) denote the familiar IS and LM schedule: (15) and (16) denote the bond and commodity market equilibrium conditions, and (17) denotes that the level of employment is given by the demand for labor in accordance with the assumption of voluntary exchange.

There is, of course, one more equation than there are unknowns to be solved for. This problem can be eliminated, however, in a manner analogous to that derivation of Walras' law in the general equilibrium model. Since voluntary exchange implies $\bar{L} = L^d$ in the aggregate, substituting from (2)-(5) into (1), adding (11) and rearranging yields

$$(I^d + C^d - Y^s) + (B^d - B^s)/r + (M^d - M_0) = 0, \quad (18)$$

the aggregate constraint on the system as a whole.[4] This constraint is a kind of truncated Walras' law which states that the excess demand for output, bonds, and money must sum to zero and implies that if any two of these excess demands are satisfied the third must be satisfied also. Thus we are able to ignore any one of equations (14), (15), or (16) without affecting the properties of the model.

The questions we wish to answer are: "to what extent is the demand for money ambiguous or arbitrary in this model, and what is the role of Walras' law within this context?"

III. The Demand for Money and Walras' Law

The concept of money demand embodied in (3) is that developed by Patinkin and corresponds to what Tucker (1971, p. 66) has called the textbook demand for money. The textbook demand for money is implied by the assumption that real balances enter the individual's utility function. By this assumption the notion that households have a choice to

[4]The existence and derivation of this constraint on the Keynesian model are not well known. Tucker (1972, p. 190) has suggested that Patinkin's discussion of money demand and Walras' law can be made consistent by defining his notion of money demand via equation (18). This suggestion misses the point. When the constraints in Patinkin's model are properly specified, equation (18) is automatically implied. The demand for money in Patinkin's model is implied by the same optimization paradigm that underlies the derivation of all the demands and supplies of his model.

make with regard to the amount of money held, goods consumed, bonds purchased, and labor supplied, and the hypothesis that these choices are interrelated, is highlighted and conveniently organized within a single analytic framework.[5]

The reason for treating the demand for money as a demand for real balances and including money in the utility function, however, goes beyond its convenience. This concept has provided the basis for an integration of monetary and value theory. When real balances are included in the utility function and households are assumed to hold stocks of money, the implied demand equations contain real balances as independent variables. Patinkin has demonstrated that changes in these real balances give rise to real balance effects on the demands of households. Without real balance effects it is exceedingly difficult to explain how changes in the stock of money lead to changes in prices. The existence of real balance effects permits a systematic analysis of the role of money in the process of price determination, in that it allows one to explain how changes in the stock of money causes shifts in demands.[6]

The textbook demand for money, that is, Patinkin's demand for real balances, is well defined for the purposes of analysis. It has proved to be a highly useful and integrative concept within the discipline and has become widely accepted within the context of equilibrium theory. The problem appears to arise within the context of disequilibrium theory.

In the Keynesian model the labor market is in disequilibrium and is characterized by an excess supply of labor. Equations (14)-(16) require the demands for money, bonds, and output to be equal to their respective supplies. Consequently, the sum of the excess demands in the model is less than zero, and Walras' law (which requires the sum of the excess demands to be equal to zero) cannot hold.[7] Tucker (1971, p. 69) has suggested that Walras' law may be saved by redefining what is meant by the "effective" demand for money. If the individual's effective demand for money is defined by substituting his other effective demands into the general budget constraint, when constraints are summed across decision making units, Tucker asserts that the effective excess demands of the system sum to zero, as is required by Walras' law. At this point, however, we are seemingly left with two concepts of money demand: the textbook demand which is implied by the choices of decision making units and for which Walras' law does not hold, and the effective demand which is implied by the budget constraint and for which Walras' law does hold. As a result, both Tucker and Grossman[8] have concluded that the entire concept of money demand is ambiguous and arbitrary. If one takes a closer look at the Tucker-Grossman concept of the effective demand for money, however, it can be demonstrated that this conclusion is unwarranted.

The Tucker-Grossman effective demand for money (M^*) in the Keynesian model is defined

[5]Including money in the utility function does not imply the individual receives real satisfaction from holding money, but only that he can make consistent choices between commodity bundles which contain quantities of money as one of their elements. For a complete discussion of this matter see Lloyd.

[6]Patinkin (Chapter VIII).

[7]This proposition was first demonstrated by Clower.

[8]There is a certain irony in Grossman's defining the effective demand for money as being given "by the budget constraint." In giving this definition of money demand he violates his own rule:

> The model thus assumes that the individual always demands—that is to say, strives to achieve—the quantity which, given his perceived constraints in other markets, he calculates to be optimal, although this optimal quantity may exceed his perceived constraints in its own market. (Grossman, p. 951)

Following this rule, the effective demand for money (in Grossman's notation) is given by $n_i'(\bar{y}_i, b_i')$ when the individual is constrained in the goods market and by $n_i'(y_i', \bar{b}_i)$ when constrained in the bond market. If the individual is constrained in both the goods and the bond markets, the effective demand for money is given by $n_i'(\bar{y}_i, \bar{b}_i) = -(\bar{y}_i + \bar{b}_i)$, a case which Grossman has failed to consider. Each of these demands corresponds to the textbook demand for money for different cases of market disequilibrium.

by substituting (3)-(5) and (7) into (1) and rearranging to obtain

$$M^* = M_0 + (B_0 - B^d)/r + WL^s + q + b - C^d. \quad (19)$$

As defined by (19), M^* represents the quantity of money the household will choose to hold if all of its other effective demands are satisfied. There is, however, a number of reasons when this concept of money is objectionable.

First, contrary to Tucker's (1971, pp. 78-79) assertion, the effective demand for money so defined cannot be treated empirically. The reason for this is that households can never be observed choosing to hold a quantity of money equal to M^* if the household is confronted with a labor market constraint on the quantity of labor that it can sell. This would require by way of (19) that all of the household's effective demands be realized. But the derivation of C^d and B^d presupposes that L^s is not realized in that L^s is not the quantity of labor sold but rather the quantity offered for sale. As a result all three of these relationships cannot be satisfied without violating the assumption that the labor market is in a state of excess supply, and households cannot actually choose to hold a quantity of money equal to M^*.[9]

Second, accepting M^* as the effective demand for money implies that Walras' law holds in the Keynesian model only in a tautological sense. In the economy outlined above the aggregate constraint on the firm sector is given by (11). Adding (19) and (11) and rearranging yields

$$(I^d + C^d - Y^s) + (B^d - B^s)/r + W(L^d - L^s) + (M^* - M_0) = 0. \quad (20)$$

This equation appears to demonstrate that the sum of the excess demands in the system is equal to zero. However, it is important to recognize that (20) is not simply a statement about the actual excess demand as measured in the market place, but rather a statement about these market excess demands and a demand for money which is defined in such a way as to make (20) hold. As a result the statement is circular and empty, as are all statements that are true by definition.[10]

Third, M^* does not solve the extra equation problem in the Keynesian model. Equation (20) can be used by substitution to eliminate either the excess demand for output or bonds from the model. However, in doing this we introduce the excess effective demand for money $(M^* - M_0)$ and the excess supply of labor $(L^s - L^d)$, neither of which is formally required to solve the system. In addition, we are still left with the other market clearing equation and the excess textbook demand for money $(M^d - M_0)$. The theory of choice underlying the Keynesian model implies a demand for money that has the same legitimacy as any other demand in the model. Simply defining M^* does not allow us to ignore M^d. We are still left with one more equation than there are unknowns. The redundant equation can only be eliminated via (18).

Defining the effective demand for money by substituting the other effective demands and supplies into the budget constraint does not lead to an empirically meaningful behavioral relationship, does not imply Walras' law in a meaningful sense, and does not solve the extra equation problem; M^* is a kind of appendage, an ad hoc construct that serves no useful purpose. When viewed from this perspective, the assertion that the concept of money demand is ambiguous or arbitrary is clearly unfounded. Only the Keynesian case of unemployment disequilibrium has been considered, but extension of the arguments to the other cases is straight-forward.

Up to this point only the static structure of the disequilibrium model has been discussed. Having clarified the money demand-Walras' law ambiguity within this context, we are now in a position to consider the role of money in dynamic disequilibrium analysis.

IV. Money Excess Demand and Dynamic Disequilibrium Analysis

Both Tucker (1972) and Grossman have excluded the excess demand for money from their dynamic analysis of disequilibrium behavior. The legitimacy of this exclusion is not at all self evident, as the liquidity preference-loanable funds debate bears witness. And yet, no analytic justification for excluding the excess demand for money is given (presumably because of the confusion over the demand for money), and no such justification can be found elsewhere in the literature. However, if one examines the structure of constraints in the disequilibrium model, an analytic justification can be found, and it is possible to explain why the excess demand for money cannot directly influence prices. The reason is the structure of constraints in the disequilibrium model implies that the excess demand for money is always equal to zero.

In the Keynesian case of labor market disequilibrium the aggregate constraint on the system, equation (18), states that excess demand for money, bonds, and output sum to zero. The derivation of this constraint, however, presupposes that the excess demands for bonds and output are each equal to zero, since it is assumed that each of these markets clear. Therefore, the aggregate constraint on the system implies that the excess demand for money is also equal to zero.

If either the excess demand for output or bonds is not equal to zero we no longer have the Keynesian case. The behavioral equations specified above can no longer be assumed to predict economic behavior, because the optimization problem from which these equations are derived ignores at least one binding constraint on the choices of decision making units. The structure of the model is changed, and the behavioral equations and equilibrium conditions must be respecified. How does this structural change affect the excess demand for money if, in addition to an excess supply of labor, the rate of interest fails to adjust to clear the bond market causing an excess demand for bonds? To answer this question we need only consider the aggregate constraint on the system for this particular case of market disequilibrium.

If only the goods market clears, and in addition to an excess supply of labor there exists an excess demand for bonds, maximizing utility subject to (1) and (2) no longer corresponds to the problem of choice faced by households. At the existing money wage and rate of interest households are not only constrained by the quantity of labor that can be sold but also by the quantity of bonds that can be purchased. The representative household is forced to maximize utility subject to (1), (2), and

$$B = \bar{B}, \quad (21)$$

[9] Tucker (1972, p. 78) has argued that under certain disequilibrium circumstances the textbook demand for money is only a hypothetical preference that is not expressed and hence is not observable. This argument presumably refers to the change of structure problem involved in going from one state of market disequilibrium to another. Interpreting the textbook demand as the demand implied by including real-balances in the utility function renders this observation incorrect. When properly specified for each state of market disequilibrium, the textbook demand is never hypothetical.

The Tucker-Grossman effective demand, however, is always hypothetical when the system is in disequilibrium. It is the quantity of money the household would choose to hold if all of its effective demands and supplies were realized. Disequilibrium implies that some of these effective demands and supplies will not be realized. It is, of course, possible to calculate M^* by observing the other effective demands and supplies and substituting in (19), but it would still make little sense to estimate equation (19). Equation (19) is a definition and definitions are identities. Identities are not behavioral relationships and there is no need to estimate them as such.

[10] In the Walrasian general equilibrium model Walras' law is clearly not a tautology implied by a definition. It is a theorem derived from the hypothesized constraints of the system. Whether or not the behavior of decision making units is actually determined by these constraints is empirically verifiable. As a result Walras' law is a statement about the actual excess demands as measured in the market and is, in principle, also empirically verifiable. Cf. Clower (p. 295n) and Leijonhufvud (pp. 87-89).

where $\bar{B}$ is the quantity of bonds the household is able to purchase and is less than the quantity the household offers to purchase. The demand for money and consumer goods implied by this maximization can be written as

$$M^d* = M^d*(Y, r, \bar{B}, B_0, M_0) \quad (22)$$

$$C^d* = C^d*(Y, r, \bar{B}, B_0, M_0). \quad (23)$$

where $\bar{B}$ becomes an independent variable in these two behavioral relations. Since voluntary exchange implies $\bar{L} = L^d$ and $\bar{B} = B^s$ in the aggregate, the aggregate constraint on the household sector can be derived by substituting (2) and (21)-(23) into (1) to obtain:

$$C^d* + (B^s - B_0)/r + (M^d* - M_0) - WL^d - b - q = 0. \quad (24)$$

The firm is on the long side of the bond market and is uneffected by the excess demand for bonds. As a result the aggregate constraint on the firm sector is still given by (11). To obtain the aggregate constraint on the system as a whole (11) is subtracted from (24) to obtain:

$$(C^d* + I^d - Y^s) + (M^d* - M_0) = 0. \quad (25)$$

This constraint states that the excess demand for output and money sum to zero. Its derivation presupposes that the excess demand for output is equal to zero, since it is assumed that the goods market clears. Therefore when there exists an excess supply of labor and an excess demand for bonds, the aggregate constraint on the system implies the excess demand for money is equal to zero as in the Keynesian case.

In the three-market economy under consideration we have only considered two of the twenty-six conceptually possible cases of market disequilibrium. There is little to be gained, however, by going through a formal derivation of the aggregate constraint on the system for the remaining twenty-four cases. The algebra of the situation is such, that whenever a market fails to clear, the quantity transacted in that market is given (in accordance with the assumption of voluntary exchange) by the short side of the market. This quantity appears in both the firm and household sector's constraints. When these two constraints are aggregated the quantities transacted in disequilibrium markets cancel. The aggregate constraint on the system states that the sum of the excess demands in those markets which clear plus the excess demand for money is equal to zero. Since the excess demand in each market that clears is by definition equal to zero, in each case of market disequilibrium the structure of constraints in the disequilibrium model implies the excess demand for money must be equal to zero also.

V. Summary of Conclusions

The purpose of this paper has been to clarify the role of money and Walras' law within the general theory of market disequilibrium. It has been demonstrated that the theory of choice underlying the disequilibrium model implies Patinkin's textbook demand for money and that this concept of money demand is well defined and unambiguous. It has also been demonstrated that Walras' law is irrelevant to disequilibrium analysis and cannot be made to hold in the disequilibrium model by arbitrarily redefining what is meant by the demand for money. Such a redefinition (1) implies Walras' law only in a tautological sense, (2) does not allow us to reduce the number of equations in the disequilibrium model, and (3) leads to a concept of money demand that is empirically meaningless. It has been further demonstrated that the structure of constraints in the disequilibrium model implies that corresponding to each case of market disequilibrium there exists an aggregate constraint on the system as a whole, which states that the sum of the excess demands in those markets which clear plus the excess demand for money is equal to zero. As a result, (1) in the analysis of each case of market disequilibrium the number of equations can be reduced either by one of the market clearing equations, or by the excess demand for money equation, without affecting the properties of the model, and (2) the excess demand for money in the disequilibrium model is always equal to zero and can have no direct effect on the process of price formation.

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