

The Finance Constraint Theory of Money: A Progress Report

Meir Kohn*

Dartmouth College

The theory of money that emerged from the Keynesian Revolution is coming increasingly into question, and a variety of new theories are being put forward as alternatives. The most promising is one I will call the finance constraint theory. This paper is a progress report on its development. It is particularly fitting that this progress report appear in a *festschrift* for S.C. Tsiang, as he has been one of the most cogent critics of the conventional theory and a major architect of the finance constraint alternative.

The issues a theory of money should address may be divided into three broad areas: (1) What is money and how is it special? (2) What is the connection between money and its various "prices" (the general price level, interest rates, and exchange rates)? (3) What is the role of money in economic fluctuations? After some introductory material, each of these areas will be taken up in turn.

I. THE CONVENTIONAL THEORY AND ITS PROBLEMS

The theory of money that is generally taught today has its intellectual origins in two works of the 1930s—Hicks' "A suggestion for simplifying the theory of money" (1935) and Keynes' liquidity preference theory of interest (Keynes, 1936).¹ Although the motivation in each case was somewhat different, the theoretical frameworks are very similar.

Hicks' motivation was essentially methodological—to integrate money into the framework of constrained individual choice. To do this, he formulated a portfolio problem in which wealth is allocated across assets in the same way that income is allocated across goods in the standard consumer problem. In the context of this portfolio problem, money

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¹This is as true of Friedman's "Monetarism" as it is of work more avowedly Keynesian (see Patinkin, 1974). Attempts to provide a distinct theoretical framework for Monetarism have largely been judged a failure (Wood, 1981)

is seen as neither more nor less than one particular asset: its role as medium of exchange is relegated to the background as part of the tastes implicitly underlying demand.²

Keynes' motivation was different. He needed a new theory of the interest rate to close his *General Theory*, having transformed the traditional theory, based on saving and investment, into a theory of income determination. Keynes built his new theory of the interest rate on the speculative demand for money that he had developed in the *Treatise* (1930).³ This new theory meshed well with Hicks' theory of money. In both, money is seen primarily as an asset, and supply and demand in the "market for money" are seen as determining the "price" of this asset—the rate of interest.⁴

In the theory of money that grew out of these two works, which I will call the *liquidity preference theory*, the central construct is the demand for money. This interacts with supply in a metaphorical "market" for money.⁵ Models are generally aggregative, analyzing the market for money either alone or as an adjunct to some sort of Keynesian macro model or neoclassical growth model. Although the theory was not formally derived from any microeconomic foundations, it was widely believed that Patinkin's "integration of monetary and value theory" had provided a valid underpinning.

The liquidity preference theory came under attack in the late 1960s, most notably by Clower (1967, 1968, 1970), Hahn (1965, 1969, 1971), and Tsiang (1966, 1969), on what were essentially logical grounds. It was not initially any empirical failure that brought it into question, but rather its failure to meet certain standards of coherence and logical consistency. All three critics attacked both the superstructure of the theory, with its positive and normative results on inflation and growth, and the implicit foundations in the work of Patinkin for basically the same reason: none of the models gave formal expression to what it was that money actually did. The problem with the liquidity preference theory was its "neglect of the nature of the technology of monetary exchange" (Clower, 1971, p 36). The *function* of money had been pushed too far into the background. If the function

²See Hicks (1982, p 8). Looking at money in this way, as no more than a particular asset, was the culmination of a line of development, associated principally with Cambridge, that had run from Marshall's cash-balance version of the quantity theory through the speculative demand for money of Keynes' *Treatise* (1930) (see Laidler, 1986, and Bridel, 1987). It was indeed the latter that provided Hicks with his point of departure.

³For more detailed discussion see Kohn (1986).

⁴In Friedman's work the "price" is the general price level; in the monetary approach to the balance of payments, it is the exchange rate.

⁵So pervasive has this theory become that it is hard today to remember that the "market for money" is indeed a metaphor, a theoretical construct, and one that would have seemed strange to earlier generations of monetary theorists.

of money was given no formal expression, how could even the positive results, let alone the normative, be taken seriously?⁶

Specifically, Clower (1967) showed that in Patinkin's formal model "money" was no more a means of payment than any other good. Supposing, for example, a rigid money wage and an excess supply of labor, an increase in the endowment of labor would have the same effect in increasing demand and so employment as would an equivalent increase in holdings of money. Furthermore, Hahn (1965) showed that Patinkin's economy possessed an equilibrium in which money had no value, implying that the economy could function perfectly well with no money at all. Clearly, whatever it was that Patinkin believed money did, that function found no formal expression in his model.

The aggregative models were no better than their microfoundations. In them, an asset called "money" was typically tacked on to a "nonmonetary" neoclassical growth model. Many of the results were paradoxical: welfare was reduced by the "introduction" of money; inflation was possible with a constant quantity of money, and such an inflation could be moderated by monetary *expansion* (Howitt, 1973, and Goldman, 1972).

In a paper that was to prove seminal, Clower (1967) suggested, as a way out of this confusion, a different way of modelling money. He suggested that the standard budget constraint of value theory be replaced by a more complicated set of finance constraints to ensure that *in the model* all purchases be made with money. This would give formal expression to the essential and unique function of money—its role as medium of exchange.⁷

Of course, the idea of seeing money essentially as a medium of exchange, and of downplaying or even ignoring its role as an asset, was not new. It had been characteristic of Classical monetary theory before the rise of the Cambridge School and its culmination in the liquidity preference theory of Hicks and Keynes (Laidler, 1986, 1989). That older tradition had continued in the work of Dennis Robertson, a major early critic of the liquidity preference theory, and in that of S.C. Tsiang. Indeed, in 1966, Tsiang had published a

⁶This is not to say that Friedman and Patinkin had nothing to say about the economic role of money: both discussed it at length. However, their *formal* models were quite silent on the subject, and this silence was deliberate: explicit modelling of the technology of exchange "was unnecessary for understanding monetary relationships, just as it was unnecessary to describe the technology of pin-making when analyzing the price/output behavior of firms in the pin-making industry" (Friedman, responding to Clower, in Clayton et al, 1971, pp. 2 and 36).

⁷Much earlier, Brunner (1951) had argued that Patinkin's method of placing real balances in the utility function was sufficient but *not*, as Patinkin claimed, necessary for a resolution of the "classical dichotomy." Brunner suggested as an alternative, a constraint, additional to the overall budget constraint, that would restrict the rate of utilization of money (and so spending). The ground proved infertile for this idea at the time—it was the solution to a problem that was not yet perceived to exist—and a quarter of a century was to pass before Clower's very similar suggestion was to take root successfully.

paper, very much in the Robertsonian tradition, that went considerably beyond Clower's in its treatment of finance constraints.⁸

Nonetheless, it was Clower's paper that caught the imagination of the profession and gave rise to a substantial literature on the "New Microfoundations" of money. This literature was concerned primarily with justifying the *existence* of finance constraints: little attempt was made to apply them to substantive questions. Indeed, Barro and Fischer, reviewing this literature in 1976, were moved to comment, "It is not clear where, if anywhere, it will lead... It is doubtful that [it] will have any major consequences for the way in which macro-models are built." This rather pessimistic assessment proved to be wrong because of another theoretical development of the 1970s, the New Classical Revolution.

There are two reasons why the New Classical Revolution gave renewed impetus to the finance constraint approach—one methodological, the other substantive.

A major element, some believe the essence, of the New Classical Revolution was its rejection of broad-brush aggregative models, subject to the "Lucas critique" in favor of simple optimizing models firmly grounded in tastes and technology. In building such models, the question naturally arose of how to model money in a structural way. Clower's finance constraint was conveniently at hand to provide a ready-made answer: money should enter the model via a carefully specified technology of exchange. As Clower and Hahn had pointed out, the liquidity preference theory had produced models of precisely the type rejected by the New Classical school: asset demands, including the demand for money, were postulated directly, rather than being derived formally from any "deep structure."

For different reasons, finance constraints also proved appealing to many *critics* of the New Classical economics. While conceding the methodological flaws of the aggregative Keynesian model, many found the alternative New Classical model of a perfectly coordinated economy unconvincing. But if the economy was not perfectly coordinated, why not? Why was coordination in the real world more of a problem than it was in the New Classical model? One possible answer lay in the incompleteness of financial markets

⁸A major failing of Clower's treatment was its attempt to describe a dynamic process with a static equilibrium model. The two parts of Clower's dichotomized budget constraint were never explicitly linked up, as they could not be without adding a time dimension to the model. One result was an unsatisfactory, if unavoidable, reticence about the capital market: the introduction of a capital market in this static model would have reduced the dichotomized budget constraint to the usual single one. Tsaing's paper, on the other hand, was fully dynamic and included a capital market.

as a consequence of asymmetric information and transactions costs. Incomplete financial markets implied finance constraints, among them finance constraints involving money.⁹

II. THE FINANCE CONSTRAINT THEORY

The finance constraint theory begins explicitly with precisely the "deep structure" that the liquidity preference theory leaves implicit. The *function* of money is central rather than its value as an asset.¹⁰

Because of problems of asymmetric information, agents are constrained in their ability to command current resources by more than simply their subjective evaluation of some intertemporal budget constraint. There is a system of monetary-financial institutions whose purpose is to deal with these informational problems and to regulate individuals' current spending—their exercise of "effective demand." Money is part of this system of regulation.

It is easiest to illustrate the finance constraint theory with a simple "cash-in-advance" model (similar to one first suggested by Howitt, 1973 and 1974):

Individuals receive a weekly endowment of goods "as manna from heaven." The endowment is specialized, but individuals wish to consume a broad spectrum of goods. Problems of asymmetric information are so severe that they preclude any kind of credit, so a *quid pro quo* is required for each exchange. An efficient arrangement in such circumstances (see Section III below) is a system of trade involving "shops," with the *quid pro quo* requirement being met by individuals paying for their acquisitions with money.

At the beginning of each "week" individuals deliver to shops the quantities of goods they wish to exchange for other goods. During the week they go from shop to shop to obtain the goods they want in exchange for the ones they have given up (each shop is specialized in a small subset of goods). Prices are assumed to be at their equilibrium levels.¹¹

If individual i holds an amount of money M_{it} at the beginning of week t , his acquisitions are constrained by

$$(1) \quad \sum_{n=1}^N p_n^t d_{in}^t \leq M_{it}$$

where p_n^t is the current money price of good n , and d_{in}^t is the current acquisition of that good.

⁹Cf. Gertler (1988).

¹⁰Although, of course, money still *is* an asset (it must be, to fulfill its function), and in the finance constraint theory, too, as we shall see, its nature as an asset is important to its properties.

¹¹Attention focuses here on the technology of exchange to the neglect of price determination; the theory of value does just the reverse, focusing on price determination, to the neglect of the technology of exchange.

The money that shops collect in this way is paid out at the end of the week to those who supplied the shops with goods, s_{in}^t , at the beginning of the week. Hence,

$$(2) \quad M_{it} = \sum_{n=1}^N p_n^{t-1} s_{in}^{t-1}.$$

Note that the money constraining purchases in week t according to (1) originates in the sales of the *preceding* week. Goods currently offered for sale do not contribute to current purchasing power; they will do so only after they have been sold.¹²

Simple cash-in-advance models like this are sometimes viewed as embodiments of a simplistic, "only money matters" view of money and credit. This is not the case. They are, rather, crude examples of a functional theory of financial institutions in which money is but one extreme of a money-credit continuum. As we shall see in Section III, the fundamental structure underlying all financial institutions—the problem of asymmetric information—is essentially the same.

The generalization of the simple cash-in-advance model to include a broader range of financial institutions—consumer credit, trade credit, the borrowing of money from others, or the sale of other assets for money—is fairly straightforward. This generalization has several important implications. First, agents no longer face a strict cash-in-advance constraint: there is no longer any necessary connection between the cash with which they enter the period and the purchases they may make. Even if they must pay for their purchases with cash, they may borrow this cash from others.¹³ (Hence, I prefer the name *finance constraint* for the general class of model, reserving the term "cash-in-advance constraint" for models with no asset markets.) Second, the introduction of other assets removes one major source of potential misinterpretation of the simple cash-in-advance model. Since money is the only store of value in that model, money-holding is inextricably mixed up with saving, making it hard to separate money-holding behavior from saving behavior. For example, Lucas (1980) and Helpman (1981a) use this type of simple model, with

¹²Cf Robertson (1933):

I assume the existence of a period of time, to be called a "day," which is finite but nevertheless so short that the income which a man receives on a given day cannot be allocated during its course to any particular use. A man's disposable income—the income about which the question arises on any particular day as to whether it shall be "saved" or "spent"—is thus the income received not on that day but on the previous one.

¹³There is one specification in which assets are "illiquid" in that they exacerbate rather than relieve the cash-in-advance constraint (see Kohn, 1981a). Most work has used "liquid asset" specifications, but Helpman and Razin (1985) use an illiquid asset model to examine the effect of the volume of financial transactions in a given currency on its rate of exchange. Salyer (1985) shows that, unless agents are heterogeneous, so that asset trade actually takes place, these different specifications produce identical equilibria.

income or tastes uncertain, to study the precautionary demand for money. They obtain results very reminiscent of those obtained by Foley and Hellwig (1975) in a study of *saving* behavior when income is uncertain.¹⁴

Although asset markets relieve the cash-in-advance constraint on the individual, there remains a cash-in-advance constraint on *aggregate* spending (see Kohn, 1981a). Individuals may redistribute the total money available to be spent among themselves by trading assets, but that total still constrains what all of them taken together may spend. While individuals need not be aware of this aggregate finance constraint, their behavior will be made consistent with it through their response to its "shadow price," the rate of interest.

The peculiar properties of finance constraint models are the result of the difference between the set of constraints in these models and the simple present-value intertemporal budget constraint agents face in a model with complete financial markets.

The first such property is a "wedge" between purchase price and sales price. Payment for goods with money implies a lag between the sale of goods and the subsequent purchase of goods (or, for firms, between the purchase of inputs and the sale of output). If agents exhibit time preference, or if the value of money is changing, this "time wedge" between sale and purchase will imply a price wedge (Wilson, 1979; Kohn, 1984).

For example, for the simple cash-in-advance model, combining (1) and (2) (assuming that all money is spent), we have

$$(3) \quad \sum_{n=1}^N p_n^{t-1} \left(s_{in}^{t-1} - \frac{p_n^t}{p_n^{t-1}} d_{in}^t \right) = 0 .$$

Note that this time-wedge will be present even if the individual cash-in-advance constraint is not binding—if agents can borrow and lend freely, for example.

This "distortion" will in general be a source of "inefficiency": marginal rates of substitution will differ as agents face different relative prices, depending on what they buy and sell, and depending on the length of their trading intervals.¹⁵ Great care must be taken, however, in drawing normative conclusions. Inefficiency relative to what? Costless instantaneous trade in the absence of informational problems? We will return to this in the discussion of the optimum quantity of money in Section IV.C.

¹⁴Cf. Hahn (1982, p 24): "A surprisingly large number of recent papers that have taken money to be the only means of intertemporal substitution have thereby missed some of the central issues of the subject, apart from providing a very unrobust theory..."

Foley and Hellwig have a positive-net-worth constraint in place of a finance constraint. Their model actually began life as a model of the demand for money, but the authors rightly concluded that such an interpretation was invalid.

¹⁵This distortion considerably complicates proof of the existence of an equilibrium (Townsend, 1987).

The existence of this time wedge between purchase and sale is fundamental to finance constraint models. If purchases and sales were simultaneous, the finance constraint would disappear, goods would buy goods directly, and money would have no explicit role in the formal model as a medium of exchange.

The second basic property of finance constraint models is present only if finance constraints are binding, so that agents face a sequence of constraints, rather than a single intertemporal budget constraint (in Hahn's term, if we have a "true sequence economy"). In this case, the circular flow of payments from one agent to another becomes important, the spending of one agent affecting the constraints of others, causing multiplier effects. These multiplier effects result in certain kinds of dynamics—self-fulfilling-expectations "sunspot" equilibria and chaotic dynamics—that are absent from models with complete financial markets (more on this in Section V).

Note that care must be taken to link up finance constraint models in an internally consistent way, so that money spent by one agent is received by another. This can be a particular problem for representative agent models;¹⁶ a finance constraint model really requires a heterogeneity of agents, so that the money outflow of one can be matched by the money inflow of another. This heterogeneity, the basis for various distribution effects that cannot occur in a representative agent model, often turns out to be important and we will see later that it underlies some important results.

How important are finance constraints empirically? Some evidence has been provided by work, not directly related to the theory of money, on the "excess sensitivity" of consumption to current income and of investment to current earnings. This work has confirmed the importance of finance constraints for many consumers and firms (Deaton, 1986; Fazzari, Hubbard, and Peterson, 1987).

III. MICROFOUNDATIONS

Clower's 1967 paper stimulated a flurry of activity in the early 1970s on the foundations of monetary theory.¹⁷ Since a recent survey by Ostroy and Starr (1988) provides an excellent discussion of this work, I will only summarize here its broad conclusions.

¹⁶The models of Grandmont and Younes (1972, 1973), Fried (1973), Stockman (1981), and Feenstra (1985) could be criticized on these grounds. Akerlof (1973), while he does not explicitly talk of a finance constraint, is very much concerned with closure of his model in terms of the circular flow of payments.

¹⁷To be distinguished from the literature on quantity-constrained real equilibrium that grew out of Clower (1965). This latter literature is surveyed by Drazen (1980) who notes that in it money plays no essential role.

The New Microfoundations literature differs from earlier work, for instance that of Baumol and Tobin, in looking at money from a social rather than from purely an individual point of view. For the individual, money is just the most liquid of assets, and the theory of money is grounded in the inventory and portfolio problems of the individual. Such a theory, for example, understands the effects of inflation in terms of a distortion of individual portfolios. The New Microfoundations literature, on the other hand, sees money as an institution enabling the division of labor and multilateral trade in a world of asymmetric information and transactions costs. The effects of inflation, using the same example, are to be understood, in this case, in terms of the damage done to this institution and in the consequent reduction in the scope of trade.

The key to understanding money lies in the difficulties of decentralized multilateral trade: rather than trading with a Walrasian auctioneer, individuals must trade with one another. Widespread specialization will generally preclude a double coincidence of wants, so that delivery of good A today to one individual must be balanced by receipt of good B from some other individual at some other place and time. Such an arrangement inevitably poses the problem of honesty or trust (Howitt, 1973; Shubik, 1973; Ostroy and Starr, 1974; Lucas, 1980; Gale, 1982). An individual having traded future delivery of good B for current delivery of good A faces a "time consistency" problem: once he has received and consumed A, it becomes tempting for him to go back on his promise to deliver B.¹⁸

Clearly some method must be found to guarantee performance. Simple bilateral contracts will not do, because, apart from the cost, it is of the essence in this sort of decentralized multilateral trade that at the time good A is delivered, the nature of good B and the identity of its future supplier may be quite unknown. All that is known is that the system is obliged to provide to the individual giving up good A something of equal value later and that the individual taking delivery of good A has a reciprocal obligation to provide something of equal value to the system.

While, in principle, this could all be organized by a centralized system of clearing and monitoring, the informational and computational costs would seem prohibitive.¹⁹ In the absence of such a centralized system, a simple *decentralized* solution is to obviate any *need* for trust or record-keeping by insisting that each trade be self-enforcing, that the individual receiving good A give up to the supplier something of equal value, a *quid pro quo*.

¹⁸Ostroy (1973) calls this a problem of "behavioral feasibility." Gale (1982) treats the trust problem in terms of a "sequential core" which cannot be "blocked" by a single individual opting out of his commitments.

¹⁹The existence of such a system is simply assumed in the "moneyless" models of the type discussed by Fama (1980) and Black (1970).

The question, then, is how this requirement for a *quid pro quo* might best be satisfied. One possibility is bilateral barter involving intermediate trades in unwanted goods. However, this may be infeasible, even if equilibrium prices are known, certainly if they are not; in any case, it is unlikely to be efficient. The use of some standard means of payment—one good serving as a *quid pro quo* in all trades—makes the attainment of a desirable allocation possible, or, if it is already possible, reduces the cost of attaining it (Ostroy, 1973; Jones, 1976; Ostroy and Starr, 1976; Feldman, 1973; Harris, 1979; Oh, 1986; Iwai, 1988). Token money, of little or no intrinsic value, makes an efficient and inexpensive means of payment.²⁰ It acquires value precisely because it is required as a means of payment in all trades. Of course, to perform this function well it is essential that the value of money in terms of goods remain stable.²¹

Individuals having to meet a *quid pro quo* requirement will face a sequence of budget constraints rather than a single present-value constraint over all time as in an Arrow-Debreu economy.²²

Understanding money in this way, as a social institution not fully comprehensible from the point of view of a single individual, leads one naturally to thinking about monetary problems in terms of externalities. Individually optimal behavior may not be socially optimal. External effects may justify policy interventions.²³

²⁰Money can be seen as relaxing the requirement for a "real" *quid pro quo*: it is a sort of "dummy" *quid pro quo* that enables trade to be carried out through a sequence of "half-barter" transactions (Koopmans, 1933).

²¹Cf. Gale (1982) who considers a finite-horizon model in which agents receive a sum of money from the "planner" at the beginning, that must be returned to him at the end:

[M]oney acts as a store of information. By arranging appropriate trades in money the planner can keep track of how much each agent has got out of the system in the past. Agents would like to pretend they were someone else but the terminal constraint on money holdings prevents them from doing this advantageously. Their money holdings provide just enough information to allow the planner to find out who they are; but the striking thing is that he can only do this if he treats money as if it had a uniform market price and uses it to "balance budgets"...

The existence of money provides a kind of collateral. To get goods today an agent has to give up money; to get his money back tomorrow he has to give up goods. [p 327]

²²Cf. Gale (1982, p 189):

Without a sequence of budget constraints there is no need for money or any other financial asset. The absence of trust explains both the need for a sequence of budget constraints and the difference between money and its closest substitutes. In this sense and in the theory of general equilibrium it appears to be the fundamental distinguishing characteristic of money as an asset.

In short, in general equilibrium models, the absence of trust leads to a sequence of budget constraints which leads to the use of assets. Money is the asset which imposes the least cost of gathering information and, in general equilibrium, these information costs must be chiefly the costs of determining the trustworthiness (in the broadest sense) of the issuer of the asset. This disposes of the question of why other assets will not do just as well as money...

²³This view of money as a social institution is close to that of Simmel—see Laidler and Rowe (1980)

Now clearly trust is not *always* impossible. In some circumstances—for instance, those involving continuing relationships—a promise to pay, rather than immediate payment, may be acceptable. Goodhart (1975) makes the useful distinction here between *media of exchange*—"those assets, or claims, whose transfer to the seller will commonly allow a sale to proceed"—and *means of payment*—for which, following the exchange, the seller considers that final payment has been made for the sale items (a *quid pro quo* has actually been received).

Empirically, it may be useful to think of fiat base money as being the unique means of payment, as being *definitive* money, with other *convertible* moneys (e.g., checkable deposits, traveller checks) and money substitutes (credit cards) representing titles to definitive money or ways of transferring title to it (see Robertson, 1922, and Osborne, 1984 and 1985). The use of convertible moneys and money substitutes may then be understood as ways of economizing on the costly holding and transfer of definitive money. While definitive money is unique as a (non-barter) means of payment, checks, credit cards, trade credit, etc., are all media of exchange.²⁴

While work continues on the microfoundations of finance constraints, it seems safe to say that these microfoundations have been fairly well established. The question then arises of how much of these microfoundations to bring into a particular model.

It is now fairly widely recognized that it is desirable to build models "from the ground up," beginning with tastes and technology, rather than specifying *ad hoc* functions or restrictions (e.g., arbitrarily rigid wages). Some work using finance constraints has been criticized as being *ad hoc* in this sense: although the microfoundations exist in principle, they are not spelled out in the model. The question, of course, is how structural does the model need to be for a given purpose? While it is clear that one could always start from the basic asymmetric information problem, the result would generally be cumbersome and unwieldy. For many purposes, especially positive ones—for instance, exhibiting the macro properties of a finance-constrained economy—it seems quite legitimate to *begin* with finance constraints, knowing that the structural story is there in the background. For other purposes, particularly normative ones (a good example is the optimum quantity result discussed below in Section IV.C), the full structure needs to be there from the beginning. The key, of course, is whether or not possible endogenous changes in the *nature* of the finance constraints may affect the validity of the results.

²⁴Gorton (1987) looks at media of exchange other than definitive money as contracts. He then asks what properties are required of convertible moneys in order for them to represent enforceable contracts.

IV. MONETARY THEORY

A. The demand for money

The demand for money, the supply of money, and the "market for money" are the central theoretical constructs of the liquidity preference theory. Explaining and estimating demand, and understanding and measuring supply, are at the top of its research agenda.²⁵

For the finance constraint theory, however, money-holding behavior is not of the same major importance. Money is understood in terms of its *function* rather than in terms of its quantity, and, from this point of view, the "market for money" analogy does not turn out to be particularly useful. As a result, finance constraint models often specify money-holding behavior in a fairly crude way.²⁶

To understand the basic difference between the two approaches, consider their respective treatments of the relationship between expenditure and the holding of money. For the liquidity preference theory, the holding of money is primary—the object of an active decision by agents on how much of their wealth to hold in this form. If agents wish to hold more or less than they actually possess, expenditure will fall or rise in response (the "real balance effect"). For the finance constraint theory, on the other hand, it is expenditure that is primary: the holding of money is a secondary consequence of decisions about sales and purchases. Agents will hold enough money to enable them to carry out their trading plans, and their attempts to acquire more money for this purpose, or dispose of the excess, will affect asset prices. Money received in exchange for sales, rather than being "demanded" as a portfolio investment, is passively "accepted" pending future disposal. Indeed, in simple finance constraint models (like the one of Section II) there is *no* demand for money as an asset. In more complicated models, a precautionary or speculative demand can be engineered, but it is a wrinkle, not the centerpiece as it is in the liquidity preference theory.²⁷

²⁵Seeing the primary purpose of monetary theory as being the basis for the aggregate money demand equation—just as investment theory is the basis for the aggregate investment function, and consumer theory for the aggregate consumption function—is part of a general Keynesian approach to macroeconomics that is increasingly losing favor.

²⁶This view of money also suggests that data on money flows may be more interesting than those on money stocks. Copeland's (1947, 1952) study of "moneyflows" was motivated by just such a view. Although the current flow-of-funds data are restricted to financial flows, Copeland had originally hoped to capture empirically the whole circular flow of money payments through the economy. This attempt found itself orphaned as the liquidity preference theory became predominant.

²⁷See Chick (1987) on the distinction between a voluntary demand for money and the passive acceptance of it, and on Hicks' own recent doubts on whether or not the "demand for money" is a useful description of money-holding behavior. The distinction between the demand for money and the passive acceptance of it, was, of course, at the heart of Tsiang's (1966) resolution of the liquidity-preference/loanable-funds controversy.

Money, then, is held primarily for transactions purposes. The dollar amount held, as noted by Robertson (1938) and Tsiang (1966), is related to the dollar value of planned expenditure. Only in the long run, in a stationary, closed economy, is this equivalent to the liquidity preference formulation of a demand for real balances dependent on real output or real wealth (see Tsiang, 1977, and Grossman and Weiss, 1983).

In an open economy, money will be held to finance imports and exports. Even when foreign trade is balanced, changes in the volume of trade may affect the relation between total transactions and income (Tsiang, 1977, shows empirical evidence of such effects for Taiwan). McKinnon (1979) has remarked on the importance of the choice of currency of invoice and of financing practices, and Townsend (1983) and Helpman and Razin (1985) have explored some of the implications in formal finance constraint models.

The old question of the empirical importance of money held for financial transactions (Keynes' "financial circulation," 1930) has recently been reopened by Field (1984a, b), who argues persuasively that the increased volume of financial transactions in the speculation of 1929 had an important role in raising real interest rates and in bringing on the Crash.

A number of recent studies lend support to the finance constraint view of money-holding behavior. Empirical estimates of the aggregate demand for money, the central construct of the liquidity preference theory, have proven to be highly unstable since the early 1970s, and the associated econometrics has come increasingly under fire (Cooley and LeRoy, 1981; Goodfriend, 1985). In particular, Goodfriend argues that the usual explanation of the presence of a lagged left-hand variable in empirical money demand equations as representing portfolio adjustment is quite implausible. He suggests instead that it is an artifact—evidence of measurement error in the right-hand variables, particularly in GNP as a measure of transactions. Osborne and Overdahl (1987) construct a time series for private spending and use it to calculate a transactions velocity for base money. They find the behavior of velocity so defined to be less mysterious than the conventionally defined velocity ($M1/GNP$). In particular, they find the drop in velocity in the Great Depression to be much greater for their measure of velocity, suggesting that an increase in demand ("scramble for cash") may have been more important, relative to a drop in supply, than had previously been supposed. Spindt (1985) has developed an index of the quantity of money using turnover rates that is much better behaved than standard $M1$.

The relation between individual holdings of money and planned expenditure is considerably more complex than that suggested by the simple model of Section II. This emerges clearly from the work of Akerlof (1979, 1982) and Clower and Howitt (1978). Average money holdings depend on "autonomous payments"—income and expenditure

flows into and out of money balances—and on the monitoring rule that determines "induced payments" to keep money holdings in the desired range. Akerlof shows that under a range of plausible monitoring rules, average holdings may be relatively insensitive in the short run to changes in the volume of autonomous payments and to changes in interest rates. Clower and Howitt (1978) show that small changes in the scheduling of payments and receipts can have large consequences for equilibrium money holdings (reviving an important theme in the work of Angell, 1937, and Ellis, 1938). Milbourne (1983) argues that trade credit may be much more important than the plain numbers suggest precisely because it may allow greater freedom in scheduling payments, with a consequently large reduction in required holdings of money.²⁸

The simple cash-in-advance model implies a constant velocity of one per period. We should, of course, distinguish here (with Keynes, 1930) between the *circuit* velocity, the speed at which money actually spent circulates, and the *effective* velocity, a weighted average of the circuit velocity of money that is spent and of zero, the "circuit velocity" of money that is *not* spent in the period. It is the circuit velocity that is fixed at unity in the simple model. Once we provide agents with a reason to hold money in excess of planned expenditures—precautionary holdings as in Lucas (1980, 1984), Helpman (1981a), and Svensson (1985b), or speculative holdings as in Kohn (1988b)—the effective velocity can vary even if the circuit velocity remains unchanged.²⁹ Another way to get away from a fixed effective velocity is to make the length of the transactions period endogenous (see, e.g., Fried, 1973; Clower and Howitt, 1978; Jovanovic, 1982; and Leach, 1983).

There is a clear distinction in finance constraint models between individual holdings of money and aggregate holdings. Changes in the latter may be the result of changes in inter-agent flows rather than of changes in any individual desire to hold money.³⁰ Akerlof (1978) illustrates this possibility in a model in which changes in flows between tightly and loosely monitored accounts result in changes in aggregate holdings even when individual monitoring rules remain the same.³¹ Kohn and Karacaoglu (1989) show that in an open economy of heterogeneous individuals with interest-*inelastic* transactions demands for

²⁸The role of trade credit as a possible substitute for money is a delicate and interesting problem. See also Brechling and Lipsey (1963), Kohn (1981a), and Lucas (1985).

²⁹As Salyer (1985) points out, while the Svensson does generate a motivation for a precautionary demand at the individual level, this has no effect at the aggregate level, because of the representative individual framework.

³⁰Liang (1980, 1984) argues that money "between" owners (various types of float) makes up, empirically, an important part of the total aggregate amount, and that this part may behave quite differently from holdings voluntarily held by individuals.

³¹In Grossman and Weiss (1983) too, flows between heterogeneous individuals affect aggregate holdings.

money there can be an aggregate money demand function of the conventional type that appears interest-elastic. This aggregate money demand function, however, is not structural in the sense of Lucas: it will not predict correctly the result of policy experiments.³²

It is clear, then, for both theoretical and empirical reasons, that there are serious problems with the liquidity preference theory and its aggregative analysis of a "market for money" based on a stable aggregate demand function for money.

An interesting attempt at rehabilitation is provided by the "buffer stock approach" developed by Laidler and others (see Laidler, 1984, and Milbourne, 1987, for references) in which the aggregate demand for money is restated in terms of microfoundations very similar to those of the finance constraint theory. It is not clear, however, that this rehabilitation is successful (see Milbourne, 1987), or even that it is desirable: it might be better to abandon this sort of aggregative analysis altogether. The following discussion will, I hope, persuade the reader that useful insights may be obtained from the finance constraint theory directly, without restating everything in terms of a market for money.

B. The real effects of inflation

This is an area in which the finance constraint approach has been particularly fruitful.³³ The key to most results is the time wedge between sale and purchase. Inflation erodes the value of money held or owed over this interval, worsening the individual's effective terms of trade, and pushing him towards autarchy. In other words, inflation acts as a tax on trade.

The long-run, steady-state, effects of this tax are explored by Stockman (1981), Leach (1983), Kohn (1984), and Rotemberg (1984). In contrast to the standard Tobin and Mundell effects, the capital stock falls, employment is reduced, and output drops.³⁴ The net yield on capital remains equal to the rate of time preference, but the marginal *physical* product rises, as inflation places a wedge between the two. The real wage falls, and, if labor supply is inelastic, the fall is more than proportionate to the tax.

Because of the fall in output (the reduction in economic activity), the welfare loss to individuals exceeds the "revenue" of the tax. Since Leach (1983) deals explicitly with transactions costs, making the length of the trading period endogenous, he is able to show

³² Lucas (1987) provides a defense of the structurality of aggregative money demand equations based on a representative individual finance constraint model. Structurality does not seem to hold up for models with heterogeneous individuals. See, too, the discussion below (Section VI.A) of the equivalence of finance constraint formulations and those involving money in the utility function.

³³ The results of the Hicks-Keynes theory are surveyed in Fischer (1988).

³⁴ Unless investment is financed out of retained earnings, so "evading" the inflation tax: see Stockman (1981). Leach (1983) and Rotemberg (1984) assume this without further discussion.

that this welfare loss is quite distinct from the increase in transaction costs that corresponds to the excess-burden triangle in the standard treatment of the inflation tax on cash balances. In a general equilibrium, comparative-tax framework, Leach finds the optimum inflation tax to be quite small.³⁵

This steady-state analysis is probably not enough in itself for a satisfactory explanation of the real effects of inflation. The "tax rate" equals the *per-period* (say monthly) inflation rate. For Israel or Argentina, one could see that a tax rate of 5-20% (particularly if uncertain) might have substantial effects, but a rate of say 1% in the U.S. or Europe hardly seems likely to have a major impact.

However, if we combine this "distortion" with other plausible departures from neoclassical perfection, larger effects can result. For instance, if capital is slow to adjust, an unanticipated increase in the rate of inflation can depress the net yield on capital below its long-run level, reducing the market value of existing capital (see Kohn, 1984).³⁶ If, in addition, the real wage is sticky, this effect on the yield to capital will be magnified and there will also be transitory unemployment.³⁷ If the real wage is sticky enough, employment, and perhaps the capital stock as well, may fall below their long-run steady-state values, with output falling more in the short run than in the long. These short-run disequilibrium effects may be substantial, and they bear at least a glancing resemblance to the set of phenomena jointly labelled "stagflation" in the 1970s.

Another departure from the standard neoclassical model that amplifies the effects of the inflationary distortion is a non-stationary increasing-returns technology of the type suggested by Romer (1986) (see also Kohn and Marion, 1987). While inflation reduces the *level* of the capital stock in the standard model, in the non-stationary model it reduces its *rate of growth* (see Rebello, 1987). Hence, even low rates of the inflation tax can have large cumulative effects over time.

The finance constraint approach makes it clear that the effects of an inflation will depend critically on how new money enters the economy (an observation that goes back to Mill and Cantillon). This is true *even in the steady state* (see Kohn, 1988a). The substitution effects of the inflation tax will always be the same, but the total impact will depend too on the income effects—how the "revenue" of the tax is distributed. This implies

³⁵Moreover, Lucas and Stokey (1983) find the inflation tax subject to a time-consistency problem that does not afflict other taxes.

³⁶An analogous result is found by Day (1984) for the unexpected part of a random inflation in a rational expectations framework.

³⁷Malinvaud (1977) calls such unemployment, associated with a rise in labor costs (caused here by the inflation tax), "Classical" unemployment, in contradistinction to the Keynesian variety.

that questions like, "What is the effect of inflation on real interest rates?" are not well formulated until it is specified precisely how the new money enters the economy. Note that for the liquidity preference theory only the *quantity* of money matters: it cannot accept that the way money enters the economy affects the results. If it did, two situations with the same quantity would not be equivalent. However, the finance constraint approach naturally leads one to think of money as a distribution device, as part of the mechanism allocating current spending among individuals and across uses (for instance, between investment and consumption). Inflation involves the creation of new purchasing power, and the way this is distributed will have effects that are important in determining the overall real impact of the inflation.

For example, Kohn (1988a) shows that the effect of inflation on the real rate of interest will differ between a government-deficit inflation—the new money buys goods and boosts consumption—and a credit inflation—the new money is offered as loans and boosts saving and investment. The former type of inflation tends to raise real rates of interest, the latter to lower them.³⁸ A failure to recognize this distinction led to serious errors in anticipating the consequences of disinflation in the United States in the early 1980s. Sargent (1986), basing his analysis on a liquidity preference view of the world, saw no problem in drawing lessons from disinflation in other countries in which inflation had been the result of monetization of government deficits. However, in the U.S., the inflation had largely been the result of a major expansion of bank credit caused by a wave of financial innovations: the government printing press had had little to do with it. While in the case studied by Sargent, the government-deficit case, disinflation tends to *lower* real rates of interest with expansionary consequences, in the credit-expansion case disinflation tends to *raise* real rates with contractionary consequences.

Another immediate implication of the careful analysis of different types of monetary injection is that perfect indexation—perfect in that it completely neutralizes the effects of inflation—is impossible. The income and substitution effects of the inflation can be precisely offset only by paying a yield on money exactly equal to the inflation rate. This requires that all new money enter the economy as indexation payments. So perfect indexation is possible only in the trivial case that the inflation is caused by, and only by, the indexation payments themselves.

The above view of the effects of inflation is much closer conceptually to the "forced saving" of pre-Keynesian monetary theory than it is to the monetarist inflation tax on cash

³⁸In general, the "Fisher relation" will not hold: see Kouri (1983) and Krugman, Persson, and Svensson (1985).

balances. The inflation tax on trade subverts the basic function of money—to enforce honesty by keeping track of what the individual owes the system and *vice versa*. Because of the tax, the real value of an individual's purchases will be strictly less than the real value of his sales. Those spending the newly created money that causes the inflation are "cheating": they do not have established entitlement to the goods they purchase by supplying goods of equal value.³⁹

C. The optimum quantity of money⁴⁰

While the question of the "optimum quantity of money," or, more correctly, the optimum yield on money, is of dubious practical significance, it constitutes a sort of touchstone for theories of money, involving, as it does, all the most difficult and delicate issues of modelling and interpretation. A theory that gives a satisfactory answer to this question may inspire greater confidence when applied to questions of greater practical importance.⁴¹

The basic Monetarist result—the "Friedman rule" as it is often called—suggests that individuals should be "satiated" with real balances. Real balances provide utility: they are seen both as a productive input in the implicit technology of exchange and as a precautionary asset, providing insurance against constrained spending. Since the marginal social cost of their creation is essentially zero, their marginal utility to individuals should be driven to zero too by making the opportunity cost of holding them nil. This can be done either by paying interest on money (financed by taxes, so that the price level remains constant) or by engineering a deflation to make the nominal rate of interest zero (by imposing a tax and not spending the proceeds).⁴²

Dissatisfaction with this result was a major stimulus to the development of the finance constraint theory. To many critics (Tsiang, 1969; Clower, 1970; Hahn, 1971), the result

³⁹See Kohn (1984) for more on forced saving. Forced saving was usually associated with inflations caused by credit expansion (inside money) rather than with government deficit inflations.

⁴⁰See Woodford (1988c) for an excellent, comprehensive discussion of this topic.

⁴¹Cf. Clower (1970, p 33):

The question of monetary optimality, like most questions in welfare economics, is important not so much for its own sake as for the stimulus it has given to monetary theorists to re-examine the foundations and strengthen the superstructure of their subject...

Perhaps we shall never have a definitive answer to the optimality problem, but we shall certainly have many attempts at it. And in the process we shall get what is most urgently needed: an improved theoretical understanding of the actual working of the economy in which we live.

⁴²Of course, as noted by Grandmont and Younes (1973), paying interest on money with new money achieves nothing. It merely causes inflation at a rate equal to the rate of interest on money and has no real effect whatsoever: the real yield on money is unaffected (compare the discussion of "perfect indexation" above). Also taxes must be lump-sum, or one distortion is being traded for another. Leach (1983) suggests, however, that modification of the Friedman rule because of non-lump-sum taxes is not large.

seemed fundamentally implausible: when perhaps the deepest intuition in economics is that there is no free lunch, it promised something for nothing. Given this criticism, the extent to which the result has been upheld in finance constraint models is somewhat surprising and perhaps disappointing. So if the result is wrong, what is wrong with it? The finance constraint approach does at least suggest some answers.

As noted in Section III, finance constraints create a "distortion." They imply a time wedge between sale and purchase, and, for individuals exhibiting time preference, this "tax on trade" affects effective relative prices. This distortion may be removed by reducing to zero the opportunity cost of holding money. This result is implicit in most finance constraint models, but is central in the papers of Wilson (1979), Rotemberg (1983), Svensson (1985b)⁴³, and Woodford (1985, 1987).

A paper by Townsend is particularly illuminating here. It compares three different trading regimes: a) autarchy; b) money-mediated decentralized exchange involving a cash-in-advance constraint; c) "centralized trade credit" that enables exchange without a *quid pro quo*. Regime (b) improves on (a) because of the gains from trade; regime (c) improves on (b) because it removes the time-wedge distortion. But remember the discussion of the microfoundations of the finance constraint in Section III. Finance constraints are the market solution to a set of informational problems. Regime (c) just *assumes* that centralized credit can improve upon the market and solve these informational problems at zero cost. The welfare gain from removing the time-wedge distortion (through centralized credit or through an appropriate yield on money) comes from assuming away the basic problem that the finance constraint is there to solve.

A part of the monetarist rationale for the optimum quantity result is that "false economy" in holding real balances leads to excessive real transactions costs (e.g., trips to the bank, "shoe leather costs"). The finance constraint literature has done much to make this idea more precise. Papers by Fried (1973), Jovanovic (1982), and Leach (1983) all derive the transactions structure (essentially the length of the trading period over which the finance constraint applies) by explicit optimization with respect to transaction costs, the yield on money being one of those costs. They all find that real transactions costs are minimized by the Friedman rule. As Clower (1969) was first to note, however, trade involves inventories of more than just money. Non-convex transaction costs imply that the goods to be sold will be accumulated for discrete sales and that consumption will be made out of inventories replenished at discrete intervals. Total transactions costs are minimized

⁴³Svensson's optimum quantity rule is actually more complex, as it applies to an economy with random shocks to money and output. However, its basis is the same and it reduces to the Friedman rule in a deterministic stationary state.

by the proper management of *all* these inventories considered together (Clower, 1970, and Clower and Howitt, 1978). The yield on one type of inventory will affect the holdings of all types in ways that are quite complex. Howitt (1988) considers a model with middlemen, in which individual decisions about inventories and trading frequencies impose a non-pecuniary externality on the middlemen. As a result of this externality, the simple optimum quantity result does not in general hold.

The second part of the Monetarist rationale for the Friedman rule rests on the role of real balances as a precautionary asset. Take a model in which the only constraint on individuals' transactions is a present-value budget constraint over time (the standard "non-monetary" model). Now add a sequence of finance constraints. Unless the additional constraints are never binding, welfare must be reduced by their introduction.⁴⁴ Now reverse the procedure. Start with a model in which agents face a sequence of finance constraints. Make a change that ensures that the sequence of constraints is non-binding. *Voilà!* Welfare is improved.

This is precisely what happens when individuals are "satiated" with real balances (see Ostroy, 1973). Grandmont and Younes (1973) and Krugman, Persson, and Svensson (1984) base their results on this sort of argument⁴⁵ (the latter paper recognizes that satiation is equivalent to the existence of a perfect capital market—that is, equivalent to individuals facing only a present-value budget constraint⁴⁶). But remember the trust problem: there is a reason for the sequence of finance constraints; nullifying them may not be a terribly good idea. What seems best for the individual, may not be best for the system, may not even be *feasible* for the system.⁴⁷

All the optimality results are achieved either by removing the frictions that justify monetary exchange in the first place or by ignoring that these frictions imply a second-best world. As Hahn (1971) has noted:

⁴⁴Note that in representative agent, exchange economies such as Lucas (1982) and Svensson (1985) there is no welfare loss because the equilibrium allocation is unchanged by the constraint. (I thank Kevin Salyer for this comment.)

⁴⁵In both cases, money is the only asset in the model, so that individuals are really satiated with *assets* rather than specifically with money. In Krugman, Persson, and Svensson, while there is another asset, trade in it takes place only *between* periods; when goods markets are open, individuals are constrained by cash alone. As Bewley (1980, 1983) and Rotemberg (1984) have noted, however, no finite level of assets may be sufficient to achieve such satiation.

⁴⁶Hahn (1965, 1982) has called this type of sequence economy *inessential*; see also Ulph and Ulph (1977).

⁴⁷Tsiang (1969) was the first to criticize the "satiation" idea on these sorts of grounds—on the grounds of externalities. His argument focused on the implications for stability in the face of external shocks. How stable would prices be if individuals all had access to unlimited purchasing power?

The necessary conditions for Pareto-efficiency in the world of uncertainty with intertemporal choice will in general be fulfilled in a market economy only if money plays no role. There are therefore no grounds for supposing that the Friedman rule is either necessary or sufficient for Pareto-efficiency since it is of the essence of an explanation for the existence of money that other conventional necessary conditions are violated.

There seems reason to believe that the Friedman rule will not hold up when all the "imperfections" are properly spelled out. Papers by Hellwig (1982), Bewley (1983), and Illing (1985) consider the issue in models that start from the fundamental informational problem that justifies the existence of finance constraints. They find in this context that the Friedman rule is infeasible if the government, in levying the necessary taxes, is subject to the same informational problems as other agents. Illing finds that the monitoring costs imposed by an income tax will nullify any benefits. Bewley and Hellwig find that a true lump-sum tax will require individuals to increase their holdings of money by enough to ensure their ability to pay the tax: but then the interest on *these* money balances must be all the government pays, leaving it with insufficient revenue to pay interest on the original money balances—a contradiction. There seems, given the basic asymmetric information problem, to be no way to reconcile full efficiency with incentive compatibility.⁴⁸

D. Self-generating inflation

Another disturbing property of liquidity preference models of money is their propensity for "self-generating inflation"—a dynamic path along which the price level grows (or falls) explosively even though the quantity of money does not change.⁴⁹ Formally, the model possesses equilibria in which prices and price expectations rise in mutually consistent paths. Agents expect inflation and their response to this expectation produces a rise in prices that sustains expectations of further inflation, and so on. This happens even though there is no monetary accommodation. In perfect-foresight or rational-expectations formulations, the actual inflation produced equals the inflation expected.

The first models found to exhibit this sort of self-generating inflation were of the standard liquidity preference type: the aggregate demand for real balances is a function of real output (usually assumed constant) and of the opportunity cost of holding money. (The latter is generally taken to be the expected rate of inflation alone, with the real rate of

⁴⁸Cf. Ostroy and Starr (1988, p. 52)

⁴⁹Hicks himself (1935) was concerned about instability due to self-fulfilling expectations in asset markets, including the "market for money" (see Laidler, 1986). The phenomenon was discussed at length by Goldman (1972), who also showed, yet more bizarre, that self-generating inflation can be halted by *increasing* the rate of growth of money.

interest assumed constant or "small" relative to the rate of inflation.) The actual price level is determined by "equilibrium in the market for money": the supply of real balances (the given nominal money supply divided by the price level) is brought into equality with demand through movement of the price level.

There are two types of reaction to this result. Some take it seriously and believe that there is indeed an inherent fragility to the continued existence of a monetary system of exchange. They are puzzled why in practice there seems to be no empirical evidence of actual self-generating inflations. Others, believing the empirical evidence, regard the formal result more as an indication that there is something wrong with the theory.

What could be wrong? Some possibilities: the theory is aggregative and not grounded in explicit optimizing behavior in a general equilibrium model; it treats money purely as an asset, ignoring money's role as medium of exchange; there is no explicit consideration of the mechanism by which price expectations are turned into actual price movements.

The first possibility turns out not to matter. It is easy to set up optimizing models that have the same properties—for instance, overlapping generations models of the type developed by Wallace (1980).

The second possibility too, matters less than one might have thought. As Woodford (1986a) notes, it is not that easy to separate the transactions demand of finance constraint models from the speculative demand of liquidity preference models: "[It] is difficult to identify analytically a purely speculative component of either the demand for cash balances or of the equilibrium value of money, given that even the demand for transactions purposes is surely dependent upon expectations regarding the rate at which money appreciates or depreciates in value while held." Woodford sets up a model with infinitely-lived agents and a cash-in-advance constraint that is formally isomorphic to the Wallace overlapping-generations model, so that the conditions for the existence of self-generating inflation are the same in the two models.⁵⁰

The third possible source of difficulty, problems with specifying the mechanism of price formation, has several levels.

⁵⁰ Woodford (1986a, p. 13) concludes:

It seems, then incorrect to claim that there is a coherent "fundamentalist view" of the value of fiat money that contrasts with the "bubbly view". If one is to assign an unambiguous meaning to the "market fundamental" of intrinsically useless fiat money, it must equal zero. Hence the overlapping generations model of money yields a valid insight into how it is possible for fiat money to be valued in a perfect foresight equilibrium, even if one believes that a realistic model of money must take into account the transactional advantages that money enjoys over other assets.

First, if we retain for the moment the quantity-theoretic idea that the price level is just the rate of spending divided by the rate of output, then expectations of inflation can cause actual inflation either by increasing spending or by reducing output. Finance constraint models are quite explicit about the connection between money and spending, and they suggest three distinct ways in which expected inflation might raise the rate of spending.

(1) Given trading practices (length of the trading period, bunching of purchases, monitoring rules for cash balances) there is a certain amount of slack in the system in the form of "idle balances"—money held as an asset beyond the amount needed for planned expenditures. Expected inflation leads to a reduction or elimination of this slack. However, since the slack is finite, it is easy to show that the consequent rise in prices is bounded (Grossman and Weiss, 1983). A continuing self-generating inflation cannot be generated in this way.

(2) Given the length of the basic trading period, purchases can be bunched nearer to the beginning of the period. If the trading periods of different individuals are staggered in time rather than synchronized, money can then complete the circular flow more quickly, sustaining a higher rate of spending, and so higher prices. However, here too the possible consequent rise in prices is bounded (Kohn, 1981a).

(3) The length of the basic trading period itself can be shortened and monitoring rules changed. Since there are non-trivial costs to making such changes, they will come in discrete jumps (e.g., going from monthly to biweekly paydays), once expected inflation crosses some threshold level (Barro, 1970). As Akerlof (1982) has shown, the potential gains from adjusting optimal monitoring rules to even quite large changes in the opportunity cost of holding money can be trivial. Also, although a shortened trading period will increase the rate of spending, it may also increase, at least temporarily, the rate at which output is being brought to market. Nonetheless, despite these good reasons for doubting the empirical plausibility of this third mechanism, there is no reason *in principle* why a self-generating inflation could not be sustained in this way.

In addition to these effects on the spending side, there can be effects on the output side. For example, in a model considered by Woodford (1986a) the anticipated "inflation tax" on labor income can cause a reduction in labor supplied sufficient to validate the expected inflation.

Of course, if we limit increases in spending by ruling out changes in the length of the trading period and limit reductions in output by assuming it to be supplied inelastically, then *explosive* self-generating inflations can be ruled out.⁵¹

However, self-generating price movements need not be explosive. Of course, in linear models of the type usually considered in the liquidity preference literature, the only alternative to stable prices is explosive inflation or implosive deflation. But with non-linear models, there may exist equilibrium paths with self-generating (rational expectations) price movements that converge to stable prices or that vary only within a bounded range (see Woodford, 1987c, *inter alia*). To obtain this kind of equilibrium, what is needed is that a change in expectations regarding the future value of the price level cause an even greater change in its current equilibrium value. This sort of strong feedback is possible in a general equilibrium model only if the price mechanism is prevented from functioning as it would in a perfectly competitive economy with complete markets. Some sort of market imperfection or incompleteness is necessary. Overlapping generations models have the required "imperfection," but, as Woodford (1986a) argues, so do infinitely-lived-individual models with finance constraints. So far from ruling out self-generating price movements, finance constraints may prove sufficient for their existence.

This brings us back again to the instantaneous quantity-theoretic determination of the price level. Will self-generating movements in spending necessarily imply self-generating movements in the price level? If we think of agents actually *setting* prices, then we must ask whether it is reasonable (a) that agents share an expectation of future inflation and (b) that they immediately incorporate this shared expectation into prices. This sort of behavior is not implausible for true asset markets—the stock market or the market for gold, say—in which the relevant price is directly observable on a more or less continuous basis, but is it reasonable for money, the "price" of which is (the inverse of) the general level of prices? The Lucas island model, for example, is based precisely on the premise that it is hard for agents to identify general from specific price movements.

However, there do seem to have been historic episodes in which price-setting did satisfy the two conditions above, (a) and (b), necessary for self-generating movements to occur in the price of money. For example, Merkin (1982) argues that, in the final explosive stages of the German hyperinflation, prices were rising so fast that price-setters were led to use the exchange rate as an indicator of the general price level. Falls in the rate of exchange were thus immediately incorporated into higher goods prices, and rising prices

⁵¹Farmer(1984b) obtains a similar result in an overlapping generations model by assuming exogenous output and a minimum unit of traded output. The latter, like the bound on period length in a finance constraint model, places an upper bound on velocity.

served further to depress the exchange rate. He argues that by this stage the expansion of the money supply was largely passive and that, in any event, it lagged behind the rise in prices. The resulting shortage of real balances (means of payment) acted through finance constraints to limit significantly the actual volume of real transactions in the economy.

E. Pegging interest rates and the determinacy of the price-level

What happens when the central bank pegs the rate of interest? This question is of considerable practical importance, because pegging the rate of interest seems to be precisely what central banks do in the real world. Indeed, given the difficulty of controlling, or even defining, monetary aggregates in a modern economy with sophisticated financial institutions, it is not clear what else they *could* do.⁵²

The liquidity preference theory suggests that what central banks appear to be doing in practice cannot be done in principle—that a policy of pegging the rate of interest is not feasible (see McCallum, 1986). Friedman (1968), for example, suggests that a policy of easy money cannot keep the nominal rate of interest low indefinitely. While it can lower it initially, in the long run, as the resulting inflation comes to be expected, the interest rate must rise to incorporate an inflation premium. (This would seem to imply that if the inflation is fully anticipated from the outset, easy money cannot lower the rate of interest even temporarily.) The only way to sustain a low nominal rate of interest is with tight money and the resulting deflation.

Other work has suggested infeasibility in a different sense. The rate of interest can be pegged, but, if it is, the price level is indeterminate. Modigliani (1944) was the first to note that pegging the interest rate left the Keynesian system under-determined;⁵³ Patinkin (1965), too, found the price level to be indeterminate in the case of a pure inside-money economy when the central bank pegged the rate of interest; and the same result is obtained in standard textbook models (e.g., Sargent, 1979, pp 92-5) and in stochastic rational expectations versions of the Keynesian model (e.g., Sargent and Wallace, 1975).⁵⁴

⁵²Saying this, that interest rates are the only practical *instrument* of monetary policy, is quite different, of course, from saying that interest rates, say low or stable interest rates, should be its *goal*: even if the goal is taken to be price stability, say, a policy of adjusting the interest rate in response to inflationary or deflationary pressure might be the only feasible one; the "quantity of money" might not be controllable directly.

⁵³He suggested, incorrectly, that this justified Keynes's claim that liquidity preference could lead to unemployment equilibrium even in the case of a flexible money wage. See Kohn (1981b) for further discussion.

⁵⁴Sargent and Wallace (1982) describe an optimizing, rather than an aggregative, model that does not exhibit this type of indeterminacy and ascribe the absence of the phenomenon, in contrast to its presence in their 1975 paper, precisely to their now employing an optimizing model. However, as McCallum (1986) notes, in the 1982 paper they peg both the rate of interest *and* the quantity of money, so that the resulting determinacy of the price level is not really counter to their 1975 result.

McCallum (1986) sees this indeterminacy as a substantive economic problem: "A 'pure interest rate peg' does not... constitute a well-formulated monetary policy.... [A] commitment by the monetary authority to peg [the rate of interest] at [a fixed]... value... is not a satisfactory description of policy behavior.... [It is] not complete enough to enable private agents to form expectations—themselves crucial for asset demand behavior—in a rational manner" (p148). McCallum quotes Patinkin (1965, p309): "a necessary condition for the determinacy of the absolute price level... is that the central bank concern itself with some money value—and in this sense be willing to suffer from money illusion."

The basic problem with using the liquidity preference theory to understand the effects of pegging the rate of interest is that it is not easy within its framework to describe what actually happens when this is done. The liquidity preference theory is a static theory of portfolio (stock) equilibrium, and is thus inherently unsuited to describing the dynamics and flows involved in pegging the rate of interest away from its equilibrium level.

The finance constraint theory, on the other hand, is practically tailor-made for the purpose. According to it, investment expenditure requires the outlay of money; the loanable funds market is where investors borrow the required money from savers; and the rate of interest is the price at which this borrowing takes place. If the rate of interest is pegged below its equilibrium level, say, there will be a flow excess demand for loans of money. The central bank will have to satisfy this flow excess demand by lending money it creates for the purpose. The requisite flow of new money is perfectly well defined, and the price level, therefore, is quite determinate. Because of the flow of new money into the economy, the price level will be rising, but at any moment of time it will be perfectly determinate.

While Wicksell, in his discussion of the "cumulative process," was the first to articulate this view of the connection between money-creation and the rate of interest, he failed to provide a satisfactory formal model.⁵⁵ The first to do so was Robertson (1934), who improved on Wicksell's description of the cumulative process, particularly with respect to deflationary situations, by integrating into it the Keynesian income-adjustment mechanism. More recently, Tsiang (1956, 1966) and Kohn (1981b) have provided aggregative models along Robertson-Wicksell lines. Kohn shows explicitly that there is no indeterminacy in this type of model when the rate of interest is pegged: the equilibrium conditions determine a particular rate of inflation or deflation, and the price level can be found by integrating past inflation. In a sense, this is consistent with Patinkin's dictum about the central bank having to concern itself with some nominal magnitude in order to anchor the nominal scale: the

⁵⁵There are earlier hints in the work of Thornton and Mill. See Kohn (1988a) on the latter.

nominal rate of interest is equivalent to a first derivative of a nominal value, and, by pegging it, the bank determines the first derivative of the nominal scale.

The formal reason for price indeterminacy in models of the liquidity preference type is that they exhibit a homogeneity in the quantity of money and price level: these variables enter the equilibrium conditions only as ratios—for example, M_t/P_t or P_t/P_{t-1} . If the quantity of money is taken as given, then the price level is determinate. If instead the nominal rate of interest is taken as given, then for any sequence (or stochastic process) $\{M_t, P_t\}$ satisfying the equilibrium conditions, the sequence $\{\theta M_t, \theta P_t\}$ will also satisfy them, for any $\theta > 0$.⁵⁶

Finance-constraint/loanable-funds models do not share these homogeneity properties. There are two reasons for this: (i) the explicitly dynamic structure imposed by the finance constraint (in contrast, the structure of liquidity preference models is essentially one of static equilibrium); (ii) the heterogeneity of agents (the liquidity preference models are explicitly or implicitly representative agent models). In the explicit loanable funds market there are distinct borrowers and lenders; pegging the nominal rate of interest away from its equilibrium value creates a determinate excess demand or supply which requires the monetary authority to purchase or sell a determinate amount of securities in exchange for money—hence a determinate addition or subtraction from the money supply. In this structure, the change in money supply does not lead to a mere scaling up of all monetary magnitudes with real magnitudes unaffected. With the interest rate pegged below the equilibrium rate, for instance, the new money comes into the hands of borrowers, increasing their purchasing power and altering the *real* allocation. The money holdings of others are not scaled up at all: their nominal purchasing power (nominal income) is predetermined and unchanged by the monetary injection.⁵⁷

⁵⁶Of course, if there are other nominal assets, then there is homogeneity in money, the price level, and these assets taken together.

This type of indeterminacy is quite distinct from the multiplicity of equilibrium that often characterizes rational expectations models (see Section IV.D above on self-generating inflation). These multiple equilibria involve different *real* allocations rather than, as here, a single real allocation consistent with a continuum of nominal scales.

Whether or not there is indeterminacy depends on how the rate of interest is pegged. McCallum discusses specifications in which certain policy feedback rules, such as setting the money stock to achieve an interest rate target or setting the interest rate to achieve a money stock target, nail down the nominal scale so that there is no indeterminacy. The policy that does cause a problem is what McCallum calls "a pure interest rate peg": the monetary authority pegs the interest rate (the price of securities) *directly* by standing ready to buy or sell any amount of securities at that interest rate (price). Friedman (1969) seems to have in mind a policy which pegs the money growth rate rather than a "pure interest rate" peg. The former, but not the latter, is consistent with his story of how the interest rate falls initially, but then rises above its initial level.

⁵⁷Gale (1982) discusses how non-robust the homogeneity result is in its dependence on either a representative individual or on precisely proportional additions to all money balances.

All this indicates that price-level indeterminacy is not a substantive economic problem of the real world, but rather a problem *of a particular class of model*. McCallum's diagnosis—that pegging the interest rate is not a fully specified policy—is quite correct, but it is correct only for that class of model. A pure interest rate peg *is* a fully specified policy in finance constraint models. This suggests that indeterminacy should not be a concern for policy-makers trying to choose an appropriate policy, but rather for economic theorists trying to choose an appropriate model.⁵⁸

The aggregative finance constraint models, of the type developed by Tsiang and Kohn, while they do provide useful insights into the short-run consequences of pegging the rate of interest, are less useful when it comes to the long run. This is so because they are essentially pure flow models, ignoring the effects of flows on stocks and the feedback from stocks to flows. They do not take into account the effect of saving on asset positions or of investment on the capital stock. The *flow* of savings is made to depend on the rate of interest and/or income, when it might seem more reasonable that desired stocks depend on these variables and that the flow is the result of adjustment over time or aggregation over heterogeneous individuals. Even accepting such a flow formulation, there are some obvious feedbacks that are ignored: investment will affect output; interest payments to or from the central bank will affect net income; and it will matter how the central bank disposes of those payments.

Clearly, what is required is a fully specified optimizing model that takes all these considerations into account. Such a model has been provided by Woodford (1985, 1987a, 1987d). Woodford adds a cash-in-advance constraint to an overlapping generations model. The cash-in-advance constraint supports a loanable funds theory of the determination of interest rates, and this enables Woodford to integrate rigorously a traditional account of the short-run liquidity effects of open market operations with an analysis of long-run equilibrium, shedding some light on whether the short-run effects can persist in the long run. The role of the overlapping generations structure is not, as in Wallace's work (e.g.,

This characterization of the difference between liquidity preference and finance constraint models in terms of their homogeneity properties is due to Woodford (1987d).

⁵⁸The finance-constraint/loanable-funds structure does not of course rule out the *multiplicity* of equilibrium, rather than indeterminacy, often associated with rational expectations.

Wicksell (1905, p. 194-5) describes a pure credit system as being in a kind of "neutral equilibrium": at the new, higher goods prices that result from a cumulative process of inflation, entrepreneurs are willing to pay higher wages even if the interest rate reverts to its natural level; there is no tendency to revert to the original price level. Patinkin (1965) mistakenly identifies this phenomenon (for which "neutral equilibrium" is a good description) with the price level indeterminacy of liquidity preference models.

1980) to support valued fiat money—that is done by the cash-in-advance constraint—but to provide a "structural" savings function based on explicit intertemporal optimization.

Woodford arrives at some striking results for his model economy: "Open market operations can keep both the nominal and the real rate of interest low forever; but whereas, in the short run, a lower interest rate is achieved only at the cost of a rise in the price level, in the long run high and low interest rates are found to be equally compatible with price level stability." This result seems in sharp contrast with Wicksell's description of a cumulative process that continues indefinitely so long as the market rate of interest is pegged below the "natural rate."

Why, in Woodford's model does the "cumulative process" eventually come to an end and the price level stabilize? According to Wicksell, lowering the nominal rate of interest below the "normal" or equilibrium rate creates an excess demand for loanable funds: investment rises, saving falls. New money is injected in the form of loans to satisfy this excess demand; this causes inflation, which lowers the *real* market rate of interest, and so increases the excess demand. But Wicksell's pure flow argument neglects the effect the process itself may have on desired saving or investment, and so on the normal rate itself. In Woodford's model, lowering the rate of interest stimulates investment only in the short run, because this investment brings the marginal product of capital down to equal the new, lower rate of interest. Once the two are equal there is no further stimulus to investment, and it returns to its original long-run value—zero. So long as the technology exhibits decreasing returns, the normal rate will eventually be lowered to equal the market rate, so ending any inflationary pressure.⁵⁹ However, if tastes and technology were such that an excess demand for loanable funds could be sustained in the long run (an increasing-returns technology, for example?), then presumably the cumulative process would continue.⁶⁰

F. The monetary adjustment mechanism under fixed exchange rates

There are obvious formal similarities between the central bank's pegging the rate of interest in a closed economy and its pegging the exchange rate in an open one. In the former case, the central bank stands ready to buy and sell bonds at a declared price (with money it creates or destroys); in the latter, it stands ready to buy or sell foreign exchange at

⁵⁹Such a possibility—that the normal rate could be lowered by investment to bring it into equality with the pegged market rate—was raised in early discussions of the cumulative process by Davidson, Cassel, and Mises and acknowledged as a theoretical possibility by Wicksell. See Uhr(1960, pp. 199-200) for a discussion and references.

⁶⁰See Romer (1986), Rebello (1987), and Kohn and Marion (1987) for discussion of various types of increasing returns technology.

a declared price. So it is not surprising that in the latter case too the finance constraint theory offers some advantages over the liquidity preference theory.

What the liquidity preference theory has to say about fixed exchange rates is contained in the "monetary approach to the balance of payments." The basic idea is simple. The economy consists of two aggregate markets—a market for goods and a "market for money." By Walras' Law, one of the markets may be dropped from the analysis, and the behavior of the economy described in terms of the other alone. So the market for goods is dropped, and the process of international monetary adjustment is analyzed in terms of adjustment in the market for money.⁶¹

This monetary approach was attacked by Tsiang (1977) on the grounds that its use of Walras' Law was invalid and its money demand equation misspecified. The two criticisms are related. Walras' Law is a tautology, so there is certainly some sense in which the mirror image of the supply and demand for goods is a "demand" and "supply" of money. The question is whether the demand and supply of money so defined correspond in any way to the individual portfolio behavior postulated in the liquidity preference theory. In more modern parlance, the question is whether or not the aggregate demand for money defined in this way is structural: if not, it is of no value in policy analysis. Kohn and Karacaoglu (1989) adapt Woodford's (1985) model to an open economy to provide a fully articulated analytical example in which there does exist an aggregate money demand function of the type relied upon by the monetary approach, and show that this aggregate money demand function is indeed not structural.

The finance constraint theory has been used to produce both aggregative and optimizing models of the balance of payments adjustment process. For the former see Tsiang (1988); for the latter Kohn and Karacaoglu (1988, 1989), Helpman (1981c), and Feenstra (1983). Many of the broad results of the monetary approach (and of its extension to multiple assets—the portfolio balance approach) are sustained in these models, but there are important differences in detail.⁶²

⁶¹Cf. Johnson (1976, pp. 282-283): "The central point of the monetary approach...is that balance-of-payments deficits or surpluses reflect stock disequilibrium between money demand and supply in the market for money." This "strong" version of the monetary approach is to be distinguished from a "weak" version that does no more than assert that the balance of payments is essentially a monetary phenomenon and that its understanding requires explicit attention to money (see Rabin and Yeager, 1982).

⁶²There are important precursors to modern work in this area. One is Machlup (1943) who uses a Robertson dynamic money-flow multiplier (see Section V below) to examine the international transmission of shocks. Another is a body of work developed over the last half century in the Netherlands (associated particularly with J. G. Koopmans, J. Zijlstra, and M. W. Holtrop and reviewed in de Jong, 1973) that has come to be known—rather misleadingly—as "Dutch Monetarism." The origins of this school are Wicksellian, and it shows the influence of Robertson more than that of Keynes.

H. Money and flexible exchange rates⁶³

In a seminal paper, Helpman (1981b) compared efficiency and welfare levels under different exchange rate regimes. He used an equilibrium model based on intertemporal utility maximization, making such welfare comparisons possible, with the role of money made explicit through the use of finance constraints. Each country's goods must be purchased with that country's currency; lenders in a particular currency must provide borrowers with the appropriate amount of that currency; and debts must be repaid in the currency in which the debt is denominated. Helpman found that in perfect foresight equilibrium, both fixed and floating regimes are Pareto-efficient. Floating and one type of fixed, a one-sided peg, support the same "real" equilibrium that would be obtained in a frictionless barter model. Lucas (1982) has found similar neutrality results in a stochastic equilibrium model with endowment and monetary shocks.

As Aschauer and Greenwood (1983) have pointed out, however, the neutrality results—including the equivalence of fixed and floating regimes—depend critically on the assumption that output is exogenous. Once output is made endogenous, the "time-wedge" property of the finance constraint comes into play. For example, fixed and floating regimes are no longer equivalent, because only the latter allows a country the freedom to set an "optimum yield on money" to remove this "distortion." Neither is monetary policy still neutral. As Rotemberg (1983) and Stockman (1985) show, inflation distorts the terms of trade between *countries* just as it does between individuals in closed economy models (see above, Section IV.B). In Rotemberg's model, inflation worsens the inflating country's terms of trade under flexible exchange rates, but not under fixed rates. In Stockman's model, the distortion affects the relative prices of traded and non-traded goods differentially, changing the composition of domestic output and the pattern of international comparative advantage and of trade flows.

The neutrality results also depend on the presence of unrestricted financial markets. The task of examining how different frictions might alter the relative desirability of different regimes has been begun by Helpman and Razin (1982). In a model with incomplete financial markets, they derive sufficient conditions for a floating regime to be superior to a one-sided peg. Svensson (1985a) introduces a similar friction into the Lucas (1982) model: trade in assets is restricted to occur before the goods market opens, creating a precautionary demand for money. Here, unlike in the Lucas model, monetary shocks can have real effects.

⁶³See also the surveys by Kimbrough (1986) and Stockman (1989).

Recent work on exchange rate dynamics goes beyond the derivation of neutrality propositions in equilibrium to examining the response of exchange rates to exogenous disturbances. It also examines the co-movement of exchange rates with other endogenous variables, such as prices, interest rates, output, and the current account.

Stockman (1980) examines the excess variability of exchange rates *vis á vis* relative prices in a stochastic equilibrium framework. This contrasts with previous work which has relied on price rigidities and disequilibrium. Exogenous real shocks cause co-movements of prices and exchange rates. Exchange rates may be serially correlated and may exhibit sufficient volatility to depart from purchasing power parity, even though prices adjust freely to clear markets. This relationship between the exchange rate and the terms of trade cannot, however, be exploited by government exchange-rate policy. There is more "action" in this model than in a similar one due to Lucas (1982), because Stockman, like Svensson (1985a), restricts asset trading to the time "between" periods. Though, as Obstfeld and Stockman (1985) point out, the Lucas model, too can support excess volatility of the exchange rate.⁶⁴

Helpman and Razin explore the implications for exchange rate dynamics of different monetary arrangements. In one paper (1985), they incorporate a transactions demand for money for financial transactions; in another (1984), they explore the implications of different currency invoicing practices (whether payment is to be made in the currency of the buyer or of the seller). The economic importance of the details of financial structure has been argued in the past—e.g., by McKinnon (1973, 1979) and by Tsiang (1977)—but only in this recent work has the finance constraint approach enabled rigorous modelling. Persson (1982, p. 5-11) notes: "[An] attractive feature in this kind of model is that the explicit formulation of all money flows makes it necessary to be very precise about the nature of the institutional monetary arrangements. This makes it possible to analyze, and may even help to discover important issues that are typically neglected in conventional models."

V. MACROECONOMICS

Much of the recent work in macroeconomics begins by assuming an economy that is essentially stable and then explains fluctuations in terms of exogenous real and monetary shocks impinging on it. In the case of monetary shocks, it attempts to explain how these cause real fluctuations, rather than merely causing fluctuations in the price level. Work based on the finance constraint theory has taken a different tack. The monetary-financial

⁶⁴See also Salyer (1989).

structure is seen less as an originator of shocks than as an amplifier and propagator of other shocks to the economy. Money is generally seen as passive and endogenous.

The chief deviation-amplifying mechanism implied by finance constraints is the "multiplier": an individual experiencing a fall in current income will reduce his own expenditure, causing the income of others to fall; or a firm experiencing a fall in current earnings will cut back the scale of its activity, reducing the earnings of others. Such behavior makes no sense at all in a world of perfect financial markets. In such a world, expenditure should depend only on "permanent" income, hardly at all on current income;⁶⁵ firm activity should depend on future prospects, not on past results. But once we recognize the problems inherent in trading without trust in a world of asymmetric information, then financial markets will be "imperfect," and there will be finance constraints and multipliers.⁶⁶

There are two reasons to doubt the optimality of equilibrium in an economy with multiplier effects. The first is externalities: actions of one agent will affect the trading possibilities of others through their effect on finance constraints. The second reason is that economies with multiplier effects often exhibit multiple equilibria that are not Pareto equivalent.

These ideas have been explored both in aggregative and in optimizing models.

A. Aggregative models

Multipliers, of course, are at the heart of the Keynesian view of the macroeconomic problem. Suppose exogenous shocks affect the expected profitability of investment. In an economy with no informational problems and perfect financial markets, this should cause only fluctuations in interest rates and shifts in expenditure between investment and consumption. But in an economy with "imperfect" financial markets, such shocks will be transmitted to the goods and labor markets and cause fluctuations in output and in employment.⁶⁷

⁶⁵Bewley (1977) has shown that the permanent income hypothesis is valid only if the sequence of finance constraints is not binding; he suggests, as a result, that the permanent income hypothesis is plausible empirically only for small, anticipated, short-run fluctuations, and not for major or unexpected fluctuations. See also Foley and Hellwig (1975).

⁶⁶There is considerable empirical evidence that finance constraints do matter: see King (1985), Flavin (1984), Mishkin (1978), and Deaton (1986) on consumers; and Fazzari, Hubbard, and Peterson (1987) on firms.

⁶⁷This absence of output effects in the case of perfect financial markets assumes that effort is supplied inelastically, so that changes in rates of intertemporal substitution do not cause fluctuations in the overall level of activity. If the supply of effort is elastic, then the distinction would be between "appropriate" fluctuations with perfect financial markets and "inappropriate" or excessive fluctuations with imperfect financial markets.

The conventional ISLM model is supposed to capture these ideas, but it turns out to be a very imperfect vehicle for the purpose. Over the years a number of authors have suggested variations that try to improve on it by combining the Keynesian income-expenditure mechanism with a finance constraint theory of money and interest, rather than with the liquidity-preference theory that is embodied in the standard ISLM model. These authors include Robertson (1934), Machlup (1939, 1943), Smith (1958), Tsiang (1956, 1966), Ackley (1961), and Kohn (1981, 1988b).

The advantage of these finance constraint models is that they express fully the dynamics of the multiplier process—Machlup (1939), Tsiang (1956), and Ackley have this as their primary purpose—and they therefore shed light on a variety of methodological and substantive issues left obscure by the conventional theory.⁶⁸ For example, Machlup (1939), Smith, Tsiang (1956), and Kohn (1981) address the relation between liquidity-preference and loanable-funds theories of the rate of interest, and Robertson, Tsiang (1966), and Kohn (1981) look at the macroeconomic consequences of pegging interest rates (see also Section IV.E above).

Kohn (1988) shows that the celebrated policy-ineffectiveness result of Sargent and Wallace (1975) does not hold for a finance constraint model. The reason it does not is precisely the explicit modelling of the multiplier process. Exogenous investment shocks provide an opportunity for individually profitable interest-rate speculation; this speculation causes fluctuations in the tightness of the aggregate finance constraint, and so fluctuations in spending. Speculation has a social cost—fluctuations in output—not borne by speculators. A monetary policy of counter-speculation can reduce output fluctuations (at the cost of trading losses to the monetary authority). Such a policy is effective, despite rational expectations, not because of any informational advantage, but because it can correct the external diseconomies of private maximizing behavior.

B. Optimizing models

Optimizing models of the finance constraint theory support many of the results of the aggregative literature. In particular, Grossman and Weiss (1983), Bewley (1984),

Leijonhufvud (1981), Tobin (1982), and Ackley (1983) have all suggested that the basic "hitch" in Keynesian theory is not insufficient flexibility in the labor market, but insufficient flexibility in the *capital* market: if adjustment in the capital market were fast enough, money wages would not need to change. Kohn's results (1981b, 1988b) suggest that both elements may be necessary (as Keynes himself believed).

⁶⁸Kohn (1981b) shows that the ISLM model describes a particular equilibrium over time of the loanable funds model, and that in this sense the loanable funds model represents a generalization of the ISLM model. The reasons why Keynes chose to express the essentially dynamic multiplier process in a static model are discussed in Kohn (1986).

Rotemberg (1984), Walsh (1984), Farmer (1985), Mossetti (1987), Woodford (1986b, 1988a), and Chatterjee (1988) all show that in the presence of finance constraints policy is effective.⁶⁹

Moreover, because they support explicit welfare analysis, optimizing models permit a more rigorous discussion of what sort of policy might be desirable. One cannot really address normative questions with aggregative models: for example, one cannot presume, as Keynesian theory tends to do, that reducing fluctuations is necessarily a good thing. Whether it is or not depends on the reason for the fluctuations and on how they are reduced.⁷⁰

Mossetti (1987) and Chatterjee (1988) have models in which real disturbances cause the basic fluctuations. They both conclude that the monetary system should not constrain these (appropriate) real fluctuations, and that monetary policy should be accommodating. The policy that achieves this best is one that targets the rate of interest, not one that targets monetary aggregates.

Woodford (1986b, 1988a) has a rather different story. There are no exogenous disturbances, but the economy is subject to endogenous "sunspot" fluctuations. Woodford shows that models with finance constraints (with incomplete financial markets) have precisely the dynamic properties needed to sustain self-fulfilling rational-expectations equilibria ("sunspot" equilibria). In one model, "capitalists" invest in production according to their expectations of profitability: there is an accommodating monetary policy that allows them to spend as they wish (i.e., they are not finance constrained). Their spending affects the income, and so the expenditure, of "workers" who *are* finance-constrained, so that the capitalists' expectations of profitability are self-fulfilling. Changes in expectations of profitability may be triggered by essentially irrelevant variables ("sunspots"), introducing extraneous—and therefore welfare-reducing—fluctuations in real variables.⁷¹

Note that the accommodating monetary policy that seems desirable in the face of real shocks in the models of Mossetti and Chatterjee is also a necessary condition for the extraneous "sunspot" disturbances in Woodford's model. However, Woodford (1986b) shows that an appropriate *fiscal* policy can eliminate the sunspot fluctuations as possible equilibria, so that the accommodating monetary policy need not be abandoned.

⁶⁹While most of the models stress finance constraints on demand, Farmer (1985) and Mossetti (1987) consider the effects via the supply side of the economy.

⁷⁰So much was clear to Robertson in 1926, and was an important theme in his resistance to the Keynesian Revolution.

⁷¹This may be seen as a formalization of similar ideas put forward by Hawtrey, Lavington, and others. See for example, Hawtrey (1928b, pp. 99-100).

VI. RELATED WORK

A. Other approaches to money

Development of the finance constraint theory has not been the only response to the perceived deficiencies of conventional monetary theory. Another major line of research has built on Samuelson's (1958) overlapping generations framework as the analytical basis for a theory of money. Despite superficial differences, there are substantial similarities between this approach and the finance constraint theory.

It is often suggested that the difference between the two is that the overlapping generations model treats money purely as a store of value, while the finance constraint theory treats it purely as a medium of exchange (McCallum, 1983; Tobin, 1980). This is not the case. The key feature of the overlapping generations model that creates a role for money is a problem of double coincidence of wants that afflicts intergenerational trade. While there are benefits to such trade, it cannot take place in the absence of an intergenerational medium of exchange. Money can play this role. It is quite possible to set up formally identical models with the same double coincidence problem, but without the overlapping generations interpretation. For example, Cass and Yaari (1966) and Townsend (1980) set up models with a finite number of "spatially separated" agents.

The use of money as an intergenerational medium of exchange in overlapping generations models involves the same sort of time wedge in trade that results from the finance constraint. Hence, entirely parallel results are obtained on the welfare loss due to inflation and on the optimality of a zero nominal rate of interest (the "optimum quantity" result) (Helpman and Sadka, 1979; Wallace, 1980).

Just as money acts as a medium of exchange in overlapping generations models, so does it act as a store of value in finance constraint models. Thus, the multiplicity of equilibrium that is a well known property of overlapping generations models is also a property of finance constraint models. Indeed as Woodford (1988a) and Huo (1987) have shown, the two models can be reduced to an identical non-linear difference equation. This equation is precisely of the type that supports "sunspot" equilibria and complex dynamics (see Section IV.D above and Woodford, 1986a, 1988a).

While there is, therefore, very little difference between the two approaches at the formal level, there are important differences in the "semantics"—the interpretation of the formal structure.

For example, in overlapping generations models, the specification of money as a vehicle of life-cycle saving is unappealing on its face (Tobin, 1980) and leads to some analytical red herrings. Since life-cycle saving (or, equivalently, the mediation of

intergenerational trade) is all there is for any asset to do, all assets must bear the same rate of return: if one asset has a higher yield, it will leave the others with no place in the model. As a result, it is hard to accommodate both money and, say, bonds in the same model without there being some restriction that prevents them from being perfect substitutes. One device is to assume some sort of "legal restriction" imposed by the government. But this seems awfully *ad hoc*, vitiating the oft-heard claim that, unlike anything else, overlapping generations models are built from first principles. What is the underlying structure that has led to the imposition of these restrictions?

On the other hand, the chief advantage of overlapping generations models is that in them the total stock of wealth is endogenous, determined by life-cycle saving. In contrast, in conventional macro models of the Hicks-Tobin type, the total stock of wealth is taken as given and the model determines only its allocation across different assets.⁷² Much of this advantage of the overlapping generations model is lost when money is treated as a life-cycle asset, because of the ease with which results on saving can be misinterpreted as results on money demand.

One way to have the advantages of the overlapping generations model without its disadvantages is to impose finance constraints on *intragenerational* trade, so differentiating money from other assets as the unique medium of exchange (see, for example, the models of Woodford, 1985, 1987a, d, and Kohn and Karacaoglu 1988, 1989).

A third approach to monetary theory that has enjoyed some popularity recently involves the use of optimizing models in which real balances have been made an argument in agents' utility functions. Indeed, it has been argued that the results of the finance constraint theory can be replicated with models of this type (Fischer, 1983; Feenstra, 1986). On the face of it, this would appear plausible. In finance constraint models, money has indirect utility, should it not be possible to find an equivalent direct utility formulation? Svensson (1985b) shows, first, that the answer is, not necessarily, and, second, that even if it is possible, the appropriate direct utility function may not be "structural." A change, say, in policy regime, in the financial structure of the model, or even a shift in analysis from stationary states to dynamics, will require a *different* direct utility function. Stockman (1989) shows too that except in special cases bringing money into the utility function in this way will also bring in other variables from the finance constraint, such as investment, that do not normally appear as arguments in a utility function. More generally, the use of models with money in the

⁷²The implications of this difference for asset valuation can be profound: see, for example, Tirole (1985).

utility function seems a poor research strategy, because it imposes too little structure.⁷³ However, as LeRoy (1984) suggests, such models may have value as a heuristic in suggesting avenues to be explored by other methods or in the exposition of results established in other ways.

B. Finance constraints without money

There is a strong affinity between the finance constraint theory of money and work that looks at the implications of finance constraints (or incomplete financial markets) in general—not necessarily in relation to money.⁷⁴

Work on the microfoundations of financial market "imperfections" in asymmetric information and incentive problems parallels the work on the microfoundations of money described in Section III. For example, Stiglitz and Weiss (1981) cite adverse selection as an obstacle to using interest rates alone to allocate credit. Greenwald, Stiglitz, and Weiss (1984) stress the importance of the institutions that specialize in evaluating trustworthiness (banks) and the role of the continuing relationship between borrowers and lenders as an incentive not to default. They also argue that adverse selection prevents firms rationed by banks from turning to the direct market. Mayshar (1982, 1983) uses asymmetries of information and differences of opinion to explain the increasing cost to firms of additional finance. Greenwald and Stiglitz (1988) argue that firms face increasing borrowing costs because of the adverse selection problems inherent in selling equity.⁷⁵

Macro models in which firms face imperfect financial markets have properties that are similar to those of macro models incorporating the finance constraint theory of money: there are "multiplier effects"; policy is effective despite rational expectations. Some examples are Blinder and Stiglitz (1983), Blinder (1983), Farmer (1984a), and Greenwald and Stiglitz (1988). The general story is that firms need credit for working capital: factors of production must be purchased before firms receive revenue from sales. Hence, changes in the availability of credit will have effects on output. Moreover, Woodford (1987b, c, 1988b) shows that the incompleteness of financial markets is a sufficient condition for the existence of sunspot equilibria and complex dynamics, so that models with "non-monetary"

⁷³Cf. Woodford (1988c) on the optimal inflation tax.

⁷⁴For a survey of that literature, see Gertler (1988). As Gertler suggests, this literature has antecedents in the work of "Classical" writers such as Hawtrey (1928a) and Fisher (1933). Whether Gurley and Shaw (1960) should be included as antecedents is less clear. Although they do stress the importance of credit and the role of financial intermediaries, they do so in the context of a Hicks-Keynes-Tobin portfolio theory of an entirely conventional kind. The recent work on finance constraints rests on very different theoretical foundations.

⁷⁵As Bewley (1982), Lucas (1983), and Townsend (1987) show, finance constraints have implications for asset pricing. They find that such "imperfections" can account for many of the phenomena, such as "excess volatility," that are anomalous from the point of view of the standard perfect-market theory.

finance constraints will tend to exhibit the same sort of dynamic behavior as monetary finance constraint models.

It is sometimes suggested that this credit story is an alternative to stories that stress the role of money. At least implicitly, however, the credit story *is* a monetary story: if firms could pay for factors of production with their own IOUs, then availability of credit would not be an issue. Their need to pay with *money*, and to borrow that money if they do not have it, is of the essence.⁷⁶

C. Other related work

There are interesting parallels between the view of macroeconomic instability that comes out of finance constraint models and recent work on the stability of general equilibrium. For example, Shubik (1983), modelling the economy as a "playable game," and Fisher (1983), modelling individual behavior "out of equilibrium," have both been drawn into detailed consideration of essentially monetary issues.

The monetary nature of trade may at the same time both increase stability and decrease it. As Shubik (1973) has noted, money is a strategic decoupling device that enables individuals, in an economy out of equilibrium, to act without prior coordination with others. Financial buffer stocks (together with other buffer stocks) make it easier for the system to adjust to exogenous shocks, because the adjustment may be spread out over time. On the other hand, finance constraints do constrain. In some situations, say when financial buffer stocks are exhausted, potentially stabilizing behavior may be rendered infeasible because it violates finance constraints. Leijonhufvud (1973) and Howitt (1978) have reconciled these conflicting tendencies to increasing and decreasing stability by suggesting that monetary economies exhibit "corridor" stability. That is, they are quite stable with respect to small shocks, but once they are displaced far enough from equilibrium, they become unstable.

While the problem of honesty or trust makes finance constraints necessary, their (socially) optimal degree of tightness might well vary with the overall situation of the economy. In this connection, Shubik (1973) has done some interesting work on optimum bankruptcy laws. Abuse of the ability to borrow must be discouraged, but not to the point of discouraging legitimate borrowing. Note the divergence between the private and social costs of erring in one direction or the other: the degree of tightness of finance constraints has an element of public good about it. Excessive laxity seems likely to have only

⁷⁶These non-monetary models are very similar to Mossetti's (1987) monetary model.

distributional consequences, but excessive tightness may result in inefficient macroeconomic fluctuations.

Another class of model that exhibits important externalities of this type is the search equilibrium model pioneered by Diamond (e.g., 1982, 1984). In this class of models, an individual's decision to engage in trade has positive (non-pecuniary) external effects on the trading opportunities of others, because markets are "thin." Like finance constraint models, these models exhibit a multiplicity of self-fulfilling expectations equilibria that are not Pareto equivalent. For example, Diamond (1988) shows that an economy with credit exhibits a kind of "bootstrap equilibrium": individuals will be inclined to give credit to others only when they receive credit themselves. This suggests, by the way, one answer to those who claim that tight *money* will have no effect because agents will substitute credit: agents who find their own finance constraints tightened are likely to respond by reducing, not increasing, the credit they extend to others (the non-cooperative rather than the cooperative solution).

VII. CONCLUSION

In many ways the finance constraint theory may be seen as a return to the Classical, pre-Cambridge-School view of money. The stress on money's being a medium of exchange, rather than on its being an asset, and on money flows rather than money stocks; the loanable funds theory of interest; the description of the monetary adjustment mechanism; the importance of stable prices as a goal; the need to accommodate real shocks and to keep money "neutral." All these are very reminiscent of the Classical theory and very different from the Cambridge approach that culminated in the work of Hicks and Keynes.⁷⁷ Indeed, if the title had not already been appropriated, the finance constraint theory might well be called a "New Classical" theory of money.

⁷⁷Cf. Laidler (1988). Although monetarism has laid claim to the Classical mantle, its *theory*, as opposed to its ideology, is purely Keynesian.

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