Introduction

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In December 1978 the Federal Reserve Bank of Minneapolis was host to a conference entitled "Models of Monetary Economies," and this volume contains the papers presented and discussed at that conference. They will be found in part 1, along with the comments of the appointed discussants. The volume also contains several papers that were not presented at the conference. Long before the conference began, and again at its conclusion, conference participants were invited to submit notes or longer papers for inclusion in the conference volume. And, happily, some obliged. Their contributions will be found in part 2.

The papers in this volume are a part of the literature of "the new microfoundations of money." (That phrase was coined by Barro and Fischer in 1976.[1]) To put that observation another way, the models presented in this volume are all very different from, or alternatives to, those of the macroeconomics literature. Nor is that an accident. The Federal Reserve Bank of Minneapolis sponsored the "Models of Monetary Economies" conference precisely because some of its research staff were so doubtful about macroeconomic models, or about the monetary and fiscal policy implications of those models. The hope was that the Bank might, by financing the conference, help in the development of more satisfactory models. That hope has been in some measure realized, although the essential conclusion of this brief introductory essay is that monetary economists still have a way, possibly rather a long way, to go.

That conclusion emerges from a survey of various models of monetary economies, macroeconomic and other. The macroeconomic models, small- and large-scale, classical and Keynesian, are inconsistent; they yield contradictory implications. They do, that is, if what has been said about them is taken seriously: namely, that their common portfolio specification can be rationalized or defended by appeal to certain underlying models. And if that is not taken seriously, then the macroeconomic models are unsatisfactory on another count: they have too few implications; they do not provide answers to important questions.

This last statement applies as well to the money-in-the-utility-function and the money-in-the-production-function models. The sequence-economy or

[1]Author names and years refer to the works listed at the end of this book.

transaction-technology models, of which the so-called Clower-constraint models are a subset, also have too few implications. But even those models that are consistent and relatively rich in implications, the overlapping generations and the communication-cost models, are not entirely satisfactory. Why is explained later on. It could well be, though, that of all the models so far fashioned by monetary economists, those models are the most satisfactory. Developing them further may be the best research strategy for the period immediately ahead.

Macroeconomic Models

Virtually all of the models of the macroeconomics literature have a common portfolio specification, hereafter referred to as the *standard specification*. It says, and this is a definition, that desired asset quantities depend, by way of fixed functions, on current and lagged income, wealth, and yields to maturity or asset prices. (See, for example, Friedman 1956 and Tobin 1969 or almost any macroeconomics textbook, say, Dornbusch and Fischer 1978.) Few, though, regard that specification as primitive. With near-unanimity, it is held that the standard specification can be rationalized by appeal to some risk-aversion portfolio model, perhaps Tobin's (1958), and/or some inventory model of money demand, whether Baumol's (1952) or Tobin's (1956), that of Miller and Orr (1966), or one of a number of others. But that claim cannot be sustained.

What does it mean that the standard specification can be rationalized by appeal to some underlying model? Presumably, that the underlying model is a part of any model containing that specification. (After all, as a matter of logic, the assumptions of an underlying model are or are not accepted.) So no implication of any such model (that is, any macroeconomic model) can contradict any implication of the underlying model. The fact is, however, that macroeconomic models do have implications which contradict those of any risk-aversion portfolio model and those of any inventory model of money demand.[2]

Any risk-aversion portfolio model implies that desired asset quantities depend on wealth and on the parameters or moments of the joint distribution of asset yields. It follows that current and lagged yields can appear in the portfolio specification of a model of an ongoing economy only as conditioning variables or forecasters of the distribution of future asset prices. (If, for example, asset yields are identically and independently distributed over time, then those observed yields should not appear.) Thus, although risk-aversion portfolio models say that asset quantities may depend on observed yields, they also say that the nature of that dependence, how asset quantities and yields are related, is determined by the yield distribution. That dependence is not analogous to the static demand theory dependence of quantities on relative prices. There is, however, no acknowledgment of that in the models of the macroeconomics literature—or, more specifically, in the standard specification, with its fixed asset demand functions. That is why macroeconomic

[2]A vague appeal to some underlying model is implicit theorizing. And that macroeconomic models are contradictory reveals that that sort of theorizing is risky. What must be shown is that the underlying model is equivalent to (if and only if with) the assumptions that it justifies. If the implication has only been shown to go one way, then the underlying model may have other implications which contradict implications of the complete macroeconomic model. Moreover, to use some of the implications of the underlying model, rather than the underlying model itself, as a part of the macroeconomic model is to run the risk of missing those other implications.

models, those which include the standard specification, are contradictory.

When any such macroeconomic model is used to determine a nonstochastic equilibrium, there is an evident contradiction. More generally, nothing guarantees that the endogenous yield distribution implied by any particular macroeconomic model matches up with the distribution underlying the model's fixed relationships between asset quantities and yields. And note that there is a guaranteed contradiction when, as in Poole 1970 or Kareken, Muench, and Wallace 1973, a macroeconomic model is used to compare the consequences of alternative monetary instrument choices or when, as in Tobin and Brainard 1963, a macroeconomic model is used to determine how an unconstrained equilibrium compares with that which obtains under an effective Regulation Q ceiling. If the fixed asset demand functions of the model are right for one policy regime, they cannot be right for the other.

It is an implication of risk-aversion portfolio models that no fixed dependence of asset quantities on observed yields should fit any arbitrary time series. That may explain why researchers have not been able to identify an econometrically stable set of fixed functions relating asset quantities to yields (and income and wealth). Another possibility is that researchers have been looking for the wrong kind of dependence, that which is suggested by static demand theory.

Macroeconomic models also have implications which contradict those of the inventory models of money demand. An assumption common to all of the inventory models is that there are transaction costs. Those costs are what rescue currency (or any zero-interest means of payment) from being dominated by, for example, riskless bonds. But the inventory models have other implications, among them, that the total of resources used up in transacting changes with a change in the proportions in which the public holds means of payment and other assets. It is, however, an implication of macroeconomic models that the total of resources used in transacting is a constant. So there is an obvious contradiction, one which cannot simply be brushed aside. A change in the amount of resources used in transacting may be the principal effect of an open market operation. (See Bryant and Wallace 1979a.)

The conclusion is, then, that the standard portfolio specification cannot be rationalized or justified by appeal to some risk-aversion portfolio model and/or some inventory or transaction-cost model. The specification can only be regarded as a primitive assumption. But as most would agree, it is unsatisfactory simply to assume that asset quantities are unspecified fixed functions of observed yields, income, and wealth. Too little follows from that assumption.

It is suggestive that users of macroeconomic models have sought to justify the standard specification by invoking risk-aversion and inventory models. Those models would seem to be true to the postulate of intrinsic uselessness, which is surely accepted by all economists: No asset is ever wanted per se, but only for the future consumption it supports. To take the standard specification as one of the primitive assumptions of the model is, however, to give up that postulate and with it any hope of doing a traditional welfare analysis of alternative monetary and fiscal policies. (In that type of analysis alternative policies are ranked by their implied consumption allocations.) Then, too, the postulate is relatively rich in implications: to mention but one, the Modigliani-Miller theorem. Intrinsic uselessness is necessary for that result. (See, in particular, Stiglitz 1969.) Clearly, it could never be obtained by simply postulating separate and general demand functions for equities and bonds. So

there is a strong case for not giving up the postulate of intrinsic uselessness, or for starting off not with the standard specification, but rather with that postulate.[3]

Money in Utility or Production Functions

There are many models in which a stock of something called money appears as an argument of utility functions (see, for example, Sidrauski 1967, Samuelson 1968, and Helpman and Sadka 1979) or of production functions (Levhari and Patinkin 1968 and Calvo 1979). As is evident, though, to assume that money is an argument of utility functions or of production functions is to indulge in implicit theorizing. No one regards either of these assumptions as primitive. To quote Samuelson (1968, p. 8),

> One can put M into the utility function, along with other things, as a real convenience in a world of stochastic uncertainty and indivisible transactions charges.
>
> If, however, one does put M directly into U, one must remember the crucial fact that M differs from every other good (such as tea) in that it is not really wanted for its own sake but only for the ultimate exchanges it will make possible.

And appended to the quoted passage there appears the following footnote:

> This is not the only way of introducing the real convenience of cash balances. An even better way would be to let U depend directly only on the time stream of [consumptions], and then to show that holding an inventory of M does contribute to a more stable and greatly preferable stream of consumptions. The present oversimplified version [putting M directly into U?] suffices to give the correct general picture.

But it does not do, making a vague appeal to "a world of stochastic uncertainty and indivisible transactions charges." More must be said of a model than that it may be consistent. Yet, unless the underlying world (environment) has been made explicit, consistency cannot be checked or therefore ensured. The criticism applies to all of the stories that have been told to justify including money among the arguments of utility and/or production functions.

As was noted above, the standard specification, as a primitive assumption, has too few implications. The assumption that something called money is one of the arguments of utility/production functions, which must also be regarded as primitive, does too. What is the thing called money? Some particular liability of government? Net outside indebtedness? Or is it some aggregate of government and private liabilities that can be spent? Suppose there are two countries. Is there some liability of the government or the private sector of one country that qualifies as money for the residents of the other? Anyone who starts off by putting money into utility/production functions must answer those questions, presumably by appealing to some implicit model or environment. Economists have for ever so long now been debating what ought to be lumped into an aggregate called money. And that is evidence enough that implicit theorizing has not served them well.

Seemingly, it is possible to avoid answering the questions of the previous

[3]It is not possible to prove the nonexistence of a set of assumptions which contains the postulate of intrinsic uselessness and which is equivalent to the standard specification. That, however, is hardly justification. Until a set has been found, the standard specification will remain largely without implications (except as ad hoc, and therefore unconvincing, restrictions are appended to it).

paragraph by including all assets as arguments of utility/production functions. What results, though, is an almost empty specification. About the only thing implied is that there are econometrically stable asset demand functions, precisely those of the standard specification. But time and again data have rejected that implication.

The alternative to putting money into utility/production functions is to make explicit use of the postulate of intrinsic uselessness. And although that may not always be easy, what results are considerably restricted asset demand functions. For to assume intrinsic uselessness is to in effect substitute profit or rate-of-return maximization for utility maximization. The contrast between standard demand theory and the demand theory of Lancaster (1966) is illustrative.

Imposing a Transaction Technology

On the surface at least, the sequence-economy models of Hahn (1973b) and others are consistent with intrinsic uselessness. There are two assumptions common to those models. The first is that there is a sequence of markets, one for each date $t = 1, 2, \ldots$, in which all goods, differing in physical characteristics and/or delivery times, may be traded. Presumably, something called money may be too. The second common assumption, one which distinguishes the sequence-economy models from the Arrow-Debreu model, is that exchange is costly. There is some resource cost associated with buying or selling any good at time t, for delivery at time $t + h$ ($h \geq 0$). That cost may vary with what good is bought or sold, the individual doing the trading, the amount involved in the trade, and the delivery date.

If the right exchange-possibility and cost assumptions are imposed, sequence-economy models can yield positive equilibrium prices of money for all periods.[4] To quote Heller and Starr (1976, p. 203),

> Any durable good or futures contract can perform the function of shifting purchasing power forward or back, but transactions and storage costs associated with some commodities used for this purpose will be prohibitive. A distinguishing feature of money should be its low transactions and storage costs as compared to goods, bonds and futures contracts.

And by assumption the transaction technologies of the Heller-Starr and the other sequence-economy models conform to that characterization of money. (See Hahn 1973b, Starrett 1973, and Kurz 1974a, Heller 1974, and Honkapohja 1978.) That is the sense in which those technologies are right.

How, though, is the Heller-Starr transaction technology (or any of the others) to be regarded? As a primitive assumption? Or as an implication of some underlying model? The latter possibility seems ever so much more likely than the former. Implicitly, certain facts, aspects of the physical environment, are embedded in the technology. Milk depreciates very quickly. Land is not uniform. (How fertile a particular piece is requires too much checking.) And would anyone use the transaction technology appropriate for a Robinson Crusoe–Friday economy in, say, a model of the U.S. economy of 1979? But why not? Actually, it is only implicit theorizing, the appeal to some underlying model or environment, that saves transaction-technology models from being without implications. In the absence of explicit models, however, controversy

[4] For any finite-horizon version, though, a final-period price of money must in effect be imposed. See Heller and Starr 1976.

can, as was pointed out above, go on endlessly. In particular, what is assumed in sequence-economy models about the exchange efficiency of outside indebtedness may not seem convincing to everyone.

What has just been said applies—if anything, more strongly—to the Clower-constraint models. "Money buys goods and goods buy money; but goods do not buy goods." That is Clower's dictum (1967, p. 5); and it is an assumption, the distinguishing assumption, of a large number of models of monetary economies, including the Shubik and Lucas models of this volume. (With some justification, though, these models might be referred to as the Brunner-constraint models. See Brunner 1951.)

In the economy modeled by Shubik, exchange involves the use of redeemable claims on government and claims on private banks. The appeal is to an earlier paper by Shubik (1973). There he showed that with the strategic use of some physical thing as a means of payment, multilateral exchange of many goods can be modeled as a particular noncooperative game, the Nash equilibrium of which approaches the competitive equilibrium. Whether that justifies all of the details of Shubik's model in this volume is, however, unclear. Also, since, as we now know, there are several noncooperative games with equilibria which converge to the competitive equilibrium, some justification must be provided for that which is singled out. (See Hurwicz's comment in this volume.)

The Lucas model is of an economy populated by individuals of infinite life who discount. There is no capital, the consumption good being nonstorable. So saving is the accumulation of outside money. With regard to exchange, Lucas makes two assumptions: the first, that the proceeds (outside money) from the sale of current output can be used to acquire future but not current consumption, and the second, that there is no borrowing and lending. (Bewley, whose model is similar to Lucas', also rules out borrowing/lending, but does not impose the Clower constraint. Townsend gets no borrowing/lending as an implication of the spatial separation he imposes.)

Shubik's view would seem to be that use of a medium of exchange, or possibly the Clower constraint, is justified by exchange being (or being best represented as) a noncooperative game. That is an interesting possibility, although at this time hardly more. For Lucas, the justification is evidently to be found in the observation, which few would dispute, that exchange is really more difficult than it is in the Arrow-Debreu economy. There are barriers which would-be traders have to surmount, and the use of outside money helps in the surmounting of them. That may be. But imposing the Clower constraint, even after having offered a plausible intuitive explanation, is starting too far along.

The objection can be put another way. Clower-constraint models are all limiting versions of the Heller-Starr model. By assumption, the cost of buying one good with another, or with any asset save that called money, is infinite. Some may dispute this, arguing that it is only required that the cost be sufficiently great. But no Clower-constraint model determines endogenously what is used as a means of payment. That is given exogenously. So, independent of what happens to the physical environment, or, more specifically, to government policy, there is never any switching from one thing to another. Thus, whatever the inflation rate may be, the residents of one country never abandon the paper money of their government in favor of that of another.

The foregoing objection would be without force if no one had ever observed

any variation in the means of payment. It is, however, a matter of record that different things have been used at different times and in different places.

Overlapping Generations Models

For quite a few years, monetary economists pretty much ignored the Samuelson (1958) pure consumption loan model. Cass and Yaari (1966a) are the conspicuous exceptions. Of late, however, the model has been the focus of considerable attention. Thus, versions of the Samuelson model will be found in two of the conference papers, those by Wallace and by Cass, Okuno, and Zilcha (COZ), and in two of the other papers, those by Brock and Scheinkman and by Townsend. Samuelson-type models (as models of monetary economies) are discussed by Bryant and by Cass and Shell.

Those models, referred to here as the *overlapping generations models,* are attractive because they are relatively explicit—perhaps not entirely so (see below) but more so than the models considered above. Why does this rather than that asset appear as an argument of utility functions? Why one transaction technology and not another? Why can individuals not borrow and lend? There is no need to ask such questions of any overlapping generations model.

Overlapping generations models may give an edge to outside indebtedness. Whether a particular model does would seem to depend on whether laissez-faire (no outside indebtedness and no tax-transfer or social security scheme) can be nonoptimal, and, more particularly, whether in equilibrium there is capital overaccumulation. (See, for example, Shell 1971.) And whether laissez-faire yields nonoptimal competitive equilibria depends on the structure of the economy: its natural growth rate, the age profile of endowments, and the technology for converting present into future consumption. As Wallace suggests, the overlapping generations models provide an interpretation of the widely held view, nicely articulated by Friedman (1960, pp. 5–6), that outside indebtedness is welfare-improving because it frees resources that would otherwise have to be used to provide a stock of commodity money. But overlapping generations models do not provide simple answers to how outside indebtedness should be managed. The policy that has received the most attention, herein referred to as *pseudo laissez-faire,* is the provision of a fixed nominal stock of such indebtedness.

Very generally, overlapping generations models have nonmonetary-like equilibria under pseudo laissez-faire, equilibria in which outside indebtedness is always without value, or in which the value of outside indebtedness converges to zero. That is true even though there may exist other optimal equilibria in which the value of outside indebtedness is bounded away from zero. If taken seriously (and the plausibility of the intrinsic uselessness postulate suggests that it should be), that conclusion implies that pseudo laissez-faire is defective. As a matter of government policy, it may be desirable to impose legal restrictions that bound the value of outside indebtedness away from zero. (See Scheinkman's comment in this volume.)

In some simple overlapping generations environments there does exist an optimal equilibrium under pseudo laissez-faire. (That conclusion is in sharp contrast to what is implied by models of infinitely lived agents who discount the future. In those models, any such equilibrium is in general nonoptimal. See the Bewley and Townsend papers.) In the COZ paper and the Cass addendum it is shown, though, that that is not generally true. Future research may further characterize the class of environments in which there is an optimal equilibrium under pseudo laissez-faire.

It has long been known that if all taxation is costly (distorting), then nothing recommends pseudo laissez-faire. A nonzero inflation tax is in general called for. (See Phelps 1973 and Helpman and Sadka 1979.) In that connection, there are very deep questions. Why should a society choose the social contrivance of outside indebtedness rather than a tax-transfer or social security scheme? And what keeps the outside indebtedness regime viable? Answers to those questions will presumably have other implications. The fact that overlapping generations models provide no answers suggests that even in them there are some implicit assumptions.

That, however, is not why many conference participants were skeptical of Wallace's claim that overlapping generations models must, by default perhaps, be the basis for analyses of monetary and fiscal policies. A common view is that overlapping generations models do not portray money as a medium of exchange. (See Tobin's comment.) That criticism is to be translated as follows. There is a clearly discernible real world pattern of transaction velocities, a pattern displayed by nearly all real-world economies, past and present. Some one thing has a large transaction velocity, or few things do, and all other things have small transaction velocities. And the only satisfactory models of monetary economies are those which yield this pattern.

There is a related, and perhaps more solidly grounded, suspicion about overlapping generations models: although they may provide reliable answers about fiscal policy, their monetary policy implications are not to be taken seriously. Nor is it irrelevant that in the preceding paragraphs the reference was exclusively to net outside indebtedness, the path of which is determined by fiscal policy (indeed, by the deficit on current account). Monetary policy determines the composition of that indebtedness and can therefore be of any consequence only if the components of the total sell at different prices. To address questions of monetary policy, it is then necessary to have a model which implies, inter alia, positive interest on default-free assets. There is such an overlapping generations model, that fashioned by Bryant and Wallace (1979a). But they too are guilty of having simply imposed a transaction technology.

In elaboration, it suffices to consider Federal Reserve notes and, as an instance of default-free assets, U.S. Treasury bills. The problem is that they are similar in the extreme. A note and a bill both promise known amounts of currency in the future, independent of the state of the world. So why do Treasury bills sell at discount? Why not at par? There is an explanation, obvious perhaps, but no less convincing for being so: Treasury bills are issued in inconvenient denominations. What if the U.S. Treasury or the Federal Reserve System stood ready, as the System does for currency, to exchange large- and small-denomination Treasury bills at no cost? Would large-denomination Treasury bills, those with par values of, say, $10,000, still sell at discount? That seems extremely unlikely. Or what if the System abandoned its policy of costless exchange of Federal Reserve notes of different denominations? Would large-denomination notes sell at par in a private market? That too seems extremely unlikely.

There is, then, a ready explanation for interest on riskless securities. Quantity discounts are offered on all kinds of things. And why not on Treasury bills? But it is not entirely satisfactory to modify the environment of an overlapping generations model by introducing a cost of intermediating large-denomination government liabilities. If it is costly for individuals to get to-

gether and share a government bond, then getting together for any other purpose, perhaps to exchange other things, cannot be costless. It is not, however, one of the assumptions of overlapping generations models that any communication or interaction among individuals is costly.

Costly Communication

It is important that the main assumption of the overlapping generations models be retained, for any model of a monetary economy must be able to address the issue of capital overaccumulation. Evidently, though, the (implicit) assumption of costless communication should be replaced. But how to model costly communication? The attempt to do so goes back only a little way in time. (To suggest that money eliminates the requirement that there be a double coincidence of wants is not to provide a model, nor, more importantly, an explanation from which anything at all follows.) Starr (1972), Ostroy (1973), and Feldman (1973) were among the first to enlist in the effort. But in the economy modeled by Ostroy and Starr (1974), all trades, although bilateral, take place at known Arrow-Debreu equilibrium prices. And their model is not dynamic; the trading process runs on in other than calendar time. Nor is Feldman's model dynamic.

In contrast, Harris' (forthcoming) model is dynamic. But, containing no outside indebtedness, it cannot be used to address present-day monetary policy questions. Townsend's models in this volume, also explicitly dynamic, do contain outside indebtedness. Also, although they do not and were never meant to explain quantity discounts on riskless securities, they may well be suggestive of models that can.[5]

If the majority view of the conference participants is a reliable guide, a model of a monetary economy, to be satisfactory, must explain not only valued fiat money but also the real-world pattern of transaction velocities. It must also explain interest on default-free assets. Seemingly then, as was observed at the beginning of this essay, monetary economists have some way to go. To say that is not in any way to belittle any of the postwar contributions to monetary economics, but only to acknowledge the extreme difficulty of the task that has confronted monetary economists.

Readers can, however, decide for themselves whether that rather somber judgement is justified. This volume contains a variety of models of monetary economies, as well as considerable informed discussion of different models. There is enough in it for readers to make up their own minds about the state of monetary economics.

[5]The equilibrium exchange ratio of any isolated market of the Townsend (or Harris) models is competitively determined. So presumably it is to be understood that there are many agents of each type in any such market. If, however, all agents of each type move together, as they do in the Townsend models, then nothing prevents all those of a type from sharing a large-denomination Treasury bill.