Discussion by Milton Harris*

1. Introduction

Robert E. Lucas' paper formulates (as do the papers by Wallace and Cass, Okuno, and Zilcha in this symposium) a model in which a role for money is endogenous and explicit. The reason for developing such models stems essentially from the argument, exposited in Lucas 1976,[1] that one cannot hope to analyze the effects of policy changes using a model in which one assumes that certain behavioral relationships (for example, demand for money) are exogenous when, in fact, these relationships vary with the policy adopted. It follows that, to analyze monetary policies, one must postulate a model in which the use of and demand for money arises endogenously and explicitly from the postulated preferences of the agents (over real goods), the information structure, and the available technology of production and exchange, that is, from the basic underlying data of the economy which can be expected to remain stable in the face of changing monetary policy. I agree that the use of such models is essential for examining the effects of monetary policy and applaud the efforts of Lucas, Wallace, Cass, and others in this direction.

2. Lucas' Model

Lucas derives a simple model with an endogenous role for money, using, in essence, the following assumptions:

- There are two classes of people, those with positive marginal product in producing goods and those with zero marginal product in producing goods but positive marginal product in trading (or shopping). One cannot produce and trade at the same time. Thus it will be optimal for agents to pair off into households (or firms) consisting of one producer-storekeeper and one shopper.
- There is no economy-wide simultaneous trading.
- Future consumption is discounted.

To simplify the analysis it is also assumed that only one type of physical good can be produced (marbles), but the good can be produced in various colors. Preferences are such that agents want to consume the colors in certain fixed

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

proportions. Technology is such that a given producer can produce marbles of only one color at an exogenously determined rate. Production requires only labor input, and there is no utility for leisure. Marbles are perfectly perishable.

It follows from these assumptions that the most efficient contract for effecting exchanges is for each household to be endowed with a certain amount of some perfectly divisible object called money (pieces of paper or credits in an account), and then all exchanges are of the following form: one agent agrees to hand over to the other agent one marble of her or his own color in exchange for each p units of money (p, the price level, is independent of color). Given that all exchanges are of this form, the shopper will return to the store periodically to consume any accumulated marbles and pick up any accumulated money. The period length (that is, length of time between returns to the store) will be independent of the money supply. The latter will be fixed exogenously at the beginning of time and not changed thereafter.

The object of the analysis is to determine the price level, p, as a function of the money supply, M.

Lucas also analyzes a model in which future preferences of consumers are uncertain. In this model, the object is to determine the steady-state distribution of real balances across consumers and the steady-state price level as a function of the fixed supply of nominal balances. The explicit dynamical formulation of these models which follows from the above assumptions is particularly simple and elegant. The main mathematical condition which generates a role for money is a simple Clower-type cash-in-advance constraint (see Clower 1967). In both models, Lucas shows that a competitive equilibrium allocation and price level exist in which the classical, quantity-theory propositions hold (velocity is constant and the price level is proportional to the quantity of nominal balances).

3. Critique

The models appear to have two major shortcomings from the point of view of policy analysis. First, the money supply is fixed once and for all at the beginning of time. Thus the models as presently formulated are useless for any practical analysis of policies concerning the evolution of the money supply over time. That is, one can analyze only once-and-for-all changes in the quantity of money. Second, the models exclude all assets other than money. In particular, there can be no analysis of open market operations. Moreover, it is not clear that Lucas' results would continue to hold in an economy with private credit as well as money.[2] It is clear that Lucas regards this paper as a first step which will form a basis for the addition of the aforementioned elements.

It is a fairly straightforward exercise to superimpose on Lucas' certainty model a stochastic law of motion (or policy rule) for the evolution of the money supply.[3] I have done this for the following formulation:

[2]Wilson (1978b) provides a model very similar to Lucas' certainty model. Wilson's model includes an explicit labor supply decision and private credit. The government may purchase and sell bonds issued by consumers. Wilson is not much concerned in his paper with the analysis of monetary policy; however, he does point out that the model is amenable to such analyses.

[3]A stochastic policy rule might reflect the assumption that the monetary authority cannot completely control the money supply but can determine some aspects of its distribution. As a special case, one can easily analyze an environment in which the monetary authority does have complete control simply by making the random variable in the policy rule degenerate.

$$M_{t+1} = (1 + \pi_{t+1}) M_t$$

where $\{\pi_t\}$ is a sequence of independent and identically distributed random variables with support in $(-1, \infty)$ and M_t is per capita nominal balances in period t. Assume that each consumer receives a transfer at the end of period t equal to $\pi_{t+1} M_t$ (independent of the consumer's holdings of money in period t) and must decide on a level of consumption in period t before the realization of π_{t+1}. In this model, equilibrium would be defined as a pricing function $P(M_t, \pi_t)$ which defines the price level in period t as a function of the per capita stock of money in period t and the rate of increase in this stock since last period such that all output is demanded and per capita demand for money in period t is M_t for each t. It can be shown that in this model the classical quantity theory results [that is, $P(M_t, \pi_t) = M_t/y$ where y is output per capita per period] hold in equilibrium if and only if the money supply does not decline too rapidly, that is, if and only if

$$E_\pi (1 + \pi)^{-1} \leq 1/\beta$$

where β is the common discount factor of all agents.

The problem with this analysis is that it is no longer clear that once we allow a growing money supply the period length will be independent of the monetary policy. In particular, it may be optimal for the shopper to return to the store to pick up accumulated cash balances more often (that is, to shorten the period length) the faster is the rate of growth of prices.[4] (Lucas argues that the period length may appropriately be regarded as exogenous, mumbling something about the rate of rotation of the earth. This seems to have about as much to do with the period length as the value of Planck's constant or Avogadro's number. Lucas' argument that the period length is exogenous is correct for his model, which has a fixed equilibrium price level. The rate of rotation of the earth notwithstanding, the argument is inappropriate if the price level may grow at different rates depending on the specific monetary policy.)

4. Conclusion

The final judgment on the efficacy of the modeling approach espoused by Lucas in this paper will have to await more elaborate versions which are capable of addressing more interesting policy issues and which provide some strong positive implications on which they can be tested. Whether Lucas' approach will prove to be more tractable or fruitful than, say, the overlapping generations models embraced by Wallace and others also remains to be seen. As mentioned above, however, it is essential, if we are accurately to predict the effects of various monetary policies, to formulate models in which the demand for money arises endogenously from assumptions on the primitive taste-technology-information data of the economy.

[4] I believe this criticism also applies to the model of Wilson (1978b).