Why the Fed Should Consider Holding M_0 Constant

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The Federal Reserve System has been making monetary policy in the dark. It has had to; economists simply have not agreed on a theory that satisfactorily explains the use of money in the economy and tells public policy makers what they should do about it. But a theory does exist which includes what's essential for a good theory of money. Economists should recognize it as the best available, and the Fed should not ignore its policy implications, for they are very different from current practice.

What is essential for a good theory of money?

Most basically, the theory must explain facts. Why do people use some objects for exchange and why some objects more than others? Specifically, why do people value and use fiat money—intrinsically worthless stuff the issuer will not convert into anything?

To explain the role of fiat money, a good theory must include "friction." In standard economic theory, markets work too well; people communicate and trade in fictitious markets without using up resources. As a result, standard economic theory cannot explain the limitations of markets—limitations that account for phenomena like centralized planning, firms as ways of organizing economic activity, nonprice allocation schemes like first-come, first-served, and the use of money.[1] Without some friction that inhibits the operation of markets, there can be no role for a lubricant like money.

To determine the best role for public policy, a good theory of money must let monetary policies be evaluated in the same way economists evaluate other governmental actions: in terms of economic efficiency. An allocation of resources is efficient or nonwasteful if no one could feasibly be made better off by a change without also making someone worse off. Without a theory that describes efficient allocations, monetary policy makers have adopted high employment, stable prices, and growth as goals. But as will be demonstrated, the pursuit of such goals can be inconsistent with the pursuit of efficiency.

The simple theory you will read about in this article does what a good theory of money must. It contains a friction that accounts for some basic facts about money, and it allows monetary policies to be evaluated in terms of efficiency, the usual goal of public policy.

The results of that evaluation are important for the Federal Reserve System. To achieve efficiency, this theory says the Fed should limit itself to holding constant the supply of U.S. fiat money (currency plus deposits of commercial banks at the Fed). This is quite different from

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[1]On markets vs. planning see L. Hurwicz, "The Design of Mechanisms for Resource Allocation," AMERICAN ECONOMIC REVIEW, May 1973, and V. Smith, "Economic Theory and its Discontents," AMERICAN ECONOMIC REVIEW, May 1974. On firms see R. H. Coase, "The Nature of the Firm," in AEA READINGS IN PRICE THEORY, eds. Stigler and Boulding (Homewood, IL: Richard D. Irwin, Inc., 1952), VI. Coase argues that firms exist as substitutes for markets; think of much vs. little vertical integration (few vs. many markets). For some remarks on first-come, first-served see N. Wallace, "Microeconomic Theories of Macroeconomic Phenomena and Their Implications for Monetary Policy," in A PRESCRIPTION FOR MONETARY POLICY: PROCEEDINGS FROM A SEMINAR SERIES, Federal Reserve Bank of Minneapolis, 1976.

the Fed's current practice of tinkering with various other measures of the money supply, a practice no satisfactory theory of money supports.

Samuelson's Overlapping Generation Model[2]

Consider a discrete time economy in which people live two periods (young in the first period, old in the second), and N new people appear each period. Each young person is endowed with some amount of a single nonstorable consumption good. (You may think of young people as having labor that can be used to produce the nonstorable consumption good and of old people as unable to work.) Nothing but their own consumption matters to these people: more consumption is preferred to less, and everyone would like to consume something in both periods.

Thus, on any date this economy has some young people, some old people, and a fixed amount of the one nonstorable consumption good. We are going to judge the efficiency or nonwastefulness of various ways of distributing the consumption good. In doing that, we will take into account those who are currently alive—the current old and the current young—and all future generations. It is, by the way, a critical feature of this economy that it has no last generation.

A Wasteful Market Solution

If we, so to speak, let matters take their course in this economy, then a likely outcome is that the current young and the young in each future period consume their endowment, but no one gets to consume when old. Call this the "no-trade allocation." I want to prove that this is a wasteful allocation, that the fixed amount of the consumption good can be divided in the current and in every future period to make everyone better off than under the no-trade allocation.

For the moment, suppose that everyone has identical preferences and endowment, and let the endowment of each young person be Y units of the nonstorable consumption good. Let C_1 be consumption when young and C_2 consumption when old. Moreover, suppose that the consumption bundle $(C_1, C_2) = (Y/2, Y/2)$ is preferred to the bundle $(C_1, C_2) = (Y, 0)$. That is, everyone prefers to get something when they're both young and old, not just when they're young.

Obviously, the fixed amount of the consumption good, NY, available to society each period could be divided so that each of the 2N people alive at each date gets Y/2 units. This produces $(C_1, C_2) = (Y/2, Y/2)$ as lifetime consumption for every young person and Y/2 as second-period consumption for the current old. This allocation would be preferred by everyone or dominates the no-trade allocation which gives the young a lifetime consumption of (Y, 0) and the current old nothing.

But how can a market produce this dominant allocation or any allocation in which people get to consume something when old? Clearly the young in each period have to surrender part of their endowment to the old. But what can the old give in exchange? In a sense, they have nothing, particularly nothing that would bind or commit the next period's young to turn over some of their endowment to the then-old. This is the friction that allows this model to have a role for fiat money.

A Fiat-Money Solution

By definition, fiat money is unbacked or inconvertible money; the issuer does not promise to exchange it for anything else. Today the United States' fiat money consists of outstanding currency plus deposits of commercial banks at the Federal Reserve (sometimes it's called "high-powered" money or the monetary base). One way to check this is to consolidate everyone's balance sheets; what is left as wealth is all real assets (buildings, land, animals, etc.) and fiat money.[3]

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[2] P. A. Samuelson, "An Exact Consumption-Loan Model of Interest With or Without the Social Contrivance of Money," JOURNAL OF POLITICAL ECONOMY, December 1958.

[3] To get this answer, one must regard government interest-bearing debt as claims on future taxes against which taxpayers have an offsetting liability.

Fiat money is also intrinsically worthless. It cannot be an object wanted for its own sake (to be consumed), nor should it help produce the consumption good (as labor and land do). To have a theory of fiat money, then, is to explain the circumstances under which intrinsically worthless stuff ends up having value as it does when it is accepted in exchange for things like the consumption good of the model we have been describing.

Once defined this way, fiat money obviously has value at any date only if people believe it will have value at the next date. So expectations play an important role in any theory of fiat money. Moreover, we see why the never-ending nature of our model is critical. Were there to be a last generation, fiat money could not have value when the last generation was old. But then it could not have had value when they were young, and so on, leading to the conclusion that fiat money could never have value.

Now if the old people currently alive have some fiat money and if this amount will never be changed, then there exists an equilibrium in which fiat money has value, an equilibrium that produces a nonwasteful allocation.

By "equilibrium" I mean a price sequence (a sequence of values of fiat money at each date in units of the consumption good at that date) and an allocation (a description of who gets what in which "who" includes everyone alive now and in the future) that satisfies the following properties:

- Individuals' choices are optimizing and subject to them assuming current and future values of fiat money and being right about the future value.
- Those choices clear the market in each period; the total demand for fiat money by the young equals the amount offered by the old.

For precision, such an equilibrium might be called a competitive, perfect-foresight, or rational expectations equilibrium, but I will simply call it an equilibrium.

How does our fiat-money economy work?

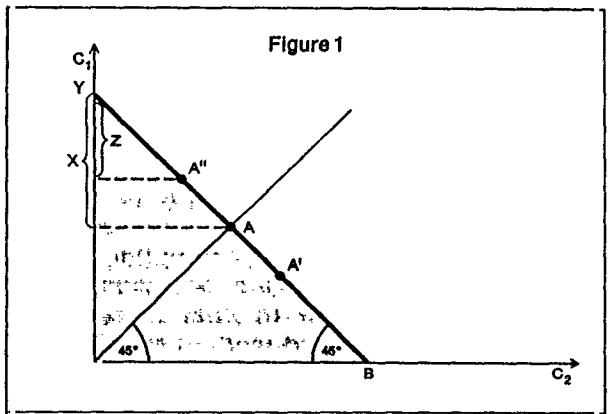
In each period, the old people offer at any price all the fiat money they have. This constitutes the supply of fiat money. The young people are demanders of fiat money, but in general their demand depends on the value of fiat money now and in the next period and on their preferences. Because conditions remain unchanged over time in this economy, in equilibrium the value of fiat money could remain constant from period to period; the supply of fiat money does not change nor do the factors that influence the demand.

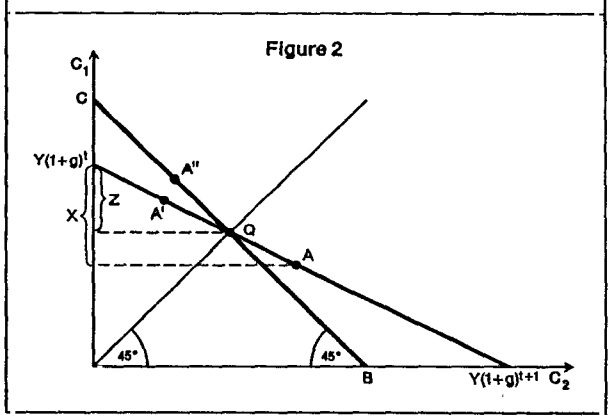
If the value of fiat money is positive and constant, then young people believe they can exchange one unit of their endowment for one unit of consumption next period. In other words, they face a zero interest rate and a choice set—a set of possibilities for first-period consumption, C_1, and second-period consumption, C_2—shown as the shaded area in Figure 1. The equilibrium value of fiat money is determined by the preferences of the young, by their choice of a point on the upper boundary of the choice set.

To pin matters down, we suppose that they display no time preference; when given the chance to trade one unit of first-period consumption for one unit of second-period consumption, they choose equal amounts of the two. In other words, they choose $(C_1, C_2) = (Y/2, Y/2)$.[4] This means that each young person offers $Y/2$ units of her or his endowment in exchange for fiat money or that in the aggregate $NY/2$ units of the consumption good are offered. If we let M denote the number of units of fiat money supplied, each unit exchanges for $(NY/2)/M$ units of the consumption good each period. It is easy to verify that such a price sequence is an equilibrium according to the definition given above.

We can also indicate why the resulting allocation is nonwasteful, at least among the class of allocations that treat all young people of

[4]An example of a utility function consistent with such preferences is the function C_1C_2.





all generations the same.[5] Any such allocation limits the consumption bundle of young people to the shaded area in Figure 1. Given the assumed preferences, the bundle $(C_1, C_2) = (Y/2, Y/2)$ is best from their standpoint. While the current old would get more if the young were constrained to a point southeast of point A, say, A', the current young and the young of all future generations would be worse off. (All points on the line segment connecting A and B, including the points A and B, are nonwasteful.) Points like A'' on the boundary northwest of A are wasteful because both the young and the current old are worse off there than at A. The current old in the aggregate consume what the young do not consume. Thus, at A'' the per capita consumption of the old is Z, while at the fixed-supply fiat-money equilibrium it is X. Obviously, the no-trade allocation is the worst point on the upper boundary of the choice set.

A Deflationary Example

The above fiat-money solution includes a fixed stock of fiat money, a constant price level, and a nonwasteful allocation. Is the constant value of fiat money an essential feature, or is it an accident, just special to that example? To answer this, consider a slightly different model: Let the endowment of successive generations grow by the factor g so that each young person of generation t has an endowment of the nonstorable consumption good equal to $Y(1+g)^t$.

First suppose that the quantity of fiat money is unchanging and equal to M. Since the quantity of the consumption good is increasing exponentially at the rate g, the value of this fixed quantity of fiat money must increase, that is, deflation occurs. And, in fact, there is an equilibrium in which the value of money grows exponentially at the rate g, implying that young people face an interest rate of g. The upper boundary of the corresponding choice set is the relatively flat line in Figure 2. The equilibrium allocation is, in general, a point like A.[6]

Now suppose instead that monetary policy keeps the value of fiat money constant. This requires that the quantity of fiat money be increased, in fact, by g percent per period. We may suppose that this required amount is handed out each period to the old people with each old person getting the same amount.[7] Everyone knows that this is the monetary policy.

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[5]For a general proof see J. Kareken and N. Wallace, "Portfolio Autarky, A Welfare Analysis," JOURNAL OF INTERNATIONAL ECONOMICS, 7, 1977.

[6]The line through A passes through the endowment $Y(1+g)^t$ and has slope equal to $-1/(1+g)$. The point Q is determined by the intersection of that line and the line that passes through the origin with slope equal to one. How do we know that point A lies southeast of point Q rather than northwest of Q, say at A'? Well, suppose to the contrary that A' is chosen when the boundary of the budget set is the line passing through Q and A. We know that if the choice set boundary were CQB, then Q would be chosen, implying that Q is preferred to A''. But A'' is preferred to A'. Hence, Q is preferred to A'. This contradicts the assumed choice of A' when the choice set boundary is the line through Q and A.

[7]This handout must be viewed by individuals as independent of the amount of money they acquire when young, but the handout needn't go to them when they are old; it could as well go to them when they are young.

This policy keeps the value of fiat money constant. It now looks to young people as if their budget set is bounded by the line CB in Figure 2. The equilibrium consumption bundle is at point Q.[8] But the bundle at point A is, in general, preferred to that at point Q. That is, the current young and all members of all future generations are better off under deflation than under the policy that keeps the price level constant. The current old also are better off, for under deflation their per capita consumption is the quantity X, while under the policy that keeps the value of fiat money constant it is only Z. For this model, this proves that a policy of holding constant the amount of fiat money and letting deflation occur dominates one that keeps the value of money constant.

In a wide variety of models like those discussed above, a policy of holding constant the quantity of fiat money produces a nonwasteful allocation. This can imply a rising value of money (deflation), as in the last example, or a falling value of money (inflation). Whichever, the resulting allocation cannot be dominated.

Complicating the Model

Like all theories, this one abstracts from certain details of the real world and should not be rejected because of that. Still, you may have some qualms about taking its implications seriously. After all, where are banks and other financial intermediaries? What about assets other than fiat money? Shouldn't we consider business cycles? And what about international monetary relations?

Private Borrowing and Lending

Does the presence of private borrowing and lending in an economy alter the conclusion that a policy of holding constant the stock of fiat money cannot be dominated? To find out, the model described above can be adjusted to include private borrowing and lending. Although it is something of a copout, we can regard financial intermediaries as institutions that do no more than carry out various kinds of borrowing and lending.[9]

Economists know that to formulate a model in which this kind of trading occurs they must populate it with people who differ from one another in either time preference or endowment. We take the latter route.

Suppose that some young of each generation are endowed with some amount of nonstorable first-period consumption and others with some amount of second-period consumption. In general, the latter, when young, will want to borrow from the former.[10] In what sense, if any, does this borrowing and lending substitute for fiat money?

If the aggregate endowment is, so to speak, tilted sufficiently toward second-period consumption, then there is not an equilibrium in which fixed-supply fiat money has value. And, indeed, then fiat money is not needed; the market equilibrium that arises without it is nonwasteful.

But if the aggregate endowment is tilted sufficiently toward first-period consumption—the limiting case being the model of the last section—then there is an equilibrium in which fixed-supply fiat money has value. And in such circumstances the market equilibrium that arises without fiat money is wasteful, while the equilibrium with it is not. Therefore, the mere existence of private borrowing and lending does not eliminate the role of fiat money.

But private borrowing and lending and fiat money do sometimes substitute for each other. So economies of the kind we have been describing that differ only in the degree to which aggregate endowments are tilted toward first-period consumption display an inverse relationship between the amount of private debt and the total value of fiat money. Also, economies that differ only because fiat money is being al-

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[8] Recall our assumption about preferences.

[9] A copout because intermediaries are firms, not mere veils. See footnote 1.

[10] If the second-period endowment is uncertain, then the borrowing and lending takes more subtle forms. There is, then, room in the model for risk-sharing agreements and portfolios diversified in a determinate way.

tered at different rates can display an inverse relationship between the total value of fiat money and the inflation rate. And finally, in such models various restrictions on private borrowing and lending—for example, an outright prohibition or a tax on it—enhance the demand for fiat money.

While these aspects of substitution between private debt and fiat money help explain widespread government interference with private debt creation (much more in other countries than here), they do not by themselves justify such interference.

If a government or monetary authority is charged with maintaining the value of fiat money, then it must be concerned with everything that goes on in the economy. If in the economy we have been describing the degree to which the aggregate endowment is tilted toward second-period consumption is increasing over time, then unless something is done the value of the fixed quantity of fiat money declines. In other words, there is inflation. The same happens if g is negative in the example above (the economy is shrinking rather than growing) or if over time technological developments make storing the consumption good easier and easier.

In their effects, such developments are similar to payments mechanism developments that reduce the demand for fiat money. As we saw in the last section, however, if the goal of monetary policy is to achieve a nonwasteful allocation of resources, then none of them calls for a response from the monetary authority. Its problem is not the development that threatens to alter the value of fiat money, but the goal of trying to keep that value constant.[11]

Other Assets and Institutions

In the model with private borrowing and lending, valued fixed-supply fiat money would exist only if the endowment is on average tilted toward first-period consumption. Would the presence of other assets or institutions weaken the need for such fiat money? Samuelson's model can be adapted to find out.

Other Physical Assets

No doubt you noticed that valued fiat money is the only asset in the models of the first section. Whether or not fiat money would be valued if other physical assets existed depends on the characteristics of those assets. We will consider two examples.

First, suppose the consumption good of the first model is storable; if k units are stored, the result is xk units the next period. If there is depreciation ($x \leq 1$), then an equilibrium with valued fixed-supply fiat money exists which is nonwasteful. If there is appreciation ($x > 1$), then an equilibrium in which a fixed supply of fiat money has value does not exist. But with appreciation the nonfiat-money equilibrium is nonwasteful.

In neither of these equilibria do individuals want to hold diversified portfolios. Diversified portfolios can be produced by complicating the storage technology, in particular, by making it uncertain. For example, suppose two outcomes of storage are possible and equally likely: $x = .6$ and $x = 1.5$. Then for a wide range of preferences, there is an equilibrium in which the young hold some valued fiat money and store some of the consumption good. But generally, a fixed-supply fiat-money equilibrium exists only if the storage technology is not too productive.

Next, suppose there is a distinct physical asset like land. If it is uniform, productive, and nondepreciating, then it dominates fixed-supply fiat money as an asset, and land and valued fiat money cannot coexist. However, if land is assumed to physically depreciate in the course of being used, then it and valued fiat money can coexist.

Is it a defect of these models that they make a fiat-money equilibrium depend on the physical characteristics of other potential assets? Should we look for models that allow valued

[11] For a more detailed but still incomplete discussion of laissez-faire toward the financial intermediation industry, see N. Wallace, "A Payments Mechanism Without Fed Involvement and Fed Monetary Policy Without Required Reserves," Research Department Staff Report #15, Federal Reserve Bank of Minneapolis, 1977.

fixed-supply fiat money to coexist with an appreciating consumption good or land that is uniform, productive, and nondepreciating?

I doubt that a search for such models would be successful. And why try? Physically appreciating consumption goods don't seem to exist. And while it may be a useful abstraction for some purposes to assume that a homogeneous, nonreproducible form of capital like nondepreciating, productive land exists, such an abstraction is disastrous for explaining why titles to land have not played a prominent commodity-money role historically.

Still, you may ask, must the "stuff" with which we endow the old be fiat money? Couldn't it be something found in nature?

The properties that natural stuff would need are homogeneity and exogenous supply. And those natural objects that have played prominent commodity-money roles—gold, for example—have to some extent displayed these properties. But it seems doubtful that any stuff found in nature could approximate these properties better than well-managed fiat money.

Other Institutions

Other institutions can substitute for valued fiat money in Samuelson's model; he emphasized a tax-transfer scheme like Social Security. But while it may be easy to implement the right Social Security scheme in a very simple model, it would not be easy in complicated models in which, for example, people differ. Even in those models, however, the fiat money solution would work.

But, again, must the government provide the fiat money? If not, who? In the simple model, every person alive at the initial date would like to be the sole issuer of a store of value. How do we settle on one or several? It may be begging the question to say that there must be a social decision, but certainly the usual appeal to free entry and private incentives does not settle matters.[12]

Business Cycles

For many the principal role of monetary policy is countercyclical policy. And for them it must seem especially bizarre to derive prescriptions for monetary policy from a model that appears to ignore business cycles.

An important feature of business cycles is a tendency for money to expand and contract with economic activity (the time series evidence). But some believe that the amount of money does not affect economic activity, and among different countries the average over time of the monetary growth rate is not associated with the average level of economic activity (the cross-section evidence).

Another version of Samuelson's model at least partially reconciles these apparent conflicts.[13] The model is peopled with individuals who are endowed with first-period labor and who value leisure. Built into it are two kinds of uncertainty and an information barrier that prevents individuals from distinguishing completely between changes in a relative price—the rate at which first-period consumption can be exchanged for second-period consumption—and changes in the value of fiat money that potentially leave this relative price unchanged. These features are combined with rational expectations—the notion that individuals use in the best way whatever information is available to them.

The resulting theory produces a positive time series correlation between the rate of change of the money supply and total output. This correlation, however, is due entirely to the uncertainty of monetary policy. The theory implies the neutrality of money in relation to economic activity in the sense that a once-for-all announced change in the quantity of money affects the value of fiat money and nothing else. It accounts for the cross-section evidence because total output does not depend on the

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[12] In A PROGRAM FOR MONETARY STABILITY (New York: Fordham University Press, 1959), Milton Friedman argues that the only competitive solution is commodity money—fiat money worth no more than the paper on which it is printed.

[13] See Robert E. Lucas, "Expectations and the Neutrality of Money," JOURNAL OF ECONOMIC THEORY, 4, 1972.

known average growth rate of the money supply.

While this model does not account for all observed features of business cycles (whatever that may mean), it currently stands as the only full elaborated, coherent model that approaches being a model of business cycles.[14] And according to it, the best the monetary authority can do is eliminate itself as a source of uncertainty since an uncertain monetary policy clearly produces a wasteful allocation. This is consistent with the prescription being advocated here.

Country-Specific Fiat Monies

So far we have only been describing models of closed economies, a serious omission in matters involving monetary policy. The kinds of models described above, however, can easily be adapted to accommodate many countries and many fiat monies, one for each of several of the countries. Such an analysis reveals some problems but does not change our general conclusion.

The model suggests that without government restrictions artificially enhancing the demand for a particular currency—capital controls being an important example—no international monetary system is consistent with uncoordinated national monetary policies. Thus the model explains why such restrictions are pervasive in the world today.

Flexible exchange rates do not by themselves allow countries to pursue independent monetary policies. Without restrictions like capital controls, one currency cannot depreciate continuously in terms of another. If it did, everyone would try to substitute the appreciating currency for the depreciating one. (Could the Canadian dollar depreciate for long at, say, 8 percent a year in terms of the U.S. dollar?) Nor can an exchange rate remain unchanged between two currencies expanding at different rates. Otherwise the residents of the country following the less expansionary policy would be subsidizing residents of the other country, a situation that would not persist.

Even if monetary policies are coordinated and, indeed, even if the quantities of the several fiat monies are held constant, without restrictions like capital controls, determining what exchange rates ought to be is a problem. Without such restrictions, exchange rates must not change over time, but the model does not determine their values. It just says one fiat money is enough. Unless made effective through restrictions like capital controls, national boundaries do not by themselves produce separate demands for country-specific fiat monies.

The presence of country-specific fiat monies, therefore, does create problems, but it does not affect the conclusion that a monetary policy that holds constant the stock of fiat money cannot be dominated. In particular, if all fiat monies are held constant, then any system of fixed exchange rates is consistent with an equilibrium that produces a nonwasteful allocation.

Conclusion

You may still be wondering whether to take all this seriously. Can the simple models I have been describing really tell us something? Can they tell us more than those 200-or-so-equation macroeconometric models that give numerical answers to many questions?

Those large models have been notoriously inaccurate. But more important, despite their size, they cannot address all sorts of questions. In particular, they do not allow policies to be evaluated in terms of efficiency, the only kind of evaluation we should trust. Besides that, the large models are all descended from Keynesian macroeconomic theory, but they have not resolved any of the many questions about the merits of that theory. This should make us wary of expecting much from them.

Of course, the simple models I have described are not perfect. There are many facts

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[14]See Robert E. Lucas, "Understanding Business Cycles," Carnegie-Rochester Conference Series on Public Policy, 5, eds. K. Brunner and A. Meltzer (North Holland, 1977), and N. Wallace, A PRESCRIPTION FOR MONETARY POLICY.

they do not confront. But they should be taken seriously because they are the best models available today for analyzing a wide range of questions about the government's role in the financial system. And their implication that the supply of fiat money should be held constant appears likely to be implied by other still-to-be-developed models.

However, two specific qualifications should be acknowledged.

The printing of money has always been recognized as one way to finance government expenditures. If we assume that any method of financing such expenditures involves coercion, then any method also involves costs—explicit collection costs and somewhat hidden distortions. With this assumption, fiat-money issue is on a par with other ways to finance government expenditures, and holding the amount of it constant is not necessarily the best policy.

And operating a fiat-money system, even one as simple as the one prescribed above, is not costless, as we have assumed. If we think of the fiat money as currency, then resources must be used to replace worn-out currency and eliminate counterfeits.

But this last qualification should not bother us. As we began by saying, a theory of money must be a theory with friction. In a good theory of money, no way of managing money should completely overcome the friction, at least not without some cost in terms of resources. The fiat money of the models described above works too well; it completely overcomes the friction. Once we take into account the cost of operating a fiat-money system, this is no longer true. At some cost and to some extent a well-managed fiat-money system overcomes market friction just as other lubricants at some cost and to some extent overcome physical friction.

The views expressed herein are those of the author and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.