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A Dictum for Monetary Theory

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Abstract

This essay argues that monetary theories should not contain an undefined object labeled *money*. Among existing theories that do not satisfy that dictum are models which assume that real balances are arguments of utility or production functions and models which assume cash-in-advance constraints. A main weakness of theories that do not satisfy the dictum is that they cannot address questions about which objects constitute *money*. Theories that do satisfy the dictum are those which specify assets by their physical properties and which permit the assets' role in exchange to be endogenous. The essay briefly describes one such theory, a random matching model with assets that differ according to whether they throw off real dividends.

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Since this is a volume about methodology and since my long-standing concern is monetary theory, I will take this opportunity to propose and defend a dictum, or rule, that monetary theory ought to satisfy. The dictum can be put quite simply: *Money* should not be a primitive in monetary theory—in the same way that *firm* should not be a primitive in industrial organization theory or *bond* a primitive in finance theory. By way of introduction to monetary theory, I start with a brief discussion of some of the challenges facing monetary theory and a brief review of existing theories. Then I present a more detailed statement of the dictum and describe which among existing models do and do not satisfy it. Then, primarily as a way to further explain the dictum, I discuss in some detail one particular model that satisfies it. I conclude with some comments in defense of the dictum.

The Challenges Facing Monetary Theory

If for no other reason, we want monetary theories in order to address questions about policy—questions of the following sort. In *The Wealth of Nations* (1776, Book 2, Chap. 2), Smith discussed whether the Scottish banks should be permitted to continue their practice of issuing bank notes. The general version of the question Smith discussed has been with us ever since: Should we attempt to distinguish among private sector liabilities according to the extent to which they play a role as a medium of exchange and regulate—through outright prohibitions, taxes, or reserve requirements—those that play that role to too great an extent? Another question concerns intervention in foreign exchange markets: Should there be intervention and, if so, of what sort? Another question concerns the conduct of monetary policy: What rule should be followed by a central bank? For example, was the Federal Reserve right to allow nominal interest rates to rise sharply during 1994?

Each of these questions is controversial. Regarding the first, it would seem strange if a matter of degree, the extent to which securities play a medium-of-exchange role, plays a role in whether we regulate or not—unless such regulation is part of an optimal tax structure. Regarding the second, since the general claims made for the virtues of unfettered markets do not apply to fiat currencies, the grounds for positions taken regarding such intervention are far from obvious. As regards the third, the sort of policy engaged in by the Federal Reserve in 1994 is inconsistent with many models.[1] We ought to be able to look to monetary theory to help us resolve such controversies. However, because most theories either fail to address these questions or do so in an unconvincing way, there has been little resolution.

The failure to address these questions convincingly is partly due to their inherent difficulty. To address the question about regulation of some private securities requires a model in which there are private securities and in which some play a medium-of-exchange role to a greater extent than others. The term *medium of exchange* refers to the transaction pattern among objects—to a feature of what Clower (1967) called the *payments matrix,* a matrix that describes what gets traded for what.[2] Most models in economics have nothing to say about transaction patterns. The question about intervention in foreign exchange markets requires a model with several currencies—and, in particular, a model with several fiat (as opposed to commodity) currencies. It is well known that getting one such object to have value is difficult; when there are several, there can also arise a well-known indeterminacy of relative values of the several fiat objects. (See, for example, Kareken and Wallace 1981.) To address the question about central bank policy requires a model in which currency coexists with securities which, in some sense, dominate the currency in terms of rate of return. According to Hicks (1935), this was the problem facing monetary theory, and most think it remains a problem. (See, for example, Hellwig 1993.)

Existing Theories

It is widely agreed that in order to address questions like these, we require a model different from the standard competitive general equilibrium (SGE) model. The SGE model has no implications for what gets traded for what, has no room for a valued fiat object, and, because it has complete markets which permit all assets to be traded at given prices in any circumstance, does not solve Hicks' coexistence problem. Not surprisingly, then, all monetary theories depart from the SGE model. Moreover, we can go some way toward describing their features by describing how they depart from that model. Although my discussion will be far from exhaustive, it will include most familiar models—at least those that satisfy a minimal degree of coherence.[3]

It is somewhat standard to describe a model in two parts. One part is the physical environment—people and their preferences, resources and the technology, and the information structure. The other part is the equilibrium concept—the rules governing interactions among people. Some existing monetary models depart only from the physical environment of the SGE model, others only from the equilibrium concept of that model, and some from both. I take up the existing models in that order.

Money-in-utility-function (MIUF) models and money-in-production-function (MIPF) models are models that depart only from the physical environment of the SGE model. Obviously, such models have an easy time with Hicks' coexistence problem and with valued fiat currency if the object in the utility or production functions is identified with a fiat currency. Not only is it a departure from the SGE model to put assets into preferences and technologies; but for obvious reasons and as emphasized by Samuelson (1968), it is not sensible to put nominal quantities of fiat objects into utility and production functions without putting prices into them—usually combined in the form of real balances.[4] Transaction cost models also depart only from the physical environment of the SGE model. Hicks (1935) suggested transaction costs as a solution to the coexistence problem, and Baumol (1952) and Tobin (1956) used inventory-theoretic models to implement Hicks' suggestion. There is a large literature on general equilibrium models with transaction costs. (See Duffie 1990 and the citations therein.) Samuelson's (1958) overlapping generations model also departs only from the physical environment of the SGE model, as does a recent asymmetric information model of Levine (1991).

Shubik's (1973, 1990) work on trading-post models, or *market games,* is the leading example of a model that departs from the SGE model only by departing from its equilibrium concept. His view is that trade ought to be modeled as an explicit noncooperative game and that if trade is so modeled, then a role for an object that plays a medium-of-exchange role may be found. Shubik's initial work posited trading posts that are pairwise in goods, one round of simultaneous trade at all or a subset of all possible trading posts, and a Nash-Cournot equilibrium concept. Cash-in-advance (CIA) models seem to be another class of models that depart only from the SGE equilibrium concept; such models posit a particular kind of market incompleteness. There is a close relationship between versions of Shubik trading-post models and CIA models. Thus, a version of Shubik's model with N objects and $N - 1$ trading posts indexed 1, 2, ..., $N - 1$, where trading post j is that at which object j trades for object N and with one round of simultaneous trade per time period, resembles a simple CIA model in which *cash* is object N.

Finally, there are many models that depart from both the physical environment and the equilibrium concept of the SGE model. One class consists of models that pursue the long-standing idea that monetary theory ought to work with environments in which there is an absence of double coincidence of wants. As far as I know, Ostroy (1973) was the first to use such a setting to try to find a role for a medium of exchange. He assumed that trade must be accomplished through meetings that are pairwise among people. Pairwise meetings go naturally with the absence-of-double-coincidence notion, as is evidenced by the fact that almost every discussion of that notion presumes such meetings. The first fully coherent version of such a model with an endogenous pattern of exchange seems to be Kiyotaki and Wright's (1989). That model departs from the physical environment of the SGE model through the assumption that trading histories are private information. As an equilibrium concept, such models use Nash equilibrium together with some bargaining rule to describe interactions in pairwise meetings.

The Dictum and Its Bite

As noted above, the proposed dictum is that money should not be a primitive in monetary theory. It is easy to describe in the abstract how to construct models that satisfy this dictum: specify both the physical environment and the equilibrium concept of the model in a way that does not rely on the concept called *money* or force the modeler at the outset to specify which objects will play a special role in trade. The physical environment and the equilibrium concept may include features that make trade difficult, more difficult than in the SGE model—features such as trading posts that are pairwise in objects, asymmetric information, or pairwise meetings. The model may also include assets that differ in their physical characteristics. For example, some assets may be indivisible and others not, some may be fiat objects while others throw off a real dividend at each date, some may physically depreciate more than others, some may be more recognizable than others, and some may yield disutility because they give off a noxious odor.[5] Given such a specification, the model determines—but, in general, not uniquely because there may be multiple equilibria—the *values* of the different assets and their distinct roles, if any, in exchange.

Some of the models mentioned above satisfy the dictum, and others do not. MIUF and MIPF models do not, while Samuelson's (1958) overlapping generations model and Levine's (1991) asymmetric information model do. As for transaction cost models, they may or may not. Transaction cost models with transaction technologies that favor some assets over others, a special case being the inventory-theoretic models, do not satisfy the dictum. A specification in which participants in any trade experience some disutility that is not related to what is traded satisfies the dictum.[6] Shubik's (1973, 1990) trading-post models may or may not satisfy the dictum; those that specify that only a strict subset of the possible trading posts are active do not, while a version that permits all posts to be active does. CIA models do not satisfy the dictum. The pairwise matching models mentioned above do.

A Model That Satisfies the Dictum

To illustrate the gain from working with models that satisfy the dictum, I here describe and present some results for a version of a pairwise matching model, one that is much like the models in Shi 1995 and Trejos and Wright 1995. I use the model to study possible coexistence between a fiat object and an asset that throws off a constant real dividend each period.

The environment is as follows. Time is discrete, and the horizon is infinite. There are N distinct nonstorable goods at each date and a [0,1] continuum of each of N types of people, where $N \geq 3$. Each type is specialized in consumption and production in the following way, which rules out double coincidences: a type i person, where i runs over integers from 1 to N, consumes good i and produces good $i + 1$ (modulo N). Each person maximizes expected discounted utility with discount factor $\beta \in (0,1)$, where utility in a period is $u(x) - y$ and x is the quantity consumed while y is the quantity produced. The function u is defined on $[0,\infty)$ and is increasing and twice differentiable, and $u(0) = 0$, $u'' < 0$, $u'(0) = \infty$, and $u'(\infty) = 0$.[7] People meet pairwise at random, and each person's trading history is private information to the agent. These assumptions rule out all but quid pro quo trade and, in particular, rule out credit. The only storable objects are indivisible assets, and each person has a storage capacity of one unit of some asset. As noted above, there are two assets. The dividend per unit of asset j is denoted $\rho_j \geq 0$, and the quantity of asset j per type is denoted $A_j > 0$. Any dividend is a perfect substitute for the consumption good of any type, and $A_1 + A_2 < 1$. This last inequality insures that an asset distribution in which some people hold one unit of some asset and others hold nothing is consistent with all assets being held.

The sequence of actions within a period is as follows. Each person begins a period holding either one unit of one of the assets or nothing. Then people meet pairwise at random and bargain. Then consumption occurs, where consumption consists of any dividend on the asset brought into the period plus any production provided by the trading partner. Then assets are transferred according to the bargaining outcome. (According to this specification, assets are traded ex-dividend.)

If the asset distribution and the trading strategies are symmetric over person types, then any trade that matters must involve production. And since there are no double-coincidence meetings, we have only to be concerned with what happens in single-coincidence meetings—meetings in which a (potential) consumer meets a (potential) producer. In such meetings, there are two potential trading situations: when the consumer has an asset and the producer does not and when the consumer has a more valuable asset than has the producer. In the former situation, the asset may be traded for some production. In the latter situation, the more valuable asset may be traded for some production and the less valuable asset. I assume the following very simple bargaining rule: the consumer makes a take-it-or-leave-it offer, and the producer accepts if made no worse off by accepting.

If the initial asset distribution is *symmetric*, meaning that the fraction of each type holding one unit of asset j is A_j, and if trading strategies are symmetric, then an equilibrium can be described solely in terms of trading strategies. Moreover, since the labeling of assets is arbitrary, I can, without loss of generality, use a notation that presumes that asset 2 is at least as valuable as asset 1. Then a *symmetric equilibrium* can be defined as a sequence of three quantities of goods produced in single-coincidence meetings: c_1, the quantity produced when the consumer starts with asset 1 and the producer starts with nothing; c_2, the quantity produced when the consumer starts with asset 2 and the producer with nothing; and c_{12}, the quantity produced when the consumer starts with asset 2 and the producer with asset 1. An equilibrium sequence of these three quantities can be defined in terms of the following *best-response function.* A given such sequence, treated as a trading strategy followed by everyone else, determines a trading environment and, hence, determines an individual best-response sequence for an individual—the date t element which consists of the three quantities produced in the different possible single-coincidence meetings at that date. A *symmetric equilibrium* is a sequence of the three quantities produced that is a fixed point of this best-response function. I will discuss what is known about constant sequences that are symmetric equilibria.

Although it does not produce the coexistence we seek, it is helpful to begin with the special case of two fiat objects: $\rho_1 = \rho_2 = 0$. There is a constant equilibrium in which the two fiat objects are valuable and not distinguished (one with $c_1 = c_2 = c^* > 0$ and $c_{12} = 0$) and one in which both are valuable and distinguished ($c_1 = c^*$ and $c_{12} > 0$). In the second equilibrium, the more valuable fiat object, object 2, may or may not be traded for goods only; if it is, then $c_2 > c_1$ (Aiyagari, Wallace, and Wright 1996). In this second equilibrium, a sufficient condition for the more valuable object to be traded for goods only is that the discount factor is bounded away from unity (*sufficient impatience*), while a sufficient condition for it not to be so traded is that the discount factor is sufficiently close to unity (*sufficient patience*). When the more valuable object is not traded for goods only, people pass up the opportunity to spend it all at once, even though that means waiting for a meeting with a producer who has the less valuable object. The only other constant equilibria are ones in which at least one of the fiat objects is valueless.

Now suppose we let one of the assets have a positive dividend and the other a zero dividend. If the positive dividend is sufficiently small, then by way of the implicit function theorem, there are constant equilibria that are in the neighborhood of the equilibria noted above in which both fiat objects are valuable. As we now explain, any one of these constant equilibria exhibits a version of the coexistence we are seeking.

Corresponding to the constant equilibrium in which the two fiat objects are not distinguished is one in which $c_2 > c_1 > c^*$ and $c_{12} > 0$; the positive dividend asset is asset 1, the less valuable asset; and $c_1 \rightarrow c^*$, $c_2 - c_1 \rightarrow 0$, and $c_{12} \rightarrow 0$ as the dividend approaches zero. Even though assets are not traded in markets of the usual sort, there are transactions in which each asset is traded for an amount of the good, amounts which an observer would treat as asset prices. Since these amounts are constant through time, an observer would conclude that asset prices are constant. Therefore, the observer would conclude that there is a positive rate of return on the positive dividend asset (because of the positive dividend) and a zero rate of return on the fiat object.

Corresponding to the constant equilibrium in which the two fiat objects are distinguished and valuable are two different constant equilibria when one of the assets has a positive and sufficiently small dividend. In one, the positive dividend asset is the less valuable asset; in the other, it is the more valuable asset. In either case, the constancy of asset prices implies a positive rate of return for the positive dividend asset and a zero rate of return for the fiat object.

As regards transaction patterns, this model does not assign a more significant medium-of-exchange role to the fiat object than to the positive dividend asset. The transaction pattern has the fiat object appearing in every trade only in the equilibrium in which the positive dividend asset is the more valuable asset and only when the parameters are such that the more valuable asset is not traded for goods only (a discount factor close enough to unity). In all other cases, the positive dividend asset trades for goods only.

Although we have obtained coexistence of positive and zero *rate-of-return* assets from a very simple model, the model is extreme in a number of respects. It has two features that inhibit trade: (1) pairwise meetings and private information about trading histories and (2) indivisible assets and an upper bound of unity on asset holdings. The model satisfies the dictum because these features apply to all trade. In particular, (2) applies to both the fiat object and the positive dividend object. Moreover, each feature seems to play an important role. If we replace (1) by assuming that everyone is together or that there is public information about individual trading histories while maintaining all the other assumptions, then we have a version of an ordinary Arrow-Debreu environment. And although we would not have to adopt the competitive equilibrium concept, we would be tempted to do so. If we did, then we would find that the fiat object is necessarily worthless. Although I don't know what happens if we amend (2) while maintaining all the other assumptions, it is possible that we lose coexistence if both assets are perfectly divisible. (The implicit function theorem argument used when the assets are indivisible does not apply because the steady states for $\rho_1 = \rho_2 = 0$ are not locally unique if the assets are perfectly divisible.) In particular, if indivisibility is necessary, then that tells us that a divisible positive dividend asset of the sort in this model is too good an asset to coexist with a fiat object even if trade is subject to the frictions of pairwise meetings and private information about trading histories.

Conclusion

Why is satisfaction of the dictum desirable? The answer seems obvious. The models that do not satisfy it force the modeler to specify the favored assets—for example, those that contribute to utility, those that constitute the *cash* of CIA models, or those that have relatively low transaction costs. How can such assumptions be defended? One way is by appeal to history, by appeal to data. However, such appeal is rarely straightforward.[8] How should history be used to determine how Mexican pesos appear in the utility functions of Mexican residents or which class of goods Mexican residents must buy with Mexican pesos now and in the future? Even if the observations were less ambiguous than they are, we would still need to argue that the future will be like the past—a long future since most models are infinite-horizon models. Of necessity, any defense of a specification that does not satisfy the dictum will end up being in terms of a specification that does. Hence, asking for satisfaction of the dictum is nothing but asking for explicitness—for laying one's cards on the table.

Although building models that satisfy the dictum might be accepted as a reasonable goal for monetary theory, don't we, in the meantime, have to make do with models that do not satisfy it—because the models that do satisfy the dictum are not rich enough in order to address the policy questions that are always before us? For example, although we obtained coexistence of a fiat object and a positive dividend asset in the model described above, there is no scope for policy in that model as it stands. (See Aiyagari and Wallace 1991 for an argument.) While the view that it takes a model (that addresses the issue at hand) to beat a model (that addresses the issue at hand) seems unexceptional, too much effort has been devoted to building models that fail to satisfy the dictum in the name of such expediency.

What, after all, have we learned and can we expect to learn from such models? They have produced one main conclusion: the so-called Friedman rule according to which the yield on *money* ought to be brought into equality with that on other assets. (See Woodford 1990 for a survey of the literature on the Friedman rule.) However, every model that implies this rule is one that fails to satisfy the dictum, and some that do satisfy the dictum do not imply the rule. In particular, Levine's (1991) asymmetric information model is one in which the features that make a fiat object essential for achieving good allocations are exactly the features that contradict the Friedman rule. More generally, the models that give rise to the Friedman rule are ones that solve Hicks' (1935) coexistence problem by their assumptions about what objects yield utility, are the *cash* in CIA models, or have low transaction costs—assumptions that violate the dictum. Therefore, we ought to be skeptical about the robustness of the Friedman rule, robustness in the sense of validity in models that satisfy the dictum.

Perhaps the most telling defect of models that fail to satisfy the dictum is that they are dead ends; they are conversation stoppers. As noted above, it is impossible to discuss what constitutes the *cash* of a CIA model without abandoning that framework in favor of one that satisfies the dictum. In contrast, the kind of model described in the last section leads immediately to additional questions concerning the effects of various generalizations and amendments of its assumptions. Progress in monetary theory will be made by asking and pursuing the answers to such questions.

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†The author is indebted to many colleagues for comments on an earlier draft. However, since he suspects that at least some would not like to be associated with the views set forth, he has decided to let all remain anonymous.

‡When this essay was written and originally published, the author was Barnett Banks Professor of Money and Banking at the University of Miami.

[1]For example, it is the kind of policy poked fun at in Sargent and Wallace 1982.

[2]The term *medium of exchange* is often introduced as one of three functions of money, the other two being *unit of account* and *store of value.* In the spirit of not using *money* as a primitive term, these three functions can be discussed not as functions of money, but as observations that we may want to explain. The medium-of-exchange observation is that one object or a small number of objects are involved in most transactions. The unit-of-account observation is that prices are expressed in terms of one object or a small number of objects. The store-of-value observation is that the object or objects that play a medium-of-exchange role and/or play a unit-of-account role are also objects that are *assets*—objects that are held through time. However, somewhat paradoxically for the store-of-value function, the challenging and crucial observation is that those objects seem often to be relatively poor stores of value.

[3]Thus, the quantity theory is not in the running, where the *quantity theory* means the SGE model augmented by one equation, the quantity equation, in one unknown, the price level. Patinkin's (1965) famous argument that such a model fails to satisfy Walras' law is, of course, correct. However, that failure is only one symptom of the incoherence of the resulting model. The SGE model is a complete model; it describes people, their preferences, their endowments. Nowhere in it is the money that appears in the quantity equation. So who is holding and trading the money in the quantity equation?

[4]The appearance of a price in utility and production functions gives rise to an externality (since other agents' demands affect prices), which accounts for the failure of a competitive equilibrium in such models to be Pareto efficient.

[5]Notice that noxious odor varies with the weight or volume of the asset, not with its value.

[6]Such an assumption can play a role by preventing the occurrence of trades in which one or more of the participants are indifferent to trading.

[7]Since types are identical except as regards what is consumed and produced, it is plausible that there are equilibria that are symmetric among types.

[8]I am reminded of Stein's (1979) description of *monetarism:* "The theory that there is a stable and predictable relation between the price level as effect and the supply of money as cause. This theory has firm empirical support if the definition of the money supply is allowed to vary in an unstable and unpredictable way."

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