In Defense of a Basic Approach

David Cass and Karl Shell*

1. Fiat Money: Not Just Another Commodity

Macroeconomic control of contemporary private enterprise economies is exercised primarily through changes in the magnitude of the government's deficit (fiscal policy) and changes in the composition of the government's debt, that is, its cumulated deficits, between "fiat" money and "fiat" bonds (monetary policy). To understand macroeconomic policy, we must be able to explain how the private sector reacts to government expenditures, taxes and transfers, and money creation and extinction.

Government debt (in its various forms) can serve in a host of roles for the private sector—as a store of value, as a convenient means for transactions, as an exclusive vehicle for tax payments, and so forth. These various roles are generally closely interdependent and strongly influenced by the particular conventional and institutional arrangements in an economy. One of them, however, is crucial to all the others: *If money and bonds do not serve as a value store, then they cannot serve any other useful function.* Our current research focuses on the role of money and bonds as a store of value—not because we are necessarily persuaded that this is the most interesting aspect of the paper assets created by the government, but rather because we are firmly

*These reflections were set down several months after the Federal Reserve Bank of Minneapolis conference on "Models of Monetary Economies." Their proximate cause was the generally negative reaction by the conference participants to Neil Wallace's forthright assertion of the importance of consumption loan or overlapping generations models for understanding monetary phenomena in a private, market economy. We support Wallace's basic position. Indeed, we have for some time believed (and preached) that these models offer an intellectually attractive framework for studying many aspects of decentralized intertemporal allocation—provided, of course, that some care is taken to distinguish between fundamental or inherent features and convenient or provisional simplifications. This opportunity to articulate our position is also a natural forum for us to air our misgivings about various currently fashionable prejudices in monetary and macroeconomic theory and to present our views about various more constructive alternatives for future development.

The collaboration underlying this paper has taken place over several years, encompassing both Shell's visit as a Guggenheim Fellow at CEPREMAP during 1977–78 and Cass' visit as a Sherman Fairchild Distinguished Scholar at Caltech during 1978–79. The paper itself represents an effort to lay out the general methodological position motivating a series of specific analytical studies of overlapping generations models. It thus constitutes part of a more extensive project being underwritten by a grant to the Center for Analytic Research in Economics and the Social Sciences (at Penn) from the National Science Foundation. We are grateful to all these institutions for their support and encouragement.

convinced that this basic function must be well understood before we can begin to understand any of their more complicated functions.

Jim Tobin has taught us that, for most purposes of understanding decentralized allocation involving stores of value, there is no essential difference between paper currency, Treasury bills, and any other government issue. So as a convenience, we will refer to all forms of government debt as simply *money*.

It is obvious (and well-known) that money cannot have a positive price—that is, cannot be a store of value—in the conventional finite-horizon model in which the "end of the world" is known with certainty. The reason is simple. At the end of the last period, money is worthless. Therefore, in the next-to-last period, all individuals desire to dispose of money holdings in order to avoid capital losses. This drives the price of money to zero at the end of the next-to-last period. And so on. Individuals with foresight, not wanting to be stuck with the monetary "hot potato," thus drive the price of money to zero in each period.

Some students of money-macro may claim that it is easy to modify the classical Walrasian model to allow (even insure!) the price of money to be positive. Simply introduce money balances as arguments in utility functions or production functions, reflecting the reduced transaction costs in a monetary economy. (Never mind how we transform nominal to real when there are many commodities.) We reject this approach. Imbedding money in preferences or technologies does nothing to explain its role as a store of value. Moreover, such reduced forms are at best poor proxies for their structural counterparts. (We will have more to say about modeling transaction constraints below.) Worst of all, to the extent that this maneuver is successful, it is also likely to be misleading.

We know that money is not just another commodity. Tastes and endowments (including production possibilities) determine the relative price of apples in terms of oranges in the simple equilibrium model. But unlike ordinary Walrasian goods, the usefulness or "productivity" of money depends on its price. In particular, suppose that a barter equilibrium exists for a given market economy (with a given payments mechanism) without nominal money. Then it must be the case that, when such money is introduced into the economy, one of the new equilibria will be the old barter equilibrium with positive nominal money bearing a zero price. It could be that all households would be better off if the price of money were positive. But this does not imply that a zero price is a disequilibrium price. Trust in fiat money is only a recent development, and even today such faith is hardly universal.

2. Modeling Fiat Money: The Overlapping Generations Approach

The natural way to avoid modeling "hot-potato" money is to avoid modeling a finite-horizon economy. Individuals surely know they won't be around forever. They likely don't even expect their influence to persist much beyond their own lifetimes; that would be silly. But they do believe—or, if you prefer, act as if they believe—that contemporary economic institutions are essentially immortal. An obvious model to build on, then, is Samuelson's model of overlapping generations: Economic agents come and go, disposing of their finite wealth over their finite lifetimes, while economic society is presumed to continue without known end.

It is unfortunate that this type of model has been almost exclusively as-

sociated with narrow issues in intertemporal welfare theory. (An outstanding exception, of course, is Bob Lucas' influential contribution to the money-macro field.) We, as much as anybody, must share the blame. Perhaps it would be useful to find a less connotative label for its basic structure; while *overlapping generations* is clearly better than *consumption loan*, it too carries overly restrictive associations. Be that as it may, this basic structure has two general features which we believe are indispensable to the development of macroeconomics as an intellectually convincing discipline. While both have already been mentioned, at least indirectly, both will bear repeating for emphasis.

First, it is genuinely dynamic. In this it significantly departs from the basically atemporal character of most received doctrine: There is explicit recognition of both the inherent mortality (as well as vitality) of the actors, together with the continual (as well as unceasing) evolution of their stage.

Second, it is fundamentally disaggregative. In this it is founded in perhaps the oldest theoretical tradition in economics: There is a clear distinction between economic agents' objectives and constraints—and hence the mainsprings of their individual behavior—and the economic system's coherent resolution of their joint interaction.

Isn't this, you ask, a pretentious basis on which to justify analysis of obviously rudimentary versions of the overlapping generations model, for instance, that contained in several of the contributions to this volume? Not at all.

While it is important to distinguish the inherent underlying character of this model, it is also important to recognize the potential significance of its various provisional specializations. These would include such simplifying assumptions as that of homogeneous households (both within and across generations), two-period lifetimes, a single physical commodity, distribution without any production (or with, at most, very elementary production), complete and costless markets, and full and accurate information (concerning both the present and the future). Taken together they constitute reducing the model to its barest essential elements (within a conventional framework of maintained assumptions, to be sure). The parallel with the reduction of the classical Walrasian model to its leading special case of pure distribution of two commodities between two households is unmistakable. In both cases such reduction is perfectly acceptable for certain purposes, according to a fundamental precept: Skeletal models yield (or verify) definite counterexamples but only suggest (or illustrate) possible theorems. Perhaps most important, we are confident that, through the normal scientific process, tentative results derived from the simplest versions of the overlapping generations model—and many other questions as well—will be investigated in much more general terms. Indeed, we know that some of these more extensive analyses are already well under way.

Following the cardinal rule that simple models can best be employed to produce counterexamples, variations of the overlapping generations parable have been insightfully utilized to teach us several valuable lessons. First and foremost, of course, are the optimality counterexamples contained in Paul Samuelson's seminal analysis itself: Purely by virtue of the one-directional, open-ended nature of time, *competitive allocation may fail to be Pareto optimal.* But there are other lessons to be learned as well, with both positive

and normative implications. Especially instructive are the determinacy counterexamples stemming from the introduction of money into the basic story: Purely by virtue of the enormous latitude associated with the consistency criterion that aggregate outcomes accord with individual predictions, *there is typically a plethora of potential monetary equilibria*.

Vast multiplicity of potential competitive equilibria is an inherent property of the economy with money (or, for that matter, with any marketable asset which can serve as a temporary abode for purchasing power into perpetuity). This central feature turns out to be of crucial importance to the theory and practice of macroeconomic policy.

Consider first the solution concept normally employed in the standard general equilibrium model as applied to its overlapping generations extension. Competitive equilibrium prices are consistent with market clearing and ultimately depend only on tastes, endowments, technology, the range of markets, and the actions of government (hereafter exclusively limited to *monetary policy*[1]). But money is not desirable for its own sake, only for its market value (particularly by those individuals who are endowed with it). Hence, even in a nonstochastic environment, there are typically very many potential monetary equilibria associated with each perfectly anticipated monetary policy; within some limits, very many perceptions of the possible state of the economy (or predicted paths of market prices for commodities in terms of money) are consistent with realizations of the actual state of the economy (or observed paths of market prices for commodities in terms of money). And this remains so even if one prespecifies, for instance, some initial price, or equivalently, its reciprocal, the (present value) price of money.

A dual result to the last is that for each positive price of money there are typically very many potential monetary policies consistent with market clearing—each generally associated with a different set of competitive allocations. In short, monetary policy matters very much!

Even though the resulting competitive equilibrium is largely indeterminate, we still find this conventional solution concept too restrictive for the overlapping generations model. For example, individuals might well believe that market prices follow a process (stochastic or nonstochastic) depending on some seemingly extraneous phenomenon, say, sunspot activity. Again within some limits, if individuals believe that the economy is affected by sunspot activity, then it might well be—even imposing the "rationality" requirement that expectations be fulfilled. In this sense, the future can be said to create its own uncertainty; because sunspot activity is held to be important, its level is a proper state variable, and its possible sequences of realizations must be fully accounted for in the appropriate solution concept.

The essential point is that in a truly dynamic context, even with perfect foresight and without intrinsic uncertainty, pure theory provides no obvious natural selection of the particular elements on which individuals condition their forecasts (a point made by Bob Shiller and others); the state variables of the system cannot be determined independent of individual beliefs. Further-

[1]We adopt the convention employed in the overlapping generations (and related money-macro) literature of referring to a sequence of injections of money into the economy by means of lump-sum transfers (with either algebraic sign) as a *monetary policy*. However, we are aware of the confusion this might cause, since—especially given the rudimentary treatment of possible actions of government in this context—such means of control is much closer to what is traditionally recognized as fiscal policy. We ask to be excused for this convenient, if misleading usage.

more, if in fact sunspot activity (or some less fanciful state variable, say, calendar time itself) induces undesirable fluctuations in the economy, it may be altogether fitting for the government to announce and pursue a policy of counteracting the resultant market disruption. Economic agents — including both households and government, and no matter how sophisticated—must not only assess the "fundamentals" of the economy, but also may very well have to pay attention to the "psychology" of the market.

3. Working Toward General Theorems

What about more definite results? How do or will studies of such elementary models lead to general theorems concerning dynamic, disaggregative allocation processes? These questions are still largely, though not completely, unanswered.

The contrast between the central thrust of the first part of the Wallace paper and that of the major part of the Cass-Okuno-Zilcha paper (together with its addendum) offers a nice illustration of this state of affairs. Both analyses deal with a plausible conjecture suggested by the simplest version of the overlapping generations model, namely, that given the institution of fiat money, some competitive equilibrium (possibly nonmonetary, likely monetary) must be Pareto optimal.

On the one hand, Wallace's work (as well as Brock and Scheinkman's parallel study) shows that this conjecture has a natural extension covering a particular class of active monetary policies. Specifically, Wallace considers the situation where the money supply is being increased (or decreased) at a constant rate by means of equal nominal transfers to (or taxes from) the households in each successive generation. Then, after insuring that his idealized economy is capable of attaining competitive equilibria which closely resemble steady states, he demonstrates that when the money supply is in fact not being strictly increased, some competitive equilibrium must be Pareto optimal. Throughout his analysis, Wallace maintains all of the various simplifying assumptions mentioned above.

On the other hand, Cass, Okuno, and Zilcha investigate the original conjecture itself and show that it is quite sensitive to relaxing just one of these standard provisional specializations. In particular, they demonstrate that the proposed result may not obtain when households display systematic diversity in tastes and endowments across succeeding generations—or even significant diversity within succeeding generations, provided households are also liable to substantial satiation in consumption over their life cycles.

Undoubtedly this conjectured proposition (as well as its suggested extension) is valid in some more general contexts (at least when there is neither widespread household diversity nor excessive potential satiation). A precise statement and proof of this sort of general theorem, however, remains to be seen.

In fact, at this writing, there are virtually no well-established general theorems for the overlapping generations model available in the literature. The prime reason for this paucity of substantial results is clear: Very little is known about the most basic properties of this model except in its rudest embodiments. Thus, for instance, only recently has serious work begun on uncovering the limiting conditions under which there necessarily exists *any* competitive equilibrium in the presence of many types of (finitely lived) households, many varieties of (exogenously given) commodities, and arbitrary (typically

active) monetary policy. It is worthwhile to notice that this fundamental enterprise, which is currently being undertaken by Okuno and Zilcha and Balasko and Shell, relies on obvious but critical insights gained from the simplest cases—for example, their common property that if there exists some competitive equilibrium (monetary or nonmonetary), then there exists a nonmonetary equilibrium. It is also important to realize that this work is relatively straightforward compared to that of formulating and analyzing the subtle issues involved in characterizing the intrinsic structure of the set of competitive equilibria (monetary as well as nonmonetary) in the same model or its even yet broader generalizations. Research into these more profound problems seems to us an essential next step in the further refinement of the overlapping generations model. These crucial investigations are also presently being pursued by those mentioned above (as well as several others, for example, McFadden, Mitra, and Majumdar).

The question of what constitutes a general result rather than a special case is at best nebulous. This is so even for our present purposes, where we have already explicitly focused on a particular class of economic models, those displaying the inherent structural features of the overlapping generations parable. One basic reason is that the answer to this question ultimately depends on adopting and maintaining some limited reference framework, itself a specialized and idealized view of individual capacities and the context of social arrangements through which they range. Another is that, even within such a stylized purview, there is no absolute law distinguishing good from bad (or useful from useless or realistic from unrealistic or...) simplifications.

Here, as in our own work, we have already implicitly chosen a conventional neoclassical framework. This particular view, embracing a large part of modern economic theory, emphasizes individual rationality (an apt if much abused descriptive phrase) and concentrates on market exchange of private commodities by competitive agents. We are prepared to defend this position, even while conceding that there are many seemingly attractive modifications and extensions. We think it will be more rewarding, however, if instead we sketch our more eclectic views of what are, given the neoclassical orthodoxy, good and bad simplifications. The next section addresses this issue. These remarks can be taken as extended comments on each of the various simplifying assumptions listed in section 2.

4. Good and Bad Simplifications

4.1. *Diversity of Households and Commodities*

Our synopsis of the state of current research into basic aspects of the overlapping generations model suggested one of our most fundamental methodological biases. We firmly believe that a satisfactory general theory must, at a minimum, encompass some diversity among households as well as some variety among commodities. There is simply not much (except perhaps tractability) to recommend constructing an elaborate macroeconomic edifice on microeconomic foundations built without any reinforcement from the admixture of distributional effects. To put this point bluntly: A behavioral specification in terms of the first-order conditions describing rational choice by a representative household between consumption today and tomorrow is every bit as crude an approximation as one in terms of an aggregate consumption function.

We do, however, freely acknowledge that it also makes little sense to ignore

the fact that there are recognizable patterns in the distribution of tastes and endowments across households; contemporary individuals are subject to many of the same formative influences, while by and large their social and economic environment itself evolves both slowly and smoothly. Our position necessarily embraces, and even positively encourages, introducing and analyzing (consistent and verifiable) regularities in aggregate behavior. Otherwise our proposed quest for a richer macroeconomics would be self-defeating.

In particular, this means that we certainly don't subscribe to the almost total agnosticism implicit in the excess demand characterizations pioneered by Hugo Sonnenschein. But then we also surely can't ignore the thrust of their central message: Diversity of households—together with what we have known for a long time, variety of commodities—will typically impose a significant constraint on our ability to derive substantial propositions concerning qualitative effects.

4.2. *Reinterpreting Periods and Commodities*

In contrast to the clearly limiting character of the postulate that representative households choose between just two (physical) commodities, it should be emphasized that certain of the simplifying assumptions that have been commonly adopted in the overlapping generations literature are by themselves not at all restrictive. In particular, when markets are perfect, a completely general model with arbitrary but finite lifetimes is formally indistinguishable from a singularly special model with at most two-period lifetimes (but with many households in each generation and many commodities in each period)—given suitable reinterpretation of both *periods* and *commodities*. Such broad latitude in interpreting what are commodities (according to physical, spatial, temporal, eventual, ... characteristics) is so familiar from the Arrow-Debreu tradition that it needs no further elaboration here, except perhaps to underline an obvious but important caveat: Reinterpretation is severely circumscribed when, for instance, markets are incomplete or information is partial (say, especially, due to the intrinsic nature of time). In any case, it is simply inappropriate to complain that existing analyses based on the overlapping generations parable necessarily involve incredibly low velocities of money, that is, holding periods of 25-year duration. (From this viewpoint, however, the existing analyses do typically involve incredibly uniform homogeneity in tastes.)

4.3. *Capital Goods as Stores of Value*

The competitive mechanism converts privately owned commodities into privately consumed goods. The standard general equilibrium literature makes clear that whether this is accomplished indirectly by production (treating technology as part of the household endowment) together with distribution or directly by distribution alone is an inessential detail. However, in models which treat time seriously, there is an important aspect of production which will need to be accounted for: Durable productive assets (land, machines, natural resources, and the like) also serve as stores of value. A first pass in understanding the role of government debt as a store of value allows us to ignore these capital goods, since the most important element common to all assets is the intrinsic difficulty in evaluating future terms of trade. Incorporation of many alternative assets into the model of overlapping generations must nonetheless be considered to have high priority on the research agenda.

Imagine macroeconomics without a description of the choice between holding real assets and government debt (and other paper assets)!

4.4. *The Costs of Trading*

The fact that trading itself requires scarce resources cannot be avoided. One of money's principal functions is to reduce these transaction costs. While a fully satisfactory microeconomic theory of money and transactions has yet to be developed, it should be clear that the analysis must be dynamic. If trading somehow took place outside time, then the problems of matching buyers and sellers and settling their complicated sets of accounts would be of little consequence. In reality, however, all trades are dynamic, since the trading process itself requires time. Even so-called spot trades involve rather sophisticated institutional arrangements because actual contracts are not conveniently signed and executed on a perfectly synchronized basis.

When longer periods of time are involved, these difficulties are compounded. Futures trading requires more detailed monitoring procedures and more careful enforcement procedures to protect against the obvious hazards of contract nonperformance. As a result, the costs associated with borrowing are typically very high for the individual without tangible assets which can be used to guarantee her/his loan. In fact, the transaction costs on unsecured borrowing are so high that, as a good first approximation, it could be assumed that all spot and futures purchases must be financed either from present money balances or from the money received from the sale of present commodity inventories.

This means that, in addition to their intertemporal (or solvency) constraints, individuals also face period-by-period (or liquidity) constraints which limit them to trades supportable by current holdings. Monetary policy, by controlling the amount, timing, and distribution of money holdings, has an effect on aggregate demand. The government's ability to influence individual liquidity constraints is an important source of the potency of its macroeconomic policies.

Liquidity constraints, representing imperfect borrowing markets, are readily incorporated into the overlapping generations model; indeed, they have already been easily incorporated into fairly robust versions of the standard general equilibrium model (with, however, limited success since that model offers no satisfactory resolution of the "hot-potato" problem). Although a fuller understanding of the detailed structure of marketing activity is clearly desirable, we believe that straightforward modeling of constraints on individual liquidity may well capture many of the essential aspects of costly trading which are critical to macroeconomic policy.

4.5. *Expectations*

At the heart of macroeconomic theory is the determination of asset prices. But assets have value today in large measure because they have (or, more precisely, are believed to have) value tomorrow. Thus asset prices must be largely based on individual expectations about the future. How are these beliefs formed, and what is the nature of the resulting competitive equilibrium?

The perfect-foresight (or, more fashionably, rational expectations) hypothesis provides a useful starting point for understanding this process. This is not because it is a realistic informational postulate; it is surely quite unrealistic. Rather, it is because the hypothesis is the exact analogue of the familiar atemporal assumption of full information and because it is consonant with the

ultimate outcome of many credible models of intelligent learning behavior. As such it provides a good benchmark (at least for some normative purposes) and accords with an inherent distaste for any theory of expectations formation which does not allow for consistent adaptation (at least in some limiting sense).

As we see it, then, the perfect-foresight hypothesis is at best a positive descriptive model only in terms of representing a plausible asymptotic structure for some very complicated process by which individuals discover how the state of the economy tomorrow will depend on the state of the world tomorrow. Modeling this process itself is therefore clearly of utmost importance. Unfortunately, like the rest of the profession, we have few specific suggestions to offer at this stage of our knowledge; idle conjecture without concrete analysis does not seem especially helpful. We can, however, foresee two obvious difficulties confronting such an enterprise.

We have argued earlier that, even given the perfect-foresight hypothesis, there is no obvious natural selection of the particular features of the world on which individuals focus in predicting the future of the economy. This must be doubly true when, in addition, individuals are groping toward enlightenment —particularly since individuals are assuredly mortal[2] (so that the learning process involves a continually changing progression of individuals) while, under the circumstances, their environment is apparently inconstant (so that there is absolutely no assurance that the world tomorrow will retain essential properties of the world today). Our parents' beliefs were greatly shaped by the advent of the New Deal; our children's will be by the advent of the OPEC cartel.

This observation suggests a related difficulty, namely, that there is no a priori justification for assuming (and therefore biasing research toward establishing) that a reasonable learning process necessarily converges to anything like perfect foresight. Even when the underlying economic "fundamentals" are agreed to be stationary, evolving market "psychology" may render perceptions of their import decidedly nonstationary. Furthermore, there is no obvious reason for assuming that an individual who holds "irrational" beliefs would be better off if converted to "rational" beliefs.

Finally, we view attempts to avoid the deep problems associated with modeling expectations formation by arbitrarily restricting either the fundamental learning process or its presumed ultimate outcome—in particular, by concentrating on uniquely determined steady states—to be basically misleading, essentially investing pure technical simplification with the aura of hard economic law. In this regard, we should mention that such restriction plays a crucial part in the purported "rational expectations" proof of the quantity theory of money. Our rebuttal to this asserted claim has already been argued in section 2.

5. Concluding Comments

There are now two main schools of thought dominating macroeconomics, the *rational expectations* (RE) school and the *Keynesian econometrics* (KE)

[2]Only gods are immortal—as well as omniscient. The assumption that households effectively live forever, not at all uncommon in the literature, is itself fairly unbelievable. But that infinitely lived households also accurately foretell eternity—even taken as an idealization—clearly defies common sense. Any fully evolved learning process necessarily requires frequently repeated individual performance, and this prerequisite is simply out of the question when a shaved die is only cast once (or, who knows, an unbalanced wheel is only spun once or...).

school. The KE school tends to reject the results of the RE school on the grounds that the assumptions of competitive behavior, complete markets, and perfect foresight are unrealistic. According to the RE school, the KE approach is suspect because it is not derived from consistent individual maximizing behavior.

We do not join this debate; we have chosen instead to accumulate more intellectual capital. It is clear to us that more fundamental research is needed before these issues can be put in proper perspective. While each school rejects many of the assumptions as well as conclusions of the other school, from our present viewpoint it is not even necessarily evident that either group's policy recommendations follow given its philosophical and theoretical predilections.

We plan to play a part in developing a truly dynamic analysis of government debt and intertemporal allocation. To be useful, the analysis must also be fundamentally disaggregative. We have, therefore, no choice but to build our theories on the foundation of the overlapping generations model. By definition, it is the only genuinely dynamic, basically disaggregate framework available.