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THEORETICAL PROGRESS IN PUBLIC ECONOMICS: A PROVOCATIVE ASSESSMENT

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1. Introduction

PUBLIC economics is a fairly recent innovation. Leif Johansen (1965) chose it as the title of an influential book, as did Margolis and Guitton (1969) for their International Economic Association conference volume. Kolm's (1964, 1987) claim of precedence also deserves to be noted. The *Journal of Public Economics* published its first issue in 1972, and Atkinson is still one of the managing editors.

The field of public economics amalgamates two older branches of economics which were falling into increasing disrepute. One branch was welfare economic theory. Its main results were efficiency theorems relying on impractical lump-sum redistribution for characterizing almost all Pareto efficient allocations. It provided often flawed discussions of welfare measurement, externalities, marginal cost pricing. It also attempted to make ethical pronouncements without value judgements.

The other branch was (applied) public finance. Much of this was about various measures of tax incidence. It never provided a theoretical foundation profound enough to understand completely the role of tax systems. It also attempted to base policy discussions on, at best, dubious concepts from welfare theory such as excess burden and deadweight loss, and, at worst, such nonsenses as "equal absolute sacrifice".

The amalgamation of the better parts of these two branches into the new discipline of public economics has done much to benefit both. Welfare economics is becoming less sterile; public finance is acquiring better theoretical foundations. While the improvements are significant, they still remain far from complete. The field has not yet been swept clean of old useless baggage. The teaching of the policy implications of theoretical microeconomics at both elementary and intermediate levels seems virtually untouched. Some theoretical issues have almost been resolved, but others still pose fundamental conceptual problems, as I shall try to explain.

2. The invisible hand is blind to injustice

Far too much applied welfare economics and microeconomic theory, especially that presented in textbooks, has been based upon perfectly competitive complete markets as a normative ideal. Departures from perfect competition such as those due to commodity taxes or monopoly power are seen as "distortions" which create "deadweight losses" or "excess burden". It is admitted that there may be exceptional "market failures" due to externalities which are difficult to treat, or due to missing markets, economies of scale, asymmetric information, etc. But the usual remedy suggested is some form of corrective taxation in order to try to get the economy functioning as it would if markets were complete, if external effects could be bought and sold, etc.

Extreme economic libertarians, of course, need no excuse for a laissez faire attitude toward markets, whether they be perfectly competitive or not. For them freedom of markets is the primary target of economic policy—indeed, there should not even be any economic policy, other than "to do nothing," as Joan Robinson put it.[1]

More orthodox economists regard markets as instruments rather than targets, and so become "instrumental" libertarians, in effect. In the tradition of Adam Smith's "invisible hand," they notice that perfectly competitive complete markets produce Pareto efficient allocations as outcomes. At least they do in the absence of those inconvenient "market failures" alluded to above. Actually, a few economists are so optimistic about laissez faire and so pessimistic about government intervention in markets that they even claim that such market failures are not really Pareto inefficient. They argue that, if Pareto improvements really were available, private individuals or institutions would find them—if necessary, through the agency of an entrepreneur talented enough to notice that some individuals are willing to make trades which benefit themselves while leaving scope for that entrepreneur to earn a profit. Carried to its extreme, this argument makes Pareto efficiency a tautology, just as it is in naive versions of the famous "Coase theorem" regarding the Pareto efficient internalization of externalities. Indeed (as Bruce Greenwald has pointed out), were this line of argument correct, then no Pareto inefficient tax system would be possible because private agencies could offset it with exactly compensating subsidies financed entirely by a Pareto efficient "private" tax system which all parties would prefer instead. Public finance becomes irrelevant![2]

Even if laissez faire did produce Pareto efficient outcomes, however, that would not necessarily make it ethically acceptable to those of us who are concerned with distributive injustice, and with its extreme manifestations in the form of poverty and starvation. As shown in Coles and Hammond (1986), perfectly competitive markets are quite capable of producing Pareto efficient allocations in which some consumers have insufficient resources to survive.[3] Bergstrom (1971) has also shown how slavery can be Pareto efficient. And giving a dictator complete power over the economy and then allowing only those individuals who are useful to him to survive is (weakly)

[1] Robinson, 1964, p. 69.

[2] A related argument is to be found in Bernheim and Bagwell (1988) who, however, reach somewhat less drastic conclusions because they consider only non-cooperative outcomes.

[3] Cf. Robinson (1946, 1951, p. 189), Koopmans (1957, pp. 55–63), Sen (1977, 1981a, 1981b) and also Dasgupta and Ray (1986, 1987).

Pareto efficient, since there is no way of making the dictator better off, by definition. The invisible hand is blind to even the grossest inequalities of power and wealth within an economy. Perhaps markets only cause gross inequality if initial endowments are very unjustly distributed. Yet the invisible hand tends to preserve and possibly even reinforce the injustices that history hands down. So the first efficiency theorem by itself has little to contribute to a serious study of ethically proper economic policy.

3. A misleading efficiency theorem

A much more promising defence of perfectly competitive markets is based, of course, on the second efficiency theorem of welfare economics. Under conditions which were first stated carefully by Arrow (1951) and Debreu (1951), any Pareto efficient allocation of resources in which no individual is on the margin of being forced below subsistence can be reached through perfectly competitive markets, *provided* that the invisible hand is supplemented by a suitable method for redistributing wealth so that each individual can just afford what the Pareto efficient allocation prescribes for him.

This last proviso is extremely important—far more important than the usual well known qualifications of convex feasible sets, convex community indifference curves (after aggregating consumers' preferences suitably), no externalities, complete markets, etc. The reason is that wealth has to be redistributed in a way which does not interfere with the workings of the perfectly competitive markets. This requires what are generally called *lump-sum transfers*. As Lerner (1947) was probably the first to point out, such lump-sum transfers are practically impossible. Practical schemes of redistribution are typically based upon ability to pay taxes or the need to receive subsidies, both of which are influenced by market decisions such as whether to participate in the labour force, saving versus spend-thriftiness, etc. Even impractical schemes like poll taxes typically affect decisions such as where to migrate, or—among the far-enough-sighted—whether to have (more) children.

Indeed, Mirrlees (1974, p. 258, 1986, section 3) has noted that, in a simple economy where leisure is a normal good (in the sense that people work less if their unearned income rises), optimal lump-sum redistribution may well involve making more skilled workers worse off, thus destroying all incentives to acquire skill or to reveal it in one's work (see also Dasgupta and Hammond, 1980). In the Mirrlees model a first-best optimum can easily be characterized by Marx's prescription, "From each according to his abilities, to each according to his needs," in the following sense. When all individuals have identical additively separable utility functions for consumption and leisure, an optimum involves the more skilled working harder, but equal consumption for all. Whereas now most socialist economies appear to have revised the latter half to, "to each according to his work." This is surely in recognition of the incentive problems which are inevitably created by attempts to implement optimal lump-sum redistribution.

4. Truthful revelation of feasibility constraints

The Mirrlees example clearly demonstrates the need for a systematic study of what allocations are truly feasible when individuals' abilities and other attributes are not publicly known. This brings us to the work on "incentive compatibility," as pioneered by Vickrey (1961) and Hurwicz (1972, 1973). The fact that some information is private means that any economic system effectively functions like some very complicated "game" of incomplete information, in the technical sense due to Harsanyi (1967–8). In this game the agents of the economy communicate, bargain, set prices, buy, sell, exchange, etc. The outcome is an economic allocation which depends upon the agents' strategic choices in the game. In equilibrium each agent has a *strategy rule* that specifies, as a function of private information, a strategy which is best among those available, given expectations about what others will do which are conditioned by that private information.

Formally, as Harsanyi certainly realized, such a strategy rule is really a fully specified strategy in an extended game where "nature" first chooses a state of the world, and then individuals condition their behaviour on what they know about nature's choice. Anyway, the equilibrium strategy rules, in the game of incomplete information which describes the economic system, must give rise to an *allocation mechanism* which determines the economic allocation as a function of the state of the world—in particular, as a function of all the agents' private information, including their personal attributes.

Consider now what would happen if some agents chose *deceptive* strategies—that is, strategies that would be specified by their equilibrium strategy rules if their private information were different—for example, working at a slower rate which would be appropriate if they were really less skilled. To the extent that these deceptions were successful, the economy would function as though those agents' private information were different. The allocation mechanism which is generated by the equlibrium strategy rules would produce a different allocation based upon the agents' apparent rather than their true private information. But in equilibrium, no such deceptive strategy can benefit any one agent, because no deception at all can be beneficial. Thus the allocation mechanism must have the property that, even if any agent could somehow "manipulate" the mechanism by pretending to have different private information, there would be no expected gain to doing so. It is as though the agents were "revealing" their private information to the mechanism, and the mechanism then has to be constructed so that truthful revelation is always an equilibrium strategy for each agent, given his expectations and private information. This is precisely the "relevation principle" which was simultaneously discovered by many writers in the late 1970's, and which is perhaps most clearly set out in Myerson (1982, 1985). This requirement that the equilibrium allocation mechanism must encourage truthful revelation is captured in *incentive* (compatibility) *constraints*.

The main significance of the relevation principle comes from understanding that the only allocation mechanisms which are *truly* feasible are precisely those which can emerge from some equilibrium of a game of incomplete information—i.e., those, which are "incentive compatible." Otherwise no matter what game of incomplete information is used in an attempt to "implement" the mechanism, there will always be some agent who has an incentive to manipulate it by using a deceptive strategy in that game.

A serious difficulty in satisfying these incentive constraints is that their precise nature is typically very sensitive to what agents know and believe about each other. Where agents know one another's attributes fully, the results of Groves and Ledyard (1977), Hurwicz and Schmeidler (1978), Hurwicz (1979a,b), Schmeidler (1980), Maskin (1980) etc. on "implementation in Nash equilibrium" are relevant. This is a rare and probably not very interesting case, however, since if individuals' abilities and other attributes are hidden from the "official" sector of the economy, they are probably hidden from most other individuals as well. This makes "implementation in Bayesian equilibrium" much more natural. But then, as Ledyard (1978, 1987), Dasgupta, Hammond and Maskin (1979) and others have pointed out, a mechanism which is "Bayesian incentive compatible" for one set of beliefs will not be for another, in general. In fact, unless agents' beliefs are known, the only mechanisms which are certain to be incentive compatible are those which are "implementable in dominant strategies". That is, they must be implementable in a game of incomplete information in which agents have dominant strategies yielding exactly the outcome prescribed by the allocation mechanism. For these mechanisms the revelation principle requires that truthful revelation itself must be a dominant strategy. The argument of this paragraph seems to justify concentrating upon such mechanisms, and I shall do so exclusively from now on.[4]

[4] The literature suggests that such "dominant strategy mechanisms" are few and far between in general economic environments. Of course one dominant strategy mechanism which often does exist is that which leaves each agent with his initial endowment—i.e., the "autarky mechanism." Clearly, better efficiency properties than those of autarky are to be desired. But then the main dominant strategy mechanisms with desirable efficiency properties are: (i) the "serial" dictatorial mechanisms discussed by Satterthwaite and Sonnenschein (1981); (ii) the generally wasteful transfer mechanisms which apply only for "quasi-linear preferences" (with a constant marginal utility of transfers) as discussed by Groves (1973, 1979), Green and Laffont (1979) and others; (iii) the mechanisms for "large" or "continuum" economies considered in Gale (1980, 1982), Champsaur and Laroque (1982), Kevin Roberts (1984), Guesnerie (1981), and Hammond (1979, 1985, 1987). A more promising alternative is: (iv) the kind of random allocation mechanism considered in Prescott and Townsend (1984a, b) which must satisfy constraints which are linear in probabilities. There is also work on "almost dominant strategy" mechanisms in large finite economies by John Roberts and Postlewaite (1976), Roberts (1976), and Palfrey and Srivastava (1986).

5. Delusions of first best

Although the characterization of truly feasible allocation mechanisms remains an area of active research, it is already clear that welfare economics will have to change in the light of the new results. To facilitate the discussion, consider continuum economics with a joint frequency distribution, in which each individual is insignificant, on the set of agents' labels and their characteristics such as preferences. And consider symmetric mechanisms which do not discriminate arbitrarily between individuals on the basis of welfare irrelevant characteristics. Even for these, the Mirrlees model discussed in Section 3 illustrates the general incentive incompatibility of lump-sum redistribution. The set of all those allocation mechanisms which happen always to produce Pareto efficient allocations as well as being incentive compatible and also anonymous were considered in Hammond (1979). The general impossibility of lump-sum redistribution based on anything except unalterable identifiable individual characteristics was demonstrated. The main exception is when it is known for sure that all individuals have characteristics in a fixed finite set of possible "classes"; then some limited redistribution is possible.[5] Of course, some discriminatory lump-sum redistribution based only on observable personal characteristics such as race, sex, or date of birth (e.g., state pensions) is also possible, though often ethically unacceptable. Thus the lump-sum redistribution which gives the second efficiency theorem its practical relevance is typically infeasible—or, at best, only very limited redistribution is feasible.[6]

Far too many economists appear to react to such results by avoiding issues of distributive justice altogether. Instead they fall back on the first efficiency theorem of the "invisible hand," which shows how perfect markets may achieve "economic efficiency". They see all considerations of distributive justice as belonging to "softer" social sciences like politics and philosophy. Yet it really is a legitimate, even a pressing, concern of economists to understand what allocations are truly feasible in the absence of lump-sum redistribution. Indeed, it is vital to understand what are the "incentive constraints" that make lump-sum redistribution impossible. Then one can begin to study what other kinds of allocation are possible. This was precisely my aim in the preliminary investigations reported in Hammond (1979, 1987), an aim which seems to be shared by authors such as Guesnerie (1981), Roberts (1984), Champsaur (1989). The literature, however, remains surprisingly sparse.

The work discussed above does more than merely demonstrate the near impossibility of lump-sum redistribution. It also helps characterize what allocation mechanisms, and what forms of redistribution, are possible. For suppose that the economy has very many individual agents who each possess

[5] See also Champsaur and Laroque (1981, 1982).

[6] The implausibility of optimal lump-sum taxation was recognized by Lerner (1947), Samuelson (1947) and Graaff (1957), amongst others. But only recently has there been work explaining this implausibility in a formal model.

private information about their own abilities, tastes, and other attributes relevant to the proper allocation of resources. Then the only feasible allocations are those which can be brought about by facing individuals who cannot be told apart with identical budget constraints and then allowing transactions within them as each individual pleases. Perfectly competitive markets with lump-sum redistribution based only on observable characteristics are a prominent example of such a "mechanism," but far from the only one. For, in perfectly competitive markets, all individuals' budget constraints are linear, with the same prices for all. Now, however, the budget constraints which we may need to consider purely on efficiency grounds can be highly nonlinear, and may discriminate between consumers and producers—e.g., by commodity, payroll, or income taxes. Indeed one form of nonlinearity in a budget constraint is rationing, as considered by Guesnerie and Roberts (1984) in particular, so that the price of a commodity demanded becomes effectively infinite (or that the price of a commodity supplied becomes effectively zero) as the rationing constraint starts to bind. Non linearities in the budget set will be especially important if linear commodity taxation is no more powerful an instrument for redistribution than Sah (1983) suggests.[7]

Such "decentralizable" or "public finance" mechanisms are incentive compatible in large economies because no individual has significant power to alter his budget constraint, just as individual agents have negligible power to affect prices in markets with many participants. Conversely, any mechanism that is incentive compatible must be decentralizable in this way because one can construct each individual's budget set as consisting precisely of all the possible net trade vectors which the individual could receive if his private information were to change. From this it follows that, in economies with many consumers, the only truly feasible allocations are precisely those which can be decentralized through some kind of "public finance mechanism," but with very little of the lump-sum redistribution which "first best" welfare theory relies on. It is time to stop deluding ourselves that we can violate the incentive constraints and characterize all Pareto efficient allocations by means of the second efficiency theorem of welfare economics.

6. Deadweight losses as sunk costs

As Graaff (1957) for one has already suggested, the obvious next step is to begin looking for "second best" Pareto efficient allocations—i.e., those which are "incentive constrained" Pareto efficient, subject not only to physical feasibility but also to incentive constraints. Generally such allocations are not Pareto efficient in the usual sense, since the incentive

[7] Sah, however, does not allow uniform lump-sum subsidies, property taxation, or land reform—all of which might be more powerful incentive-compatible instruments of redistribution.

constraints really do bind and prevent first-best efficient redistribution of resources.

I suppose that the presence of such a constrained frontier is often implicitly recognized by those public economists who talk of a "trade-off between equity and efficiency". They do recognize that achieving any reasonable degree of distributive justice may well entail moving some way below points of the "first best" frontier that could be reached if only an omniscient economic planner could institute appropriate lump-sum redistribution. But these delusions of first-best need to be abandoned. The true trade-offs are simply between different people's real incomes as we move along the incentive constrained Pareto efficient frontier—most points of which involve what naive first-best theory calls "distortions". Indeed, the kind of "optimal" commodity taxes which Diamond and Mirrlees (1971), etc. have considered really are optimal when lump-sum redistribution is infeasible.[8] Their work might have attracted more of the attention it deserves had they pointed out that such taxes also characterize virtually all constrained Pareto efficient allocations. How, then, can Pareto efficient commodity taxes be "distortionary"?

From this it also follows that, by themselves, measures of deadweight loss are very misleading. After all, for such measures to be useful, it should be true that policies which reduce deadweight loss are beneficial. Yet a (constrained) optimal allocation with non-zero optimal commodity taxes has a positive deadweight loss. Whereas laissez faire gives a deadweight loss of zero, but is typically worse because the distribution of real income is less just than it is for some allocations which are constrained Pareto efficient. Deadweight loss is typically unavoidable at an optimal allocation because history has left us with a world economy in which endowments are very unjustly distributed, and we lack the information required for optimal lump-sum redistribution. In this sense the deadweight losses associated with a constrained optimum are like sunk costs—costs which arise because of history. They are no more relevant to the design of good policy than sunk costs are to good investment policies by the firm.

7. Markets as failures

Of course the main problem with rationing, non-linear pricing, taxation, and other forms of interference with free markets, is that often individuals will try to circumvent the "official" pricing or rationing system and trade in the "informal" economy instead. This possibility prompted Gale (1980, 1982), Guesnerie (1981) and Hammond (1979, 1987) to consider what additional constraints are imposed if individuals cannot always be prevented from trading in the informal sector. The answers may not be too surprising.

[8] Although Diamond and Mirrlees are right to acknowledge the priority of Samuelson's (1951, 1986) work, it has to be pointed out that Samuelson (like Ramsey, 1927 before him) actually postulated a representative consumer—possibly justified by optimal lump-sum redistribution!

In the extreme case, when individuals always remain free to trade any good in the informal sector, and there are many individuals, the only feasible allocations in the economy are those which result from a perfectly competitive equilibrium in the informal markets—the government loses virtually all power to influence the economy through the formal sector, because whatever it tries to do to affect informal market outcomes is promptly undone by those markets. At best, it is reduced to selecting among equilibria when there happen to be multiple equilibria. Not even tax collection is possible, because all taxes are evaded. And no lump-sum redistribution is possible except that which is based upon identifiable and unalterable characteristics. In more realistic cases, the government will be able to exact some taxes on transactions it can monitor (or effectively threaten to monitor ex post, as in the auditing of tax returns), as well as using non-linear pricing, and even some rationing—especially of goods which are primarily provided through the public sector.

The most striking implication of this work is a new view of the role of markets in the allocation of resources. The old view has been of markets as efficient allocators of resources, and so as desirable instruments of economic policy. Much discussion of economic policy has been concerned with remedying market failures. This new view, by contrast, is of markets—or, more precisely, of market forces—as constraints on economic policy. Perhaps the clearest contemporary illustration of this is the inability of governments to suppress the trade in narcotic drugs. More generally, Pareto superior allocations could often be achieved if market forces were less powerful, if taxpayers were more honest, or if cheaper ways of ensuring more compliance became available.

This new view by no means condones all or even many forms of market interference. Where market forces are destructive, but too strong to resist, it is surely far better to recognize that fact and allow markets to function than it is to damage the credibility of the legal system by instituting virtually unenforceable controls, perhaps backed up by extreme sanctions against those who are unfortunate enough to be caught violating those controls (cf. Mirrlees, 1974). What this illustrates, indeed, is a point made by Hahn (1982)—one should judge an economic system not just by the allocation which it actually produces but also by the means it has to employ in order to achieve that allocation. Is the system one which allows individuals reasonable opportunities to further their own interests within certain reasonable rules, or one that leaves individuals feeling frustrated, coerced, and threatened? In the end, the libertarians' argument for free markets may be less suspect than the (neo) classical welfare economists.[9] Then, however, we should include the means used to overcome market constraints within the description of an allocation of resources. We should ask how much are we

[9] Cf. Rowley and Peacock (1975), and also the group of papers, Kornai (1988), Sen (1988) and Lindbeck (1988), which were presented as the main lectures at the 1987 Congress of the European Economic Association.

willing to spend to enforce prohibitions against drugs, or to enforce compliance with the tax laws.

There may be other benefits of markets which this discussion neglects. For instance, they may economize on administrators' ability and honesty, or on the complexity of decision rules which agents need to use. They may constrain the effects of incompetent or even maleficent government policies. Alternatives to markets seem to require having politicians of dubious competence and integrity introduce their own biases and ambitions into the politico-economic system. But politicians have been set a disgraceful example by economists who advance spurious efficiency claims for the allocation of resources which free markets produce. Of course, it is by no means clear that business people's competence, integrity, biases and ambitions are much better than those of politicians once markets are understood to be constraints rather than instruments. It is time to cease talking of tinkering with market failures, and to recognize instead that markets themselves represent a failure to devise a better system for distributing goods justly as well as efficiently in the presence of incentive constraints. Where markets really are best, we should be honest about why the alternatives are even worse.

8. The *n*th best as enemy of the good

Whatever else the above discussion may show, it reveals that there are no simple characterizations of optimal economic policies. Fortunately, most applied economists seem to sense this anyway, but it will do no harm if their feelings can be given a more secure theoretical foundation. What many also sense is that their time is better spent searching for policy improvements rather than trying to move the economy to some elusive optimum. Such an optimum is extremely hard to characterize. The literature on optimal linear commodity taxation (with a few worthy exceptions) is a plethora of first order conditions which, because the problem is inherently not a concave programming problem, cannot guarantee more than local optimality (cf. Mirrlees, 1986). Indeed, checking second order conditions seems to have been quite rare, so the first order conditions could easily leave the economy stuck at a saddle point or even a local minimum. Moreover the first order conditions all depend upon demand and supply elasticities at the presumed optimum, and who knows what they may be unless we have been somewhere near in the past? As for optimal nonlinear taxes, the optimal provision of public goods, optimal policy regarding externalities . . . . The theoretical problems abound, and the empirical requirements become unmanageable.

An alternative approach has been to content oneself with local improvements—specifically, to look for directions in which to make small beneficial changes in policy. This is the approach embodied in much project evaluation or cost-benefit analysis (see, for instance, Drèze and Stern, 1987), as well as the formal analysis of tax reform pioneered by Guesnerie (1977). It relies on estimated elasticities at the point where the economy would be without any policy change, so there is some hope of being able to obtain such estimates. It even identifies when the first order conditions for an optimal policy are satisfied, since those conditions state precisely that any small improvement has no first order effects on welfare. And the procedures for estimating first order effects on each individual's welfare are in principle rather simple, assuming that policy changes result in predictable responses. First one calculates the comparative static effects of a policy change on all prices and quantities in the economy, including (individual) shadow prices and quantities of public goods, externalities, rationed goods, un(der)-employed labour, etc. Then the first order effect on any individual's real income, as measured by willingness to pay, is just given by

$$\mathrm{d}U = \mathrm{d}m - \mathrm{d}p\, x + q\, \mathrm{d}z \tag{1}$$

where:

(i) $\mathrm{d}m$ is the change in exogeneous (unearned) wealth due to taxes, transfers, etc.;

(ii) $\mathrm{d}p$ is the change in the vector of prices for those goods which the individual trades as a price-taker;

(iii) x is the vector of net demand quantities for this first group of goods;

(iv) $\mathrm{d}z$ is the change in the vector of net demand quantities z for those goods which face the individual with quantity constraints, such as public or publicly provided goods, goods subject to rationing or even to a multi-part tariff, and other welfare-relevant features of the economy which are not even economic commodities in the usual sense—see, for instance, Sen's (1985, 1987) discussion of "commodities and capabilities";

(v) q is the vector of demand/supply or "shadow" prices for this second group of goods or features of the economy.

This calculation assumes that m, p, and z are indeed predictable and differentiable functions of the policy parameters which are being subjected to a small change—an assumption which should be justified by examining the structure of the equilibrium set rather carefully along the lines pioneered by Debreu (1970, 1976), Guesnerie (1979), Fuchs and Guesnerie (1983), Hildenbrand (1983), Mas-Colell (1985) and others.

Notice that $\mathrm{d}U$ is the change in the money metric utility function, so the marginal utility of money is normalized to be one. Notice too that the measure $\mathrm{d}U$ is entirely empirical—its calculation depends only on "positive economics".

The total effect on social welfare still has to be determined, of course. This effect can only be found if one moves from positive to normative by making certain value judgements. Assuming "consumer sovereignty"—i.e., the value judgement that what consumers demand is of benefit to them, and to society as well—the total effect on social welfare will be $\mathrm{d}W = \sum_i w_i\, \mathrm{d}U_i$, where w_i denotes the positive social welfare weight attached to individual i's real income at the margin. But how do we determine these welfare weights?

9. Intermonetary comparisons of gains and losses

Choosing the welfare weights amounts to comparing different individuals' monetary gains and losses. That has made it seem natural to some—notably Harberger (1971), despite a partial retraction in (1978), and Posner (1981), which was extensively discussed in Hammond (1982)—that all welfare weights should be equal, with $dW = \sum_i dU_i$. And that, of course, is how Kaldor and Hicks proposed doing compensation tests of potential welfare improvements. To translate potential into actual welfare improvements, however, requires exactly that kind of lump-sum redistribution of income which is incentive incompatible, even at the margin. Delusions of first best again. As for Judge Posner, his concept of justice is clearly very different from that of most of us—dollars, not people, should be treated equally according to his theory. Harberger's (1971) excuse was the way that economic statistics are published—cf. the discussion following equation (17) below. This has prompted Jorgenson and his co-authors to propose what amounts to a different way of computing economic statistics such as personal income, consumer price-indices and measures of inequality and poverty. Unfortunately, at the time of writing, their cardinal measures appear also to have been chosen merely for their mathematical convenience. There is no reason to suppose, however, that this cardinalization is ethically appropriate, even though it probably does embody more justice.[10]

Determining different individuals' welfare weights is a problem that will not go away easily because it relies on deriving unanimously agreed ethical objectives, in effect. This reminds me of an afternoon spent in the Central Statistical Office in London about ten years ago. We discussed how to report measures of inequality in income and wealth, following the work of Dalton (1920), Champernowne (1952, 1973), Aigner and Heins (1967), Atkinson (1970), Sen (1973), and many successors. The consensus seemed to be that, while the Gini coefficient was far from ideal, it was not too bad, and that in any case the most important thing was to publish as much of the full Lorenz curve as possible so that anybody who cared to could then calculate their own preferred inequality indices.

Here the situation is very similar. The important thing to know is the entire vector $(dU_i)_{i=1}^I$ of monetary measures of net gains in real income accruing to all I individuals who are affected by the project—possibly far in excess of 5 billion, allowing for future generations. Then everybody who cares to can work out their own welfare weighted sums $\sum_i w_i\, dU_i$. Actually, considerable economy can often be achieved by report-

[10] See Jorgenson and Slesnick (1984, 1987), Jorgenson (1987), as well as McKenzie's (1987) criticisms of Frisch.

ing just the joint frequency distribution $f(a, \mathrm{d}U)$ of individual net gains $\mathrm{d}U$ and of those personal attributes a that might be relevant in determining welfare weights $w_i = w(a_i)$. Then, for any set of welfare weights which do depend only on the attributes a, one has

$$\mathrm{d}W = \sum_i w_i \, \mathrm{d}U_i = \sum_a \sum_{\mathrm{d}U} f(a, \mathrm{d}U) w(a) \, \mathrm{d}U. \tag{2}$$

The task of econometricians ought then to be to estimate as well as they can the joint frequency distribution of a and $\mathrm{d}U$—or of a, $\mathrm{d}m$, x, $\mathrm{d}p$, q, and $\mathrm{d}z$—so that equation (1) can be applied in order to derive $f(a, \mathrm{d}U)$. Of course, such estimation faces enormous practical difficulties, especially as data concerning the individual shadow price vectors q will be virtually impossible to obtain. Nevertheless, it is often important to understand what would be ideal estimates with unlimited data in order to know what data should be sought and what should be done with it. After $f(a, \mathrm{d}U)$ has been estimated, the Euclidean space whose dimension equals the number of different possible personal attributes a can be separated into two parts by the hyperplane of weights $w(a)$ which make $\mathrm{d}W = 0$, according to equation (2). On one side of the hyperplane $\mathrm{d}W > 0$ and on the other $\mathrm{d}W < 0$; it then becomes easier to consider whether it is more plausible that $\mathrm{d}W > 0$ or $\mathrm{d}W < 0$ for those welfare weights which may be deemed ethically acceptable.

10. Few worthwhile changes are small

The algebra in equations (1) and (2) is intended to help identify favourable directions for policy change—including small projects. A small step in a direction identified as favourable will indeed be beneficial, provided that the analysis has been done properly and the welfare weights are ethically appropriate. These first order approximations lose their validity, however, if a project or policy change is large enough to have a significant effect on the demand/supply quantities x or prices q. And here is the problem—worthwhile policy changes are unlikely to be small. Indeed, it is hard to think of a project which really is small in the relevant sense. After all, even a project to deepen the well which serves a small rural village had better have a significant impact upon the quantity (or the quality) and so also shadow price of water in the village, if it is to be worthwhile. Thus equations (1) and (2) may give misleading answers even for one village well by misstating the benefits to the main beneficiaries. Of course, mistakes in one village have an insignificant impact on the world as a whole. But good rules for project evaluation should be applied consistently everywhere. Rules based on (1) and (2) clearly fail this test, because the effects of misstating the benefits of *all* well projects in a region will not be small.

The remedy is clear. The first order approximation (1) needs replacing by a more exact measure of welfare change which takes account of variations in net demands x and individual shadow prices q as well as in income m, prices p, and net demands z for public goods and other features of the economy which are excluded from the vector x. Let m^0, x^0, p^0, q^0, z^0 denote initial values before the change, and let m^1, x^1, p^1, q^1, z^1 denote final values after the change. Let $U(x, z)$ be any ordinal utility representation of the individual's preferences, and write

$$u^0 = U(x^0, z^0), \qquad u^1 := U(X^1, z^1). \tag{3}$$

Define $V(p, z, m)$ as the corresponding indirect utility function, when the consumer chooses x to maximize $U(x, z)$, with z fixed, subject to his budget constraint $px = m$ at prices p and exogenous wealth m, plus whatever other constraints he faces because z is fixed. Then the *equivalent variation* EV of the change is defined so that

$$u^1 = V(p^1, z^1, m^1) = V(p^0, z^0, m^0 + \mathrm{EV}) \tag{4}$$

or

$$\mathrm{EV} = E(p^0, z^0, u^1) - m^0 \tag{5}$$

where $E(p, z, u)$ denotes the level of exogeneous wealth needed to allow the consumer to achieve utility level u when faced with exogenous prices p and quantities z—the *expenditure function*. Thus EV measures the net increase in initial exogeneous wealth that is equivalent to the change from (p^0, z^0, m^0) to (p^1, z^1, m^1), and so it is a money metric measure of net benefit which is strictly increasing in the final utility level u^1. Of course $\mathrm{EV} = 0$ when $u^1 = u^0$ because $E(p^0, z^0, u^0) = m^0$.[11]

A common procedure for going from individual measures of gain to a social measure would be simply to construct the welfare weighted sum $\sum_i w_i \mathrm{EV}_i$ of different individuals' net gains. Yet many projects are likely to make this formula inapplicable. They may well alter the distribution of income, even in the village whose well is being deepened, to such an extent that the appropriate welfare weights w_i^0 change. Indeed this is precisely the kind of change which a scheme for poverty relief is intended to bring about. The obvious remedy is to follow Sen's (1976, 1979) suggestion of treating different individuals' consumption of identical goods as different, and to regard society as consuming the entire list $(x_i, z_i)_{i=1}^N$ of "individualized commodities" while facing the list of individualized welfare weighted prices $(w_i p, w_i q_i)_{i=1}^N$. Then one needs to calculate a measure of equivalent variation for the society as a whole, along the lines suggested in Hammond (1984, 1988). The algebra becomes far less transparent, unfortunately.

In any case, if my suggestion in Section 9 is appropriate, what should be done first is to discover the entire joint frequency distribution $f(a, \mathrm{EV})$ of welfare relevant attributes a together with equivalent variation measures of

[11] Note that the corresponding compensated variation measure, $\mathrm{CV} = m^1 - E(p^1, z^1, u^0)$, is *not* a utility function at all in general, because p^1, z^1 vary as the final allocation varies. See Chipman and Moore (1980).

new welfare gain. Given the inevitable disagreements over welfare weights, complex precise calculations of social equivalent variation can no doubt be correctly viewed as somewhat esoteric.[12]

11. Surplus economics

Consider now how to calculate EV from equation (5). One has $m^1 = E(p^1, z^1, u^1)$. Also

$$\text{grad}_p\, E(p, z, u) \equiv x(p, z, u); \qquad \text{grad}_z\, E(p, z, u) \equiv -q(p, z, u) \tag{6}$$

where $x(p, z, u)$ and $q(p, z, u)$ respectively denote the *compensated* net demand vector for goods whose prices are exogenous, and the *compensated* net demand price vector for goods whose quantities are exogenous. The minus sign in the second equation of (6) arises because increases in desirable public goods reduce the expenditure needed to achieve a fixed utility level. Then (5) implies that

$$\begin{aligned} \text{EV} &= E(p^0, z^0, u^1) - E(p^1, z^1, u^1) + m^1 - m^0 \\ &= -\int_0^1 [\dot{p}x(p, z, u^1) - q(p, z, u^1)\dot{z}]\, \mathrm{d}t + m^1 - m^0 \end{aligned} \tag{7}$$

along any smooth path $p(t)$, $z(t)$ $(0 \leq t \leq 1)$ which has

$$p(0) = p^0, \qquad z(0) = z^0, \qquad p(1) = p^1, \qquad z(1) = z^1$$

and where $\dot{p} = \mathrm{d}p/\mathrm{d}t$, $\dot{z} = \mathrm{d}z/\mathrm{d}t$. All too often, the correct formula (7) is replaced by the (Marshallian) "consumer surplus" measurement

$$\text{CS} = -\int_0^1 [\dot{p}h(p, z, m^0) - r(p, z, m^0)\dot{z}]\, \mathrm{d}t + m^1 - m^0 \tag{8}$$

where $h(p, z, m)$ is the consumer's *uncompensated* demand vector, as a function of exogenous prices, quantities and wealth, for goods whose prices are exogenous, and $r(p, z, m)$ is the consumer's *uncompensated* demand price vector, as a function of the same variables, for goods whose quantities are exogenous. The standard excuse offered for using (8) is that the uncompensated demand functions are observable, whereas the compensated demand functions are not, and that anyway (8) is often a good approximation (Willig, 1976). But often it is not (Markandya, 1978 and Hausman, 1981). Nor does any econometrician I know claim that uncompensated demand functions are observable—instead, they have to be carefully estimated by simultaneous equation methods that separate demand and supply effects. Even if uncompensated demands were observable, it is not

[12] Some steps in the right direction have been taken by Jorgenson, Lau and Stoker (1980, 1981), King (1983, 1987), Atkinson, Bourgignon and Chiappori (1988), and no doubt others as well.

too difficult to infer compensated demands from uncompensated demands.[13] The path integral (7) needs replacing by a solution to a "path differential equation". For one has

$$x(p, z, u^1) \equiv h(p, z, E(p, z, u^1)); \quad q(p, z, u^1) \equiv r(p, z, E(p, z, u^1)) \tag{9}$$

and so

$$\begin{aligned}\frac{\mathrm{d}}{\mathrm{d}t} E(p, z, u^1) &= \dot{p}x(p, z, u^1) - q(p, z, u^1)\dot{z} \\ &= \dot{p}h(p, z, E(p, z, u^1)) - r(p, z, E(p, z, u^1))\dot{z}.\end{aligned} \tag{10}$$

It follows that

$$\mathrm{EV} = E(0) - E(1) + m^1 - m^0 = E(0) - m^0 \tag{11}$$

where $E(t)$ $(0 \leqslant t \leqslant 1)$ is the solution to the path differential equation

$$\frac{\mathrm{d}E}{\mathrm{d}t} = \dot{p}h(p, z, E) - r(p, z, E)\dot{z} \tag{12}$$

which satisfies the end condition that

$$E(1) = m^1. \tag{13}$$

For then, of course, $E(t) \equiv E(p(t), z(t), u^1)$ $(0 \leqslant t \leqslant 1)$ along the particular path chosen, but $E(0)$ is independent of the path chosen, and so is EV. The differential equation (12) is an *ordinary* differential equation which can be solved by standard numerical techniques.[14]

By contrast

$$\mathrm{CS} = C(0) - m^0 \tag{14}$$

where $C(t)$ $(0 \leqslant t \leqslant 1)$ is the solution to the path differential equation

$$\frac{\mathrm{d}C}{\mathrm{d}t} = \dot{p}h(p, z, m^0) - r(p, z, m^0)\dot{z} \tag{15}$$

which satisfies the end condition that

$$C(1) = m^1. \tag{16}$$

The difference between CS and EV will be small under conditions investigated by Willig (1976), but there is little reason to accept what may be a poor approximation when the proper calculation is scarcely more difficult. So it is remarkable how the "surplus economics" embodied in (8) persists. The only reason, apart from dogma and sloppiness, might be that

[13] See Hausman (1981), Vartia (1983), Ahlheim and Rose (1984, especially pp. 340–344), and notably McKenzie and Ulph (1986).

[14] See, for instance, McKenzie and Ulph (1986).

total consumer surplus calculations give:

$$\sum_i \mathrm{CS}_i \equiv -\int_0^1 \left[\dot{p} \sum_i h_i(p, z, m_i^0) - \sum_i r_i(p, z, m_i^0)\dot{z}\right] \mathrm{d}t + \sum_i (m_i^1 - m_i^0) \quad (17)$$

so that aggregation seems very simple because it involves only:

(i) aggregate demand $\sum_i h_i(p, z, m_i^0)$;

(ii) aggregate marginal willingness to pay $\sum_i r_i(p, z, m_i^0)$;

(iii) the change in aggregate income $\sum_i (m_i^1 - m_i^0)$.

Whereas computing $\sum_i \mathrm{EV}_i$ generally requires keeping track of each individual's compensated income level $E_i(t)$ $(0 \leq t \leq 1)$ along the entire path.[15] Thus correct aggregation is undoubtedly more complicated. But, as argued in Sections 9 and 10 above, this type of aggregation should be avoided anyway, as it is based on ethically dubious "intermonetary" comparisons.

12. Surplus econometrics

Even when surplus measures are corrected for income effects and EV_i is calculated properly for each individual i, a difficulty remains. In practice, functional forms for the demand system (9) have to be estimated from very incomplete and imprecise data, so the EV measures really ought to reflect this imprecision. Indeed, very often the calculation process is circumvented because the econometric estimation starts from a postulated functional form $E(p, z, u; \theta)$ for the expenditure function which depends on unknown parameters θ. Then $h(p, z, m, \theta)$, $r(p, z, m; \theta)$ are calculated as the corresponding functional forms for demands, and each consumer i's parameter vector θ_i is estimated from observations of p, x_i, q_i, z_i, m_i over time. The estimated value $\hat{\theta}_i$ is then just substituted into (5) to give

$$\mathrm{EV}_i = E(p^0, z_i^0, u_i^1; \hat{\theta}_i) - m_i^0 \quad (18)$$

for each consumer.

This direct approach presents two drawbacks, at least. The first is simply that (18) is too precise. It conveys nothing of the uncertainty surrounding the true value of the parameter vector θ_i. Indeed, EV_i is really just an econometric estimate. Yet before King (1983) nothing was even said about its standard error, typically. Of course, if there happen to be so many observations that the error distribution for θ_i is approximately multivariate normal with a small variance-covariance matrix, then that for EV_i will be

[15] The merit of the Jorgenson, Lau and Stoker (1980, 1981) approach is the avoidance of this problem by a judicious choice of functional form, relying upon Lau's (1982) extension of Gorman's (1953) aggregation theorem. Its demerit is the undue restrictiveness of this functional form.

approximately normal with a small and easily calculated standard error. That is not the typical situation, however, especially when one considers that the estimates are intended to apply to *actual* individuals rather than to some hypothetical "representative consumer".

A second drawback of (18) is more fundamental. The functional forms $E(p, z, u; \theta)$ have typically been chosen so that the corresponding uncompensated demand functions $h(p, z, m; \theta)$, $r(p, z, m; \theta)$ can be derived algebraically. Despite the efforts reported most recently in Diewert and Wales (1987) to avoid imposing restrictions on local behaviour through the choice of a "flexible" functional form, these corresponding demand functions often turn out not to fit the data very well. As Varian (1982) has noted, aggregate consumption data in the U.S. over an extended period after the war is consistent with movement up the income consumption curve of a representative American consumer. Yet attempts to fit even flexible functional forms to this data often lead to rejections of the hypothesis of representative consumer maximization. The fitted demand functions will typically violate homogeneity and Slutsky symmetry unless these restrictions are imposed upon them; then tests of these restrictions show that they should be rejected at any reasonable level of significance. Of course, the hypothesis that there really is a representative consumer is absurd anyway; the point is that parametric methods remain far too inflexible. The rejection of the utility maximization hypothesis for aggregate U.S. data, even though those data are actually consistent with the hypothesis, just illustrates this inflexibility.

The obvious remedy for insufficient flexibility is to use the kind of non-parametric approach suggested by Afriat (1967, 1977) and Varian (1982), even when one is concerned with individual rather than aggregate demand behaviour. An open problem, however, appears to be the integration of their approach with the probabilistic methods that have become familiar in econometrics ever since the work of Haavelmo (1943, 1944). After all, there are bound to be serious problems with missing observations and errors in variables, at least.

The EV calculations discussed above are all for policy changes which move each consumer from one known allocation to another. Yet, even if the intertemporal allocation p^0, x^0, q^0, z^0 in the absence of the contemplated change is known—itself an extremely dubious assumption—finding the allocation p^1, x^1, q^1, z^1 after the change is bound to rely on estimates of demand and supply responses, etc. This adds to the uncertainty surrounding the EV calculations.

By now it should be clear that the results of a proper policy analysis are vastly more complicated than has usually been assumed. Even if there were no uncertainty about demand and supply functions, etc., the result would be a joint frequency distribution

$$\varphi(a, h, r, p^0, x^0, q^0, z^0, p^1, x^1, q^1, z^1) \tag{19}$$

in the population of all individuals of their welfare relevant attributes a, of their demand functions h and r, and of their allocations and prices before and after the policy change. This frequency distribution has all the information required to compute the joint distribution $f(a, \text{EV})$ of welfare relevant attributes a and of net welfare gains EV. It also enables calculation of a measure of social net gain for any postulated form of social welfare function which depends only upon the "economic welfare" of the individuals in the society and on welfare relevant attributes. When it is recognized, however, that all the variables in the distribution (19) are observed, inferred, or estimated with error, the proper result of a project analysis has to be expressed as a probability distribution $\Phi(\varphi)$ on the possible values of the joint frequency distribution φ in the population. From this basic information can be computed marginal probability distributions over the gains and losses of particular individuals or types of individual, probability distributions over social net gain, etc. While reporting Φ seems enormously complicated by contemporary standards, anything less is surely a short cut which will be increasingly hard to justify as computing resources continue to become so much less expensive.

13. Unbalanced policies

Section 12 allowed uncertainty about a great many of the variables relevant to evaluating policy changes. But one of the most important sources of uncertainty has not yet been discussed. This concerns the policy change itself. Obviously policies are not set in concrete. Indeed, the whole purpose of evaluating policy changes is to keep finding new changes which generate successive welfare improvements, rather like iterative planning procedures such as those considered by Malinvaud (1967, 1971, 1972), Drèze and de la Vallée Poussin (1971), Heal (1973), and also the "reform" approach to project evaluation discussed in Hammond (1980, 1986). So the problem would not arise if policy changes were really completely specified.

But usually they are not. In our economic models, it is usual to assume that consumers satisfy their lifetime budget constraints automatically, both in equilibrium and out of it, because their intertemporal net demands are always chosen to satisfy that constraint no matter what prices, taxes, and quantity controls they may face. Similarly firms are assumed to satisfy their budget constraints by returning to their owners any profits that they earn. Typically, moreover, an "equilibrium" model of the economy can be extended to allow "default" on "fixed interest" bonds, in the sense that all agents understand that capital and interest payments are not really fixed, because there is always an implicit option not to repay any loan, even though that option will usually not be exercised because unpleasant sanctions would be inflicted upon the defaulter. With this extension of the model, bankruptcy is no longer an unforseen event but a forseeable contingency in which the borrower's repayments are reduced, and his budget constraint is satisfied in a modified form.

If there were no public sector, having all private agents satisfy their individual budget constraints in this way implies that the aggregate budget constraint is also satisfied—i.e., that Walras' Law applies. This is true even with quantity constraints, nonlinear prices, etc. The public sector, however, makes a crucial difference. Usually this is modelled in a way that does *not* imply satisfaction of its budget constraint. To see this, consider what happens if the government both taxes tobacco and subsidizes housing at fixed *ad valorem* rates. If the government's budget constraint were automatically balanced, like those of agents in the private sector, it would be balanced both before and after a shift in consumer tastes away from tobacco toward (better) houses. Yet in fact such a change in tastes will typically increase the government deficit (or reduce any surplus). This is because specifying fixed *ad valorem* rates for commodity taxes on tobacco and subsidies on housing is only a partial specification of the relevant public policy. A full specification would also have to include how the government responds to any deficit created by such a change of tastes. In other words, a fully specified public policy has to be self-financing, including mechanisms such as issuing bonds or raising new taxes in order to ensure that the budget constraint really is satisfied.

Until governments become honest enough to specify self-financing fiscal policies, it will be necessary to evaluate unbalanced policy changes, and changes to existing unbalanced policies. There will be surpluses or deficits to include in the benefits or costs of a policy change. The question of how these should be evaluated in a final overall assessment of social welfare gain or loss depends upon what further policy changes will occur in response to the (changed) imbalance. It has been traditional to multiply budget deficits or surpluses by a Lagrange multiplier associated with the government's budget constraint. But this presumes that the government adjusts optimally to deficits or surpluses, whereas the whole purpose of policy evaluation is to help identify improvements when an optimum is difficult to find. So overall welfare assessments are bound to remain very tentative. For reasons, moreover, that have nothing to do with the difficulty of making satisfactory interpersonal (or intermonetary) comparisons of welfare gain and loss. In the meantime, one is really reduced to reporting the effects of policy change in the form of a joint probability distribution $\Psi(\varphi, B)$ over frequency distributions like (19) together with an entire list B of budget net surpluses at different times for numerous national, regional and city governments and their agencies.

14. Unresolved issues

The theoretical foundations of public economies have progressed far in the last twenty years. Much further, I believe, than most economists yet realize. And way out of sight of what passes for knowledge in most courses on microeconomics. These remain, in my view, no less than a major scandal, leading at best to a highly imperfect understanding of the market forces which limit the scope of microeconomic policy when we have to respect the incentive constraints which arise because of private information. One can hope, however, that the new perspectives discussed in Sections 3 to 7 of this essay will help to break the old ways of thinking, with their neglect of incentive constraints and consequent failure to explain properly why markets can be desirable instruments of policy. This part of the theory, it seems, is fairly well on the way to being properly worked out, except for the important problem of reassessing markets when one cares about more than just the allocations produced by the economic system, but about liberty or administrative costs, etc.

After Section 8 pointed to the need for satisfactory methods of evaluating policy changes, Sections 9 to 13 concerned themselves with the theoretical issues such evaluations raise. Since aggregation into social measures of net gain relies on controversial choices of welfare weights, perhaps applied economists should concentrate more on disaggregated data, and attempt to estimate the joint frequency distribution of welfare relevant attributes and (proper) measures of individual welfare gain. No more "surplus economics"! Furthermore, since point estimates of parameters of demand systems surely convey an impression of excessive precision, one really needs to develop non-parametric methods for estimating a probability distribution over the joint frequency distribution mentioned above. Moreover, most policies and policy changes lead to budget deficits or surpluses which will induce later policy changes. Where these later policy changes are unknown, the applied economist probably needs to consider joint probability distributions over combinations of frequency distributions and budget deficits or surpluses. These theoretical issues remain largely unexplored, but one can already see a broad research strategy based on foreseeable developments to existing theory.

Complacency is uncalled for, however, Much work remains even to complete the theoretical ideas outlined in Sections 3 to 7 above. The general theory of incentive compatible mechanisms discussed there is really only worked out for static economies with a continuum of consumers. Additional incentive constraints arise in sequence economies where default on loan contracts becomes an issue.[16] There are even incentive constraints on an ideal government's behaviour because it has the chance to change the allocation mechanism after learning about individuals' characteristics.[17] There is not a properly worked out theory of competitive market equilibrium in the face of private information.[18] Nor are imperfectly competitive alternatives very well understood. Until we have a good general theory of intertemporal market equilibrium, we cannot even understand what con-

[16] See Hammond (1989).

[17] See Roberts (1984), Kumar (1985), Tesfatsion (1986).

[18] Cf. Rothschild and Stiglitz (1976), Wilson (1977) and the enormous ensuing literature, much of which is surveyed in Stiglitz (1987).

straints the economic policy maker faces. One thing we do know is that incentive constraints often cause serious nonconvexities, as in Prescott and Townsend (1984a, b), and that current techniques for measuring welfare typically depend on smooth preferences and demand functions—with the notable exception of Small and Rosen (1981). And, of course, because macroeconomists have so far not been provided with any satisfactory microeconomics to serve as a microeconomic foundation, so all issues of macroeconomic policy can really only be properly discussed when a new microeconomic theory of money, interest, employment, inflation, and other "macroeconomic phenomena" is available.

This brings me to the last and most fundamental unresolved issue of all. Virtually all economics is built on the assumption of "unbounded rationality." The economic agent is modelled as somebody who not only plays chess perfectly, even when confronted with a large number of opponents he has to play simultaneously while blindfolded, but as one who can make complete contingent predictions of what every other chess player in the world will do into the indefinite future. Humans find difficulty in understanding much beyond the most obvious next step, and rationally economize by avoiding the unduly complex. This undermines the value judgement of consumer sovereignty—that what a consumer chooses is good for him—on which so much public economics rests (cf. Broome, 1978). It also undermines many of our "neoclassical" equilibrium models in which policies are evaluated—even those that do embody quantity constraints and other departures from Walrasian market clearing. Finally, however, it does explain why economic agents have not yet already cooperated to formulate a perfect economic policy which would make all of public economies—all of economics, indeed—completely redundant.

This assessment of progress in public economics has deliberately been both provocative and idiosyncratic. It will have succeeded if it evokes strong reactions, preferably in the form of good new work, but any reaction other than traditional complacency will be welcome. Otherwise economists will deserve to be ignored by policy makers, in my view.

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