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Asymmetric Information and Public Economics: The Mirrlees-Vickrey Nobel Prize

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On October 8, 1996, the Royal Swedish Academy of Sciences announced that the Nobel Memorial Prize in Economics had been awarded to James A. Mirrlees of the University of Cambridge and William Vickrey of Columbia University ''for their fundamental contributions to the economic theory of incentives under asymmetric information.'' The citation seems to refer to contributions which are very much in the area of pure theory. However, those who are familiar with the work of the two laureates know that—in rather different ways—their work is very much concerned with matters of public policy. In these reflections on the nature of their work, I shall take the policy issues as my point of departure and then draw implications from the policy-oriented work for the more methodological issue of how to model problems characterized by asymmetric information. I believe that this way of presenting their main achievements also reflects the work processes of the laureates themselves.[1]

The attention given to situations of asymmetric information may be looked at as a new development in the economics of uncertainty. When that field was being systematically developed in the first decades of the postwar period by Kenneth Arrow, Gérard Debreu and many others, the emphasis was on *exogenous uncertainty*, the sources of which were to be found outside the economic system itself. It is no coincidence that a central concept in the formulation of the theory of resource

[1] For more detailed descriptions of the work of Vickrey and Mirrlees, the reader should consult the articles by Drèze (1997) and Dixit and Besley (1997). Both articles are published in the ''Nobel issue'' of the *Scandinavian Journal of Economics*, which also contains detailed bibliographies.

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allocation under uncertainty was that of a state of nature, a description of all relevant aspects of the exogeneous environment that would be of relevance for the decisionmaker. By contrast, the theory of asymmetric information focuses on the type of uncertainty where individuals have different types of information, the typical situation being that they have private information about their own characteristics that is not directly available to other people, like those responsible for the design of public policy. Examples of such situations can be found in the relationship between the employer and his or her employees, where the latter have information about their own preferences and skills that are not observable by the employer, and more generally in the area of contracts when buyers and sellers have different information about the quality of the good to be traded. A provider of a public good would like to have information about the willingness to pay of the consumers who benefit from it, but the only people who possess this information are the consumers themselves. Similarly, an auctioneer does not know the maximum willingness to pay of the prospective bidders, and a government which is in the process of designing a system of redistributive taxation does not know the ability to pay of the individual taxpayer. I begin by taking a closer look at the last of these issues.

Ability to Pay and Redistributive Taxation: An Outline of the Mirrlees Model

It is an old insight in welfare economics and public finance that the ideal redistributive tax policy would consist of lump sum transfers. When each taxpayer has to pay a fixed amount of taxes (or possibly receive a fixed amount of subsidy), the marginal tax (or subsidy) rate is zero. Therefore, personal choices with respect to labor supply, saving, portfolio choice and consumption are undistorted by the tax system and no efficiency losses are associated with a policy of redistribution. In other words, a system of lump sum transfers involves no tradeoff between equality and efficiency. This is essentially the second main theorem of welfare economics, whereby any Pareto optimum can be sustained as a competitive equilibrium, given an appropriate redistribution of initial resources.

Probably the main reason why we do not have lump sum transfers is that the implementation of such a system requires information that the tax authorities do not have. If a redistributive policy is to be based on egalitarian considerations, it requires that transfers are from those with high to those with low ability to pay. But how do we know who is who? To say that we may take ability to pay to be measured by income misses the point about non-distortionary transfers, for income is not an exogeneous characteristic of the taxpayer. Rather, it is the result of a number of decisions about labor supply, saving, risk-taking and so on, and an income tax therefore distorts these choices and creates efficiency losses in the economy. The information that the policymaker would need to implement an optimal system of lump sum transfers are things like the inherent productivity of the taxpayer, a person's built-in energy and drive, and the like, and this information is clearly beyond the reach of the tax administrator.

James A. Mirrlees

Instead, the tax designers are driven back to the second-best strategy of basing the tax system on some observable characteristic like income, realizing that the problem then becomes how to design a system that trades off equality against efficiency in a rational manner. The modern formulation of this problem is associated with Mirrlees's path-breaking 1971 article. But let me first make a brief historical digression.

The old-fashioned utilitarian approach to this issue can be found in works by Francis Y. Edgeworth (1897) and Arthur C. Pigou (1932). Following them, let us make the following assumptions:

1) Social welfare is the unweighted sum of individual utility functions;

2) All individuals have the same utility function;

3) Individual utility is an increasing function of income and this function is strictly concave, which means it has decreasing marginal utility;

4) The total income of society is fixed.

These are obviously very strong assumptions. Note in particular that the first three assumptions involve more than the empirical assumption that people have the same preferences; they imply that utility is interpersonally comparable, and this is clearly an ethical postulate, not an hypothesis that can be settled with reference to empirical data.

With these assumptions, what is the distribution of income that maximizes social welfare? A moment's thought will convince us that this consists in each of the n individuals in society getting a share of exactly *1/nth* of society's total income. In other words, the optimal distribution of income is one of complete equality. The optimal redistributive tax system is one that imposes a 100 percent marginal tax rate on all incomes above the average and uses the revenue to subsidize low-income earners so as to give everyone the same after-tax income.

Note that the assumptions imply that the individual consumer and worker has no choice with respect to the amount of his or her income. This means that the marginal income tax has no effect on the worker's or society's pretax income. Even at a time when marginal tax rates were low by today's standard, this was an unrealistic assumption, and Pigou (1932) modified the conclusion by saying that the move towards full equality should be tempered by adverse incentive effects.[2] However, he did not provide any more specific guidelines for how to think about the compromise between equality and efficiency.

Mirrlees's 1971 article can in some ways be seen as a direct descendant of the classical utilitarian approach. Interestingly, he adopts the first three assumptions, although with the qualification that the utility function now depends both on income (or consumption) and leisure. One may easily forget that this set of assumptions, which is by now often referred to as ''standard,'' was in fact far from standard in 1971. Classical utilitarianism had gone out of fashion in economics, and specifications of social welfare functions did not usually proceed beyond the very general formulations familiar from the work of Abram Bergson (1938) and Paul Samuelson (1947). The fact that we now once more look upon the utilitarian formulation as familiar and acceptable is to a large extent due to the influence of Mirrlees, who had demonstrated that it could be put to practical use in the analysis of economic policy.

The novel feature of his model is that income is no longer exogeneously given. Gross income is the product of the wage rate and hours worked, with hours, and accordingly also income, being determined by the maximization of a utility function which has income (or consumption) and leisure as its arguments.

A salient feature of Mirrlees's model is that the wage rate is specific to each individual (which does not preclude that many individuals have the same wage rate); the wage rate is each taxpayer's individual characteristic. Had the tax authorities known the wage rates (which are the competitive labor markets' assessment of individual workers' ability or productivity), it could have based a system of lump sum taxes on these, but by assumption they know only the incomes of individuals. Here lies the asymmetric information feature of the model. Individuals know their wage rate and their labor effort; the government knows only the product of the two, although it knows the statistical frequency distribution of abilities or wage rates in the population.

If effort could be interpreted simply as hours worked—which is the literal interpretation of the Mirrlees model—it is perhaps not totally convincing to insist that hours cannot be observed. If they can, then one can also observe ability simply by dividing income by hours, and a non-distortionary tax can then presumably be levied on the basis of ability. But to make sense of the model, one should interpret it more broadly. The supply of effort is not simply

[2] ''The old 'law of diminishing utility' [sic] thus leads securely to the proposition: Any cause which increases the absolute share of real income in the hands of the poor, provided that it does not lead to a contraction in the size of the national dividend from any point of view, will, in general, increase economic welfare'' (Pigou, 1932, p. 89).

equal to hours but also to an ''intensity'' factor, which in any case is hard to measure. Moreover, the wage rate computed by this procedure would in a large number of cases be a function of past effort, resulting in the accumulation of experience and human capital. If the individual knew that in the future he or she would be taxed on the basis of observed ability, the individual would be faced with a disincentive to attain this ability level, and this is clearly just another version of the basic incentive problem. This and similar concerns can be seen as being captured indirectly in the simplified framework of the wage-hours model adopted by Mirrlees.

In the model a redistributive tax has to be levied on income, with the result that it distorts the labor-leisure decisions. The question Mirrlees asked is the following: What are the properties of the optimal income tax function? Of particular interest is the question of how the marginal tax rate varies with income. We have already seen that without incentive effects the utilitarian tax scheme would have an optimal marginal tax rate of 100 percent. When incentive effects are introduced we would naturally expect the marginal tax rate to be lower—but can one say anything about how much?

It turned out that by purely analytical methods Mirrlees could not say a great deal about the properties of the optimal tax function. He could prove the optimal tax function to be continuous and increasing, but he was not able to say anything very precise about the general relationship between pre-tax income and the marginal tax rate. To proceed further he made some much more specific assumptions, such that the utility functions were Cobb-Douglas and that the frequency distribution was lognormal, and turned to simulation studies. The results of these studies were somewhat surprising. It turned out that the optimal tax function was close to linear—although with a positive intercept so that the tax system was progressive—with an approximately constant marginal tax rate. As to the nature of the approximation, if anything the marginal tax rate showed a tendency to *decline* with income.

In fact, later work by Edmund S. Phelps (1973) and by Mirrlees' student Jesus Seade (1977) established the analytical result that the marginal tax rate at the top of the income scale—that is, for the most able person—should be zero! To interpret this apparently paradoxical result it should be kept in mind that the redistributive effect depends on the variation of the average tax rate, not the marginal tax rate. To achieve a redistribution of income, we must have the average tax rate increasing with income, and this requires the marginal rate to be positive and higher than the average rate, at least for most of the income range. But at the very top this point is no longer valid, since there is no one above the person with the highest income. Distorting this person's choice of effort has accordingly no redistributional justification, but it does imply an efficiency loss. Hence the top marginal rate should be zero. It should be stressed that this is a result about limits, and that it does not necessarily support the view that the rate applicable to, say, the upper percentile of income earners should be zero.

So far I have been presenting the Mirrlees optimum income tax model with little explicit attention to its contribution to the theory of asymmetric information.

In this I am in line with Mirrlees himself, who in his original exposition hardly mentioned the problem of information,[3] while ''asymmetric'' is a word that does not even occur in the article. The informational interpretation came later, both in work by Mirrlees and others.

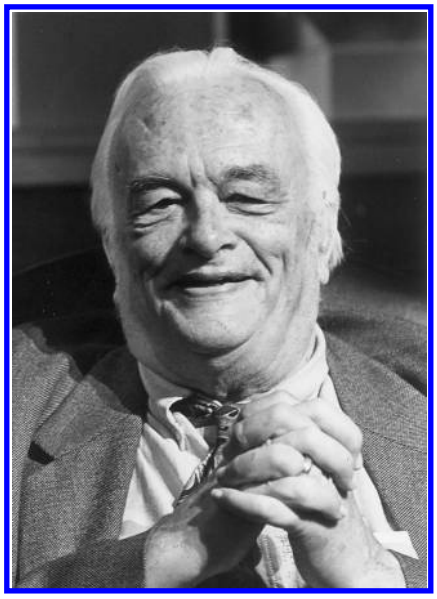
Vickrey on Optimum Redistribution

Before going on to a discussion of the significance of the Mirrlees article for the development of the theory of asymmetric information, it is worthwhile to consider William Vickrey's contribution to this area. This came actually much earlier, in a 1945 article entitled ''Measuring marginal utility by reactions to risk.'' Rereading that article today, one is struck by the fact that it contains extremely insightful discussions of two issues that later came to occupy much attention in the economics profession. One of these is the derivation of the utilitarian social welfare function from axioms taken from the von Neumann-Morgenstern expected utility theorem. The other is the optimum income tax problem, presented in a manner that bears a strong resemblance to its later formulation by Mirrlees.

On the first of these issues—the derivation of the utilitarian social welfare function—the standard reference in the literature is John Harsanyi (1955). Harsanyi postulated that the proper way to evaluate the welfare of society is to think of oneself as making a choice behind a veil of uncertainty about one's personal characteristics. The choice is between lotteries, each lottery pertaining to a particular country or society, where the prize in each of the lotteries is the equal probability of becoming a particular individual in that society. Harsanyi showed formally that if the way a person evaluated the lotteries conformed to the rationality axioms of von Neumann and Morgenstern, each person would evaluate each lottery in terms of its expected utility; that is, as the sum across all individuals of $1/n$ times the utility of becoming one particular person. But apart from the scale factor $1/n$ (which is irrelevant as long as population is constant), this is equivalent to the utilitarian sum of utilities. This idea is also clearly and explicitly formulated, although with less formal rigor, in the Vickrey (1945, p. 329) article:

> If utility is defined as that quantity the mathematical expectation of which is maximized by an individual making choices involving risk, then to maximize the aggregate of such utility over the population is equivalent to choosing that distribution of income which such an individual would select were he asked

[3] Paradoxically, the only point at which the word ''information'' occurs is in the context of a list of assumptions underlying the analysis in which Mirrlees (1971, p. 176) writes that the state ''is supposed to have perfect information about the individuals in the economy, their utilities, and consequently, their actions.'' This statement seems to go directly against the later emphasis on the asymmetric information assumption, but there is of course a sense in which the quoted statement is true; that is, the state has perfect information about individuals, *contingent on their ability*, and this is clearly what Mirrlees had in mind.



William Vickrey

> which of various variants of the economy he would like to become a member of, assuming that once he selects a given economy with a given distribution of income he has an equal chance of landing in the shoes of each member of it.

If in addition to the basic von Neumann-Morgenstern axioms it is assumed that individuals are risk averse, so that they have strictly concave utility functions, then they will also display risk aversion in their choice between hypothetical income distributions. In other words, risk aversion implies inequality aversion.

Having established this foundation for the utilitarian social welfare function, Vickrey (1945) goes on to point out the implication that if all have the same utility function and if total income is fixed, the social optimum will be one of complete equality. But the assumption of fixed income abstracts from the incentive problem, so that ''with these practical effects to consider, the question of the ideal distribution of income, and hence of the proper progression of the tax system, becomes a matter of compromise between equality and incentives'' (p. 329). He then formulates an explicit analytical model to analyze this point, assuming (as did Mirrlees later on) that there is a continuum of individuals and writing the problem as one in the calculus of variations. Having derived the first-order Euler conditions, however, he despairs of arriving at an economically meaningful solution to the problem, commenting that ''even in this simplified form the problem resists any facile solution'' (p. 331).

In his treatment of these central problems of welfare and public economics, Vickrey was far ahead of his time. Still, his analysis stopped significantly short of the

Mirrlees contribution, because it was the latter who found a set of assumptions which made the problem solvable in a way that brought out the economic implications, both for theory and policy. But the puzzle is why during the next couple of decades nobody was inspired by the Vickrey article to continue work on the problem that he sketched but did not finish; as witnessed by the editors of the recent collection of his papers, Richard Arnott, Kenneth Arrow, Anthony Atkinson and Jacques Drèze (Vickrey, 1994), this cannot have been for the lack of attentive and gifted students. The fact that the paper came out in *Econometrica* should also have assured it high visibility among analytically-minded economists.[4] Whatever the explanation, the fact remains that the paper stands as an isolated attempt to come to grips with the problem of optimum income taxation two and a half decades before the Mirrlees breakthrough.

This leads us to the question of exactly what it was about the Mirrlees formulation that made him succeed where Vickrey had to give up. In trying to answer this question we shall also get closer to the more general implications of his analysis for the theory of asymmetric information.

Taxation, Information and Moral Hazard

As we have seen, a basic assumption of the Mirrlees model is that the government cannot observe the individual's wage rate (or ''ability'') and labor supply separately. If it could do so, it could impose a lump sum tax conditional on the ability parameter itself, which would obviously, given the assumptions of the model, have been non-distortionary. In that case the utilitarian tax optimum would have had a system of lump sum taxes that would be increasing in inherent abilities. To understand the properties of the second best optimal tax system it is useful to have the first best solution at the back of one's mind. Can we be sure that by taxing income we also tax the more able more than the less able? Clearly, this will be true only if the more able actually decide to earn more income, and for this to be the case we need to make some assumptions about their preferences. From the theory of labor supply we know that an increase in the wage rate has both an income and a substitution effect on income (or consumption). The substitution effect is positive, while the income effect can be of either sign; the indifference map therefore has to have the property that the income effect is not too negative. The property that Mirrlees identified to ensure this, which is now known as ''single crossing,''[5] has

[4] In addition to the quality of the journal, one might think that the author's academic affiliation would also be of importance for the attention given to an article by a young economist. In *Econometrica* this is given as ''Civilian Public Service Camp No. 114, Bluemont, Virginia.'' What this suggested to readers at that time I am unable to guess.

[5] Technically, single crossing refers to a diagram showing the indifference curves for a high-ability and a low-ability worker with respect to income before and after tax; for example, see Mirrlees (1997, p. 1316). When these indifference curves cross only once, the result is that both utility and gross income will be increasing functions of the wage rate. Accordingly, when the tax is an increasing function of income, those with higher ability and utility pay more tax. It should be noted that the assumption that consumption is a normal good is sufficient to ensure single crossing; the assumption is therefore one which is intuitively reasonable.

turned out to be of major interest for the whole field of the economics of asymmetric information. Given the right incentives individuals will, through their choice of effort and income, reveal their ability *ranking* although the individual abilities remain unobservable by the government.

The Mirrlees optimal income tax schedule can accordingly be seen as the solution to a problem of optimal design of incentives under asymmetric information, and it is clear that this class of problems is much larger than the particular problem to which Mirrlees addressed himself in his 1971 article. Another type of asymmetric information problem had been formulated and analyzed in a celebrated article by George Akerlof (1970), who studied the problem of adverse selection. While his point of departure is the used car market, the analysis has interesting applications to insurance. If the insurance company only has statistical information about the risk characteristics of their customers, an actuarially fair policy will be unattractive to low-risk individuals. If a special policy is designed for these, the company has to make sure that the two policies are designed in such a way that each type buys the policy that is designed for it; by their choice of policy, they reveal their type. The problem of optimum income taxation may similarly be seen as constrained by self-selection; it should not encourage high-ability individuals to pose as low-ability types by working less. This approach to the theory of optimal income taxation was pioneered by Stiglitz (1982), who thereby succeeded in throwing new light on the informational basis of the tax scheme.

The other main type of asymmetric information problem is what is now known as moral hazard. The origin of this term is in insurance, where the insurance company has to realize that an insurance policy may change the behavior of the insured in a way which makes the event covered by the insurance policy more likely to happen. Fire insurance may make homeowners exercise less care to prevent fires, unemployment insurance may cause workers to exercise less care in holding on to their jobs, and so on. It is difficult for the insurance company to determine, once a fire has occurred, whether it was due to an exogeneous event or to negligence. Another application of the concept is to agency problems, where an agent enters into a contract requiring the agent to exert himself in the best interests of a principal. The principal, who is only able to observe the result, cannot determine the extent to which this is due to the agent's effort or to some exogeneous cause.

The problem both for the insurance company and the principal is to design a contract which gives the insured or the agent appropriate incentives to provide care or exert effort, while at the same time satisfying their need (assuming that they are risk averse) for protection against uncertainty. In such a contract there has to be a tradeoff between the two considerations. If all emphasis were to be put on the risk protection consideration, this would call for complete insurance coverage and a fixed salary for the agent. At the other extreme, a maximum weight on incentives would call for no insurance at all and an agent remuneration in proportion to the observed result.

It is clear that there is a strong similarity between these examples of contract design in the presence of moral hazard and the Mirrlees problem of tax design.

The counterpart to the outcome of complete risk coverage in the two examples above would be complete income equality with no reward to effort at the margin. A maximum weight on incentives would entail a zero marginal tax rate for all workers, possibly combined with a head tax to cover the need for tax revenue for other purposes than the purely redistributive. Behind this similarity lies an informational problem with exactly the same structure as those of insurance contracts or agent remuneration. The government can only observe the taxpayer's gross income, not the extent to which this is due to ability or effort.

Mirrlees (1974, 1976) himself has made very important contributions to the general theory of incentive design under moral hazard. Among other things, he made further progress in characterizing the tradeoff between risk protection and incentives, showing for example how optimal contract design depended on the agent's degree of risk aversion and the degree to which the agent's effort could be assessed on the basis of information about outcomes. In so doing, he gradually came to emphasize more strongly the information-theoretic content of his 1971 contribution. Thus, 15 years later Mirrlees (1986, p. 1197) wrote emphatically that ''The central element in the theory is information,'' thus stressing the informational basis for the second best constraints on taxation that were more implicit in his (and others') early work on optimum taxation.

Vickrey on Auctions

As already noted, auctions, particularly of the closed form whereby each bidder can only bid once and without knowledge of the bids of the others, provide another example of situations characterized by asymmetric information. The auctioneer does not know the willingness to pay of the individual buyers, nor does the individual buyer know the reservation prices of the buyer's competitors. Efficiency calls for the object of the auction—like a work of art, a piece of property, a right to exploit a natural resource—to go to the bidder with the highest willingness to pay. But how do you design an auction of this kind in such a way that the person who submits the highest bid is also the one with the highest willingness to pay? This problem was taken up in two famous articles by Vickrey (1961, 1962), which probably represent his single most important and influential contribution as a theorist.

As a starting point for understanding the central result of Vickrey's analysis, one may consider the problem of the price that would emerge at an open auction where everyone bid up to their true willingness to pay. As the bid level increases, more and more prospective buyers withdraw until only two are left. As the price reaches the level of the willingness to pay of the person with the second highest reservation price, that buyer is on the margin of withdrawal. The other person, realizing this, has only to raise the price marginally above that level to secure the object for himself. The object therefore goes to the highest bidder, who pays only the price corresponding to the second highest bidder's willingness to pay.

What Vickrey did was to design a mechanism for closed auctions which exactly replicates this outcome. Called the second price auction, the mechanism is simply

that the object goes to the highest bidder, who is however only to pay the price corresponding to the second highest bid. The point is that this leads each buyer to reveal his or her true willingness to pay and to abstain from ''strategic bidding.'' Suppose you consider submitting a bid which is below your highest price. You then run the risk that someone else will submit a bid which is higher than yours but still below your highest price. That buyer will then get the object, and you will be worse off than if you got the object at your highest price. Now suppose that you consider bidding above your highest price. Then someone might submit a bid below yours but above your true willingness to pay. You would then have to buy the object at that price and suffer a loss. Your best strategy is therefore to bid an amount equal to your true willingness to pay. The auction mechanism is such that you are led in your own best interest to reveal private information.

Vickrey was not only interested in the efficiency properties of auctions; he also asked the question of which form of auction would yield the highest income to the seller. He compared the second price closed auction with the first price auction, where the object also goes to the highest bidder, but where the price paid by the highest bidder is equal to the high bid. He then compared these two closed auctions with two forms of open auctions, the English and the Dutch. In the English auction the auctioneer asks for successively higher bids, and the bidding stops when no further increases are forthcoming; the object then goes to the highest bidder, who pays according to his bid. The Dutch auction has the auctioneer starting at a high price and then moves it down until someone accepts to pay that price. Vickrey showed that the English and second price auctions are strategically equivalent, and so are the Dutch and the first price auctions.[6] He also showed that there exists a certain set of assumptions (involving, among other assumptions, risk neutrality among buyers) which ensures the strategic equivalence of all four auctions, making them also equivalent from the seller's point of view in terms of revenue.

The study of auctions is obviously of great interest in itself, since it is an important allocation mechanism in many areas of economic life. But a notable feature of Vickrey's analysis is that it also has interesting applications outside of auctions in the narrow sense of the word. In the early 1970s, there emerged an interesting new literature on the revelation of preferences for public goods. From Samuelson (1954) we know that an efficient supply of public goods is characterized by the condition that the sum of marginal willingnesses to pay over all consumers should be equal to the marginal cost. But how do you get consumers to reveal their willingness to pay? Edward Clarke (1971) and Theodore Groves and Martin Loeb (1975) showed that this comes about if consumers are told that they will have to pay a price equal to the marginal cost minus the sum of the marginal willingnesses

[6] To better understand the equivalence between the closed first price auction and the Dutch auction, consider the popular idea of the ''winner's curse,'' according to which the winner always pays too much. If people have different estimates of the value of the object for which they bid, the winner almost by definition will have a high estimate of its value and therefore be more likely to be disappointed. If the bidders are aware of this point, they might be led both in the first price and Dutch auctions to be cautious and hold back their bids even at the risk of seeing the object being secured by someone else.

to pay of all others. This corresponds to the net social cost that they impose on society by their own decision. There is an obvious similarity here to Vickrey's second price auction. There the bidder also pays the cost imposed on others by his own successful bid, which, since the object of the auction is a private good, is simply the second highest bid.

Marginal Cost Pricing and Commodity Taxation

A clear implication of the efficiency theorems of welfare economics is that a competitive equilibrium is efficient when prices equal marginal costs. This general insight has important implications for several different fields of applications, such as public utility pricing, cost-benefit analysis and commodity taxation. The general area is one to which the two laureates have made some of their most important and widely-cited contributions, although it is only indirectly related to the problem of asymmetric information.

Vickrey's contributions to the literature on marginal cost pricing are less concerned with fundamentals than with practical implementation. He takes the desirability of the principle more or less as given and concerns himself chiefly with setting out guidelines for its practical implementation. He discusses, for example, how depreciation should be taken into account in marginal cost pricing, and how prices should be set when, for administrative reasons, different uses have to be priced uniformly. As an example of his approach to these problems, it is interesting to look at one of his most cited papers in the area, his 1955 proposal for revising the fare structure on the New York subway. This is a very detailed study of cost and demand conditions, including the nature of congestion externalities, and the analysis is carried to the point where he actually presents numerical estimates of the efficiency costs for a number of alternative fare schemes. Although Vickrey's work on marginal cost pricing presents little in the way of formal theory, the attentive reader will discover in these articles many of the themes that have been in the foreground in the more formal research on optimal pricing and formed such an important part of the public finance literature since about 1970.[7]

Mirrlees's work in this area is concerned on the one hand with commodity taxation and on the other hand with cost-benefit analysis. His major contribution in the first of these fields are his celebrated two articles with Peter Diamond (1971) on optimal commodity taxation. Appearing as they did in the same year as Mirrlees's paper on income taxation, they became another landmark at the start of a development which was soon being referred to as ''the new public economics.''[8] The

[7] For a more detailed description of Vickrey's contribution in this area and its relationship to the work carried out by French economists, particularly Marcel Boiteux, during the same period, the reader should consult the articles by Drèze (1995) in this journal, and also Drèze (1997).

[8] My own first encounter with the new public economics was at the European Winter Meeting of the Econometric Society in January 1968, where Mirrlees presented an early version of his joint paper with Diamond. I remember the excitement that I felt at being presented with this new development which seemed to promise a much more constructive role for theory in the analysis of policy issues, and the experience may well have been decisive for my own move into public economics.

problem analyzed in these articles is how to characterize an optimal structure of indirect taxes, given that lump sum taxes cannot be used. This problem had already been studied by Frank Ramsey (1927) and also in a remarkable 1951 memorandum by Paul Samuelson, which was published only in 1986. But Diamond and Mirrlees carried the analysis much further, providing an existence theorem for a tax-distorted economy, integrating a number of characterization results and—not the least of their achievements—proving what is now commonly referred to as the Diamond-Mirrlees theorem. This theorem says that in the absence of consumer income from profits, either as the result of constant returns to scale or from a 100 percent profits tax, production efficiency is desirable, implying that transactions between producers should not be taxed.

There are some obvious links between Mirrlees's work on optimal commodity taxes and his contributions to cost-benefit analysis, where the most important single publication is Little and Mirrlees (1974). This book is to a large extent concerned with the determination of the correct shadow prices to be used in the evaluation of public projects, particularly in developing countries, and one of the main recommendations of the book is that the choice of shadow or accounting prices should be such as to achieve production efficiency in the public sector.

On the face of it, the work by Vickrey and Mirrlees on optimum pricing and commodity taxation has less to do with asymmetric information than their contributions in the other fields that have been surveyed above. However, there *is* a connection. This is simply that the rationale for the second best nature of the problem is the absence of lump sum taxes, and the reason that these are assumed to be nonexistent is precisely the informational problem that also underlies the analysis of the optimal income tax. In this sense, the characterization of the work of the two laureates as being the study of incentives with asymmetric information has a broader applicability than simply to their core contributions to the analysis of this problem.

Some Asymmetries of Research Styles

When the Royal Swedish Academy of Sciences announced the joint award of the Nobel Prize to Mirrlees and Vickrey there were doubtless a number of economists who were surprised at this particular coupling of names. However, as we have seen, there is much justification for the joint award in terms of the main theoretical achievements of the two laureates. The puzzlement in the economics community may to a large extent have been due to the difference in research styles. Vickrey was a broad-based general public finance economist whose work spanned more or less the whole field from micro- to macroeconomics, from pure theory to very detailed applications. Mirrlees is a mathematical economist whose work has been much more concentrated on one particular set of issues. Both of them can be considered to be ''applied theorists,'' being interested in economic theory as a tool for better understanding of important issues of public policy. But whereas Mirrlees's

writings are almost exclusively directed to the scientific community, Vickrey's work clearly attempts to reach out to governmental decisionmakers.

In his presidential address to the American Economic Association, Vickrey (1993, p. 1) wrote: ''Economists should see to it that market prices correctly reflect the relevant marginal social cost of various alternatives. I have devoted a major part of my career to the promotion of such marginal-cost pricing, but thus far with a notable lack of practical success outside academia.'' The address is otherwise a passionate plea for economists to take a strong stand on the desirability of moving rapidly towards a state of full employment and not to ''tie our hands with financial shibboleths'' (p. 10). If it had not been for Vickrey's untimely death, only two days after the announcement of the Prize award, my guess is that he would have delivered a Nobel Prize Lecture very much along the same lines as his Presidential Address to the AEA.

Mirrlees's Prize Lecture (Mirrlees, 1997) is written in a totally different style. It contains no references to current issues of economic policy, but many more references to the academic literature (Vickrey's AEA presidential address contains none). Mirrlees describes some basic ideas in welfare economics and public finance that can be traced back to Adam Smith, and considers the state of economic theory at the time when he made his pathbreaking contributions to optimal tax theory around 1970. He then goes on to discuss the main theoretical achievements in the literature since then as well as some of the remaining unsolved problems. There are no complaints about lack of success outside academia.

This contrast in styles should most definitely not be taken as a lack of concern with policy on Mirrlees's part or a neglect of the literature in Vickrey's case. I believe, however, that it demonstrates two different perceptions of the role of the economist in the study of policy. Vickrey was obviously deeply concerned with having his ideas adopted by policymakers in the fairly short run. Mirrlees, on the other hand, is more concerned with influencing other economists, whose research may be more directly relevant for detailed decisions about policy.

Another asymmetry between the two laureates lies, as I have already noted, in the speed with which their ideas have been adopted by the academic community. Mirrlees's main contributions have been instant successes. His work on optimal income and commodity taxation and on moral hazard gained immediate recognition as being contributions of major significance. Public finance economists were quick to perceive that a revolution had occurred in their area, and that Mirrlees was one of its leaders. Many economists all over the world began to work in the field that he had started to develop. In Vickrey's case I have already remarked on the fact that his 1945 *Econometrica* article was largely neglected in the literature, in spite of the fact that it contains very clear and constructive formulations of models that became famous much later through the work of Harsanyi and Mirrlees (neither of whom refers to it). It is not easy to know why. Let me offer a few suggestions.

It is always tempting to suggest as an explanation for this kind of puzzle that in 1945 the time for this problem had not yet come. This sounds dangerously like a truism, but there may be some real content to it. It is often the case that when a theoretical breakthrough occurs, there are in effect many people who have been

thinking along similar lines. These people first provide a receptive audience for the pioneering article and then are ready to start working in the new field that has been opened up. This was clearly the case in 1971, when a number of other economists were concerned with the development of models of optimal second best taxation, and it was evidently not the case in 1945, when the mind of the profession was on other issues. In the 1970s, references to Mirrlees's articles were all over the journal literature; in the 1940s, Vickrey's paper created little notice. In addition, what we now see as the most important contributions of the Vickrey article were not clearly advertised by its title, and the author did not really follow them up himself. By contrast, Vickrey's work on auctions gained much more rapid recognition, both in auction theory itself and in the more general area of preference revelation mechanisms.

The central importance given to problems of asymmetric information in the work of Mirrlees and Vickrey has made it possible to formulate theoretical models with informational structures that are much more easily recognizable by actual decisionmakers. Thus, while their work contains a number of important contributions to ''pure theory,'' it is also remarkable for bringing theory closer to the study of concrete problems of economic policy.

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