

WILLIAM VICKREY

CONTRIBUTIONS TO PUBLIC POLICY

October 1997

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William Vickrey

Contributions to Public Policy

Bill Vickrey's cast of mind was that of a theorist. His interests, however, lay in public policy. This combination of traits -- in addition to genius -- resulted in his producing a magnificent body of research in applied economic theory, but at the same time in his having only limited success in the public policy arena. The apparent failure of his crusading, whether for congestion pricing, cumulative averaging in income taxation, a larger deficit, or full employment, was a source of real disappointment to him. He should have realized, however, that those traits which lead to good applied theorizing -- abstracting from detail and focusing on only a few aspects of a policy issue -- are not conducive to balanced policy advice. He should also have taken heart in the thought of Keynes' proverbial academic scribbler. While Vickrey's work has to date had only a modest impact on public policy, there is good reason to believe that in the fullness of time his ideas will percolate into public policy culture and have considerable influence, and that many of his policy proposals, appropriately modified to account for practical considerations, will be taken up. His seminal work on auction theory has already had a major impact on the allocation of drilling rights, timber rights and bandwidth; his work on marginal-cost pricing has been influential in the adoption of more sophisticated pricing policies by a wide range of public utilities and will become increasingly influential as cost-effective technologies to implement his proposals are developed; congestion pricing of urban auto travel is being actively debated in a host of jurisdictions, and crude forms of it have been introduced in some; his proposals for an income tax system with a more coherent treatment of progression should receive renewed attention when the pendulum swings back towards more compassionate public policy; and in time even his now-heretical views on macroeconomic policy may gain an audience in policy circles.

This essay will not do justice to Vickrey's breadth of conceptualization, inventiveness, subtlety of thought, depth of intellect, and generosity of spirit. To appreciate these, there is no substitute for reading his papers. An excellent collection of them, along with a commented

bibliography, is presented in Public Economics: Selected Papers by William Vickrey. This essay will have done its job if it persuades the reader to peruse the book.

Vickrey's style of economics was such that it is impossible to draw a sharp line between his contributions to theory and his contributions to public policy. Accordingly, this essay will review the full range of Vickrey's work, but from a public policy perspective. The essay will organize Vickrey's contributions in the same way as does the book: social choice and allocation mechanisms, taxation, marginal-cost pricing, urban transportation, urban economics, macroeconomic policy, and miscellany.

### Social Choice and Allocation Mechanisms

Vickrey's first paper on social choice theory, "Measuring Marginal Utility by Reactions to Risk" (1945a), is altogether brilliant. It touches on a wide range of issues related to the conceptual foundations for a theory of optimal public policy.

One issue it addresses is the appropriate maximand of public policy. Optimal public policy is that which "an individual would select were he asked which of various variants of the economy he would like to become a member of, assuming that once he selects a given economy -- he has an equal chance of landing in the shoes of each member of it." (p. 24) This was the first statement in the literature of what later came to be known, through John Rawls' (1971) work, as the "veil of ignorance". Vickrey combined the veil of ignorance with the then-recent concept of expected utility (von Neumann and Morgenstern (1944)). Since maximization of an individual's expected utility behind the veil of ignorance is equivalent to the maximization of the sum of utilities over the population, Vickrey provided a sophisticated conceptual basis for utilitarianism.

The next step Vickrey took was to recognize that, by examining an individual's choices in risky situations, the elasticity of his marginal utility with respect to income (now termed the degree of relative risk aversion) can be calculated for different levels of income, and that this permits calibration of the utility function in the utilitarian social welfare function up to an affine transformation, which is sufficient to determine optimal policy. Thus, Vickrey essentially derived

the social welfare function by combining the veil of ignorance, expected utility theory, and observed choice under risk. The procedure assumes that different individuals have the same tastes with respect to risk, which is certainly a limitation. Nevertheless, it provides a logically coherent and ethically defensible basis for specifying the social welfare function to be used in the derivation of optimal policy.

The paper went further. At the time he wrote this paper, Vickrey was completing his Ph.D. thesis on income taxation (to be discussed later), so it was natural that his policy interest was optimal income taxation. The second major contribution of the paper, a contribution that was highlighted in the Nobel Prize citation, was to provide the first statement of the optimal income tax problem, which was subsequently solved almost a quarter-century later by James Mirrlees (1972).

“Assuming that the marginal utility of money declines with increasing income, maximizing the total utility derived by a population from a given fixed aggregate income implies that this income be distributed equally, due allowance being made for varying needs. -- But the aggregate amount of income to be distributed cannot in practice be considered independent of the way in which it is distributed. It is generally considered that if individual incomes were made substantially independent of individual effort, production would suffer and there would be less to divide among the population. Accordingly, some degree of inequality is needed to provide the required incentives and stimuli to efficient cooperation of individuals in the production process -- the question of the ideal distribution of income, and hence of the proper progression of the tax system, [then] becomes a matter of compromise between equality and incentives.” (p. 25)

The importance of the optimal income tax problem in the history of economic thought is widely recognized. Not only was it the first theoretical problem in economics that took explicit<sup>1</sup> account of asymmetric information (including both hidden type/adverse selection and hidden action/moral hazard) but also the techniques employed in its solution by Mirrlees have subsequently been applied in the mechanism design literature to a broad range of public policy issues such as public utility regulation (Laffont and Tirole (1993)). Thus, Vickrey’s paper is a precursor to the asymmetric information revolution which has profoundly altered the way economists think about policy problems and the appropriate role of government.

Despite the importance of the ideas it contained, this paper had almost no impact. Its brilliance was recognized only after its main ideas were independently discovered by others. Why was the paper neglected, as were many other of Vickrey’s papers which contained important

insights? It is often said that Vickrey was ahead of his time. This is a curious statement since it presupposes that there is a natural time for an idea to be born. A less flattering explanation is that Vickrey's idiosyncratic cast of mind and, manner of presentation and his lack of interest in cultivating disciples, made him a poor salesman of ideas.

Vickrey had little interest in theory for theory's sake. Almost all the theory he developed was with a particular public policy context in mind. Once he developed a particular line of theory sufficiently to make the desired point, he would drop the theory and move on. As a result, at the time of original publication, many of his theoretical contributions were overlooked by theorists and unappreciated by public policy economists. To make matters worse, in a misguided attempt to make his work more accessible and to appeal to a broader audience, he wrote most of his papers in a discursive style using a minimum of mathematics. In consequence, many theorists, used to mathematics as the language of discourse, overlooked his papers, while many public policy economists, in addition to failing to appreciate the significance of his ideas, no doubt found the density and precision of his logic alien if not impenetrable. Putting a positive spin on Vickrey's singular style of thought and expression, James Tobin (1992) called Vickrey "an applied economist's theorist, as well as a theorist's applied economist". With equal justification, however, one could say that Vickrey spoke to theorists in the language of a policy economist and to policy economists using the style of reasoning of the theorist. This criticism in no way calls into question Vickrey's genius, but it does help explain why widespread recognition of it came so late in his life.

Another reason that many of Vickrey's contributions were overlooked at the time of original publication is that he was an intellectual loner. He rarely co-authored and had few thesis students<sup>2</sup>. As a result, he never developed a network of disciples to disseminate and extend his ideas, or to modify them for the public policy arena. As well, particularly beyond middle age, he showed little concern for where he published. Some of the papers published in odd places have been discovered, but many still languish in obscurity.

Vickrey's most famous paper is "Counterspeculation, Auctions and Competitive Sealed Tenders" (1961b). In the paper, Vickrey posed a series of theoretical questions concerning

allocation mechanisms with a small number of buyers and/or sellers. The sections on auctions and sealed bids concern the allocation of indivisible goods. Three of the results are particularly well-known. The first is that an English (ascending-bid) auction is Pareto efficient, while a Dutch (descending asking price) is not. The second is that a sealed-bid auction is Pareto efficient if the indivisible good is awarded to the highest bidder but sold at the price equal to the second-highest bid; such an auction is now termed a Vickrey auction. And the third is the Revenue Equivalence Theorem which states the equivalence of the expected price under several auction procedures. The paper also contained a section on the allocation of a divisible commodity with a small number of demanders and suppliers. The procedure developed there was independently derived a decade later in the context of preference revelation for public goods (Clarke (1971), Groves and Loeb (1975)), and is now widely known as the Groves-Clarke-Vickrey mechanism. This paper is justly celebrated as the seminal paper in the mechanism design literature. The sections on auctions have spawned a voluminous literature on auction theory which has been applied to a wide range of practical problems, including the sale of timber and drilling rights and bandwidth. The paper may also be viewed as the starting point for the financial literature on ‘microstructure’, which investigates the properties of alternative trading mechanisms.

Why did this paper become so widely-known while “Measuring Marginal Utility by Reactions to Risk” and many other of Vickrey’s important papers were overlooked?<sup>3</sup> The main reason, I think, is that its style of presentation is more conventional than that of most of Vickrey’s papers. After an introductory paragraph which is something of a red herring<sup>4</sup>, it provides clear statements of the theoretical problems, complete mathematical derivations, and a fairly comprehensive elaboration of the basic ideas.

The auctions paper is so well-known that, prior to winning the Nobel Prize, Vickrey was recognized by many economists only for this one paper. He no doubt tired of being introduced as the father of auction theory, while his other work was largely ignored, which probably explains why he perversely insisted that this paper was among his lesser contributions.

Vickrey wrote a few other papers on theory per se. The best-known is “Utility, Strategy,

and Social Decision Rules” (1960), which addressed a nexus of issues concerning the implications of Arrow’s Impossibility Theorem (Arrow (1951)) for welfare economics.

As noted earlier, the distinction between theory and policy in Vickrey’s writings is blurred. His contributions to theory, which this section has surveyed, were all concerned with public policy, albeit at an abstract level. His contributions to policy, meanwhile, as we shall see in subsequent sections, contained much original theory.

### Taxation

Vickrey’s earliest writings were on taxation. His graduate training at Columbia in the mid-1930’s, in public finance under Robert Haig and Carl Shoup and in theory under Harold Hotelling, was probably the best available at that time. After receiving his M.A., he worked in the Tax Research Division of the U.S. Treasury, which gave him experience with the practical difficulties in the design of tax systems. Thus, at a young age, he was well prepared to make important and mature contributions to the theory of tax policy.

All his work on taxation is linked by a common thread. He envisaged a progressive income tax whose base is comprehensive lifetime income. Almost all his writings on taxation were devoted to designing a tax system that would embody this principle and be practically implementable.

His first mature paper on taxation, “Averaging of Income for Income Tax Purposes”, published in 1939 when he was twenty-five, described in broad terms how such a tax system would be implemented. Each year a person’s cumulative (present value of) tax liability would be computed based on his tax age and his cumulative income, and his current-year tax liability would be computed as the difference between his current cumulative tax liability and his previous year’s cumulative tax liability brought forward one year.

The procedure would be straightforward to implement. Computing the current-year tax liability requires only current income, average income, and the tax function. And updating average income requires only current income, average income, tax age, and the discount rate. The

cumulative averaging procedure can easily be generalized to incorporate inflation and a time-varying discount rate and tax function and to treat consumption rather than income taxation.

Such a tax system would be horizontally equitable in the sense that two individuals of the same tax age with the same present value of income would pay the same present value of taxes, independent of the timing of income. In contrast, a progressive tax system with annual income as the base taxes more heavily individuals who have an uneven income stream. As well as being unfair, this provides individuals with an incentive to self-average income, which can be done by altering the timing of receipts and expenditures. With today's only slightly progressive income tax system, avoiding taxes through self-averaging is not a major concern to most taxpayers. But back when Vickrey wrote his article and up to the mid-1980's when marginal income tax rates were flattened almost everywhere, tax lawyers and accountants devoted a major portion of their attention to the timing of their clients' income, a form of tax avoidance which tax authorities worked hard to counter. In the early 1970's, Vickrey casually estimated that the adoption of cumulative averaging would have allowed the then-current tax code to be cut in half (1972b, p. 123); a decade earlier, Blum and Kalven (1963) argued that eliminating incentives to self-average income would substantially reduce the income tax work of tax lawyers and accountants.

Despite its appeal on both equity and efficiency grounds, income averaging for income tax purposes has never caught on, though a number of countries, including Canada, have experimented with limited forms of averaging (such as averaging on the basis of the last five years' income). Why has income averaging not been widely adopted? One problem is that there would be practical difficulties in implementation, particularly with respect to migration, inter-jurisdictional tax harmonization, and changes in tax laws. A second is that cumulative averaging would not score well in terms of comprehensibility; even undergraduate economics students have difficulty in understanding present value calculations. Vickrey recognized these problems, but tended to downplay them. These problems notwithstanding, averaging may gain political favor if there is a return to more progressive income taxation, particularly since the computerization of tax filing and administration facilitates more complex tax systems.



It is puzzling that the profession has paid so little attention in recent years to the taxation of intergenerational transfers. There has been virtually no discussion of the conceptual basis for such taxation, and very little of its mechanics, even though there is general recognition that the tax payable on an estate can be greatly reduced through informed tax management. Perhaps the incentives for succession tax avoidance are so strong that the wealthy taxpayer will always be one step ahead of the tax authorities; perhaps the wealthy have so much political clout that the taxation of intergenerational transfers will always be full of loopholes; perhaps retirees are sufficiently sensitive to tax considerations in their choice of residence that inter-jurisdictional tax competition will drive intergenerational transfer tax rates down to zero. Nevertheless, inherited wealth is so at variance with equality of opportunity that a society which fails to tax it fairly does so at its peril.

In 1944, Vickrey published two related papers on the taxation of intergenerational transfers, “An Integrated Successions Tax” and “The Rationalization of Succession Taxation”, the latter providing a more formal and technical treatment of the same material. The question this pair of papers addressed was how to design the taxation of inter-generational transfers in such a way as to be neutral with respect to generation-skipping and at the same time be progressive with respect to the recipient’s wealth. More interesting than the details of the analysis, which are complex, is the object and method of the exercise -- to develop a coherent successions tax that satisfies certain desiderata. To my knowledge, no such exercise had been performed before nor has a similar exercise been performed since. While Vickrey’s particular scheme has had little if any impact on actual succession taxation, he is to be credited both for advocating the rationalization of succession taxation and for proposing an essentially axiomatic approach to the design of a coherent succession tax system. The form of succession taxation is so important a determinant of the distribution of wealth and economic power and so central an element of economic justice that it is bound to become an important policy issue in due course, and when it does, Vickrey’s work will serve as the point of departure for academic discussion of the subject.

Vickrey’s crowning achievement in the field of taxation is An Agenda for Progressive Taxation, his 500 page Ph.D. thesis first published in 1947. It ambitiously attempts to design a

complete, coherent, and implementable progressive tax system, derived from basic principles but modified to take into account practical considerations of tax administration, enforcement, and compliance, and recognizing the difficulties of squaring simple economic concepts, such as income, with the complexity and ambiguity of actual behavior. The book is comprehensive in its approach, addressing such arcane issues as the tax treatment of gambling gains and losses and of insurance. While no one will agree with all of Vickrey's decisions concerning the compromise between theoretical and practical considerations, one cannot but admire his attempt to design as coherent and rational a tax system as is practicable. Several subsequent attempts to do so have been successful in stimulating basic tax reform and focusing its direction, notably the reports of the Carter Commission in Canada and the Meade Committee in the UK. While few of Vickrey's specific proposals have been adopted, his method of deriving a tax system from basic principles has been influential, and many of the principles he employed have since guided tax reform efforts.

Unlike the majority of applied theorists who view their job as done with the publication of an academic paper, Vickrey labored hard to take a policy concept from research through development, from invention through innovation, and then to implementation. Why then have so many of his policy innovations been ignored? (His 1993 Presidential Address to the Atlantic Economic Association was entitled "My Innovative Failures in Economics".) One reason is political naiveté; he consistently underestimated the power of vested interests. Another is his inability or reluctance to package his policy proposals in a way that would have common appeal. Yet another is that many of his proposed policies require the application of new technologies whose implementation is not yet cost-effective. As well, many of his policy proposals seem deficient in (my notion of) common sense. He was not a practical man by nature and, like many theorists who give policy advice, tended to emphasize one to two facets of a problem while neglecting others and to bend too little towards practicality. Since he was invariably rigorously logical, I always find it instructive to ponder why a particular Vickrey policy proposal strikes me as lacking in common sense -- what essential considerations the underlying theory ignores and how it could be modified to incorporate them. One lesson is that simplicity of concept does not

necessarily translate into simplicity of execution; congestion pricing is a case in point. Another is that conceptually sophisticated policies such as cumulative averaging are often not appreciated by the general public. Thus, simplicity of policy is often desirable even when it comes at the cost of some loss of efficiency, equity, and conceptual coherence.

A curious feature of Vickrey's policy advocacy, despite the moral sentiment which permeates his work -- that the goal of economics is to improve the human condition -- is that his policy proposals are aimed at improving efficiency and horizontal equity. On vertical equity he was typically silent. Even his crusade for full employment was motivated more by a concern for the waste unemployment entails than for its being borne disproportionately by the have-nots of society. Probably he felt it inappropriate to mix his ethical beliefs -- which one suspects were strongly egalitarian -- with scientific discourse.

### Marginal Cost Pricing

To begin, I should admit my limited knowledge of the history of the marginal cost pricing of public utilities. As a result, my discussion draws heavily on Jacques Drèze's masterly introduction to the marginal cost pricing section of Public Economics, as well as on Vickrey's own work.

The efficiency of the marginal cost pricing of public utilities was first recognized by Jules Dupuit in the 1840's, but his contribution was unknown to Anglo-Saxon economists until the 1950's. In the Anglo-Saxon world, understanding of the principle grew out of the marginalist revolution due to Jevons and Edgeworth and gradually evolved through the thinking of Marshall, Pigou, Hotelling, Lange and Lerner. The principle was firmly established by the time Vickrey was a graduate student, through the work of his teacher Harold Hotelling.

Vickrey's contributions entailed extending the theory in the direction of practical application and proposing schemes for its implementation. He wrote some forty articles on the subject, almost all of which explored the application of marginal cost pricing in specific contexts -- most notably to urban transportation (these papers will be discussed in the next section) but also to electricity,

telephone service, water supply, local public services, and air travel.

In his first paper on the topic, “Some Objections to Marginal Cost Pricing” (1948), Vickrey countered, not raised, objections to marginal cost pricing. The paper introduced two ideas that were to run through all his work on marginal cost pricing. The first was that efficiency requires that price be set equal to short-run marginal cost, the second, that random fluctuations in demand may be dealt with through responsive pricing.

The theory of public utility pricing is now so widely-understood -- we teach it to our undergraduates -- that it is hard for us to conceive how the efficiency of short-run marginal cost pricing could have been controversial, but it was. At the same time that Vickrey was developing his ideas at Columbia, a group of economists at the Electricité de France, the best-known of whom is Boiteux, was also working on the practical implementation of the marginal cost pricing of public utilities. They advocated pricing at long-run marginal cost. With continuous additions to capacity made optimally, the two pricing rules coincide. With lumpy additions to capacity made optimally, however, the two pricing policies diverge, as they do when capacity is not optimal. Vickrey was clearly right in terms of the basic models employed to analyze optimal pricing with or without optimal capacity. Nevertheless, the French economists had a legitimate concern, even if it was hard to incorporate into theory. Due to increasing returns to capacity additions, capacity for most public utilities is added in lumps. Immediately before a capacity expansion, existing capacity is heavily utilized and short-run marginal cost is high; with the addition, short-run marginal cost falls discontinuously. Thus, the path of prices under short-run marginal cost pricing has a saw-tooth pattern. The French economists were concerned with the disruptive effect of such price fluctuations. But Vickrey remained adamant in his position. In principle, the issue is easy to resolve. If indeed there are costs associated with fluctuating prices, these should be incorporated into the analysis. In practice, though, the measurement of such costs is difficult so that the desirable extent of price smoothing becomes largely a matter of judgment.

Vickrey was the first to address the efficient pricing of public utilities with both systematic and random fluctuations in demand. Here, too, Vickrey’s answer was theoretically correct: price

at expected short-run marginal cost, where the expectation is conditioned on the information available to the user at the time he undertakes his usage decision. To gain an appreciation of this rule, consider the extreme situation where the user has no information on the demand fluctuation (including that potentially contained in prices). In this case, pricing at ex post marginal cost rather than expected marginal cost introduces undesirable fluctuations in price without altering the user's behavior. An interesting example of an attempt to inappropriately price at ex post marginal cost is a scheme proposed for "downtown" Cambridge, England. Cars were to be charged on the basis of the actual length of time taken to traverse downtown without being given real time information on traffic conditions. One can imagine the road rage of a driver caught in an unexpected traffic snarl; not only would she suffer unexpected delay, but to add insult to injury, she would have to pay for it as well.

Vickrey illustrated this principle through the example of ticket sales for an airline flight. If the price is set ex ante, there may be empty seats on one hand or overbooking on the other, both of which are inefficient. But with an ongoing spot market for tickets for a particular flight, seats are efficiently rationed by price. If demand turns out to be unexpectedly low, a person who bought her ticket earlier at a higher price values that ticket at greater than that higher price. While she may regret not having waited to buy the ticket later at a lower price, her having paid the higher price generates no inefficiency. If demand turns out to be unexpectedly high, a person who bought her ticket earlier at a lower price can resell it if her valuation is less than the current spot price and will simply have enjoyed a windfall gain otherwise.

Responsive pricing can also be used effectively for electricity, water, and telephone usage. The user would base her decision on the current spot price which would be based on current system usage. These and other applications, as well as the availability of technology for their implementation, are discussed in "Responsive Pricing of Public Utility Services" (1970). "Airline Overbooking: Some Further Solutions" (1972a) provides a more detailed discussion of mechanisms to deal with the allocation of seats on airline flights.

Vickrey recognized that responsive pricing is not always the most efficient way to deal with

fluctuations in demand. In some cases, the transaction costs associated with implementing responsive pricing would exceed the efficiency gains; city bus travel is an example. In other cases, the characteristics of demand and of the congestion technology render other mechanisms more effective.

Vickrey's commitment to working out solutions to economic problems all the way from theory to practical implementation is nowhere more evident than in his work on marginal cost pricing. Recognizing that the actual application of marginal cost pricing requires a detailed knowledge of the congestion technology, Vickrey informed himself of the technology of each public utility he considered. This was particularly true of urban transportation, where he kept abreast of technological developments relevant to the implementation of congestion pricing. He regularly attended the annual Transportation Research Board Meetings (the equivalent of the AEA Meetings for traffic engineers and transportation scientists) and in his travels would routinely take time off to examine at first hand technological innovations in public transportation. He had a sound knowledge of the technology of public utilities too. I first encountered Vickrey in the summer of 1975 when he gave two guest lectures to an M.I.T. summer course on urban economics. His topic for the morning lecture was congestion in electrical networks!

Vickrey's interest in -- indeed fascination with -- technology is legendary. His bent for engineering no doubt manifested itself in childhood. His first degree, from Yale, was in mathematics and electrical engineering. Throughout his life he dabbled in engineering, but always with the efficient utilization of resources in mind. Most of this work was concerned with the technological implementation of congestion pricing; for example, in his 1959 study of auto congestion in Washington, D.C. (to be discussed in the next section) he designed and costed out the technology for implementing congestion pricing, and later wrote a paper on processing data for congestion pricing ("Sorting in the Light of Information Theory: Some New Techniques", 1969b). But he also wrote some papers which examined non-pricing aspects of the efficient provision of public utility services -- a study of efficient scheduling of trains in India (1963a), a proposal for improving the efficiency of short-headway bus service with automatic digitalized radio

signals (1966), and a discussion of efficient provision of subway services (1974), which deals with platform lengths, train weight, skip-stop scheduling, and schedule coordination, among other things. We associate Vickrey's name with pricing solutions to congestion, but he clearly recognized the importance of applying economics in the design of public utility capacity and in scheduling. In his ideal world, engineering economics would occupy a position of prominence and efficient pricing would be only one element -- albeit a central one -- of good engineering practice.

In view of his interest in engineering, it is puzzling that Vickrey did not pay more attention to the interaction between capacity and pricing, in particular to the simultaneous determination of efficient pricing and optimal capacity, though he clearly understood the issues. The French School considered the two simultaneously, and after the work of Mohring and Harwitz (1962) transport economists have also. Perhaps he viewed the two as separate because capacity is rarely close to optimal and because capacity and pricing decisions are often made largely independently.

Another curious feature of Vickrey's work on marginal cost pricing is its lack of attention to second-best issues. Not only did he understand the issues -- he was the first to articulate them in the context of urban transportation! In his pathbreaking study on pricing New York's subways, undertaken in the early 1950's, he discussed optimal deviations from marginal cost pricing in light of distortionary financing of the transit deficit, fare collection costs, equity, and political considerations. And in his Washington, D.C. study, he actually provided an independent derivation of Ramsey-Boiteux pricing of public utilities. Subsequent to those studies, however, his focus was sharply on the implementation of first-best congestion pricing. Perhaps the reason was methodological -- before modifying the price structure to reflect second-best considerations, it is important to have a thorough understanding of first-best pricing; perhaps it was strategic -- introducing second-best issues while crusading for marginal cost pricing would muddy the waters; with respect to equity, perhaps he considered that income taxation was the appropriate policy instrument.

A final point is that, since his innovative work on marginal cost pricing predates the

asymmetric information revolution, it is not surprising that his proposals neglect the (dis)incentive effects of subsidizing public utilities, a prominent theme in recent work (Laffont and Tirole (1993)).

In any event, while the influence (though never the intelligence or originality) of Vickrey's work in some fields -- notably public finance and macroeconomics -- may be disputed, there is no denying the impact his work has had and will continue to have on the implementation of marginal cost pricing.

### Urban Transportation

Prior to winning the Nobel Prize, Vickrey was probably best known to the average economist as the author of the seminal paper on auction theory, particularly for the Vickrey auction, as a co-discoverer of the Groves-Clarke-Vickrey demand-revelation mechanism, and as a tireless crusader for congestion pricing who proposed futuristic technologies for its implementation. The breadth of his work, as well as his brilliance, was not appreciated by the average economist, at least until recently. His greatness has, however, been recognized for many years by urban transportation economists.

Vickrey's professional interest in urban transportation came about by accident. Recall that in the late forties he had been working on marginal cost pricing. In a fortuitous turn of events, Carl Shoup and Robert Haig directed a study in the early 1950's of New York City's finances and assigned Vickrey the task of proposing a transit fare structure for the City. His study was altogether remarkable for the quality of its economic reasoning, its method, its originality, and its anticipation of subsequent developments not only in urban transport economics but also in the theory of the second best. It was indeed the first modern work in urban transport economic policy analysis.

The article based on the study, "A Proposal for Revising New York's Subway Fare Structure" (1955), starts off with a general statement of the efficiency of marginal cost pricing and then goes on to estimate the marginal cost of trips by origin-destination and time of day. The cost



study is particularly noteworthy for its detailed treatment of the costs of passenger congestion. Having derived what would now be termed the first-best fare schedule, the article goes on to describe second-best adjustments to the fare schedule to account for distortionary financing of the deficit, equity, popular acceptance, and collection costs. Another innovative feature of the study is its attention to the mechanics of fare collection. Vickrey proposed that a traveler should pay a quarter (the maximum fare) upon entering the system. The traveler would then receive a magnetically encoded token containing information on time and point of entrance. Placing the token in the exit turnstile, she would then receive a refund equal to the difference between a quarter and the fare. This was the first of Vickrey's many ingenious proposals for the technological implementation of congestion pricing. The New York subway fare study was pathbreaking and much of the subsequent work in urban transport economic theory has entailed elaborating and formalizing its insights and conceptual framework. Despite its theoretical importance, the article has had little impact on transit pricing practice. Transit pricing still appears to be set according to the political and budgetary pressures of the moment.

Vickrey's next major work in transportation, in the late 1950's, was a study of Washington, D.C.'s urban transportation problems<sup>5</sup>. While it considered public transportation, its signal contributions were to the pricing of urban auto travel. In contrast to the New York City study, the Washington, D.C. study recognizes the importance of the underpricing of rush-hour auto travel. Vickrey proposed electronic toll assessment to deal with the problem, and devoted several pages of the study to the engineering details and cost of such a system. Each car would be equipped with a transponder whose personalized signal would be picked up when the car passed through an intersection. The signal would then be relayed to a computer which would calculate the charge according to the intersection and time of day, and add it to the car's bill. Other noteworthy features of the study are an independent derivation of Ramsey pricing and the application of responsive congestion pricing to parking. In its stress on congestion pricing of urban auto travel, it anticipates the celebrated 1964 UK Smeed Report.

"Pricing in Urban and Suburban Transport" (1963a) is the best-known of a large number

of more popular papers Vickrey wrote advocating congestion pricing of urban travel. As with his other papers in a similar vein, its style is distinctive, curious, and distinguished. Vickrey had a flair for language. Despite a penchant for long sentences, his writing is clear, literate, engaging, entertaining, and eminently quotable. At the same time, his popular writings are in fact not very popular since their economic arguments are so sophisticated and dense that only a well-trained economist can fully appreciate them. Another curious feature of his popular articles is that many contain gems of insight, dropped so casually, without emphasis or elaboration, that they are easily overlooked; in fact, many were overlooked until they were independently discovered years later. For these reasons full appreciation of a Vickrey paper requires repeated reading.

“Congestion Theory and Transport Investment” (1969a) is a paper of deceptive simplicity. Perhaps because it laid the foundation for much of my own research (with André de Palma, Robin Lindsey, and Marvin Kraus) over the last decade, I consider it to be one of the three or four most important papers in urban transport economics. At the time the paper was written, urban economists modeled traffic congestion as a simple type of flow congestion -- average travel speed over the period of analysis depends on the average flow of traffic and on road capacity. This treatment of congestion is deficient in two important respects. First, it fails to take into account that a given level of flow is consistent with more than one travel speed; for example, zero flow may correspond to either gridlock or no traffic and hence free flow. In assuming that flow and velocity are negatively related, it ignores traffic jam (hypercongestion) situations. Second, in assuming that average speed depends on average flow, it treats congestion as essentially static. Transport engineers had been working for many years with dynamic models of flow congestion that account for hypercongestion, but such models were analytically unmanageable. In a stroke of genius, Vickrey captured the essence of the transport engineering approach, while dramatically simplifying it thereby permitting economic analysis, by modeling congestion as a queue behind a bottleneck.

But the paper went further. Vickrey recognized that the bottleneck model of congestion permits analysis of the dynamic equilibrium of rush-hour auto congestion. In the morning rush hour, for example, each commuter chooses when to leave home for work so as to maximize utility,

trading off the greater travel time (and a higher toll if a time-varying toll is applied) from traveling at the peak against the increased convenience of doing so. Application of this equilibrium condition permits solution, under alternative tolling régimes, of the evolution of queue length over the rush hour as well as the time pattern of departures. This paper has changed the way urban economists think about congestion; for instance, it is now taken as obvious that worsening congestion leads to a lengthening of the rush hour, whereas previously this was rarely even mentioned. Since the bottleneck model accounts for the efficiency gains from congestion tolling that derive from redistributing traffic over the rush hour, the benefits from congestion tolling are considerably larger according to the bottleneck model than according to the standard model. Thus, the paper strengthens the case for congestion pricing. It also points to the potential gains from making tolls time-varying.

When Vickrey was crusading for congestion pricing of urban auto travel in the sixties and seventies, his ideas were regarded as impractical and futuristic. There continues to be strong resistance to congestion pricing, but the tide is slowly turning. Polls indicate that in heavily-congested areas, a majority of commuters now favor limited congestion tolling, e.g. for bridges and tunnels, as long as the toll revenues are used to upgrade transportation infrastructure; the technology of congestion tolling continues to become more user-friendly, e.g. smart cards, and is strongly complementary to the technology under development for smart cars; and traffic congestion in most cities continues to worsen. The question now is not whether congestion tolling of urban auto travel will be implemented but when and in what form. In this policy context at least, Vickrey's vision will be at least partially realized. It is gratifying that Vickrey lived to see at least one of his innovative failures gaining currency.

One further paper bears note -- "Automobile Accidents, Tort Law, Externalities, and Insurance, an Economist's Critique" (1968) remains the most comprehensive and intelligent piece written on the economics of auto accidents.

Urban economics comprises four principal subject areas: location and land use, transportation, housing, and local public finance. Vickrey's principal contribution to the field was his pioneering work on urban transportation. His work in the other areas of urban economics was at the front of the field, but not seminal.

His first paper in urban economics, outside transportation, is "General and Specific Financing of Urban Services" (1963b). This is a well-known paper that will stand the test of time. Its subject is the application of marginal cost pricing to urban public services. The paper starts off with a discussion of the principles relating to whether a specific public service should be financed from user fees or from general revenue, and argues for more extensive application of user fees. The paper then goes on to provide an ingenious discussion of the application of marginal cost pricing to specific urban public services. With respect to fire protection, for example, Vickrey argued as follows. To a first approximation, a fire station services a fixed area and costs a fixed amount to build and operate. Since the costs of providing fire services for a city are therefore proportional to the city's area, the fee a household pays for fire protection should be proportional to the size of lot it occupies. To what extent the significant trend in recent years away from general financing and toward user fees in U.S. local public finance is due to this paper is hard to judge.

One of the most intriguing results in urban economics is the Henry George Theorem. Optimal city population size occurs at the point of minimum average cost, where the agglomerative economies of scale that are responsible for the city's formation are balanced by diseconomies of scale in lot production due to longer commutes. Since the point of minimum average cost is a point of locally constant returns to scale, the product exhaustion theorem applies. With marginal cost pricing, therefore, the profits from lot production, which are manifest as urban land rents, exactly equal the losses associated with those activities characterized by agglomerative economies of scale. If, for example, the source of agglomeration economies is a pure local public good, the Theorem states that in the optimal city, urban land rents exactly cover the costs of financing the pure local public good. A confiscatory tax on land rents is therefore the "single tax" required to finance the public good. The Theorem is so named because Henry George (1879), a populist U.S. writer of

the last century and a founder of the Progressive Movement, argued for just such a single tax -- though for different reasons. The Theorem was discovered independently by Serck-Hanssen (1969), Starrett (1974), and Flatters, Henderson, and Mieszkowski (1974), as well as by Vickrey in "The City as a Firm" (1977). Unfortunately, by being the last into print, Vickrey forfeited paternity of the Theorem. Nevertheless, his paper provides an elegant formulation of a variant of the Theorem and an insightful explanation and discussion of it.

Is the Theorem a theoretical curiosum or does it have practical implications? On one hand, the Theorem is remarkably robust; for example, with congestible public services, the Theorem states that in a city of optimal size, user fees plus the revenue from a confiscatory tax on land rent just cover the cost of the optimal capacity for the congestible public services. On the other hand, the result jars with intuition, appearing just too neat. Vickrey characteristically did take the Theorem seriously and used it to buttress his argument for site value taxation.

Vickrey was also a pioneer in the analysis of the relationship between urban transportation and urban spatial structure. His paper with Robert Solow, "Land Use in a Long, Narrow City" (1971), one of the classics in the new urban economics, was the first theoretical paper to examine the allocation of land to transportation in the presence of traffic congestion. Each unit of business area generates a fixed amount of traffic per unit time, with destinations uniformly distributed over all other units of business area. In a long, narrow city, how should the road be laid out to minimize aggregate transport costs? The paper was also the first to raise a now-familiar question. Suppose that traffic is not charged for the congestion externality it imposes and that land is allocated to roads not taking this into account. How is urban spatial structure distorted? After the paper's publication, it was recognized that, with a simple relabelling of variables, the model can be reinterpreted to describe individuals' interaction over urban space. The paper can also therefore lay claim to providing the first spatial interaction model in urban economics.

Several of Vickrey's papers, such as the auctions paper, have had a major impact, as evidenced by the extensive literatures to which they have given rise. Apart from such papers, however, there is some ambiguity concerning the significance of much of Vickrey's work despite

its uniform brilliance. Many of his papers were published in such obscure places that they have essentially never been read. Hopefully, his receipt of the Nobel Prize will encourage some enterprising souls to search out these papers and uncover some of the gems they no doubt contain. Then there is another set of works whose contributions are even more difficult to evaluate -- those which contain important results that went unrecognized until they were independently discovered years later. Does Vickrey deserve credit for these ideas even though his presentation of them was overlooked? His statements of the veil of ignorance and of the optimal income tax problem in “Measuring Marginal Utility by Reaction to Risk” are two well-known examples. Another is the bottleneck model whose significance was not in fact recognized until the model was rediscovered in the early 1980’s by a pair of transportation scientists (Hendrickson and Kocur (1981)). Yet another example is his work on spatial competition theory, published in 1964 (pps. 323-334) as a section of his graduate microeconomics textbooks, Microstatics. This work anticipated almost all the major modeling initiatives and new results in the field up to the current day, yet even now is unknown to all but a handful of experts in the field.

### Macroeconomics

Vickrey published papers on macroeconomics throughout his professional life, as well as a graduate textbook, Metastatics and Macroeconomics (1964d), and during the last decade of his life was preoccupied with macroeconomic issues. His impact on the field has, however, been only minor, and it seems unlikely that future generations will discover in his macroeconomic work a brilliance that his contemporaries failed to recognize. It is indeed interesting that few economists appear gifted in both microeconomics and macroeconomics. Perhaps microeconomics, with its emphasis on the behavior of an ultra-rational individual, leads to a style of reasoning that is inappropriate for the study of macroeconomics.

A case in point is “Design of a Market Anti-Inflation Program” (1986a) which introduced the idea of marketable markup warrants, to which Vickrey returned in his 1993 Presidential Address to the American Economic Association (1993b). Tradable pollution rights have been an

interesting and largely successful experiment; under the policy, industries have, for example, bought up old, heavily-polluting cars, using the pollution rights acquired to employ more polluting but also more cost-effective technologies. Why not, Vickrey reasoned, create an analogous market for price increases (at least for major standardized products)? By restricting the number of marketable markup warrants, the government could control the overall level of price increases, and could therefore pursue expansionary macroeconomic policy, thereby reducing unemployment, without worrying about creating inflationary pressures. The proposal is ingenious but at the same time not very sensible.

During the last decade of his life, Vickrey crusaded not only for marketable markup warrants, but also against the balanced budget amendment and more radically for larger government deficits. His argument (1986b, 1996), as best I -- a microeconomist not gifted in macroeconomics -- understand it, runs as follows. Start with the accounting identity<sup>6</sup>  $C + S + T = C + I + G$ . Rearranging yields  $D = G - T = S - I$ , where  $D$  is the size of the government deficit. On a steady-state growth path, private sector savings should equal private sector investment, implying government budget balance. But a zero deficit is not necessarily optimal when the economy is off the steady-state growth path. At the present time, our economy is responding to two major transient phenomena, the aging of the baby boomers and a transition from capital-intensive manufacturing to labor-intensive services. Efficient response to the former calls for savings above the steady-state level, and to the latter investment below the steady-state level. These responses together require that the government run a deficit. The government should lower taxes to stimulate private savings, and finance increased public infrastructure spending through debt to absorb the increased private savings. This argument is not without merit, but in the current policy climate which emphasizes fiscal discipline has fallen on deaf ears.

Vickrey was very concerned by the waste and loss of dignity caused by unemployment, and considered something to be fundamentally wrong with any economic system that generates persistent unemployment. He made the point repeatedly that there is nothing natural about the natural rate of unemployment, and favored a radical restructuring of the economy if that is what is

needed to eliminate unemployment. Given the U.S. experience of the last few years -- a significant reduction in the rate of unemployment without increasing inflationary pressure -- his challenging of the conventional wisdom of the 1980's has been vindicated. But he failed to provide a practical alternative to standard policy approaches.

### Miscellany

Considering his breadth of vision, it should come as no surprise that Vickrey wrote many papers outside his main areas of interest. All relate to public policy in some way or another; some focus on the philosophical or methodological basis of economics, others discuss and propose policy, while yet others concentrate on more technical aspects of economic policy analysis.

“Ethics and Economics: An Exchange of Questions between Economics and Philosophy” (1950) is of interest not so much for its contribution to philosophy or economics, as for the insight it provides into Vickrey's conception of what economics should do, and into the moral purpose underlying all his work:

Economic theory, in its purest and most abstract form, can be treated as a system of logic, having no more ethical content than a proposition in Euclidean geometry. And even with applied economics, it is possible to approach the study with the detachment of an entomologist observing an anthill. Yet no scientific investigation, however abstract or detached, can entirely escape the probability of having ethical consequences -- Economics, as a social science, deals with human beings directly - - Economic studies in complete abstraction from all human values would be an insubstantial discipline, for economics is pivotally concerned with values. (p. 148-149)

And

Our best hope is to make the self-interested part of our economic system as smooth running as possible, so that more and more of our conscious effort can be directed towards the solution of those problems that cannot be resolved without explicit ethical consideration. (p. 177)

The latter quote provides at least part of the answer to a question posed earlier -- why Vickrey, despite his strong commitment to social justice, tended to propose policies aimed at improving efficiency.

The policy papers cover topics ranging from student loans (1962b), philanthropy (1962a), the poverty gap (1967), and gerrymandering (1961a), to the resolution of international disputes



(1978) and the application of demand-revelation mechanisms to Congressional decision-making (1993a). All are remarkable for the novelty of their perspective, as well as for their ingenuity and logical rigor. Among the group, one paper has had a substantial impact, “One Economist’s View of Philanthropy” (1962a). According to Martin Feldstein (1976), the paper is “the first fundamental study of the economics of charities”. Wide-ranging, but focusing on the motives for charity and on its redistributive impact, the paper remains a cornerstone of the growing literature on the subject.

Vickrey’s more technical papers cover such topics as cost-of-living indices (1961c), equivalence scales (1949), and sorting theory (1969b). “Resource Distribution Patterns and the Classification of Families” (1949) examines the appropriate aggregation of different family sizes for measurement of the distribution of income, the propensity to consume, and the distribution of the tax burden. This paper influenced Modigliani and Brumberg (1954) in their analysis of the consumption function, and Friedman (1957) in his thinking about the permanent income hypothesis.

Vickrey’s breadth of conception is unusual even among economic theorists. Not only did he have an exceptionally wide range of interests, but he also kept up to date with recent developments in many disciplines by attending seminars throughout Columbia University. He was indeed well-known as an inveterate and somnolently acute seminar participant.

### Research Style and Intellectual Influences

Vickrey’s research style was quite idiosyncratic. In most of his work, he seems to have started with a policy issue, and then to have thought about what light economics can cast on it. A paper would record his train of thought on the issue. One suspects that he went through several drafts on a paper, on each successive draft refining the argument and, where necessary, developing a model to make a point more precisely -- model-assisted rather than model-based reasoning. As a result, his papers are coherent but tend to be organic rather than formal in structure. An attractive feature of this style of reasoning and presentation is that his papers have an immediacy and

spontaneity that few academic papers have. A disadvantage is that models and tangential ideas rarely get elaborated because doing so would distract from the flow of the argument. Great men with breadth of vision can carry off this method of discourse with success (Arrow's essays on medical care (1963) and the limits of organization (1974) are similar in style). Lesser mortals, however, need to structure their arguments more formally to avoid illogic and incoherence.

With all great thinkers, the whole of their thought is, in some respect or another, greater than the sum of the parts. Vickrey's corpus of work compellingly demonstrates how the rigorous application of economic reasoning can raise the level of debate on a tremendously broad range of policy issues.

In his obituary article on Vickrey, David Warsh, the economics columnist of the Boston Globe, asserted (1996) that Vickrey's thought was heavily influenced by the Progressive Movement. That I had no idea whether this assertion is correct prompted me to realize that, even though I have read most of Vickrey's work, I know little of the intellectual currents that influenced it. His papers, being idiosyncratically short on references, provide few clues. Since he was the scion of a patrician Canadian family whose father was active in refugee work, I had guessed him to be an intellectual descendant of Benthamite utilitarianism and Fabian socialism. But I could easily be wrong. In any event, I hope a biographer will in due course set the record straight.

### Public Policy Experience

While Vickrey is considerably better known for his academic work than for concrete contributions in the policy arena, over the course of his life he did have fairly extensive public policy experience, which no doubt informed his academic work and stimulated his thinking on many problems. He worked on the Shoup Tax Mission (1949) which laid the foundation for the postwar tax system of Japan. This was followed by participation in tax missions to Puerto Rico, Venezuela (1960), and Liberia (1970). He spent his 1974-5 sabbatical year as an adviser on fiscal matters for the United Nations in Singapore, Malaysia, Iran, Zambia, the Ivory Coast, Libya, and Surinam. He also provided advisory and consulting services to a range of public utilities, starting

with the Electric Power Industry in 1939, and on urban planning and transportation in India, Argentina, and Venezuela. Finally, in a different vein, he worked extensively with a wide range of policy advocacy groups.

### Vickrey: The Man

The previous pages have woven a tapestry of William Vickrey, the scholar, with particular emphasis on his contributions to public policy. The dominant theme was that Vickrey had the cast of mind of a theorist but interests in public policy. As a result, his corpus of research is distinctive and unusually broad in scope. To every problem he addressed he brought a novel perspective, a rare breadth of vision, and incisive logic. Many of his policy proposals appear to lack common sense. But his brilliance lay in pursuing a line of economic reasoning to its logical conclusion, and in doing so, he inevitably challenged the conventional wisdom and brought into question the bounds of what is practical. Some of the policy innovations deriving from his work have been an unqualified success, most notably applications of auction theory. Others, such as congestion tolling and responsive pricing, should gain acceptance in time as the policy environment becomes more receptive and the technology for their implementation becomes more familiar and cost-effective. Yet others seem doomed to failure. But even his innovative failures are instructive for what they imply about the limitations of existing economic theory.

Vickrey, the scholar, is there in print. Vickrey, the man, is far more elusive. Some obituaries portrayed him as a cross between Albert Einstein and the Nutty Professor. He was brilliant, eccentric, and other - worldly. But he was no buffoon. He was a moral philosopher, deeply committed to the beneficial application of economics, whose eccentricities derived from a lack of concern for external appearances and material acquisition. He traveled alone above the fray with dignity. Despite his moral seriousness, he was gentle, kind, tolerant, and consistently good-natured. He was also remarkably good company, providing bonhomie and stimulating conversation which mixed wit, anecdote, erudition, trenchant observation, brilliant insight, and quirky ideas. Much of his charm came from his almost child-like innocence and optimism.

Despite his disappointment that few of his policy proposals received serious attention, he never succumbed to bitterness or cynicism and to the end kept the faith that policies derived from benevolence and clear thinking would ultimately prevail. What were the roots of this faith? He was an active Quaker and a conscientious objector in World War II. Much more than this, however, we shall probably never know for he was an intensely private man.

### Conclusion

In this review I have tried to convey to the reader something of Vickrey's greatness and of the richness of his ideas. Public Economics: Selected Papers by William Vickrey provides an excellent introduction to his work, but only an introduction. There are many other, virtually unknown papers, which no doubt contain as yet undiscovered pearls of wisdom.

Let us now praise famous men. Vickrey was a great man and ultimately a famous one. The form of tribute he would most have appreciated is that his works be read and that his ideas be pursued.

## Notes

\* This paper was written in recognition of William Vickrey's receipt of the 1996 Nobel Prize in Economics. Since he died three days after receipt of the Prize, it is also an *in memoriam* tribute. Without implicating them for the opinions expressed in this essay, I would like to thank Dan O'Flaherty, Kelly Chaston, and David Wildasin for their insightful comments on an earlier draft.

<sup>1</sup> The Ramsey optimal commodity tax problem (Ramsey (1927)) implicitly assumes asymmetric information.

<sup>2</sup> He did, however, have two exceptional students, Kenneth Arrow and Jacques Drèze, both of whom have championed his ideas.

<sup>3</sup> The paper was not an instant success, however, its value went unrecognized for over a decade after publication.

<sup>4</sup> "In his Economics of Control, A.P. Lerner threw out an interesting suggestion that where markets are imperfectly competitive, a state agency, through "counterspeculation", might be able to create the conditions whereby the marginal conditions for efficient resource allocation could be maintained". (p. 55)

<sup>5</sup> This study is published in full in the Congressional record -- the full citation is given in the references (1959). Excerpts are published in Vickrey (1994a) and Vickrey (1994b).

<sup>6</sup> This, of course, is the accounting identity for a closed economy. How Vickrey intended the argument to be modified to account for the openness of the U.S. economy, I do not know.

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