The Fundamental Theorems of Modern Welfare Economics, Historically Contemplated

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Modern welfare economics is formally summed up in two so-called fundamental theorems. The first fundamental theorem states that, subject to certain exceptions—such as externalities, public goods, economies of scale, and imperfect information—every competitive equilibrium is Pareto-optimal. The second fundamental theorem states that every Pareto-optimal allocation of resources is an equilibrium for a perfectly competitive economy, provided a redistribution of initial endowments and property rights is permitted; alternatively expressed, every Pareto-optimal allocation of resources can be realized as the outcome of competitive equilibrium after a lump-sum transfer of claims on income. The thinking behind these theorems was laid down in the 1950s after the publication of the Arrow-Debreu (1954) proof of the existence of general equilibrium. Nevertheless, the labels "first and second fundamental theorems," or rather "first and second optimality theorems," seem to have been first used by Kenneth Arrow (1963, 942–43). These labels are not found in the many books and articles on welfare economics that appeared in the 1950s and 1960s (Boulding 1957; Koopmans 1957; De V. Graaff 1957; Little 1957; Baumol 1965), and yet by 1970 or thereabouts, these labels had become canonical (Varian 1987, 510–17; Layard and Walters 1978, 26).

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What has also become canonical is the pedigree ascribed to these two theorems. The first theorem was credited to Vilfredo Pareto, who literally invented it in 1906. It was subsequently forgotten and then revived and amplified by John R. Hicks (1939) and Nicholas Kaldor (1939) to become the centerpiece of "the new welfare economics." At this point, it was traced back to Adam Smith's references to an "invisible hand," which were widely acclaimed as an early informal version of the first fundamental theorem. The history of the second fundamental theorem is more tortuous, and it was never well delineated. Historians of economic thought knew of John Stuart Mill's distinction between the immutable "laws of production" and the mutable "laws of distribution" and were aware of the frequent references in the nineteenth-century literature to a trade-off in economic policy between equity and efficiency, but even they have failed to recognize that the second fundamental theorem only emerged as such in the marginal cost pricing debates of the 1930s.

My purpose in this article is to pin down the history of the two fundamental theorems of modern welfare economics and in so doing, to assess their continued relevance, if any. These are familiar ideas, which in some sense are the bread-and-butter of every intermediate and even elementary textbook in economics. But their philosophical foundations are actually somewhat shaky, and we will show that economists are by no means agreed on their significance. A better appreciation of the history of these ideas may help to bring them more clearly into focus.

1. The First Fundamental Theorem

The doctrine that competition somehow maximizes social welfare dates back to the eighteenth century, and the idea that social welfare is quite simply the arithmetic sum of independent individuals' welfare is at least as old as Jeremy Bentham. Both strands are reflected in Alfred Marshall's rather murky conception of the optimal properties of competition, or what Joseph Schumpeter (1954, 233) called "the Maximum Doctrine of Perfect Competition." What made the doctrine so murky was the intractable problem of adding up the individual utilities without any compelling method of comparing them, other than conventionally counting them equally (as Bentham had always advocated).[1] Pareto's master stroke was to ask what

1. Bentham had a more sophisticated utility theory than his later acolytes, William Stanley Jevons and Francis Y. Edgeworth; see Warke 2000.

an old-fashioned "positivist" might be able to say about social welfare if interpersonal comparisons of utility (ICU) were ruled out as unobservable and nonoperational.[2] As every first-year student of economics knows, the answer is as follows: Social welfare is maximized by an allocation of resources that meets with unanimous approval, meaning that it is then impossible to reassign inputs and outputs so as to make any individual strictly better off (in his or her own judgment) without making at least one other individual worse off. If we add to this the notion of perfect competition, an economic regime in which all firms are too small to influence the price at which they sell their product, being "price-takers and not price-makers" in Tibor Scitovsky's (1952, 21) immortal phrase, we reach the first fundamental theorem. It is a generalization of the case of bilateral exchange, which, being voluntary, must be welfare-enhancing for both parties. If all individuals face the same prices for commodities, what is true for two individuals is also true for *n* individuals. That is why perfect competition is essential to the proof of the first fundamental theorem.

Having been stated by Pareto ([1906] 1972, 451–52) in 1906, the first theorem was more or less forgotten until Hicks and Kaldor, preceded by Enrico Barone, gave up the notion of finding a unique social optimum and instead introduced the concept of compensating payments to evaluate alternative social optima. This is a story that has been told many times before (Nath 1969, 94–116; De V. Graaff 1957, 82–92; Ng 1983, 59–78; Blaug 1997b, 573–75), but it is briefly told again to remind us that the concept of Pareto optimality, a characterization of a social optimum that does not require any ICU, was only dimly perceived (mostly by Walras) before Pareto. The idea that unanimity allows for a definition of optimality that is free of the conundrum of ICU was picked up by Knut Wicksell ([1895] 1958) as the foundation of his essay "A New Principle of Just Taxation" (see also Wicksell 1896). Nevertheless, the genuine history of the first fundamental theorem of modern welfare economics begins in 1906 and only in 1906.

That, however, is not what we are told by textbook writers and even leading mainstream economists. Ross Starr's (1997, 146) introductory text to general equilibrium theory states categorically that "the First Fundamental Theorem of Welfare Economics, is a mathematical statement of Adam Smith's notion of the invisible hand leading to an efficient

2. This is merely a plausible conjecture about Pareto's philosophical outlook, because little is known about the origins of his thinking; see Bruni 2002, chap. 2.

allocation" (see also 7, 238). Similarly Mas-Colell, Whinston, and Green's *Microeconomic Theory*, a textbook that is currently assigned to first-year graduate students at Harvard, asserts repeatedly that the first fundamental theorem is a formalization of Smith's claims about the "invisible hand" of the market (1995, 308, 327, 524, 545, 549). Their words are echoed by Arrow and Hahn (1971, 1), Hahn (1982, 1), Tobin (1991), Milgrom and Roberts (1992, 62, 69, 72, 85), Stiglitz (1994, 43; 2002, 73, 254; 2003, 12–13), Telser (1996, 86), Barro (2002, 8–9), and Segura and Braun (2004, 1, 194).

We can find statements by Adam Smith that appear to endorse something like the first fundamental theorem, particularly in the frequently cited second chapter of book 4 of *The Wealth of Nations*. Capitalists have a preference for home over foreign investment for reasons of security, Smith ([1776] 1976, 455–56) asserts, and

> every individual who employs his capital in support of domestic industry, necessarily endeavours so to direct that industry that its produce may be of the greatest possible value.
>
> The produce of industry is what it adds to the subject or materials upon which it is employed. In proportion, as the value of this produce is great or small, so will likewise be the profits of the employer. . . .
>
> But the annual revenue of every society is always precisely equal to the exchangeable value of the whole annual produce of its industry.

The natural interpretation of these passages is that, at least for domestic industry, total product is maximized by free competition. This is almost the first fundamental theorem—but not quite.

First of all, a presumption of maximization is not a mathematical theorem, and second and more significantly, free competition or free unrestricted entry into industries is a far cry from *perfect* competition, without which the price-taking behavior of numerous small competitors, adjusting only the quantities they buy or sell, falls to the ground. Augustin Cournot invented the concept of perfect competition in 1838—perhaps the one time in the history of economic thought that a fundamental idea was invented *de novo* without any predecessors—and since the proof of the first fundamental theorem absolutely requires the concept of perfect competition, the idea that Adam Smith somehow stated a primitive version of the first theorem is a historical invention; indeed, it is a historical travesty.

Yes, Adam Smith believed in competition, or rather "the simple and perfect system of natural liberty," but his idea of competition was a behavioral one, not limited to the number of firms in a market as in Cournot.

Competition for Smith, as for all the classical economists, implied rivalry by price and by nonprice means, rivalry among consumers bidding for a limited supply, and rivalry among producers to dispose of that supply on the most advantageous terms. In other words, he held what I have elsewhere called "a process conception of competition," nowadays associated with Austrian economics, in contrast to the orthodox "end-state conception of competition," in which all emphasis is directed to the nature of the final equilibrium, regardless of how that final equilibrium is attained (Blaug 1997a, 678; see also Kirzner 2000).[3]

Although the first theorem cannot be found in *The Wealth of Nations*, what can be found is the notion conveyed by the first theorem that competition has desirable properties; however, in Smith's case it is the conviction that competition promotes "the wealth of nations," meaning the growth of national income, which results in the material improvement of the standard of living of even the poorest members of society. This idea is not only the mainspring of the famous opening chapter of the book, on the division of labor in the pin factory, but it also accounts for the emphasis throughout the book on capital accumulation and on the crucial distinction between "productive and unproductive" labor in book 2, not to mention the content of the whole of book 3 with its revealing title "The Different Progress of Opulence in Different Nations," which, translated into modern jargon, reads "On Differences in the Growth Rates of Different Countries." Much of book 3 was devoted to persuading the reader that there had been material progress in Britain since Elizabeth I, a thesis that surprisingly was frequently denied at the time.[4] In short, what was good about what he called "the commercial society" was that it grew rapidly, not that it was efficient, a term and indeed a concept that never appears in *The Wealth of Nations*.

3. Ronald Coase (1997, 318) said it all: "One of the great strengths of Adam Smith's view of economics was that he thought of competition . . . as rivalry, as a process, rather than a condition defined by a high elasticity of demand, as would be true for most modern economists. I need not conceal from you my belief that ultimately the Smithian view of competition will prevail." For an excellent brief history of the still-much-misunderstood concept of competition, see High 2001, xii–xiv.

4. A subsidiary argument, fully developed in book 4 of *The Wealth of Nations*, was that manufacturing and inland trade had been overdeveloped relative to agriculture by state interference with "the simple and perfect system of natural liberty." For a superb historical reconstruction of Smith's optimistic growth theory, resisting all attempts by other commentators to modernize the theory by a rational reconstruction, see Eltis 1975; Fleischacker 2004, 55–57; and Kennedy 2005, 167, 188.

Let us distinguish between "static efficiency," an idea that is foreign to Adam Smith, and "dynamic progress," which does capture Smith's meaning. Dynamic progress is not easy to define, but it is revealed by growth in the total product of a firm or industry, which adds up to growth of national income. Static efficiency is usually defined as maximization of the output derived from given inputs; however, the inputs themselves are not always given, and then the definition becomes more complicated and is often ambiguous. Be that as it may, the point of the distinction is to stress that static efficiency does not necessarily imply dynamic progress, while dynamic progress may be incompatible with static efficiency.

No one expressed the distinction between static efficiency and dynamic progress with more conviction than Joseph Schumpeter (1947), for whom it amounted to his whole defense of big business.[5] The distinction crops up repeatedly in the history of international trade theory, most notoriously in David Ricardo's demonstration of comparative advantage in chapter 7 of his *Principles of Political Economy*, to reveal the static gains from a more efficient global allocation of resource via free trade, while elsewhere in his writings (and even later in the same chapter), he analyzed the dynamic long-run effects of the repeal of the Corn Laws. In the same way, both John Stuart Mill and Marshall endorsed the comparative cost doctrine of Ricardo on grounds of static efficiency, but nevertheless harked back to Adam Smith's dynamic treatment of free trade as an engine of economic growth, emphasizing its effects on the worldwide diffusion of technical knowledge (Maneschi 1998, 202, 212; Gomes 2003, 63–64, 183–90, 205–8).[6]

2. The Invisible Hand

I hope that I have now said enough to show that even the most apparently innocuous claim that "the Philosophy of the First Fundamental Theorem of Welfare Economics can be traced back to . . . Smith" (Feldman 1987, 4:889) is deeply misleading. Adam Smith's reference to an "invisible hand" in book 4 of *The Wealth of Nations* has attracted an enormous

5. "A system . . . that at *every* given point of time fully utilized its possibilities to the best advantage may in the long run be inferior to a system that does so at *no* given time; because the latter's failure to do so may be a condition for the level or speed of long-run performance" (Schumpeter 1947, 83).

6. Another striking example of this distinction is the great patents debate of the nineteenth century, which is actually still ongoing: patents (and copyrights) are temporary monopolies granted by governments, a static inefficiency, which is only tolerated because of the dynamic effects of the disclosure and dissemination of knowledge that patents produce (Blaug 2005).

secondary literature,[7] no doubt because they express three closely connected but separable ideas: (1) that the *private* action of individuals have unintended *social* consequences; (2) that these private self-interested actions and unintended social consequences may be harmonious in mutually promoting the interests of society; and (3) that there is an order in social events as if private self-interested actions were centrally coordinated to produce a coherent overall pattern. This is a profound assembly of ideas that captures the doctrine of spontaneous order via the doctrine of unintended social consequences—a doctrine employed by many Scottish thinkers of the Enlightenment to explain the emergence of such social institutions as language, the law, private property, the monetary system, and even the market economy itself, not by central design or collective regulation but by individual action undertaken for quite different reasons. But important as this idea may have been to Turgot, Hume, Mandeville, Ferguson, and Dugald Stewart, it was not in the forefront of Adam Smith's thinking and, in any case, he never characterized the price system or competition as "an invisible hand."[8] This is a modern reading of him under the influence of Léon Walras and Pareto as translated by Arrow and Debreu.[9]

7. For a small, carefully selected sample, see Hayek 1973, chap. 2; Vaughn 1987; Grampp 2000; Rothschild 2001, 116–28; Streissler 2003; Minowitz 2004; and Vivenza 2001. Let us add that the much-praised invisible hand passage in *The Wealth of Nations* is offset by a single controversial invisible hand passage in *The Theory of Moral Sentiments* (Smith [1759] 1976, 184–85), which argues that mankind has progressed in the face of pronounced and persistent inequalities and that the rich, despite their natural selfishness, inadvertently end up sharing their wealth with the poor. Both William Grampp (2000) and Peter Minowitz (2004) object to Smith's conclusions in *The Theory of Moral Sentiments* as too Panglossian. It is worth remembering that Smith revised the sixth edition of *The Theory of Moral Sentiments* in the same year in which he revised the fifth edition of *The Wealth of Nations*, and he did not use the occasion to refer the reader of one book to the other book, almost as if they were written by two different authors. The relationship between the two books—the so-called Adam Smith problem—remains an unsolved mystery, despite repeated attempts to deny there is any problem. For a superb history of this question, which argues that it remains unsolved, see Otteson 2002, chap. 4; see also Minowitz 1993.

8. Jerry Evensky (1993, 198 n), who, like everyone else, recognizes that the invisible hand metaphor occurs only twice in Smith's published writings and only once in his unpublished *Essays on Philosophical Subjects*, nevertheless believes that "the image is central to his moral philosophy." Even this assertion strikes me as an exaggeration.

9. Paul Samuelson and William Nordhaus (1992, 376–77) quote the invisible hand passage in *The Wealth of Nations*, adding: "Smith was unable to prove the essence of his invisible-hand doctrine. Indeed, until the 1940's, no one knew how to prove, or even to state properly, the kernel of truth in this proposition about the efficiency of perfectly competitive markets!" But they escape the charge of a Whiggish reading of Smith by adding that "Smith's approach was to prove by example. His masterpiece is a practical handbook that might be entitled *How to make the GNP grow.* At the same time, it lays the foundation for modern analysis of supply and demand."

It was only in the last quarter of the nineteenth century (as a result of German critics of Smith) that the phrase "invisible hand," which actually surfaces only once in *The Wealth of Nations*, was elevated to a proposition of profound significance. Emma Rothschild (2001, 116) deals expertly with this subject and concludes that "the image of the invisible hand is best interpreted as a mild ironic joke." This may be going a little too far in the opposite direction to the now-prevailing interpretation, but there is no doubt that Smith himself did not attach great importance to the idea of an invisible agency channeling the behavior of self-interested individuals, and instead regarded the metaphor of the invisible hand as an ironic, and indeed sardonic, comment on the self-deception of all of us, including moral philosophers.

I had thought that I was alone in this iconoclastic reading of *The Wealth of Nations*, but I was delighted to discover that others had got there before me (see Winch 1997; Peil 1999, chap. 4; Porta and Scazzieri 2001, 11; Montes 2004, 13, 130, 151–59). William Baumol and Charles Wilson (2001, 1:vii–viii), in their exemplary survey of the history of welfare economics, note that the famous invisible hand passage in *The Wealth of Nations* is silent on the question of efficient allocation and that Smith had little to say on the subject anywhere else in *The Wealth of Nations*. Similarly, John Kay (2003, 190), in his popular book *Truth about Markets*, cites James Tobin (1991) to show that

> some economists regarded the Arrow-Debreu results [on the existence of general equilibrium] and the fundamental theorems of welfare economics as the modern expression of Smith's invisible hand. . . . But Smith would be surprised at what is attributed to him today. . . . On careful reading Smith does not say that selfish behaviour is praiseworthy, is bound to pay, or necessarily promotes the best interests of society. . . . The passage containing the invisible hand metaphor is not about general equilibrium theory: its purpose is to explain why merchants would continue to buy British products even if tariffs were removed.

3. The First Fundamental Theorem in Modern Dress

Let us now put Adam Smith behind us and consider the possible meaning and significance of the two fundamental theorems. It sometimes seems that general equilibrium theorists invoke the name of Adam Smith so frequently when expounding the fundamental theorems in order to endow

them with an impressive intellectual pedigree, thus disguising the fact that the status and precise implications of the theorems are actually very dubious. Take the relatively uncomplicated first fundamental theorem, which the new welfare economics of the 1930s amplified by the Hicks-Kaldor compensation payment, with the result that what used to be Pareto optimality turned into a potential Pareto improvement as a measure of a desirable economic change. Since first-best Pareto optima are unachievable in the real world, this redirection into criteria of second-best, piecemeal improvements was a step toward policy applicability. However, whenever a potential Pareto improvement becomes an actual Pareto improvement, it opens the door to strategic bargaining on the part of potential gainers and losers of an economic change, the very complication that Pareto thought he had banished with his taboo on ICU.

Harking back before Pareto, we need to remember that Marshall himself never had any qualms about ICU,[10] but he had no need of them because Daniel Bernoulli's hypothesis of diminishing marginal utility of income, coupled with the old Benthamite assumption that "all men are equal" (or must be regarded as equal)—differing only in income but not in the capacity for want satisfaction—allowed him straightaway to reach the hoped-for conclusion that greater equality of income distribution would increase social welfare. Stronger assumptions about the income utility schedules are needed to justify a progressive income tax, but Marshall did not hesitate to make those assumptions, and in general, all the neoclassical followers of Marshall likewise favored the use of the tax system to promote egalitarian ends (Groenewegen 1990; Blaug 1997b, 320–22).[11] Similarly, but more stridently, Arthur Pigou (1952, xi) openly sanctioned ICU, declaring that "changes in the distribution of the national dividend in favour of

10. Peter Hennipman (1995, 165) usefully distinguishes between two kinds of ICU, one in which the comparison is made by means of empathy and one in which an ethical value judgment is employed to make the comparison, and he shows that this distinction has a long history going back to Bentham. This is related to two ways of using the term *utility* in economics: one as a measurable concept to illuminate individual consumption decisions and one where it is used to as a rough-and-ready term to reflect shared, generally accepted values. Alongside this distinction is another one between "decision utility," the kind of utility implied by standard economics, and "experienced utility," the utility that people actually perceive, which may well differ (Kahneman, Wakker, and Sarin 1997).

11. This went well beyond the beliefs of the classical economists. For example, John Stuart Mill, despite favoring progressive inheritance taxation, an extremely radical proposal in 1848, and of course taxation of "the unearned increment of rental values," nevertheless refused to endorse progressive income taxation and expressed a preference for taxation of expenditures rather than incomes (Blaug 1997b, 184, 206).

the poor may be brought about in several ways, the most important of which is by a transference of purchasing power from richer persons. . . . Except in very special circumstance, such a transference, must increase economic welfare."

These two strands in neoclassical economics, the Paretian strand eschewing ICU and the Pigovian strand making no bones about very definite ICU, existed side by side for more than a generation until Lionel Robbins (1935, 132, 134) endorsed Pareto's disdain of such comparisons, going so far as to declare them as empirically meaningless. One answer to Robbins was to abandon the quest for a unique social optimum defined in static terms and instead to follow Hicks (1939) and Kaldor (1939) by confining welfare economics to the dynamic appraisal of economic changes. The "new welfare economics" à la Hicks and Kaldor scored a triumph in the early 1940s by actually reconciling the "old welfare economics" of Marshall and Pigou with the new notion of potential Pareto improvements.

Marshall had learned from Jules Dupuit that an individual demand curve can be interpreted as a marginal-willingness-to-pay curve, and if most individuals in a market have similar incomes, then an ordinary uncompensated market demand curve can be employed to provide a money-based measure of consumers' surplus, expressing the aggregate willingness to pay of all consumers damaged by a price rise. He had a symmetrical argument about producers' surplus being read from the supply curve to measure the producers' aggregate willingness to accept compensation when producers are damaged by a price fall.[12] Moreover, he combined this belief in the measurability of consumers' and producers' surplus with a conviction that individual industries could be characterized as exhibiting increasing, constant, or decreasing returns of scale, culminating in his geometric demonstration that the state can always increase social welfare, even in competitive equilibrium, by taxing increasing-cost industries and subsidizing decreasing-cost industries. This was his major criticism of what he called "the doctrine of maximum satisfactions," or in our language, the first fundamental theorem of welfare economics. He and Wicksell were in fact the only nineteenth-century marginalists to reject the doctrine.

In several papers published in the early 1940s, and summed up in his *Revisions of Demand Theory*, Hicks (1956) showed that if the income effect of a price change is small, the consumers' surplus read off an ordi-

12. For a history of this story, see Currie, Murphy, and Schmitz 1971 and Blaug 1997b, 340–52, 367–73, 383–84, 397–98.

nary constant money-income demand curve does approximately measure, in case of an economic change, the gainers' willingness to pay to keep the change, as well as the losers' willingness to be compensated to accept the change.[13] This implies that, provided we can accurately estimate demand and supply curves, we can place upper and lower bounds on the income transfers that might allow the gainers of an economic change to bribe the losers, so that overall welfare is improved. But even so, within these bounds someone will have to make an ICU and, of course, the bounds themselves may invite controversy. In short, the Hicksian reconciliation of the old and new welfare economics, while a genuine step forward, does not entirely escape the morass of ICU.

A very different approach to the bugbear of ICU was advocated by Abram Bergson and applauded by Paul Samuelson, namely, to aggregate individuals' welfare by applying a set of weights to individual utility functions derived from a political process whose precise nature was never explained,[14] the point being that the choice of some such social welfare function is inescapable if welfare economics is to be anything other than an academic exercise (De V. Graaff 1957, 37–52). But since no one knows how to construct such a community welfare function, it remains an academic exercise. Another very different answer to Robbins, advocated by Amartya Sen (1993), is to replace the utilities that society is supposed to be maximizing by "capabilities," that is, functionings that people have reason to value, such as good medical care, good schooling, adequate shelter, and so on. This may not achieve a complete ordering in respect of social welfare, but only a partial and possibly fuzzy ordering, which must then be resolved by democratic debate.

However, even if we swallow the notion that a social welfare function can somehow be established, we are still left with the first fundamental theorem, whose validity depends on certain clearly stated circumstances, such as perfect competition, that are only approximately realized in the

13. See Willig 1976. For an excellent textbook presentation of this result, see Just, Hueth, and Schmitz 2004, chap. 6, 123–56.

14. Similarly, leading applied welfare economists like Just, Hueth, and Schmitz (2004, 8–10, 579) settle all difficulties on comparing the gains and losses of an economic change by referring to "the policy-maker" or "officials . . . elected or appointed for the purpose of making value judgments for society." Along the same lines, Buchanan and Tullock (1962) and Buchanan (1990) urge us to separate "the rules of the game," laid down in the "constitution" to be decided unanimously behind a Rawlsian "veil of ignorance," from the contentious issues of policy-making in the law courts and the halls of congress. This clarifies the problem of designing a workable social welfare function but does not solve it.

real world, if at all. The belief that the real world comes close to the ideal world enshrined in the first fundamental theorem has been labeled the "Chicago View" (Boadway and Bruce 1984, 84) and the "good approximation assumption," which Melvin Reder (1982) identified as a principal element in the "tight prior equilibrium theory" of Chicago economics. This view took a cruel blow from R. G. Lipsey and Kelvin Lancaster's (1996) essay "The General Theory of the Second Best," which said in so many words that there is no general theoretical presumption that third-best optima are better than second-best optima are better than first-best optima.[15] To make such welfare comparisons, each optimum must be studied on its own merits, and a massive amount of context-specific knowledge is needed to make such comparisons. The Chicago judgment that the real economy is close to the first-best optimum may be right or wrong (and is almost certainly wrong), but the issue is more complex than just fulfilling one of the currently unfulfilled optimum conditions somewhere in the economy.

Richard Just, David Hueth, and Andrew Schmitz (2004, 27–28), in their textbook defense of applied welfare economics, are in no doubt that the first fundamental theorem is "probably the single most powerful result in the theory of market economies and is widely used by economists who believe that markets are competitive and that governments should not intervene in economic activity. Milton Friedman and the 'Chicago School' are the best known defenders of this position. In addition, because of its efficiency properties, competitive equilibrium offers a useful standard for policy analysis." Similarly, Franklin Fisher (2003, 4) claims that the "central set of propositions that economists have to offer the outside world—propositions that are in a real sense, the foundations of Western capitalism—comprise the two welfare theories. These theorems elucidate the relations between general competitive equilibrium on the one hand and Pareto-efficiency on the other. They underlie all looser statements about the desirability of a free-market system. These propositions are also well understood and firmly grounded." Here is a perfect illustration of the difference between static efficiency and dynamic progress alluded to before; there is actually a world of difference between the ideal output enshrined in the first fundamental theorem and the real-world dynamic performance of a competitive economy. Adam Smith never made that leap

15. When two or more distortions exist—for example, a monopoly and an externality—then a correction for one of the distortions may actually drive the economy further away from the point of social optimality than if the distortions had been allowed to offset one another.

from one world to the other, but modern general equilibrium theorists do so without the slightest hesitation.

4. The Second Fundamental Theorem

Any doubts about the cogency of the first fundamental theorem are as nothing compared to the widely shared misgivings about the second fundamental theorem.[16] This theorem emerged out of a discussion of the principle of marginal cost pricing applied to public enterprises, a discussion that was sparked off by a classic paper published by Harold Hotelling (1938), which argued that the deficits of "natural monopolies" resulting from the application of marginal cost pricing must be financed out of what he called "lump-sum taxes," that is, taxes that do not affect the behavior of economic agents because they leave the pattern of posttax income the same as that for pretax income.[17] In other words, lump-sum transfers are a mode of redistribution that leave economic efficiency unaffected. He thought that taxes on land rent, inherited income, and even annual income all qualified as lump-sum taxes (for which he was immediately rebuked), but the idea of lump-sum taxes was soon picked up by transport economists. Nancy Ruggles (1949–50a; 1949–50b) provided a classic review of the early phases of this debate, which to some extent remains unresolved to this date (Blaug 1997b, 586–91).

Virtually all writers on welfare economics, and certainly all applied economists, dismiss the second theorem as being of limited practical relevance because a lump-sum tax is a personal liability that no action by the taxpayer can alter, while a lump-sum bounty is equivalent to an adjustment of initial endowments; thus a lump-sum transfer of income or wealth must be based on individuals' personal characteristics that are either directly observable by a fiscal authority or that individuals have an incentive truthfully to reveal to that authority, neither of which conditions is ever likely to be met (Myles 1995, 41–48; Atkinson and Stiglitz

16. In fact, Little (1957), alone among all the writers on welfare economics in the 1950s, rejected the second theorem without naming it, insisting on the necessity of adding a distributional judgment to any Pareto-optimal conclusion (he popularized the label "Pareto optimality"). Charles Rowley and Alan Peacock (1975) were the only ones to reject the first fundamental theorem in favor of a lexicographic preference for individual freedom over allocative efficiency.

17. It is significant that Hotelling was one of Arrow's most influential teachers (Arrow 1951, x), and Hotelling used the phrase "fundamental theorem" when he demonstrated the superiority of an income tax over an excise tax as a method of financing the deficits of decreasing-cost industries.

1980, lectures 11 and 12; Baumol and Wilson 2001, 1:xxxix–lx). Of course, unavoidable lump-sum taxes might be randomly levied on individuals, say, by taxing only individuals whose last names begin with a vowel, but such taxes would be politically unsupportable. "Much of public economics," says one author of a textbook on the subject, "takes as its starting point the rejection of the practical value of the Second Theorem" (Myles 1995, 19). Baumol (2002, 143) goes further and calls the second fundamental theorem a "fairy tale" that must be discarded. His knockdown argument is that lump-sum transfers are not only difficult but are actually impossible to implement, because they are always required to correct an objectionable distributional consequence of some inefficient pattern of resource allocation, thus necessarily furnishing both transfer payers and recipients with an incentive to alter their level of activities in direct violation of the definition of a lump-sum transfer. Baumol (2002, 143) quotes George Akerlof as saying that applied economists are well aware that, generally, lump-sum transfers are impossible, adding, "I certainly agree. More than that, even pure theorists must know this in their heart. But this does not stop them from using this mythical device in their formal writing to focus exclusively on allocative efficiency, assuming away the implications for distribution."

This brings us close to the core of the schizophrenic attitude of mainstream economists to the fundamental theorems. They are thought to be very important, and pages and pages in textbooks are devoted to teaching students how to prove them—after all, they are *fundamental* theorems—and yet at the same time, students are told that they do not actually apply to the real world. Consider, first, the enormous importance that some general equilibrium theorists attach to what Baumol calls a "fairy tale." "The Second Fundamental Theorem represents a significant defense of the market's resource allocation mechanism," Starr (1997, 151) tells us:

> It is the basis of the common prescription on public finance that any attainable distribution of welfare can be achieved using the market mechanism and lump-sum taxes (corresponding to the redistribution of endowments). On this basis, public authority intervention in the market through direct provision of services (housing, education, medical care, child care, etc.) is an unnecessary escape from market allocation mechanisms with their efficiency properties. Public authority redistribution of income should be sufficient to achieve the desired reallocation of welfare while retaining the market discipline for efficient resource allocation.

This is strong language for undergraduates, but graduate students are provided with hardly less rousing admonitions. As a case in point, we note the treatment of welfare economics in Mas-Colell, Whinston, and Green's graduate-level textbook on microeconomics. First, they work hard to suggest to readers that the existence of Walrasian general equilibrium is a significant economic question (Mas-Colell, Whinston, and Green 1995, 584–89), but in a footnote they concede that "finding a class of conditions that guarantee the existence of a Walrasian equilibrium does not say that this is the outcome that will occur whenever preferences, endowments and technology satisfy the assumptions of the existence theorems: the behavioural assumptions of price taking and the institutional assumptions of complete markets must also hold!" However, in a book of almost 1,000 pages, they never take time to indicate how economists might go about discovering whether the critical behavioral and institutional assumptions do pertain here and now.

Similarly, they put special emphasis on the two fundamental theorems of welfare economics, to which they devote a chapter even before they have demonstrated the existence of general equilibrium (311–49), adding that the second theorem "offers a strong conceptual affirmation of the use of competitive markets, even for dealing with distributional concerns" (556; see also 308, 327). Nevertheless, they candidly admit that to employ lump-sum income transfers, "the authority must know, at least, the joint distribution of preferences, endowments, and other relevant characteristics of the agents that actually exist in the economy." In addition, "it must have the ability to tell who is who by observing each individual's characteristics . . . perfectly. Such information is extremely unlikely to be available in practice; as a result, most common transfer schemes fail to be lump-sum schemes. . . . Because of these informational and enforceable limitations, it is in practice unlikely that extensive lump-sum taxation will be possible" (556–57). Despite all these qualifications, they conclude that "the second welfare theorem is a very useful reference point. . . . it serves a cautionary purpose" (557).

These are already insurmountable problems in a stagnant economy, but they are compounded in a growing economy. Any policy adopted for efficiency reasons with its undesirable distributional effect redressed through lump-sum taxes will typically cause people to alter those parts of their behavior that will determine their wealth and income in the future. To assume that if welfare problems have been solved in a static economy, they have also been solved in a growing economy is almost scandalous in its irrelevance.

How can something that is so patently impractical be a *useful* reference point? Well, actually, it cannot, and so there must be some other reason for both asserting mathematical theorems to be valid while simultaneously denying their practical import. I believe that it is a methodological fear that no one will separate equity from efficiency unless that separation is enshrined in mathematical theorems, mathematical theorems that the uninitiated cannot comprehend but that the initiated will be inclined to accept as a hallmark of their professional competence. The perfect exemplar of this gambit is the celebrated Arrow and Debreu (1954) proof of the existence of general equilibrium.

5. The Coase Theorem

The same consideration may well account for the reputation of the so-called Coase theorem, which virtually created the discipline of law and economics. As is well known, Ronald Coase himself declined to use the label "Coase theorem." It was an invention of George Stigler (Medema 1995, xvii). The Coase theorem is the proposition that in a world of zero transaction costs and no legal impediments to bargaining, the allocation of resources that results from competitive equilibrium is independent of the initial assignment of property rights; any inefficient assignment of assets will be eliminated by the voluntary exchange of property rights, so that assets will always be held by those who can use them most effectively, irrespective of their wealth (Medema 1995, xvii–xix; Medema and Zerba 2000). A moment's reflection will show that the Coase theorem is nothing but the first fundamental theorem of welfare economics in disguise—and if we add the implied but not always stated proviso that the bargaining agents who are exchanging property rights are in no sense credit constrained (Bowles 2004, 337), we reach the full scope of both the first and second fundamental theorems.

But just as welfare economists know that the fundamental theorems apply only to a world without externalities, without public goods, without missing markets including forward markets, and in which all returns to scale are nonincreasing, so Coaseans know that the Coase theorem is a truth confined to the logical fiction of a world without transaction costs (Regan 1972) and, indeed, in that world the Coase theorem is simply a tautology.[18]

18. As Dan Usher (1998, 9) put it in a withering critique: "The strictly correct version of the Coase theorem boils down to the proposition: if people can agree upon an efficient outcome, then there will be an efficient outcome."

6. Conclusion

This sort of intellectual schizophrenia would be excusable provided it were well understood that the irrelevance of the initial distribution of property rights to a final allocation of resources is, like the Pareto-optimal properties of competitive equilibrium, a truth about economic models and not a truth about the real world. But I doubt that is sufficiently underlined, because such underlining would destroy the ceremonial value of formal theorems in a subject like economics. Many economists know in their heart that the market is efficient, and know it as an unexamined ideological belief but do not want to admit to themselves that it is ideological. So they revel in mathematical theorems that satisfy their self-respect. In support of this view, note that it is conservatives who tend to accept the Chicago view and liberals and radicals who attack it. In other words, those that know in their heart that markets work accept the judgment that the theorems are close to reality, while those that distrust markets do not.

Thus, Richard Posner (1992, 13–16, 23), the leading light of the law and economics movement, collapses the two fundamental theorems, which he never mentions by name, into one grand "wealth maximization hypothesis," claiming that the common law strives to maximize the wealth of society. Without saying so, he assumes that agents are never credit constrained—as if there are no inequalities in the distribution of income or wealth. Of course, he grants that the attainment of wealth-maximizing efficiency depends on the distribution of wealth, meaning income, but this concession appears more as an aside than as a fundamental feature of the striving for social efficiency. Similarly, he grants that the Coase theorem is a tautology in a world of zero transaction costs but insists that it can be given empirical content if restated as the hypothesis that the initial assignment of property rights will not affect the ultimate use of property whenever transaction costs are minimal. He notes that "there have been efforts to test the hypothesis, with mixed results" (51), but this concession is no sooner granted than it is forgotten for the rest of the book.

Recall also the extravagant claims made by so many authors on behalf of the two fundamental theorems. As Baumol and Wilson (2001, 1:x–xi) remark:

> The two welfare theorems lead us to expect a tendency to Pareto optimality in a stationary snapshot of the economy's workings. . . . [But] in practice the market economies have little to brag about in terms of their static efficiency. . . . Clearly, no-one, other than a professional economist, is deeply impressed by the stationary performance of the

> capitalist economy, perhaps because of such phenomena as imperfect competition, pervasive externalities and all sorts of governmental and other interference in the workings of the market. It is the growth record, not the static efficiency of the industrial economies that make them the envy of other nations.

In short, it is the dynamic performance of capitalism that is its major achievement, and yet when we study welfare economics, it is always the static efficiency of the capitalist economy that is trumpeted aloud. Here as elsewhere, we are false to the spirit and even the letter of Adam Smith. To say that "it is all in Adam Smith" is clearly an exaggeration, but it is amazing how many of the most important ideas in economics are indeed found in the writings of Adam Smith.

The apparent sterility of modern welfare economics, of which earlier writers like Ian Little (1957) and Jan De V. Graaff (1957) complained, is noted with alarm by many mainstream economists. Their retort is to point to the endless political squabbling that attends most policy debates, arguing that if economists were to return to pre-Robbinsian days, there would be little to choose between a so-called "hard" science like economics and a "soft" science like political science or social psychology. But the fact is that there may well be little to choose between these subjects and ours. Ultimately, all policy debates turn into fuzzy comparisons between slightly incommensurate entities. What economics can contribute to policy matters is not finely etched precision in tightly stated logical propositions but a possibly superior understanding of what variables must be assessed in order to arrive at a conclusion, and possibly a somewhat better grasp of the magnitude of these variables.

I have room for only one example to illustrate my point. Virtually all economists are in favor of road pricing because they believe that the potential Pareto improvement created by reducing road congestion and saving travel time greatly outweigh the costs of installing the necessary hardware, including the enforcement costs of policing whatever system is installed. There will be many gainers but there will also be many losers, namely all those living in areas and cities poorly served by public transport as well as those too poor to pay for the charge. Here once again we have the classic difficulty of separating efficiency from equity. What do economists in fact bring to such an argument? First of all, a considerable familiarity with the facts regarding the use of public and private vehicles. Secondly, a considerable familiarity with the facts regarding family income and transport expenditure patterns, including the posses-

sion of private cars, allowing for accurate estimates of the price elasticity of demand for more or less fuel-efficient vehicles, not to mention the price elasticity of demand for gasoline. Thirdly, considerable experience with survey evidence in large-scale social experiments comparing families and individuals with unequal access to transport to gauge the effect of, say, a miles-traveled tax rather than a fuel-based tax, possibly varying across people with different risks of causing accidents. None of this will provide neat answers to the revolutionary introduction of road pricing. All it will do is to add one more highly informed voice to the squabble and that, I say, is what modern welfare economics is about and ought to be about, rather than teaching and learning a set of mathematically expressed fundamental theorems.

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