

General Equilibrium Theory and Welfare Economics: Theory vs. Praxis

The development of economic thought after World War II has been nothing short of protean in character, yet it can be traced, at least in part, by following a number of lines resulting from attempts to flesh-out, resolve, or simply come to terms with general equilibrium theory. As you might recall from subunit 4.1.2, general equilibrium theory came about in the latter half of the 19th century explicitly in the form of Leon Walras's 1874 work, *Elements of Pure Economics*, and subsequently with the addition of graphical representation in his 1892 paper "Geometrical Theory of the Determination of Prices":

It follows from the nature of the [supply and demand] curves, that we shall obtain the provisional current price of (B) by raising it in case of a surplus of effective demand over effective supply, and lowering it, on the contrary, in case of a surplus of effective supply over effective demand. Passing then to the determination of the current price of (C), then to the current price of (D) ..., we obtain them by the same means. It is quite true that, in determining the price of (C), we may destroy the equilibrium in respect to (B); that, in determining the price of (D), we may destroy the equilibrium in respect to (B), and in respect to (C), and so on. But as the determinations of the prices of (C), (D) ... in respect to the demand and supply of (B), will result in a contrary way, we shall always be nearer the equilibrium at the second trial than at the first. We enter here on the theory of trial and error, such as I have developed in my work, and by virtue of which we arrive at the equilibrium of a market by raising the price of commodities, the demand for which is greater than the supply, and by lowering the price of those, the supply of which is greater than the demand.

It is due to the concurrent employment of analytic expression and geometric representation that we have here, in the case of the exchange of several commodities among themselves, not only the idea but the picture of the phenomenon of the determination of prices upon the market. And with this, it seems to me, we possess at last the theory (1892, 52–53).

Walras first formulated the state of an economic system at any point of time as the solution of a system of simultaneous equations representing the demand for goods by consumers, the supply of goods by producers, exchange, production, capital formation, and money. He specified the interrelations between these phenomena, studied their disequilibrium behavior, and described their conditions of equilibrium. The theory analyzes the mechanism by which the choices of economic agents are coordinated across all markets, with general equilibrium theory distinguished from partial equilibrium theory in the attempt to look at several markets simultaneously rather than a single market in isolation. Nonetheless, the general theory retains the perspective of an individual with each consumer acting to maximize his or her utility and each producer acting to maximize his or her profit while conditions of perfect

competition prevail – equilibrium being a unique and stable end-state of a competitive process.

Walras did not provide any conclusive arguments to show that his equations might have a solution, and the subject of equilibrium – or constrained optimization as the allocation of scarce resources among competing ends – became central to the work of successors to Walras, such as Pareto and Cassel. Pareto endorsed Walras's approach of attempting to incorporate empirical observations of the real economy into theoretical representations in the form of mathematical equations. Both Walras and Pareto understood demand as a function of utility; however, unlike Walras, Pareto thought that it was impossible to accurately represent utility through the assignation of cardinal numbers (1, 2, 3, 4, etc.), so he substituted an ordinal ranking (first, second, third, fourth, etc.), meaning that although it might be impossible to determine how much utility an individual secures from a particular commodity, it is possible to determine if a person prefers one commodity, or one batch of commodities, over another. Unlike Walras, Pareto also held that the utilities of different commodities were not independent, with some commodities functioning as substitutes or complements for each other, or the consumption of a commodity affecting the utility of another commodity in some fashion.

As Pareto elaborated upon Walras's employment of utility in general equilibrium theory according to what he saw as empirically valid observations, Cassel developed a theory according to a more formalized, analytical approach and argued against the incorporation of utility altogether. For Cassel, demand was not a function of utility but of price, thus abandoning the emphasis placed by Walras and Pareto on marginal utility. Cassel also argued that factors of production were indivisible and adopted the assumption of fixed coefficients of production, which was incompatible with the theory of marginal productivity employed by Walras and Pareto. In general, where Walras and Pareto first analyzed prices as outcomes of market processes before attempting to incorporate or represent these observations in equations, Cassel did not consider the behavior of producers and consumers as formative of prices. Walras and Pareto started from observed disequilibrium and through a process of adjustments approached general equilibrium, while Cassel's very formal models were always in equilibrium from the start.

Cassel's models were published in German, which meant that they were more widely read than Walras and Pareto, and his more formalized approach to general equilibrium theory was dominant in his 1918 work *The Theory of Social Economy*. During the interwar period, questions of the existence (meaning in mathematical terms: *for a, b, and c, there is one solution where...*) and uniqueness (*for a, b, and c, there is one and only one solution where...*) of general equilibrium that had been assumed by Cassel were at the forefront of concerns among theorists coming from a variety of backgrounds – not only mathematics and economics but statistics, the physical sciences, and philosophy. Operating under the name of the Vienna Colloquium, Frederik Zeuthen, Hans Neisser, and Heinrich von Stackelberg found problems with Cassel's equations derived from Walras's work, with Karl Schlesinger, Abraham Wald, and John von Neumann also working on various aspects associated with the existence, stability, and

uniqueness of general equilibrium. Running concurrently and crossing over with the Colloquium was the Vienna Circle – an association of philosophers, mathematicians, and scientists led by Moritz Schlick – which included Gustav Bergmann, Rudolph Carnap, Hans Hahn, Otto Neurath, Olga Hahn-Neurath, Victor Kraft, Philipp Frank, Karl Menger, and A.J. Ayer.

The Colloquium was substantially influenced by the Circle's commitment to *logical empiricism* or *logical positivism*, where it was held that:

- there is knowledge only from experience, and
- this empiricist, scientific worldview is marked by the application of logical analysis, meaning an extensive use of symbolic logic.

In short, for the logical positivists, the task of philosophy was to provide clarification of language through the method of logical analysis of problems and assertions. Known as the *linguistic turn*, meaning a turning away from many of the traditional problems of philosophy and in particular metaphysics, for the most part the self-perceived purpose of the positivists was to dispel that which is meaningless or nonsense and to make warranted and useful distinctions through an assiduous analysis of the use of language in any context. The Circle considered both logic and mathematics to be analytic as opposed to synthetic in nature, meaning statements of logic and mathematical statements did not express factual truths about the external world like the synthetic statements of science; rather, these statements expressed formal truths that were internally coherent. Without any empirical content, analytical statements were only concerned with ways of representing the world, and philosophical analysis was concerned with the articulation of implications resulting from relations between statements (Uebel 2011). Arithmetic was considered a part of logic, and its truth was held to be exhausted by what is provable from the premises and rules of a formal symbolic system. Appeals to rational intuition as a mental substrata of sorts separate from the external world – not to mention appeals to any other metaphysical construct – as justification for the validity of knowledge claims was considered meaningless, and the contribution of pure reason to human knowledge in the form of logic and mathematics was thought to be easily integrated into the service of an empirical worldview. In the words of Carnap, “Philosophy is to be replaced by the language of science – that is to say, by the logical analysis of the concepts and sentences of the sciences, for the logic of science is nothing other than the logical syntax of the language of science” (1937, p. xiii).

Logical positivism took many different twists and turns over the years, as did developments internal to the Colloquium. The positivist framework fit well with the general trajectory of economics in emphasizing the authoritative use of empirical observations of existing economic phenomena to inform abstract, formal representations meant to disclose the principles and laws governing the structure of economies in general. Those principles and laws, and the knowledge gained of how

economies hold together under idealized conditions, would in turn be informative to understanding and perhaps addressing existing economic fluctuations or problems.

One significant outcome or development within the Circle, particularly for the Colloquium, was Carnap's *The Logical Syntax of Language*, written in German in 1934 and published in English in 1937. Carnap's notion accommodated Gödel's incompleteness theorems of 1931 by separating the measure of analyticity – or the given degree of internal coherence of logical or mathematical statements – from effective provability and by postulating that arithmetic consisted of an infinite series of increasingly ornate arithmetical languages. As stated in Uebel's article, “Gödel proved that every formal system strong enough to represent number theory contains a formula that is true but neither itself or its negation is provable in that system; such formulae—known since as Gödel sentences—are provable in a still stronger system which, however, also contains a formula of its own that is true but not provable in it (and neither is its negation). Commonly, Gödel's proof is taken to have undermined the thesis of the analyticity of arithmetic” (2011). Based on Gödel's proof, the boundary of the analyticity of arithmetic was not airtight, and for the Colloquium's work on general equilibrium theory, Carnap's invocation of ever richer arithmetical languages was problematic and would prove to be prophetic at least with regard to general equilibrium theory. Consider this passage from a 1935 letter by Karl Menger regarding Abraham Wald's work on the equilibrium equations of Walras and Cassel:

In any event I wish to remark in conclusion that with Wald's work we bring to a close the period in which economists simply formulated equations, without concern for the existence or uniqueness of their solutions, or at best, made sure that the number of equations and unknowns be equal (something that is neither necessary nor sufficient for solvability and uniqueness). In the future as the economists formulate equations and concern themselves with their solution (as the physicists have long done) they will have to deal explicitly with the deep mathematical questions of existence and uniqueness. (Weintraub 1983, p. 9)

Although Wald had not managed to put the existence and uniqueness of general equilibrium conclusively to rest, what he and others of the Colloquium had ensured was that these issues would remain central to work in economic theory and would not be readily dismissed as ineffectual abstractions. However, for the time being, the German invasion of Austria meant the end of the Vienna Colloquium and of the Circle, with many of the participants fleeing to the United Kingdom or the United States and thus upsetting the general vitality and varied trajectories of work done up to that point.

From another angle and running concurrently to developments associated with the Vienna Colloquium, partly out of the academic concerns prompted by both utilitarian and Marxist strands of economic thought among others and partly as a result of historical and political factors associated with the industrial age leading up to the Great Depression and after, the concern with equilibrium between demand and supply

functions was accompanied by a focus on welfare outcomes of equilibrium allocations with regard to issues associated with inequality, poverty, political stability, and justice. For instance, a figure no less even than the University of Chicago's Frank Knight – one of the considered founders of the Chicago School of economic thought – considered in 1923 that a number of charges are to be made against claims that a competitive economic system is both efficient and just:

1. an economic system molds the tastes of its members, so the system cannot be defended on the ground that it satisfies demands efficiently;
2. the economic system is not perfectly efficient: there are indivisibilities, imperfect knowledge, monopoly, and externalities;
3. the paramount defect of the competitive system is that it distributes income largely on the basis of inheritance and luck (with some minor influence of effort), and the inequality of income increases cumulatively under competition; and
4. viewed as a game, competition is poorly fashioned to meet acceptable standards of fairness, such as giving everyone an even start and allowing a diversity of types of rivalries. (Knight 1923, 579–587)

In the 1930s, Abba Lerner and Oskar Lange among others demonstrated what became known as the two fundamental theorems of welfare economics: "that every competitive equilibrium is Pareto-optimal (or efficient), such that no one can be made better off without making someone else worse off, and that any Pareto-optimal allocation can be achieved as a competitive equilibrium with some redistribution of the agents' initial endowments" (Rizvi 2003). The first theorem provides analytical confirmation that competitive markets under perfect conditions provide for an efficient allocation of resources. However, recall from Professor Ian Shapiro's lecture 6 in subunit 3.3 that Pareto efficient outcomes are not necessarily desirable outcomes; they merely indicate that no one can be made better off without someone being made worse off. The second theorem states that out of all possible Pareto-efficient outcomes, any particular outcome can be achieved by a redistribution of many possible degrees of initial holdings. The second theorem lends analytical support to the notion that intervention/redistribution has a legitimate place in public policy: redistributions allow selection from all efficient outcomes for one that has other desired features, whatever those may be. For instance, Lange, Lerner, and others used these results to construct models for market-based socialism – a form of planned economy where a central planning board allocates investment and capital goods with markets reserved for labor and consumer goods.

Traditional welfare economics was developed by utilitarian economists such as Marshall and Pigou, taking inspiration from their predecessor Jeremy Bentham. As seen in subunit 3.3, Bentham had pioneered the use of utilitarian calculus to obtain judgments about the social interest by aggregating the personal interests of different individuals in the form of their respective utilities. Bentham's concern and that of utilitarianism in general was with the total utility of a community irrespective of the distribution of that total. For example, a person who is unlucky enough to have a uniformly lower capability to generate utility out of income because of a disability would also be given, in a

utilitarian ideal world, a lower share of a given total amount of resources; this is a consequence of the single-minded pursuit of maximizing the sum-total of utilities. The utilitarian interest in taking comparative note of the gains and losses of different people was itself a significant development during its time and would later become central to welfare economics in mathematically representing a class of information in the form of comparisons of utility gains and losses of different persons under different Pareto outcomes. Nonetheless, by the 1930's, under the influence of logical positivism as described above, utilitarian welfare economics was substantially criticized if not undermined by the argument that interpersonal comparisons of utility had no scientific basis. Minds or cognitive mental states and hence the capacity to measure utility were understood as inscrutable to every other mind; therefore, the calculus used in utilitarian welfare economics was considered by many to be academically bereft of significance.

Regardless of the difficulties with general equilibrium theory as a whole and welfare economics in particular, mathematical microeconomics resumed after the end of the war in the US and the UK, primarily at Harvard, Chicago, and the London School of Economics, and was most closely associated with Paul Samuelson as well as Oskar Lange, Harold Hotelling, John Hicks, Maurice Allais, and Abba Lerner (Rizvi 2003). Faced with the positivist informational restriction on mental states, welfare economics in the late 1940's became, somewhat ironically, *new welfare economics*, which used only one basic criterion of social improvement called the *Pareto comparison*. This criterion asserts that an alternative situation to one already Pareto efficient would only be better if the change would increase the utility of everyone involved, or benefit some while leaving others unaffected. For example, starting with a situation of two agents, Bob has eight units of resources and Mark has four. Under the criterion, an alternative situation would not be better if Bob had seven units and Mark had five, or if Bob had nine units and Mark had three. The situation would be decidedly worse if Bob had five units and Mark had five units, even though the inequality between them would be eliminated. A situation would be better if Bob had nine units and Mark had five, or if Bob had 20 units and Mark had five, regardless of a marked increase in inequality in the latter case. With this shift in focus, much of subsequent welfare economics restricted attention to Pareto efficiency only, meaning focus was placed on making sure that there were no further adjustments to be made whereby everyone could become better off or some could become better off with the rest staying the same. The criterion takes no interest whatsoever in distributional issues – meaning comparisons of outcomes that have different distributions but the same amount of total utility within a given jurisdiction (or state). To be able to adjudicate as to which distributional outcome might be more worthy as a choice would involve knowing the preferences of those involved and adjudicating the conflicts of interest that come with interpersonal comparisons. It could be discussed, for instance, whether the same person would have more utility in one jurisdiction compared to another, but the comparison could not be made between the utility of one person with that of another in the same jurisdiction.

Following up on the concept of a social welfare function introduced by Abram Bergson in 1938, Samuelson's post-war work included the Bergson/Samuelson social welfare

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function, which although still problematic along positivist grounds, provided a framework for ranking different social states on the basis of a configuration or profile of individual preferences. However, a further criterion was needed for making social welfare judgments, if any were to be made, and this demand along with the outlying issues surrounding general equilibrium in general led directly to Kenneth Arrow's formulation of social choice theory based upon a social welfare function defined as a statement of a society's objectives in which the level of social welfare or well-being is represented as a function of the way in which resources are allocated. In 1950, Arrow framed the issue as such:

In a capitalist democracy there are essentially two methods by which social choices can be made: voting, typically used to make "political" decisions, and the market mechanism, typically used to make "economic" decisions. In the emerging democracies with mixed economic systems, Great Britain, France, and Scandinavia, the same two modes of making social choices prevail, though more scope is given to the method of voting and to decisions based directly or indirectly on it and less to the rule of the price mechanism. Elsewhere in the world, and even in smaller social units within the democracies, the social decisions are sometimes made by single individuals or small groups and sometimes (more and more rarely in this modern world) by a widely encompassing set of traditional rules for making the social choice in any given situation, e.g., a religious code.

The last two methods of social choice, dictatorship and convention, have in their formal structure a certain definiteness absent from voting or the market mechanism. In an ideal dictatorship, there is but one will involved in choice; in an ideal society ruled by convention, there is but the divine will or perhaps, by assumption, a common will of all individuals concerning social decisions, so that in either case no conflict of individual wills is involved. The methods of voting and of the market, on the other hand, are methods of amalgamating the tastes of many individuals in the making of social choices. The methods of dictatorship and convention are, or can be, rational in the sense that any individual can be rational in his choice. Can such consistency be attributed to collective modes of choice, where the wills of many people are involved? (1950, p. 328)

Consider that competition as a concept is commensurate with:

- a preference for liberty of contract/exchange and the associated ideal of competition free of government intervention, and
- the preference for eliminating gross inequalities and the associated ideal of competition free of private and consolidated economic power.

Both a regime where liberty of contract and exchange predominates and a regime committed to recognizing the impact of economic power in transactions produce

predictable patterns of wealth distribution. It could be said that competition is something of a paradox: it is commensurate with an unmitigated commitment to individual liberty that is antithetical to equality, and it is commensurate with a strong commitment to equality which is consistent with varying degrees of commitment to individual liberty. What economists have generally settled upon, at least implicitly, is that other values which might overcome the presumptive identification of competition with efficiency are too indeterminate or weak in some respect, or fall outside the scope of economics. Arrow analyzed the process by which a social welfare function might be formulated, arguing that a social welfare function is only a valid concept if it is derived from the preferences of the individuals composing the society. The Bergson-Samuelson function is usually described as constructing a social utility function corresponding to a particular configuration or profile of individual preferences – an approximation of what people's utility might be. The Arrow function, on the other hand, is to devise a rule that associates a social preference ordering with every logically possible profile of individual orderings, although interpersonal comparisons are excluded (Pollak 1979). Arrow's analysis, provided in the seminal 1951 work *Social Choice and Individual Values*, rests on the view that a social welfare function is equivalent to a decision rule or constitution. He then considers whether a rule may be formulated which fulfills certain reasonable criteria. These criteria are:

1. Pareto efficiency: If every individual in society prefers situation A to situation B, then A is ranked above B by the social welfare function.
2. Non-dictatorship: There is no individual whose preferences automatically overrule everyone else's preferences.
3. Independence of irrelevant alternatives: The social choice made from a group of alternatives depends only on individuals' preferences between those alternatives. If individuals are choosing between A, B, and C, all that matters are the preferences of those individuals concerning A, B, and C; their attitude to situations O and E are irrelevant.
4. Unrestricted domain: the social welfare function will indicate a choice between alternatives on the basis of any given pattern of individual preferences concerning the alternatives available (1951).

In his Impossibility Theorem, Arrow demonstrates under very mild conditions that social or group decisions as to what the individual members of a society want cannot be simultaneously satisfied by any social choice procedure that could be described as rational and democratic (1951). As such, neoclassical economics could not presume to say much about the overall ranking of allocations except in terms of the partial ordering implied by the first welfare theorem and its emphasis on Pareto efficiency. The usefulness of the second welfare theorem was also limited: asserting that any competitive equilibrium could be obtained with a suitable configuration of endowments, Arrow was unable to develop coherent comparative statistics by which changes in endowments could relate to changes in equilibria, and as such, the assertion could arguably never approach practical implementation (Rizvi 2003, 380). Subsequent work focused on elucidating Arrow's conditions and considering whether they are reasonable.

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However, the force and widespread presence of impossibility results generated a consolidated sense of pessimism, and this became a dominant theme in welfare economics and social choice theory in general. Relaxation of some of the conditions renders a social welfare function of this type possible, and as we will come to see, economists continue to differ in their views of the significance of Arrow's results.

For the time being, let us return to general equilibrium theory proper. Although the single method of constrained optimization proved practically useful and popular in many different contexts, the underlying theory of general equilibrium remained circumspect post WWII for a variety of reasons. Finding the equilibrium solution of a model has always been the aim of economic theory, where equilibrium is the end-state of a process thought of as competition. Recall Walras in stating that we shall always be nearer the equilibrium at the second trial than at the first, and by virtue of trial and error, we arrive at equilibrium. However, economic analysis could emphasize the nature of the end-state, or the nature of the competitive process that may converge on a possibly real or possibly hypothetical end-state. From that latter viewpoint and from a macroeconomic perspective, consider that WWII provided a favorable context for a practical Keynesian approach to economic thinking. Keynes had diagnosed the Great Depression of the 1930s as a failure of aggregate demand. The war supplied an impetus to aggregate demand that finally ended the Great Depression and led governments to accept the legitimacy of deliberate interventions to direct an economy. Also, consider that postwar practical policy concerns required good information on the state of the economy and the design of systematic national accounts. The collection of macroeconomic data accelerated rapidly after the war in most developed countries, which not only supplied the necessary material for practical policy making but also accentuated scientific research in macroeconomics. Still, regardless of these worldly influences and practical concerns if not demands, the notion in academia remained that any macroeconomic framework had to rely upon a microeconomic foundation, which in turn could only be understood and explained by coming to terms with general equilibrium theory. In short, the emphasis of economic analysis was not to be on the competitive process that could lead to general equilibrium, but on the nature of the end-state of equilibrium itself.

Arrow's Impossibility Theorem substantially affected neoclassical economic theory in general and the emphasis on the end-state of general equilibrium. Much of the work in neoclassical economics and social science dealt with and continues to deal with aggregates such as countries, societies, groups, and institutions. Arrow's theorem dismissed the notion that statements employing these aggregates could have solid microeconomic foundations in individual optimization; he was able to prove mathematically that there is no method for constructing social preferences from arbitrary individual preferences. While Arrow's existence proofs demonstrated that general equilibrium equations had some solution, they did not show that there was just one equilibrium (uniqueness); that an economy in disequilibrium would necessarily converge to equilibrium (stability); and that the precise characteristics of equilibrium could be

found once the data of preferences, endowments, and technology had been given (computability). Rizvi states,

Other important concerns were not addressed but had to be if general equilibrium theory were to be a progressive research program. One was the issue of comparative statics, which answered the question: If an aspect of the data of the problem (preferences, endowments, or technology) changed in some direction, how would the equilibrium change and could we expect this change to be uniformly in a particular direction? Other questions were: Could existence of equilibrium be proved for imperfectly competitive economies? Could the general equilibrium project help to identify econometric equations? Could general equilibrium theory underpin the theories of money and of macroeconomics more generally? (2003, 382)

Rizvi notes that in attempts to answer these questions, the result was a theory that became increasingly abstruse and rarefied, such that the average practitioner increasingly became disenchanted with and unable to understand or use general equilibrium theory. It could be said that Carnap's infinite series of mathematical languages mentioned above had come to fruition but with a bitter taste.

With the intent to supply much-needed clarity and progress in general equilibrium theory, Arrow and F.H. Hahn wrote the 1971 textbook *General Competitive Analysis*. Here, they restated and summarized the main results of the general equilibrium efforts of the 1950s and 1960s and formulated a series of research questions that would have to be answered for the theory to make progress. The problems again were uniqueness, stability, comparative statics, econometric identification, imperfectly competitive general equilibrium, and the microfoundations of macroeconomics. By the 1970s, microeconomic theory had become central to all aspects of economics, meaning that for a theory to be well-founded, it had to have a microeconomic foundation based in formal truth. This premise, which arguably amounts to nothing more than a supposition, was in some ways a reversal in priority and order of the original postulates of logical positivism that:

- there is knowledge only from experience, and
- this empiricist, scientific worldview is marked by the application of logical (and mathematical) analysis.

Economic theory had come to employ a particular methodological outlook where theory was understood to correspond with truth and was prior to the dissembling world of praxis. If problems were to be solved, it was through isolation, analysis, and abstraction from phenomena, where a full-fledged ideal theory would come closest to an approximation of concrete cases. Deductive reasoning was paramount to inductive reasoning, and theoretical development proceeded with a particularly abstract construction of the individual and a rarefied notion of human behavior. Rizvi writes,

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"Since all of the formal theory of economics was evidently at the microeconomic level, and formalist general equilibrium theory was microeconomics *par excellence*, no sub-field of economics could be said to have an adequate foundation without becoming, as it were, an applied field of general equilibrium theory" (2003, 384).

Many neoclassical ways of thinking such as partial equilibrium arguments, textbook presentations, and much of macroeconomic practice persisted and still persist regardless of whether they explicitly or implicitly make reference to an underlying general equilibrium model. In terms of theoretical developments, game theory gained momentum in the 1980s, and rational-choice game theory reached beyond pure theory transforming many fields, including industrial organization and international economics. Unfortunately, rational-choice game theory carried with it key foundational problems surrounding the very concept of rationality in a game-theoretic setting. The primary difficulty is that its common solution concepts, meaning prescriptions as to how to play a game, are burdened with extremely implausible common-knowledge assumptions (Rizvi 2003, 386). Common knowledge means that each player knows that each player knows that each player knows (and so on) each player's rationality and structure of the game. Rizvi writes, "With such an immense structure of knowledge being assumed, the idea of strategizing, which involves guesswork in the face of a lack of knowledge, is nearly rendered incoherent" (2003, 386).

Partly because of its problems with rationality and partly because of incompatible experimental evidence, rational-choice game theory was confronted with evolutionary game theory, as well as developments in social choice theory. In the context of game theory, some economists wondered if some players were simply not maximizers. Evolutionary-type reasoning is amenable in principle to a multiplicity of player types, such as own-gain maximizers and those preferring equality. Agents are rule following rather than maximizing and display a bounded rationality, meaning what may be considered rational might not be overriding or is operationally limited by either complexity of calculation or lack of full information. In contrast with boundedly rational agents, evolutionary players need not even be rational: the population of agent types evolves as more successful types replace less successful ones, with equilibrium represented in the stability of population compositions.

Evolutionary game theory exemplifies how far contemporary neoclassical economics has come from a time when rationally maximizing behavior on the part of individuals was thought to be necessary for a coherent economic model. For instance, Amartya Sen, a pioneer and advocate of social choice theory, has attacked the notion of the abstract individual subject displaying a rarefied form of social behavior integral to the history of economic theory as too simplistic. A person is given one preference ordering, and this is supposed to reflect that person's interests, represent his or her welfare, summarize his or her idea of what should be done, and describe his or her actual choices and behavior. Sen writes, "A person thus described may be 'rational' in the limited sense of revealing no inconsistencies in his choice behavior, but if he has no use

for these distinctions between quite different concepts, he must be a bit of a fool. The purely economic man is indeed close to being a social moron" (1977, 336).

Earlier, it was said that Arrow attempted to devise a rule that associates a social preference ordering with every logically possible profile of individual orderings, although interpersonal comparisons were excluded and no such rule could be formulated. It was also said that with relaxation of some of the conditions a social welfare function is possible, and economists differ in their views of the significance of Arrow's results. For instance, Sen is much more optimistic than Rizvi, and his point of relaxation of Arrow's criteria is the long-standing exclusion of interpersonal comparisons.

Sen sympathetically addresses Arrow's framework from a number of angles. To begin, Arrow's theory assumes that "it is intuitive that the preferences of individuals in a society can be expressed formally and then aggregated into an expression of social preferences – a social choice function. Arrow's paradox or impossibility result is that individual preferences having certain well-behaved formalizations cannot be aggregated into a similarly well-behaved social choice function that satisfies Arrow's four conditions" (Audi 1995). Consider a simple example where we want to find the social preference for three candidates, X, Y, and Z. One possible method for determining the social preference is by majority voting on choices between each pair of candidates. A set of preferences are said to be rational or transitive if it is the case when X is preferred to Y and Y is preferred to Z, then X is preferred to Z. Suppose a population is evenly divided between three groups, A, B, and C and that the rankings of the three candidates for each of the groups would come out as follows. For Group A, people vote for X as their number one choice, Y as their number two choice, and Z as their number three choice. For Group B, people vote for X as their number two choice, Y as their number three choice, and Z as their number one choice. For Group C, people vote for X as their number three choice, Y as their number one choice, and Z as their number two choice. Now, consider how the vote would go among the three possible pairs of candidates. In a vote between two candidates, it is assumed that people vote for the candidate that ranks highest among their preferences, even though their number one choice may be different from the two being considered. In a choice between X and Y, the A group would vote for X, the B group would also vote for X, and the Z group would vote for Y. So, X would win over Y. In a choice between candidates Y and Z, the A group would vote for Y, the B group would vote for Z, and the C group would vote for Y. So, Y would win over Z. Lastly, in a choice between X and Z, the A group would vote for X, the B group would vote for Z, and the C group would vote for Z. So, Z would win over X. The result is irrational in that X is preferred to Y and Y is preferred to Z, but Z is preferred to X.

For Sen's purposes and interests, the manner in which Arrow treats the formal expression of the preferences of individuals in a society is problematic. He argues that Arrow's voting-based procedures are entirely natural for some kinds of social choice problems, such as elections, referendums, or committee decisions, but they are unsuitable for many other problems associated with social choice (Sen 1970). The

information obtained through voting does not convey the amount and kind of information that is useful in making accurate determinations over matters such as the distribution of public goods and burdens across a given society. Consider the commonly used example of choosing between different distributions of a chocolate cake between four people. Under Arrow's framework, no comparison could be made between the utility that each person would secure from various portions of the cake. In deciding how much of the cake to take, each individual is aware that there are three other individuals, but the situation and preferences of those individuals is entirely unknown, like whether one person happens to be allergic to chocolate, while another person has not eaten in days and has no source of income. Interpersonal comparisons of the well-being and relative advantages among individuals affect how one person would reason when in the presence of others as opposed to reasoning in isolation. This difference in reasoning has substantial effects on individual preferences and in turn social choice outcomes. Arrow ruled out the use of interpersonal comparisons in following the general consensus that had emerged from the Vienna Colloquium, and after that, interpersonal comparisons of utilities had no meaning. Sen argues that the totality of the axiom combination used by Arrow had the effect of confining social choice procedures to rules that are essentially of the voting type, and the impossibility theorem is a result of those rules (Sen 1970).

To reject the historical consensus against the use of interpersonal comparisons means asking if it is possible to represent those comparisons involving many persons mathematically and whether such representations would be of practical use. According to Sen, interpersonal comparisons of various types can be represented in axioms and incorporated in social choice procedures in a generalized framework, formally constructed as a social welfare function (Sen 1970). But what is telling in his approach is a flexibility not found in the approach to economic theory as explained up to this point: interpersonal comparisons for Sen need not be confined to all-or-none dichotomies. Interpersonal comparisons can be made to some extent, but not in every comparison or with a constant and high degree of exactness (Sen 1970). There is room for partial comparability, denying the extreme position of having full comparability or none at all. Where the use or non-use of comparability does result in disclosure of incommensurability between preferences, Sen sees this as beneficial in fostering public reason and compromise in approaching what can be settled upon as the best available outcome, which would include the questioning of the normative standing of preferences. This flexibility departs considerably from the drive for certainty so dominant in formal microeconomic theory. Sen also makes the empirical point that there may be no general need for terribly refined interpersonal comparisons for arriving at definite social decisions. Limited levels of partial comparability can be adequate for making social decisions, making the project of practically employing interpersonal comparisons less daunting.

Sen's deeper point of attack is directed at the identification of interpersonal comparisons of personal welfare (or, in less utilitarian terms, individual advantage) with comparisons of mental states. A case can be made for taking incomes, or commodity bundles, or

resources more generally, to be of direct interest in judging a person's comparative advantage, as opposed to the feelings or *units of utility* that these things might help to generate. This kind of approach can be elaborated further by taking note not only of the ownership of primary goods and resources, but also of interpersonal differences in the capacity to convert resources into living in a manner a person has reason to value. This capability approach focuses on the substantive freedoms that people have, rather than on the particular outcomes with which they end up, meaning freedom and choices are considered to be and are counted as parts of actual lives. To give an example, a person's life is affected if she is forced to stay at home rather than choosing to stay at home when she has other alternatives. That capability to move, or freedom of movement, under the capability approach is counted as much as any units of utility she might be said to gain from any particular basket of commodities. The same collection of primary goods and resources may coincide with very different overall social pictures and with different societal arrangements, opportunities, and freedoms. Traditional welfare economics does not countenance or measure these non-utility bearing features, so the same utility numbers would apply regardless of serious barriers to very basic human freedoms of both the positive variety (freedom to accessible education, for instance) and the negative variety (freedom from interference by others, including the state). The singular focus on utility and the lack of interpersonal comparison presents a barrier to the inclusion of information that would allow for reasoned judgments about what kind of social arrangement would at the least be an improvement over the status quo. That information might not be authoritative – in fact, it is impossible that it would be – but it is information nonetheless. Along these lines, applied welfare economics has attempted to make sensible interpersonal comparisons of well-being using a number of different tactics. Some have been based on studying expenditure patterns, and using this measure to assess comparative well-being of different persons. Other approaches have combined this with further informational inputs such as indicators with regard to freedom of movement, property rights, and gender-based restrictions. Other works have focused on establishing quantifiable quality of life indicators to draw conclusions on comparative living standards of varying geographic scope. A wide literature on basic needs and capabilities to use primary resources has provided an empirical approach to understanding comparative deprivations. For instance, since 1990, at the United Nations Development Programme (UNDP), systematic use of a particular type of informational broadening to make comparisons based on observed features of living conditions is reported annually in the UNDP Human Development Report.

What is somewhat ironic is that although none of these approaches is methodologically airtight given the nature of interpersonal comparisons, there is little doubt about the interest in the empirical information garnered from these works for analytic economic theory. The employment of partial interpersonal comparisons has substantially broadened understanding of individual advantages and their empirical correlates. Despite the varied degree of empirical approaches and their flaws, the overall practical, empirical results support informational widening with regard to the analytical framework surrounding social choice theory, and the analytical systems of welfare economics and social choice theory today are broader and more flexible than those of Arrow. They are

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also analytically general enough to allow different empirical interpretations and to permit alternative informational bases for social choice. The diverse empirical methodologies can be seen to be represented in this broader analytical perspective, turning the original order of the postulates presented by the logical positivists of the Vienna Circle back to their arguably appropriate priority and sequence. The movements in formal theory have been in this sense closely linked to the advances in practical economics, which gives Sen and potentially many others cause for optimism.

Summary

- General equilibrium theory first came about in 1874 when Leon Walras formulated the state of an economic system at any point of time as the solution of a system of simultaneous equations representing the demand for goods by consumers, the supply of goods by producers, exchange, production, capital formation, and money. He specified the interrelations between these phenomena, studied their disequilibrium behavior, and described their conditions of equilibrium. The theory analyzes the mechanism by which the choices of economic agents are coordinated across all markets, with general equilibrium theory distinguished from partial equilibrium theory in the attempt to look at several markets simultaneously rather than a single market in isolation.
- The work of Walras was followed up by Pareto and Cassel, with Pareto taking a more empirical approach to general equilibrium theory and Cassel a more formal, analytical approach. Cassel's work, however, became more influential in the field given that it was written in German, a predominant language of the concerned scholars at that time.
- In the 1930s, the Vienna Colloquium continued to work on the possibility of the existence, stability, and uniqueness of general equilibrium theory in increasingly complex formal mathematical models. At the same time, Abba Lerner and Oskar Lange among others demonstrated what became known as the two fundamental theorems of welfare economics: "that every competitive equilibrium is Pareto-optimal (or efficient), such that no one can be made better off without making someone else worse off, and that any Pareto-optimal allocation can be achieved as a competitive equilibrium with some redistribution of the agents' initial endowments" (Rizvi 2003).
- Under the influence of logical positivism, utilitarian welfare economics was substantially criticized, if not undermined, by the argument that interpersonal comparisons of utility had no scientific basis. Minds or cognitive mental states and hence the capacity to measure utility were understood as inscrutable to every other mind; therefore, the calculus used in utilitarian welfare economics was considered by many to be academically bereft of significance.
- Faced with the positivist informational restriction on mental states, a further criterion was needed for making social welfare judgments, if any were to be made. This demand along with the outlying issues surrounding general equilibrium in general led directly to Kenneth Arrow's formulation of social choice theory based upon a social welfare function defined as a statement of a society's

objectives in which the level of social welfare or well-being is represented as a function of the way in which resources are allocated. However, Arrow's Impossibility Theorem demonstrated under very mild conditions that social decisions as to what the individual members of a society want cannot be simultaneously satisfied by any social choice procedure that could be described as rational and democratic (1951).

- Arrow's work resulted in further attempts by many to prove the uniqueness, stability, and computability of general equilibrium in ever more rarefied and abstruse mathematical formulations with nothing in the way of positive outcomes.
- From 1970 onwards, Amartya Sen has developed an argument in favor of the inclusion of interpersonal comparisons in social choice theory, which in some ways resolves problems associated with Arrow's impossibility outcomes.
- Sen breaks with traditional welfare economics in making the case for taking incomes, or commodity bundles, or resources more generally, to be of direct interest in judging a person's comparative advantage, as opposed to the feelings or *units of utility* that these things might help to generate. Sen further expands this approach by taking note of the ownership of primary goods and resources as well as interpersonal differences in the capacity to convert resources into living in a manner a person has reason to value. This capability approach focuses on the substantive freedoms that people have rather than on the particular outcomes with which they end up, meaning freedom and choices are considered to be and are counted as parts of actual lives.

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