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JOHN EATWELL

MURRAY MILGATE

PETER NEWMAN

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E to J

M

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equity. Depending on the user's inclinations, 'equity' can mean almost anything; this user will adopt a meaning which has been followed by economists and other social scientists since the late 1960s (see particularly Foley, 1967), a meaning close to equality or fairness.

Although 'equality' is less ambiguous than 'equity', it too has many definitions: Jefferson's adage that 'all men are created equal' clearly does not mean that they all have the same talents, skills, inherited and acquired wealth; it only means that they share, or ought to share, certain narrowly defined legal rights and political powers. However, in a simple economic model, equality can be made simple. If we assume that society is comprised of a certain set of n individuals who produce among themselves certain quantities of various goods, we can speak of an equal division of the goods: an allocation that would give each person exactly $1/n$ of the total of each good. Economists would agree that this is equality (at least on the consumption side). Most would also agree that it is an undesirable state of affairs, if for no other reason than that no two people would ever want to consume exactly the same bundle of goods. They would be equal, but not especially happy. Moreover, getting society to that equal allocation would require transferring wealth from the more productive individuals to the less productive, and the transfer mechanism itself would destroy incentives to produce.

So equality in its extreme form – an equal consumption bundle for every consumer – is an obviously unworkable idea, and needs to be weakened. We shall say in this assay that individual i *envies* individual j if i would rather have j's consumption bundle than his own. Formally, let $u_i(\cdot)$ represent individual i's utility function, and x_i represent his consumption bundle. (For now, production is ignored.) Then i envies j if $u_i(x_j) > u_i(x_i)$. This is now a more-or-less standard usage by economists, who have ignored wiser and older counsel, for example, J. S. Mill, who calls envy 'that most odious and anti-social of all passions' (*On Liberty*, ch. 4). Mill would presumably not endorse an economic analysis founded on envy.

Following Varian (1974) we define an allocation as *equitable* if under it no individual envies another; that is, if

$$u_i(x_i) \geqslant u_i(x_j) \quad \text{for all } i \text{ and } j.$$

Obviously, the equal allocation is equitable. But equity does not share equality's obvious disadvantage of forcing all to consume the same no matter what their tastes. If Adam loves apples and Eve loves oranges, and if God has endowed them with a total of one apple and one orange, then the equal allocation (half an apple and half an orange for each) is clearly foolish, but the equitable allocation (one apple for Adam and one orange for Eve) makes good sense.

But the notion of equity has an obvious disadvantage, aside from its being founded on that odious passion. For instance, the economist's model, which reduces person i to a utility function $u_i(\cdot)$ and a bundle of goods x_i, ignores the fact that life is full of things not captured in $u_i(\cdot)$ or x_i, for instance, non-transferable attributes like beauty, health and family. Even if the division of economic goods is equitable, i will probably envy j his looks, or his good health. This problem was alluded to by Kolm (1972). A well-meaning economist who follows his equity theory to its bitter end will conclude that the beautiful should be disfigured, and the well made sick.

Less obvious disadvantages of the idea of equity require references to Pareto efficiency, the foundation of modern welfare economics. An allocation y is *Pareto superior* to an allocation x if all individuals prefer y to x. (This assumes, of course, a constant set of individuals who are making the judgement.) If y is Pareto superior to x, the move from x to y is a *Pareto move*. An allocation x is *Pareto optimal* if there is no y that is Pareto superior to it.

Several authors (e.g. Kolm, 1972) have established that in an economy where there is no production, there exist allocations that are both equitable and Pareto optimal. To find one, start at the equal allocation and move the economy to a competitive equilibrium. By the first fundamental theorem of welfare economics, a competitive equilibrium is Pareto optimal. Since the equilibrium is based on the equal allocation, every individual has the same budget. But if i has the same budget as j, he cannot envy the bundle j buys since he could have bought it himself. So this theorem creates a link between equity and the more traditional, more fundamental notion of Pareto optimality.

But it is a weak link. Pazner and Schmeidler (1974) and Varian (1974) consider an economy with production, where i's utility depends not only on his consumption bundle x_i, but also on the number of hours he works q_i. However, production attributes are non-transferable. If person i is ten times as productive as j, there may be no Pareto optimal distribution of consumption goods and of work hours that is also equitable. Think of an economy of which you are a part and Luciano Pavarotti is a part. You would have to train for 10 lifetimes before you could sing an aria like he does, and therefore there may be no possibility of arriving at an allocation of consumption and work effort among all that is both equitable and Pareto optimal.

Various possible solutions to this quandary have been suggested (e.g. in Pazner, 1976, and Pazner and Schmeidler, 1978). For instance, consider an economy where 'everybody shares an equal property right in everybody's time'. This may lead to the existence of allocations that are both equitable and optimal, but it makes Pavarotti a slave to everyone who is less gifted. Or, as another possible solution, consider an *egalitarian equivalent* allocation. This is one such that the utility distribution it produces could be generated by a theoretical economy in which all consumers are assigned identical consumption bundles. Pazner and Schmeidler (1978) show that egalitarian equivalent allocations that are also Pareto optimal exist, even in economies with production. But this idea is also unworkable; it is simply too airy.

Turn back to an economy without production. It is true that there will exist, under general assumptions, allocations that are both equitable and Pareto optimal in the pure exchange economy. But Feldman and Kirman (1974) show two disturbing facts: First, even if traders start at the equal allocation, and they make a Pareto move to the core (the solution set for frictionless barter), they may end up at an inequitable allocation. Second, if traders start at an equitable allocation, and make a Pareto move to a competitive equilibrium they may end up at an allocation where someone envies someone else. The 'green sickness' springs up where once there was equity.

The Edgeworth box diagram below illustrates the second possibility. In the figure, x_{I1} and x_{I2} represent quantities of goods 1 and 2 belonging to trader I; x_{J1} and x_{J2} represent quantities belonging to J. Also, i_1 and i_2 are two of trader I's indifference curves: j_1 and j_2 and two of trader J's indifference curves; $w = (w_i, w_j)$ is the initial allocation; $w^{-1} = (w_j, w_i)$ is the allocation which switches the bundles between I and J. Note that w^{-1} is found by reflecting w through the centre of the box. Now w is equitable since the indifference curves through it pass above w^{-1}, and the move from w to x is a competitive equilibrium trade that makes both better off. But $x = (x_i, x_j)$ is not equitable, since i_2 passes below $x^{-1} = (x_j, x_i)$, which means that trader I envies J when they are at x.

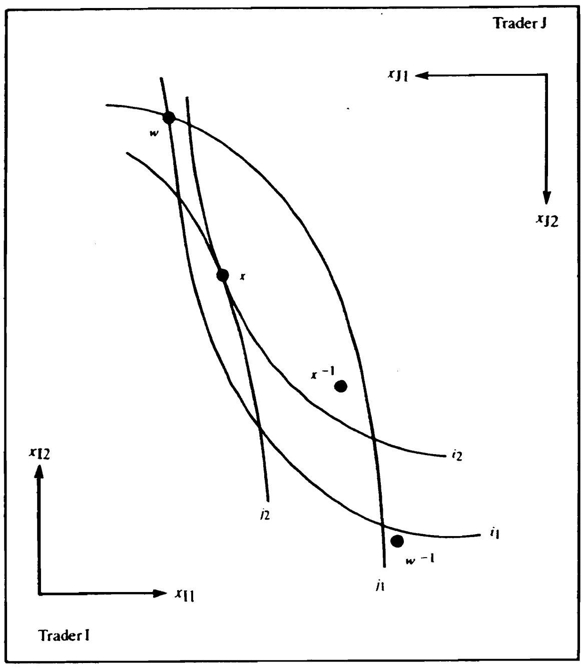

Figure 1

In an interesting extension of the Feldman and Kirman result, Goldman and Sussangkarn (1978) show with generality that in 2 person, 2 good exchange economies there exist allocations x such that (a) x is equitable in the non-envy sense but (b) x is not Pareto optimal and (c) every y which is Pareto superior to x is inequitable! This is formal proof of Johnson's assertion (*The Rambler*, No.183) that 'envy is almost the only vice which is practicable at all times, and in every place; the only passion which can never lie quiet from want of irritation'.

The concept of equity as non-envy is still alive among prominent economists; for instance, Baumol (1982) applies non-envy to an analysis of rationing. This in spite of the fact that recent history suggests the average man fares better under regimes that are less committed to elimination of envy through redistribution of goods, and in spite of the serious theoretical objections raised to the concept as outlined above. Should we care about equity? The temptation to pronounce judgement on what is equitable and what is not may be irresistible. But economic theory suggests that the pursuit of equity in the sense of non-envy will lead to some peculiar and unpalatable results.

ALLAN M. FELDMAN

See also FAIRNESS.

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equivalent income scales. *See* CHARACTERISTICS; HOUSEHOLD BUDGETS; SEPARABILITY.

ergodic theory. To begin in the middle; for that is where ergodic theory started, in the middle of the development of statistical mechanics, with the solution, by von Neumann and Birkhoff, of the problem of identifying space averages with time averages. This problem can be formulated as follows: If $x_t(-\infty < t < \infty)$ represents the trajectory (orbit) passing through the point $x = x_0$ at time $t = 0$ of a *conservative dynamical system*, when can one make the identification

$$(*) \lim_{T\to\infty} (1/T) \int_0^T f(x_t)\,dt = \int_\Omega f\,dm/m(\Omega)$$

for suitable functions defined on the *phase space* Ω of the system?

There are many things to be explained here. For example one might imagine a 'large' number of particles contained in a box, which collide with one another and with the sides of the box according to the usual laws of elastic collision. Each of these particles has three coordinates of position and three coordinates of velocity so that the state of the system is describable by $6n$ coordinates if n is the number of particles. Newtonian laws, of course, provide a history and future for each of these points in $6n$ dimensional space. The same laws imply the law of conservation of energy, so that in principle dynamical systems may be studied with the assumption that energy is constant for each trajectory of a conservative system. Thus in (*) we take the phase space Ω to be that hypersurface of $6n$ dimensional space where the total energy has a given (constant) value, and m is the hypersurface volume (measure) associated with the Liouville invariant volume whose existence