Check your understanding: Economic efficiency

EC 20

September 6, 2017

A discussion of economic efficiency and Pareto optimality

Economic way of thinking

Economics about *human activity* not *money*. Money is medium of exchange usually issued by governments, although bitcoins are threatening on the end to this age-old practice. The basic economic problem is *scarcity*. Wants are assumed to be unlimited, the assumption of *non satiation*. Resources (factors of production capital and labor) are not unlimited and scarcity therefore implies *choice* between alternative ends. Lionel Robbins is famous for his definition of *economics* the study of "...human behaviour as a relationship between ends and scarce means which have alternative uses."

In economics, all agents are given a *utility function*. Utility defined only for households, not firms, government or foreigners. This way, there is no double counting. An agent may work in a firm or government, but all agents live in households. So counting households not only prevents double counting but also ensures that every agent is included.

No agent has "anointed preferences"; everyone is viewed equally in economics theory. An amusement park and national park are different, but from the economic perspective they are similar: both provide utility to their users. There is nothing special about a national park. Thus, agents who prefer national parks are not "better people" with "better preferences". There is simply no such thing in economics.

Utility measures subjetive *well-being*. Note that well-being is *not happiness*. The distinction is subtle and boils down to this: when agents report that they are happy or unhappy, it may have little to do with their current well-being. The patient who has just survived open-heart surgery may not report that he is happy. If the patient needed the operation, the patient is clearly better off and higher well-being. Utility is defined over a *set of goods*, X, $U = U(X)$ where X is a *vector* $X = [x_1, x_2, ..., x_n]$ where n is number of goods. The number of goods can be *large*, depending on the problem, but usually two goods suffices to illustrate the economic principles involved. The Cobb-Douglas function is frequently used for both utility functions as well as production functions. **Example:** Let $U = x_1^{\alpha} x_2^{1-\alpha}$ for $n = 2$. In general α represents consumer tastes and is in the range $[0, 1]$. For

$\alpha = 1/2$, the utility function is *square root*.

Example: How much utility does a consumer get from 2 units of $x_1 = food$ and 8 units of housing $x_2 = housing$ assuming a square-root utility function?

Answer: $U = \sqrt{2 \times 8} = \sqrt{16} = 4$

Social well-being is defined as the well-being of individuals in the economy. In particular, there is no *outside observer*. It follows that there is no such thing as society other than the individuals that make it up. All well-being (utility) must be resolved at the individual level. There is nobody else to whom a utility function can be given. Agents are firms, consumers (households), government and foreign. If an individual thinks he/she is better off economic theory holds that they *are* better off. This is implied by the absence of an outside observer.

Example: When is "society as a whole better off"? *Answer*: This is not really a valid question in the economic way of thinking since society as a whole does not have a utility function.

People (economic agents) are said to own the government not the other way around. Therefore government policy should reflect the preferences of the economic agents. A difficult problem is that of *preference aggregation* and *preference revelation*. It is often difficult or *impossible* to aggregate dissimilar preferences and this can lead to *irrational* or cyclical decisions. **Example**: A school is preferred to the stadium and the stadium is preferred to a hospital the hospital is preferred to a school. This is the area of public choice economics and is covered in more detail in other CYUs. Also agents may not truthfully reveal their preferences for good supplied by the government.

Economics is often considered a branch of applied mathematics. Economist use simple mathematical models to try to capture the essence of real-world phenomena. These models are always a simplification of reality. A *model* is defined as a set of equations for which the number for equations is equal to the number of unknowns. The symbols in the equations are either given parameters or unknowns. When any parameter changes, the values of all the variables, for which the equations are defined, can potentially change. Causality is established by the method of *comparative statics*. This is the change in the equilibrium values of the variables with respect to a change one and only one parameter. If more than one parameter is changed at time, the model is referred to as a *simulation model*. Causality cannot be established due to the fact that the effect of one parameter on the values of the variables cannot be isolated.

Models tell simple stories to help understand complex economic phenomena. What is the most basic economic model? Given the parameters tastes, technology and the initial endowment of factors, an economic model can determine the values of **prices** and **quantities**

traded for all goods in the system. This model of general economic equilibrium was considered to be one of the major achievements of the 20th Century, solved in the 1950s by Arrow and Debreu.

The method of economics is the *scientific method*. Various other pseudo or cripto methods such as critical thinking, sustainability, social justice, post-modernism, the precautionary principle, anecdotes, and other modes of thought are not germane to the economic way of thinking. The scientific method depends on hypotheses derived from models that are then tested against data. *Replication* is essential to the scientific method. **Example**: If one found a as J.B.S. Haldane famously noted, one would have evidence that the theory of evolution was *incorrect*. Randomized control trials (RCTs) are the **gold standard** of empirical research in economics, just as they are in medicine. One implication of the scientific method is that one cannot use the word "proof"(except in mathematics) in that observational data only "supports" a given hypothesis or theory.

What is the key empirical problem for economics? The identification of *causal effects* by way of what economists call *clean identification*. This simply means separating out *correlation* from *causation*. Many variables are correlated: for example, the consumption of ice cream and drownings. Ice cream and drownings are not, however, **causally** related. Causality is essential to policy making. **Example**: the effect of a minimum wage on employment. The minimum wage is usually set exogenously, by some outside political process. In economics it is taken as a given parameter. When the minimum wage is increased from say $10 to $15 per hour, there are specific causal links that imply a lower level of employment. These are tested and re-tested empirically. Occasionally it is found the higher with minimum wages do not lead to lower employment levels. In those studies that find no link to higher unemployment, the question becomes "were the causal links cleanly identified?". This is the level at which much of the economic debate takes place.

There are also models that are only useful for *prediction* and do not attempt clean identification of causal effects. **Example:** class-size is not causally related to test scores in most studies of school performance. Thus, if a policy-maker wanted to improve test scores in a given school, reducing the class size would be an unreliable way to do so. A new mother who comes into the district could use class-size is an accurate predictor of test scores. How did you do so? Smaller classes are associated with high-income neighborhoods. Class size is then a proxy for income. Since higher income families can provide better learning environments for their children, class sizes not causal. As a predictor, however, class size will work very well.

To predict economic outcomes one must only know their *correlates*. When does correlation NOT imply causality? When there is "omitted variable bias" in other words, a missing third variable. "Reverse causality" can also confound causal effects. **Example**: Do ads with red colors increases sales? Walmart seem to think so and started to put red colors in all of its ads. The problem is is that red is a color associated with Christmas and sales naturally rise in Christmas time. There is correlation but no causation. Randomized controlled trials can sort this out, but the details are beyond the scope of this CYU. **Example**: is "does education always cause higher earnings." Again a randomized controlled trial would be the right way to attack this problem. This could be expensive, impractical or unethical, however, and this is a problem that economists frequently confront.

Scarcity

A good is scarce if more is preferred to less (a "bad" is just the opposite). The factors of production (labor, land and capital) are therefore also *scarce*, since if they were not, they could be used to an excess supply of goods. When prices are working properly as *signals*, prices should reflect scarcity. Opportunity cost is the only measure of cost in economics. The true cost of a good is just what an agent would have to give up in order to consume that good. If the agent has to give up *nothing* to get the good, there is no opportunity cost and the good is not scarce. **Example**: Air may be considered to be a non-scarce good, although in some locales (such as China) clean, breathable air might well be scarce.

Prices are signals. Goods with positive opportunity cost should not have zero prices since that would lead to *wasting the good*. Such goods may actually be in excess supply, but they also might be *public goods*, goods for which the quantity available is *not* diminished by consumption. Defense and MP3s are good examples. Research is another.

Exchange is the way in which humans minimize the deleterious effects of scarcity. Two agents trade, for example, and both become better off. Each agent trades a good with a lower value for one with higher value. This would not be possible were there an outside observer. Trade is the essence of cooperation. Cooperation works only because of heterogenous tastes. **Example**: How can exchange improve utility of both traders?*Answer:* The benefits relay on the heterogeneity of tastes. If all agents had the same tastes, there would be no trade.

Revealed preference of agents

Economics is not about money, per se, but about human activity: making goods from factors of production and trading them among themselves. Preferences of agents are revealed in trade. For the first agent, it is clear that what the agent receives is valued more highly that what the agent gives up. The same is true for the other agent.

The basic theory of demand is that people spend according to their preferences. Economists assume that individuals know their own self interest best. When they reveal their preferences through purchases, economists have scientific evidence of the nature of the subjective utility of the agents. The data recovered is just as good as any other scientific observation, including for example, the mass of a proton.

Declarative preferences are verbal and not backed up by actual spending. An agent may say "I love Lamborghinis" or whales, polar bears or whatever. Economists question this assertion, however, if the agent is unwilling to do what it takes to obtain the good for which they have expressed their desire. The scientific status of the declarative preferences is virtually nil. It is often derided in economics as "cheap talk."

The difference between revealed and declared preferences is that few people (probably no one) are willing to buy goods they don't want when they actually have to spend their own money. This is why economists trust revealed preferences but not declared preferences.

These remarks hold only for cooperative behavior. Economists say "cooperation yes, coercion no." There is little economic theory about coercion. If someone holds a knife to the throat of an economic agent, what that economic agent says or does in that situation has little scientific validity.

It also follows that economic agents cannot trust government officials to do what is in the agents best interest, even though government is owned by the agents. This is known as the *principal-agent problem*. If a principle (in this case the economic agent) hires an agent to do something, how does the economic agent know that his employee is going to perform properly. Incentives must be provided to ensure that the preferences of the agent are aligned with the preferences of the principal. Politics is one area in which the principal-agent problem is particularly thorny.

Since government officials are themselves economic agents, and they are always spending taxpayer money rather than their own, most of what they say can be considered cheap talk, that is statements designed to benefit the agent without having to give up any real resources. Government officials are bound by a complex set of rules to prevent politicians from acting in their own interest as op-

posed to the public interest. If well-designed, these rules can result in a solution for the principal-agent problem and potentially for the preference aggregation problem. The latter is more difficult of course, since different principals may have different preferences. If these rules are not binding, sloppy or ineffective, preferences may not be aggregated accurately. The result is public policy that is not properly reflecting the preferences of consumers (households).

Pareto optimality and efficiency

In economics, efficiency is measured by the Pareto principle. An allocation of resources is efficient if it is true that no one agent can be better off without having some other agent be worse off. See Pareto principle for some historical detail. The Pareto principle is the cornerstone of economic thinking and defines the efficiency of resource allocation. The idea is allow agents to make themselves as better off as they can be without forcible reallocation, that is, taking from one person and giving to another.

The Pareto principle is narrow. It does not take into account many things that humans seem to value, especially in the political realm. It does not, for example, take into account *social justice*. Social justice may well require taking from the rich and giving to the poor. It is clear from the definition of the Pareto principal that social justice policies are not necessarily Pareto optimal. Nothing prevents an agent from giving income to another agent. As long as the giver is willing to release resources to the recipient a Pareto optimal allocation can result. Coercive social justice involves taking resources from individuals who do not want to release them in order to make others better off. Non-Paretian social justice has problems from the point of view of an economist. Since those enforcing this form of social justice are not spending their own resources to make it happen, the policy is unlikely to be efficient. [1]

Policy that is Pareto optimal may not always be feasible in the real world. Politicians violate the condition for Pareto optimality regularly. They seem to be quite willing to hurt some agents in order to improve the lot of their favored constituency, whenever they see fit. Once someone is hurt there is no way to say scientifically that the economy as a whole is better off. If questioned, politicians would probably claim that the Pareto principle is just too narrow.

Pareto optimality does seems to challenge the common notion of fairness. One person can take all the available resources, but the allocation is still efficient because all resources were used and no trade was blocked (no waste and no one worse off since no one else has anything to trade. **Example:** Nazis have allied prisoners of war

[1] This is a fundamental problem of economic theory and will not be resolved in this course. Many courses in the economics department take up the problem of social justice from various perspectives; John Rawls, for example, offers a theory of justice based on game theory.

and give them an endowment one chocolate bar and one package of cigarettes daily. [2] The initial endowment is not economically efficient because some prisoners are heavy smokers and others do not smoke. It follows that differences in taste is at the root cause of the inefficiency. A reallocation of chocolates and cigarettes can make everyone better often no one worse off.[3]

Trade takes place in *markets*. One can imagine that in the prisoner of war camp, a market forms immediately after the allocation is delivered to the prisoners. The market will *clear* when every prisoner has what they want the most. The results is a Pareto optimal allocation of resources. The Pareto optimum is the best outcome that can be recognized scientifically. Here is an important point: Economists do not deny that after a market has cleared, it might be possible to coerce one person, often thought to be a rich person, to give another person, say a poor person, either chocolate or cigarettes. The loss to the rich person may be less than the gain to the poor person. If so, then overall social welfare would presumably rise. Is this true?

The problem is that economists do not know how to compare utility function between two people. In the mind of one agent an indifference curve enables the agent to put a price on a subjective experience, perhaps a date with a member of the opposite sex. To say that one is indifferent between the date and some other good or service in the market is to say that the opportunity cost of the two is the same. Using the indifference curve, the agent is able put a price on practically all aspects of human activity. The problem arises win there are two agents involved. Since indifference curves do not stretch between agents no one can truly say two agents will be indifferent between two different allocations of resources. And omniscient outside observer would be able to say this, some form of a deity on supposes, but economics does not allow for the existence of any such external observer.

Moreover, as noted above, since people can lie or misrepresent their preferences, there is no scientific way to say that total welfare will actually rise as a result of the coercion. This, according to economics, is a significant problem. People on the receiving end will always “say" they are better off, but there is no true way of knowing that they are better off until they give up something for what they get.

This is why economics relies on Pareto optimality despite its problems.

[2] This is one of the most famous examples in all economic theory. See Prisoner of War reading on Blackboard.

[3] Note that if there were an infinite supply of chocolates and cigarettes in the camp there would be no scarcity and no problem of resource allocation for economics to solve. The prices of both goods would be zero.

Market inefficiency

The *fundamental theorem of economics* is that free-trade maximizes utility, for each agent in the economy. Blocked trades lead to lower levels of utility. **Example**: Consider a trade of a kidney between a donor and a patient with kidney disease. The latter is willing to pay the former a price and so both agents could be better off. If a payment for a kidney were possible the supply of donated kidneys would rise and many of the 80 thousand patients that die while awaiting a kidney would survive every year. The government blocks this kind of trade for political reasons. There is no economic reason to do so.

Market inefficiency arrises when something or somebody prevents (blocks) a trade for each agent wishes to engaging. Economics efficiency is therefore defined as no **blocked trades**. Blocked trades create distortions. Distortions in the pattern of resource allocation are inefficient. When there is an inefficiency in the system, all agents can have more of what they value if resources were simply rearranged, without having to augment supply.

Distortions arises from blocked trade. someone (e.g. government agents) telling economic what is in there best interests even if it is not consistent with the agents preferences you. Much of the “vice" trade cigarettes, alcohol, prostitution, body parts, sweatshops, informal sector activity and above all illegal drugs, fall into this category. [4]

Is important to see that economic efficiency is not the same as the efficiency concept used in the physical sciences. This latter is largely based on energy input into a machine versus useful work done by the machine. The work-energy theorem shows that two concepts are comparable. From this, it is seen that a machine is more efficient if more useful work arises from the same energy input. Engineering, or what is sometimes called technical efficiency, is a subset of economic efficiency. It Is by large left to the engineers, however, to ensure that the technology is efficient in the engineering sense. It is easy to see that this has very little to do with the efficiency and economic sense, which is itself a much less objective and more subjective idea. A technically efficient space heater in summertime or in a burning desert is of no value to humans even though it may be very well-designed. Heat is not *scarce* in this example. Therefore, economic agents will be unwilling to spend resources to obtain additional heat.[5]

[4] Listen to Alvin Roth, Nobel prize laureate discuss the attempt to increase the efficiency of organ donations on EconTalk.

[5] Engineering efficiency or heat efficiency came from the study of steam engines from physics in the late 18th century: Joule.

Conclusions

Exchange is fundamental to economic reasoning and logic. Exchange depends on ownership property rights that must be protected by

government. Economic efficiency implies no blocked trades. Exchanges generate a system of relative prices. Prices *allocate resources* in that the send signals about opportunity costs to economic agents. The main way in which economists measure social welfare is the Pareto principle. The concept is limited in its applicability, but has the advantage of providing a positive rather than normative analysis.