

ECONOMIC EXTERNALITIES

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Summary

We define the concept of externalities as used by economists and explain how the presence of externality interferes with the efficiency of decentralized decision-making. Subsequently, we discuss briefly methods for correcting externalities using market and non-market instruments.

1. Introduction

The concept of externality has played a central role in the economic theory of resource allocation. The idea behind the concept is simple to state: an externality exists when the actions of a specified group of economic agents have significant economic repercussions on agents outside the group. However, there are considerable difficulties in making this concept precise, mostly having to do with the operational meaning of “significant.” To illustrate the difficulty, note that virtually every economic action you take has some impact on some other agent. If I buy an orange, the seller has more money and fewer oranges, and there are similar repercussions for every market transaction. Yet these situations are not ones that any economist would identify as externality producing. To qualify as externality, there must be an involuntary element in the repercussions and an associated distortion in economic incentives. Clearly, this extra requirement eliminates market transactions for

which participation is strictly voluntary. However, what is left is still somewhat amorphous, and we find it important to define externality precisely as an analytic concept.

Many definitions have been suggested for this concept, but it is difficult to give a precise one that covers adequately all of the various examples that have emerged in applications. Indeed, here we find it necessary to divide the concept into at least two subcategories with separate definitions: dDirect eExternalities and iIndirect eExternalities. We will discuss these categories separately, though later we will see that the line between them is not always distinct.

2. Direct Externalities

We will say that a direct externality exists whenever a choice variable of one agent (or decision-making group) enters into the direct objective function of some other agent(s). Clearly, when there is an externality in this sense, the associated choice made will have involuntary impacts on the affected agent(s). This definition encompasses many of the best known examples. In the case of air pollution, the smoke put into the air by a factory helps to determine ambient air quality, a variable that enters into the utility functions of resident consumers. In the case of road congestion, one driver's decision to enter a crowded highway affects average traffic speed, which in turn affects the utility of other users. The externality of the "commons" also fits within this definition. When many ranchers graze their cattle on a piece of open land, the decision by one rancher to add to his its herd will lower the amount of forage available to others, which in turn lowers the productivity (and hence profits) of other ranchers. We discuss first this class of externality and its implications for economic allocation. Later we will argue that the concept needs to be generalized somewhat to include other situations that generate similar outcome characteristics.

2.1. Externalities and Inefficiency

As suggested above, there is a general presumption that externalities are a bad thing, in that when they are present and not dealt with in a centralized way, the resulting allocations are going to be economically inefficient. We can see now that this is generally true for the definition just given. Suppose agents behave toward each other in a decentralized Nash way—that is each makes his its own decisions, taking as given the behavior of other agents. Suppose further that we are in a general situation in which payoffs of the various agents depend on actions they all take. Let a^i stand for the (vector) of decision variables available to agent i . To the extent that agents face constraints, we assume that they can be solved for a dependent set as functions of some independent subset, and that a^i represents the independent subset. The matrix of all actions will be simply denoted a (without a superscript). Further, the notation (a^i, b^{-i}) will mean the configuration in which agent i plays from configuration a whereas everyone else plays from b . Let $P^i(a)$ stand for the objective function of agent i . Now a^* will be an equilibrium outcome for the group if each they all finds it best to use their * decision as long as she expects everyone else to do so as well; that is:

$$\text{for all } i, P^i(a^*) \geq P^i(a^i, a^{*-i}), \quad \text{for all feasible choices } a^i \quad (1)$$

We now argue that equilibrium in this context will generically be nonoptimal from the point of view of the group as a whole. This conclusion will hold no matter how we choose to weight individual payoffs in defining the group objective. Suppose we assign weights w_j and consider the social objective $W(a) = \sum_j w_j P^j(a^i)$. Thinking of a^i as one dimensional, we can define its marginal social benefit and marginal private benefit as:

$$MSB^i(a) = \sum_j w_j \partial P^j / \partial a^i, \quad (2)$$

$$MPB^i(a) = \partial P^i / \partial a^i \quad (3)$$

Now, by the definition of equilibrium (a^*), $MPB^i(a^*) = 0$, so:

$$MSB^i(a) = \sum_{j \neq i} w_j \partial P^j / \partial a^i \quad (4)$$

Thus, as long as the interdependences are generic, we expect to find the MSB 's not equal to zero at equilibrium, so the group can be made better off through marginal changes in private choice variables. Further, we can measure the marginal external cost of choice a^i as $MSB^i(a) - MPB^i(a)$. We will see how this measure is represented in a number of concrete examples below.

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The survey of externality topics given in this paper merely skims the surface of a very large subject. The reader should consult references below for more in depth coverage of indicated topics.

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Biographical Sketch

David A. Starrett is pProfessor (eEmeritus) at Stanford University. A Fellow of the Econometric Society, he is well-known for his wide-ranging and definitive contributions to economic theory.