

The Nature of Externalities

By

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Theory and Measurement of Economics Externalities, 1976

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Discussion

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In this stimulating paper, a definition of *externality* is presented, three theoretical observations are made concerning externalities, and a discussion of remedies for the nonoptimality of market systems in the presence of externalities, is carried out. As Heller and Starrett point out, "part of the result is just a justification of commonly held beliefs." However, they do accomplish, in part, their other goal which is to "provide some additional insights into when the problems are likely to arise, and what remedies are likely to work." Most of the insights they provide are valuable and deserve emphasizing even if they have been previously recognized; however, some of their remarks are debatable. A discussion of these issues can, it is hoped, lead to a better understanding of the nature of externalities.

I. WHAT ARE EXTERNALITIES?

Heller and Starrett provide us with the following "somewhat imprecise" definition: "externalities [are] nearly synonymous with nonexistence of markets." I find this a useful definition. Their garbage disposal example gives emphasis to its validity. Standard general equilibrium and welfare theory tells us

that if enough markets exist and if consumers are locally nonsatiated (i.e., they desire to spend all their wealth), then a market equilibrium with price-taking agents will be Pareto optimal. Thus (taking the second assumption as holding) nonoptimality of competitive market systems arises only when potential markets do not exist. Since "externalities" are of interest only because they lead to a nonoptimal allocation of resources, a theory of externalities must encompass a theory of the existence or nonexistence of markets. Heller and Starrett's definition correctly emphasizes this fact.

Three primary sources of problems are identified which might operate to hinder the establishment of a potential market: transaction setup costs, property rights setup costs, and the absence of relevant information. There is another source of market failure which was hinted at but not really confronted at all in Heller and Starrett's paper: the failure of an equilibrium price to exist even if the market is in operation. Without dwelling on this well-known problem at this time, let me just mention that the results contained in Section III of the paper (that external economies may imply increasing returns to scale) indicate that even if we establish enough property rights, pay the appropriate transactions costs, informed markets may still lead to a nonoptimal allocation of resources because of a failure of the existence of equilibrium. This is especially important to recognize when considering remedies for externalities.

Finally, I should note one possible drawback to the externality definition that they propose. It depends on an equilibrium concept and is not institution free. That is, to identify whether an externality exists (or not) we must calculate whether, *in equilibrium*, a potential market will operate or not. This in turn may depend on such things as the distribution of initial endowments, etc. Clearly it would be more desirable if one did not have to compute an equilibrium before recognizing where the problems will occur.

II. SOME THEORETICAL OBSERVATIONS

Heller and Starrett make two theoretical observations in their paper. One, contained in Section V, is that in the absence of returns to scale a type of externality considered by Scitovsky can be attributed to the lack of effective futures markets. This is a valid and important observation with obvious implications for, among other things, development economics.

A second observation, contained in Section III, is an extension of an argument contained in Starrett [4]. The argument is basically that external diseconomies create a "fundamental nonconvexity" in the aggregate production possibility set. This insight is important for its implications for the existence of tax-subsidy schemes to counteract the nonoptimality property of externalities.¹

¹In particular, if the production possibility set is nonconvex, one may not be able to "support" Pareto-optimal allocations with a tax-subsidy scheme.

Heller and Starrett seem to say that the existence of this nonconvexity implies that "all diseconomies must be inherently public in nature." Apparently they have their argument backward. That is, it is the public nature of the externality that creates the nonconvexity, not the converse. To see this let us consider a formal argument that provides conditions under which the nonconvexity exists. To make things simple we consider only two firms (imaginatively called A and B) each producing a single output with a single input and one firm's output produces an external diseconomy for the other. (The argument is easily generalized to many firms and many commodities.) We let Y be the feasible set of pairs of input output plans (x^A, y^A, x^B, y^B) where x is an output and y is an input. We let

$$Y^A(\bar{x}^B, y^B) = \{(x^A, y^A) \mid (x^A, y^A, \bar{x}^B, y^B) \in Y\}.$$

Heller and Starrett's argument seems to be that if $\bar{x}^B > x^{*B}$ implies $Y^A(\bar{x}^B, y^B) \subset Y^A(x^{*B}, y^{*B})$ (i.e., \bar{x}^B creates an external diseconomy), then Y cannot be convex. This is in fact not true. For example, let

$$Y = \{(x^A, y^A, x^B, y^B) \mid x^A + y^A + x^B \leq 0, \\ x^B + y^B \leq 0, x^A \geq 0, x^B \geq 0, y^A \geq 0, y^B \geq 0\}.$$

Then \bar{x}^B creates an external diseconomy, but Y is convex as is $Y^A(\bar{x}^B, \bar{y}^B)$ for all (\bar{x}^B, \bar{y}^B) . An additional condition is needed. The firm must be allowed to escape the impact of the diseconomy through inaction. More precisely we mean that $(0, 0) \in Y^A(\bar{x}^B, \bar{y}^B)$ for all $\bar{x}^B > 0$. Taking these together we have

Proposition The following three conditions cannot hold simultaneously:

- (1) Y is convex.
- (2) $(0, 0) \in Y^A(\bar{x}^B)$ for all $\bar{x}^B \geq 0$.
- (3) There is an efficient allocation (x^A, y^A) in $Y^A(\bar{x}^B)$ such that

$$\{(x^A, y^A, \bar{x}^B)\} + \Omega \cap Z = \{(x^A, y^A, \bar{x}^B)\}$$

where Ω is the nonnegative orthant of three-dimensional space and

$$Z = \{(x^A, y^A, \bar{x}^B) \mid (x^A, y^A) \in Y^A(\bar{x}^B)\}.$$

((3) simply states there is at least one efficient point at which an external diseconomy occurs.)

Proof (1) implies Z is convex. Let $s = (x^A, y^A, \bar{x}^B)$ be the allocation whose existence is guaranteed by (3), $s \in \text{Boundary } Z$. Hence, there exists a supporting hyperplane to Z through s . That is, there is a vector $\pi = (\pi_1, \pi_2, \pi_3)$ such that $\pi \cdot r \leq \pi \cdot s$ for all $r \in Z$. Furthermore, by (3), π can be chosen such that $\pi_i > 0$ for $i = 1, 2, 3$. Now condition (2) implies, therefore, that $\pi(0, 0, x^{*B}) \leq \pi \cdot s$ for all $x^{*B} \geq 0$ since $(0, 0, x^{*B}) \in Z$. Choose $x^{*B} > \pi \cdot s / \pi_1$. Then we have a contradiction. q.e.d.

Several relationships can be highlighted by this proposition. First, any two of the conditions taken alone are not inconsistent. Second if (1) were changed to requiring that $0 \in Y^A(x^B)$ for all $x^B \in Y_{x^B}$ (the projection of Y on x^B), it is possible that the conclusion need not follow. This is indeed true if $Y_{x^B} \subseteq [0, K]$ for some finite bound K . This can be illustrated by Heller and Starrett's example of a common green for grazing sheep. Clearly there is an upper bound on the number of sheep the other person can have grazing. Therefore, it is perfectly possible to have convexity in the production possibilities set even if inaction is usually possible.

Finally, the proposition indicates that one should make a distinction between exclusion of an externality and *escape* from one. By perfect exclusion I mean that (at zero cost) $Y^A(x^B) = \bar{Y}^A$ for all x^B . By perfect escape I mean that $0 \in Y^A(x^B)$ for all x^B . No escape and no exclusion would mean that condition (2) of our proposition need not hold and, therefore, that the "fundamental nonconvexity" need not exist.² One is tempted, at this point, to enter into a metaphysical discussion about the similarity and differences between escape being possible and allowing $Y^A(x^B) = \phi$ (the empty set). Rather than dwell on the distinction I have in mind, let me illustrate with an example proposed by Stanley Reiter. Suppose a government is willing to subsidize farmers who do not grow poppies. How do they distinguish between those who are currently choosing inaction (the zero input-output vector) and those who were not producers in the first place since with reasonable capital markets anyone could potentially be a poppy grower? The dilemma is one not allowed for by our models of production.

III. A DISCUSSION OF REMEDIES

Heller and Starrett's main point, and one that I heartily agree with, is that in discussing remedies for correcting the nonoptimality created by externalities one "cannot ignore the costs of the institutions in making social decisions." In fact, this is always a relevant consideration in any choice of institutional arrangements for the allocation of resources. For example, it must be considered when choosing between a centrally planned economy and a market system.³ That is, one should be interested in *net* optimality, the level of social satisfaction attained after institutional costs are netted out. Heller and Starrett make these points; however, they do not carry them to their logical conclusion. In particular, let us look at their final example, in Section VI. The problem is to allocate a fixed piece of land among shepherds. They state, without proof, that

² Another problem arises, however, for market equilibrium since it is now possible, but not necessary unless Y is a cone, that losses will be sustained by firm A in equilibrium.

³ See Hurwicz [2] for a fuller elaboration of these ideas.

"of course, both of these schemes (taxes or property rights) are second best compared to the alternative of turning the common over to a single owner." In saying this they ignore the costs to the single owner of operating the common as a competitive firm. If there were no costs of administering such a firm, one might argue that, even with externalities, the best organization of production for all economies is that in which one firm carries out all the productive activity of the world. Empirical evidence seems to contradict such a conclusion. Thus, before accepting single ownership as an optimal one, one must also weigh the costs of that institution. In particular, it may not be desirable to internalize all externalities if there is a cheaper way to solve the problem.

IV. CONCLUSION

I find much of interest in Heller and Starrett's paper. It should be required reading for anyone interested in externalities. However, one must be careful to distinguish those conclusions grounded on solid theoretical analysis from those that are supported only by example. The latter, in many cases, raise more questions than they answer. For example, we need more research on models into which are incorporated the costs of assigning property rights and the costs of exclusion.

A good paper should not only provide answers but should also lead to provocative questions. Therefore, Heller and Starrett's is a good paper.

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