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Adele P. Massell
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The Rand Corporation
Santa Monica, California 90406

# THE SOCIAL OPTIMALITY OF PRODUCTION BY NONPROFIT INSTITUTIONS: COMMENT

Adele P. Massell and James R. Hosek*

In a pathbreaking theoretical analysis, Joseph Newhouse (1970) developed a model of optimization by nonprofit institutions based on two primary assumptions:

(1) Both quality and quantity of output are elements in the nonprofit decisionmaker's maximand; and

(2) The constraint facing nonprofit institutions is that they must break even (i.e., total cost must equal total revenue).

In his analysis, Newhouse concluded that: (1) factors such as philanthropy, favorable tax status and legal restrictions pose barriers to entry by profit-maximizing firms and may result in production above minimum average cost, and (2) relative to profit-maximizing firms, nonprofit institutions will have a *"bias against producing low-quality products"* [page 69] — that is, nonprofit institutions may tend not to supply the market with lower quality products which would be offered by profit-maximizing firms. The quality-bias conclusion was the basis for a test of the model's relevance using a comparison of quality measures for proprietary and nonprofit hospitals.

In the present paper we demonstrate that although a quality bias can be derived from the Newhouse model if the decisionmaker's maximand includes both *average* quality and total quantity, the conclusion does not apply if nonprofit utility maximization involves specialization in

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*Both authors are economists, The Rand Corporation. We would like to express our gratitude to Joseph Newhouse for helpful comments on an earlier draft.

a single quality level. Since the Newhouse model is ambiguous about which utility specification is relevant, and since either might be applicable to alternative markets served by nonprofit firms, it is useful to elaborate upon the two specifications.

## I. THE NEWHOUSE MODEL

In Newhouse's geometric presentation, he assumes there is a continuum of quality levels of output, with quantity of output measured in common units (e.g., hospital patient-days) for all quality levels. For each quality level there are associated a demand (average revenue) and an average cost curve, both as functions of quantity.[1] For simplicity, Newhouse treats the case in which both the demand and cost functions for a particular quality level are independent of those for other qualities; the same simplification is used here.

Assuming, for the moment, that philanthropic gifts are not available, the restriction that the nonprofit institution break even implies that at a chosen quality level, quantity will be set so that average revenue equals average cost.[2] The set of quality-quantity combinations satisfying this restriction is the choice-set of the nonprofit decisionmaker, which Newhouse describes as a *"trade-off"* curve and illustrates as in Figure I.

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[1] Newhouse makes some more precise assumptions about the relevant set of quality levels and the relation between alternative qualities and their respective cost functions [see page *67*]. For reasons noted below, these assumptions may or may not be appropriate, depending on the precise specification of the model.

[2] We do, of course, assume that if average revenue equals average cost at more than one quantity level for a given quality, the nonprofit firm always produces the largest quantity.

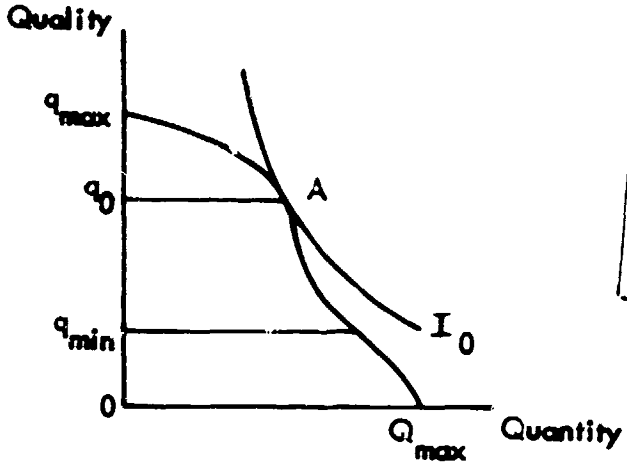


Fig. I — Trade-off and Indifference Curves

Assuming both quality and quantity are *"goods"* in the decisionmaker's utility function, utility is maximized (under the usual assumptions) by selecting a quality-quantity combination, shown at point A in the figure, which places the decisionmaker on his highest achievable indifference curve ($I_0$).

There are two issues of particular interest concerning this analysis. First, shifts in the demand and/or cost schedules modify the tradeoff curve and can result in a different optimal output mix even if the utility-function parameters are unchanged. This is a complicating factor in both empirical and theoretical comparisons of product mix of profit-maximizing firms with what would be produced by a potentially smaller number of nonprofit institutions.

Second, there are (at least) two alternative interpretations of Figure I. On the one hand, we may assume that each point on the curve represents the break-even quantity associated with production at a unique quality level. In this case, utility maximization involves the choice of a single quality level to be produced. That is, individual nonprofit institutions would specialize in certain qualities of care. Alternatively, we might suppose that the decisionmaker will not restrict himself to a single quality level but will be interested instead in the *average* level of quality produced. That is, he may produce at more than one quality level if the larger quantity (summed over all quality levels produced) compensates him for reductions in the average quality of care. Although Newhouse makes reference to a decisionmaker's concern with average quality [page 69],[3] the analysis does not adequately deal with the option of providing multiple levels of care. This option will be considered below.

## II. A QUALITY-BIAS?

To reevaluate Newhouse's quality-bias conclusion, let us first postulate that nonprofit firms maximize utility by specializing in a single quality level (point A in Figure I).[4] Let us also initially assume that nonprofit firms receive no subsidy. Profit-maximizing firms select output quantity for each quality at the point at which marginal revenue equals marginal cost; this may imply that for-profit firms would produce a different quantity of a given quality than would nonprofit firms. However, it is necessarily true that any quality for which there is a break-even quantity (without subsidies) also has a nonzero profit-maximizing quantity. Thus, all qualities represented

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[3]On the other hand, Newhouse assumes that, a given choice between two qualities having the same break-even levels of cost, only the one with the larger quantity level is relevant. This implies that he is considering the specialization case. (See footnote 3 of this paper.)

[4]It should be clear from the foregoing discussion that this is an assumption about the form of the utility function rather than a conclusion derived from the Newhouse model.

on the break-even curve would be produced (in some quantity) by profit-maximizing firms -- *including, in Figure I, qualities above A as well as below it.*[5] Given nonprofit specialization and no subsidies, there is no *a priori* reason to expect a quality bias relative to profit-maximizing firms.

Even if we introduce philanthropy or favorable tax status into the nonprofit specialization case, we still do not obtain an *a priori* argument for a quality bias. The nonprofit firm will view such subsidies as a potential downward shift in the cost functions for all quality levels, and may therefore view as feasible some quality levels not available to unsubsidized profit firms. The nonprofit firm may (or may not) choose to produce one of these qualities, but there is no *a priori* reason to expect the additional quality to lie at the top, middle, or lower portion of the quality range feasible for profit-maximizing firms.

## III. OUTPUT MIX UNDER THE MULTIPRODUCT HYPOTHESIS

Whereas specialization may partially reflect behavior of nonprofit firms in some markets (e.g., museums), nonprofit firms in other markets (notably, hospitals) characteristically produce many products in a single firm. This may, of course, reflect interdependencies in demand and production of the different products. Alternatively, it may be consistent with independent production and demand but with the form of the nonprofit maximand whose elements are *average* quality and *total* quantity. Let us consider this alternative.

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[5] The conclusion also applies if the market is served by several nonprofits specializing in different qualities, even though the argument is presented in terms of a single nonprofit firm.

To do so, let us postulate a cardinal measure of quality such that we can compute average quality by summing the products of quality (q) and quantity (Q) over each quality level produced (i) and dividing by total quantity. For the time being, let us also suppose that the nonprofit firm will attempt to break even for *each* quality level independently of the others. Under these assumptions, the nonprofit optimization rule is to select a combination of values of i so as to:

$$\max_{\{i\}} U\left(\frac{\sum_i q_i Q_i}{\sum_i Q_i}, \sum_i Q_i\right)$$

$$\text{s.t.} \quad Q_i - f(q_i) = 0, \qquad (1)$$

where U is the utility function and $f(q_i)$ is the break-even level of output as a function of quality, $q_i$.

We shall now argue that these conditions will generally result in multiproduct production by nonprofit firms and in a bias toward production of high quality products relative to the product mix of profit-maximizing firms.[6] We assume that there is a functional relation, $q = q(Q)$, describing the locus of break-even points and that the inverse of this function, $Q = Q(q)$, exists.[7]

We find that the maximization problem given by (1) is soluble in a straightforward way provided that nonprofit firms that produce multiple

[6] By same reasoning as was presented earlier, any quality for which there is a break-even point for unsubsidized nonprofit firms also has a profit-maximizing possibility. That subsidies increase the choice set of nonprofit firms does not affect the conclusions reached in the no-subsidy case described here.

[7] In fact, we need only assume that there is a functional relation, $Q = Q(q)$. It is, perhaps, more reasonable to assume that this function is single-valued (such that there is only one break-even quantity that would be produced at each quality level) than that $q = q(Q)$ is single-valued (such that only one quality has a given break-even quantity).

qualities always produce all qualities within a range rather than selecting a set of disjoint points on the break-even locus. This condition is in fact satisfied under the assumptions made above. Indeed, we can show that the optimization problem reduces to selecting the minimum quality level to produce, since utility maximization will involve producing at *all* break-even points corresponding to higher levels of quality.

This conclusion is easily derived by considering the decision-maker's option of producing other quality levels in addition to $q_0$ in Figure I. Any higher quality level produced contributes to total output without reducing average quality, and thus permits utility levels above the one corresponding to $I_0$. If there is a quality level below $q_0$ (say, $q_{min}$) at which production would increase utility still further, the same reasoning suggests that all qualities between $q_0$ and the $q_{min}$ would yield even greater utility gains. Thus, the utility maximization problem given by (1) reduces to the more easily solved form:

$$\max_{q^*} U = U\left( \frac{\int_{q^*}^{q_{max}} q \cdot Q(q)dq}{\int_{q^*}^{q_{max}} Q(q)dq}, \int_{q^*}^{q_{max}} Q(q)dq \right), \qquad (2)$$

where $q^*$ is the minimum quality to produce.[8]

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[8]The first-order condition for this maximization is:

$U_1 \frac{\partial \bar{q}(q^*)}{\partial q^*} \leq - \left[ U_2 \frac{\partial TQ(q^*)}{\partial q^*} \right]$, where $U_1 = \partial U/\partial \bar{q}$, $U_2 = \partial U/\partial TQ$, $TQ(q^*)$ = total quantity (as a function of $q^*$), and $\bar{q}(q^*)$ = average quality (as a function of $q^*$).

Since all qualities on the break-even locus would be produced by profit-maximizing firms, the possibility that q* is greater than zero is another way of describing the potential for a quality bias.[9] That is, if nonprofit firms do not produce all feasible quality levels (q* > 0), then the set of quality levels they will produce always comes from the top of the feasible range.[10]

In order to reach this quality-bias conclusion, however, we assumed that the nonprofit firm producing multiple products would attempt to break even with respect to individual products. Given the utility function specified above, there seems little reason to expect this kind of behavior. To the contrary, we should expect nonprofit firms to be constrained to break even only over the *entire* production process and to use revenues from *"profitable"* low-quality products to aid in covering costs of higher quality products.

Thus, in addition to philanthropy and barriers to entry, the opportunity to provide multiple products is a reason that the set of feasible quality-quantity combinations for the nonprofit firm may differ from the set of profit-maximizing combinations. These factors generally permit nonprofit firms to produce larger quantities of high quality care than would profit-maximizing firms.

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[9] It is difficult to imagine a positive quality that can be produced with zero quantity output and vice versa. For this reason, the axis points of the tradeoff curve should be omitted and the issue is whether q* is within a small neighborhood of zero.

[10] In the analysis underlying this paper, a number of assumed functional forms for Q = Q(q) were considered. For many of the simple forms examined, there were *no* utility function formulations which would yield a zero value for q*.

## IV. SUMMARY

This comment has considered the comparison of output mix by nonprofit firms with that of profit-maximizing firms within the Newhouse model of nonprofit optimization. More detailed analysis than that provided by the Newhouse paper was devoted to nonprofit optimization, assuming that the nonprofit firm is constrained to break even with respect to each quality level of output produced. We concluded that:

(1) If nonprofit firms specialize in a single quality of care, there is no reason to suppose that a quality bias exists;

(2) If nonprofit firms maximize utility as a function of *"average"* quality and total quantity, there is a potential bias in favor of the high-quality range of products.

While not in conflict with Newhouse's conclusions, the analysis provides a better understanding of the power of the Newhouse model to predict specific behavior patterns of nonprofit decisionmakers, and therefore provides a more elaborate foundation for comparing the applicability of the Newhouse model relative to alternative frameworks for analyzing nonprofit firms.

## REFERENCE

Newhouse, Joseph P., "Toward a Theory of Nonprofit Institutions: An Economic Model of a Hospital," *Amer. Econ. Rev.*, March 1970, *60*, 64-74.