Public provision of private goods is usually modeled as the displacement of a market where people can buy as much or as little of a good as they please, with tax-financed provision by the government of equal and identical amounts of the good per person. But public provision is not always equal per person because some goods cannot be supplied equally or because the government does not choose to supply goods equally. There may be fewer organs available for transplant than there are people who need them. The best education and medical care are unavoidably rationed because teachers and doctors differ in skill or dedication. Total public expenditure may be insufficient to provide for everybody when there is a lower limit to useful expenditure per person.

PUBLIC PROVISION OF INDIVISIBLE PRIVATE GOODS IN SHORT SUPPLY

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> It takes months to get an appointment with a specialist and months to get badly needed surgery for hip replacement or cataracts—unless one has enough personal contacts to climb up the waiting list. (The existence of a "nomenclatura" that gets preferential treatment is the best-kept secret of our celebrated medical care.)
>
> —Lysiane Gagnon (1998, D3)

Two people are traveling in the desert with enough water for one of them to survive the journey but not both. Who gets the water?

This ancient conundrum has its counterparts in contemporary public finance:

> Long ago at Manchester University, a cleaning lady who was one of Manchester's little people (for you could guess a person's social class by his height in those days) complained to me that her family had been wait-

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ing for years to be assigned public housing, though other people with no better claim than they had been assigned public housing already.

Today in Ontario, a child in elementary school has a significant chance of sharing the class with children who are mentally ill and who take up a disproportionate amount of the teacher's time, lowering the quality of education. A parent can avoid this risk by enrolling his or her child in French emersion or in an alternative school with restricted enrollment.

Women about to give birth are sometimes flown from Toronto to obstetric wards in Kingston when Toronto hospitals are especially overcrowded. This is not a pleasant experience for the women involved, especially as they are often put on the bus back home a few hours after their children are born. It has been alleged that a disproportionate number of such women are Black.

A hospital in Ottawa treated senior politicians, senior bureaucrats, top soldiers, and nobody else.

Some time ago, an aged and distinguished politician received a heart transplant, although similar transplants are usually denied to people of his age and state of health.

Recently, a woman died after waiting for 20 hours in the emergency ward of a hospital. Not everybody waits that long. By what process was it determined that she should do so, and could her life have been saved if some influential person had intervened on her behalf? It is a fair bet that the woman was not a doctor, a dependent of a doctor, or a premier of the province.

Many Queen's students believe that the allocation of loans to students by the Ontario government is arbitrary and unfair.

These examples have a common theme: It is exceedingly difficult for the government to allocate indivisible private goods when there is not enough for everybody. Goods are said to be indivisible when they are only available or useful in lumps of a certain size. Kidneys available for transplant are indivisible in this sense of the term. If there are only three kidneys available for transplant and there are six people who need them, then three people must do without, for half a kidney is no use at all. There may be fewer places in university than qualified students to fill them. Almost by definition, there are fewer highly qualified surgeons than patients wanting their services. Indivisibilities are not especially problematic in the private sector, where the price mech-

anism automatically allocates the available supply to whomever is prepared to pay the most for access. Indivisibilities become problematic in the public sector.

The crux of the problem is that the preferred principle of public-sector allocation—that everybody be treated alike—may be inoperative because it is in the very nature of certain goods that they cannot be allocated equally. The preceding examples suggest not just that we sometimes deviate from equality—falling short of our ideal as people always do—but that there are times when our ideal of equality cannot be realized for technical rather than moral reasons. The problem arises in the allocation of places in old people's homes, medical care, access to education, public housing, and a variety of other goods supplied by the government.

We think of people in a capitalist democracy as having two types of rights: property rights, which are intrinsically unequal, and political rights, such as the rights to vote and protection under the law, which are intrinsically equal. When a good or service is supplied in the private sector, it is expected to be allocated unequally according to what people are willing or can afford to buy. When a good or service is supplied in the public sector, it is expected that everybody's right to the good is the same. When governments deliberately depart from equal allocation, we say they are unjust. But governments may sometimes allocate unequally because they cannot do otherwise. Some goods must, by their very nature, be allocated on different principles. The preceding examples are of instances when the allocation goes sour. This article is an attempt to formalize the problem with particular reference to medical care.

Equality of public provision is less straightforward than one might suppose: Equality may be of input or output. In allocating funds for the police among the different localities, a central government might supply equal expenditure per person or attempt to equalize crime rates by providing extra funds to relatively crime-ridden localities. Equality may be ex post or ex ante. Education would be equal ex post if expenditure on every child—clever or not, disabled or in good health—were the same. Education would be the equal ex ante if entry to limited places in university were allocated by competitive examination in cir-

cumstances where the wealth or social class of the parents played no role whatsoever. This is a slippery distinction because even ex ante equality is at most the disregarding of some circumstances of candidates for limited places and because wealth can influence a candidate's preparation. Equality may be of offer or supply. We would say that public housing is offered equally if accommodation of a given standard is made available to everybody, even though the wealthier part of the population prefers to acquire better accommodation on the open market. Nor is it obvious what the domain of equality should be. Public funds devoted to the treatment of prostate cancer would be allocated equally if the same rules applied to everybody with the disease, but women would not be treated equally with men if a disproportionate amount of medical funds were devoted to prostate cancer rather than breast cancer. The distinction between equality of input and equality of output may be important in this context because research in one disease may be much more promising in one disease than in another.[1]

Reasons for public provision—some good, some bad—are not the subject of this article. For instance, medical care may be socialized to avoid the "Samaritan's dilemma," in which a person neglects to care for himself or herself or to provide for the risk of illness, knowing that others will not allow him or her to die for want of medical care, no matter how improvident the ill person may have been; or to avoid the considerable overhead cost of private medical insurance; or in fear that insurance companies and health maintenance organizations may let sick people die when medical care becomes especially expensive; or because universal insurance is blocked by too much readily available information on people's health status when they apply for insurance. Education might be in the public sector because each of the present generation of adults is concerned not just about their own children but about the entire future generation. Regardless, the starting point of this article is that, for whatever reasons, indivisible goods are provided by the government. The question is how and to whom they are supplied.

INDIVISIBLE GOODS DEFINED

An indivisible good is available altogether in a lump or not at all. It does not admit more or less. You cannot have half a kidney transplant as you can have half a loaf of bread or half a glass of water. People may differ in their valuations of indivisible goods. Some would give up a great deal for a kidney transplant; others would give up a great deal to avoid one. The essential feature of indivisible goods is that the available supply cannot be divided up equally among would-be recipients unless there is enough to go around. Otherwise, some people acquire the good, and others have to do without.

Indivisible goods can be seen as one of many types of goods that economists have come to recognize once Samuelson opened the field with his articles on public goods. At first, we recognized only private goods and public goods, as though all goods in the world could be classified as one or the other. Deluded, perhaps, by the connotations of words, we were inclined to suppose that public goods were what the government supplies. In introducing club goods, Buchanan (1965) was one of the first to recognize the existence of other types of goods in between, with other implications about the role of government in the economy. Since then, there has been a profusion of new types of goods: congested public goods, shared goods (such as the police force, with total cost dependent on the number of beneficiaries but with identical benefits to everybody in the relevant catchment area), personal goods, privately provided public goods, publicly provided private goods, preclusive goods, and so on. Indivisible goods are one more type.

Indivisible goods may be uniform or variegated. Uniform indivisible goods, exemplified by kidney transplants, appear in the utility function as either 1 (if you have it) or 0 (if you do not).

$$u_i = u^i(x_i; \delta), \tag{1}$$

where u_i is the utility of person i, x_i is a vector of his or her consumption of all other goods, and δ is either 1 or 0 depending on whether person i does or does not acquire the indivisible good. People vary in their evaluation of the indivisible good, and some people may not want it at all. Person i wants the indivisible good if and only if

$$u^i(x_i; 1) > u^i(x_i; 0). \tag{2}$$

Variegated indivisible goods, exemplified by doctors who can be ordered from best to worst, are represented in the utility function as numbers. The utility function of person i becomes

$$u_i = u^i(x_i; q), \tag{3}$$

where q is the quality of medical care, graduated so that $q = 0$ signifies either no medical care or a quality of medical care so poor that one would be just as well off without it. Medical care becomes a variegated indivisible good when, for example, there are a total of D doctors, each doctor can service r people, and doctors differ in skill. With s distinct categories of medical skill, there are d_s doctors supplying medical care of top quality, q_s; d_{s-1} doctors supplying medical care of somewhat lower quality, q_{s-1}; and so on. There may or may not be enough doctors to go around; that is, rD may or may not be greater than P (total population). Regardless, the superior-quality doctors must somehow be assigned to patients through the market or in some other way.

In a competitive market, indivisible goods are allocated by prices. The price of a uniform indivisible good is the lowest of the reservation prices of the people who acquire the good, where each person's reservation price is the most he or she would be prepared to pay to acquire the good rather than to do without it. Suppose K kidney transplants are available for a population of P people who need them. Suppose $P > K$, so that some people must be denied the indivisible good. Let R_i be the reservation price of the ith person ordered by reservation prices so that, for all i, $R_i > R_{i+1}$. The first K people get transplants. The rest of the population does not. The market price of a kidney transplant would be R_K. Everybody except the Kth purchaser enjoys a surplus, the difference between his or her reservation price and the market price, R_K.

The allocation of variegated indivisible goods is similar but more complex. With D doctors to serve P would-be patients, and when each doctor can service r patients, the market must churn up a fee schedule $f(q_j)$, where j refers to the jth level of skill, so that the earnings of a doctor at the jth level of skill becomes $rf(q_j)$. The fees—$f(q_j)$ per patient for a doctor with skill j—must have the property that each patient is satisfied with his or her doctor. The patient of a doctor with skill j would be

unwilling to pay the extra $f(j + 1) - f(j)$ for the services of a doctor of skill $j + 1$ or to become a patient of a doctor with skill $j - 1$ for a saving of $f(j) - f(j - 1)$. In equilibrium, some would-be patients may have no doctor, and there may be some doctors with no patients—incompetent doctors for whom f is negative. The skill bands can be wide or narrow. At one extreme, all doctors are equally skilled, but there are not enough to go around. At the other extreme, each and every doctor can be ranked according to his or her skill. In the examination of public provision to follow, we flip back and forth between specifications of indivisible goods, assuming them to be uniform or variegated depending on which is the more appropriate for the purpose at hand.[2]

METHODS OF ALLOCATING INDIVISIBLE GOODS

Nine methods are to be discussed and compared: sale, merit, cost-benefit rules, random allocation, extra billing, a private fringe, queuing, rent seeking, and influence.

SALE

The public sector could replicate the private sector. It does precisely that in the allocation of tickets for trips on the state-owned railway or access to toll roads. Publicly administered medical care could also be allocated by sale, but with that allocation, it would make little sense to supply medical care in the public sector at all. We shall nevertheless use medical care as an example to trace out the implications of this form of public allocation. Assume that medical services are uniform rather than variegated but that there are simply not enough services to go around, so that some people must do without. Imagine a society of identical people whose tastes are represented by the common utility function

$$u(x; \delta) = \ln(x) + \delta, \tag{4}$$

which is the same as Equation (1) above except that there is only one private good, x, and the utility function is separable in x and δ. As above, the value of δ is 1 if one is allocated medical services, and it is 0

if one is not. Less than one unit is useless, and any excess over and above one unit is useless as well. Each person is endowed with an income y, varying uniformly from a low of $10,000 to a high of $190,000, so that the median income is $100,000. The key assumption here is that there is only enough of the indivisible good for half the population.

Suppose initially that medical services are privately supplied in a market, where the price of the ordinary private good is 1 and the fee for medical services, f, must be just high enough to deter half the population from purchasing medical services. A person's consumption, x, of the ordinary private good is either y or $y - f$, depending on whether one chooses to purchase a unit of the indivisible good.

If the indivisible good were provided in a competitive market, its market-clearing price would allocate the available supply so that everybody who wants to buy access at that price may do so, with nothing left over. As an intermediate step, define $f^R(y)$ as the reservation price of the indivisible good for a person with an income of y, the price at which he or she is indifferent between acquiring and not acquiring a unit of the indivisible good. Indifference implies that

$$\ln(y - f^R(y)) + 1 = \ln(y) \tag{5}$$

or, equivalently,

$$f^R(y) = y(1 - e^{-1}), \tag{6}$$

which is a simple multiple of y.

A person acquires medical services if and only if his or her reservation price exceeds the market price. Because the reservation price increases with income, the available medical services are purchased by the richer half of the population. To clear the market, the price of medical services must equal the reservation price of the person with the median income. With incomes varying uniformly from $10,000 to $190,000, people's reservation prices vary from a low of $6,321 [$f^R$ ($10,000)] in accordance with Equation [6] to a high of $120,103 [$f^R$ ($190,000)]. The market-clearing price is the median reservation price, which turns out to be $63,212 [$f^R$ ($100,000)].

Public provision by sale would be identical to private provision in an ordinary competitive market if the government purchased medical services at what would have been the market-clearing price. The outcome differs if the good is acquired by the government—like blood donations—free or at less than the market-clearing price under private provision. Consider a government that has already acquired enough medical services to supply half the population and that cannot acquire any more. With a fee, f, paid to the government and with only half enough medical care to go around (so that revenue per head from the sale of medical care becomes $f/2$), each person's gross income before the purchase of medical care is augmented by whatever portion he or she is assigned of the total revenue from the sale of medical care. Suppose, for simplicity, that revenue from medical care is allocated among all citizens equally, raising everybody's income from its initial level, y, to $y + f/2$. One's consumption of other goods becomes $y - f/2$ if one purchases medical care or $y + f/2$ if one does not. Once again, the market-clearing price of medical care must be the reservation price of the person with the median income, where the median income and the average income are the same because the distribution of income has been assumed to be uniform. The reservation price, f^R, of a patient with income y is identified by

$$\ln(y - f^R/2) + 1 = \ln(y + f^R/2). \tag{7}$$

A simple manipulation of Equation (7) reveals that with a median income of \$100,000, the market-clearing price of medical care has to be \$92,423, somewhat higher than with out-and-out private provision because everybody's income is augmented by the revenue from the sale of medical care.

Note particularly that the poorest of the would-be patients are actually better off when medical care is sold for whatever the market will bear than they would be if they had received medical care "free" from the government. The revenue from the sale of medical care finances a transfer per person of \$46,212. A person is better off with the transfer than he or she would be with "free" medical care when his or her income is low enough that

$$\ln(y + 46{,}212) > \ln(y) + 1. \tag{8}$$

The critical income is $26,894. Anybody whose income is less than $26,894 is better off with his or her share of the proceeds of the sale of medical care than he or she would be if supplied with medical care instead.

Of course, this result is entirely contingent on arbitrarily chosen numbers. The point of the example is that public provision of private goods, especially when there is not enough to go around, may be a poor instrument for the promotion of equality among people. The natural vehicle for redistribution is the simple transfer of money, ideally through some variant of the negative income tax. The principal justification for public provision of private goods must lie elsewhere, in externalities or in some impediment to redistribution through the intermediary of money. Otherwise, when goods are allocated equally, the discrepancy between the values to the rich and to the poor creates an unnecessary inefficiency that is beneficial neither to the rich nor to the poor.[3]

MERIT

The limited supply of publicly provided private goods may be assigned to those who "deserve" them, as when scarce places in university are assigned to the best students. Merit has at least three distinct interpretations. It may be a throwback to an aristocratic view of the world in which some people are simply better than others—people of good breeding, people of quality, a Nomenklatura of the politically or the socially well connected. Especially in universities, it would be rash to assume that such a view of the world, once commonplace, has entirely disappeared or has no residual bearing on public decisions.

Alternatively, merit may refer to the effect of allocating the scarce good on the marginal contribution of the recipient to the welfare, somehow defined, of the community as a whole. Everyone may agree to allocate places in the physics department to students expected to become the best physicists. Few would gain from any other principle of allocation, unfair as it may be to the less competent among us who bear the cost of education but get little or none themselves. The attractiveness of this interpretation of merit depends very much on the anticipated relation between the wage and the marginal product of labor. If

full contribution to society is reflected in one's wage, it might be best for the government to allocate scarce benefits by sale rather than by gift. Only when one's prospective contribution to society is not reflected in prospective income—when significant externalities are anticipated—might allocation by merit as anticipated contribution be warranted.

A third interpretation of merit is that scarce privileges should accrue to those who will gain the most from them, when gain refers not to monetary valuation but to some absolute measure of utility: food for the hungry, housing for the homeless, education in the arts to those with the keenest sense of beauty. As a criterion for the public sector, this interpretation of merit has much to be said for it, but it is not within the subject of this article. This article is about indivisible goods in short supply. As a criterion for allocation, "food for the hungry" refers to a world where there is already plenty of food for the rich over and above what the government has at its disposal to supply.

COST-BENEFIT RULES

A cost-benefit rule is somewhat like merit, but with an emphasis on evaluation in dollars' worth to the recipients of public projects or programs. The fundamental principles of cost-benefit analysis—that benefits of projects be evaluated by the government according the valuations of the beneficiaries and that all dollar values of benefits be weighed equally "to whomsoever they may accrue"—might be extended from the choice of projects to the choice of beneficiaries of public provision of indivisible and heterogeneous goods. Indispensable for the public provision of roads, bridges, and airports, cost-benefit analysis has its place in public provision of medical care too, but it is a tool that must be employed with care and subject to important qualifications.

To see what is at stake, consider once again the simple model of medical care in which all doctors are equally skilled, but there are not enough doctors to go around. Suppose medical care is socialized with a view to providing the same standard of care for everyone, insofar as possible. With that objective of socialization, the allocation of medical care by strict adherence to the principles of ordinary cost-benefit anal-

ysis can be dismissed out of hand because the recipients of medical care would be precisely those rich folks who would purchase medical care if it were for sale. Public provision would then provide "for free' what the recipients would otherwise have to buy. The reason is simple enough. With only half enough doctors to go around and on the assumptions we have made about taste and the distribution of income, patients' reservation prices for medical care are proportional to their incomes: $f^R(y) = y(1 - e^{-1})$ as in Equation (6). A cost-benefit rule would automatically allocate medical care to people for whom the benefit, as reflected in their reservation prices, $f^R(y)$, is largest. By comparison with private provision of medical care, the poor have everything to lose because they pay part of the cost of medical care but receive none of the benefits. It is difficult to say what the practical implications of this extreme case may be, except perhaps that governments do not and ought not to carry cost-benefit principles to their logical extreme.

If cost-benefit analysis is to be adopted for medical care at all, it can only be with reference to a special calculus of pain, suffering, and death, where costs are assigned to aspects of ill health independently of wealth-induced variations in people's willingness to pay. Suppose reservation prices for hip replacements are $R(y_i, x_i) = y_i A(x_i)$, where x_i is a vector representing aspects of a person i's medical condition and y_i is his or her income. For medical cost-benefit analysis, the assigned value of person i's hip replacement for cost-benefit analysis would have to be something such as $YA(x_i)$, where Y is the average income in the community as a whole. For medical cost-benefit analysis, a life is a life is a life, regardless of whether one is rich or poor, although other circumstances, such as whether one is old or young, would have to be considered.

RANDOM ALLOCATION

With only enough medical care for half the population, equality ex post is unattainable, but equality ex ante can be attained by randomization. Would-be patients could be treated alike by assigning access to medical care by chance. Names of all patients are put in a hat, half the names are chosen at random, and only the winners in this lottery

are provided with medical care. Rich and poor are placed on exactly the same footing.

To assess the consequences of random allocation, consider once again a society where the government controls a supply of medical care, where there is exactly half enough medical care to go around, where initially the available medical care is sold for what the market will bear, and where the proceeds of the sale are redistributed equally to everybody, those who buy medical care and those who do not. The question at hand is, Who gains and who loses from the transition to random allocation? This broad question breaks down into three more specific questions: (1) Who gains and who loses ex post from the transition? (2) Who gains and who loses ex ante from the transition? (3) Could the rich bribe the poor to give up their entitlement to a chance of access to medical care under random allocation? These questions will be discussed in turn.

To deal with the first question, think of random allocation as creating four groups of people ex post: the lucky rich, the lucky poor, the unlucky rich, and the unlucky poor. The lucky rich are unambiguously better off than they would be if medical care were sold because they are getting free what they would otherwise have to buy. The unlucky poor are unambiguously worse off because they lose their share of the proceeds from the sale of medical care. The unlucky rich are also worse off because their valuation of medical care exceeds their share of the proceeds from the sale. One might suppose by symmetry that the lucky poor would be better off too, but that is not always so. The richer among them are better off, but the poor among them are worse off because access to medical care is worth less to them than the transfer forgone.

If medical care were sold by the government for what the market would bear and if the proceeds of the sale were divided equally among all would-be patients, the market price would have to be the reservation price of the person with the median income. As shown above, the market price turns out to be $92,423—providing a transfer from the government of $46,212 per person—when the incomes of the would-be patients vary uniformly from $10,000 to $190,000. The transfer is automatically forgone when the available medical care is allocated at random.

To see who among the lucky poor are made worse off by the switch from sale to random allocation, note that a lucky person is made worse off under random allocation when his or her income is small enough that

$$\ln(y) + 1 \leq \ln(y + f^*/2), \tag{9}$$

where $\ln(y) + 1$ is his or her utility with medical care but no transfer, $\ln(y + f^*/2)$ is his or her utility with a transfer but no medical care, and $f^*/2 = \$46{,}212$. Rearranging Equation (9), we see that a lucky person is worse off under random allocation when

$$y \leq [f^*/2]/[e - 1] = \$26{,}894. \tag{10}$$

Among the poorest of the poor (those with incomes less than $26,894), even the lucky patients to whom medical care is provided free are worse off when the medical care is allocated randomly than when medical care is sold. Thus, more than half of the population is better off ex post when medical care is sold in the market: the unlucky rich, the unlucky poor, and the poorest of the lucky poor with incomes between $10,000 and $26,894.

The comparison ex ante is somewhat different. Under random allocation, the expected utility of a patient with income y is

$$\tfrac{1}{2}\,[\ln(y) + 1] + \tfrac{1}{2}\,[\ln(y)] = \ln(y) + \tfrac{1}{2}. \tag{11}$$

By contrast, when medical care is sold, a patient's utility depends on whether he or she buys medical care, and that, in turn, depends on his or her income. Let f^* be the price of medical care as it would be if medical care were sold and the proceeds redistributed equally, so that $f^*/2$ is at once the net financial gain of someone who does not purchase medical care and the net financial loss of one who does. If $y > \$100{,}000$, the patient buys medical care, and his or her utility becomes $[\ln(y - f^*/2) + 1]$. If $y < \$100{,}000$, the patient buys no medical care, and his or her utility becomes $[\ln(y + f^*/2)]$. Someone whose income is exactly $100,000 is indifferent between buying medical care and not buying medical care. For such a person,

$$[\ln(y + f^*/2)] = [\ln(y - f^*/2) + 1]$$

$$= \tfrac{1}{2}\,[\ln(y + f^*/2) + \ln(y - f^*/2)] + \tfrac{1}{2}$$

$$= \ln[y^2 - (f^*/2)^2]^{1/2} + \tfrac{1}{2} < \ln(y) + \tfrac{1}{2}, \tag{12}$$

indicating that, ex ante, a person whose income is exactly $100,000 is actually better off under random allocation than he or she would be if medical care were sold. This is an unusual outcome in which risk would seem to be preferred to certainty. Because, as assumed in Equation (4), utility is additive in δ and concave in x, a random provision of medical care is evaluated at its expected value, but the corresponding certainty of income under random allocation of medical care is preferable to the choice between $y - f^*/2$ and $y + f^*/2$, depending on whether medical care is purchased.[4]

There is a band of incomes around $100,000 within which random allocation is preferable to sale and outside of which sale is preferable to random allocation. Upper and lower limits of the band are easily computed. To determine the lower limit, y^L, note that a patient is indifferent between random allocation and sale (together with the transfer of income when medical care is for sale) if

$$\ln(y^L) + \tfrac{1}{2} = \ln(y^L + f^*/2), \tag{13}$$

so that

$$y^L = f^*/[2(e^{1/2} - 1)] = \$71{,}234. \tag{14}$$

Similarly, the upper limit, y^H, is an income such that

$$\ln(y^H) + \tfrac{1}{2} = \ln(y^H - f^*/2) + 1, \tag{15}$$

so that

$$y^H = (e^{1/2})f^*/[2(e^{1/2} - 1)] = \$117{,}446. \tag{16}$$

Thus, ex ante, one is better off with random allocation than if health care is sold when one's income is between $71,234 and $117,446. A patient whose income lies outside these limits would prefer health care to be sold for what the market will bear. If the patient's income is below the lower limit, he or she places a higher value on the transfer

than on the chance of "free" medical care. If the patient's income is above the upper limit, he or she places a high value on the assurance that medical care will be provided.

Whether the rich could bribe the poor to relinquish their entitlement to a chance of acquiring medical care depends critically on how and about whom the question is posed. Consider a pair of patients with incomes equally above and equally below the median income, y^*, of \$100,000. The assumed uniformity of the income distribution guarantees that the entire population can be divided into such pairs with nobody left over. The incomes of any such pair are $y^* + x$ and $y^* - x$, for all x greater than zero and less than \$90,000. Now imagine a random allocation slightly different from what we have postulated so far. Suppose health care is provided to one randomly chosen person in each pair. The question at hand is whether, before it is known who will receive medical care, a mutually advantageous deal can be struck in which the richer party pays an amount $P(x)$ to the poor party to give up his or her right to a chance at medical care.

Their expected utilities under random allocation are $\ln(y^* + x) + ½$ and $\ln(y^* - x) + ½$. After payment of $P(x)$ from the richer to the poorer party in return for giving up the entitlement to a chance at health care, their utilities become $\ln(y^* + x - P(x)) + 1$ and $\ln(y^* - x + P(x))$. The question becomes whether there is any range of $P(x)$ for which both parties are better off. The poor person is better off if

$$\ln(y^* - x + P(x)) > \ln(y^* - x) + ½. \tag{17}$$

The rich person is better off if

$$\ln(y^* + x - P(x)) + 1 > \ln(y^* + x) + ½. \tag{18}$$

From these inequalities, it follows that

$$[P(x)/(y^* - x)] > (e^{1/2} - 1) = .649 \tag{19}$$

and

$$[P(x)/(y^* + x)] < (1 - 1/e^{1/2}) = .393. \tag{20}$$

These conditions will hold simultaneously when x is large but not when x is small. Equations (19) and (20) are inconsistent when $x = 0$; no deal is possible in that case. But if x = \$50,000, then $y^* - x$ = \$50,000 and $y^* + x$ = \$150, so that any P(50,000) between \$32,450 and \$58,950 would make both parties better off. Whether a more complex deal makes every single person better off than he or she would be under random allocation depends on the range of disparities of income. The wider the initial disparity, the more likely is such a deal to be feasible.

EXTRA BILLING

Little has been said so far about the remuneration of doctors. The government was assumed to have acquired a supply of doctors sufficient to provide medical care to half the population. The government's pay scale might reflect skill, or it might not. If not, doctors' skill rents would, in effect, be shared among all doctors. But skill rents might revert to the skilled doctors themselves under a system of extra billing.

In practice, the term *extra billing* is a catchall term covering a variety of methods of compensation. The method examined here is simple and uncompromising to emphasize a particular aspect of extra billing. Suppose that doctors' skills vary uniformly over some range, that the patient-doctor ratio is invariant but there are not enough doctors to go around. Suppose also that all doctors are paid a stipend by the government, but that extra billing is permitted.

It is obvious what happens. In the short run, with a given supply of doctors of different skills, extra billing replicates market-determined fees in the allocation of medical care. Recipients of medical care are precisely those people who would receive medical care under private provision, and the assignment of skilled doctors remains exactly the same. Poor patients still receive no medical care. The best doctors continue to treat the wealthier patients. Having no role to play in the allocation of scarce resources in medical care, a publicly supplied stipend to doctors becomes like a transfer of income from all patients to all doctors. As a device for equalizing the provision of medical care or for shifting skill rents from doctors to patients, public provision with extra billing is a complete failure.

Governments are unlikely to be as shortsighted in designing a program of public provision of medical care as this analysis would suggest. Doctors may be paid per patient or per unit of medical service. Limits may be imposed on the amount of extra billing. Nevertheless, a residue of our extreme example may persist under more sophisticated methods of medical care. Extra billing may not be a good idea.

PUBLIC PROVISION WITH A PRIVATE FRINGE

Normally, public provision drives out private provision because nobody would willingly pay for what the government provides free of charge. A private sector where patients pay for medical care can only coexist side by side with a public sector where medical care is provided free when private care provides something over and above what is provided in the public sector. Medical care may be a mix of services, only some of which are supplied free in the public sector. Here the feature differentiating private from public medical care is the quality of medical care as a reflection of doctors' skill. Medical care is looked on as a variegated indivisible good. Suppose that every doctor serves a fixed number of patients, that there are just enough doctors to go around, and that doctors' skill, represented by the quality of medical service q, varies *uniformly* from a minimum of q^{min} to a maximum of q^{max}. Coexistence of public and private sectors is only possible when better doctors work in the private sector and worse doctors work in the public sector. That, in turn, requires all doctors in the private fringe to earn more than or at least as much as any doctor in the public sector when doctors are free to work in one sector or the other.

Suppose the government sets these rules for the provision of medical care: (a) Doctors may choose to work in the public sector for a fixed stipend regardless of skill, or they may choose to work in the private sector for whatever fees their patients are prepared to pay. (b) Patients may receive "free" medical care in the public sector, or they may buy medical care in the private sector at whatever the equilibrium skill-determined fee schedule happens to be. (c) Publicly provided medical care is financed by proportional income taxation, with no exemption for people acquiring medical care privately. (d) Matching of patients and doctors in the public sector is entirely random. A patient's expected quality of care in the public sector is the average quality of all

doctors in the public sector. Assume for convenience that each doctor treats one, and only one, patient so that the doctor's wage and the patient's fee in the private sector are the same.

In entirely private medical care, the market would churn up a fee schedule with higher fees for better doctors. Such a schedule is illustrated as a curve on the left-hand side of Figure 1. Doctors' skill—represented by the quality of care they provide from a minimum of q^{min} to a maximum of q^{max}—is shown on the horizontal axis, and doctors' fees is shown on the vertical axis. The market determined "fee-skill" schedule, $f(q)$, must be upward sloping and might be convex as well. Equilibrium in the market for medical care requires that very patient must prefer the fee-quality combination he or she acquires to every other combination along the fee-quality curve.

In public medical care with a private fringe, the government sets a standard fee, called f^*, for all doctors in the public sector, and all patients must decide whether to accept "free" medical care or to buy medical care in the private sector. In response to the government's choice of f^*, there must emerge a cutoff quality of care, q^*, such that all doctors with skill less than q^* work in the public sector, and all doctors with skill greater than q^* work in the private sector. The resulting fee schedule is illustrated on the right-hand side of Figure 1, which is identical to the left-hand side except for the shape of the fee-skill schedule, designated by $g(q)$ rather than by $f(q)$ to signify that even over the range of skill in the private fringe, the two schedules need not be quite the same. From q^{min} to q^*, the schedule $g(q)$ is flat because all doctors in the public sector are paid the same. From q^* to q^{max}, the schedule $g(q)$ rises because patients in the private sector are prepared to pay higher fees to better doctors.

This arrangement is characterized by two equilibrium conditions, one pertaining to doctors and the other to patients. First, the fee of the least skilled doctor in the private sector must equal the fee that the government provides for doctors in the public sector:

$$g(q^*) = f^*. \tag{21}$$

These must be equal because if $g(q^*) < f^*$, the least skilled among the doctors in the public sector would offer his or her services to the public sector instead, and if $g(q^*) > f^*$, the most skilled doctor in the public

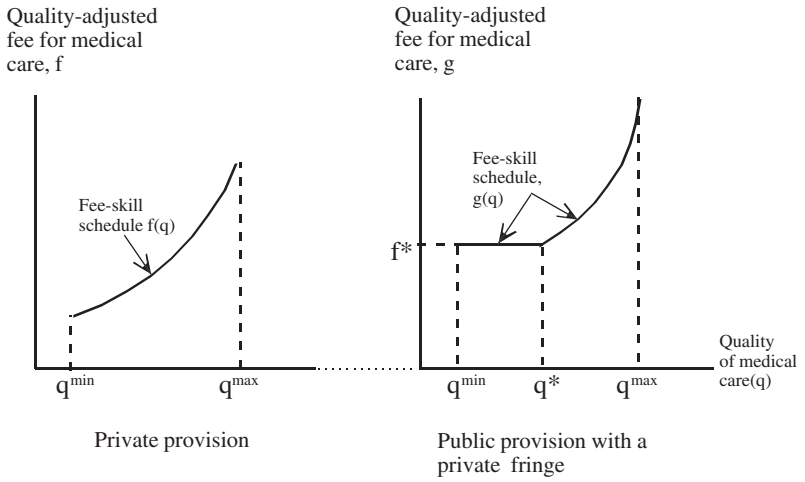

Figure 1: Private Provision Compared to Public Provision With a Private Fringe

sector would undercut the fee of the least skilled doctor in the private sector. Second, the patient using the services of the least skilled doctor in the private sector must be indifferent between public and private provision. If a patient opts for the public sector, his or her expected quality of care is $(q^{min} + q^*)/2$, and the patient pays nothing for medical care over and above the tax that must be paid regardless of the choice between the public system and the private system. If he or she opts for the private sector, the quality of care is q, and the patient must pay a fee of $g(q)$, where q is necessarily greater than q^*. A patient whose income is y and whose utility function is as shown in Equation (4) is indifferent between public and private care if and only if

$$\ln(y - g(q^*)) + q^* = \ln(y) + (q^{min} + q^*)/2. \tag{22}$$

It is immediately evident from Equation (22) that there is some critical income, y^*, for which the equation holds and that a person with an income larger than y^* opts for private medical care and a person with an income smaller than y^* opts for the public system.

Although less than fully rigorous, this analysis of public provision with a private fringe suggests three reasons why it might be inadvis-

able. First, with a given skill distribution of doctors, the private fringe necessarily attracts the more skillful doctors, automatically lowering the quality of medical care in public sector. Second, although the government is relieved of the requirement to pay doctors in the private fringe, the prospect of employment in the private fringe may drive up the required payment to doctors in the public sector, lest too many skilled doctors choose to work in the private fringe instead. Third, there is a political danger in this method of provision. The possibility of escape from public provision to a private fringe creates an incentive among the rich to favor cost cutting in public provision, no matter what the consequences for the quality of care. This could be a serious concern if the rich are disproportionately influential in public decision making. A case can be made for forbidding a private fringe to ensure that the rich and influential must partake of whatever services they provide for the peasants.[5]

QUEUING

Strictly speaking, there is no place for queuing in the models in this article because queuing takes time, and the models, as developed so far, are atemporal. Queuing can, nevertheless, be contrasted with random allocation in a simple example. Suppose 1,000 people require heart surgery each year, and there is only capacity for 500 operations. Inevitably, 500 people each year must do without. Assume for the sake of the argument that all cases are equally grave so that the medical establishment does not have the option of directing scarce resources to the worst or most needy cases. With random allocation, names of 500 out of the 1,000 new cases each year are picked out of a hat, operations are provided for the lucky people whose names have been chosen, and the rest are left to their fate. With queuing, everybody in need of heart surgery is placed on a list that must grow long enough for 500 people to die each year waiting for heart surgery, so that the 1,000 new cases each year are balanced by 500 surgeries and 500 deaths. For example, if the common mortality rate of people in need of heart surgery is 20% per year, there must in equilibrium be 2,500 people on the list (so that 500 people die each year), and the waiting time must be 3½ years. (The waiting time is t, where $500 = 1{,}000e^{-(.2)t}$.) If waiting is unpleasant, then the misery of waiting must be counted as a cost of queuing

that could be avoided, for those who ultimately receive operations, by choosing recipients of the operation by lottery instead. If life expectancy on receiving the operation after a delay of 3½ years is reduced by more than 3½ years, then that loss of life expectancy constitutes an additional cost of queuing that could be avoided by immediate random allocation. Human nature being what it is, discretion on the part of the medical establishment about who belongs where in the queue is likely to be employed unfairly, as will be discussed below under the heading of "Influence."

RENT SEEKING

Rent seeking is like queuing in some respects, but it differs from queuing in that resources of patients are directed to influencing the allocation of public largesse. Think of the government as intending to allocate medical care by merit, although there really is no solid criterion of merit, and patients are seen by the government as meritorious according to their efforts or resources deployed in puffing up their claims. Such rent seeking is pure waste rather than disguised bribery. Nevertheless, the present context suggests a distinction I have not seen elsewhere in the rent-seeking literature. Patients may compete for medical care by expenditure of *goods* or by expenditure of *labor.* Both are wasteful, but they are wasteful in different ways, and the form of competition may determine whether medical care accrues in the end to the rich or to the poor.

Suppose once again that all doctors are equally skilled but that there are not enough doctors to go around. Specifically, there are only enough doctors to supply half of the would-be patients with medical care. To distinguish rent seeking in labor from rent seeking in goods, assume that all would-be patients have equal supplies of labor time but that some patients are more productive than others. Everybody has the same initial supply of labor, L, which may be used either for production of ordinary nonmedical goods and services or for rent seeking to obtain medical services. Leisure plays no role in this analysis because everybody's leisure time is assumed to be the same. Productivity of labor, p, varies uniformly from a minimum of p^{min} to a maximum of p^{max}. A person's income, y, and his or her consumption, x, of nonmedical

goods depend on his or her productivity of labor, p; rent seeking in labor, R; and rent seeking in goods, r. Specifically,

$$y = p(L - R) \text{ and } y = x + r. \tag{23}$$

The mode of rent seeking—in labor, goods, or both—is chosen to maximize utility, which is dependent on the amount of nonmedical goods and on the quality of medical care.

Two possibilities will be considered in turn:

1. Would-be patients may compete for medical care with goods, in which case there is established a *price in goods*.
2. Would-be patients may compete for medical care with labor, in which case there is established a *price in labor*.

Competing with goods. Rent seeking is usually modeled as expenditure to influence the allocation by the government of a benefit or prize that is what it is regardless of anybody's efforts to attain it (see, e.g., Tullock 1980). Suppose access to medical care requires a contribution of goods to be burned at the altar of Hippocrates. This method of allocation is like the purchase of medical care except that everybody's net income is lower because the sacrifice makes no contribution to public revenue, and doctors have to be paid regardless. Each person's reservation price for medical care is determined in accordance with Equation (5) above rather than in accordance with Equation (9) because income devoted to rent seeking is, by definition, wasted rather than returned in a lump sum to taxpayers. (Remember, we are assuming that the government has already acquired a stock of the scarce private good. Had we allowed for the cost of the government's acquisition of the scarce private good, the detail of the example would have been more complex, but the story would be essentially the same.) The cost of successful rent seeking rises to the point where half the population of would-be patients drops out of the race. Access to medical care is supplied to people who are prepared to pay as much in rent seeking as they would have to pay if medical care were sold.

Allocation by rent seeking in goods leaves everybody worse off than if medical care were sold outright: The rich still acquire the available medical care, the poor still get none, and everybody, rich and poor

alike, loses a share of the revenue from the sale of medical care. Alternatively, if the cost to the government of acquiring medical care is taken into account, the rich lose because they pay twice for medical care—once involuntarily through taxation and again voluntarily through their offerings to the statue of Hippocrates—and the poor lose the tax they pay to cover their share of the government's cost of medical care that accrues in the end to others.

Competing with labor. Rent seeking now consists not of goods supplied to the rent setter but to time devoted to meditation in the presence of the statue of Hippocrates. When scarce medical care is provided to those who devote the most time to meditation, there must emerge a critical meditation time, R^*, such that everybody who meditates more than R^* hours gets medical care and everybody who meditates less gets none. The population must then divide itself into two groups, those who meditate for R^* hours and those who do not meditate at all. The utility of a person with productivity p who does not choose to meditate—and forgoes medical care—becomes $\ln(pL)$. The utility of a person with productivity p who chooses to meditate becomes $\ln(p(L - R^*)) + 1$. To determine what R^* must be, let $R(p)$ be the reservation price in labor for medical care of a person whose productivity is p. This reservation price is the maximum amount of time one would willingly devote to obtaining medical care. For every value of p, the reservation price is determined implicitly by the equality

$$\ln(pL) = \ln(p(L - R(p))) + 1, \tag{24}$$

where the left-hand side is one's utility without medical care, and the right-hand side is one's utility with medical care acquired at a rent-seeking cost of $R(p)$. A little manipulation of Equation (24) reveals that

$$R(p) = L(1 - e^{-1}), \tag{25}$$

which means that everybody's reservation price, regardless of productivity, is the same.

That being so, the equilibrium price, R^*, must be the common value of everybody's reservation price, and the allocation among people of medical care must be indeterminate. At a rent-seeking cost of R^* units

of labor, everybody is indifferent between acquiring medical care and not acquiring medical care, and one cannot predict who purchasers of medical care will turn out to be. The rich place the higher monetary value on access to medical care as well as on time; there is no predicting which will predominate. The implication in practice is that scarce access to medical care might be acquired by the rich or by the poor depending on the specifics of the tax system and the shapes of the utility functions.

Suppose, for example, that the utility function is $u = .x + q$ rather than $u = \ln(x) + q$. It can then be shown that the reservation price, in labor rather than in money, *decreases* with productivity, p, so that the poor, rather than the rich, become the "purchasers" through rent seeking of medical care.[6] There is nothing queer or anomalous about this result. Some public services are occupied by the poor rather than by the rich when access is by queuing rather than by willingness to pay cash.

INFLUENCE

In the old Soviet Union, bureaucrats were not especially well paid, but they were compensated by preferential treatment in the allocation of goods, including medical care, and by the right to shop at stores where goods unavailable to ordinary folk could be purchased at moderate prices. The delightful term *Nomenklatura* was invented to identify members of the ruling class not by their contribution to society or even by their authority but by their privileges in an officially egalitarian society. Nothing so blatant can be found in Canada or the United States, but "everybody knows" that there are privileged people among us who, by virtue of their influence, get first pick at government largesse. Admittedly, much that everybody knows is false, and it is difficult to produce hard evidence on the matter.

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There is considerable evidence that the poor have worse health and shorter lives than the rich, but it is hard to sort out cause and effect (see

Daniels, Kennedy, and Kawachi 2000). Do the poor have shorter lives because they have worse medical care, because income buys good health through better food and a healthier style of life, or because certain characteristics render people less likely to be wealthy and more likely to be ill? I cannot get to the bottom of this question. The most I can do is to present a few scraps of data from two studies, one from Great Britain and the other from Canada, on variations in life expectancy by social class.

The British data presented in Table 1 are remarkable for the size of the gaps between occupational classes and because, despite the introduction of the socialized medicine, these gaps appear to have widened over the period from 1930 to 1970. As shown in Table 1, people are divided into five occupational classes:

I: professional,
II: managerial,
III: skilled manual and nonmanual,
IV: partly skilled,
V: unskilled.

For each class, the table shows the "percentage of the group reporting illness" and "standardized mortality ratios," defined as the groups' percentages of the average mortality rate for the entire population with corrections for differences among classes in age and gender. For instance, the top right-hand corner of Table 1 shows that, among males from ages 15 to 65, the mortality rate of professionals is 77% of the average mortality rate for all occupations. The table shows that class differences are large and widening, although it should be borne in mind that a widening of a percentage difference may coincide with a narrowing of an absolute difference when, as is the case, all mortality is falling over time.

The Canadian data in Table 2 are for the city of Winnipeg in 1992, with people classified by income rather than by occupation. The five social classes are based on average income by neighborhood, a principle of classification that was, presumably, made necessary by the absence of direct evidence of health status by income. Among men, there is a full 10-year gap between the life expectancies of the wealthiest and the poorest quintiles of the population; among women, the gap is

TABLE 1: Illness and Mortality by Social Class in Great Britain

Social Class	Percentage of Group Reporting Illness, 1976	Mortality Rates (national average = 100)			
		1930-1932	1949-1953	1959-1963	1970-1972
I: Professional	17.0	90	86	76	77
II: Managerial	18.7	94	92	81	81
III: Skilled manual	21.9	97	101	100	104
IV: Partly skilled	25.5	102	104	103	114
V: Unskilled	32.1	111	118	143	137

SOURCE: Le Grand (1982, Tables 3.2 and 3.3).
NOTE: Some of Le Grand's categories have been combined or ignored.

only slightly less, 8 years rather than 10. Note also the unfortunate departure from gender equity among the poor, although the mortality experience of men and women is similar among the rich.

Two questions arise at this point: Who gets to allocate indivisible goods in the gift of the government? For whose benefit is the allocation undertaken? Whoever the allocator of public services may be, one would expect the allocation to be biased in his or her favor to a greater or lesser extent. Bias could range from relatively innocuous privileges, such as queue jumping for his or her family, to the out-and-out sale of access to medical care and other publicly provided private goods. With public provision of medical care, allocation would have to be undertaken by public officials or by the doctors themselves. When allocation is the responsibility of the medical profession, one would expect a doctor who can only care for so many patients and whose list is closed to the clerk at the local supermarket to extend "professional courtesy" to other doctors and their families and to accommodate a range of people who he or she finds especially sympathetic: golf buddies, a prominent lawyer in town, or an official of the Ministry of Health who can influence the remuneration of the medical profession. When allocation is the responsibility of public servants, medical services may be allocated in accordance with the interests of their political masters. First-class medical facilities may appear in constituencies that support the party in office: "Vote for me or expect your illnesses to remain untreated." Alternatively, influence may be exerted politically by pressure groups that may or may not be wealthy.

TABLE 2: Life Expectancy in Winnipeg, 1992

	Poorest Quintile	*Second Poorest Quintile*	*Third Quintile*	*Second Wealthiest Quintile*	*Wealthiest Quintile*
Males	65.3	70.5	72.8	74.3	76.6
Females	74.4	77.8	79.5	80.0	82.1

SOURCE: Roos and Mustard (1997, 89-111, Table 2).

Such influence intensifies conflict among social groups and regions of a country. Join a union and you can expect better medical care not because you pay for it through your dues but because the union is influential in the Ministry of Health. Vote for the party in office and you can expect better doctors and better medical facilities in your constituency. Call attention to yourself or convey the impression that you have favors to grant or can make life unpleasant if you are crossed, and you can expect better medical care at no extra cost. Politics becomes that much nastier as a win for one's party in an election becomes entitlement to medical care and for whatever else is being allocated by influence. A vote for the socialist party becomes a vote to supply medical care for union members but not for farmers. A vote for the conservative party becomes a vote to supply medical care for farmers but not for union members. Political leaders would be well looked after in either case. Politics becomes, quite literally, a matter of life and death.

CONCLUSION

One might draw two morals from the analysis. The first is that public provision of private goods may be a poor vehicle for the promotion of equality, especially when goods are indivisible. The reason is encapsulated in the old saying that "it's only money," that money is unimportant by comparison with goods. Take away a dollar, and one automatically loses a dollar's worth of the most dispensable bits of the bundle of goods that one consumes. Take away a dollar's worth of salt (on the understanding that the loss cannot be made up by purchase), and one may be seriously harmed. Public disposition of scarce goods and services can wreak enormous harm on those left out. Financially

equivalent redistribution from rich to poor may be borne with little inconvenience by the ultimate benefactors. Redistribution should be undertaken, wherever possible, with money. Public provision of private goods requires justification in market failure or externalities.

The other moral is that if the government is to provide indivisible goods, it should strive to ensure that there is enough to go around. That is not always possible. There may be an unavoidable shortage of kidneys available for transplant. Nevertheless, when the government has some choice in the matter, ordinary market allocation of scarce goods at one extreme and universal public provision at the other extreme may both be preferable to poorly funded public provision, with many omissions and exceptions. Poorly funded socialization gives rise to a great scramble for privileges in the gift of the government of the day. Strict uniform provision is the counterpart in expenditure to horizontal equity in taxation. Divergence from either has similar effects on the economy and on society in general. Travelers in the desert should carry enough water for everybody.

In the words of Carl Shoup (1964, 383),

> Little is known about the distribution of government services by location, race, race income class, or other category. Usually, no record is made, no estimate attempted. The laws providing the services are silent in this respect; the authorizing or appropriating committees of legislatures do not discuss it; budgets submitted by the executive say nothing about how a given service is to be distributed among the users. The silence reflects in part a social propensity to discriminate covertly in ways that are not tolerable in taxation, where the pattern of impact is more obvious.

NOTES

1. The natural first assumption about the public provision of private goods is that they would be allocated equally among all eligible citizens: equal schooling for all children, equal medical care for all sick people, equal public housing for all who would otherwise be homeless, and so on. I was typical of the literature in employing that assumption in my earlier piece on public provision more than 20 years ago (Usher 1977). Epple and Romero (1996a, 1996b) employed that assumption with some very interesting wrinkles. But even when goods are divisible, the meaning of equality is not as clear-cut and unambiguous as one might at first suppose, for equality may be

defined as input or as output, in total or at the margin. The problem was identified by Shoup (1964) and then developed by Kennett (1982).

2. On markets where goods vary in quality, see Rosen (1986). The market for medical care of varying quality has been discussed in an earlier version of this article (see Usher 1998).

3. In *The Strategy of Equality*, Julian Le Grand (1982) reviewed the principal items of public expenditure on private goods in the United Kingdom, found their redistributive impact to be disappointingly small, and concluded that public provision of private goods is no substitute for the simple redistribution of money.

4. The argument here is similar to an argument for random allocation of access to university education by Garratt and Marshall (1994). There is some question about the validity of the argument under different specifications of utility.

5. What is here called "public provision with a private fringe" is institutionally equivalent to what Epple and Romano (1996a, 1996b) called a GM (mnemonic for government-market) regime. Their model differs from the model presented here in that their publicly provided good (also called medical care) is not assumed to be indivisible. It is an ordinary good available in any amount at a constant rate of trade-off in production with the other good in the economy.

6. If $u = \sqrt{x} + q$, where q equals 0 or 1, then each person's reservation rent-seeking price for medical care becomes the solution to

$$\sqrt{[p(L - R(p))]} + 1 = \sqrt{[pL]}.$$

Differentiating this totally with respect to p, we see that

$$dR/dp = \left\{\sqrt{[L - R]}\right\}\left\{\sqrt{[L - R]} - \sqrt{[L]}\right\} / p < 0.$$

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