An Economic Analysis of Transplant Organs: A Comment and Extension

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I. Introduction

In a recent issue of this *Journal*, Barney and Reynolds (B-R) analyze three alternative organ procurement policies: the current altruistic system, a free market system, and a system of presumed consent (which B-R interpret as a reassignment of property rights in cadaveric organs from the deceased donor or deceased donor's family to the recipient at the time of death). This comparative economic analysis of alternative systems provides a useful first step toward the development of a more rational public policy toward organ procurements for transplantation purposes. Moreover, as B-R point out, this is an area of public policy that is in extreme need of objective analysis and serious debate.

Unfortunately, B-R's analysis contains several shortcomings that should be corrected before the policy debate proceeds. While none of these errors is particularly egregious in nature, they serve to cloud some potentially important issues. Specifically, three such areas need attention. First, some of the analytical statements concerning the social welfare effects of the alternative procurement systems are inaccurate. Second, B-R's economic interpretation of the policy of presumed consent is not appropriately qualified. And third, the model dealing with the economic effect of the input supply restriction brought about by the current altruistic system on the market for transplant operations is not fully explored.

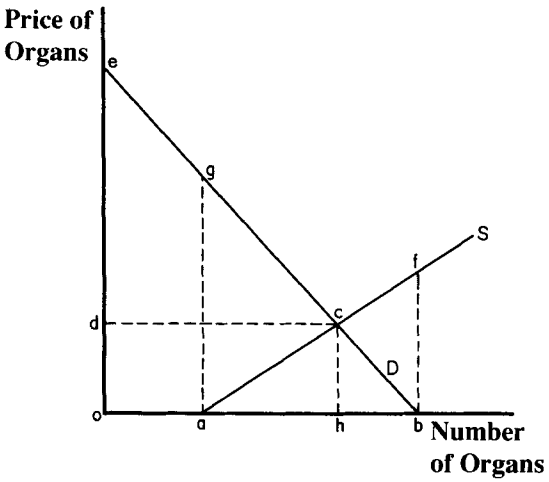
The purpose of this note is to correct, clarify, and extend the analysis presented by B-R. The objective is not so much to criticize the analysis itself as it is to tie up some loose ends so that further work can proceed from a more solid base. And such further work, one hopes, is imminent.

II. The Welfare Effects of Alternative Policies

B-R illustrate the social welfare implications of the three organ procurement systems via a graphical representation of the two vertically related stages involved in the production of transplant operations — the organ acquisition stage (which yields the necessary input for a transplant operation, an organ) and the transplant operation stage produced by surgeons and hospitals. In order to illustrate the basic shortcoming of their welfare analysis, however, it is not necessary to diagram both stages of production. The essential point can be demonstrated with a simpler graph that depicts the upstream (organ acquisition) stage only.

This graph is shown in Figure I, below. Here, D is the derived demand for some specific transplantable organ (hearts, lungs, livers, kidneys, pancreas, corneas, and bone marrow have all been successfully transplanted), and S is the organ supply curve. Given this demand and supply, the current altruistic system of organ procurement, which mandates a price of zero, yields oa organs for transplantation with an excess demand of ab. Under a market system, equilibrium occurs at point c which yields oh organs for transplantation at a price of od. And under a system which reassigns property rights in cadaveric organs from

FIGURE I



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the family of the deceased to potential organ recipients, *ob* organs will be collected and used in transplant operations.[1]

Now, B-R indicate in equation (7) of their paper that the consumer surplus realized under the current system is equal to the area *egao* (except that they choose to assess the magnitude of consumer surplus at the downstream stage while the equivalent magnitude at the upstream stage is shown here). This area, however, is not a precise measure of the consumer surplus realized under altruistic supply but is, instead, an upper bound on the consumer surplus obtained under this system. The reason for this systematic overstatement of the consumer surplus is that, under the current procurement system, price is not allowed to serve its normal role in allocating the available supply to consumers in descending order of their willingness to pay. In other words, the *oa* organs that are supplied under this system are not put up for bid. Rather, they are allocated by transplant surgeons and organ procurement officials on the basis of perceived *need*.

Basically, potential organ recipients are placed on a waiting list. Their position on this list is influenced by a number of objective and subjective criteria such as the length of time on the list, age, degree of tissue match, physical condition, and employment status. Despite these criteria, however, those responsible for maintaining these lists and deciding which potential recipient will receive a given organ that has become available (usually the chief surgeon at a transplant center) have considerable discretion in allocating available organs among the pool of potential recipients. Nonetheless, one's willingness to pay for the organ, which is revealed along the demand curve, usually has no bearing on the allocation decision.

As a result, the *oa* organs available under this system may very well be allocated to individuals located far below point *g* on the organ demand curve. Consequently, the consumer surplus realized under the altruistic procurement policy is less than area *egao* and may be substantially less. Then, because this area is subtracted from the overall social welfare realized under a market system (area *ecao*) to calculate the net welfare gain attributable to adoption of a market-based organ procurement system (which is given in equation (9) of B-R's paper), this latter calculation will represent an understatement of the total gain. Thus, B-R's equalities in equations (7) and (9) should be replaced with inequalities, with $a <$ in equation (7) and $a >$ in equation (9). This correction serves to strengthen the case for a policy change from altruistic supply to a market system of cadaveric organ procurement.

Although B-R do not discuss the welfare effects of moving from a policy that reassigns property rights to recipients to a free market policy, an analogous argument applies here as well. Under a reassignment of property rights approach, there is a *minimum* welfare loss equal to area *cfb* in Figure I. The reason this is a minimum is that, with potential recipients owning the organs of deceased individuals, there is no bidding mechanism in place to ensure that the organs are collected in ascending order of the supply prices of the prior owners. Consequently, under this system, organs may very well be taken from individuals or families who place a relatively high value on burying the body intact. Again, the market system is clearly superior on social welfare grounds and the net gain revealed in the graph is a lower bound on the actual welfare gain realized by movement to a market system of organ procurements.

Finally, B-R point out that potential transplant recipients may engage in advertising or public appeals in order to improve the odds that they will obtain an organ. Such behavior may be characterized as rent-seeking, and it is not limited to advertising efforts alone. For example, it appears that certain wealthy individuals have managed to improve their positions on official waiting lists by making substantial *donations* to transplant centers.[2] Consequently, realized consumer surplus under the current altruistic procurement system is

[1]For reasons discussed later in this paper, a policy that provides strong property rights in the deceased's organs to potential organ recipients does not, in fact, correspond to current versions of a policy of presumed consent. Moreover, if property rights are reassigned and market transactions are not proscribed, then equilibrium will occur at point c under this system and well.

[2]Additional rent-seeking activities occur on the supply side at the transplant operation stage of production. These activities are discussed in detail in Section IV.

reduced even further as such surplus is disappated on a variety of socially unproductive rent-seeking activities.

III. The Economics of Presumed Consent

B-R characterize the policy of presumed consent in the following way [1989, p. 15]

> "An alternative property rights structure is 'presumed consent.' Under this policy, the rights to the transplantable organs are assigned to some agency (the medical association, state, hopsital, and the like) that can allocate the organs to recipients. Under presumed consent, with the property rights assigned to the acquiring agency, the family or the victim (presumably with a card) must inform the system if they *do not* wish to be a donor. Thus, the policy essentially reduces the costs of being an organ donor, and imposes costs on those who do not want to donate."

Because the potential donor can *buy back* the organs at a nominal price of zero and, it would appear, at a full price that is very close to zero, a policy of presumed consent does not appear to constitute a meaningful reassignment of property rights. Where one can withhold supply simply by stating a preference to do so, property rights can hardly be said to have been taken away. If one wishes to view this policy as a reassignment of rights to the transplantable organs from the donor's family to the state or potential recipients, then it must be recognized that the legal restraints placed on these rights are so severe as to make them virtually worthless. Where individual *A* can take an asset from individual *B* merely by stating a desire to do so, individual *B* does not hold any significant property right in the asset.

Although the policy of presumed consent does not represent a true reassignment of property rights, B-R correctly point out that it shifts some transaction costs onto the potential donor or the potential donor's family. That is, to claim their property rights to the organs (i.e., to bury them), these parties must explicitly state a preference not to donate.[3] The important question for public policy then becomes: How many potential donors place a low enough value on burying the body intact to make it optimal for them to refrain from bearing the (apparently very low) costs of exercising their property right? That is, with regard to Figure I, how far to the right will this policy shift point *a*? Because the cost of refusing to donate is so low under this policy, very few additional organs can be expected to become available under presumed consent.

Under the current altruistic system, a physician or other hospital official must approach the family of the deceased to request permission to collect the needed organs. By the same token, under presumed consent, a hospital official will probably have to inform the family of their right to refuse to donate. Thus, in practice, presumed consent is not likely to differ significantly from the current system. Consequently, these two alternative systems are likely to produce approximately the same number of organs for transplantation. The question of the impact of a policy of presumed consent, however, is (as B-R point out) an empirical one that is in serious need of investigation. An analysis of the organ collection rates of those countries that have adopted this system should provide the needed answers.

Finally, another important characteristic shared by a policy of presumed consent and the current altruistic system is that, unlike the free market approach, neither of these policies supplies a direct profit motive for organ collection. Although such a motive may be offensive to some, the search for profit, as Adam Smith first pointed out, has channeled private energies into serving the public good for many centuries. In this instance, the invisible hand of the marketplace, by increasing the number of organs made available for transplantation, can save lives and alleviate suffering. Therefore, those who oppose reliance on market forces to solve the organ shortage are, in effect, trading lives for a policy whose only *virtue* is that it denies monetary compensation to organ suppliers. The alleged ethical superiority of such an exchange is far from obvious.

An interesting procurement option which contains elements of both presumed consent and market procurement was pointed out by an anonymous referee. A tax on organs could be added to

[3]Thus, the motivating force behind this policy is laziness (people will not bother to bear even the small costs required to exercise their property right to bury the body intact), while the motivating force behind the market approach is greed. Without meaning to sound too pessimistic about human nature, history teaches us that both of these characteristics are more ubiquitous than altruism. Consequently, either of these two policies (presumed consent or market forces) is likely to yield more organs for transplantation than the current system.

the current inheritance tax. Cadaveric organs donated for transplantation could then be exempted from taxation. The referee suggests that such a tax "should make an immensely larger than necessary supply of organs available for transplant." He also suggests that a tax on undonated organs could be a rare example of a tax which is actually popular.

Despite some reservations about such an approach, it is certainly innovative, provocative and deserving of further attention. However, a careful treatment of the inheritance tax approach to organ procurement is beyond the scope of this note.

IV. The Altruistic Procurement System as a Cartel Enforcement Mechanism

B-R recognize that the current system of organ procurement enables surgeons and organ transplant centers to capture economic rents from demanders of transplants. Simply put, they base their conclusion on the observation that organs are but one input into the organ transplant procedure. By setting the price paid to organ donors at zero, the availability of organs is restricted. The resulting smaller number of transplantable organs in turn limits the number of possible transplant procedures and, therefore, increases the demand price for transplant operations. Part of this increase in the demand price for transplants can be captured by suppliers of other inputs. Hence, as the principal suppliers of other inputs, surgeons and transplant centers can capture rents by restricting the number of organs supplied.

B-R's conclusion is entirely correct. Indeed, the authors of this note have made the same argument elsewhere.[4] However, B-R do not fully explore the implications of their hypothesis. Further, while they recognize that dialysis is a substitute for kidney transplantation, they do not observe that suppliers of dialysis services (many of whom are physicians) can also benefit economically from a kidney shortage.

For many potential kidney recipients, dialysis is both a substitute for transplantation and a means of survival until a suitable organ can be found. Hence, a shortage of organs increases the demand for dialysis. This higher demand, in turn, increases the profitability of dialysis centers. Moreover, the high rate of entry by for-profit dialysis centers suggests that these profits are large. The number of for-profit providers of dialysis has increased by more than 150 percent since 1980. Table 1 provides more detailed renal provider statistics.

The potential benefit of a supply restriction on organs is, perhaps, less obvious for transplant centers. Nonetheless, it is easy to show that, by restricting the quantity supplied of an essential input, the quantity of output is similarly restricted, and the potential profits of the industry are increased. This result is demonstrated in Figure II. Here, MC_t is the marginal cost of performing the transplant operation, and D_t is the market demand for transplant operations with associated marginal revenue of MR_t. S_o is the supply curve of transplantable organs. Due to the fixed, one-to-one, ratio of organ input and transplant output, the derived demand for transplantable organs, D_o, is equal to the demand for transplants minus the marginal cost of performing the transplant operation. Thus, in Figure II, $D_o = D_t - MC_t$.

If organs were subject to purchase and sale, *and* transplant operations were competitively supplied, the market supply curve for transplants (including the organs) would be S_t^c. Under such competitive conditions, market equilibration yields Q_t^c transplant operations at a total price of P_t^c per operation, where this price includes the price of the organ, P_o^c. Note that supply and demand of both operations and organs equilibrate at identical outputs (i.e., $Q_t^c = Q_o^c$). At this competitive solution, the price of the transplant minus the price of the organ input just equals the marginal cost of the transplant operation, i.e., $P_t^c - P_o^c = MC_t$. As a result, transplant surgeons earn a competitive return.

Under conditions of monopoly supply of transplant operations, transplant surgeons would restrict output to Q_t^M, where the marginal cost of transplants equals the marginal revenue of transplants. The organs needed for these transplants can be obtained free of charge as the organ supply curve falls on the horizontal axis at this level of

[4]See Kaserman [1989] and Kaserman and Barnett [1989].

TABLE 1

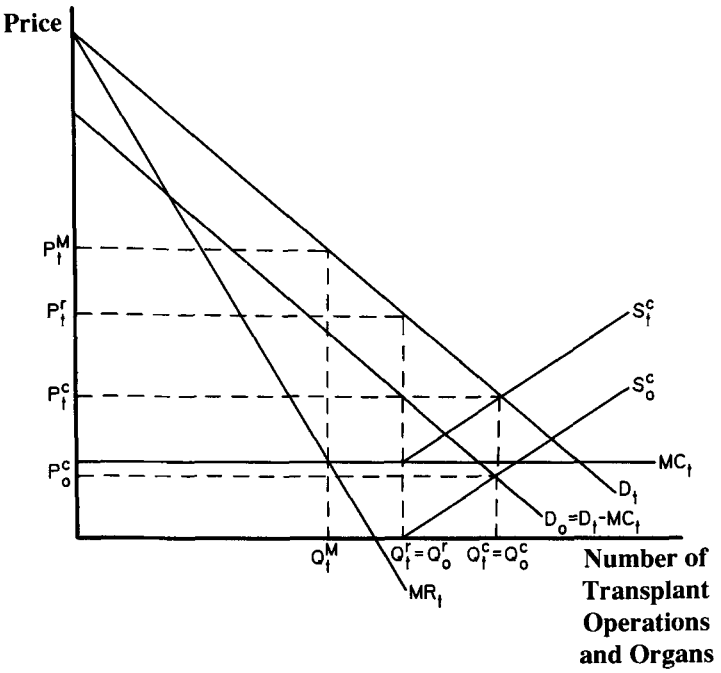
Medicare Renal Provider Statistics, by Calendar Year 1980-88

Calendar Year	Total Providers	Total Hosp-Based Providers	Hospital Dialysis Providers	Independent Providers	Transplant Providers	For-Profit Providers	Approved Outpatient Stations
12/80	1,054	649	636	405	151	343	12,329
12/81	1,162	676	657	486	157	408	13,784
12/82	1,218	690	642	528	159	437	14,438
12/83	1,308	682	620	627	159	504	15,506
12/84	1,368	700	622	668	170	544	16,594
12/85	1,463	715	632	748	178	616	17,845
12/86	1,578	717	639	861	184	715	19,383
12/87	1,701	741	660	960	199	805	21,246
12/88	1,819	753	668	1,066	202	907	22,605

Source: U.S. Department of Health and Human Services [1989].

FIGURE II

THE PROFITABILITY OF A RESTRICTED SUPPLY OF ORGANS



output.[5] At this price and output, transplant demand would necessarily be in the price elastic region, and industry profits would be at the maximum possible level. These profits are given by the area $(P_t^M - MC_t)\ Q_t^M$ in the graph.

In order to restrict supply to this level, however, it would be necessary for transplant surgeons to form a cartel which would set price at P_t^M and establish quotas on the number of operations each surgeon could perform, so that the total output would equal Q_t^M. Such a cartel would face the perennial problems encountered by all such arrangements — entry and cheating. The excess profits that exist at the P_t^M, Q_t^M solution attract new producers into the industry and create strong incentives for cartel members to expand production beyond the authorized amount.

Such output-expanding activities are effectively prevented by restricting the number of transplantable organs available. By forcing a zero price on organs, the quantity of organs supplied is artificially restricted to Q_o^r, thereby restricting the number of transplants to Q_t^r. Economic reasoning suggests that $Q_t^M < Q_t^r < Q_t^c$. That is, the current number of transplants is between the monopoly and competitive levels. This conclusion is supported by two considerations. First, transplant demand is price inelastic at current output levels. This suggests that $Q_t^M < Q_t^r$, because monopoly output always falls in the elastic region of demand. And second, there is currently significant excess demand for transplantable organs. This suggests that $Q_t^r < Q_t^c$, because, as noted above, the organ market clears at the competitive solution.

Thus, it appears that, by adopting an organ procurement policy that relies upon altruism for supply, surgeons are able to successfully restrict transplant output below the competitive level. Such output restriction, in turn, increases profits above the competitive level. The profits that surgeons receive from an altruistic organ procurement policy are shown as the area $(P_t^r - MC_t)\ Q_t^r$ in the graph. Thus, a system that relies upon altruism at one stage of production can serve the purpose of greed at another.

Physicians are not likely to publicly oppose a market-based system of organ procurement on the grounds that their personal fortunes are at stake. Instead, support for the current system is likely to be based upon other concerns of an ethical nature. Moreover, these expressions of concern are not necessarily artificial, false, or insincere. Given the complexity of the issues involved, the paucity of available information, the sometimes intentional obfuscation of opposing parties, and the uncertainty concerning the actual parameters of supply and demand, the latitude of ostensibly defensible positions is great in this area. Nevertheless, the current prohibition of organ markets serves to enforce a cartel for transplant providers.

The enforcement mechanism is imperfect, however, because entry of new transplant providers is possible. If economic profits are created by the organ shortages, one would expect new transplant centers to enter the market. This is precisely what is now being observed. A recent *Wall Street Journal* article [Winslow, 1989] chronicled the "rush to transplant organs," noting that "Health care experts fear an explosion in the number of transplant facilities ... diluting expertise for these expensive and complex operations."

In most markets, the entry of new firms into a profitable industry drives price down to the competitive level. Since organ prices are fixed at zero, however, the entry of new transplant centers cannot generate a significant increase in the number of organs supplied. An increase in the number of such centers may increase public exposure for organ donation programs and, therefore, marginally increase donations. But, for the most part, new entrants will simply compete with existing centers for a relatively constant pool of organs. Thus, entry results in more transplant facilities, each performing fewer transplant procedures. Consequently, unless average costs are independent of the number of transplants performed, additional entrants induce production inefficiencies as providers are forced to produce at less than minimum efficient scale.

Assuming that average costs for a transplant facility decline over some range of transplant procedures, entry will continue until costs are

[5] In fact, in the situation depicted here, there would be an excess supply of organs equal to the distance $Q_t^r - Q_t^M$, which would require disposal. This, however, is not a general result.

driven up to equal average revenue.[6] Economic profits then will be driven down until they are zero for new entrants. In short, profits fall to zero not because entry drives price down to competitive levels, as in the traditional neo-classical theory of the firm, but because average costs for new entrants are driven up to meet cartel prices. Long-run equilibrium is thus achieved with zero profits at the margin and cartel, not competitive, prices.

Further, this equilibrium may be characterized by permanent above normal profits for some transplant centers. Whether a cost (scale) advantage, and hence economic profits, persists for some suppliers depends upon how successful the older transplant centers are at protecting their ability to procure organs. If new entrants are able to acquire organs at the same rate as these older centers, profits will tend toward zero for all firms. In this case, long-run equilibrium will be characterized by many producers, all producing at an approximately equal rate of output that is lower than minimum efficient scale. Both prices and average cost will be above competitive levels.

If, on the other hand, existing transplant centers are able to protect their sources of organs,[7] then new entrants will produce at much lower than minimum efficient scale, while earlier entrants will continue to produce at a more efficient scale. New entrants will therefore earn only normal profits but earlier entrants will earn positive economic profits.[8]

V. Conclusion

The recent paper by B-R should be applauded for bringing to light an extremely important and controversial public policy issue. The authors of this note have been students of antitrust, regulation, and related microeconomic policy issues for over fifteen years. Yet, they can safely say that they have never encountered a single policy that is more at odds with the public welfare than is the current organ procurement policy.

As economists, it is easy to describe and analyze the tremendous inefficiencies, waste, and market distortions created by the current altruistic system. But as human beings, the authors are incensed at the unnecessary suffering and loss of life that is caused by the current policy and is so poorly revealed in formal diagrams. Hopefully, B-R's paper, along with this corrective note, will help to spawn a more rational public policy toward cadaveric organ procurement.

[6]There appears to be widespread concern among experts in the transplant field that the number of transplants performed by many centers is below the minimum efficient scale. See Winslow [1989].

[7]This may be possible because of reciprocal agreements, personal relationships, the power of reputation and other factors which give existing centers a procurement advantage over new entrants. For example, in a cost cutting move, Prudential Insurance company directs policy holders to one of about a dozen transplant facilities based on the experience of surgeons and the number of procedures performed. Centers on the Prudential list therefore have a larger pool of transplant recipients and, as a consequence, perform a larger number of transplant operations. See Winslow [1989].

[8]Of course, it could be argued that physicians and transplant centers are price takers, not price setters as the analysis here implies. This is because HCFA establishes fees that will be paid for transplant services. However, these fees are set incorporating information about production costs, which are inflated by production inefficiencies, and customary charges for services, which reflect market conditions. In short, while the influence of induced shortages on fees paid to health care providers may be less direct than the analysis assumes, the direction of the effect of organ shortages on prices will have the same signs as those predicted. Only the magnitude of the effect would be affected by this indirect price-setting mechanism.

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