

A positive analysis of financial incentives for cadaveric organ donation

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Abstract

Financial incentives of various kinds have been suggested to alleviate the chronic shortage of transplantable organs in the United States. This paper analyzes the possible consequences of financial incentives on organ supply. We show that under current practice and current law (which are not the same), inducements to donate organs or to register as an organ donor may lead to a decline in the supply of organs. Furthermore, some financial incentives that have been proposed lead to time inconsistent choices. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

On 31 October 1999, 66,175 patients in the United States were on waiting lists for one or more organ transplants. During 1998, there were 10,073 organ donors, of whom 5799 were cadaveric donors capable of supplying more than a single kidney or the lobe of a liver (UNOS, 1999). These numbers distort the gap between organ demand and availability in various ways. On the one hand, the gap is exaggerated because most patients are awaiting a single organ and because cadavers capable of supplying one transplantable organ are often also capable of supplying more than one. On the other hand, the criteria used to admit patients to waiting lists are stringent in part because of the shortage of transplantable organs (Randall, 1991; Barnett et al., 1992). Nonetheless, it is clear that the shortage of organs is acute, and the shortage is the main reason that over 4000 patients on waiting lists died during

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1998. The situation has also been deteriorating for some time. Since 1988, the number of patients on the waiting list has risen 313 percent; at the same time, the number of cadaveric donors has risen only 42 percent, even though medical advances have allowed the standards for cadaveric donation to be relaxed.

Chronic shortages of organs have led to numerous proposals to provide financial inducements for cadaveric organ donation. Nor have all these proposals emanated from academia, where there is often a reward for, but little cost of, making daring proposals. In response to a resolution introduced at the 1993 annual meeting of the American Medical Association (AMA), its Council on Ethical and Judicial Affairs produced a report on the use of financial incentives to enhance cadaveric donation (CEJA, 1995) in which they concluded that '(t)here is enough evidence in favor of employing some form of financial incentive to justify the implementation of a pilot program.' One such pilot program does, in fact, exist: Pennsylvania's organ donor law, which came into effect in 1995, allows state residents renewing their driver's license to donate US\$ 1 to a Donor Awareness Trust Fund (Eshleman, 1994). Ten percent of this fund was reserved in trust for families of organ donors to recover funeral expenses. By January 1999, the trust had accumulated US\$ 300,000, and families were granted leave to apply for grants, each not exceeding US\$ 300.¹

Over the past decade, a large literature on financial incentives has developed. Much of this literature has consisted of a proposal for an ad hoc incentive, and a discussion of its ethical properties. This paper contributes to the debate by studying the positive consequences of these proposals. There is a small economics literature on financial incentives for organ donation that has emerged in recent years, but we find ourselves methodologically at odds with much of it. Barney and Reynold's (1989) analysis of financial incentives for organ donation, and the subsequent corrections to their analysis by Kaserman and Barnett (1991), treat organs as a production good that can be adequately modeled with the standard tools of supply and demand curves. Our impression of these contributions is that, in a model that bears little resemblance to the institutional structure in which organs are procured and transplanted, the first welfare theorem has been restated. Blair and Kaserman's (1991) support for market incentives in both procurement and allocation similarly rests on little more than the standard supply and demand model, but they do pay substantial attention to weaknesses in the current institutional arrangements. However, well-worn arguments that the market for livers would function more effectively if only it looked more like the market for pork bellies are not going to earn economists a bigger voice at the policy-making table.²

Health care policy is made in a distinctly second-best world. This paper analyzes positive aspects of financial incentives for organ donation in a setting that attempts to capture some of those second-best features. We study rational agents with well-defined and stable propensities to donate organs and who, *ceteris paribus*, respond in the usual manner to financial rewards. But we also acknowledge that agents are altruistic, and that they are constrained by social customs that should not be assumed away. In this setting, we find that some proposed

¹ The program is in place despite the prohibition, under the 1984 National Organ Transplant Act (PL98-507), on the sale of human organs.

² As an interesting exception, Howard (1999) has modeled organ acceptance as an optimal stopping problem to be solved by physicians. He generates a negative correlation between the average quality of transplant organs and the length of the waiting list.

financial incentives can induce perverse supply responses. Some proposals may also fail because they induce time inconsistent choices.

These results are obtained in a setting in which potential donors signal their preferences regarding organ donation by registering, or failing to register, as an organ donor. In a society that customarily does not discuss issues related to death, surviving family members update their beliefs about their loved one's preferences from the registration decision, and use the signal as a guide when deciding whether to grant approval for organ harvesting. We show that financial incentives, whether paid as a reward for registration or whether paid as a reward for donation, distort the signal that registration makes about preferences in such a way as to permit perverse supply responses.

Excluding perverse responses requires two institutional changes. First, autonomy must be granted to registered donors, thereby avoiding the need to secure permission from surviving family members. The 1969 Uniform Anatomical Gift Act (UAGA, amended 1987) does in fact contain just this provision although, as we explain later, no organ procurement organizations (OPOs) assert their rights under the law. However, practicing what the UAGA allows is insufficient. Under the UAGA, failure to register as a donor is not taken to mean that the individual is opposed to organ donation. For individuals not registered as donors, permission for organ harvesting is to be sought from family members, and their response is again subject to the signal noise introduced by financial rewards. Thus, the second requirement to exclude perverse responses is that every individual be required to register either as a donor or as a non-donor. Obviously, these two changes need not induce an increase in the supply of organs. However, they do ensure that supply responses to financial incentives are normal, and that there exists a price at which sufficient organs will be donated.

Time inconsistency arises in proposals to provide a reward for registration as a donor. Under such proposals, there will be a non-trivial fraction of the population who register as a donor to receive the reward, but who will prefer not to have their organs harvested after receiving the reward. If implicit contracts are not enforced, the outcome is that everyone registers as a donor but the eventual supply of organs is unchanged from the status quo ante. Time-inconsistent contractual obligations that are enforced are an example par excellence of the commodification of the human body, and as such are probably prohibited by PL98-507.³ To avoid time-inconsistent contracts, financial rewards must be payable posthumously only after organ donation has taken place.

The layout of the remainder of the paper is as follows. Sections 2 and 3 describe the institutional environment for organ procurement, and a taxonomy of proposals. Section 4 analyses the signaling problem that arises whenever surviving family members have a say in organ donation. Section 5 explains the time consistency problem. Section 6 concludes, and suggests an attainable institutional environment in which time inconsistency and perverse supply responses are not possible.

Before proceeding, we should also delineate clearly what this paper is *not* about. The use of incentives to promote cadaveric organ donation raises profound ethical issues which

³ In an analysis of advance directives (Byrne and Thompson, 2000), we have argued that time consistency is a principal criterion by which to judge whether a policy is medically ethical.

have motivated a large and unresolved literature;⁴ it raises questions about the sensitivity of altruism to financial incentives;⁵ and it remains unclear whether financial incentives are politically acceptable.⁶ This paper addresses none of these issues because economists have little to offer, methodologically speaking, to the debate surrounding them.⁷ It follows that no advocacy is intended in this paper.

2. Institutions

To understand current arrangements for organ procurement in the United States, it is important to distinguish between current *practice* and current *law*. Under current *practice*, individuals are encouraged to indicate their willingness to be a donor by registering, most commonly at the time they obtain or renew a driver's license. The decision to be a registered donor is reversible at any time. Donor registration is not presumed to confer on the state any rights to an individual's organs upon his or her death. Nor is an individual's decision not to register presumed to preclude the state from harvesting organs. When an individual with potentially transplantable organs dies, parties interested in procuring organs obtain consent from the deceased's next of kin. Without this consent, organs are not harvested even if the deceased was a registered donor; with consent, organs may be harvested even if the deceased was not a registered donor.

Much of this has little to do with current *law* in most states. The 1969 Uniform Anatomical Gift Act (UAGA, amended 1987) established proposals⁸ allowing individuals to carry a legally binding statement of his or her wishes regarding organ donation. The overriding principle of the UAGA is that the wishes of the individuals must be respected. Thus, it is possible to register as a donor, or register as a non-donor, in such a way as to neutralize the decision-making authority of surviving family members. Few organ procurement organizations (OPOs) avail themselves of this legal right, and they continue to subject themselves to family veto power (Overcast et al., 1984). The decision of OPOs not to exploit their

⁴ Recent papers include Keyserlingk (1990), Dossetor and Manickavel (1991), Pellegrino (1991), and Caplan et al. (1993). Societal values about the rights of the dead as expressed through case law are discussed in Nelkin and Andrews (1998).

⁵ See Belk (1990), Dossetor and Manickavel (1991), and Prottas (1992), DeJong et al. (1995).

⁶ Altshuler and Evanisko (1992) and Guttman and Gutmann (1992) study the attitudes of health-care providers. Prottas (1992), DeJong et al. (1995), and Cosse et al. (1997) survey public sentiment.

⁷ Economists lacking training in ethics almost invariably express narrow consequentialist or utilitarian ethical views. This focus reflects but a subset of the wider ethical debate and appears to be governed primarily by economists' methodological training. For an example of economists' take on the ethical debate, see Barnett et al. (1992) in which the ethical issues raised and discarded are concerned only with consequences.

⁸ Uniform Laws are legislative proposals that have no legal force until adopted as state law. Most Uniform Laws are adopted only after revision, and so the law is rarely uniform across states. Uniform Laws are prepared by a non-governmental organization, the National Conference of Commissioners on Uniform State Laws. Roughly half of the Uniform Laws proposed by the Conference since its inception in 1892 have not been adopted by a single state. However, the Uniform Anatomical Gift Act of 1968 had been adopted (after revisions) in every state by 1972. The 1987 revision removes the requirement for witnesses to the potential donor's signature and strengthens the wording indicating that family permission is not required; the latter revision was to 'relieve the anxieties of those in a medical setting who could not bring themselves to believe that the 1968 Act really allowed them to rely on the document of gift.' (NCCUSL, 1999). By 1999, the 1987 revision had been adopted in 22 states.

rights under the UAGA has generally been encouraged by states. Florida is typical. Its law states that ‘An anatomical gift made by an adult and not revoked by the donor . . . is irrevocable and does not require the consent or concurrence of any person after the donor’s death.’ (Fla Stat. 732.912 (1)). At the same time, information provided by various state departments promoting organ donation indicates that donors should make sure to explain their preferences to their families, and that family members will be asked permission for donation.

The United States therefore offers two distinct institutional arrangements. Customary practice grants family members all decision-making rights, whether or not the deceased individual had previously expressed a preference. The other, usually permissible by law but not followed in practice, excludes the family from the decision-making process altogether whenever an individual has expressed a preference. Other countries’ arrangements fall into one of these two categories, although sometimes with significant changes in detail. While Britain requires permission from next of kin, Belgians are presumed to have provided the state with consent to harvest organs unless they specifically register an objection. Presumed consent, absent documentation to the contrary, also exists in Austria, Australia, Denmark, Finland, France, Norway, and Switzerland, among others.⁹ But, as in the United States, there is often a distinction between law and practice, and presumed consent does not always bypass the potential family veto: for example, it remains normal practice in both Australia and France to seek family consent.¹⁰

3. Proposals

A comprehensive listing of the myriad proposals that have emerged in the literature during the last 20 years or so would be impractical. However, one can usefully distinguish among them along two dimensions.

- Some incentives are explicitly financial. These proposals include cash payments, contributions to burial expenses and discounts on estate taxes.¹¹ Most authors have suggested a specific monetary amount, although the numbers are generally arbitrary.¹² Barnett et al. (1992) have suggested that market forces be allowed to determine the appropriate (i.e. equilibrium, in economists’ parlance) price. Other proposals provide valuable consideration for which explicit market prices have not been established. For example, changing from an opt-in to an opt-out donor registration program alters the relative (opportunity) costs of being a donor and not being a donor. Kleinman and Lowy (1989) have proposed

⁹ The important institutional distinction here is that presumed consent neutralizes family veto power; the difference between opting in and opting out is, as discussed, more conveniently viewed as an implicit financial incentive.

¹⁰ See Thompson et al. (1995), Dorozynski (1998), and Roels (1999).

¹¹ Proposals along these various lines have been made by Brams (1977), Schwandt and Vining (1986), Rinehart (1988), Cohen (1989), Kevorkian (1989), Barney and Reynolds (1989), Blair and Kaserman (1991), Kaserman and Barnett (1991), Kittur et al. (1991), Peters (1991), Altshuler and Evanisko (1992), Barnett et al. (1992), and Khanna (1992).

¹² For example, Peters (1991) suggested US\$ 1000.

that each adult be allowed to enroll in an organ donation program, in return for which he or she would receive priority for organs needed at a later date.¹³

- Some rewards are intended to be given in exchange for registration as a potential donor. Others are to be given in exchange for organ donation.

Kleinman and Lowy's (1989) proposal is a prominent example of a registration reward. Rewards for donation are, naturally, to be given to surviving family members. For our analysis, it is this second dimension that matters. Non-financial incentives can in principle be valued in terms of monetary equivalents. Similarly, a monetary equivalent payment to the potential donor can be employed to value rewards payable to the potential donor's family. The timing of the reward will prove to have important consequences for the following analysis.

4. The signaling problem

When organ procurement organizations defer to the wishes of surviving family members, donor registration is nothing more than a signaling device which may be helpful in a society in which issues related to death are rarely discussed.¹⁴ In this section, we show that payments distort the signal that registration makes about preferences for organ donation. It is then easy to construct examples in which a payment induces a perverse supply response. The formal analysis, in Section 4.1, is carried out in a setting in which a reward is paid upon registering as a potential donor. Section 4.2 explains that the signaling problem is much the same when payments are made posthumously. Finally, Section 4.3 asks whether the UAGA, which grants autonomy to registered donors but requires that OPOs seek consent from the families of non-registered individuals, resolves the problem. It does not.

4.1. Registration rewards

Two settings are analyzed. In the first, the utility of a potential donor is directly affected by the registration decision. In the second, her utility depends on whether or not she expects her organs actually to be donated after her death. The first setting, which may be interpreted as a form of donor myopia, is easier to analyze. The second setting leads to a two-stage game in which the registration decision is a strategic choice variable. However, while the two-stage game may be more satisfying on theoretical grounds, we are not convinced that it is a more realistic representation of the decision problems facing potential donors.

¹³ See also Schwindt and Vining's (1998) recent proposal for a mutual insurance pool.

¹⁴ Donor registration also provides a useful signal to officials: the state informs family members that the deceased was a registered donor in an attempt to influence their decision; most states advise donors at the time of registration to discuss their preferences with their family; and some states also use donor registration as a means of targeting advertising, so that only registered donors receive literature encouraging them to discuss their preferences with family members. For example, the Illinois Donor Registry, established in 1992, is used as a mailing list for letters with the message to 'tell your family'. 3.2 million drivers (39 percent of the driving population) registered as donors and received these letters. The remaining 61 percent that chose not to participate have not been urged to talk with family members about their donation decision.

4.1.1. A model with donor myopia

An agent decides whether or not she would like to have her organs donated upon death. She signals her preference by registering or failing to register as an organ donor. Two parameters influence the agent's decision. First, there is the psychic reward to being a donor that depends on an agent-specific taste parameter, $\phi \in (-\infty, \infty)$, where a larger ϕ represents, ceteris paribus, a greater preference for being a donor. For ϕ small enough, the psychic reward from being a donor is negative. Second, the state may offer an incentive with value r to all agents registering as donors. Let $U = U(\phi, r(a); a)$ denote the agent's utility; $a = \{0, 1\}$ is a choice variable taking the value 1 if she registers as a donor, and zero otherwise. Under the status quo ante, $r(a) = 0$ for $a = \{0, 1\}$; the incentive proposal sets $r(0) = 0$ and $r(1) > 0$. Utility is continuous with bounded derivatives with respect to its first two arguments.

Let $u(\phi, r) = U(\phi, r(1); 1) - U(\phi, 0; 0)$ denote the net gain in utility if the agent becomes a registered donor. Letting subscripts denote partial derivatives, it is assumed that $u_\phi > 0$ and $u_r > 0$. Moreover, it is assumed that $\lim_{\phi \rightarrow -\infty} u(\phi, r) < 0$ and $\lim_{\phi \rightarrow \infty} u(\phi, r) > 0, \forall r$. From these assumptions, it is easy to verify that there exists a unique interior value, $\hat{\phi}(r)$, such that $u(\hat{\phi}, r) = 0$, and that the agent's optimal strategy is to choose $a(\phi) = 1$ iff $\phi \geq \hat{\phi}$. Differentiation of u establishes that $\hat{\phi}'(r) < 0$.

Upon her death, the state is required to ask the agent's closest surviving relative whether he will allow her organs to be harvested. The relative cares about his own preferences, $\lambda \in (-\infty, \infty)$, for organ donation, and the preference, ϕ , of the deceased. His utility is given by $V = V(\lambda, \phi; h)$, where $h = \{0, 1\}$ takes the value 1 if permission to harvest organs is granted, and zero otherwise. The fact that a payment, r , may have been made at some time in the past is of no direct consequence. The difficulty for the relative is that he does not know the preference of the deceased, but must infer it from observing whether or not she had registered as a donor. Individual values of ϕ are not observable, because social taboos and custom prevent individuals from accurately communicating their preferences to others. The imprecise nature of the surviving relative's knowledge is captured in the usual way: he believes that the agent's ϕ is a random draw from some (perhaps agent-specific) density function $f(\phi)$.

The key result is that introduction of an incentive payment $r(1) > 0$ distorts the signal about ϕ in such a way that the family member's posterior estimate of ϕ is adjusted downwards whatever the decision a . This result is expressed formally in the sense of first-order stochastic dominance:

Proposition 1. Let $g(\phi|a; r)$ denote the posterior density of ϕ after observing action a . For any $r > 0$, and any $x \in (-\infty, \infty)$, $\int_x^\infty g(\phi|a; r) d\phi \leq \int_x^\infty g(\phi|a; 0) d\phi$.

Proof. See Appendix A. □

The analysis has not assumed that the surviving relative has no information about the agent's preferences (i.e. $f(\phi)$ may be different from the population density). However, under this condition, the intuition behind Proposition 1 is more easily seen and is as follows. When a donation payment $r > 0$ is introduced, the only agents who change strategies are those whose preferences lie in a compact interval with upper bound $\hat{\phi}(r)$; these individuals

switch from $a=0$ to $a=1$. In doing so, they add mass to the lower tail of the density of ϕ over individuals choosing to be donors, and they remove mass from the upper tail of the density over individuals choosing not to be donors.

It is now a simple matter to construct an example in which financial incentives reduce the supply of organs. Assume that the relative's utility function takes the linear form $V = (\phi + \lambda)h$. He will only grant permission for organ harvesting if the conditional expectation of the preference parameter, ϕ , exceeds $-\lambda$. Let $E(\phi|a, r)$ denote the conditional expectation of ϕ given observed action a and payment r . First-order stochastic dominance implies that $E(\phi|a, r > 0) \leq E(\phi|a, r = 0)$; the optimality condition for the potential donor implies that, for any r , $E(\phi|0, r) < E(\phi|1, r)$. Consider, then, the following feasible sequence of inequalities: $E(\phi|0, r > 0) < E(\phi|0, r = 0) < E(\phi|1, r > 0) < -\lambda < E(\phi|1, r = 0)$. Given these inequalities and no payment, the relative agrees to organ harvesting only if the agent had registered as a donor. Once the state raises the payment to $r > 0$, however, permission will not be granted even if the agent was a registered donor. Note that the payment encourages registration, so the supply of organs may decline at the same time that the number of registered donors rises. Similarly, if $E(\phi|0, r > 0) < -\lambda < E(\phi|0, r = 0)$, permission to harvest organs is always granted when $r=0$, but it is granted only for the organs of registered donors when $r > 0$.¹⁵

As noted, the previous analysis has not assumed that the surviving relative has no information about the agent's. However, the probability that financial incentives induce a perverse supply response does depend on the degree of prior uncertainty embodied in $f(\phi)$. As the precision of the prior estimate of ϕ rises, the difference $E(\phi|a, r > 0) - E(\phi|a, r = 0)$ diminishes in absolute value. For a given population density, $k(\lambda)$, the probability that $E(\phi|1, r > 0) < -\lambda < E(\phi|1, r = 0)$ therefore declines also. Obviously, in the limiting case of perfect information¹⁶, $f(\phi)$ is degenerate and the agent's decision cannot affect the surviving relative's beliefs about her preferences. In the limiting case, financial incentives have no effect, positive or negative, on organ supply.

4.1.2. A two-stage game

The potential for perverse responses to financial incentives survives an extension to the somewhat more complicated setting in which the utility of a potential donor depends on the probability that her organs will be donated, rather than whether or not she registers as a donor. Assume that the agent's utility is given by $U(\phi, r(a); h)$. The only difference here is that utility now depends on h rather than a . The surviving relative's utility function is unchanged. In contrast to the previous subsection, this setting leads to an explicit two-stage game. In the first stage, the potential donor chooses action a in an attempt to influence her relative's subsequent action h .

The relative chooses h to maximize expected utility

$$EV = \arg \max_{h \in \{0,1\}} \int_{-\infty}^{\infty} V(\lambda, \phi; h) g(\phi|a) d\phi,$$

¹⁵ In fact, the supply of cadaveric organs rises in response to a payment for donor registration only if $E(\phi|0, r = 0) < -\lambda < E(\phi|1, r > 0)$. In this case, permission to harvest organs is granted only for registered donors (with and without the payment). Because the number of registered donors rises, the supply of organs rises.

¹⁶ Or, of course, when the surviving relative *thinks* he has perfect information.

while in the first stage, the potential donor chooses a to maximize

$$EU = \arg \max_{a \in \{0,1\}} [(\text{prob}\{h = 0\})U(\phi, r(a); 0) + (\text{prob}\{h = 1\})U(\phi, r(a); 1)].$$

To show that the potential for a perverse supply response survives this more complicated setting, the key step is to show that Proposition 1 continues to hold.

Proposition 2. *The result of Proposition 1 extends to the two-stage game.*

Proof. See Appendix A. □

Hence, as before, one can readily construct family utility functions, V , such that the supply of organs declines after the introduction of a financial reward for registration.

4.2. Donation rewards

Some of the proposals discussed earlier do not offer rewards for registration as a donor, but rather delay rewards until organ donation actually takes place. The reader may suspect that incentives of this type would not be subject to possibly perverse supply responses. Donors themselves cannot benefit directly from rewards to cadaveric donation, and one might then suppose that the signal content of their decisions about registering is not distorted by financial incentives. It then follows that, unless the family's preference, λ , for organ donation is independent of the amount of financial incentive offered, the fraction of family members agreeing to organ harvesting will rise.

This conclusion is misleading. The promise of a reward paid to surviving family members affects the registration decision of all potential donors who care about the welfare of their relatives. A donation reward will therefore distort the signal content of registration in just the same way that a registration reward has been shown to do. The analysis of signal distortion follows the same steps as in Section 3, and is not repeated here.¹⁷

4.3. Does the UAGA solve the signaling problem?

The Uniform Anatomical Gift Act intended that donor/non-donor autonomy be respected at all times. If an individual registers as a donor, her family's consent is not required for organ harvesting; if she registers as a non-donor, her family cannot override this preference. But there is a subtle asymmetry in the way that the UAGA intended those who register and those who do not to be treated. Government has made organ registration simple, most commonly at the time of renewing one's license to drive; no comparable facility is offered to individuals wishing to register as a non-donor. Non-donors must pay a significant cost to produce a document, usually in the form of a 'living will', to register their views. While

¹⁷ The only difference is that surviving family members themselves enjoy an income gain if they grant permission for organ harvesting. This income inducement tends to offset the potentially perverse effects of signal distortion. Obviously, however, one can construct functions V such that the price effect is small relative to the signal distortion effects.

most people are not registered donors, very few have registered their opposition to being one.

What proportion of the non-registered population is actively opposed to their organs being used? We do not know, and organ procurement organizations also do not necessarily know whether any individual presented to them had in life been actively opposed to organ donation. It is, of course, difficult to grant donor autonomy under such circumstances. Even under the UAGA, family hegemony is restored in these cases. Thus, the UAGA ameliorates, but does not resolve, the signaling problem. On the one hand, the supply of registered donors rises in response to a reward. On the other, the posterior expectation of ϕ of everyone who does not register is lowered by the reward, and surviving relatives are more likely to refuse a request to harvest organs. The latter effect may outweigh the former, yielding a perverse supply response.

5. The time inconsistency problem

It appears that perverse supply responses can be excluded only by entirely removing surviving relatives from the decision-making process. This section discusses registration rewards under such circumstances. A simple characterization of registration rewards under donor and non-donor autonomy is as follows. In the first stage, an agent chooses whether or not to register as a donor. In the second stage, a reward is given to those who registered. In the third stage, the agent dies and her organs may be harvested. This is the game plan proposed in Schwindt and Vining (1998) mutual insurance pools, or in Kleinman and Lowy (1989) idea to grant registered donors preferential access to organs.

Proposals granting rewards to registered donors are time inconsistent.¹⁸ Let us imagine that offers of donations may be rescinded. Consider an agent with preference parameter ϕ , and whose lifetime utility depends on income and whether or not she expects her organs to be donated. The solution to the agent's problem is straightforward. In the first stage she registers as a donor, and in the second stage she receives the reward. After receiving the reward, she chooses to rescind her donor status if doing so raises her utility. The key insight is that the last decision depends on ϕ , but not on the reward. The result is that everyone registers as a donor and everyone receives the reward, but actual donation rates remain unchanged from the status quo ante. If, instead, the first decision cannot be rescinded after receiving the reward, there will be a non-trivial proportion of the population whose organs will be taken even though their most recent preference is not to be a donor. Byrne and Thompson (2000) have argued in some detail that enforcing time inconsistent decisions on patients leads physicians to violate their ethical obligations. It is unclear whether these physicians also have similar ethical obligations to the dead.

Cash payments offered upon registration are naturally more susceptible to the time inconsistency problem than are arrangements such as mutual insurance pools.¹⁹ In the latter

¹⁸ The concept of time consistency is well understood, and need not be modeled at any length here. Stokey (1989) provides a short and synthetic discussion of time consistency.

¹⁹ However, the selection bias induced by such a scheme may well lead to a mutual insurance pool consisting largely of individuals with sub-standard organs.

case, the benefits of registering as a donor only last as long as donor status is not rescinded. Moreover, if death is unexpected, agents have no opportunity to rescind their donor status. However, agents diagnosed with a terminal illness for which an organ transplant is not helpful may rescind their donor status without cost.

6. Conclusions

The preceding analysis has identified two problems in proposals to alleviate the supply of cadaveric organs. First, under current institutional arrangements, financial inducements to be a registered donor distort the signal about preferences that donor registration makes. The introduction of financial incentives induce surviving family members to impute a weaker preference for organ donation on the part of the recently deceased, and *ceteris paribus* raises the likelihood that they will refuse consent to harvest organs. We have shown that the signaling problem affects the inferences of relatives of those who registered as donors and those who did not, and that it is present both when rewards are paid for registration and when they are paid upon donation. The potential for a perverse supply response requires only that surviving family members be imperfectly informed in the sense that their subjective distribution about the preferences of the recently deceased is not degenerate.

The second problem concerns some recent proposals for rewards that accrue to an individual after registration but before death. For a non-trivial fraction of the population, rewards for registration lead to time-inconsistent choices: they will register as a donor, but they will prefer to rescind their decision after receiving the reward. If the initial act of registration as a donor is viewed by the state as an irreversible decision, physicians will be forced to harvest organs from individuals whose most recent preference was known to oppose organ donation. This is an ethically challenging route for the state to take. However, if the initial registration decision can later be rescinded, registration rewards induce no change in the supply of organs.

Resolving the second problem is straightforward: financial rewards should be limited to payments made posthumously after the act of donation. The UAGA, granting autonomy to registered donors, makes some progress toward resolving the signaling problem. But it does not go far enough, and the possibility of perverse supply responses remains. Eliminating perverse supply responses requires that all individuals make an explicit choice. For example, organ donor registration programs conducted through driver licensing departments currently ask only whether an individual wishes to register as a donor. These programs should be changed so that every individual must register either as a donor or a non-donor. One might not expect that such a change could help increase the supply of organs. In and of itself it would not. But it would exclude perverse supply responses and ensure that there exist prices at which cadaveric organ supply rises significantly.

We anticipate that the price necessary to induce a sufficient supply of organs would be small relative to the total cost of an organ transplant. However, estimating the price response is not a trivial task. It would have to be inferred from the limited experience from experiments such as the one being conducted in Pennsylvania. Moreover, the institutional arrangements

under which the Pennsylvania law operates are rather different from those suggested here. Recalling the Lucas critique, estimation of the price response will require a fully-specified behavioral model that lends itself to empirical work. Reduced form estimation will not do.

Appendix A

Proof of Proposition 1. $\Pr\{\phi \geq x \cap \phi \geq \hat{\phi}\} = \Pr\{\phi \geq \max(x, \hat{\phi})\} = \int_{\max(x, \hat{\phi})}^{\infty} f(\phi) d\phi$. For $a=1$, Bayes' rule implies that

$$\int_{-\infty}^x g(\phi|a=1; r) d\phi = \Pr\{\phi > x|a=1\} = \frac{\int_{\max(x, \hat{\phi})}^{\infty} f(\phi) d\phi}{\int_{\hat{\phi}}^{\infty} f(\phi) d\phi}.$$

Differentiating with respect to r gives

$$\frac{f(\hat{\phi})}{\int_{\hat{\phi}}^{\infty} f(\phi) d\phi} \frac{\partial \phi}{\partial r} \left[\frac{\int_{\max(x, \hat{\phi})}^{\infty} f(\phi) d\phi}{\int_{\hat{\phi}}^{\infty} f(\phi) d\phi} - \delta \right] \begin{cases} = 0 & \text{if } x \leq \hat{\phi}, \\ < 0 & \text{if } x > \hat{\phi}, \end{cases}$$

where $\delta=1$ if $\hat{\phi} \geq x$, and zero otherwise. The inequality is established upon noting that

$$\frac{\int_{\max(x, \hat{\phi})}^{\infty} f(\phi) d\phi}{\int_{\hat{\phi}}^{\infty} f(\phi) d\phi} = 1$$

when $\delta=1$, and lies in the unit interval when $\delta=0$. For $a=0$, we can write

$$\int_{-\infty}^x g(\phi|a=0; r) d\phi = \frac{\int_{-\infty}^{\min(x, \hat{\phi})} f(\phi) d\phi}{\int_{-\infty}^{\hat{\phi}} f(\phi) d\phi}$$

and differentiating with respect to r yields

$$\frac{f(\hat{\phi})}{\int_{-\infty}^{\hat{\phi}} f(\phi) d\phi} \frac{\partial \phi}{\partial r} \left[\delta - \frac{\int_{-\infty}^{\min(x, \hat{\phi})} f(\phi) d\phi}{\int_{-\infty}^x f(\phi) d\phi} \right] \begin{cases} = 0 & \text{if } x \geq \hat{\phi}, \\ > 0 & \text{if } x < \hat{\phi}, \end{cases}$$

where $\delta=1$ if $\hat{\phi} \leq x$, and zero otherwise. Noting that

$$\frac{d \left[\int_{-\infty}^x g(\phi|a; r) d\phi \right]}{dr} = \frac{-d \left[\int_x^{\infty} g(\phi|a; r) d\phi \right]}{dr}$$

establishes the required inequality. \square

Proof of Proposition 2. Let $k(\lambda)$ denote the density of λ . Then, the probability that $h=1$ is given by $\int_{\lambda^*}^{\infty} k(\lambda) d\lambda$, where λ^* satisfies

$$\lambda^*(r; a) = \inf \left\{ \lambda : \int_{-\infty}^{\infty} [V(\lambda, \phi; 1) - V(\lambda, \phi; 0)] g(\phi|a; r) d\phi \geq 0 \right\}.$$

Let $\hat{\phi}$ denote the minimum value of ϕ such that $a=1$ is chosen. That is $\hat{\phi}$ satisfies

$$\begin{aligned} & \int_{-\infty}^{\lambda^*(r;1)} k(\lambda) d\lambda U(\hat{\phi}, r; 0) + \int_{\lambda^*(r;1)}^{\infty} k(\lambda) d\lambda U(\hat{\phi}, r; 1) \\ &= \int_{-\infty}^{\lambda^*(r;0)} k(\lambda) d\lambda U(\hat{\phi}, 0; 0) + \int_{\lambda^*(r;0)}^{\infty} k(\lambda) d\lambda U(\hat{\phi}, 0; 1). \end{aligned} \quad (\text{A.1})$$

When no payment offered for registration (i.e. $r=0$), (A.1) simplifies to

$$\left[\int_{\lambda^*(r;1)}^{\lambda^*(r;0)} k(\lambda) d\lambda \right] [U(\hat{\phi}, 0; 0) - U(\hat{\phi}, 0; 1)] = 0. \quad (\text{A.2})$$

Excepting the special case in which the family member does not care at all about the potential donor's preferences, the integral in (A.2) is strictly positive and $\hat{\phi}$ does not depend on the density $k(\lambda)$. Equivalently, a potential donor who is indifferent between $h=0$ and $h=1$ is also indifferent between action $a=0$ and $a=1$. When payments are offered, $\hat{\phi}$ is no longer independent of $k(\lambda)$. To see this, rearrange (A.1) to obtain

$$\begin{aligned} & \left[\int_{\lambda^*(r;1)}^{\lambda^*(r;0)} k(\lambda) d\lambda \right] [U(\hat{\phi}, 0; 0) - U(\hat{\phi}, 0; 1)] \\ &= \int_{-\infty}^{\lambda^*(r;1)} k(\lambda) d\lambda [U(\hat{\phi}, r; 0) - U(\hat{\phi}, 0; 0)] \\ &+ \int_{\lambda^*(r;1)}^{\infty} k(\lambda) d\lambda [U(\hat{\phi}, r; 1) - U(\hat{\phi}, 0; 1)]. \end{aligned} \quad (\text{A.3})$$

Because U is increasing in r , the right-hand side of (A.3) is unambiguously positive. It follows that $[U(\hat{\phi}, 0; 0) - U(\hat{\phi}, 0; 1)]$ is positive and, since this expression is decreasing in $\hat{\phi}$, the introduction of a registration reward, r , reduces $\hat{\phi}$. The introduction of a registration reward removes mass from the upper tail of the set of individuals for whom $a=0$ had been optimal, and adds this mass to the lower tail of the set for whom $a=1$ had been optimal. For both groups, $E(\phi|a)$ declines, and there exist functions V such that the supply of organs declines in response to the reward. \square

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