Organ Allocation Policy and the Decision to Donate·

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ABSTRACT

Organ donations from deceased donors provide the majority of transplanted organs in the United States, and one deceased donor can save numerous lives by providing multiple organs. Nevertheless, most Americans are not registered organ donors despite the relative ease of becoming one. We study in the laboratory an experimental game modeled on the decision to register as an organ donor, and investigate how changes in the management of organ waiting lists might impact donations. We find that an organ allocation policy giving priority on waiting lists to those who previously registered as donors has a significant positive impact on registration.

The majority of transplanted organs in the United States come from deceased donors, whose organs are transplanted into patients following the donor's death.[1] Despite the need for organs (over 110,000 patients are currently awaiting organ transplants in the United States[2]) and the ease of registering as a donor (a few clicks on a website or checking a box when getting a driver's

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[1] Based on OPTN data as of July 29, 2011 (see http://optn.transplant.hrsa.gov/latestData/rptData.asp).

[2] For example, over 89,000 are on the waiting list for a kidney. Waiting list numbers are based on Organ Procurement and Transplantation Network (OPTN) data as of July 29, 2011.

license), only 40.3% of individuals over the age of 18 in the United States are registered as organ donors.[3]

Changes in organ allocation procedures can influence the supply of transplantable organs. One line of research, concerning kidney exchange among incompatible patient-donor pairs, has investigated how matching mechanisms for *live* donors can increase the number of kidney transplants (Roth, Tayfun Sönmez, and M. Utku Ünver 2004, 2005a,b, 2007; Roth et al. 2006; Susan L. Saidman et al. 2006; C. Bradley Wallis et al. 2011) and has led to a number of new practices and institutions.[4] Kidney exchanges match incompatible patient-donor pairs to other incompatible patient-donor pairs, allowing for exchanges and also for chains of donation that start with an undirected donor and that increase the number of transplants that live donation can achieve (Michael A. Rees et al. 2009; Itai Ashlagi et al. 2011) Thus allocation policies can increase the donation rate of live donors as well as deceased donors. Despite a growing (but still small) number of transplants resulting from kidney exchange, the kidney waiting list has continued to grow and shows no signs of slowing down. For kidneys in the United States, Table 1 lists the number of donors, transplants, and the number of people on the waiting list. Kidneys have longer waiting lists than other organs because dialysis can keep patients in need of kidney transplants alive for a time while waiting, but the need for other organs is great as well, and patients who do not promptly receive a transplant often die while waiting.

In addition, economists and others have discussed the possibility of cash markets for organs, in which kidneys could be bought and sold to address the current excess demand for kidneys. Proposals to introduce monetary payments for

[3] Based on the Donate Life America *National Donor Designation Report Card 2011* (which can be found at http://donatelife.net/wp-content/uploads/2011/04/DLA-Report-BKLT-30733-2.pdf).
[4] For example, the New England Program for Kidney Exchange (NEPKE) and the Alliance for Paired Donation (APD). Following the passage of new federal legislation in 2007, plans are underway for a national exchange, which is running a pilot program that began in October 2010.

organs are constrained by concerns about the morality and ethicality of such practices, and *repugnance* towards cash markets for organs limits their feasibility, at least for now (see Roth 2007; Stephen Leider and Roth 2010 and the references there).

Table 1: U.S. Kidney Transplants

Year	Deceased Donors	Deceased Donor Transplants	Living Donors	All Wait-list Patients	New Wait-list Additions
1999	5,386	8,044	4,725	41,177	21,843
2000	5,489	8,126	5,499	44,568	22,352
2001	5,528	8,233	6,042	47,574	22,500
2002	5,638	8,539	6,240	50,296	23,630
2003	5,753	8,667	6,473	53,513	24,681
2004	6,325	9,358	6,647	57,141	27,279
2005	6,700	9,913	6,571	61,505	29,143
2006	7,178	10,661	6,435	66,255	32,358
2007	7,240	10,591	6,043	71,601	32,420
2008	7,188	10,552	5,968	76,089	32,583
2009	7,248	10,442	6,387	82,657	33,664
2010	7,241	10,622	6,282	89,316	34,419

The data for years 1999–2010 are provided by OPTN as of July 29, 2011. New Wait-list Additions counts patients (rather than registrants) to eliminate the problems of counting multiple times people who register in multiple centers. All Wait-list Patients also counts patients rather than registratants. All Wait-list Patients data from 1999-2008 are from the *2009 OPTN/SRTR Annual Report; All Wait-list Patients* data from 2009 and 2010 are extrapolated from Wait-list Additions and Waitlist Removals provided by OPTN as of July 29, 2011.

Here we focus on deceased donation and mechanisms to increase the number of individuals registering to be organ donors (individuals who agree to donate those of their organs that are usable in the event of an untimely death). Deceased organ donation is a natural place to focus attention since the registration rates for organ donation are rather low (40.3 percent nationally and, for example, only 7 percent in Texas and 15 percent in New York, the second and third most

populous states respectively).[5] Since next of kin can provide consent for donation at time of death, donation rates of eligible deceased donors are higher than registration rates, although still well below 100 percent. In addition, the gains to generating more deceased organ donors are substantial: one deceased donor can provide multiple vital organs (including kidneys, liver, heart, pancreas, lungs, and intestine) as well as tissues (including corneas, skin, heart valves, cartilage, bone, tendons, and ligaments). Finally, while exchanges and donor chains can increase the number of transplanted kidneys, there is essentially no possibility of live donation for other solid organs such as the heart, pancreas, and intestine, and not much transplantation of live donor lungs or livers. Live donation of blood and of bone marrow is very feasible, and has been the subject of considerable study. (Recent work on blood donation has investigated whether incentives for blood donors can be effectively used to increase donations, or whether the donations suffer from a "crowding out" (see Nicola Lacetera and Mario Macis 2008; Carl Mellstrom and Magnus Johannesson 2008; Lacetera, Macis, and Robert Slonim 2009).[6] Research on bone marrow donations by Ted C. Bergstrom, Rodney J. Garratt, and Damien Sheehan-Connor (2009, 2011), Frédérique, A. Fève and Jean-Pierre Florens (2005), and Fève et al. (2007) argues that fewer individuals are on the bone marrow registry than is optimal.)

In this paper we consider deceased organ allocation policies that give priority for receiving organs to people who are themselves registered donors (and

[5] Based on the Donate Life America *National Donor Designation Report Card 2011* (which can be found at http://donatelife.net/wp-content/uploads/2011/04/DLA-Report-BKLT-30733-2.pdf).
[6] Both Mellstrom and Johannesson (2008) and Lacetera, Macis, and Slonim (2009) investigate the hypothesis of Richard M. Titmuss (1970) that paying for blood donation might crowd out the altruistic reasons for giving and lead to less donation. While Mellstrom and Johannesson (2008) find evidence of crowding out in a field experiment on blood donation in Sweden, Lacetera, Macis, and Slonim (2009) do not find crowding out on blood donations from observational data and a field experiment in America. Nicola Lacetera and Mario Macis (2008) find that giving recognition to donors increases the number of blood donations and the timing of the donations.

have been registered for some time).[7] Such policies provide an incentive for registering to be an organ donor. This kind of donor-priority system is in use in Singapore (since the 1986 passage of their Human Organ Transplant Act[8]) and is being implemented in Israel (following passage of a 2008 organ transplant law[9]). Singapore has an opt out system, in which everyone is by default a donor in the national registry, and any citizen or permanent resident of Singapore who opts out of being an organ donor gets lower priority for deceased donor organs in the event that they need one. Israel has an opt in system, in which (once the system is fully implemented) anyone who has registered to be a deceased donor at least three years earlier will receive priority. Such donor-priority policies generate an incentive for becoming a donor within the organ donation system and do not require additional incentives from outside of the system. A related approach is being attempted in the U.S. by a private club called Lifesharers, which prioritizes deceased donations of organs by its members to its members who need them. Lifesharers is not part of the national allocation system, so it requires individuals to opt into the club in addition to registering as a donor, and gives priority access to only those organs donated by members of the club.[10]

One strategy discussed for increasing registration rates in the United States is to change to an opt out system in which those who take no action are assumed to be donors at death, as in Singapore, Spain (which has the highest rate of

[7] A literature that advocates giving priority in organ allocation to registered organ donors can be found in legal journals, medical ethics journals, and health journals (see e.g. Adam J. Kolber 2003 and Christopher T. Robertson 2007 and the references in those papers).
[8] The Human Organ Transplant Act can be found at http://www.moh.gov.sg/mohcorp/legislations.aspx?id=1672
[9] The proposed Israeli policy gives priority to the individuals and family members of those who have signed donor cards or made live organ donations (news stories can be found at http://www.medicalnewstoday.com/articles/174514.php and http://www.jpost.com/HealthAndSci-Tech/Health/Article.aspx?id=195354). The details of the implementation of this program have been highly contested and were still being debated at the time of final submission of this paper.
[10] As of July 2011, Lifesharers' membership is less than 15,000 and there has not yet been a transplant on the Lifesharers network (see http://www.lifesharers.org/).

deceased organ recovery), and other European countries (most of which have lower rates of organ recovery and transplantation than the United States). This policy is an interesting and important one to consider but may have legal consequences that make it less effective at increasing final donation rates than increasing registration rates. We discuss this again in the conclusion.

This paper investigates incentives to donate by means of an experimental game that models the decision to register as an organ donor. The main manipulation is the introduction of a priority rule, inspired by the Singapore and Israeli legislation, which assigns available organs first to those who had also registered to be organ donors. Another experimental condition replicates the incentive effects of the priority rule (in expectation) but provides organs by a standard waiting list. A final condition institutes a simple discount in the cost of agreeing to be an organ donor.

Results from our laboratory study suggest that providing priority on waiting lists for registered donors has a significant positive impact on donation.[11] We are able to replicate most of the benefit with a rebate that provides the same incentive for donating as priority, and with a discount in the cost of donation, although only when they are introduced after the subjects have made donation decisions a number of times. When the policies are introduced at the start of the game, the priority rule outperforms an equivalent change in the cost of donation.

It may be helpful to pause for a moment and think about what kinds of hypotheses relevant to organ donation can be investigated in a laboratory experiment that does not involve actual organ donation decisions. While there are obviously important questions related to organ donation that *cannot* be studied in the abstract, there are also important aspects of the actual organ donation decision

[11] In our experiment, registration results in donation whenever the registered organ donor becomes deceased and a recipient is available. We will discuss in the conclusion some of the legal and practical gaps between registration as an organ donor and successful donation and transplantation.

that cannot be reliably or systematically manipulated, but which *can* be manipulated in the lab.

To see both sides of this, consider the issues that arise in modeling in the laboratory the costs associated with the decision to donate an organ after death. The costs of registering to be an organ donor are difficult to identify and to manipulate in the field. These costs may include worries that doctors will not work as hard to keep organ donors alive or that organs will be removed prematurely, and there may be visceral issues in thinking about actual organ donation such as discomfort in thinking about one's own death. In the laboratory, monetary costs can be imposed and manipulated, to model to some level of approximation the costs experienced by donors. And since compensation for donation is not allowed by United States law,[12] cash rebates or cash transfers are not possible for actual organ donation decisions, so conditions that manipulate the net costs of registering as an organ donor with cash payments can only be run in the laboratory.

So in the laboratory we do not use real organs, but we impose real (monetary) costs. The cost of registering to be a donor in the experiment is imposed and denoted in dollars (it decreases cash payment from the experiment). We take advantage of the opportunity to manipulate the cost of donation by running two conditions (discount and rebate) that decrease the costs of registering to be a donor to better understand why the priority rule generates an increase in the number of donors. While a donor-priority rule can be implemented in the world and in the lab, cash rebates and discounts cannot be implemented outside of the lab, but they allow us to test hypotheses about which features of the priority rule are responsible for increasing registration rates in the lab.

[12] The National Organ Transplant Act of 1984 states, in part: "it shall be unlawful for any person to knowingly acquire, receive or otherwise transfer any human organ for valuable consideration for use in human transplantation." (Section 301, National Organ Transplant Act (NOTA), 42 U.S.C. 274e 1984)

While organ transplantation is a private good—only one person can receive each organ—it is useful to think of the organ donor *registry* as resembling a public good, since *ex ante* the pool of registered organ donors provides organs for the pool of potential recipients (from which no medically eligible candidate can be excluded under present US law). Even though an individual who is a deceased organ donor will not get to be an organ recipient, a larger pool of potential donors benefits everyone, including potential donors who end up needing organs rather than providing them. In other words, registering to be an organ donor resembles a public good *ex ante* that is a private good *ex post*.[13] It may be that the donor-priority organ allocation policy increases registration rates in part because the allocation rules allow for non-donors to be excluded (or to have a smaller probability of receiving an organ), effectively turning the registry into a club good and generating an incentive to become a donor. We investigate the impact of this incentive in a simple model in Section IV.[14]

Our laboratory environment allows us to study the incentive issues involved in this type of public good, abstracted away from the important but complex sentiments and institutional details associated with actual organs. Results suggest that rewarding contributors with first access to the *ex post* private goods generated by the *ex ante* public good—by transforming the public good into something more like a club good—may generate increased contribution in public good environments of this form.

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[13] The organ donor registry is rival (or congestible) in that the more people who take advantage of the pool of organs make it less likely another person is able to take advantage of it, but this characteristic is shared by other non-excludable goods (i.e. public parks, roads, and bridges) that are commonly thought of as public goods.

[14] Unlike other games in the experimental literature on excludible public goods (for examples see Kurtis J. Swope 2002; Matthias Cinyabuguma, Talbot Page and Louis Putterman 2005; and T. K. Ahn, R. Mark Isaac and Timothy C. Salmon 2009) our game does not fully exclude non-contributors from accessing the public good but instead provides priority to those who contribute. Different potential recipients have different shares in the public good, in the sense that different priorities may give them different probabilities of drawing from the public good if need arises. In particular, non donors receive a smaller probability of access to the public good.

I. Experimental Design

In the experiment, subjects made a decision modeled on the decision to register as an organ donor. In the experiment there is no difference between registering (in advance) to donate and being an available donor at death, and we will refer to this decision as "donating". The instructions to subjects were stated in abstract terms, not in terms of organs. Subjects started each round with one "A unit" (which can be thought of as a brain) and two "B units" (representing kidneys). Each subject earned $1 in each period in which they had both an active A unit and at least one active B unit (representing a flow of utility from being alive and healthy). Each period, the subject's A unit had a 10% probability of failing and the B units had a 20% chance of failing (both B units operated or failed together).

Before making the donation decision in the first round, all subjects were informed that each round began with the subject having $2 and consisted of a number of periods in which they could earn more money. Whenever a subject's A unit failed, he lost $1 and the round ended for him (representing brain death). When a subject's B units failed, he had up to five periods to receive a B unit from someone else (representing dialysis, during which time he did not earn any money), if a subject did not receive a B unit in those five periods, he lost $1 and the round ended for him (again representing death). Subjects could receive a B unit from another player in a given period if that player's A unit failed in that period while his B units were still active, if and only if the player had agreed to donate his B units at the start of that round.

Subjects made a donation decision 31 times in a fixed group of 12 subjects. Subjects were not informed of the number of times they would make the decision but were told they would be paid for four randomly selected rounds. The donation decision was always asked at the start of the round, before any periods

had passed, so subjects made the donation decision before knowing whether their A unit or B units would fail first.

Subjects were randomly assigned at the beginning of the game to have either low or high costs of donation (each group of 12 subjects had 6 low-cost donors and 6 high-cost donors) and were only informed of their own cost of donation. Low cost donors had to pay $0.40 so that their B units would be given to other subjects in the event that they had A unit failure (subjects who agreed to be donors always paid the cost, regardless of whether they had A unit failure or B unit failure first, representing the psychological costs of donation incurred at the time of the decision to register as a donor). High cost donors had to pay $0.80 for their B units to be donated in the event of A unit failure. Subjects remained high cost or low cost donors for the entire experiment.

All subjects were told that if they were a donor and their A unit failed first, each of their B units would be donated to a subject who had failed B units and was waiting for a B unit if such a subject was present in that period. They were also told that B units could not be donated again in the same round (i.e. a donated B unit could not be donated again after the failure of the recipient's A unit). After making the donation decision, subjects watched their outcome for each period of that round and were able to observe if any of their units failed in that period, how many periods they were waiting for a B unit, whether they received a B unit in that period, and how much money they had earned so far in that round of the game. After a subject could not earn any more money in a round, he stopped receiving information each period and waited for the next round to begin. Subjects received no information about the donation decisions or earnings of other subjects, and subjects were not informed if B units they donated were actually provided to other subjects (i.e. they did not know whether a subject needed a B unit in the period in which their A unit failed).

There were 4 different conditions under which subjects made donation decisions in the experiment. In the *control* condition, subjects were informed that donated B units were provided to those who needed B units in the order that those subjects had been waiting for B units: so subjects who had been waiting 5 periods would receive an available B unit before a subject who had been waiting 4 periods and so on.[15]

In the *priority* condition (motivated by the donor-priority rules in Singapore and Israel), subjects were informed that those who agreed to be donors at the start of the round would be given priority should they need to receive a B unit, and that B units would be provided first to subjects who had agreed to be donors, and only if no donors were in need of B units would B units be provided to subjects who were not donors. Within each priority group, B units were assigned by the length of time subjects had been waiting for B units with those who were waiting the longest getting available B units first. The priority condition generated an incentive for donating, the value of which depended on the number of other subjects who registered as donors. As long at least one other member of the group donated, donors were more likely than non-donors to receive a B unit if they needed one. In addition, in the priority condition, registering as a donor provided a relatively strong positive externality to other donors since they are more likely than non-donors to receive donated B units.

In the *discount* condition, B units were assigned as in the control condition, but all subject costs were $0.35 lower than in the control condition, so low cost donors paid $0.05 to donate their B units and high cost donors paid $0.45 to donate their B units. The $0.35 discount approximates the expected value of the incentive for donation achieved by the priority rule (and the amount paid to

[15] If multiple subjects had been waiting the same number of periods and there were not enough B units for all of them, the B units were assigned randomly among the subjects who had been waiting the longest.

donors in the rebate condition, described next) if 5 to 6 donors are contributing in a round.[16] This treatment was run to investigate whether the behavior change due to the priority rule could be replicated by a discount alone, simply offsetting the costs of donation and not generating the positive externalities to other donors.

In the *rebate* condition, B units were assigned as in the control condition, but subjects were informed that those who paid to be a donor would receive a rebate at the *end* of the experiment based on the number of other subjects in their group who also agreed to be donors. (Rebates were reported only at the end of the experiment to avoid giving subjects direct information about the number of donors or how that number was changing from round to round, since this information was not available in the discount treatment.) This treatment was meant to reproduce the incentive effects and the externality effects of the priority condition without affecting the allocation of B units. This treatment was run to investigate whether the priority rule was changing behavior as a result of the incentives associated with creating a club good. The rebate amounts were selected to be the expected value of receiving priority in the priority condition of the experiment. The rebate consequently depended on the number of other donors (just as the benefits of priority depend on the number of other donors and how many others in need of B units also have priority). The rebate amounts were the expected benefit of having priority given the probability of A unit and B unit failure in the experiment. The rebate was weakly increasing and concave in the number of other donors in that round. Subjects received no rebate if they were the only donor and received up to $0.46 if 10 or 11 other subjects in their group were

[16] Since the average donation rate across all rounds of the discount condition turns out to be 55.4% (implying an average of 6.65 donors per round), this $0.35 discount turns out to be remarkably similar to the benefit from donating they would have received from donating in the priority condition (in expectation), and to the rebate donating subjects would have received if they had been in the rebate condition, described next.

donors in that round.[17] This meant that at the time of the donation decision, the private incentives in the rebate condition matched the private expected value of the incentives in the priority condition. Like being a donor in the priority condition (in which B units are more likely to go to other donors) being a donor in the *rebate* condition had a relatively strong positive externality on other donors, which distinguishes it from the discount condition.

Subjects were not told how many rounds they would play the game, but all subjects played 15 rounds in one of the conditions followed by 16 rounds in another condition. All subjects played the *control* condition either for the first 15 or last 16 rounds (36 subjects, in three groups, played the *control* condition in all 31 rounds to test for a restart effect). After the first 15 rounds, subjects were informed that the rules of the game had changed and any changes in the game were explained. Three groups of subjects who had played the first 15 rounds in the control condition were stopped after round 15 and told that there were no changes in the rules of the game. After round 30, all groups were interrupted and told that they would play the game one final time (in the same condition they had been playing for the past 15 rounds). The number of groups who played in each of the orderings of conditions is displayed in Table 2.

[17] The expected value of receiving priority was calculated by simulating one million rounds of the game for each number of donors from 1 to 12 and estimating the earnings of subjects who were given priority and those who were not conditional for each number of donors. The rebate profile was: \$0 for 0 other donors, \$0.10 for 1 other donor, \$0.20 for 2 other donors, \$0.28 for 3, \$0.33 for 4, \$0.37 for 5, \$0.40 for 6, \$0.42 for 7, \$0.44 for 8, \$0.45 for 9, \$0.46 for 10 or 11 other donors. Note that the return to donation is increasing in the number of other donors up to 11, reflecting that with these parameter choices there remains a shortage of kidneys even when all possible donors are registered. (If there were excess kidneys, so that the queue was always empty, priority on the queue would no longer be valuable.)

Table 2: Number of Groups (Subjects) in each order of conditions

		Condition in second set of rounds (Round 16-31)			
Condition in first set of rounds (Round 1-15)		Control	Priority	Rebate	Discount
	Control	3 Groups (36 Ss)	8 Groups (96 Ss)	5 Groups (60 Ss)	4 Groups (48 Ss)
	Priority	4 Groups (48 Ss)	No Groups		
	Rebate	4 Groups (48 Ss)			
	Discount	4 Groups (48 Ss)			

After all rounds had been played, subjects were informed of which 4 rounds had been randomly selected for payment and were informed of any rebate earnings in those rounds (if subjects played in the *rebate* condition). All subjects were paid in cash at the end of the experiment.

II. Results

The experimental results are from 384 subjects who participated in the experiment in 32 groups in one of 23 sessions in the Spring and Summer of 2009.[18] Subjects were students at Boston-area colleges and universities. The experiment lasted up to one and a half hours and average earnings were $25.87 per subject, including a $10 show up fee. The experiment was conducted using z-Tree 2.1.4 (Urs Fischbacher 2007).

Figure 1 displays the results across all sessions. The graph displays the percent of subjects who were donors in each round of the game for each condition (again for exposition, we will refer to registering as an organ donor as "donating"

[18] Subjects played in groups of 12 in sessions of either 12 or 24 subjects. When two groups played simultaneously, they received the same order of conditions so all instructions (except for the costs of donating, which differed between subjects) could be read aloud.

or "being a donor"). The break in the lines after round 15 represents the break in play during which groups may have been switched into one of the other conditions. Twenty groups played in the control condition for the first 15 rounds of the experiment and then either switched to one of the three other treatment conditions (17 groups) or stayed in the control condition (3 groups). The other twelve groups played one of the three treatment conditions for the first 15 rounds and then switched to the control condition for the last 16 rounds. Consequently, for the first 15 periods of the game the control line represents the 20 groups who made donation decisions in the *control* condition—these groups went on to all four of the conditions in the second 16 rounds. For the last 16 periods of the game, the control line also represents the 15 groups who made donations in the *control* condition (aggregated from the groups that, in the first 15 periods, were in any of the four conditions).[19]

[19] There were no significant differences in donation in the control condition in the last 16 rounds of the experiment between groups that played in the four different conditions in the first 15 rounds of the experiment.

Figure 1: Share Donating by Round

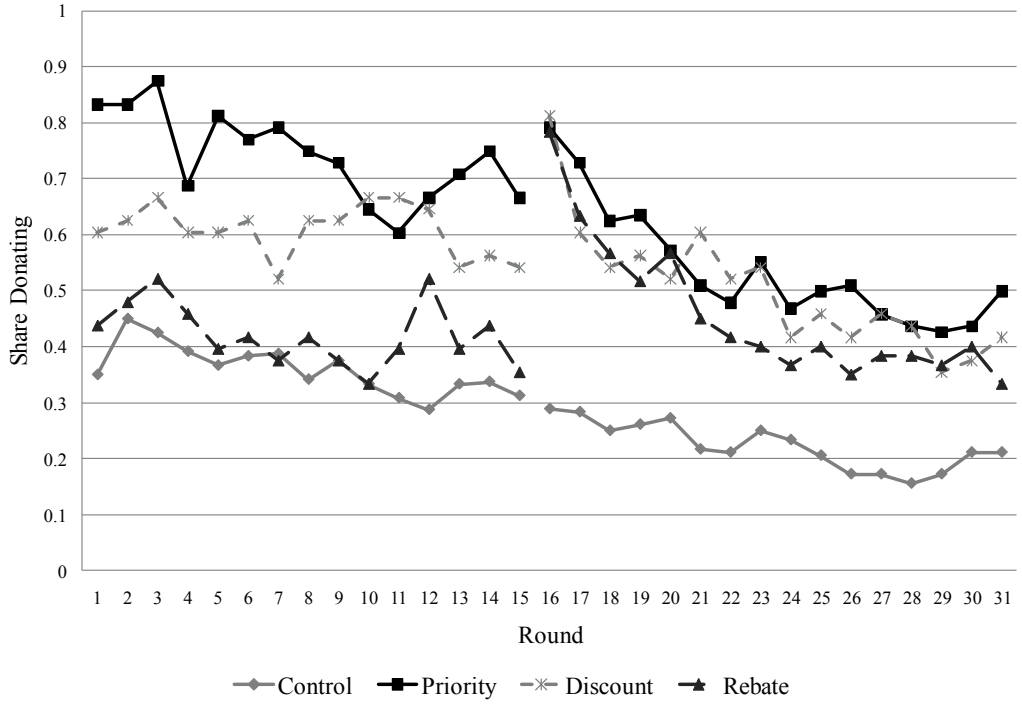


Figure 1 suggests that the *priority* condition had a significant positive impact on donation rates, starting in the first round in which it was implemented (either round 1 or round 16). In round 1, organ donation rates averaged 83.3% for the *priority* condition and only 35% percent for the control condition. In round 16, organ donation rates averaged 79.2% for the *priority* condition and only 28.9% percent for the *control* condition. Averaging across the first 15 rounds of the game, the *priority* condition averaged a donation rate of 74.2% while *control* condition averaged a much lower donation rate of 35.9%. Over the last 16 rounds of the game, *priority* averaged 54.0%, while *control* condition averaged a much lower donation rate of 22.3%. That the donation rate in the *priority* condition is 2 to 2.5 times higher than the donation rate under the *control* condition suggests a significant impact of the allocation rules on donation decisions. No additional financial incentives were added to the donation decision, so the rule change

increased donations at no additional cost, simply providing incentives for the donors in terms of a higher probability of receiving a B unit.

To investigate why the *priority* condition is so effective at increasing donation rates, we ran two additional treatment conditions that provide some of the incentive effects of the priority rule. Compared to the *control* condition, the *priority* condition provides an incentive to donate in terms of an increased likelihood of getting a B unit when it is needed, and it provides a relatively strong positive externality to other donors (since when a subject donates, other donors are more likely to reap the benefits).

The *rebate* condition captures these two effects, providing the same direct incentives for donating as the priority rule. The *rebate* condition directly replicates the extra earnings that accrue to donors in the *priority* condition (in expectation) and replicates the relatively strong positive externality on other donors (also in expectation). The rebate condition does not change organ allocation, however, and so does not penalize non-donors with decreased access to B-units.

The *discount* condition only provides a decrease in cost for donors relative to the *control* condition but does not provide positive externalities to other donors. The discount of $0.35 means that in each round donation is still costly, even for the subjects whose initial costs of donation were only $0.40, although much less costly than the *control* condition. The discount is provided to all donors but does not provide any positive externality to other donors.[20]

Figure 1 shows that the *rebate* and *discount* conditions perform differently in the first 15 periods (when subjects play the treatment condition first) and the last 16 rounds (when subjects play the *control* condition for the first 15 periods). In the

[20] The two treatment conditions (*rebate* and *discount*) that involve a decrease in the costs of becoming an organ donor should be seen as relative costs, since the psychological costs underlying the decision to become an organ donor are hard to measure. The lesson from these treatments is that lowering costs has a significant, positive effect on behavior.

first fifteen rounds of the game, the *priority* condition generates significantly more contribution than the *discount*, *rebate*, and *control* conditions. In addition, the *discount* condition generates significantly more contribution than the *rebate* and *control* conditions (which cannot be ranked).[21] When implemented in round 16 of the game (after 15 rounds of the control condition), the *priority*, *rebate* and *discount* conditions all have similar effects (and all outperform the control condition).[22]

That the *priority* condition performs so much better than the *rebate* condition when implemented at the start of the experiment is particularly striking when we consider that the rebate provides the same incentives as the priority rule and that the rebate does just as well as priority after subjects have become familiar with the game (by playing 15 rounds in the *control* condition). We want to avoid over-fitting the theory to our experimental data, but while we think of the priority and rebate conditions as being essentially the same on the most relevant dimensions, there are a number of small differences between the conditions that might explain why the priority rule outperforms the rebate condition in round 1 of the game and not in round 16 (after the subjects have played 15 rounds in the *control* condition).

The private benefits of *priority* and the *rebate* condition depend on the number of other donors in a given round, and subjects in the two conditions get different information about the number of other donors over the course of the experiment. In the *priority* condition, subjects who are donors in a given round are more likely to receive a B unit when they need one (and thus are more likely to get information that others are donating while the experiment is still ongoing).

[21] Probit tests on donation rate (without additional controls) and with standard errors clustered by subject find over the first 15 rounds that: Priority > Discount ($p=0.015$); Discount > Rebate ($p=0.003$); Rebate = Control ($p=0.205$).

[22] Probit tests on donation rate (without additional controls) and with standard errors clustered by subject find no differences between Priority, Discount and Rebate over rounds 16-31 ($p>0.1$ for all tests).

In the *rebate* condition, however, donors are no more likely than a non-donor to receive a B unit, and rebates are only received at the end of the experiment, after all decisions have been made. Thus, the positive reinforcement of receiving a B unit is likely to be more effective at encouraging donors in the *priority* condition (where the B units are more likely to go donors, who learn about them in a timely way) than in the *rebate* condition (where B units are not more likely to go to donors, and rebates are only paid at the end).[23] This difference in information is most stark at the start of the game, since subjects without experience do not have any information about the number of donors while subjects with 15 rounds of experience may have a much better perception of the number of donors, since they have observed how often they received a B unit when they needed one over the 15 rounds in the *control* condition for 15 rounds.

Of the mechanisms that we examined in the lab, the *priority* allocation rule is the most effective at increasing organ donation rates when implemented at the start of the experiment and it is as effective when implemented after subjects have become familiar with the game. In addition, it is worth noting again that we can implement the priority rule outside of the lab, but we do not know how to decrease the psychological costs of registering to be an organ donor. Also, legal constraints prohibit the use monetary payments like cash rebates to compensate for registering to be an organ donor. We will discuss these issues in the conclusion.

Table 3 demonstrates the results from Figure 1 in a regression analysis, estimating the probability the subjects chose to be a donor in each of the conditions. In addition, Table 3 displays results about the between-subject effect of being a high cost donor. Finally, the random failure of A and B units in each

[23] This is consistent with models of reinforcement learning such as those explored in Roth and Ido Erev (1995) and Erev and Roth (1998).

round allows for a more-in-depth analysis of the motivations for being a donor across rounds.[24]

The significant positive coefficients on *Priority*, *Rebate*, and *Discount* in regression (1) show that across all 31 rounds, subjects are 14 to 31 percentage points more likely to donate when they are in one of the three treatment conditions than in the control condition (representing roughly 50% to 100% more donations than the 30% donation rate in the control condition), results that are highly statistically significant. Including all of the rounds in the analysis in regression (1), *Priority* outperforms *Rebate* ($p<0.01$) and *Discount* outperforms *Rebate* ($p=0.017$), but *Priority* and *Discount* are statistically indistinguishable ($p=0.254$).

Regression (2) separates the effect of the treatment into the first half and the second half by including a control *Second Half* that is equal to 1 in rounds 16 to 31 and is interacted with the treatment conditions. Donation is about 14% less likely in the second half of the experiment (*Second Half* is negative and significant). The positive coefficient on *Second Half*Rebate* represents the *Rebate* condition working particularly well in the second half of the experiment,

[24] Table 3 reports linear probability models using OLS regression specifications with robust standard errors clustered at the subject level. The results are qualitatively the same whether we add session dummies, or cluster at the group level, or cluster by round. The results are also qualitatively the same if we include subject dummies (although this specification prevents estimation of between-subject variables that do not change over the course of the experiment, like the effect of having a high cost of donating). In addition, the results are qualitatively the same when we specify Probit rather than a linear probability model. While the linear probability model is inefficient, it is unbiased and we use robust standard errors to address the heteroskedasticity of the error terms. In addition, none of our specifications imply estimated probabilities less than 0 or greater than 1. The linear probability model is the primary specification since the regressions are meant to demonstrate the differential average effects across the treatments and since Probit specifications can introduce bias in estimates of interaction terms (see Chunrong Ai and Edward C. Norton 2003 for an explanation of the bias and for a correction). We also estimated coefficients for each interaction using a Probit specification and the correction proposed in Norton, Hua Wang and Ai (2004) and the coefficients are almost identical to those estimated by the linear probability model (i.e. all coefficient estimates are quantitatively similar and therefore we never estimate a different sign or a different level of significance from the linearly probability model when using the corrected Probit).

after subjects have experience with the game from playing in the *Control* condition for 15 rounds. Using estimates from regression (2), we find that *Priority* outperforms *Discount* and *Rebate* in the first 15 rounds of the experiment but the three are indistinguishable in the second half of the experiment.

Regression (3) additionally controls for whether the subjects had randomly been assigned the high cost of donating ($0.80) rather than the low cost ($0.40). The coefficient on *High Cost* is negative and significant, suggesting that facing a donation cost that is $0.40 lower makes subjects 6% more likely to donate.[25] The variable *High Cost* is also interacted with all three treatment conditions. The only significant coefficient on these interaction terms are for the *Discount* condition, which suggests that the *Discount* condition had a more significant impact on the low cost donors than on high cost donors. The *Discount* condition may have been particularly appealing for the low cost donors since the discount decreased the cost of donation to only $0.05 each round for the low cost donors.

[25] The estimate of 6% for the between-subject effect of lower costs is small relative to the within-subject effect of 26%, as estimated in regression (1) that results from a $0.35 discount being implemented. This difference may be due to a difference in information. Subjects have only private information about own donation costs but information about the discount is made publicly, so subjects may infer changes in the donation behavior of others that reinforces their own donation decisions.

Table 3: Donation by Condition

	Linear Probability Model (OLS)			
	(1)	(2)	(3)	(4)
Priority	0.306	0.383	0.395	
	(0.029)***	(0.041)***	(0.048)***	
Rebate	0.143	0.062	0.083	0.080
	(0.030)***	(0.050)	(0.058)	(0.059)
Discount	0.255	0.249	0.327	0.321
	(0.034)***	(0.045)***	(0.055)***	(0.057)***
Second Half		-0.136	-0.136	-0.133
		(0.028)***	(0.028)***	(0.028)***
Second Half*Priority		-0.066	-0.066	0.000
		(0.066)	(0.065)	0.000
Second Half*Rebate		0.172	0.172	0.169
		(0.081)**	(0.081)**	(0.081)**
Second Half*Discount		0.030	0.030	0.032
		(0.077)	(0.073)	(0.074)
High Cost			-0.062	-0.058
			(0.031)**	(0.031)*
High Cost*Priority			-0.025	
			(0.055)	
High Cost*Rebate			-0.042	-0.046
			(0.060)	(0.061)
High Cost*Discount			-0.155	-0.158
			(0.063)**	(0.064)**
Recipient Last Time				0.054
				(0.019)***
Earnings Last Time				0.005
				(0.002)***
Earned from Receipt Last Time				0.004
				(0.004)
Constant	0.298	0.359	0.390	0.359
	(0.016)***	(0.020)***	(0.025)***	(0.026)***
Observations	11904	11904	11904	9312
R-squared	0.07	0.09	0.1	0.07

Robust standard errors, clustered by subject are in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%

Independent Variables: Priority, Rebate and Discount are dummy variables representing the treatment; Second Half is a dummy variable equal to 1 for rounds 16 to 31; High Cost is a dummy variable equal to 1 if the potential donor faced the $0.80 cost rather than the $0.40 cost; Recipient Last Time is a dummy variable equal to 1 if the subject received a B unit in the last round; Earnings Last Time are earnings from the previous round (excluding the costs of donating); Earned from receipt last time represent the earnigns associated with the receipt of a B unit in the previous round.

Regression (4) investigates the role of receiving a B unit in this round on donation in the following round. Receiving a B unit is the only way a subject can get positive information about the donation decisions of other subjects (if his A unit fails first, he does not see any information about the donations of others; if his B unit fails first and he never receives a B unit, he gets negative information about the number of people in his group that are donating their B units). Regression (4) excludes data from the *Priority* condition since the probability of getting a B unit in that treatment is correlated with the decision to be a donor. The coefficient on *Recipient Last Time* is positive and significant, suggesting that subjects are about 5% more likely to be a donor when receiving a B unit in the previous round. The higher probability of donation after receiving a B unit is driven in part by the positive news and in part due to the additional earnings of a subject who receives a B unit, since higher earnings in a previous round increase the likelihood of donating (*Earnings Last Time* is positive and significant). However, there is no additional increase in the likelihood of donation when the earnings came after a B unit was needed and received (*Earned from Receipt Last Time* is not significant).

III. Simple Model

The experimental results demonstrate that the priority rule implemented in the priority condition had a significant positive impact on donation in the experiment. The priority rule provides an incentive for registration as an organ donor within the organ allocation system. To help interpret the effect of the priority rule, we develop a simple model to examine the equilibrium impact of introducing this incentive and we conduct welfare analysis. Compared to the game subjects played in the experiment, the model makes three simplifying assumptions for analytical tractability.

First, the model collapses the game into two periods. The stochastic process by which A units and B units fail in the experiment is complicated, but it is not essential to understanding the effect of the priority rule. In the experiment, all subjects decide whether to donate before the first period of each round and so their decisions are made before they have received any information about the failure of their units or any information about their payouts. Thus, the stochastic process allows subjects to observe the period-by-period outcomes that generate the final payoff in the round, but each round has first a decision period followed by a payoff (accumulated over potentially many periods as determined by the stochastic process and donation decisions of other subjects). The model presented here collapses this into a two-period game. In the first period, subjects simultaneously make donation decisions, and all payoffs are revealed in the second period.

Second, we model the agents as a continuum rather than the 12-person groups used in the experiment. Usually when making this leap we need to take into account that in a small group an agent's contribution impacts his own payoff (while it does not in a continuum of agents). In our setting, however, a subject can never give himself an organ. Consequently, in the laboratory experiment, as in a continuum of agents, a subject who donates does not increase his likelihood of getting a B unit by increasing the organ supply, while donation in the priority condition increases priority in the continuum model as in the lab.

Third, the model assumes that all agents know the distribution of costs agents face for donating. As will be discussed below, this cost collapses the direct cost of donating and any altruism or positive feelings associated with making a donation, which means the cost can be negative. In the laboratory experiment, subjects only know their own monetary cost of donating ($0.40 and $0.80 as randomly assigned by the experiment) and not the distribution of these costs or any warm glow laboratory subjects might feel from donating.

To summarize, we model the decision to register as an organ donor as a two-period game. In the first period, a continuum of agents decide whether to register as an organ donor. In the second period, agents realize their health states, their organ outcomes (whether they receive an organ if they need one), and their payoffs.

An agent's health state is either: (1) dead from brain death (and in a position to donate an organ if the agent had registered as an organ donor), which occurs with probability $\beta > 0$; (2) in need of an organ (we assume that everyone who needs an organ needs only one), which occurs with probability $\theta > 0$; or (3) neither, which occurs with probability $1 - \theta - \beta \geq 0$. If an agent is in need of an organ, he also realizes his organ outcome. He either: (1) receives an organ (for simplicity all donated organs are treated as identical) or (2) does not receive an organ. The number of organs made available by the brain death of an agent is α, and the probability of receiving an organ depends on the decisions of other agents in equilibrium.

The first part of the payoff is associated with an agent's health and organ outcome. This part of the payoff is normalized to be 0 when the agent is in need of an organ and no organ is received, and the payoff is normalized to be $V > 0$ when an agent is in need of an organ and receives one. The assumption that all agents are homogeneous in their value of receiving an organ is not necessary, and we will weaken the assumption when analyzing welfare. The payoffs for all other states of the world are unrestricted, since they never enter the decision problem.

The second part of the payoff is the cost associated with registering as an organ donor, which is additively separable from the payoffs from health and organ outcomes. Agents incur a cost of registering as an organ donor c that combines the direct costs of registering (for example, fear of worse medical treatment or discomfort the agent feels from thinking about his own death) with the benefits of being a donor (for example altruism or warm glow from registering

as a donor). We assume a continuum of agents with cost of donating $c \sim F(c)$ where c can be less than 0 so that some agents get a private benefit from donating.

Baseline Case

In the baseline case organs are assigned randomly to anyone who needs one. There is no incentive for an agent to register as an organ donor and the share of agents who become organ donors in equilibrium depends only on their costs of registering as an organ donor. Only agents with a cost $c \leq 0$ choose to register as donors. There is no additional incentive to register as a donor before priority is introduced, so the share of organ donors is $F(0)$.

A θ share of agents end up needing organs and a share β of agents suffer from brain death and are in a position to donate α organs each, but only if they have previously registered as an organ donor. Since the share of registered donors is $F(0)$, the equilibrium probability of receiving a kidney conditional on needing one is $p = \min\left\{\frac{\alpha\beta}{\theta}F(0), 1\right\}$.

Notice that when $\theta \leq \alpha\beta F(0)$ then $p = 1$, so all agents who need an organ receive one. To model an environment like the one in the U.S. today, where there is excess demand for organs, we assume in all that follows that $\theta > \alpha\beta F(0)$, so that not enough organs are provided in the equilibrium without a priority rule or some other intervention.

Priority for registered donors

With the introduction of a donor-priority rule there is a benefit to registering as an organ donor. Under a donor-priority rule, agents who have registered as donors get priority for any available organs, and those who are not registered donors only receive an organ if all registered donors who need an organ receive one. (If there are not enough organs for all agents in a priority group, then

any available organs are assigned randomly among members of that priority group.)

The *priority* and *rebate* conditions of the experiment mirror the case of donor-priority in the model in that being an organ donor generates an incentive that is a function of the number of other donors. In the *priority* condition, being a donor increases the likelihood of receiving an organ when one is needed. In the *rebate* condition, being a donor generates a cash benefit equivalent to the expected value of having priority in the priority condition.[26]

It should be noted that if $F(0) = 0$, so that no agents have a cost of contribution of 0 or less, then there is always an equilibrium in which no one registers as a donor, even under a donor-priority rule. This equilibrium exists since an agent can never give an organ to himself, so there is no donor-priority benefit to being the only registered organ donor. Notice that this does not result from assuming a continuum of agents; even with a finite number of agents, an agent can never donate an organ to himself. Consequently, we focus on the case $F(0) > 0$, so that at least some agents prefer to register as an organ donor even without donor priority and the no-registration equilibrium does not exist. This assumption mirrors the data in our experiment, in which agents registered as donors even in the control condition, and the data for organ donation in the U.S., where 37% of eligible adults are registered as organ donors in the absence of a donor-priority rule.

We define the probability that a registered donor who needs an organ gets one as p_d. Under the donor-priority rule, with $F(0) > 0$, p_d is

$$p_d = \min\left\{\frac{\alpha\beta}{\theta}, 1\right\}$$

[26] As noted above, the experiment has many periods within each round that are collapsed into one payoff period in the model.

where θ can now be interpreted as the share of registered donors who need organs (which is of course the same as the share of the general population).

We look for a cutoff equilibrium in the cost space, where c^* is defined as the cost at which agents are indifferent between registering as an organ donor and not registering. All agents with $c \leq c^*$ choose to register and all agents with $c > c^*$ choose not to register. Agents who do not register do not get priority and, if they need an organ, receive one with probability p_n, which is the share of remaining organs $(\alpha\beta - \theta)F(c^*)$ divided by the share of agents who are not registered donors but are in need of an organ $\theta\big(1 - F(c^*)\big)$ or

$$p_n = \max\left\{0, \min\left\{\frac{(\alpha\beta - \theta)F(c^*)}{\theta(1 - F(c^*))}, 1\right\}\right\}$$

Note that $p_n = 0$ if $p_d < 1$, since all the donated organs are going to registered donors who ended up needing an organ. Equilibrium requires that

$$c^* = V\theta\big[p_d\big(F(c^*)\big) - p_n\big(F(c^*)\big)\big]$$

so that the agent who has cost c^* is indifferent between not registering, which generates no cost and no benefit from registering, or registering, which generates a cost c^* and increases an agent's probability of receiving an organ (and thus increases the probability of a payout of V) by $\theta[p_d - p_n]$ where θ is the probability of needing an organ and $p_d - p_n$ is the increase in probability of receiving the organ with priority.

Notice that the equilibrium depends on whether agents who are not registered donors ever get an organ in equilibrium, this is equivalent to whether $\frac{\alpha\beta}{\theta} > 1$ or $\frac{\alpha\beta}{\theta} \leq 1$. We can think of $\frac{\alpha\beta}{\theta}$ as the "production-need ratio" of organs. When $\frac{\alpha\beta}{\theta} > 1$, registered donors who suffer brain death produce enough organs to supply organs to all the registered donors who need organs and some organs go to people who are not registered donors.

When $\frac{\alpha\beta}{\theta} \leq 1$ then $p_d = \frac{\alpha\beta}{\theta}$, so not all registered donors receive an organ when they need one (unless $\frac{\alpha\beta}{\theta} = 1$). In this case, $p_n = 0$. Thus equilibrium requires $c^* = V\theta\left[\frac{\alpha\beta}{\theta} - 0\right] = \alpha\beta V$.

So agents contribute when they have $c \leq \alpha\beta V$ and in equilibrium the share of agents who contribute is $F(\alpha\beta V)$. Notice that if $F(\alpha\beta V) > F(0)$, then there are more donors under the donor-priority rule than in the baseline case. Donor priority introduces a positive incentive for registering as a donor in the form of a higher likelihood of receiving an organ if it is needed, which encourages donation.

When $\frac{\alpha\beta}{\theta} > 1$, all registered donors who need an organ receive one and there are organs available for some non-registered agents as well. In this case, $p_d = 1$ and $p_n = \frac{(\alpha\beta - \theta)F(c^*)}{\theta(1-F(c^*))}$ (since we have assumed that $\theta > \alpha\beta F(0)$, which rules out $p_n = 1$). This means that in equilibrium

$$c^* = V\theta\left[1 - \frac{(\alpha\beta - \theta)F(c^*)}{\theta(1 - F(c^*))}\right]$$

which implies that

$$F(c^*) = \frac{\theta V - c^*}{\alpha\beta V - c^*}$$

This condition defines c^* and implies that $F(c^*) < 1$ (since $\alpha\beta > \theta$ in this case), so not all agents register as organ donors. Consequently, $p_d = 1$ and $p_n = 1 - \frac{c^*}{\theta V}$. We can see that $c^* > 0$ since $c^* \leq 0$ is ruled out by the assumption that $F(0) < \frac{\theta}{\alpha\beta}$.

The $\frac{\alpha\beta}{\theta} > 1$ case demonstrates the countervailing forces to register as a donor present under the donor-priority rule. First, there is an incentive for individuals to register as a donor in the form of a higher likelihood of receiving an

organ if it is needed, which encourages donation. Second, there is a countervailing force in that the extra donors generated by the priority rule are producing more organs for those who are not registered donors, so as more people register or more organs are provided, the chance of getting an organ when not registered increases.[27]

Depending on the "production-need ratio" of organs, the share of agents who are registered as organ donors is given by

$$F(\alpha\beta V) \text{ if } \frac{\alpha\beta}{\theta} \leq 1$$

$$F(c^*) = \frac{\theta V - c^*}{\alpha\beta V - c^*} \text{ if } \frac{\alpha\beta}{\theta} > 1$$

The effect of decreased costs

A decrease in the cost of donation, as implemented in the experiment in the *discount* condition, serves to decrease the cost for all agents. This change in the cost of donation would increase the share of agents who register as donors by increasing the share of agents who have negative costs.

[27] While not described in detail here, the model makes possible comparative static analysis on the number of donors that identifies differences between the donor-priority allocation rule and the current allocation rule without priority. Under the donor-priority rule, the number of donor registrations responds to increased success in recovering organs by increasing until enough organs are recovered that those without priority also have positive probability of receiving an organ, after which it decreases. The number of organ registrations also increases in response to an increase in the rate of organ failure, until so many organs are failing that all organs go to registered donors, after which there is no change in the donation rate as the organ failure rate continues to rise. Finally, as the value of transplantation compared to non-transplantation increases (e.g. through better surgical techniques that promise longer survival of the transplanted organ), so does the rate of donation under the donor-priority rule. In contrast, under the rule without priority, the registration rate does not vary in response to the recovery rate, the incidence of disease, or the increased benefit of transplantation. While not modeled here, it is possible that the "warm glow" that some part of the population feels from the decision to register as a donor may respond to these changes in parameters under both a donor-priority rule or in the baseline case.

For example, if the distribution of original costs $c \sim F(c)$, then a decrease in costs of d generate a net cost of donation of $c - d$. Now, donors who have an original cost of $c \leq d$ are willing to register, leading to a share of agents $F(d)$ who register as donors, which generates $\alpha\beta F(d)$ kidneys. If $F(d) > F(0)$ then the decrease in costs increases the probability an agent receives an organ if one is needed from $p = \min\left\{\frac{\alpha\beta}{\theta}F(0), 1\right\}$ to $p = \min\left\{\frac{\alpha\beta}{\theta}F(d), 1\right\}$.

Welfare Analysis

The model as formulated above allows for a welfare analysis of different policies that affect the number of organ donors. A social planner interested in maximizing the sum of welfare of the continuum of agents is concerned with the welfare benefit of receiving a kidney, V, weighted by the probability that it is needed and received, and the welfare cost associated with being a deceased organ donor, c, which may be negative. Total welfare can be written as the sum of these two terms:

$$W(c^*) = V\theta\left[p_d F(c^*) + p_n\left(1 - F(c^*)\right)\right] - E[c|c < F(c^*)]F(c^*)$$

where p_d and p_n are again the probabilities that registered donor and non-registered donors (respectively) receive an organ if they need one. Again c^* is the cutoff cost such that those with $c \leq c^*$ register as organ donors and those with $c > c^*$ do not. The first term is the benefit of receiving an organ when it is needed and the second term is the expected cost of registering as a donor multiplied by the share of the population that registers. The first term calculates the probability of receiving an organ as the sum of the probability of getting an organ when registered as a donor, p_d, times the share of agents who are registered donors $F(c^*)$ plus the probability of getting an organ when not registered as a donor, p_n, times the share of agents who are not registered donors $1 - F(c^*)$.

Welfare in the baseline case

Without a donor-priority rule, $p_d = p_n = p = \frac{\alpha\beta}{\theta}F(0)$ and $c^* = 0$ so welfare simplifies to

$$W_B = V\theta p - E[c|c \leq F(0)]F(0)$$

$$W_B = V\theta\left[\frac{\alpha\beta}{\theta}F(0)\right] - E[c|c \leq F(0)]F(0)$$

$$W_B = V\alpha\beta F(0) - E[c|c \leq F(0)]F(0)$$

Since the only people who register as donors when there is no donor-priority rule are those who have a negative cost of donation, $W_B \geq 0$ and $W_B > 0$ if $F(0) > 0$.

Welfare with donor priority

With a donor-priority rule, both the cases above generate welfare with the same general form. As noted above, when $\frac{\alpha\beta}{\theta} \leq 1$ then $p_d = \frac{\alpha\beta}{\theta}$, so (unless $\frac{\alpha\beta}{\theta} = 1$) not all registered donors receive an organ when they need one. In this case, $p_n = 0$, $c^* = \alpha\beta V$, and welfare is

$$W_{DP,\frac{\alpha\beta}{\theta}\leq 1} = V[\alpha\beta F(\alpha\beta V)] - E[c|c \leq \alpha\beta V]F(\alpha\beta V)$$

Alternatively, when $\frac{\alpha\beta}{\theta} > 1$, all registered donors who need an organ receive one and there are organs available for some non-registered donors as well. In this case, $p_d = 1$, $p_n = \frac{(\alpha\beta-\theta)F(c^*)}{\theta(1-F(c^*))}$, $c^* = V\theta\left[1 - \frac{(\alpha\beta-\theta)F(c^*)}{\theta(1-F(c^*))}\right]$, and $F(c^*) = \frac{\theta V - c^*}{\alpha\beta V - c^*}$, so welfare is therefore

$$W_{DP,\frac{\alpha\beta}{\theta}>1} = V\theta\left[F(c^*) + \frac{(\alpha\beta-\theta)F(c^*)}{\theta\left(1-F(c^*)\right)}\left(1-F(c^*)\right)\right] - E[c|c < c^*]F(c^*)$$

Notice that welfare in both cases simplifies to the same form, where

$$W_{DP} = V[\alpha\beta F(c^*)] - E[c|c \leq c^*]F(c^*)$$

and $c^* = \alpha\beta V$ or $c^* = V\theta\left[1 - \frac{(\alpha\beta-\theta)F(c^*)}{\theta(1-F(c^*))}\right]$, depending on the case.

In addition we can compare welfare under a donor-priority rule to welfare in the baseline case. We rewrite welfare under a donor-priority rule W_{DP} as as

$$W_{DP} = V\left[\alpha\beta F(0) + \alpha\beta\left(F(c^*) - F(0)\right)\right] - E[c|c \leq 0]F(0) - E[c|0 < c \leq c^*][F(c^*) - F(0)]$$

which implies that

$$W_{DP} - W_B = (V\alpha\beta - E[c|0 < c \leq c^*])[F(c^*) - F(0)]$$

Essentially, the change welfare associated with switching from the baseline case to a donor-priority rule is the share of donors induced to donate by the priority rule $F(c^*) - F(0)$ times the difference of the expected benefit from each additional organ donor, $V\alpha\beta$, and the average cost of donation for these new donors $E[c|0 < c \leq c^*]$. While the two cases (with respect to $\frac{\alpha\beta}{\theta}$) are different, the welfare gain is never negative since the cost of a marginal donor is never greater than the benefit from donating. Welfare is strictly increased whenever there is a positive measure $F(c^*) - F(0)$ of new donors.

The welfare change associated with introducing a donor-priority rule when $\frac{\alpha\beta}{\theta} \leq 1$ and thus $c^* = V\alpha\beta$ is weakly positive. We can see this by noting that (in this case) the donors with the highest cost of donation, $c = \alpha\beta V$, incur a cost that is equal to the benefit that they create in extra organs. Any agents who have c in the range $0 < c < \alpha\beta V$ generate a net welfare gain by choosing to become donors. Consequently, the welfare gain of the priority rule $W_{P,\frac{\alpha\beta}{\theta}\leq 1} - W_B > 0$ so long as at there are agents with c in the range $0 < c < \alpha\beta V$.

When $\frac{\alpha\beta}{\theta} > 1$, however, $c^* = V\theta\left[1 - \frac{(\alpha\beta-\theta)F(c^*)}{\theta(1-F(c^*))}\right] < V\theta < V\alpha\beta$, with the last inequality arising from the condition that $\alpha\beta > \theta$. This means that fewer people are donors in equilibrium when $\frac{\alpha\beta}{\theta} > 1$ than when $\frac{\alpha\beta}{\theta} \leq 1$. This decrease in

share of donors arises from the weakening of incentives associated with having priority when $\frac{\alpha\beta}{\theta} > 1$. In this case, some non-donors get organs, which decreases the benefit of priority. Thus, the highest cost incurred by a donor in this case is below the expected benefit created by their donation. Thus $W_{P,\frac{\alpha\beta}{\theta}>1} - W_B > 0$ whenever $F(c^*) > F(0)$, whenever the are agents with c in the range $0 < c \leq c^*$.

Welfare with decreased costs

There are two ways that the social planner can decrease costs: by somehow manipulating the underlying distribution of $F(c)$ or by providing transfers that decrease the net costs of contributing.

If the social planner can directly decrease the costs of donation by manipulating $F(c)$, say by increasing the warm glow from giving or alleviating psychological costs of contribution, she can increase welfare by doing so. A decrease in the costs of donation for all agents: makes all previous donors better off by making previously negative costs more negative, makes some previously positive costs negative getting new agents to donate, and makes some agents better off because they receive the organs generated by the new donors.

If instead agents' costs of donation are lowered through transfers (and assuming there is not a cost of raising the revenue for the transfers or a cost of implementing them) the welfare benefit of decreasing the costs of donation is a function of the number of new organs created minus the added costs for new donors. We can compare welfare under the first-best transfer with welfare under the donor-priority rule.

If $\frac{\alpha\beta}{\theta} \leq 1$, the optimal transfer will achieve organ donor registration from anyone who has $c \leq \alpha\beta V$ (i.e. a cost less than or equal to the expected benefit of the organs the registered donor creates). So the optimal decrease in costs is

$d = \alpha\beta V$. Notice that in this case, the donor-priority rule achieves the same first best outcome as the optimal transfer policy. If $\frac{\alpha\beta}{\theta} > 1$, then the expected benefit of generating a new donor is $\alpha\beta V$ until a share of agents q is donating such that $\alpha\beta q = \theta$, which implies that everyone is getting a kidney who needs one (and so new donors do not increase welfare). Consequently, to maximize welfare the social planner wants to induce everyone to enter who has $c \leq \alpha\beta V$ so long as $F(c) \leq q$. The social planner sets d such that $d \leq \alpha\beta V$ and $F(d) = \frac{\theta}{\alpha\beta}$ or $d = \alpha\beta V$ and $F(d) \leq \frac{\theta}{\alpha\beta}$. Notice that in this case, the social planner can achieve the first best with a transfer while the donor-priority rule generates fewer donors than is optimal, since some non-donors get organs from donors, which weakens the incentive of having priority.

Welfare with value priority

The donor-priority rule uses organ allocation to create an incentive for organ donation. However, there are other ways one might use organ allocation to increase welfare. One proposal is to assign deceased donor organs to maximize expected life years of the recipients rather than to purely satisfy a first-come-first-served allocation procedure (Organ Procurement and Transplantation Network 2011).

To demonstrate the relative benefit of a donor-priority rule and a policy that allocates deceased donor organs to those who value them the most (a value-priority rule) we need to introduce heterogeneity in the value of receiving an organ into the model. We do this simply by assuming there are two types of agents, those who have a high value from receiving an organ V_H and those who have a low value V_L. The difference in value for an organ can derive from agents being at different ages or different quality of health when the need for an organ

arises. We call δ the share of the population that has V_H and redefine $V = \delta V_H + (1-\delta)V_L$ to be the average value of receiving an organ (the expected value of receiving an organ before an agent knows his type).

To make the contrast between donor priority and value priority most stark, we assume that agents do not know their value when they make their organ donation decision (otherwise, those who have a high value for organs would get a larger expected benefit from donation under a donor-priority rule and donor-priority would work to achieve sorting on value as well).

We compare the welfare under the donor-priority rule with welfare under a value-priority rule and look for conditions when one outperforms the other. We have already solved for welfare under a donor-priority rule, since it does not distinguish between high and low value recipients, we can treat each organ as having its expected value V

$$W_{DP} = V[\alpha\beta F(c^*)] - E[c|c \le c^*]F(c^*)$$

where $c^* = \alpha\beta V$ when $\frac{\alpha\beta}{\theta} \le 1$ and $c^* = V\theta\left[1 - \frac{(\alpha\beta-\theta)F(c^*)}{\theta(1-F(c^*))}\right]$ when $\frac{\alpha\beta}{\theta} > 1$.

Welfare under a value-priority rule depends on whether $\alpha\beta F(0) \le \delta$, so all organs go to high value types or whether $\alpha\beta F(0) > \delta$, so some organs go to low value types. We can solve for welfare in each case:

$$W_{VP,\alpha\beta F(0)\le\delta} = V_H\alpha\beta F(0) - E[c|c \le 0]F(0)$$

$$W_{VP,\alpha\beta F(0)>\delta} = V_H\delta + V_L[\alpha\beta F(0) - \delta] - E[c|c \le 0]F(0)$$

We look for the conditions under which the donor-priority rule outperforms the value-priority rule in each of the cases. We start first with $\alpha\beta F(0) \le \delta$. We can see that $W_{DP} > W_{VP,\alpha\beta F(0)\le\delta}$ when

$$V\alpha\beta F(c^*) - E[c|c \le c^*]F(c^*) > V_H\alpha\beta F(0) - E[c|c \le 0]F(0)$$

Which simplifies to

$$V_H - V < (V\alpha\beta - E[c|0 < c \le c^*])\frac{[F(c^*) - F(0)]}{\alpha\beta F(0)}$$

and can be rewritten as

$$V_H - V < \frac{W_{DP} - W_B}{\alpha\beta F(0)}$$

This result demonstrates that donor priority outperforms value priority as long as the high value, V_H, is not too much larger than the average value, V.

We can now investigate the case where $\alpha\beta F(0) > \delta$. We can see that $W_{DP} > W_{VP,\alpha\beta F(0)>\delta}$ when

$$V[\alpha\beta F(c^*)] - E[c|c \leq c^*]F(c^*) > V_H\delta + V_L[\alpha\beta F(0) - \delta] - E[c|c \leq 0]F(0)$$

Which simplifies to

$$V_H - V < (V\alpha\beta - E[c|0 < c \leq c^*])\frac{[F(c^*) - F(0)]}{1 - \alpha\beta F(0)}\left(\frac{1-\delta}{\delta}\right)$$

and can be rewritten as

$$V_H - V < \frac{W_{DP} - W_B}{1 - \alpha\beta F(0)}\left(\frac{1-\delta}{\delta}\right)$$

or as

$$V - V_L < \frac{W_{DP} - W_B}{1 - \alpha\beta F(0)}$$

Which shows that donor priority outperforms value priority as long as the average value, V, is not too much larger than the low value, V_L.

Again depending on the parameters of the model, the donor-priority rule or the value-priority rule will be optimal. The basic tradeoff is that a donor priority rule produces more organs, but does not necessarily allocate them to the recipients who would gain the most from them.

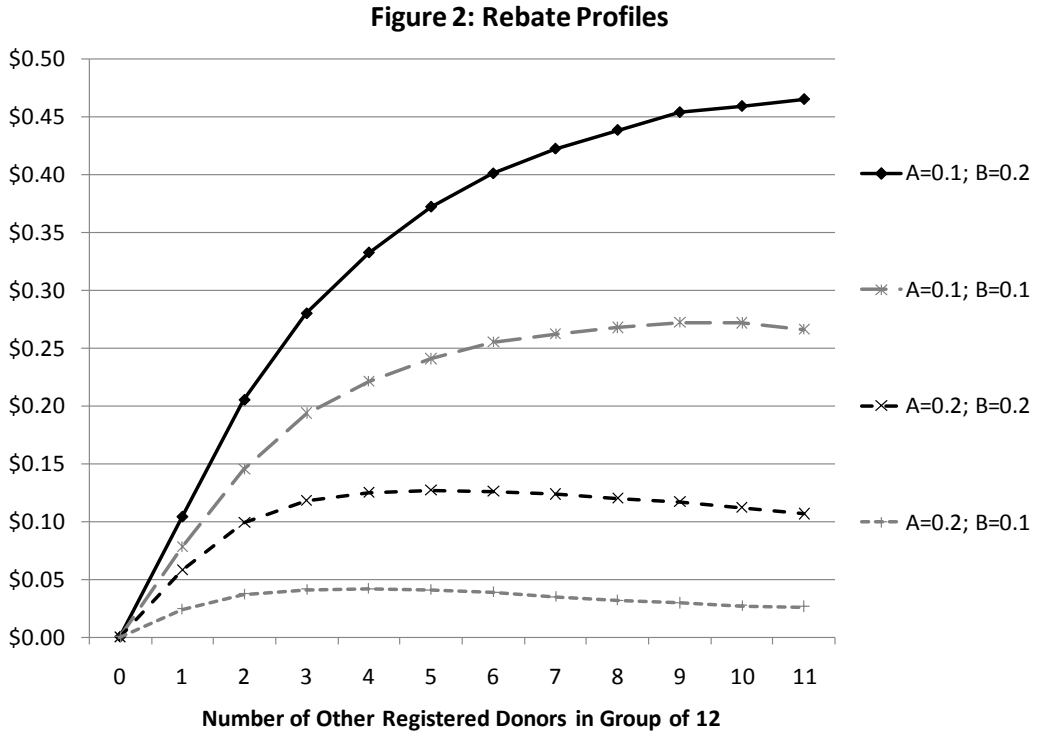
One could also imagine taking advantage of both donor status and value in organ allocation. For example, organs could be assigned first based on donor status and then, within a priority class, based on value; or, organs could be assigned first based on value and then based on donor status within a priority

class. While we do not formally address these cases, they would further leverage allocation policy to enhance welfare.

Experimental Parameters

Our experimental game has the same structure as the 2-period model outlined above. Subjects make registration decisions in period 1 and then payoffs are revealed. However, the payoff "period" has a more complicated structure and occurs over a number of periods instead of one. In our experiment, payoffs are generated by a stochastic process in which subjects suffer from B-unit failure with a 20% probability in each period and suffer brain death with a 10% probability in each period. Rather than collect and distribute all organs simultaneously, we introduce more complicated timing and allow subjects who have B-unit failure to survive for up to 5 periods without a B unit, during which time they may receive a B-unit and earn a stochastic payoff that is a function of the number of periods they survive after that.

Since the payoffs in the game are complicated, it is most useful to simulate the payoffs associated with priority. Figure 2 shows the expected benefit of receiving priority under the priority rule for different parameter values (based on 10 million simulations of each number of other donors for each set of parameters). The parameter values vary the probability of A-unit and B-unit failure for groups of 12 players who each have two B units available for donation when they suffer A-unit failure.



The top-most rebate profile is the benefit of having priority with the parameters actually used in the experiment. Notice that the benefit to having priority is increasing with the number of other donors and that even when all 11 other players are registered donors, there is still a significant benefit to having priority. One can interpret this feature of our payoffs as suggesting that there is a significant waiting list for organs (and so there is always a benefit to having priority). Notice that while the payoff structure in our experiment guarantees that under a priority rule, a subject who is not a donor cannot get a B unit in a period when a subject who is a donor needs but does not receive one. However, the payoffs in the experiment are more complicated than in the model, which is a simplified version of both the experimental game and actual decisions to donate. Consequently, the rebate profiles in Figure 2 representing the benefit of priority

collapse the benefits and costs and simply represent the benefit of priority, which is most similar to the value in the model of

$$V\theta\left[p_d\left(F(c^*)\right) - p_n\left(F(c^*)\right)\right]$$

The functions in Figure 2 demonstrate the benefit to priority under different parameter values, which make the probability of brain death relatively higher (similar to increasing β) or the probability of organ failure lower (similar to decreasing θ) or both.[28]

If the only costs the subjects face for registering as a donor in the experiment are the financial costs imposed in the experiment (and if subjects do not have altruistic or warm glow motive for donating) then in our experiment the only equilibrium of the game is for no one to register as a donor, even under the priority and rebate rules. Each group of 12 subjects had 6 subjects who had a donation cost of \$0.40 and 6 subjects who had a donation cost of \$0.80. Since the expected benefit of priority when 5 other subjects are contributing is only \$0.38, there is no equilibrium in which these 6 low-cost subjects all contribute. However, we see many subjects registering as a donor even without priority, suggesting that there may be altruism or warm glow associated with the decision to register as a donor. In the case of heterogeneous costs, in which some agents contribute in the absence of a priority rule, we expect priority and the rebate conditions to generate more contribution than the control condition in equilibrium, which is what we observe in the experimental data.

[28] In the three functions that lie below the rebate profile used in the experiment, the benefit to priority peaks in the interior, so while there is always a positive benefit of priority, it is not always increasing in the number of other donors. While the model assumed a distribution of costs of registering as an organ donor, if all subjects had a common cost of registering as an organ donor, there would be certain common costs at which a mixed strategy equilibrium would exist in which only some agents registered as organ donors and everyone was indifferent between not getting priority and incurring the cost of registering in order to get priority.

Lifesharers

With the model providing intuition about behavior with and without priority rules, we can consider other proposals similar to the donor-priority rule discussed here. For example, the Lifesharers club has formed in the United States to provide priority-type incentives for registering as a donor and joining the Lifesharers club. Individuals who join Lifesharers and register as organ donors commit to directing their deceased organs to other members of Lifesharers who might need them.

Notice that if the existence of the Lifesharers club were widely known and if registering as an organ donor automatically registered an individual in Lifesharers at no cost, the club would replicate the donor-priority rule discussed here. However, the existence of the Lifesharers club is not widely known, and while there is no financial cost to joining the club, there may still be a cost of informing your next of kin that you are a member of the club (and that they will inherit the task of enforcing your wishes to have your organs be offered first to other members of Lifesharers) or similar psychological costs to joining Lifesharers as with registering as an organ donor. As soon as there is an additional cost of joining Lifesharers, there is an equilibrium at which no one joins, since there is no benefit to being the only member of Lifesharers (and little benefit to being one of few members). Introducing a priority system nationally eliminates this non-participation equilibrium, since registering as a donor in a national donor-priority system provides priority access to the organs provided by all those people who chose to register as donors together with all the additional unregistered donors whose next of kin decide to donate their organs.

IV. Discussion

The donor-priority rule significantly increased registration rates for organ donation in our experiment. When implemented at the start of the game, the

priority rule was more effective at increasing donation rates than either the rebate or the discount. When implemented after subjects were familiar with the game, the increase in registration rates generated by the priority rule was also achieved by the discount that directly decreased the costs of donation and by the rebate that provided the same incentive for registration as the priority rule, and the same positive externalities to other donors, in expectation.

The rules for allocating deceased donor organs present a complex problem, because they determine not merely who receives the next available organ, but may also influence how many organs become available, by influencing the decisions of potential donors. As in other areas of market design involved with exploring incremental improvements to complicated existing institutions, it is necessary to think about how any proposed change will interact with existing rules and procedures (cf. Roth 2002, 2008). One reason this paper focuses on donor-priority rules is that we think that these might fit well with the existing legal and procedural institutions.

In this respect it is worth noting that there are other ways to change policy that could increase the number of registered organ donors. For example, one proposal that has received a good deal of attention would change the current "opt in" registration method used in the United States to an "opt out" system in which everyone is presumed to be a donor unless he or she actively indicates otherwise.[29] Another proposal, "mandated choice" would require everyone (e.g. who applies for a driver's license) to specifically indicate whether they wished to be a donor or not. We want to briefly argue here that the priority rule that we

[29] Switching to an "opt out" system might not be easy, as shown by the so-far-failed attempt to do so in Britain. In 2008, senior British politicians supported changing British organ donation registration from an "opt in" to an "opt out" system, but faced considerable opposition (http://marketdesigner.blogspot.com/2008/11/british-organ-donation-opt-in-versus.html). Sheila M. Bird and John Harris (2010) report on the continued effort to change the system. Similarly, in a speech announcing a new organ donor registry in California, Governor Schwarzenegger said an opt out system had been suggested to him, but that an opt-out system was not plausible due to constitutional concerns (http://gov.ca.gov/speech/16126/).

consider may create a more direct link between registration as an organ donor and subsequent successful organ recovery and transplantation than policies that change the procedure by which individuals register as organ donors.

Attempts to increase organ donation rates by changing the default organ registration status (and adopting an "opt out" policy) would surely generate more organ donor *registrations*, since those who do not take any explicit action would automatically be registered as donors (see Eric J. Johnson and Daniel G. Goldstein 2003, 2004, who find direct evidence that registration rates are higher with an "opt out" system).[30] However, such a policy may weaken the link between the registration decision and the legal clarity of the potential donors' last wishes. Under current United States gift law, changing the default status is likely to have legal consequences that could be detrimental to organ retrieval.

Since the Uniform Anatomical Gift Act of 1968 (UAGA), an individual can make his or her own legally binding decision to be an organ donor after death, which does not require the consent of next of kin (Alexandra K. Glazier 2009). However, a donor symbol on a driver's license has not been considered sufficient evidence of the deceased's intent to donate to proceed without permission from the next of kin. Aside from the fact that the driver's license is often not available in a timely way, the law allowed that a registered donor could have changed his or her mind about donation subsequent to the issuance of the driver's license (Glazier 2006).

In recent years, computer registries have allowed for fast checks of organ registration status. They also provide individuals with a way to easily change their organ donor status online, which allows the presence in the registry to be interpreted as intent to donate. The legal status of the anatomical gift has meant

[30] Manipulation of defaults in choice situations has been shown to be a powerful force in changing behavior in many settings (see Shlomo Benartzi and Richard H. Thaler 2007 and Thaler and Cass R. Sunstein 2008).

doctors can recover donated organs without receiving explicit permission the next of kin (see Glazier 2006). In contrast, a donor registration that does not reflect a positive decision to donate (as under an "opt out" policy) might not be taken as evidence of the deceased's intent in the legally compelling way that registration is currently. Under an opt out policy, approval from next of kin might again become necessary for an organ to be transplanted.[31]

A "mandated choice" system would also change the way in which individuals became registered donors (see Thaler and Sunstein 2008 and Thaler 2009). Under "mandated choice," every individual who registered for a driver's license (or potentially other state or federal documentation) would be required to indicate that he will be an organ donor or that he will not. While there is suggestive evidence that a "mandated choice" policy would (like "opt out") generate more registration of organ donors (Johnson and Goldstein 2003, 2004), similar concerns arise about whether a change to mandated choice would lead to more donated organs and transplants. While the UAGA makes registering to be a donor legally binding under an "opt in" policy, *failing to register* as an organ donor is not a legally binding decision, whereas registering as a person who *declines* to donate could be legally binding on the next of kin.[32] Discussions with the staff at the New England Organ Bank suggests that they are able to recover organs from about half of all non-registered potential donors in New England by approaching next of kin. This means that more than half of the people who are not

[31] In addition to finding high rates of willingness to register in a survey of potential organ donors, Johnson and Goldstein (2003, 2004) also suggest that more organs are recovered and transplanted in European countries that have "opt out" systems. Bruno Deffains and Jean Mercier Ythier (2010) argue, on the other hand, that the success of organ recovery rates in Spain (which has the highest recovery rates in Europe) is not due to the "opt out" system but to the way in which the Spanish transplant system has professionalized the harvesting of organs, by specialists who do nothing else. See also Kieran Healy (2006).

[32] Mandated choices could of course be framed so that a negative decision was merely recorded as a decision "not to register as a donor at this time," but even this less binding formulation might inform next of kin's beliefs about the deceased's intentions and wishes.

currently registered under "opt in" would need to choose "yes" in mandated choice to increase the recovery rate. Consequently, it remains an empirical question whether a change to "mandated choice" would generate more organ transplants.

Even though registration under "opt out" and "mandated choice" systems may raise legal concerns about the intent of registrants under the UAGA, changing the procedure by which individuals register as donors may still be a fruitful avenue to pursue to increase organ donation and recovery.[33] Gift laws can also potentially be changed to address any legal concerns that might arise from new policies. We simply see these legal issues as additional hurdles to monitor and overcome in successfully implementing a change in registration policy. One attraction of the donor-priority rule is that it seems to avoid these particular hurdles since it preserves the current donor registration process as is (and thus is consistent with current United States law regarding donor intent at time of death).

Although changing priority rules would involve a regulatory rather than a legislative process, a change such as we consider here would nevertheless involve substantial debate and principled opposition. Much of the opposition would likely have to do with thinking of priorities as reflecting justified claims. For example, we would not feel that a serial killer serving a life sentence who happens to be a registered donor would have a more justified claim to a scarce organ than an exemplary citizen who happened not to be registered as a donor. And, under a donor-priority system, there would likely be opposition if there were disparity across groups in the opportunity to register and receive priority.

While comparing the different mechanisms in our experiment, the priority rule, rebate, and discount all generate an incentive to donate that offsets the costs

[33] Some of the U.S. states have been pursuing these avenues independently. In New York, a discussion has recently begun about the potential to switch to an opt out system (see http://www.dailynews.com/news/ci_14970110) and Illinois has had a mandated choice system in place since 2006 (see Thaler 2009).

of donation. But the priority rule has an advantage over the rebate and discount, namely priority rule seems feasible and can be implemented without any additional costs to the system. In contrast, decreasing the costs of registering to be an organ donor may be difficult (both to understand the costs and to decrease them) and decreasing net costs through monetary incentives is not currently allowed by the U.S. National Organ Transplant Act and by similar legislation in many countries.

Decreasing the costs of registering to be a donor is a particular challenge in part because the costs are hard to identify. Since the physical removal of the organs only occurs after death and since the monetary costs are not borne by the donor's estate, it is unlikely that the costs are physical or monetary. Additionally, the costs appear to be more substantial than transaction costs, since registering to be an organ donor in most states only requires checking a box at the time of receiving a driver's license (and the registration rates remain low while the benefits to others are substantial). These facts suggest that the costs of registering to be an organ donor are most likely psychological costs.

The psychological costs may involve fear of improper medical treatment if registered as an organ donor. A national survey of 5,100 adults conducted in January 2010 on behalf of Donate Life America found that 52% of survey respondents believe doctors will try less hard to save them and 61% of survey respondents believed they might have their organs removed when they might still come back to life.[34] (We have not seen evidence consistent with these beliefs, but regardless of whether this is properly labeled as a "psychological" cost, it is a cost that seems difficult or impossible to decrease. For example, attempts to dispel such beliefs about worse medical treatment of organ donors may only serve to strengthen it or introduce it into the minds of others). In addition, deciding to be

[34] Based on the Donate Life America *National Donor Designation Report Card 2010*.

an organ donor requires an individual to think about his own death, which may itself generate psychological costs. It remains unclear how these costs can be effectively lowered. While future research should certainly investigate the costs to registering to be an organ donor and how policies aimed at decreasing these costs might work, allocation policy that implements a priority rule is likely to increase registration rates, even with the current costs in place.[35]

Care must always be taken in extrapolating experimental results to complex environments outside the lab, and caution is particularly called for when the lab setting abstracts away from important but intangible issues, as we do here. However the difficulty of performing comparable experiments or comparisons outside of the lab makes it sensible to look to simple experiments to generate hypotheses about organ donation policies. The results of our experiment lend support to the hypothesis that the priority rule used in Singapore and being introduced in Israel is a potentially powerful policy tool. Results from this experiment suggest that it performs as well as or better than discounts and rebates that are of a similar magnitude to the benefits of priority, and that, along with other policies, it is a plausible mechanism to increase rates of registration.

In conclusion, we note that many scarce resources are allocated via queues. One of the things that makes organs for transplantation unusual in this respect is that the way the queues are administered can influence the scarcity of the resource, by influencing donor decisions.

[35] Changes in allocation policy may have additional benefits beyond the incentives of higher priority in motivating individuals to register as donors. Contracts between agents have been shown to establish social norms that can lead to more prosocial behavior (Kessler and Leider 2011). By providing a benefit (in terms of higher priority for deceased donor organs) an allocation policy like the one in Singapore may act as an implicit contract, setting a social norm of behavior at registering to be a donor.

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http://marketdesigner.blogspot.com/search/label/chains
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LEGISLATION
Section 301, National Organ Transplant Act (NOTA), 42 U.S.C. 274e 1984
Human Organ Transplant Act:
http://www.moh.gov.sg/mohcorp/legislations.aspx?id=1672

PROPOSED LEGISLATION
http://assembly.state.ny.us/leg/?default_fld=&bn=A09865&Summary=Y&Actions=Y&Text=Y