Introducing Incentives in the Market for Live and Cadaveric Organ Donations*

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Abstract

We evaluate the introduction of monetary incentives in the market for live and cadaveric organ donations. We show that monetary incentives would increase the supply of organs for transplant sufficiently to eliminate the very large queues in organ markets, and the suffering and deaths of many of those waiting, without increasing the total cost of transplant surgery by more than 12%. We build on the value of life literature and other parts of economic analysis to estimate the equilibrium cost of live transplants for kidneys and livers. We also show that price will be determined by the cost of live donations, even though most organs will come from cadavers.

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1- Introduction

Organ transplants began about one half-century ago with a kidney transplant performed at Brigham & Women's hospital in Boston. But the market only began to take off with the development in the 1970's of immunosuppressive drugs that could prevent the rejection of transplanted organs. Since then the number of kidney, liver, heart, and other organ transplants has grown rapidly, but not nearly as rapidly as the growth in the number of persons with defective organs that desire transplants. The result has been the development of longer and longer queues to receive organs. Seriously ill individuals often die while waiting for transplants. It is also professionally frustrating to transplant surgeons who have the means to help many more individuals with defective organs.

When an economist sees a persistent gap between demand and supply- as in the demand for and supply of organs for transplants -he generally concludes that there are obstacles to equilibrating that market. And the obstacles are obvious in the market for transplants since no country allows monetary incentives to acquire organs either from living individuals or from cadavers.

This paper argues that monetary incentives could increase the supply of organs for transplant sufficiently to eliminate even the large queues in the organ market. And it would do this without increasing the total cost of transplant surgery by a large percent. These incentives would eliminate all the suffering and deaths of individuals who now must wait in long queues to receive organs.

The few papers that have discussed using monetary incentives have concentrated exclusively on increasing the supply of organs from cadavers (see, for example, Cohen, 1989, Becker, 1997, Kaserman and Barnett, 2002, and Epstein, 1993). Our paper instead stresses the potential from using incentives to elicit more live donations, although we also consider the use of monetary incentives to obtain cadaver donations.

Live transplants already account for almost half the kidney transplants in the United States, and for almost 8% of liver transplants. Live transplants would be much more important if individuals had greater incentive to take the risk involved in donating one of these organs.

Some of the issues involved in using monetary incentives for live and cadaver transplant surgery are similar, but others are very different. It might appear that incentives to increase cadaver transplants raise fewer difficult issues, especially since they involve no risk to the already deceased donors. However, we will show that in several respects live donations are less subject to abuse and corruption, and they have several other advantages that have received insufficient attention. In any case, reasonable estimates indicate that the market equilibrium price for kidneys, and perhaps also for livers, will be determined by live donations even though most organs would come from cadavers.

Section 2 discusses some salient empirical features of the supply and demand for organ transplants in the United States, with a few comparative statistics for other nations. The emphasis is on the excess between demand and supply, which is responsible for the growing list of persons in need of transplant surgery.

Section 3 considers characteristics of living donors, while section 4 builds on the value of life literature and other parts of economic analysis to estimate how much it would cost to increase the supply of organs for live transplants sufficiently to eliminate any significant waiting for organs. Section 4 also contrasts the issues involved in paying to get organs from cadavers with those involved in getting live donors, and the market equilibrium when payment is allowed for both live donors and for donations from cadavers. Section 5 considers various objections on moral and other grounds to paying for organs.

2- The Market for Organs for Transplant Surgery[i]

We can tell the story of the market for organ transplants through figures. Figure 1 presents, from 1990 to 2005 the total number of kidney transplants, the number with live donors, and the number of persons waiting for kidney transplants in the United States. The number of kidney transplants grew slowly over the period from about 10,000 in 1990 to over 13,700 in 2005.

The number of live donors grew rapidly over the same period, so that by the beginning of this century, almost half of all kidney transplants used live donors. Part of this increase can be attributed to the growing use of laparoscopic nephrectomy, a minimally-invasive procedure with equivalent recipient outcomes and lower donor morbidity than traditional open nephrectomy. However, most of the increase can be attributed to the sustained increase in waiting times to receive an organ due the inability of the current system to procure enough organs, imposing an increasing pressure among family members and other relatives to donate their organs.

Almost 17,000 persons were already waiting for a kidney transplant in 1990. But this number grew rapidly, so that about 65,000 persons were on this waiting list by the beginning of 2006. The ratio of this number to the annual number of transplants is a little below five years, which is an estimate of the average waiting time to get a kidney in 2005.

During the 1990's, reported median waiting times for kidneys and livers grew over time, but they were much longer for kidneys. The median waiting time to get a kidney transplant increased from 1 year in 1990 to 3.2 years in 2001, which is a little lower than the 3.3 years wait in 2001 estimated from the ratio of the number waiting to the annual number of transplants. Part of the discrepancy results from exits from the organ queue due to deaths of some of those waiting, some of them become too sick to go through transplant surgery (in 2001 over 850 persons left the kidney waiting list, or 1.7% of the kidney waiting list, because they became too sick to undergo transplant surgery), some purchase organs in the black market, some decide to remain on dialysis, and some exit for other reasons. But waiting times and the number waiting both increased sharply over time, and both indicate that persons who need a kidney transplant must wait a long time before they get one.

Figure 2 presents, the number of liver transplants, the waiting list for a transplant, and the number of live donors for the period from 1990 to 2005. Over the 1990-2001 period the number of liver transplants almost doubled to reach about 5,000 by 2001, but the waiting list grew much faster. It increased from about 1,200 persons in 1990 to over 18,700 by 2001, or to about three and half times the annual number of liver transplants.

In 2002 the number of persons in the waiting list declines to over 17,200, and remains very stable through the end of the data. This sharp decrease in the number persons on the waiting list can be attributable to the introduction of the Model for End-stage Liver Disease and Pediatric End-stage Liver Disease allocation system (MELD/PELD) in 2002. Most of the decrease can be accounted by the increase in the number of removals for "other" reasons (607 persons compared to 28 persons in 2001), “condition improved” (567 compared with -23 in 2001) and to sick to go to transplant (198 compared to 14 in 2001). These unusual changes in removals were likely to occur because “when centers were required to re-examine wait-listed patients when the MELD/PELD system was first implemented, they may have then found patients who were not appropriate candidates for transplantation” under the current system (See UNOS, 2003).

Liver transplants with live donors were pioneered by Dr. Christoph Broelsch and others starting in the late 1980’s. This explains why only fourteen such transplants took place in 1990. They grew at a rapid rate over the succeeding decade to reach a peak of 518 in 2001. But live liver transplants are still less than 10 per cent of all liver transplants. The main reason for that is the shortage of donors, not the risks of the surgery. As we show later, the safety of live liver transplant surgery has considerably improved, and that now poses only a small, although real, risk to donors.

The median waiting time to get a liver transplant increased from under 50 days in 1990 to about 670 days in 2001. In 2002, with the introduction of the MELD/PELD allocation system waiting time declines to 430 days. That under the current system living donations respond in part to family pressure is indicated by the significant drop of over 30% in the number of living donors in 2002 coincident with the big decline in waiting times.

Median waiting times to get a liver transplant are considerably less than waiting time estimated from the ratio of the number on the queue to the number of liver transplants. That this difference is greater than the difference in waiting time estimates for kidneys is probably explained by the fact that a much larger fraction of persons die, or become too sick to endure transplant surgery, while waiting for livers than while waiting for kidneys (15% for livers versus 6% for kidneys in 2002). Many persons in need of a kidney transplant can remain longer on dialysis while waiting- although prolonged use of dialysis often leads to diabetes and other diseases. However, persons in need of a liver transplant usually have no good temporary alternative available.

This explanation is supported by Figure 3, which gives the number of persons who died while waiting for kidney or liver transplants. Of course, some of them die from other causes, but many of those waiting for livers die from hepatitis C, cirrhosis, and other liver diseases that explains why they need liver transplants. In 2000, over 80% of the patient who died while waiting for an organ belonged to the group with the least urgent degree of severity according to the status code of medical urgency in the Organ Procurement and Transplantation Network (OPTN) classification. These are patients with some degree of severity of liver disease according to the Child-Turcotte-Pugh (CTP) score classification[ii]. Even though death rate for patients in the least urgent groups is lower than in the most urgent group, they represent a larger fraction on the total number of patients who die while waiting because there are more people in the least urgent categories than in the most urgent categories.

Figure 4 uses the previous figures to estimate for both livers and kidneys the trend in the gap between the annual number of transplants and the annual number who join the queue in need of a transplant. This gap equals the annual growth in the waiting list plus the number who leave the list because of death and other reasons. The data in Figure 4 estimates the gap between demand and supply from the growth in the waiting list in any year plus the number who died while waiting for a transplant over the year. In addition, in

2005 over 1,050 persons left the kidney waiting list (1.7% of the waiting list), and about 600 left the liver waiting list (3% of the waiting list), because they became too sick to undergo transplant surgery.

Figure 4 shows that not only does demand exceed supply in every year, but the gap for both kidneys and livers increased rapidly over time during the last decade, although more rapidly for livers. In 1991, excess demand equaled 2,500 persons in the kidney market and under 1,000 persons in the liver market. The gap grew in virtually every year, and by the year 2000 reached almost 7,000 and over 4,000 persons in the kidney and liver markets, respectively. So the malfunctioning of both transplant markets not only continued over time, but became much worse.

Table 1 shows that the long queues for transplants are not unique to the United States, but are found in other nations as well. This table gives for several nations the total number of kidney transplants in 2000, the number of live transplants, and the size of the waiting list per million of population. The largest of these programs, for Germany and Spain, are only about one-fifth the size of the American program.

Moreover, live donors constitute a much smaller fraction of all transplants in other nations than in the United States. Perhaps then it is not surprising that the average waiting time in Germany for a kidney transplant- estimated at about five years from the ratio of the waiting list to the annual number of kidney transplants -is longer than that in the United States. However, average waiting times in other nations, including Spain and UK and Ireland, are smaller than in America. This may be because governments and private insurance companies in these nations impose harsher eligibility conditions for publically subsidized or insurance-paid transplant surgery.

3- Living Donors

In 2004, about 80 per cent of living donors and recipients in the United States were related, either as parents, children, siblings, spouses, or other relatives. The first live liver transplant in the United States involved a mother who donated part of her liver to her young daughter. A professional basketball player who earns millions of dollars per year, Gregg Ostertag of the Utah Jazz, possibly jeopardized the duration of his basketball career by donating a kidney to his sister.

It is not surprising that family members supply the overwhelming number of live organ donations when payment to donors is illegal. Then the motive for giving has to be caring or altruism, and it is well known that this is typically much stronger within families than between persons unrelated either by blood or by marriage.

The evidence on the relation between living donors and donor recipient for the United States in 2004 demonstrates powerful within-family altruism and caring, at least for the small number of families involved in live transplants. However, those individuals in need of transplants who do not have sufficiently altruistic relations, or who do not belong to a numerous family, are out of luck under the present system. They must wait years until they become eligible for a useable organ from a cadaver.

Of course, some live donors may not feel very altruistic, but may be under strong family pressure to donate their organs to save the life of sibling or parent, which is partly reflected by the increase in the fraction of living transplantations and in the percentage of unrelated living donors (excluding spouses), which has increased from 4.7% in 1995 to 20.9% in 2004. However, some non-relatives who are sufficiently altruistic to donate their organs are prevented from donating because of suspicions that the donors are being paid “under the table”.

Is it better for a Gregg Ostertag to donate his kidney and possibly jeopardize his career than for him to pay for an organ donation from a stranger to their family? We find it difficult to appreciate why one is morally better than the other. And surely it would be much more efficient for him to pay for a kidney from a different donor, and to maintain his career than to supply his own kidney and put his career at risk.

4- Monetary Incentives and Economic Analysis

The present legal market for kidney transplants can be represented by the supply curve SS and the demand curve DD in Figure 5, where the horizontal axis measures the number of kidney transplants, and the vertical axis the total cost of a typical kidney transplant. In most nations, the cost of transplant surgery is mainly borne either by governments or by private health insurance companies. Their willingness to qualify individuals for this expensive surgery increases as its cost declined. This is the main reason why the effective quantity demanded, given by the curve DD, increases as costs fall.

Demand by wealthy individuals who finance much of their own transplant costs clearly also tends to be negatively related to costs. However, under the present system, it appears that some of the people use the black market to pay either for live donors or for organs from cadavers in order to reduce their waiting times.

When donors or their heirs receive no compensation for their organs, one would not expect the supply of organs to depend much on the price above the cost of the surgery. This is why the supply curve for either live or cadaver legal transplants is L-shaped, where the horizontal segment correspond to the average cost of kidney transplants and then it becomes vertical, or independent of price, at the number of total altruistic donors, Q^0.

The gap plotted in Figure 4 measures the horizontal distance between the demand and supply curves in Figure 5 at the cost of transplants- we assume in Figure 5 that the average cost of a kidney transplant is $160,000. The gap would be smaller at higher costs because quantity demanded is reduced by a rise in cost, but the technological progress that reduced the cost of organ transplants and made them safer during the past 15 years raised excess demand and waiting lists by encouraging greater demand.

Monetary payments to donors or their heirs would increase the total cost of transplants since costs would include such payments. But since higher payments would elicit a larger number of organs, they would rotate the supply curve clockwise, from SS to S*S*, and thereby increase its elasticity. If government subsidies or private insurance cover payments to donors, a legal market would affect the location of demand functions only by redistributing some demand from the black to the legal sector, and by encouraging more patients in need of organs to apply since the wait would be sharply reduced. But still, monetary incentives would help close the gap between supply and demand both by increasing the number of organs available and by raising the total cost of transplant surgery.

In fact, monetary incentives should change the supply of organs from being completely inelastic with respect to costs to being highly elastic. The reason is that the number of potential useable organs from live donors and cadavers, especially live donors, is very large compared to the number of transplants. But the present system ignores almost all of this potential supply by disallowing payments for organs.

We provide rough estimates of what it would cost to attract enough live donors with financial incentives to close the gap between supply and demand.

4.1- The price of an organ

Donating an organ for transplantation may affect an individual's quality of life, risk of mortality and his ability to perform market and non-market activities for some period of time after the surgery. How much pay is required to induce an individual to sell an organ? We estimate the value or price of an organ from living donors by computing how much additional income or market consumption an individual will requires in order to be indifferent between selling an organ or not. Following the value of life literature, the additional income required by an individual in order to be willing to sell his organ will be given by the change in the value of life induced by changes in health, or quality of life, mortality risk, and full income.

To compute the price, we assume that organ transplants involve two kinds of risks for the seller: Risk of death and risk of nonfatal injury. In addition, we consider the time lost during recovery since after surgery donors cannot work for a period of time. Under these assumptions, the reservation price of an organ have three main additive components: A monetary compensation for the risk of death, a monetary compensation for the time lost during recovery, and a monetary compensation for the risk of reducing quality of life.

The monetary compensation required by an organ seller to face the risk of dying as a result of the transplant, the first component of the reservation price, will be given by the risk of dying multiplied by the money premium required to bear a small increase in the probability of death. This last factor has been estimated empirically in many studies from risky market activities that involve tradeoffs between money and fatality risks and is referred to as the value of a statistical life. The many studies of the average value of a statistical life of young persons in the United States suggests a range from about $11/2 million to $10 million per statistical life, expressed in 2004 dollars, for an average annual income of $35,000 approximately (see Viscusi and Aldy, 2003).

The risk of a donor dying as a result of a kidney transplant seems to be no more than 0.1%[iii]. Assuming a value of statistical life of $5 million, as in Murphy and Topel (2003), this means that a 1/1000 increase in the probability of dying to a young kidney donor would be valued at $5 million/1000, or at $5,000. In some respects, this is clearly an overestimate of the supply price of live donors because some donors- such as parents - are not young.

However, this estimate does not include the 3-5 weeks for donors to recover from kidney transplant surgery, and the value of any reduction in the quality of life to donors. The monetary compensation for the time lost during recovery, the second component of the reservation price, will be given by forgone earnings. One of the main determinants of the value of statistical life is the level of income of individuals. As mentioned before, a value of life of $5 millions corresponds to an average annual earnings of $35,000 approximately, which results in foregone earnings from not working for 4 weeks due to the surgery of $2,700.

The monetary compensation required by an organ seller to face the risk of reducing his quality of life, the third component, will be given by the expected change in the quality of life multiplied by the money premium required to bear a small decrease in the quality of life. However, we do not have good way to value the effects of donating a kidney on the quality of life[iv]. A few studies suggest that persons who donate one kidney can live normal lives, except if they are athletes or engage in other activities with considerable physical contact that can damage their remaining kidney. Some studies report that living donors may have a greater chance of developing high blood pressure. For the remaining discussion, we arbitrarily add another $7,500 to measure the quality of life component of the price; in the next section we return to the problem of measuring this component of the price and perform a sensitivity analysis to see how the results that follow might change.

Adding all the components together gives a total expected cost to donors of $15,200. Relative to the small number of persons who need a kidney transplant, a very large supply of live kidney donors would be available at about $15,200 per donor. This means that the total supply of live donors would be essentially infinitely elastic at a cost that adds together all the component costs of live transplants, including the amount that must be paid to donors.

To check our numbers, we present in Table 2 estimates of the price paid for kidneys to live donors in India during the 1990's where payment was sometimes legal, and payment was common even when it was officially illegal. The average price paid per kidney is $1,177 in dollars of 2005. This estimate was computed by Goyal et. al. (2002) from a cross-sectional survey conducted in 2001 among 305 individuals who had sold a kidney in India an average of 6 years before the survey.

Indian real per capita income is about 1/15 of that in the United States, when purchasing power parity is used to adjust for cost of living differences between India and the United States. If, therefore, the Indian payment is multiplied by 15- which assumes a unitary income elasticity of supply -these data, aside from one obviously unrealistic outlier, imply a cost of kidneys from live donors in the U.S. of about $17,000, close to our estimate. Of course, the actual income elasticity might be above (or below) unity[v], but the Indian data suggest our estimate for the U.S. is not unreasonable.

Table 2 also presents data on payments to live kidney donors in Iran. Interestingly, in Iran payment to live donors of organs is legal, but the Iranian theocratic government outlaws the use of organs from cadavers for transplants because that is assumed to violate the Koran. The implied values in U.S. dollars of these Iranian payments are less than $15,200.

A sizeable fraction of Indians (48% of the sample) who were paid for providing a kidney reported bad health experiences afterwards, and so did a considerable fraction (60%) of Iranians. Perhaps as a result of this, many (79%) asserted that if they could do it over, they would not have sold their kidneys (see Goyal et al., 2002, and Zargooshi, 2001b). Some critics of buying organs have used this evidence to support their opposition to paying for organs (see Rothman, 2002).

However, the experience in these two poor nations is hardly comparable to what would happen in the United States or other advanced nations that began to pay for organs. The quality of the surgery would be far superior, as would be both the pre and post care, especially since some of the Indian cases occurred during periods when paying for organs was illegal, and occurred in the underground medical economy. The US experience earlier indicates that the subsequent health of kidney donors is high, and there is little reason to expect worse experience for those who get paid. So we do not believe that much weight can be assigned to the data on self-reported responses of paid donors in India and Iran, even if they accurately measured their true beliefs.

The cost of organ transplant surgeries vary greatly, not only with the type of transplant, but with the transplant center where the procedure is being done. Ortner (2005) estimates an average cost of kidney and liver transplant in the United States in 2005 of $210,000 and $392,800 respectively. These are estimates based on first-year billed charges per transplant and include procurement costs. Since in a market system procurement costs are expected to be low we subtract these services from the total cost. After subtracting procurement costs, the average cost of transplantation for kidneys and liver are $160,000 and $335,000 respectively.

If the direct cost of a live kidney transplant in the United States is about $160,000, the supply of live donors would be infinitely elastic at a total cost of about $175,200. Note that payments to donors has a rather small effect on the total cost of live kidney transplants, but it has an enormous effect on the elasticity of supply. It converts supply from being completely inelastic to being completely elastic at a price that is less than 10% above the price without payments- compare SS with the horizontal S*S* in Figure 5.

S*S* intersects the demand function DD at the market-clearing point e*. The number of kidney transplants would increase, but probably by less than the gap estimated in Figure 4 because quantity demanded may be a little lower because the total cost is a little higher. Unless the demand function is highly elastic- which is unlikely -the 9.5 per cent increase in total cost due to payments to donors would not have a large negative effect on the effective demand for transplants.

The equilibrium number of transplants under the incentives system can be computed as actual demand (i.e. actual number of transplants + actual gap) minus the change in actual demand due to the change in price (i.e. actual number of transplants x price elasticity of demand x %change in price/100). For example, if the demand elasticity is -1, a 9.5 per cent increase in price would lower effective demand by about 9.5 per cent. With about 13,500 kidney transplants in 2005, and a gap of about 8,000, a 9.5 per cent decline in demand is about 2,040 persons, so that kidney transplants would increase from 13,500 persons to over 19,460 persons, or by 44 per cent.

The risk of a donor dying as a result of a liver transplant seems to be no more than 1/300 at the major transplant centers[vi]. At a value of life equal to $5 million, young persons would value the risk of dying from donating part of their liver at about $16,600.

We assume that liver donors lose 9 weeks of work at a total value of about $6,000. We add another $15,000 as a guess about the value of the effect of donating parts of one's liver on the quality of remaining life. This gives a total cost of $37,600. According to Ortner (2005), the average cost of a liver transplant is about $335,000 in the United States. So our estimated required compensation for live liver donors would add 11.2 per cent to total cost.

The demand elasticity for livers is probably less than that for kidneys since persons with defective kidneys have dialysis as an option. If we assume a demand elasticity of –0.5, a 11.2 per cent increase in cost would reduce demand by 5.6 per cent. Since total demand for a liver transplant in 2001, before the new restrictions on demand through the MELD/PELD system was imposed, was about 9,200- 5,200 transplants and a gap equal to about 4,000 -a 5.6 per cent reduction in demand is a reduction of about 515 persons. Therefore, liver transplants would increase by about 3,485, from 5,200 to 8,685, or by 67 per cent.

4.2- Sensitivity Analysis

The final effect on the total number of organ transplantations of introducing monetary incentives computed in the previous section depends on two main factors: (1) the share of the price of organs on the total cost of organ transplantation; and (2) the price elasticity of the demand for organ transplantations. In this section we explore the sensitivity of our results to variations in the values of the key parameters of the model.

The estimates for the price of kidney and of liver of $15,200 and $37,600 may seem low. Yet these estimates are a direct result of the following factors: (1) the $5,000,000 value of life drawn from economic research on individuals' willingness to take on risk; (2) the low mortality risk of kidney and liver donations; (3) the expected change in quality of life; and (4) the short recovery period.

Table 3 presents estimates of the price of an organ and its effect on the total number of transplants for different values of the value of statistical life. Results are shown separately for kidneys and livers transplants. We calculate the value of each component of the price for different values of the value of statistical life assuming a conservative risk of death of 0.1% for kidneys and 0.33% for livers, an average annual income of $35,000, and an expected change in the quality of life of 0.15% and 0.3% for kidneys and livers respectively.

As we mentioned in the previous section, the quality of life component of the price is the most difficult to estimate since it is hard to measure the expected change in health or quality of life. In order to compute this component we consider conservative numbers for the risk of non-fatal risk injury and for the score value of health in the bad state. The risk of non-fatal risk injury is assumed to be 1% and 2% for kidneys and livers respectively, while the score value of health in the bad state is assumed to be 0.85, and is assumed to be the same for livers and kidneys (for way of comparison, according to Cutler and Richardson (1998) the health score for an amputee in 1990 was 0.89 and for blindness was 0.87). This gives a expected change in the quality of life of 0.15% for kidneys and 0.3% for livers.

Columns 4 and 5 of table 3 present estimates of the risk of death and the quality of life components of the price. Both values are proportional to the value of statistical life, the factor of proportionality being the risk of death and the expected reduction of quality of life from donating an organ for each component respectively. The forgone earnings component of the price is constant since we assume the same annual income across estimates. This implies that doubling the value of life will less than double the price of an organ estimates.

As the table shows, with these parameters and assuming a range of $2-$10 million for the value of life, the price of an organ will be in a range of $7,600-$27,500 for kidneys and $18,600-$69,000 for livers (see column 1 in table 3). With a price elasticity of demand for transplants of -1 for kidneys and -0.5 for livers, this would imply a percentage increase in the total number transplants in a range of 52% to 32% for kidneys and 58% to 71% for livers (see last column in table 3). Even with a high, and possibly unrealistic, value of statistical life for potential donors, the effects on the total number of transplants are large.

4.3- Social Gains of the Market System

It is useful to place the results of the previous section in context of the value to society of increasing the number of persons who can get transplants without prolonged waiting times. We make some calculations for kidney transplants, by far the most common transplanted organ.

Waiting time is a sizeable risk factor in organ transplantation. The risk of death increases as time passes, and the health and quality of life of patients waiting for transplants deteriorates. As we showed in section 2, many of those patients often die while waiting for transplants.

The benefits of getting immediate access to transplant are significant. Longer waiting times on dialysis negatively impact post-transplant graft, success rate of transplantation, and patient survival. Long-term mortality rates are between 50 to 80 percent lower among transplant recipients than among patients on the waiting list (See Wolfe et al., 1999, Edwards et al., 1997). Average time to graft failure increase by about one year if the patient is transplanted immediately instead of waiting 3 to 4 years before transplant (See Meier-Kriesche et al., 2000).

Perhaps the most egregious effect of the organ shortage on those people who wait is the suffering and the deterioration in the quality of life while waiting for an organ. For example, most people waiting for transplant are unable to work. Studies show that the difference in employment rates among people on the kidney waiting list and those who have received a kidney transplant is at least 15 percentage points. Quality of life, as measured by a score that range from 0 to 1, increase between 0.15 and 0.35 after a successful transplantation compared to remaining on dyalysis (See for example Laupacis et al., 1996, and Russell et al., 1992).

Held and Port (2003) estimate the willingness to pay by End Stage Renal Disease patients to get immediate access to kidney transplantation by computing the increase in the value of life, including medical costs. They estimate a social cost per patient of the prolonged waiting to be $122,700, and a total social cost of the list of $1.3 billion. We believe, however, that even these large values significantly underestimate the total value of gaining immediate access to a kidney transplant, partly because these authors assume only one transplant per person over their lifetimes. Our more complete estimates suggest a value well over $500,000 per person transplanted immediately after netting out total cost of kidney transplants, which include pay to donors (unpublished calculations available on request).

4.4- Live versus Cadaver Organ Markets

The small literature advocating payments for organs has concentrated exclusively on the cadaver market. This is not surprising considering that most organ transplants use cadavers, and that live transplants are not even possible for heart, pancreas, lung, and many other organs.

Still, transplants using live donors have become a larger proportion of both kidney and liver transplants, especially of kidney transplants. And when live transplants are possible, in some ways paying live donors raise less thorny issues than paying heirs for organs from deceased individuals. Although our discussion mainly focuses on payment to live donors, we also support payment for organs from cadavers.

One reason why some critics have opposed payment for organs from cadavers is a fear that totalitarian governments and others might kill prisoners or other individuals to get their organs to sell. Although we believe that risk is exaggerated, it would be absent when the payment goes to live donors for their own organs.

Heirs often refuse to allow organs from diseased loved ones to be harvested because they feel that violates their bodies. They often can make the organs of deceased relatives unusable, even if the deceased gave approval, by delaying the legal proceedings. There is little religious objection to individuals supplying their own organs for live transplants.

Some nations use the principle of “implied consent”, so that organs from cadavers can be harvested unless individuals prior to death expressly indicated that they did not want their organs harvested. We believe that implied consent is a dangerous principle that denies heirs full control over the human capital remains of loved ones. It would be comparable to requiring that all assets of deceased persons automatically go to governments, or to particular private organizations or other purposes, unless wills stipulated otherwise.

But what is more important the “implied consent” organ procurement approach does not eliminate the long queues for transplants. Many persons advocate greater use of implied consent as a way to increase the number of organ donations. We have various doubts about the use of implied consent if children do have the last word. In addition, Gay’s theoretical and empirical study (2006) indicates that implied consent systems may reduce rather than raise the number of organs donated compared to systems of presumed consent.

The long-term outcome of medical transplantation depends on the quality of the match between organs of donors and recipients, and the “timing” of surgical interventions. Factors like blood type and tissue type determines match quality, and a good match raises the chance that an organ will help a recipient. One shortcoming of cadaver markets is that organs harvested must be transferred immediately to organ transplant surgery. Harvested organs remain viable for transplant for 48 to 72 hours for kidneys, and 24 to 48 hours for livers. These time constraints make it harder to get an excellent match between organ donors and recipients, and leads to more wasting of organs than would happen in a live organ market.

In addition, live transplants give much greater flexibility on timing of transplants than with cadaver organ transplants. So transplant surgery with live donors can take place when both the donor and recipient are in the best possible condition. In particular, live transplants can occur when recipients are in relatively good health.

Partly for reasons of match and timing, the long-term success rate of live organ transplants is generally greater than for cadaver organ transplants. The renal graft survival rate at one year are 89.2% for cadaveric donor transplants and 94.7% for living donor transplants, while the renal graft survival rate at ten years are 35.8% for cadaveric donor transplants, and 55.8% for living donor transplants. For liver, the graft survival rate at one year are 80.3% for cadaveric donor transplants and 71.9% for living donor transplants, but the graft survival rates at ten years are 43.7% for cadaveric donors and 53.3% for live transplants[vii].

Perhaps most crucially, the present gap between demand and supply of kidneys could not be fully met from cadavers even with full payments for cadaver organs. To be usable, donors must have healthy, well functioning organs and be free of infections at the time of their death. The majority of cadaveric organs come from accident or stroke victims who have been declared brain dead. In 2000, stroke victims account for over 40% of all cadaveric donors.

Table 4 presents various estimates of the maximum potential supply of cadaveric organs. Taking into account the need to have healthy organs, these estimates suggests that between 10,000 and 16,000 of those dying annually are considered medically suitable for organ donation. Since all organs are not always useable from any single cadaver, the number of organs available for transplantation per cadaveric organ donor is limited. In 2000, the average number of kidneys and livers recovered per cadaveric organ donor was 1.82 and 0.83, respectively. The average number of kidneys and livers recovered and actually transplanted per cadaveric organ donor are much lower. In 2000 it was 1.57 for kidneys and 0.76 for livers.

These numbers and the number of useable cadavers indicate that the most reasonable estimates of the supply of cadaveric kidneys– in row 6 of Table 6 –imply a maximum number of cadaveric kidneys between 19,000 and 25,000. This overlaps the actual demand for kidneys transplants in 2005 at 21,500. Yet only a fraction of all useable cadavers are likely to be offered for sale, or useable even if offered.

Moreover, once a market for organs is in place, the actual demand would surpass present demand since now kidney transplants are only offered to people who have irreversible kidney failure. Other medical or surgical treatments for kidney problems are usually tried before consideration of a kidney transplant. So it is highly unlikely that the full demand for kidney transplants could be met with organs of deceased persons.

This is shown in Figure 6, which plots the supply curve of kidney organs in a market with kidneys from both cadavers and live donors. This figure assumes a market with a single price for kidneys, no matter what the source, although our analysis suggests that organs from live donors are more valuable to recipients. For simplicity, the demand curve is taken to be the same as that in Figure 5.

The supply curve in this market would start just slightly above the cost of surgery since some cadaver organs would be made available cheaply. A rise in price would induce more cadaver organs to be offered, and perhaps even a few from live donors. Eventually, the available organs from cadavers would run out, and the supply price would rise sharply to reach the main market for live donors. At that point the supply elasticity rises sharply because the potential live donor market is huge relative to demand.

If our earlier discussion is right that the cadaver market would be insufficient to meet the demand for kidney transplants, the supply and demand curves in Figure 6 would intersect where supply is elastic, and where the marginal suppliers are live donors. Donors of organs from cadavers would receive a substantial surplus over the price they would be willing to accept because the market is too big to be supplied entirely by cadavers. The equilibrium price for organs would be similar to the price in Figure 5 which considers only live donors because live donors would be the marginal donors in a full market equilibrium. Although most organs would be from cadavers, the market clearing price would be determined by the supply of live donors. Consequently, under the assumptions of this section about the number of cadaver organs available, the cost of buying organs to satisfy the demand for kidney transplants is not appreciably affected by integrating into the analysis the significant potential organ supply from cadavers.

The estimates in Table 4 suggest that the maximum number of livers that could be harvested is between about 8,800 and 11,000. Since the estimated total demand for liver transplants is 9,000, it is possible that cadavers could supply all the needed livers if payments were allowed. But if only a quarter of the useable cadaveric livers were not offered for sale, market equilibrium would require live donors. In that case, the equilibrium price would be determined by the cost of livers from live donors. So also in the market for liver transplants, most organs would come from cadavers, but the equilibrium price would likely be determined by the cost of livers from live donors.

5- Criticisms and Evaluation of Monetary Incentives

Proposals to pay for organs, even from cadavers, have been sharply criticized on several grounds. One of the most common is that payment is “immoral” because it involves the “commodification” of body parts. Individuals who make this argument deny that people have the right to control the use of their bodies.

If women can get paid to host the eggs of other women and bear their children- as they can in the United States -why cannot men and women get paid for selling their organs to save the lives of others? Surely, the moral considerations involved in allowing pay for organs that save lives are no weaker, and for many persons would be stronger, than those involved in allowing pay for the use of wombs to create lives.

Table 5 considers the most important arguments that have been advanced against payment for organs by comparing that system with issues raised by a voluntary army. The first row and first column discuss the claim that monetary payments for organs is undesirable because that involves commodification of body parts. But the voluntary army used by the United States and many other nations allows the commodification of the whole body since volunteers expose themselves to injury and death if they are sent into conflict. Not only has the voluntary army been considered a success in the United States, but several European nations- such as France- that originally favored the draft have been shifting to a voluntary army.

The sale of organs has also been opposed because poor individuals probably would be the main ones who would sell their organs. But should poor individuals be deprived of revenue that could be highly useful to them, especially when their organs might save the lives of persons who desperately need to replace their defective organs?

This argument was also made against the voluntary army, that it would become an army of the poor. However, it did not quite work out that way. The very poorest often cannot qualify for the armed forces because they have insufficient education, low test scores, may use drugs, and so forth. Similarly, the organs of poor individuals who use drugs, or have aids, hepatitis, or other serious illnesses would be rejected as posing too large a risk to recipients. So probably the healthy poor and middle classes would actually provide most of the organs for live transplants under a market incentive system. Of course, a quota could be placed on the number of organs from poor individuals, but is that desirable?

It is also claimed that payment for organ donations from living individuals would encourage impulsive and reckless provision of organs, partly because donors would not be able to sufficiently calculate the risks involved. If impulsive donations were a problem, a few weeks cooling off period could be required to give donors sufficient time to change their minds.

It must also be required that donors be informed in writing fully of the risks during surgery, the length of the recovery period, and other possible risks. In fact, some evidence suggests that persons engaging in risky activities often overestimate rather than under estimate the risks, especially when the risks get much publicity, such as the health risks of smoking (see Viscusi, 1990).

Similar arguments about impulsive military enlistments and underestimation of military risks were used in discussing the voluntary army, although these do not seem to have been major problem. True, an enlistment decision is more reversable than the donation of an organ, so a longer cooling off period might be justified for organ donations.

Row 4 of table 5 mentions the opposition to paying for organs because that might reduce the supply of organs from altruistic reasons. Although paying for organs does not prevent persons from supplying organs out of altruistic motives, usually to help relatives, altruism clearly has been an insufficient motive under the present system. Otherwise, the demand for organs would not be so much larger than the supply.

Again, a comparison with a voluntary army is instructive. Critics claimed that it would be difficult to get volunteers at a reasonable price because paying for volunteers would crowd out persons who would otherwise volunteer for patriotic motives. In fact, people have enlisted under a voluntary army for a variety of motives, including patriotism. In particular, military volunteers surged after the terrorist attack on 9/11 because of patriotism.

The long wait for organs under the present system has encouraged the development of a black market in live or cadaveric organs, where donors or their heirs get paid. These transplants are available only to wealthier individuals who usually must bear the total expense themselves. They are also often much riskier because organs are not screened as carefully for disease, are not matched as closely to recipients, and operating conditions and the quality of surgeons tend to be inferior.

Allowing the purchase of organs would essentially knock out the black market in organs, and all its problems of quality control. The purchase of organs would also reduce the advantages of wealth in getting organs since poorer individuals in need of organs who cannot afford the black market would no longer have to wait so long before getting their organs through the Medicaid or Medicare payment system.

But above all, the most effective answer to the critics of paying for organs is that the present system imposes an intolerable burden on many very ill individuals who cannot afford to wait years until suitable organs become available. Increasing supply through payment would largely eliminate this wait and thus enormously improve the efficiency of the transplant market.

Endnotes

[i] The data and analyses reported in the 2005 Annual Report of the U.S. Organ Procurement and Transplantation Network and the Scientific Registry of Transplant Recipients have been supplied by United Network for Organ Sharing (UNOS) and University Renal Research and Education Association (URREA) under contract with HHS. The authors alone are responsible for reporting and interpreting of these data. UNOS, a nonprofit charitable organization, administers and maintains the nation's organ transplant waiting list under contract with the Health Resources and Services Administration of the U.S. Department of Health and Human Services. URREA is a nonprofit organization established for the purpose of conducting clinical and economic studies. It administers the Scientific Registry of Transplant Recipients (SRTR) under contract with the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS).

[ii] Patients with a CTP score equal or greater than 7. Each candidate on the liver waiting lists is assigned a status code which corresponds to how medically urgent it is that he or she receives a transplant. Until 2001, the determination of the patient status was partially based on the Child-Turcotte-Pugh (CTP) score, which provides a measure for liver disease severity that range from 5 to 15.

[iii] According to the Maria Lea Johnson Richards Transplantation Center NYU School of Medicine, the risk of death from the surgery is estimated to be less than 1/100 of 1%.

Estimates of living donor mortality associated with the donor operation are available from three large American survey covering nearly 10,000 operations, and single center reports (see Bia et al., 1995, Johnson et al., 1997, Bay et al., 1987, and Kasiske et al., 1996). The reported death rates range from 0.03% to 0.06%. With respect to late mortality, Fehrman-Ekholm et al. (1997), "Kidney donors live longer", based in 459 living donor nephrectomies performed in Stockholm from 1964 until the end of 1994 shown that the cause of death in the kidneys donors was similar to that seen in the general population. After 20 years of follow-up of 430 donors still living in Sweden, 85% of the donors were alive, whereas the expected survival rate was 66%. Survival was thus 29% better in the donor group. There was a deterioration in the renal function with increasing age, similar to what is seen among normal healthy subjects. The better survival among donors is probably due to the fact that only healthy persons are accepted for living kidney donation.

[iv] Many studies have documented the excellent results of living organ donation in developed countries. Johnson et al. (1999) sent a questionnaire to 979 who had donated a kidney between August 1, 1984, and December 31, 1996. Of the 60% who responded, the vast majority had an excellent quality of life. As a group, they scored higher than the national norm on the SF-36, a standardized quality of life health questionnaire. However, 4% were dissatisfied and regretted the decision to donate. Results showed that donors have a higher quality of life than the general population, confirming they have an increased self-worth and positive self-esteem. An overwhelming 96% would donate again. However, donation was self-reported as more stressful when complications were experienced and when donors were female. Relatives other than immediate family members (extended relatives) were more likely to be among the 4% who said they would not donate again.

Jacobs et al. (1998) studied 524 donors who had a higher quality of life than the general population, and 96% would donate again. A total of 104 Canadian donors were reported on by Vlaovic et al. (1999), and less than 5% of them said that renal donation severely affected any aspect of life. For the 55 kidney donors evaluated by Corley et al. (2000) all quality of life scores were high. Of the 167 donors in the study by Schover et al. (1997) 90% would make the same choice again and 83% would strongly encourage others to donate. Westlie et al. (1993) examined 494 Norwegian donors and concluded that the quality of life is better than that in the general population.

[v] Estimates of the income elasticity of the value of a statistical life vary in a wide range from 0.5 to 2.3 (see a review in Viscusi and Aldy, 2003). Using numerous studies of the value of a statistical life in United States and international evidence, Viscusi and Aldy (2003) estimates an income elasticity of the value of a statistical life from about 0.5 to 0.6. However, when we recalculate their estimations excluding the three studies about India, which yield unrealistically large values of statistical life, the income elasticity of the value of a statistical life increases to 1.15.

[vi] More than 2000 Living donor liver transplantations have been performed worldwide, with four donor deaths (see Emre, 2001). According the University of Colorado Hospital, the risk of dying from donating a

portion of the liver is estimated to be 1 in 500. According to the Maria Lea Johnson Richards Transplantation Center NYU School of Medicine, the risk of death from the surgery is estimated to be between 1/100 and 1/500.

[vii] See UNOS. The cohorts used to compute the survival rate are 1998 and 1999 for the graft survival rate at one year, and 1989 and 1990 for the graft survival rate at ten years.

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Tables and Figures

Table 1

Kidney Transplants: Total Number of Transplants, Living Transplants and Number of persons on the Waiting list

Per million of Population

2000

	Total number of Transplants	Living Transplants	Number of persons on the Waiting list
Germany	24.1	4.2	115.6
Spain	47.6	0.5	97.8
UK and Ireland	29.2	5.4	100.5
United States	46.8	18.4	167.8

Source: Own calculations using data from Eurotransplant, Organizacion Nacional de Transplantes, UK Transplant, UNOS, and Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.

Table 2

Price of Kidney – International Evidence

Country	Year	Price of a Kidney in local currency	Price of a Kidney in US$ 2001[h]	Equivalent Cost of Kidney in US in US$ 2001[i]
Iran[a]	1997	10 millions Rials	$1,480	$8,536
Iran[b]	1996	3.5 millions Rials	$518	$2,989
India[c]	1985-1999		$1,177 [d]	$17,655
England[e]	1990	Pounds 2,500-3,360	$6,260 - $8,413	$9,077 - $12,199
India[f]	1984-1988	40,000-50,000 Indian Rupees	$4,281 - $5,434	$64,218 - $81,510
India[g]	1997	35,000 Indian Rupees	$1,139	$17,078

Sources: a,b) Zargooshi, J., 2001. c) Goyal, M. et al., 2002. d) Range $450-$2,660. The persons that sold the kidney during the 80's, when it was legal, received $1,603 compared with $975 for persons who sold the kidney during the 90's, when it was illegal. e) In 1990, a Harley Street physician who arranged transplant operations in which four Turks were paid between Pounds 2,500 and Pounds 3,360, was struck of the medical profession. f) Salahudeen et al., 1990. g) Casual evidence from The Hindu India's National Magazine, 1997. Based in two cases of Kidney's vendors. h) Computed using data on exchange rates and price index from IMF. i) Own calculations using data on income per capita from World Development Indicators Database, 2002, The World Bank.

Table 3

Estimation of the Price of Organs for Transplantation and the Impact on the Total Number of Transplants under different assumptions about the Value of Statistical Life

Kidneys and Livers

Price of Organ	Value of Statistical Life	Risk of Death	Risk of Death Component	Quality of Life Component	Value of Time[(1)]	%Change in price[(2)]	% Change in Total Number of Transplants[(3)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(c) + (d) + (e)	(a)	(b)	(c) = (a) * (b)	(d)	(e)		
Kidneys							
$7,663	$2,000,000	0.001	$2,000	$2,971	$2,692	4.8%	52%
$10,149	$3,000,000	0.001	$3,000	$4,457	$2,692	6.3%	49%
$15,121	$5,000,000	0.001	$5,000	$7,429	$2,692	9.5%	44%
$20,092	$7,000,000	0.001	$7,000	$10,400	$2,692	12.6%	39%
$27,549	$10,000,000	0.001	$10,000	$14,857	$2,692	17.2%	32%
Livers							
$18,663	$2,000,000	0.0033	$6,667	$5,938	$6,058	5.6%	71%
$24,965	$3,000,000	0.0033	$10,000	$8,907	$6,058	7.5%	69%
$37,570	$5,000,000	0.0033	$16,667	$14,845	$6,058	11.2%	66%
$50,173	$7,000,000	0.0033	$23,333	$20,782	$6,058	15.0%	63%
$69,080	$10,000,000	0.0033	$33,333	$29,689	$6,058	20.6%	58%

Note: The quality of Life Component is computed as the product of the expected change in the quality of life, assuming two health states, and the value of statistical life. We assume a risk of non-fatal risk injury of 1% and a score value of health in the bad state of 0.85 for Kidneys, and a risk of non-fatal risk injury of 2% and a score value of health in the bad state of 0.85 for Livers.

(1) Value of Time = Annual Income * Time for Recovery in years. Value of Time for Kidney Transplants = $35,000 * 4 weeks / 52 weeks. Value of Time for Liver Transplants = $35,000 * 9 weeks / 52 weeks.

(2) % Change in price of Transplant = (Price of the Organ/Cost of Surgery) * 100. We assume a Cost of Surgery of $160,000, and $335,000 for kidney and liver transplants respectively.

(3) % Change in Total Number of Transplants = {[(Gap + Actual Number of Transplants) (1- price elasticity of demand for transplants * % Change in Price of the organ)] / Actual Number of Transplants – 1} * 100

Table 4

Estimates of Supply of Potential Cadaver Donors

Population	Study	Year	Donors PMP	Estimated Number of Donors in the Year of the Study	Estimated Number of Donors in 2006*
Georgia	Bart et al. (1981a)	1975	43	10,694	12,839
		1976-1979	55	13,679	16,422
Georgia, Kansas, Missouri	Bart et al. (1981b)	1975	55	13,679	16,422
			116	28,849	34,636
United States	National Task Force on Organ Transplantation (see Evans, 1990)	1986	68	16,912	20,304
			104	25,865	31,053
Pennsylvania	Nathan et al. (1991)	1987	38.7	9,625	11,555
			55.2	13,728	16,482
Kentucky	Richardson (1990)	1989	48	11,938	14,332
United States	Evans et al. (1992)	1991	28.5	6,900	8,510
			43.7	10,700	13,048
California, Kentucky, Minnesota and Washington DC	Gortmaker et al. (1996)	1990	55	13,700 (12,600-15,100)	16,422
35 OPOs – 27 states	AOPO Death Record Review Sample	1997-1999		10,900-13,700	

*Based upon 298,590,500 United States population in April 2006 (est.).

Table 5

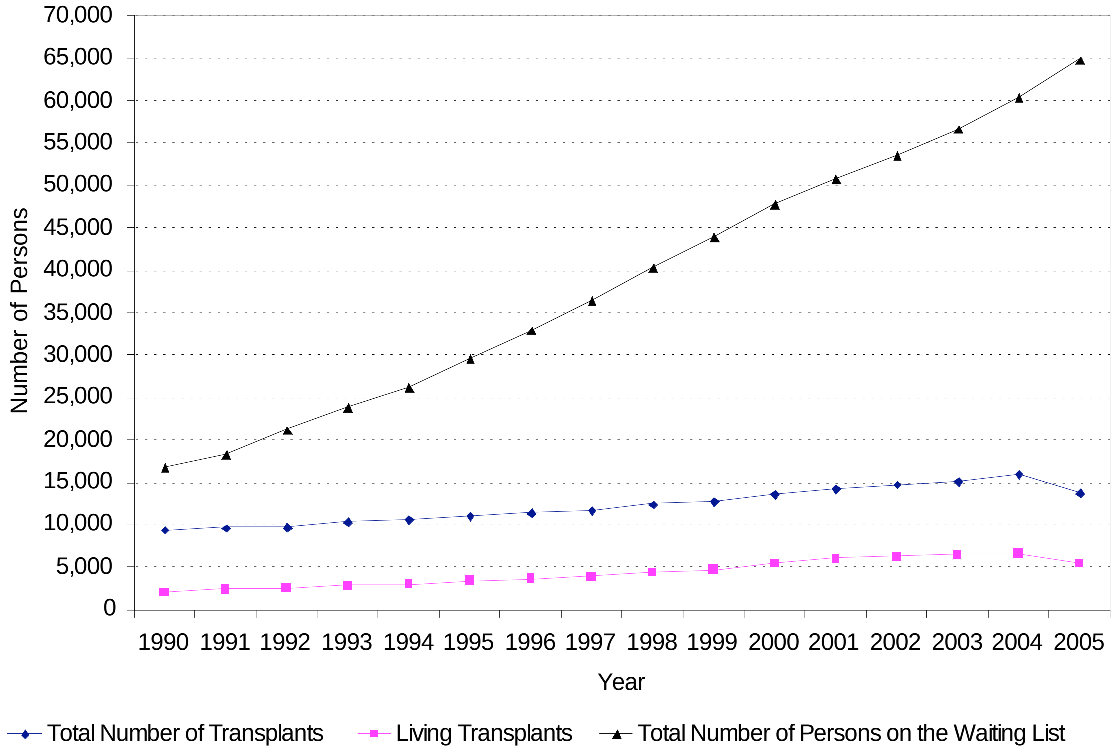
Comparison between “Payment to Living Donors” and “Voluntary Army”

Payment to Living Donors	Voluntary Army
• “Commodification” of Body Parts.	• “Commodification” of life. • Worked well.
• Mainly Desperate poor donors. • If can help poor, Why bad?	• Poor Man’s Army. • Not really: Healthy poor and middle class.
• Difficulty in calculating risks, impulsive. • Low real risks? • Can have cooling-off period, Written Consent.	• Worked here.
• Pay does not prevent other motives, such as to help relatives who are sick.	• Can volunteer for patriotism. • And non-monetary motives.
• Eliminates “Black Market” in organ transplants: - Healthier Conditions. - Better Matches.	
• Save lives of those needing transplants, Improve quality.	• Defend Nation more effectively.

Figure 1

Kidney Transplants: Total Number of Transplants, Living Transplants and Total Number of persons on the Waiting list

United States – 1990-2005

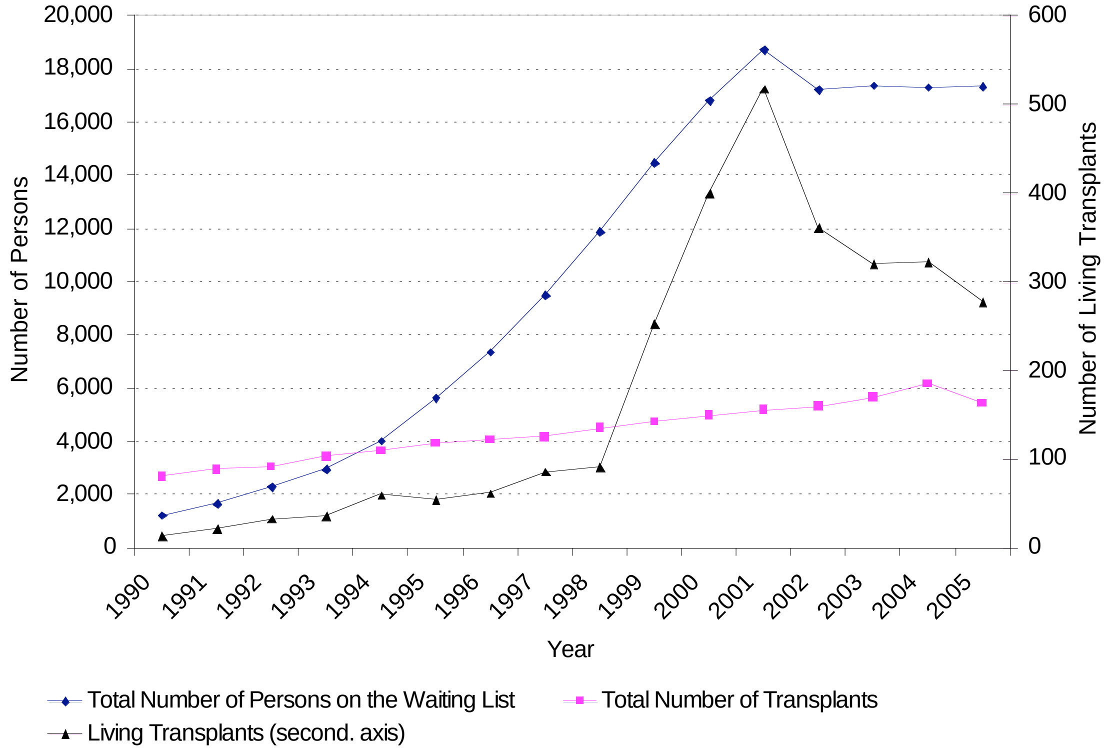


Source: UNOS

Figure 2

Liver Transplants: Total Number of Transplants, Living Transplants and Total Number of persons on the Waiting list

United States – 1990-2005

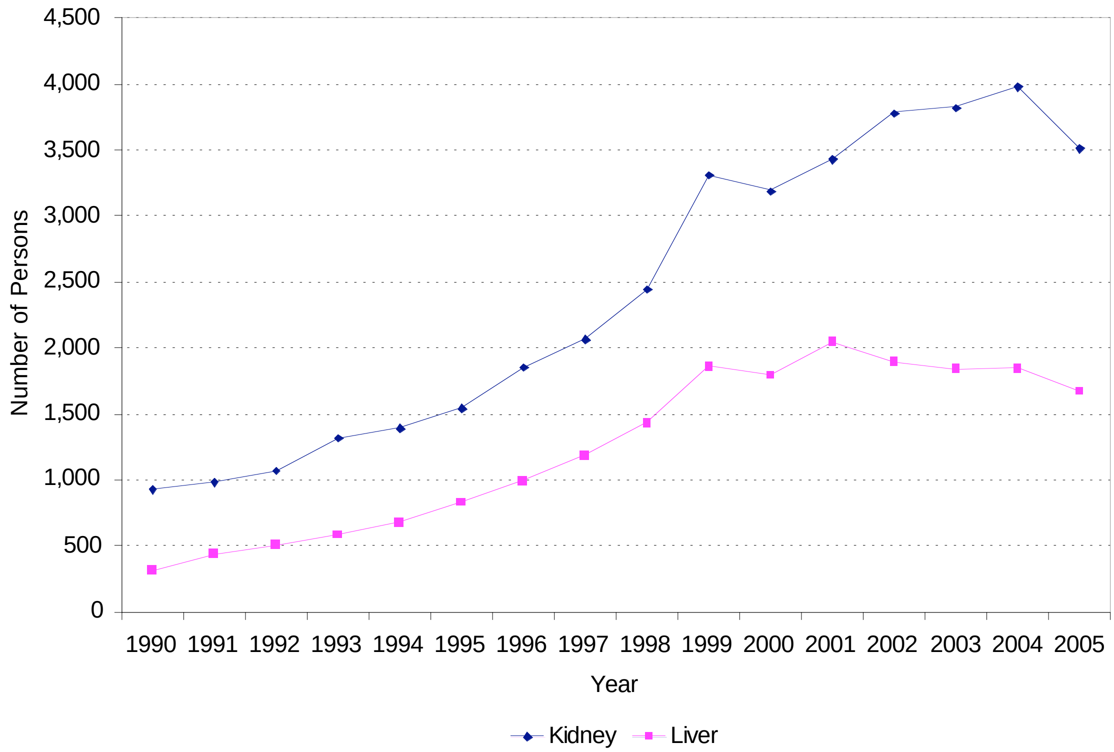


Source: UNOS

Figure 3

Kidney and Liver Transplants: Deaths on the Waiting List

United States – 1990-2005



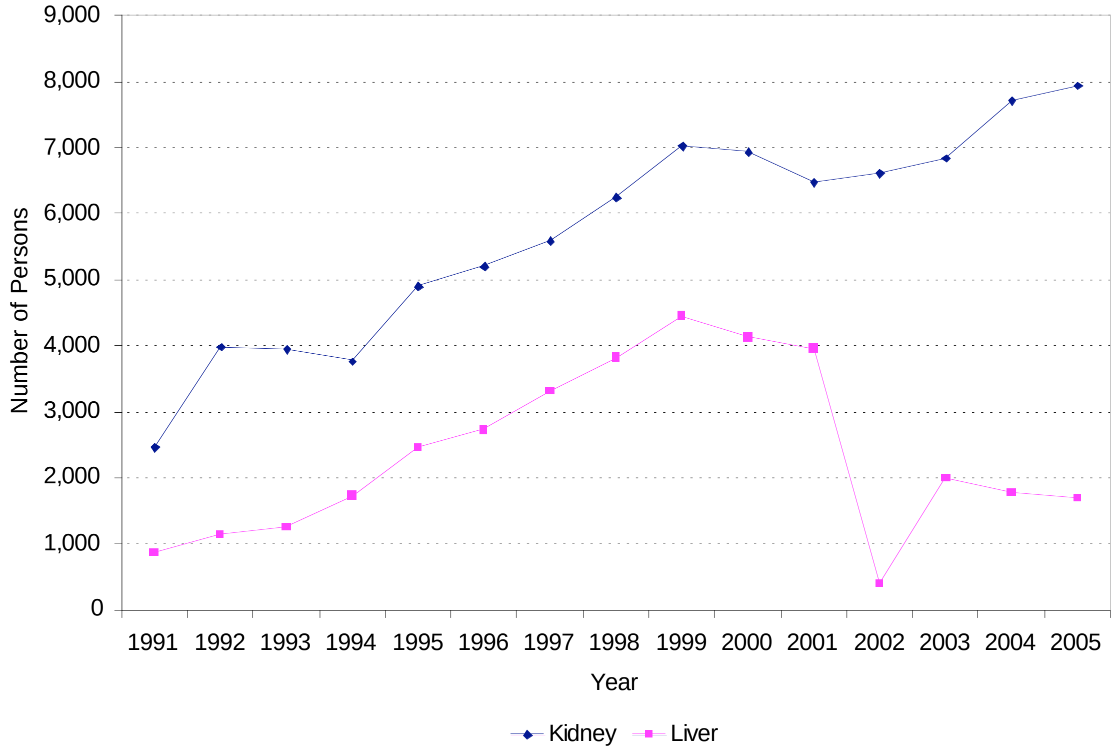
Source: UNOS

Figure 4

Gap Between Demand and Supply

Kidney and Liver Transplants

United States – 1991-2005



Source: Own calculations using data from UNOS.

Figure 5

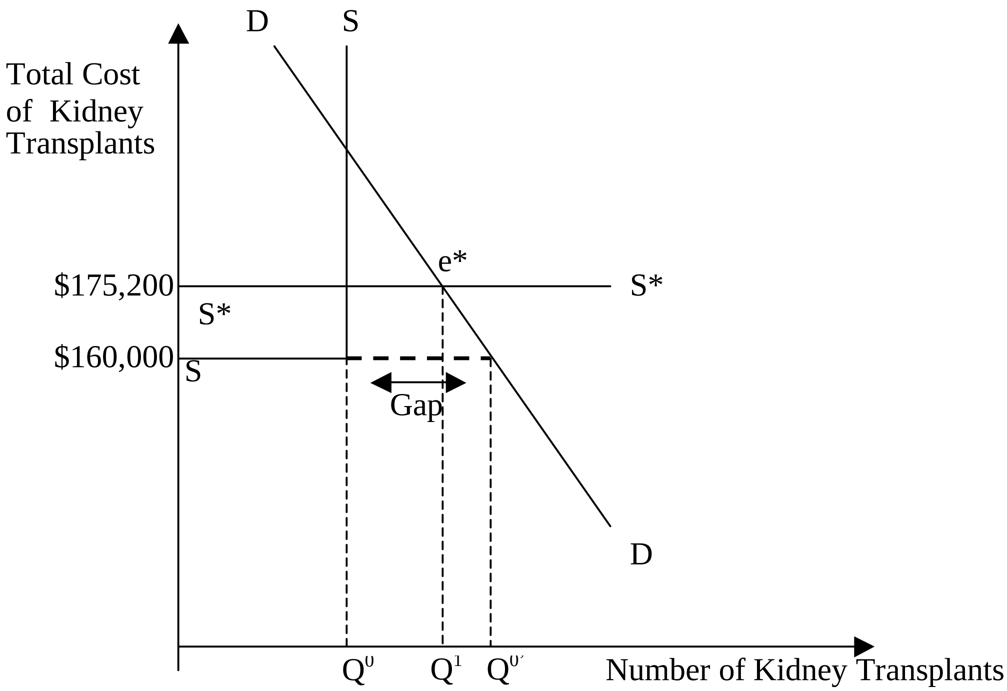
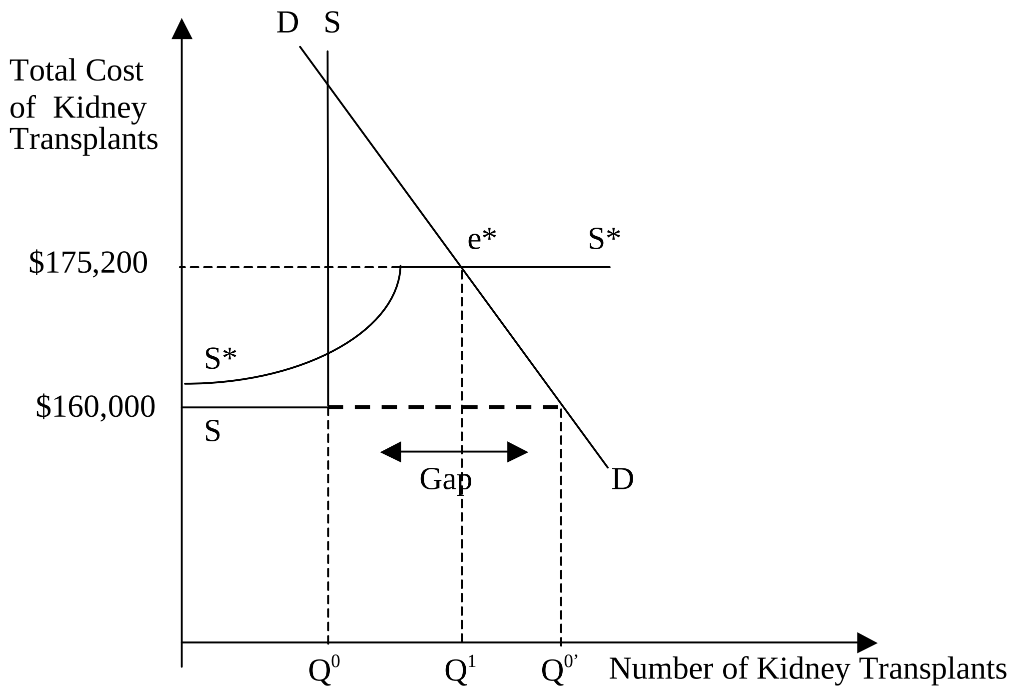

D
S
Total Cost
of Kidney
Transplants
e*
$175,200
S*
S*
$160,000
S
Gap
D
Q0
Q1
Q0′
Number of Kidney Transplants

Figure 6



D
S
Total Cost
of Kidney
Transplants
$175,200
e*
S*
S*
$160,000
S
Gap
D
Q0
Q1
Q0'
Number of Kidney Transplants