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Determinants of Organ Donor Registration Rates Among Young Americans

Syed Umar Farooq
Claremont McKenna College

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Umar Farooq

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Abstract

In this paper I examine the factors that affect the likelihood an individual is a registered organ donor. Unlike many studies which focus on subpopulations in specific regions, I utilize national data to get a broader assessment of individuals from around the country across a number of racial and religious classifications. Using a probit model and controlling for a variety of parameters, I find that some racial and religious variables are negatively and significantly associated with organ donor registration rates, while education and being female are positively associated with organ donor registration rates. I conclude by discussing the implications of my results and the potential for future research.

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Chapter 1: Introduction

More than 120,000 individuals in the US are currently on a national waiting list for an organ transplant. The need continues to grow, with one person being added to a waiting list every 10 minutes (American Transplant Foundation 2016). A 2005 Gallup poll found that 95% of Americans "support or strongly support" organ donation (Gallup Organization 2005). Yet registration rates for organ donors do not reflect this support, with only 48% of US citizens being registered organ donors (Organ Procurement and Transplantation Network 2016). Though the percentage of Americans registered as organ donors has increased in recent years, the number of organ transplants has not kept pace with the size in the waiting list. This has led to a dramatic increase in the gap between the number of people on the waitlist and the number of organ transplants possible (Siegel et al. 2014). Figure 1 depicts this gap from 1993-2015, with the green segment representing the unmet need for organ donations. As a result of this increase, approximately 8000 people on the waitlist died in 2013, up from 5000 people in 1999 (Ehrle et al. 1999).

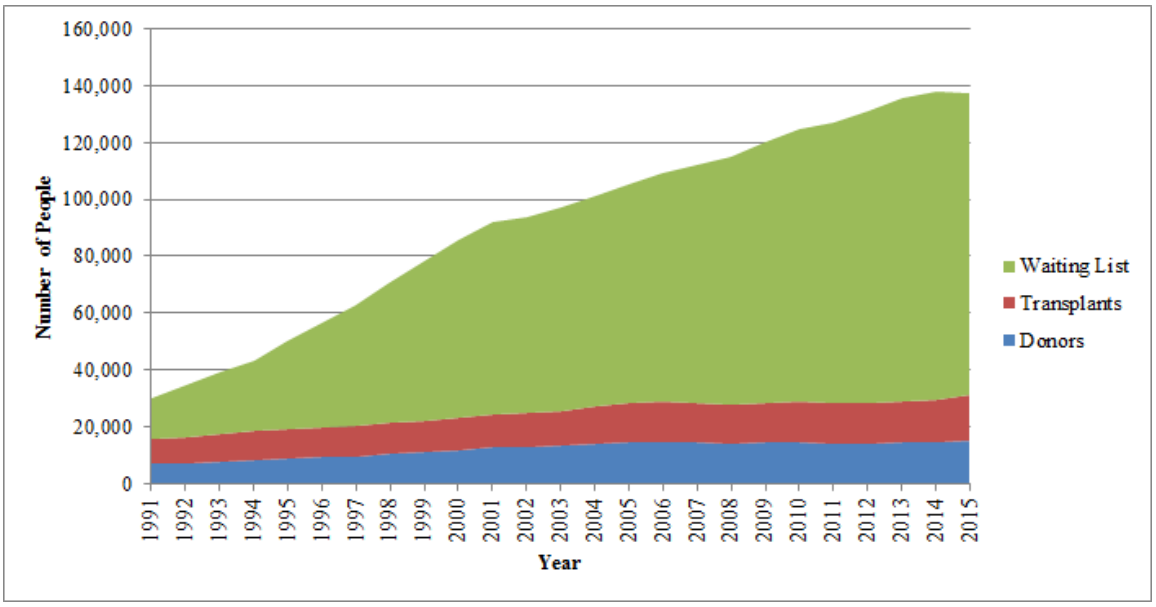

Fig. 1: Area Chart of the number of transplants, donors, and people on an organ waiting list[1]

Racial minority groups currently comprise the majority of candidates on waitlists, with African Americans comprising 30% of candidates and Hispanics comprising 18.7% of candidates. Despite having a higher need for organ transplants than the general population, less than 14% of organ donors are African American while only 11.6% of organ donors are Hispanic (Organ Procurement and Transplantation Network 2016).

Differences in the racial composition of organ donors and those awaiting a transplant can have significant health consequences. Maron describes the issue for African Americans in particular, writing, "Successful organ transplantation hinges on finding a strong tissue match between donor and recipient, with certain proteins in common, and closer matches most often come from individuals in the same ethnic groups. Because the donor pool among blacks is smaller, it has been difficult to find enough donors for black people in need." (Maron 2005). In the absence of sufficient

[1] Based on a data and figures from the Organ Procurement and Transplantation Network (2016). Full data table available in the Appendix.

numbers of registered organ donors from racial minority groups, the need for organs remains unfulfilled. Blacks, for instance, represented 20.3% of people on the waiting list for an intestine but received only 15.8% of transplants. Understanding what drives individuals to register as organ donors can have potentially life-saving implications, especially for minorities.

Previous research has often attempted to answer this question through surveying particular subpopulations in a given geographic area. Though this may provide insight into a subpopulation, it does little to address the problem holistically. Moreover, many of these studies note the correlation between factors such as education and race, but do not control for them in a regression or other statistical tool to assess the importance of each factor. I contribute to the literature by examining a national sample of individuals from multiple religious and ethnic backgrounds. After controlling for race, religion, gender, education, and health in a probit regression, I find that certain races and religions are less likely to be registered organ donors, and that the likelihood also varies based on education and gender.

This paper is organized as follows. The next section surveys the existing literature, attempting to determine the potential reasons an individual might not donate. The third section describes my data and hypothesizes about the effect of certain parameters on the likelihood someone is a registered organ donor. The fourth section explains the results of my analysis, offering potential explanations on the significance and direction of relevant parameters. The fifth section examines potential limitations on inferences that can be drawn from the results, and the possible effect of these limitations.

Finally, the sixth section concludes with a discussion of the results' implications for organ donation agencies.

Chapter 2: Literature Review

One prominent explanation of the United States' unmet need for organ transplants is the administrative structure surrounding registering to be an organ donor. Organ donation in the US is an opt-in system, meaning an individual who wants to register as an organ donor must express a preference to do so. Most European states, conversely, utilize a presumed consent model, also known as an opt-out system. In this system, an individual is assumed an organ donor unless they file a claim otherwise. This has led to dramatically varying registration rates across Europe, with opt-out countries like Sweden and Austria having registered organ donor rates of 86% and 99% respectively. Opt-in countries like Denmark and Germany have rates as low as 4% and 12% respectively (Johnson and Goldstein 2003). Figure 2 represents the difference in registration rates between countries with an opt-in system and those with an opt-out system.

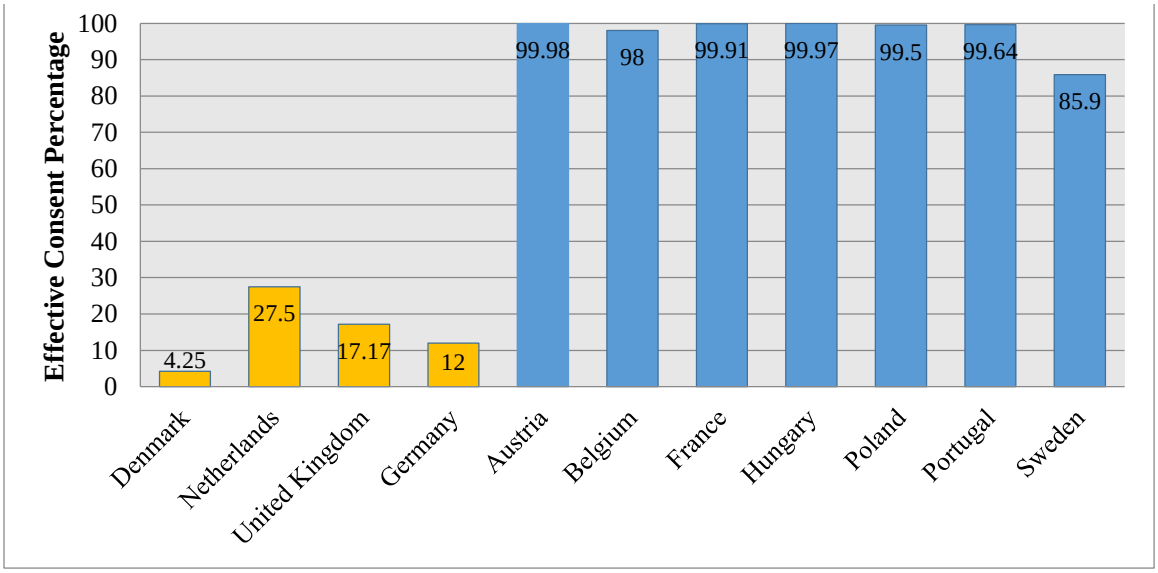

Fig. 2: Bar Chart comparing effective consent rates by country. Opt-out countries are in gold and opt-in countries are in blue (Johnson and Goldstein 2003).

The relationship between organ donor registration and the number of transplants is worth clarifying here. Though not always true, higher registration rates are typically associated with increased levels of organ transplants. This is evident in countries with opt-out systems, which generally appear to have higher rates of registered organ donors (Abadie and Gay 2006). Figure 3 shows the relationship between the percentage of people registered to be organ donors and cadaveric donation rates in Europe and the United States. Ugur (2015) finds that amongst 27 European countries from 2000-2010, opt-out systems typically have 28-32% higher donation rates. Other authors find similar results (Makmor et al. 2015; Rithalia 2005; Gimbel 2003). These findings underscore the importance of higher registration rates and their potential to lead to additional organ transplants.

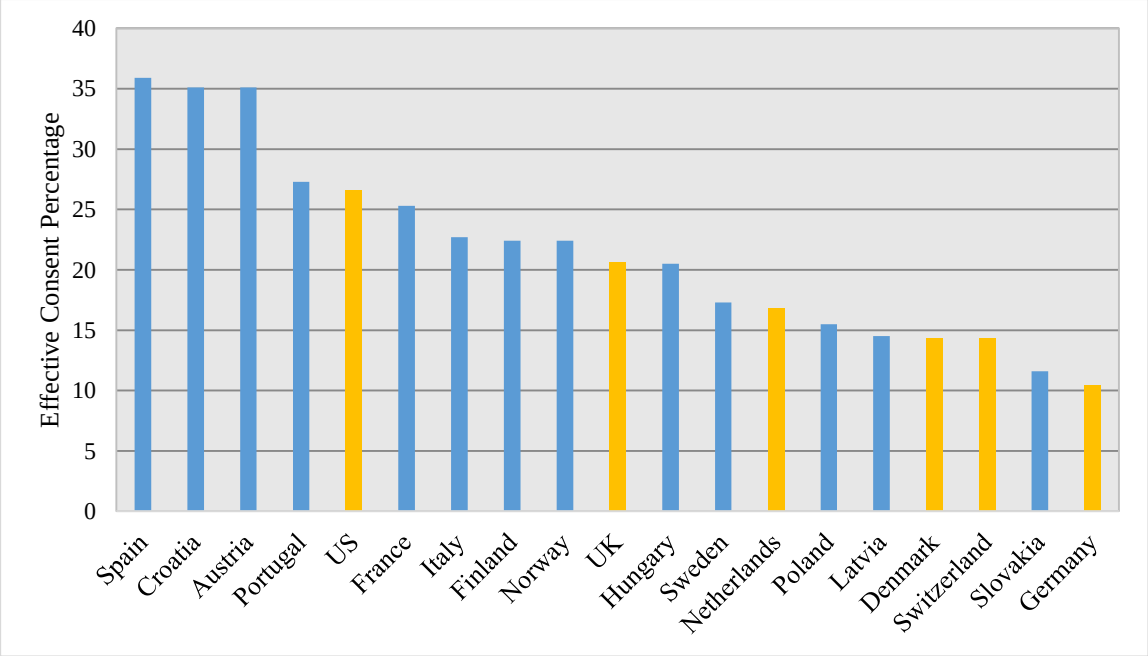

Fig. 3: Bar Chart of Cadaveric Donation Rates in 2014. Dark bars represent presumed consent countries and light bars represent informed consent countries. Data drawn from (Shepherd et al. 2014).

Each US state handles organ donation registration differently. Though most states register organ donors through their Department of Motor Vehicles, some maintain their organ donor registry through the state's Department of Public Health. Others, such as Washington and Oregon, have a privatized registry run by a nonprofit agency. Some advocates have argued that adopting a privatized system would lead to better outcomes, noting that, of the top ten states with the highest registration rates, eight have nonprofit administered donor registries (Virtanen 2014).

Though these administrative factors may be important, additional factors affect an individual's decision to register as an organ donor. For instance, when Brazil and France moved from an informed consent registration system to a presumed consent model both countries saw the number of registered donors go down due in part to "increased levels of mistrust towards medical professionals." (Shepherd et al. 2014). In a systematic review of presumed consent systems, Rithalia et al. (2009) find that presumed consent models alone cannot explain the variation in the organ donation rates within a country; the individual-level decision is still immensely important. Additionally, organ donation policies might function differently in European countries than they do in the United States. The US is significantly more diverse than most European states, for instance, meaning that trends which hold true in more ethnically homogenous countries may not hold true in the US, particularly for minority populations (Alesina et al. 2003). Within US states a number of additional factors may affect a state's percentage of registered donors. For example, states with privatized donor registries are often also healthier overall, making it difficult to draw conclusions about effectiveness (MetroFocus 2011). Examining the decision-

making process for individuals about organ donation might yield insights into what drives registration rates.

On an individual level, the disparity between the number of people who express support for organ donation and those who are registered donors is vast. Approximately 95% of Americans support organ donation, but only about half are registered. A number of authors have proposed potential reasons for this discrepancy. Falomir-Pichastor et al. (2003) identify a host of factors that can influence organ donation decisions. They argue that socioeconomic conditions, religious reasons, racial characteristics, and philosophical beliefs about the importance of bodily integrity, can all affect the decision to be an organ donor. They also highlight misunderstanding or mistrust of the medical system, which can deter individuals from being registered organ donors. For instance, Jacoby and Jaccard (2010) find that individuals who thought their guardians received low quality care when hospitalized were less likely to donate. Some studies have identified social barriers as well, such as the perceived reaction of family and friends after donating in the case of live organ donations (Flower and Balamurugan 2013).

Some of these factors may drive the difference in organ donor registration rates for minorities specifically. Siminioff et al. (2006) collect data from 1,283 respondents in Ohio, comparing the answers of black respondents to those of whites. They find that mistrust in the medical system is markedly higher among African Americans, with 47.9% of African Americans expressing distrust in the medical system as compared to only 39.5% of whites. Among African American respondents, 38.6% claimed that that doctors would not try to save their life if they knew they were an organ donor, compared with only 25.9% of white respondents. This difference in trust might drive lower donation

rates for minorities, but it is difficult to determine given the presence of other factors. For instance, African Americans in the survey by Siminoff et al. (2006) were far more likely to have lower incomes, with 79.9% of subjects having an income of less than $50,000 per year compared with only 57.9% of white subjects. Education levels were lower as well, with the percentage of African American subjects with a college degree or higher at less than half that of whites.

Other studies support the findings of Siminioff et al., (2006) finding higher levels of mistrust between doctors and African American patients than with white patients. One survey of donors found that African Americans were twice as likely to as whites to mistrust doctors (Minniefield et al. 2001). Yet it is difficult to disaggregate if mistrust is what is truly driving the disparity between minority and white registration rates or not. Ladin et al. (2005) create a social capital-based model to determine if organ donation is affected by community characteristics. They find that community parameters, such as levels of social capital, the percentage of whites in an area, income, and workforce participation substantially affected the likelihood of organ donation. In particular, they note that the higher levels of poverty and crime in minority communities, along with higher levels of racial segregation, drives decreased amounts of social capital and might account for lower donation rates.

African Americans are certainly not the only group which donates less than the average. Some evidence indicates Hispanics and Catholics are less likely to donate than whites and Protestant Christians respectively (Mocan and Tekin 2007). Some international studies have also indicated that Asians may be less likely to register as organ donors (Li et al. 2015).

Current literature is limited in a few respects. With the exception of meta-analyses and review studies, all of the literature discussed focuses on people in a given geographic area, often a US state or a city. I am unaware of any analyses which include data from respondents across the United States. Moreover, many of these studies focus specifically on the decisions of a specific subpopulation. Excluding Mocan & Tekin (2007) and Li et al., (2015) there is little discussion of other racial minority groups, or virtually any religious minority groups. This makes it difficult to compare the differences between racial groups in terms of the factors researchers study (e.g. income, medical mistrust, etc.) Though there are no direct biological implications for donation rates within a religion, they are still relevant. If members of a religious group are less likely to donate, that can tell hospitals or advocacy groups where to target efforts to find more donors. Finally, a number of these surveys do not ask respondents about prior health history. This is a potential complication, because a history of poor health might make one ineligible to donate. This is especially crucial in studies which evaluate why African Americans are less likely to be registered organ donors because some conditions are more common amongst African Americans than the population at large. End-stage renal disease (ESRD), for instance, is nearly four times as prevalent amongst blacks in the US as it is in the US population on the whole (Martins and Norris 2002). ESRD renders someone unable to be a kidney donor. Without controls for health, it is unclear if minorities are less likely to register due to health reasons or not.

Chapter 3: Data and Hypotheses

To evaluate which factors affect the probability that an individual is a registered organ donor I utilize the public-use sample of the National Adolescent Health Survey (Add Health), a longitudinal survey examining the health outcomes and behaviors of adolescent youth in grades seven through twelve. I utilize data from the public use segment of Add Health's third wave of interviews, which surveyed respondents in 2001 and 2002, when they were 18-28 years old. Since all subjects in the sample are legal adults, they are all eligible to be organ donors in terms of their age. This wave contains responses from 4,882 interview subjects, and is the only one in which subjects were asked if they had an organ donor card. Of these respondents, 4,825 have information about their organ donation registration status, represented by the variable named *donorcard* in Table 1 below. This variable has a mean of approximately 0.36, meaning that approximately 36% of respondents are registered organ donors.

Table 1: Summary statistics for holding an organ donor card

	(1) Observations	(2) Mean	(3) Std. Dev.	(4) Min.	(5) Max.
Donorcard	4,825	0.35855	0.47962	0	1

My dependent variable is an individual's organ donation registration status. Since this is a binary variable, a linear regression model cannot be used to measure the effect of independent variables; a one-unit change in a continuous independent variable does not give us the change in the outcome variable since it can only take on two values. Instead, the coefficients on independent variables in a multivariable linear regression represent probabilities, turning the linear regression model into a linear probability model (LPM).

Yet an LPM still presents a number of difficulties. For instance, the model can predict probabilities outside of the range [0,1] because ordinary least squares (OLS) are not constrained by the range of possible probabilities. An LPM also assumes the change in probability is linear, meaning that a one-unit change in a continuous independent variable will have the same effect on probability regardless of the value of the continuous variable. To address these issues I utilize a probit regression, a nonlinear model use when the dependent variable is a binary variable. Though this alleviates the prior issues, it brings challenges of its own. I elaborate on these challenges when discussing the results.

I control for several sets of independent variables. This allows me to isolate which variables are the most relevant. The first is a series of racial binary variables, with each variable corresponding to a different racial group. Table 2 gives summary statistics for these racial control variables. Since these are binary variables, their means can be interpreted as percentages, telling us what percentage of the sample is a member of that particular racial group. The sample surveyed consists predominantly of white respondents, but a sizeable percentage of the survey subjects are black, Hispanic, and Asian, along with a few Native American respondents.

Table 2: Summary statistics for racial binary variables

	(1) Observations	(2) Mean	(3) Std. Dev.	(4) Min.	(5) Max.
white	4,825	0.69202	0.46171	0	1
black	4,825	0.24891	0.43243	0	1
hispanic	4,825	0.10715	0.30934	0	1
asian	4,825	0.04539	0.20818	0	1
native	4,825	0.04663	0.21087	0	1

A number of studies argue racial minorities have greater levels of mistrust in the medical system than whites. Writing on healthcare disparities amongst Hispanics, Escarce and Kapur (2006) note, "Studies have found that language barriers between providers and patients may result in excessive ordering of medical tests, lack of understanding of medication side effects and provider instructions, decreased use of primary care, increased use of the emergency department, and inadequate follow-up" Siminioff et al. (2006) find similar results for African Americans, writing that their study suggests, "the inequalities experienced by African Americans in their overall dealings with the health care system might negatively affect their willingness to donate organs."

The evidence for Asian Americans is somewhat more mixed. Ngo-Metzger et al. (2004) find Asian Americans are more likely than whites to report that their doctors spent less time with them, did not listen to them, and did not adequately involve them in decisions. Yet they also find Asian Americans trust their doctors as much as white Americans. There is a dearth of literature about Native American perceptions of medical institutions, though there is some evidence of higher levels of mistrust. (Guadagnolo et al. 2009).

It should be noted at this point that this paper does not seek to evaluate the validity of claims of discrimination. The lack of questions about medical mistrust makes it impossible for us to assess this hypothesis. Rather, these studies help shape our hypotheses by giving reasons why certain minority groups may be less likely to donate than others.

H1: Race will significantly and negatively affect the likelihood that an individual is a registered organ donor for both Blacks and Hispanics, but not have an effect for Asians, or Native Americans.

I also control on a set of religious binary variables. Table 3 provides summary statistics for these variables. As with the racial binary variables, parameter means can be interpreted as the percentage of respondents who identify as a member of that religion. The largest segment of the sample is Christians who do not identify as Protestant or Catholic, followed by Catholics and Protestants. The sample includes a number of religions, including Buddhism, Judaism, and Islam, though these faiths have far fewer respondents than who various branches of Christianity.

Table 3: Summary statistics for religious binary variables

	(1) Observations	(2) Mean	(3) Std. Dev	(4) Min.	(5) Max
christian	4,825	0.32187	0.46724	0	1
catholic	4,825	0.20705	0.40523	0	1
protestant	4,825	0.16456	0.37082	0	1
jewish	4,825	0.00829	0.09068	0	1
muslim	4,825	0.00311	0.05568	0	1
buddhist	4,825	0.00352	0.05926	0	1
areligious	4,825	0.18902	0.39156	0	1

Though previous surveys have identified religion as an important factor in an individual's decision to donate an organ, they often do not specify which religions have an effect, or in what direction. Religion may inculcate charitable values and thus promote donation. Conversely, strict religious mores regarding bodily integrity may deter people from registering to be organ donors (Shepherd et al. 2014) There is little evidence to confirm either way. Mocan and Tekin claim Catholics donate at lower rates than the general population, and there is some circumstantial evidence suggesting Muslims do not donate frequently, (McManus 2015) but empirical evidence about the likelihood of particular religious groups being registered is scant. The small number of responses from Buddhist, Muslim, and Jewish respondents also suggests it might be difficult to draw inferences from this data.

H2: Religion will not be a significant predictor of registration likelihood across all categories.

I also regress on gender, age, and education. Table 4 has summary statistics for these variables.

Table 4: Summary statistics for demographic variables

	(1) Observations	(2) Mean	(3) Std. Dev.	(4) Min.	(5) Max.
Male	4,825	0.46073	0.49851	0	1
female	4,825	0.53927	0.49851	0	1
age	4,825	21.8261	1.81064	18	28
education	4,821	13.2066	1.98742	6	22

Gender is included because of the role it plays in organ donation dynamics. On average, there are nearly 1.5 times as many living female donors as there are living male donors annually, and there are nearly 1.5 times as many deceased male donors as there are deceased female donors (Dobson 2002). Explanations vary, with researchers proposing everything from sociocultural expectations for women to serve as caretakers to immunologic differences (Mohs and Hubner 2013; Gordan and Ladner 2012). The reasons for gender disparity within both living and deceased donors and between the two categories are beyond the scope of this paper. Still, results about differences between males and females in terms of registration likelihood might shed light on if registered organ donors are more likely to consider being live donors or deceased donors. Because women are less likely to be donors for deceased organ donation and more likely for live organ donation, I find it plausible these will cancel each other out and the effect of gender on registration will not be significant.

H3: Gender will not be a statistically significant determinant of registration likelihood.

I also include age as a parameter to see if registration rates are different for older or younger respondents. Because Add Health focuses on youth, subjects' ages only range from 18-28. This limited range makes it less probable that registration likelihood will vary with age.

H4: Age will not be a statistically significant determinant of registration likelihood.

Moreover, I control for the years of education an individual has. Given the aforementioned literature on mistrust of the medical system or misinformation about organ donation procedures, additional years of education may increase the likelihood someone is a registered donor.

H5: Education will be statistically significant and positively correlated with registration likelihood.

Lastly, I control for variables which measure a respondent's health. An individual who has poor health or a history of certain diseases may be less inclined or ineligible to donate. I use two variables as proxies for health. The first is the number of times an individual has been hospitalized in the last five years, labeled *hospitalvisits*. In this case, a hospitalization is defined as an instance where the person was kept overnight in the hospital for at least one night. The second is a binary variable if the individual has had issues with high blood pressure in the last 5 years, labeled *bloodpressure*. Summary statistics for these two variables are given in Table 5. Though these variables may be useful in measuring health, it is unclear how important they will be given the young age of survey respondents. Still, given that some respondents have been hospitalized upward of 20 times in the last five years, I find it plausible that these proxy variables for health might be associated with registration status.

Table 5: Summary statistics for health variables

	(1) Observations	(2) Mean	(3) Std. Dev.	(4) Min.	(5) Max.
bloodpressure	4,822	0.06325	0.24344	0	1
hospitalvisits	4,769	0.43049	1.04062	0	30

H6: Both the binary variable for high blood pressure and the number of hospitalizations will be statistically significant and negative predictors of registration likelihood.

Add Health is, to my knowledge, the only national data set which includes information about organ donation registration, yet it still lacks several variables which would prove immensely useful in this analysis. For instance, Add Health provides no information about a respondent's zip code, making it difficult to test the social capital argument put forward by Ladin et al. (2005) Additionally, the survey does not ask respondents about their faith in the medical system, making it impossible to test the mistrust hypothesis several researchers have put forward.

There are also problems with some of the variables included in the survey. For example, Add Health asks individuals about their income and their marital status. Previous literature suggests income might be an important factor when donating an organ because the potential costs of organ donation might deter someone from registering. Even if a state provides tax incentives to donate, individuals unfamiliar with these incentives may feel less inclined to register as an organ donor. Marital status could be a potential regressor because there is some evidence about the likelihood of donation increasing for couples who co-donate (Anteby et al. 2012). It is also possible married individuals have stronger social ties or feel more charitable. Unfortunately, the vast majority of survey respondents opted not to answer these questions. Though marital status and income may be important control variables, including them would reduce the sample size by more than 80 percent. For this reason, I opt to exclude these variables from this analysis.

The design of the survey also poses some difficulties. Add Health survey respondents are not representative of the national population of adolescents. Specifically,

the authors note that higher-income African American students were oversampled in the initial wave of interviews. meaning I must use sampling weights to determine the actual coefficients and standard errors for independent variables.

Chapter 4: Results and Discussion

To avoid multicollinearity when regressing on multiple binary variables, I exclude one particular binary variable from that set. This means a given parameter's coefficient can be interpreted as the difference between that parameter and the excluded parameter. For instance, if I exclude the binary variable for being male in my regression and only regress on the binary variable for being female, its coefficient tells me the how much more or less likely a female is to be an organ donor than a male. For race and gender binary variables, I exclude the variables for white and male respectively. Religion is a bit trickier, since respondents can either be classified as Catholic, Protestant, or a Christian who does not identify as either Protestant or Catholic. No decision is more or less optimal in this case, so I opt to exclude the variable *christian*. This is because the variable likely has a larger mix of Christian denominations within it; I argue it makes more sense to include it as a baseline.

As mentioned earlier, the nonlinearity of the probit model means the regressor coefficients do not have clear, generalizable interpretations. For this reason, I do not use a standard probit regression.[2] I use the average value of each variable, also known as the multivariate point of means, as my reference, measuring the marginal effect of a change from that point. STATA refers to this as a dprobit regression. Lastly, to account for the fact that Add Health is not a representative sample of the population, I adjust the data by incorporating sampling weights.

[2] Results for the actual probit regression can be found in the Appendix.

Table 6: Regression Results

VARIABLES	(1) donorcard
black	-0.166***
	(0.0183)
hispanic	-0.134***
	(0.0242)
asian	-0.102***
	(0.0346)
native	-0.0403
	(0.0381)
catholic	-0.0442**
	(0.0224)
protestant	0.0108
	(0.0241)
jewish	0.0954
	(0.0913)
muslim	-0.338***
	(0.0260)
buddhist	-0.124
	(0.115)
areligious	0.0163
	(0.0229)
female	0.102***
	(0.0168)
age	-0.00684
	(0.00467)
education	0.0375***
	(0.00460)
bloodpressure	0.0337
	(0.0373)
hospitalvisits	0.00518
	(0.00817)
Observations	4,762

Note: Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 presents the results of our probit regression at the multivariate point of means. The interpretations that follow are all at the multivariate point of means as well.

Racial Variables

Hypothesis 1 predicted individuals who were black, and Hispanic would be less likely to be registered, but that there would be no statistically significant results for other races. While the coefficients for the racial binary variables for blacks and Hispanics are both negative and statistically significant parameters at the 1% level, the same is true of Asians at the 1% level. In comparison with whites, blacks are approximately 16.6% less likely to have an organ donor card, with Hispanics being 13.4% less likely and Asians being 10.2% less likely respectively.

Religious Variables

Given the sparse literature, Hypothesis 2 argued no religion would be a significant predictor of an individual's organ donation registration status. Instead, my results indicate Catholics are 4.4% less likely and Muslims are 33.8% less likely to be registered as organ donors than non-denominational Christians, at the multivariate point of means. The coefficient for Catholics is significant at a 10% level while that for Muslims is significant at a 1% level. The latter also has the largest coefficient out of all of the independent variables.

These results support the claim from Mocan and Tekin (2007) that Catholics are less likely to be organ donors. Perhaps more surprisingly, these results suggest Muslims are significantly less likely to be organ donors than any other racial or religious group. There is some evidence to suggest why such a relationship exists. AlKhawari et al. (2005) interview 141 Muslims living in the UK about their thoughts and opinions on organ donation and note, "A large number of participants expressed their belief that Islam forbids organ donation, on the basis of statements from the *Qur'an* and traditional Islamic

literature." They note that many people expressed a strong belief in the sacredness of the body, and that it was not to be disturbed after death for cadaveric organ donation. Interestingly, there is a large body of religious scholarship from Islamic authorities indicating the permissibility of organ donation in Islam (Islamic Religious Council of Singapore 2016). This indicates a possible lack of clarity in the ruling, or a misunderstanding about either organ donation or Islamic rulings.

Gender

In contrast to Hypothesis 3's prediction, gender is a highly statistically significant predictor of registration likelihood. Specifically, females are 10.2% more likely to register as organ donors than males on average, all else being equal. This is significant at the 1% level.

As mentioned before, there are 50% more females on the living donor list than there are males. The increased registration likelihood for females suggests some of those who register to be organ donors might be more likely to be living donors. Whether this is due to intention, a byproduct of being a registered organ donor, or outside factors is unclear.

Education

Hypothesis 5 argued education would be a significant predictor of registration likelihood. My results substantiate this, demonstrating that education is a positively associated with the probability an individual is a registered organ donor at the 1% level. Specifically, the model shows an additional year of education makes someone 3.75 percentage points more likely to be a registered organ donor at the multivariate point of means.

The rest of the variables in the regression were not statistically significant. Intriguingly, no proxy health variable was associated with the likelihood of someone holding an organ donor card. This may be due to a number of possible factors. First, the young age and relative healthiness of respondents likely reduces the variance in health outcomes. This is evident in the fact that just over 6% of respondents have high blood pressure and that the average number of hospitalizations in the last five years was 0.43. The standard deviation for hospitalizations was 1.04, meaning the vast majority of respondents had been hospitalized about two times in the last five years. Alternatively, it is possible these variables are not relevant proxies for healthcare outcomes important to organ donation registration.

Chapter 5: Limitations

Though these results both confirm previous hypotheses and suggest additional relationships, we must interpret their implications cautiously. Several religion and race binary variables were negative and significant, indicating members of those groups were less likely to be registered organ donors. Knowing the signs and significance levels of the coefficients is insufficient in telling us why those relationships exist; we cannot test either the mistrust or the religious misunderstanding explanations discussed before due to data limitations.

Omitted variables may also skew our results. Without a variable for religiosity, for instance, we cannot tell if the relationships between being Catholic or Muslim and registration probability is due to increased religiosity among the sample or not. The small sample size for Muslim respondents is also a concern; only 0.3% of the sample is Muslim, a fraction of their percentage of the US population. This small sample size limits our certainty of the relationship between Islam and organ donation. I am also unable to control for marriage and income given the high rate of non-responses to those questions.

Chapter 6: Conclusion

This study complements the literature examining factors affecting the rate of organ donations at an individual level. Confirming the importance of education and race as parameters, this study also suggests gender and certain religious beliefs may strongly affect the probability of being a registered organ donor.

The decreased likelihood for several racial groups and religious groups to be registered organ donors has important consequences for the unmet demand for organ transplants. Because racial minorities comprise the majority of waitlist recipients, continued rates of registration and transplants have potentially life-threatening consequences. Further research should examine why such attitudes exist among groups who were statistically less likely to be registered organ donors. Understanding the driving factors of those attitudes can shape government policy and advocacy groups to better address the concerns of racial minorities and religious groups, leading to higher rates of registration in communities with the greatest need.

Bibliography

Abadie, Alberto and Gay, Sebastien, (2006), The impact of presumed consent legislation on cadaveric organ donation: A cross-country study, Journal of Health Economics, 25, issue 4, p. 599-620, http://EconPapers.repec.org/RePEc:eee:jhecon:v:25:y:2006:i:4:p:599-620.

Alesina, A., A. Devleeschauwer, W. Easterly, S. Kurlat, and R. Wacziarg. 2003. "Fractionalization." Journal of Economic Growth 8(2): 155–194. doi:10.1023/A:1024471506938

Alkhawari, Fawzi S., Gerry V. Stimson, and Anthony N. Warrens. "Attitudes Toward Transplantation in U.K. Muslim Indo-Asians in West London." American Journal of Transplantation 5, no. 6 (March 9, 2005): 1326-331. doi:10.1111/j.1600-6143.2005.00814.x.

Anteby M, Garip F, Martorana PV, Lozanoff S (2012) Individuals' Decision to Co-Donate or Donate Alone: An Archival Study of Married Whole Body Donors in Hawaii. PLoS ONE 7(8): e42673. doi:10.1371/journal.pone.0042673

Dobson, Roger. "More Women than Men Become Living Organ Donors." BMJ : British Medical Journal 325 (2002): 851.

"Donor Leave Laws and Tax Deductions/Credits for Living Donors." The National Kidney Foundation. July 11, 2016.

Ehrle, Ronald N., Teresa J. Shafer, and Kristine R. Nelson. "Referral, Request, and Consent for Organ Donation: Best Practice--A Blueprint for Success." Critical Care Nurse 19, no. 2 (April 1, 1999): 21-30.

"Facts and Myths." American Transplant Foundation. 2016. http://www.americantransplantfoundation.org/about-transplant/facts-and-myths/.

Falomir-Pichastor, Juan M., Jacques A. Berent, and Andrea Pereira. "Social Psychological Factors of Post-mortem Organ Donation: A Theoretical Review of Determinants and Promotion Strategies." Health Psychology Review 7, no. 2 (May 17, 2013): 202-47. doi:10.1080/17437199.2011.570516.

Flower, Josephine R., and Balamurugan E. "A Study on Public Intention to Donate Organ: Perceived Barriers and Facilitators." British Journal of Medical Practitioners 6, no. 4 (December 2013): 1-4.

Gallup Organization. (2005). 2005 National Survey of Organ and Tissue Donation Attitudes and Behaviors. Washington, DC: Author.

Gordon, Elisa J., and Daniela P. Ladner. "Gender Inequities Pervade Organ Transplantation Access—See Related Article, P. 513." Transplantation Journal 94, no. 5 (September 15, 2012): 447-48. doi:10.1097/tp.0b013e31825d15a1.

Guadagnolo, B. Ashleigh, Kristin Cina, Petra Helbig, Kevin Molloy, Mary Reiner, E. Francis Cook, and Daniel G. Petereit. "Medical Mistrust and Less Satisfaction With Health Care Among Native Americans Presenting for Cancer Treatment." Journal of Health Care for the Poor and Underserved 20, no. 1 (February 2009): 210-26. doi:10.1353/hpu.0.0108.

Jacoby L., Jaccard J. Perceived support among families deciding about organ donation for their loved ones: donor vs nondonor next of kin. Am J Crit Care2010;19:e52-61. doi:10.4037/ajcc2010396.

Ladin, Keren, Rui Wang, Aaron Fleishman, Matthew Boger, and James R. Rodrigue. "Does Social Capital Explain Community-Level Differences in Organ Donor Designation?" Milbank Quarterly 93, no. 3 (November 3, 2015): 609-41. doi:10.1111/1468-0009.12139.

Li AH-t, McArthur E, Maclean J, Isenor C, Prakash V, Kim SJ, et al. (2015) Deceased Organ Donation Registration and Familial Consent among Chinese and South Asians in Ontario, Canada. PLoS ONE 10(7): e0124321. doi:10.1371/journal.pone.0124321

Maron, Dina Fine. "Racial Gap in Kidney Transplants Combated by Policy Changes." Scientific American. September 03, 2015. https://www.scientificamerican.com/article/racial-gap-in-kidney-transplants-combated-by-policy-changes/.

Martins, D., N. Tareen, and K.c. Norris. "The Epidemiology of End-Stage Renal Disease among African Americans." The American Journal of the Medical Sciences 323, no. 2 (February 2002): 65-71. doi:10.1097/00000441-200202000-00002.

McManus, John. "Hospitals Urge Muslims to Donate Organs." BBC News. June 16, 2015. http://www.bbc.com/news/uk-33155326.

Minniefield, William J., Jun Yang, and Paola Muti. "Differences in Attitudes toward Organ Donation among African Americans and Whites in the United States." Journal of the National Medical Association 93, no. 10 (2001): 372-29.

Mocan, Naci and Erdal Tekin. “The Determinants of the Willingness to Donate an Organ among Young Adults: Evidence from the United States and the European Union.” Social Science and Medicine 65, 12 (December 2007): 2527-2538.

Mohs, Anja, and Gundula Hübner. "Organ Donation: The Role of Gender in the Attitude-behavior Relationship." Journal of Applied Social Psychology 43, no. S1 (March 18, 2013): E64-70. doi:10.1111/jasp.12042.

"National Data." Organ Procurement and Transplantation Network. 2016. https://optn.transplant.hrsa.gov/data/view-data-reports/national-data/.

"Need an Organ Transplant? Don’t Count on New York." MetroFocus. October 17, 2011. http://www.thirteen.org/metrofocus/2011/10/need-an-organ-donation-dont-count-on-new-york/.

Ngo-Metzger, Quyen, Anna T. R. Legedza, and Russell S. Phillips. "Asian Americans’ Reports of Their Health Care Experiences." *Journal of General Internal Medicine* 19, no. 2 (February 2004): 111-19. doi:10.1111/j.1525-1497.2004.30143.x.

Rithalia, A., McDaid, C., Suekarran, S., Norman, G., Myers, L., & Sowden, A. (2009). Systematic review of presumed consent systems for deceased organ donation. Health Technology Assessment, 13(26), 1-95.

Shepherd, Lee, Ronan E. O’Carroll, and Eamonn Ferguson. "An International Comparison of Deceased and Living Organ Donation/transplant Rates in Opt-in and Opt-out Systems: A Panel Study." BMC Medicine 12, no. 131 (September 24, 2014). doi:10.1186/s12916-014-0131-4.

Siegel, Jason T., Mario A. Navarro, Cara N. Tan, and Melissa K. Hyde. "Attitude–behavior Consistency, the Principle of Compatibility, and Organ Donation: A Classic Innovation." Health Psychology 33, no. 9 (September 2014): 1084-091. doi:10.1037/hea0000062.

Singapore. Islamic Religious Council of Singapore. Office of the Mufti. *Organ Transplant in Islam*. 2016.

Siminoff, Laura A., Christopher J. Burant, and Said A. Ibrahim. "Racial Disparities in Preferences and Perceptions regarding Organ Donation." Journal of General Internal Medicine 21, no. 9 (September 2006): 995-1000. doi:10.1007/bf02743151.

Tumin, Makmor, Khaled Tafran, and NurulHuda Mohd Satar. "Family Response to Presume Consent System on Organ Donation from a Review of Literature." International E-Journal of Science, Medicine & Education 9, no. 3 (2015): 20-26.

Ugur, Zeynep Burcu. "Does Presumed Consent Save Lives? Evidence from Europe." Health Economics 24, no. 12 (October 02, 2014): 1560-572. doi:10.1002/hec.3111.

Virtanen, Michael. "NY State Lags US In Organ Donation Sign-Ups". Dailyfreeman.com. N.p., 2016. Web. 30 Nov. 2016.

Appendix

Table A: Waitlist for Organ Transplants by Year

Year	Donors	Transplants
1991	6,953	15,756
1992	7,091	16,134
1993	7,766	17,631
1994	8,203	18,298
1995	8,859	19,396
1996	9,222	19,765
1997	9,545	20,314
1998	10,362	21,523
1999	10,869	22,026
2000	11,934	23,266
2001	12,702	24,239
2002	12,821	24,910
2003	13,285	25,473
2004	14,154	27,040
2005	14,497	28,118
2006	14,750	28,940
2007	14,400	28,366
2008	14,207	27,964
2009	14,631	28,458
2010	14,504	28,662
2011	14,149	28,539
2012	14,011	28,054
2013	14,257	28,954
2014	14,412	29,532
2015	15,062	30,973

Table B: Probit Results

VARIABLES	(1) donorcard
black	-0.479***
	(0.0578)
hispanic	-0.384***
	(0.0754)
asian	-0.289***
	(0.105)
native	-0.110
	(0.106)
catholic	-0.120*
	(0.0615)
protestant	0.0289
	(0.0640)
jewish	0.246
	(0.230)
muslim	-1.633***
	(0.445)
buddhist	-0.360
	(0.374)
areligious	0.0433
	(0.0607)
female	0.272***
	(0.0455)
age	-0.0183
	(0.0125)
education	0.100***
	(0.0123)
bloodpressure	0.0890
	(0.0971)
hospitalvisits	0.0138
	(0.0218)
Constant	-1.262***
	(0.293)
Observations	4,762

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1