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ORGAN DONATIONS WITHIN SWEDEN: EXPLORING ORGANIZATIONAL EFFECTS REGIONALLY

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Abstract

Sweden has an unusually low rate of deceased organ donors compared to most other European countries. However, Sweden has factors that have been shown in previously literature to contribute to higher rates of organ donation, with its favorable legislative framework and positive attitude toward organ donation among the population. While the average donation rate is low, some counties in Sweden perform at similar levels to the better performing European countries, while other counties are performing substantially worse. In our thesis, we discuss the plausible organizational reasons behind the differences, and construct a panel data set of the number of donators per million population for the 21 Swedish counties between year 2008 and 2013, and utilize a pooled OLS model to investigate the sources of the differences between the counties. We find that the presence of a transplantation hospital has no effect on the donation rates, while presenting some evidence that the presence of a neurosurgery unit does have a significantly positive impact on donation rates. Moreover, time-invariant dummy variables are used to capture the organizational effects, which we find to be significant. Our conclusion is that there is considerable variation in the organ donation rates between counties that is not related to demographic or behavioral factors.

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1. Introduction

An organ transplant can help a patient to radically lengthen their life expectancy and improve their quality of life. However, the gap between the demand and the supply of organs is large and increasing in many countries. Patients spend years on waiting lists and every year some patients die while waiting. Even though the general attitude toward donating organs is positive, there are some countries that have noticeably low donation rates. The reasons behind the lack of organ donors vary between countries. In poor countries the complex procedure of organ transplantation as well as the cost is a hinder. In middle-income countries the waiting lists grow longer as the population ages and obesity and hypertension increases. The richer countries experience an exacerbation of the lack of organ donors due to a fall in traffic accident deaths and strokes, which are the main sources of organs (Anonymous2008).

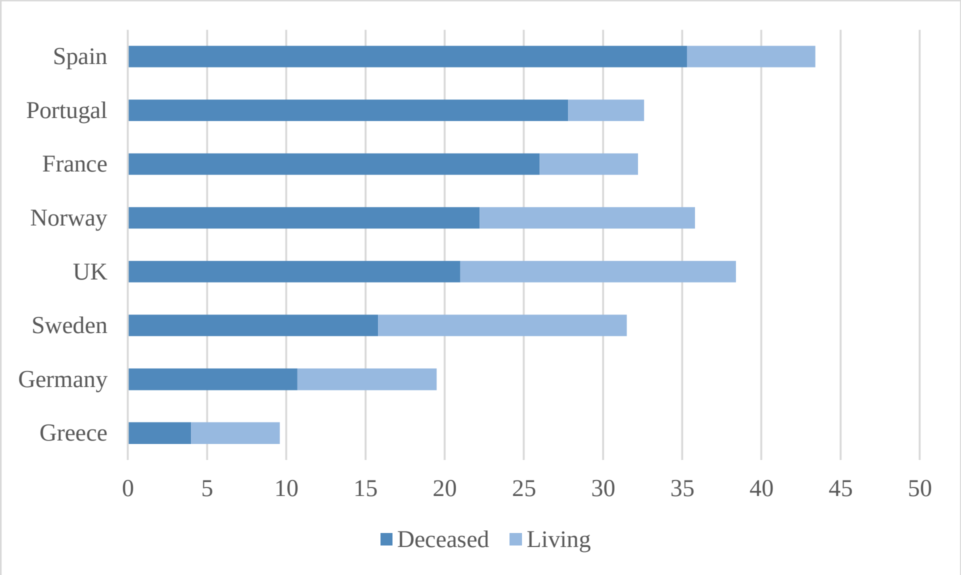
There are multiple ways of becoming a donor; by becoming a living donor, a deceased donor, as well as donating blood and donating your body to science after your death (Mer Organdonation no datec). A living donor can donate a kidney or part of their liver (Mer Organdonation no datea), while a deceased donor can donate up to 37 different organs and tissues (Anonymous2008). In Sweden the organs that are transplanted are kidneys, heart, lungs, liver, pancreas and sometimes intestines (Mer Organdonation no dateb).

There is variation in the donation rates between countries, both in living and deceased donation with little correlation between the two different donation types. A possible reason for these differences in donation rates is how issues related to organ donation are portrayed in the media (Anonymous2008). However, the most important influencing factors of the deceased donation rate are the legislation, the attitude of the population and the organization of organ transplantations (Tibell, Henriksson 2012).

Sweden has a presumed consent legislation, which means that the law assumes that the deceased person is willing to donate unless the person has shown that he or she was not willing to become a donor (Tibell, Henriksson 2012). Presumed consent is believed to have a positive impact on donation rates, but is still discussed by academics (Kessler, Roth 2012). In surveys done by the European Commission the Swedish population has the most positive attitude toward organ donation (European Commission 2010, European Commission 2007). This is somewhat reflected in actual donation rates, as Sweden has a high rate of living donors, but a relatively low donation rate from deceased donors, as shown in graph 1 (European Commission 2014).

The positive attitude of the Swedish population and the high donation rate from living donors makes the low organ donation rate from deceased donors puzzling.

Graph 1. Donors per million, deceased and living, selected European countries in 2013



Source: European Commission (2014).

When investigating further into the number of deceased donors in different counties of Sweden, the high variation of deceased donors between counties is noticeable (See Table 1). There are several explanations as to why these differences exist, for example, attitudes toward organ donation or differences in how organ donations and transplantations are organized. As the presumed consent legislation is the same for the entire country, and the attitude toward organ donation is the most positive in Europe it is likely that the organization of organ transplantation is the limiting factor that results in the low rates of deceased donors. As the rate of living donation is high and since only a few organs can be donated while the donor is alive, the organization of deceased organ donation and transplantation is the most interesting and significant topic to investigate.

Table 1. Deceased organ donors per million, Swedish county comparison 2008-2013, Averages from the data set compiled

Region	Mean
Blekinge	7.66
Dalarna	13.86
Gotland	23.30
Gävleborg	15.67
Jämtland	30.29
Jönköping	5.41
Kalmar	4.29
Kronoberg	14.51
Norrbotten	7.23
Skåne	14.81
Stockholm	12.33
Södermanland	11.07
Uppsala	36.56
Värmland	9.75
Västerbotten	33.45
Västernorrland	8.25
Västmanland	11.17
Västra Götaland	18.15
Örebro	13.61
Östergötland	12.01
Total	15.03

In this paper, we intend to investigate the county differences by considering the organization of organ transplantations in Sweden. The effects we are mainly exploring are those of regional coordination, including both coordination of transplantation and general healthcare between counties, and those of transplantation-related infrastructure, meaning neurosurgery units and hospitals capable of performing organ transplantations. Moreover, we include a number of variables that have previously been shown to affect national rates of organ donation to capture other important factors.

This paper is organized as follows; firstly we examine why we as economists are interested in the issue of organ donations. This is followed by setting a background where we investigate what the situation for organ donation is in Sweden and in other countries to have an overview of the topic, followed by a literature review where the utility of organ donation is discussed, how organ donation functions and what rules and limitations there are, and what factors affect organ donation rates. Then a detailed description of the organization of organ donation and transplantation in Sweden is made, as we believe that this is an important factor influencing the donation rate in Sweden. This is followed by our research question where we outline in further detail how we will investigate the differences of donation rates within Sweden. Subsequently we present our framework and research question, the model applied and our data set. Utilizing these we then present our results and analyze them, ending the paper with our conclusions and a short summary.

2. Purpose

The purpose of this paper is to investigate the comparably low rate of deceased donors in Sweden by exploring the differences between counties to see if there is an organizational effect. Organ donors can increase the expected life-years and quality of life for the patients who receive an organ transplant (Schnitzler et al. 2005). An organ transplant can also be cost efficient for society by reducing healthcare costs (Whiting et al. 2004). In Sweden there are many living organ donors compared to other countries (as shown in graph 1), but the rate of deceased donors is quite low. Our focus will be on deceased donors for two reasons, firstly that Sweden already has a high rate of organ donation from living donors (Anonymous2012). Secondly, the decision of becoming a living donor is different from becoming a deceased donor, as a deceased person does not have any practical use from the organs, which a living donor still has. It could also be that some individuals do not wish to think about their own death and therefore avoid taking a stand to if they wish to become an organ donor or not.

A large share of the Swedish population, over 80%, has a positive attitude toward organ donation. Sweden has the population with the highest share of the people with a positive attitude toward organ donation in the European Union (European Commission 2010). Spain has the highest donation rate in the world (Kessler, Roth 2014), but has a lower share of the population with a positive attitude toward organ donation compared to Sweden (European Commission 2010). That Sweden has a high rate of living organ donation, yet a low rate of deceased organ donation while having a very positive attitude indicates that there are other factors than attitude affecting the rate of deceased organ donation.

In studies where the differences in organ donation rates between countries are studied panel data is used on a national level, for example to investigate the effect of the legislation on organ donation (Abadie, Gay 2006, Ugur 2014). As there is a lot of variation in organ donation rates between counties within Sweden, as shown in table 1, this enables us to use panel data on a county level in a similar way to national panel data used earlier by other studies. By focusing on the differences within Sweden on a county level we aim to gain a better understanding of what factors affect deceased organ donation rates in Sweden. To do this we collected data on deceased donors for every county in Sweden for the years 2008-2013 and other variables that have been shown to affect donation rates in previous literature as well as variables considered to have a potential impact. With this data set we aim to perform a pooled OLS regression to find which variables have an effect on the rate of deceased organ donation and to what extent they influence the donation rate.

Deffian and Ythier (2010) studies the Spanish model of how deceased organ donation and transplantation is organized and creates a model of how the Spanish system works. The authors find that the reason for Spain being so successful in having a high donation rate is that the organization of organ donation and transplantation activities are handled by a national agency that optimize the process (Deffain, Mercier Ythier 2010). It is, therefore, important for us to have a good understanding of how the healthcare and organization of organ donation and transplantation is organized in Sweden. It is also important to find the other factors affecting the donation rate so that the potential unexplained variation is as small as possible. To our knowledge there has been no previous study that investigates the factors affecting deceased organ donation rates in Sweden on a county level, and we hope that what we may find will help in increasing the donation rate, as an organ donor extends and improves the lives of the patients who receive the organs in an organ transplant.

3. Background

In this section we present an overview of deceased organ donation in Sweden and compare it to other countries. Firstly, an explanation on how the legislation concerning organ donation in Sweden works and some possible barriers to higher donation rates are presented. Then the organ donation rate in Sweden is compared to organ donation rates in other countries, mainly European countries which are similar to Sweden in resources available for organ donation and somewhat similar in culture. The comparisons are then deepened by examining the attitude toward deceased organ donation in Sweden compared to other EU countries. As the country with the highest donation rate in the world, Spain is an interesting country to compare with Sweden to discover what aspects of organ donation are similar and what are different between the two countries. The aspects that differ could help us in narrowing down our focus and find possible aspects and variables that are the cause for Sweden's lower donation rate.

3.1 Swedish legislation

The law governing organ donation has as a default choice that possible donors should be presumed to be willing to donate organs if they have not communicated their wish to not become organ donors. However, unless the deceased possible donor is registered in a donation registry or carry a donation card the willingness to become a donor has be shown through an investigation that the preference of the deceased individual is compatible with a positive attitude toward organ donation. If the preferences of the deceased individual is unknown and the individual has not spoken out against organ donation or in some other way shown a preference against organ donation, it is allowed to make use of the organs from the deceased individual. If there is conflicting information about the deceased individual's preferences it is not allowed to obtain the organs. If the deceased individual has unknown preferences and the family is against organ donation the deceased is not allowed to be an organ donor, meaning that the family can veto organ donation if the deceased has not explicitly expressed a wish to become a donor. The family of a possible organ donor must be informed about the intended procedure and have a reasonable amount of time to consider it (Sveriges Riksdag 1995).

A hospital that is allowed to perform any form of organ transplant procedure, including obtaining organs, must have a doctor and a nurse that are responsible for preparing organ donations and provide support and information to the family of the deceased individual (Sveriges Riksdag 1995). The intensive care units in hospitals are responsible for noting all possible organ donors. It is the responsibility of the organ donation doctor and nurse to work actively to identify possible donors, ensure adequate education of staff and to make sure that there are good routines for handling possible organ donors as well as evaluate the activities associated with organ transplantation (Tibell, Henriksson 2012).

To be a possible organ donor the patient has to suffer from a total brain infarction, meaning that the brain has been damaged to such an extent that all brain function is gone permanently and the patient is on a respirator, and the patient is considered to be brain dead. In Sweden it is only allowed to provide healthcare for the sake of the patient with the exception in cases of living organ donation, but there are no such exceptions for dying patients who are willing to become organ donors. Some care is allowed for a short time after the time of death to make organ donation possible, but for no more than 24 hours after death has been proclaimed. Starting intensive care before death is controversial as a way to enable organ donation, as care provided to a patient should be in the interest of the patient and if a patient is severely injured it can be deemed more humane to let the patient pass away rather than starting intensive care. The initiation intensive care for severely injured patients would enable the identification of more possible organ donors, but to start intensive care in order to possibly obtain the organs for organ transplantations contradicts the principle of only providing healthcare for the sake of the patient. Sometimes intensive care is not initiated, or if initiated interrupted, for patients if they are considered to be too severely injured, instead of having a short period of intensive care and observe if the patient is brain dead. This situation is also made more difficult as it is not allowed to check a patient's willingness to become an organ donator until after death, which means that care can be seen as meaningless and terminated before the willingness to donate is investigated. This could make it impossible to follow the deceased individual's wish to become an organ donor. Adjusting the regulations to make it possible to investigate a patient's willingness to donate organs before death would support the healthcare staff responsible to promote organ transplantation (Tibell, Henriksson 2012).

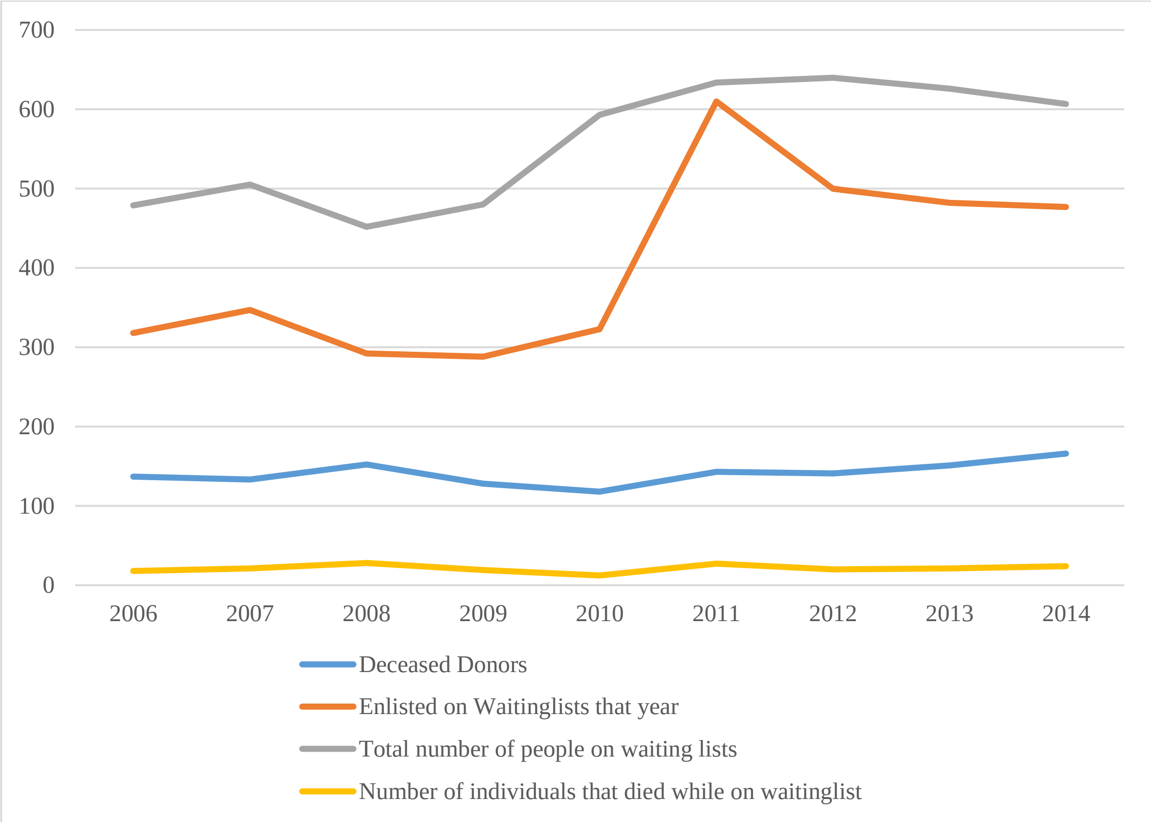
3.2 Swedish donation rates compared to other countries

The small supply of organ donors has been an issue in Sweden for many years. In the 1980's there were up to 150 willing deceased donors per year but that number fell to around 100 donors per year at the turn of the millennia. In 2002 Sweden had 11.2 donors per million population, PMP. Compared to the Nordic countries, that Sweden cooperates with in Scandiatransplant, Denmark had 12.7 donors PMP, Norway 13.7 and Finland 17.0 in 2002. Some European countries have had substantially higher donation rates; France 20.0 donors PMP, Belgium 21.7, Austria 24.3 and Spain 33.7 donors PMP in 2002. Due to these low donor numbers there was a call for by Gäbel and Asplund (2004) to initiate the collection of information regarding organ donation in Sweden. The information that should be gathered is how many of the deceased in Sweden each year are potential donors, how many of these that are noted by healthcare staff, to what extent the willingness to donate is investigated in potential donors, how often donation occurs and how often relatives rejects organ donation due to the possible donors own views or by the use of a veto if the will of the possible donor is unknown. The reason for wanting to gather this information is to be able to answer two main questions; Does Sweden have a lower rate of possible donors compared to other countries and does Sweden have the resources needed to ensure that all donors are found and are made as much use of as possible (Gäbel, Asplund 2004).

In a regional investigation, conducted by Persson et al. (2005), into how many possible donors there really were by reviewing medical records in 1999-2003 in southern Sweden, the possible numbers of donors were found to be 20 donors PMP. One of the reasons why it was so low according to the authors was that consent to organ donation was not given in half of the possible donor cases. Comparing the situation in southern Sweden to Spain with the highest donation rates PMP the authors found that the amount of deaths in the intensive care units, where possible donors are found, were equal, but the number of cases were brain death were diagnosed were double in Spain compared to southern Sweden. There was a higher consent rate in Spain and the share of possible donors that were medically eligible was about the same. The authors mean that some of these effects lay in the different approaches as to how care was provided between Sweden and Spain, and to what extent patients are put on respirators and other kinds of life support (Persson et al. 2005).

In 2009 an investigation was done by the Council of Organ and Tissue Donation (Vävnadsrådet) by examining all deceased patients with recent severe head trauma that were on a respirator in 40 intensive care units, ICUs, in Sweden. By using the number of cases where the question of organ donation could have been brought up with high probability (25 cases), and with a lower probability (34 cases), it was estimated that the number of potential donors per year is 200-250 deceased donors (Tibell, Henriksson 2012). For the recent statistics of deceased donors, how many new patients that are added to waiting lists, the total number of patients on the waiting lists and how many died while on waiting list see graph 2 with information from Scandiatransplant.

Graph 2. Swedish annual data on deceased donors, enlisted on waiting list that year, total number of people on waiting lists, number of individuals that died while on the waiting list for the years 2006-2014.



Source: Scandiatransplant (2007), Scandiatransplant (2008), Scandiatransplant (2009), Scandiatransplant (2010), Scandiatransplant (2011), Scandiatransplant (2012), Scandiatransplant (2013), Scandiatransplant (2014), Scandiatransplant (2015).

When comparing the Swedish development of the rate of donors PMP to other countries between 2005 and 2010, Swedish rates were increasing, reaching a peak in 2008, but were still relatively low. Spain, which has the highest donation rate in the world, has a rate of around 35 donors PMP every year. Norway, a neighboring country with a relatively similar society and culture, has around 20 donors PMP annually, which is higher than the donor rate in Sweden of around 15 donors PMP annually (Tibell, Henriksson 2012). As Spain has the highest organ donation rate in the world Sweden's average deceased organ donation rate is 20 donors PMP lower than Spain. Considering the similar legislation and that Sweden has a larger share of population positive towards organ donation, this difference is unreasonably big. The difference is especially absurd if the three most important pillars to enable organ donation is considered. The three pillars of effective organ donation is to have a suitable, favorable legislation surrounding organ donation, a positive attitude among the population toward organ donation and an adequate organization that enable and handle organ donation (Tibell, Henriksson 2012).

As the first two pillars in Sweden is similar to Spain it is reasonable to investigate the reason of the low donation rate in Sweden, and as the donation rate varies greatly in Sweden it is important to first understand why it varies so much within Sweden before it is possible to understand the reason as to why there is such an incredibly big difference between Sweden and Spain in organ donation rates.

3.3 Attitudes toward organ donation in Sweden and the EU

Organ transplantation is dependent on three pillars, as mentioned earlier, one of them is the attitude of the population toward organ donation and transplantation (Tibell, Henriksson 2012). In surveys conducted by the European Commission that investigated the European attitude toward organ donation, the attitude in Sweden was persistently very positive (European Commission 2010, European Commission 2007). In a survey performed in 2006 Sweden had the highest amount of positive answers to the question asking if the respondent would be willing to become a donor after their death, 81% answered yes compared to the EU average of 56% (European Commission 2007). In 2009 the share of positive answers increased to 83%, again the highest share of positive answers of all European countries, the average EU being 55% as shown in table 2 (European Commission 2010).

Table 2. Would you be willing to donate one of your organs to an organ donation service immediately after your death? National surveys performed 2009.

Country	Percentage: Yes
Sweden	83%
Malta	77%
Belgium	72%
Finland	72%
Denmark	70%
France	66%
Netherlands	64%
Ireland	64%
Cyprus	63%
Luxemburg	62%
Slovenia	61%
United Kingdom	61%
Spain	60%
Portugal	55%
EU27	55%
Estonia	55%
Poland	53%
Hungary	53%
Lithuania	50%
Italy	49%
Slovakia	48%
Germany	47%
Czech Republic	45%
Greece	43%
Bulgaria	42%
Austria	39%
Romania	31%
Latvia	25%
Croatia	53%
Turkey	52%
Macedonia	26%

Source: European Commission (2010).

When asked about the willingness to donate a family member's organs Sweden has the highest share of positive answers in both surveys with 74% answering yes in 2006 and 73% in 2009. A large share of the Swedish population taking part of the two surveys had discussed organ donation with their family, resulting in the second highest share of respondents who had discussed the topic with their family. In 2006 66% had discussed the topic, and in 2009 62% had discussed it compared to the EU average of 40% (European Commission 2010, European Commission 2007). In one of the surveys one question was if the respondents were aware of the legislation in their country about organ transplants and organ donation. To this question 33% of the Swedish respondents answered yes, the seventh highest share of positive answers compared to other European countries with an EU average of 28% (European Commission 2010). These surveys are consistent with the attitudes in real cases of possible organ donation, as shown in table 3.

Table 3. Attitudes toward organ donation when the question has been brought up in possible cases in Sweden, year 2008-2013.

Year	Positive attitude toward donation: Presumed consent (%)	Negative attitude: Relatives veto or disagree (%)	Not possible to inform relatives (%)
2008	70	26	4
2009	63	36	1
2010	74	23	3
2011	71	26	3
2012	68	32	0
2013	73	24	3

Source: National Board of Health and Welfare (2014).

Comparing the attitudes in Sweden to the attitude toward organ donation in Spain, which has a substantially higher organ donation rate (Tibell, Henriksson 2012), the Swedish respondents have a larger share of positive answers than Spain. In response to the question if the respondent would be willing to become an organ donor after death 45% answered yes in 2006 and 40% answered yes in 2009 in Spain, which is close to the EU average. The same pattern was seen for Spain for the question if the respondent would be willing to let a deceased family member become an organ donor with 57% and 61% responding yes in 2006 and 2009, and if the respondent had discussed the topic with their family with 45% in 2006 and 40% in 2009 responding positively. The results for both questions were the same as or slightly higher than the EU average (European Commission 2010, European Commission 2007). The fact that Spain has a less positive attitude toward organ donation, but a higher rate of organ donations suggests that other factors are more important or that Spain utilizes those with positive attitudes more efficiently.

4. Literature review

In the literature review the starting point is to consider why people are willing to donate their organs as charity and what utility this might provide for them. This is followed by investigating what benefit there is to gain from performing organ transplantations, for which organ donations are essential. After these broader topics have been established, we continue by examining what institutions affect the organization of organ donation from an economic perspective by analyzing the market for organ donation and legislation concerning organ donation. After this setting for organ donation is established we go into further details by exploring what factors influence organ donation and what variables have been shown to be relevant in previous studies. Special attention is given to the importance of the organization and the infrastructure that enable organ transplantation as we consider this to be an important factor to why Sweden has low donation rates. The literature of the importance of the infrastructure surrounding organ donation and transplantation is then complemented by adding the notion of transaction costs and how the theory of transaction cost can help us to understand how the organization and the infrastructure surrounding organ donation can differ between areas and hospitals.

4.1 The act of giving

To fully understand organ donation it is important to understand why individuals are willing to give their organs to unknown individuals in need of an organ transplant. The model of impure altruism explains what utility individuals who donate their organs when they are deceased receive from registering as willing to become a deceased organ donor. To donate organs is an act of giving one's organs to unknown patients and can be viewed as a form of private charity (an individual's organs) given to a public good (the healthcare system).

A previously common approach when considering the motives for private giving to a public good was to assume that the individual preferences are purely altruistic, meaning that the individual who gives gain no utility from the actual act of giving and that the individual utility is a function of the total supply of the public good and the consumption of the private good combined. The model of pure altruism fails to confirm empirical observations of giving and charity. However, by modelling giving and charity as impure altruism the different reasons that giving occurs can be included, such as guilt, sympathy, an ethic for duty, a desire for fairness, or a desire for recognition (Andreoni 1988). This model of impure altruism fits with empirical observations (Andreoni 1989).

The model of impure altruism has two reasons for the act of giving to charity, firstly that there is more demand of the public good, altruism, and, secondly, that the individual gain utility form the actual act of giving, known as warm-glow giving. Since the second reason for giving is seemingly selfish the model is called impure altruism. In a model of impure altruism the giving by others to a public good is not a perfect substitute for giving yourself, as the act of giving provides additional individual utility added to the increase of the public good. This means that an individual gains more total utility if the individual donates to charity themselves rather than relying on other to be charitable for the public good (Andreoni 1989). The degree of how much a person is driven by altruistic preferences of warm glow preferences varies, where some individuals are purely altruistic and some individuals are purely egoistic. This means that if there is some sort of redistribution of income of wealth from less altruistic individuals to more altruistic individuals this would increase the total provision of a public good (Andreoni 1990). In an experiment made by Andreoni and Miller (2002) where there were several opportunities to share a surplus with another anonymous subject with varying degrees of cost of sharing and the surplus available to share, the authors found that about 25% of the subjects were selfish money-maximizers while the rest of the subjects showed varying degrees of altruism (Andreoni, Miller 2002).

The impure altruism model explains why organ donation occurs, modeling organ donation as private charity given to a public good. The next step is, therefore, to understand what the benefits of organ donation and transplantation are.

4.2 Benefits of organ donation

Economically there are several articles that show the societal and economic benefit of organ donation from deceased donors, it saves lives and increase life expectancy as well as lowers medical costs (Kessler, Roth 2014). However, most countries have long waiting lists for patients in need of organ transplantation and the demand for organs keep on increasing faster than the supply (Kessler, Roth 2014, Abadie, Gay 2006). The lack of organs is considered the biggest problem within organ transplantation procedures (Schnitzler et al. 2005). From a purely utilitarian perspective the shortage, more specifically the possible donors that do not become donors, represent a waste of resources as life-saving organs are not used for organ transplants, as they derive no utility from their organs once dead (Abadie, Gay 2006).

Schnitzler et al. (2005) investigated how many life-years that were gained from one additional deceased donor by estimating the extra life-years that all the different organ transplants resulting from a single donor leads to. The authors use data from the United States Scientific Registry of Transplant Recipients for the period 1995-2002, comparing life expectancy between those on waiting lists that are expected to receive an organ soon, which is not equal to the average life expectancy for the entire waiting list, and those who received an organ. A deceased donor could help up to seven people with one liver, one heart, one pancreas, two lungs and two kidneys, the lungs and kidneys being transplanted not in pairs, but to separate individuals. On average one deceased donor provides organs to 2.9 organ recipients, with the most common organ donated being kidney (81.1 % of donors donated a kidney), followed by liver (79.2%), heart (34.9%), kidney-pancreas (14.6%), lung (14.0%) and pancreas (8.9%). All organ transplantations except pancreas transplantations were found to have a significant positive effect on expected life-years, with a liver transplant increasing the expected life-years by 16.9 years compared to those who had not received a liver transplant. A heart transplant provided 14.5 additional life-years, kidney and pancreas gave 12.9 additional life-years, kidney transplant 7.2 life-years and lung transplant an additional 2.1 life-years on average. A deceased donor who gives all organs to a liver, a kidney, a heart, a kidney pancreas transplantation and two lung transplantations results in an additional 55.8 expected life-years for the recipients, and the average donor who helps 2.9 recipients results in 30.8 additional life-years in total. The age of the deceased donor is important for the expected life-years gained with the organs from deceased donors of age 40 and under resulting in the highest life-year gains while the additional life-years expected decrease with the age of the deceased donor. Organ transplants do not only provide additional life-years, but also significantly improve the quality of life for the recipients. Given this large positive impact of organ donation from deceased donors it would be beneficial for all possible deceased donors to donate organs but only 42% of suitable donors in the data set become donors. Schnitzler et al. (2005) account this to several different reasons, mentioning system problems, lack of identification and lack of consent. The authors find that their results suggest that it would be beneficial for patients on the waiting lists as well as society as a whole to increase the rate of deceased donors (Schnitzler et al. 2005).

In an evaluation of what impact a lung transplant has on the quality of life Anyanwu et al. (2001) uses the EuroQol questionnaire to compare patients who have had a lung transfer and the long term effect compared to patients waiting for a lung transplant. The questionnaire makes it possible to assign utility values to health related quality of life by dividing health into five dimensions; mobility, self-care, usual activities, pain and discomfort, and anxiety or depression. The respondent has three possible answering options for each dimension; that there is no problem, moderate problems or severe problems. Each dimension is given a utility value if there are moderate or severe problems. The answers for each dimension is then combined to provide an answer between one and zero, one being perfect health and zero being equal to being dead.

The questionnaire was answered from four out of seven lung transplant centers in the United Kingdom during six month in 1998. For patients on the waiting list the mean utility was 0.31, patients that had completed a single lung transplant had a utility of 0.61 three years after the transplant, bilateral lung transplant had a utility value of 0.82 and 0.87 for heart-lung transplants. This shows how quality of life improves with a lung transplant for a patient, a bilateral lung transplant having a larger positive effect than a single lung transplant (Anyanwu et al. 2001).

Further evaluating the benefits of organ transplants by using quality-adjusted life-years, QALYs, are used by Mendeloff et al. (2004) and Ouwens et al. (2003). A QALY is the quality-adjusted life-year, calculated by multiplying the expected life years with the utility score. This measure then takes into account both the length of a life and the quality of life (Ouwens et al. 2003). Mendeloff et al. (2004) estimate the economic benefits of organ transplantation by examining the average number of QALYs that result from the organs of a deceased donor, and the associated medical costs, to measure the benefits of organ donation and transplantation. Using data from the Organ Procurement and Transplantation Network in the United States from the 1990's the authors estimate patient survival rates for liver, heart and kidney transplants and compares this to patients on the waiting list that has not received an organ transplant. The authors use three different scenarios with a central estimation, as well as best and worst case estimates for the three types of organ transplant. In the central scenario the authors estimate an increase of about 13 QALYs at a cost of $16,000 per QALY from a typical donor. The worst case cost estimated to $57,000 per QALY and in some of the best case scenario estimates the cost is negative. The authors then use the central scenario result to estimate how much society should be willing to spend to increase the numbers of deceased donors. The societal benefits of organ donation from deceased donors for these three organs are dependent on what one more QALY is worth. Valuing a QALY $100,000 the benefit from one donor is $1.3 million while the costs are $214,000 implicating that society should be willing to spend over $1 million to obtain one more donor (Mendeloff et al. 2004).

Comparing the benefits of lung transplants to heart and liver transplants in the Netherlands, Ouwens et al. (2003) find that the utility from a lung transplant is higher than from a liver transplant and equal to a heart transplant. However, the life-years gained from transplantation for lung transplants patients is only slightly higher compared to patients without a transplant, only 4.4 expected additional life-years compared to heart, 8.8 life-years, and liver transplants, 14.7 life-years. The QALY gain is therefore lower for lung transplant, at 5.2 QALYs, compared to heart transplant, 6.8 QALYs, and liver transplant, 11.5 QALYs (Ouwens et al. 2003).

It is hard to compare an organ transplant to other possible treatments, except for kidney transplants which could be substituted with dialysis, as there are few alternatives. (Whiting et al. 2004) However, patients not undergoing a heart transplant can have other surgeries as part of a treatment (Mendeloff et al. 2004). Since there is an alternative treatment to kidney transplant in the form of dialysis there have been estimations on how the two treatments compare to each other. Whiting et al. (2004) uses a Markov model to estimate the net present value cost savings and additional QALYs from increased organ donation rates. Data from Canada is used to estimate the QALY for each treatment as well as the cost for each treatment. Transplantation has a 1.99 higher QALY than dialysis and a cost saving of CAD104,000 over a period of twenty years (Whiting et al. 2004). Even when the patient is non-adherent to the treatment after the kidney transplant the benefits of a kidney transplant is higher than dialysis, when considering the life-time costs, although adherent patients who have had a kidney transplant are the most cost saving as they live longer after the transplantation (Cleemput et al. 2004).

There are several papers that have shown that organ transplants are beneficial for the patients receiving it as well as for society as a whole. It is therefore desirable for society to optimize organ transplantations. In order to do this it is important to know how the organization of organ donations within a society functions and what characteristics the market of organ donation has.

4.3 The supply of organs

As the supply of organs is a big problem and a bottleneck for increasing organ transplantations, it is reasonable for economists to start by examining the market for organ donation. A first standard response would be to raise the price of the commodity, different organs, to increase the supply. At the moment the price is most often zero as organs are donated rather than sold and bought. Increasing the price of organs is unlikely as it is illegal in many countries to make any monetary transactions associated with organ transplantation (Kessler, Roth 2014). The laws against this kind of market are due to reasonably widespread repugnance among the population in a country, which establishes the constraint on buying and selling organs (Roth 2007).

Some markets become repugnant when money is involved in the transaction as opposed to gifts or in-kind exchanges according to Roth (2007). The different reasons as to why money can make a transaction repugnant can be divided into three concerns; 1: objectification, where an item becomes an impersonal object which they should not be; 2: coercion, that the transaction is coercive and leaves some people open for exploitation and that they need to be protected and 3: that the transaction could lead to a slippery slope leading to genuinely repugnant transactions. As to the possibility of an organ market different religions can object due to objectification reasons. Here Roth (2007) notes that the pope is against it while the Jewish consensus is that with regards to live kidney donation, under some circumstances, it could be allowable to offer and accept compensation. As to coercion, the compensation for a live kidney donation might allow the poor to be exploited, especially if the compensation is relatively high compared to other income. As for compensation for organs from deceased donors being repugnant is due to the slippery slope that might lead to the buying and selling of live organ donations. This reasoning comes from the black market of organs and fears that it would lead to the richest benefiting rather than a mutual benefit. Another concern is that monetary markets for organs might crowd out altruistic giving and harm other characteristics of the organ transplantation process as well as losing the intrinsic motivation. There are also concerns that a monetary market for organs might reduce the incidence of deceased donation, which supplies several organs and not only kidneys. While live organ donation, such as kidneys, taking place in a monetary market is repugnant, there is no general repugnance against kidney exchanges where the transaction is in-kind. A kidney exchange is where a patient has a willing live donor, which is not a match, and there is a pair in similar situation that are matched together and the transaction is made in kind, i.e. the pairs exchange kidneys from the living donors (Roth 2007).

One way to increase organ donation is to create non-monetary incentives. One such attempt has been done in Singapore and Israel, where a patient who has registered as a donor and later on comes to need an organ transplant receive priority on the waiting list. The policy is too recent to know what outcome it will have. Kessler and Roth (2014) attempted to examine the effect of the Israeli design in a behavioral experiment with a loop hole. The experiment has shown that the increase in numbers of organ donation and registration as an organ donor when there is a loop hole in the rules completely erased the benefit of the incentive of signing up as a donor compared to when there is no loop hole. In this experiment the loop hole leads to fewer donations in a priority system than in a first-come, first-served system where the donation is due to altruistic or warm glow reasons. Examining each round in the experiment more closely Kessler and Roth (2014) found that the effect is driven by a conditional cooperation motive. If the loop hole in the system makes it possible to not pay the cost of donation even though the person is registered as a donor others are less likely to donate if they know that some subjects are using the loop hole. In the experiment '… subjects treat taking the loop hole as a worse affront than simply not donating, presumably since those who take the loop whole are explicitly abusing a system designed to reward donors. Consequently, subjects withheld donation more in response to observing others use the loop hole than in response to observing others who choose not to donate' (Kessler, Roth 2014). It is too early to know the outcome of the new Israeli system with priority in waiting lists, but the experiments highlight the importance of how a priority is implemented and the possible effects on the organ market (Kessler, Roth 2014).

The imbalance between the demand and supply of organs available for organ transplantations is not possible to rectify by adjusting the price of organs. This is not possible as monetary compensation for organs are illegal due to widespread repugnance in the population. Incentives other than monetary compensation could possibly be viewed as acceptable, such as kidney exchanges or priority for patients on waiting lists for organs that have prior to their illness registered to become organ donors upon their death. However, it is important to consider the design of the alternative incentives given to register as a donor as the detail of policy might counteract other incentives to donate, such as altruism and warm glow. The legislation surrounding the organ market shows how important organ transplantation laws are, and like policies to increase donation, it can affect donation behavior.

4.4 Presumed consent

There are two different legal approaches toward organ donation, where the difference is in what the default choice is. One possibility is to have an opt-in law like the United States, where donors register their willingness to become donors. The other possible default option, which is common in Europe, is that there is presumed consent, i.e. an opt-out system and it is assumed that a possible donor is willing to become a donor unless it has registered, or communicated in another way, the wish to not become a donor. In hypothetical choice data studies, subjects are more likely to remain on a donor registry in an opt-out system than they are to register in an opt-in system. There are studies that show that countries in Europe that have a presumed consent law have higher donation rates (Kessler, Roth 2014). Abadie and Gay (2006) used panel data for 22 countries over ten years to investigate the impact of presumed consent laws. Using control variables the authors found that a presumed consent law increase organ donations from deceased patients by 25-30%. The authors argued that families making the organ donation decision for their deceased family member are influenced by the default option even if the legislation is not enforced (Abadie, Gay 2006). Ugur (2014) used a panel data set over ten years from the EU-27 countries and Croatia, to compare countries with and without presumed consent legislation. Controlling for other variables the effect of presumed consent was that it increased deceased donation with 28-32% compared to countries without presumed consent legislation (Ugur 2014).

However, the effect of presumed consent legislation is questioned. Rithalia et al. (2009) made a literature study and concluded that it cannot be inferred that introducing presumed consent legislation will lead to an increase in organ donation rates. The literature review consists of 26 studies; five comparisons before and after an introduction of presumed consent in a country, eight comparisons between with different legislation and thirteen surveys of public and professional attitudes to presumed consent. The authors argue that 'availability of potential donors, the underpinning infrastructure for transplantation, wealth and investment in healthcare, and underlying public attitudes may all have a role' (Rithalia et al. 2009).

Kessler and Roth (2014) also question the impact of presumed consent and the possible effects it could have in the United States. Especially since the only European country with more organ donors than the United States is Spain and there is an indication that the Spanish model and system of organ retrieval is the cause of the high recovery rates due to the efficiency of the organization in the transplant services. In addition to this argument it is not tenable to switch to a presumed legislation in the United States for legal reasons. Instead some states in the United States have changed their legislation form an opt-in system to a mandated choice, meaning that the states try to make as many citizens as possible to make a choice if they are willing to become donors or not. This has been done by individuals being asked about their willingness to donate their organs in the department of vehicles, as they get their driver's license, with yes or no as possible answers, a blank answer being interpreted as no. The mandated choice model is supported by hypothetical choice data which shows that subjects are more likely to report being willing to join a registry when asked within a mandated choice framework compared to an opt-in system. However, results from an experimental study on actual decisions showed that the mandated choice model may not increase organ donations. In fact, the organ donation decreased in a mandated choice model compared to an opt-in system. This was because many donors are not registered but the donation is approved by next of kin, and in a mandated choice model the next of kin is more likely to interpret an unregistered answer as no. Therefore the mandated choice model might make it harder to get permission from next of kin for unregistered possible donors. This becomes troublesome if taking consideration to historical data from the state of Massachusetts where over half of the unregistered potential donors become donors due to the permission from next of kin (Kessler, Roth 2014).

Transplantation laws have an effect on donation rates by altering the default choice if the possible donors have not taken an active stance to organ donation. Many papers have come to the conclusion that presumed consent legislation contributes to higher donation rates. The effect of presumed consent is generally accepted, but is still somewhat contested. The legislation is, however, not the only factor influencing donation rates. When comparing countries with presumed consent the donation rate can still vary greatly, for example Spain, which have a presumed consent legislation, has much higher donation rates than Sweden which also has a presumed consent legislation (Tibell, Henriksson 2012). As the interest of this paper is to compare donation rates within Sweden the legislation will be the same for all counties, making other factors rather than the organ donation legislation more relevant when investigating donation rates.

4.5 Factors influencing organ donation

When investigating whether presumed consent has an impact on deceased organ donation Abadie and Gay (2006) and Ugur (2014) included other variables as controls. The controls that are used and statistically significant at a 10% or 5% level by Abadie and Gay (2006) are log GDP per capita, log of health expenditures per capita, a variable showing if the legislative system is a common law system and a variable to capture the mortality rate from motor vehicle accidents and cerebro-vascular diseases. The one variable used to capture religious beliefs was a variable showing whether the country is catholic, and it was not statistically significant (Abadie, Gay 2006). Ugur (2014) also included variables of health spending and potential donors by including motor vehicle accidents and cerebro-vascular disease mortality combined with homicide rates, but these were in this pooled OLS regression statistically insignificant. The variable log of hospital beds per 100,000 people as a representation of medical infrastructure was also statistically insignificant. Trust in the system, measured by a corruption score, and religious beliefs, captured as the percentage of population that have no religion or being Roman Catholic, were statistically significant. The variable measuring the percentage of the population that have a higher educational attainment was significant though the gender matters as women with higher education are more likely to become deceased donors while men are less likely to (Ugur 2014).

In their literary review, Rithalia et al. (2009) summarized the factors except presumed consent that factors into organ donation rates. In the four studies that the authors found to be of good quality investigating the effect of presumed consent across different countries the variable for mortality in traffic accidents showed a significant association with donation rates, which is reasonable as it attempts to capture, to some extent, the availability of potential donors. In an effort to capture the effect of wealth and health expenditure on donation rates measures of per capita wealth and expenditures were included and were found to be significant. The only religion included in some of the studies where Catholicism which was a significant variable in some studies, but not all. In the studies including common law as a legal system, where the right for the individual is more in focus compared to civil law, common law was associated with a significant positive effect (Rithalia et al. 2009).

Other variables encountered in individual studies reviewed by Rithalia et al. (2009) were the influence of blood donation rates and the availability of information, with internet access as a proxy, both had some influence on donation rates (Rithalia et al. 2009). The impact of media on donation rates has been investigated further in other papers. In a study from the Murcia region in Spain, Conesa et.al (2004) found that television had the greatest impact, followed by press and radio, thirdly magazines and talking to friends and family, followed by posters and information campaigns and lastly information provided by health professionals. However, the opinion on donation among the respondents was more favorable when the information had come from health professionals in a specialized meeting or individually (Conesa et al. 2004). In a study done by Quick et.al (2007) a content analysis was done for three networks in the United States for the period 1990-2005 that showed an overall positive association between coverage and transplantation rates (Quick et al. 2007). Another plausible influence of organ donation is the efficiency, extent and coordination of organ transplants in a country. In one study evaluated by Rithalia et al. (2009) this was somewhat included by transplant capacity defined as the number of transplant centers PMP, which had an influence when accounted for (Rithalia et al. 2009).

In a survey conducted by the EU Commission in 2009 there were significant relationships between the willingness to donate organs after death with occupation and level of education. Respondents with a higher education were more willing to become an organ donor. Comparing individuals with managerial jobs to unemployed or those looking after the home, those with managerial jobs are more likely to be willing to become an organ donor. As those in managerial positions were more likely to have higher education, the two variables intertwine but the key variable was the level of education. The level of education was also important as to whether or not the respondent had discussed organ donation with their family, a higher level of education implying a higher probability of having discussed the topic with family. The same association between higher education and willingness to donate the organs of a deceased family member was true (European Commission 2010).

In a small study in the southeast of the United States, Rodruige et al. (2005) investigated what characteristics of the family member deciding on organ donation for a deceased relative have an influence. Including controls for the characteristics of the deceased, the significant variables were the age of the deceased, if the deceased had been employed, marital status of the possible donor, the deceased's own attitude toward organ donation and if there had been a discussion about organ donation. The decision of the deceased patient's family depended on the kind of relationship it had to the deceased, for example if the next of kin was a parent, sibling or spouse, the own attitude toward organ donation and whether or not the family member fully understood the concept of brain death. It was also important by whom the family was approached about the possibility of the deceased becoming a donor, and if that person came across as compassionate (Rodrigue, Cornell & Howard 2006).

In addition to the topics so far described above, one important factor influencing donation rates that has been mentioned as important is the organization of organ transplants. A well-functioning organization and administration of organ transplantations is one of the three pillars for efficient organ transplantation and to increase donation rates.

4.6 Organization of organ transplantation

When comparing the donation rates in different countries, Spain has the highest donation rate PMP and during a ten year period starting in the early 1990's the numbers of donors PMP per year increased from 14 to 34 (Miranda, Vilardell & Grinyó 2003). The Spanish national organ transplant organization for procuring organs is considered the most efficient, known as the Spanish Model with three important features. Firstly that there is a system of independent transplantation teams that request consent from families of potential donors, meaning that the burden of organ procurement was taken away from transplant surgeons and treating physicians. Secondly, hospitals receive reimbursements to compensate them from the procurement costs from a hospital reimbursement policy. Lastly there is a multi-layered network that coordinates and manages procurement activities on national, regional and hospital level (Abadie, Gay 2006).

The features of the Spanish Model are found in other countries. When looking at transplantation in Canada Whiting et al. (2004) argued that transplantation procurement in Canada was underfunded and that a national federal program to promote and oversee organ retrieval was needed, and that there were disincentives for hospitals financially to handle the procurement or organ transplants. There was also no reimbursement or infrastructure that helped identifying donors and procuring organs (Whiting et al. 2004). Gill et al. (2008) supported these ideas, when investigating the low donation rate in Canada, as they believed that the, then new, national overseeing body had the potential to substantially improve the situation. The new national body was believed by the authors to improve the donation rate by increasing the structure around organ transplant production and formalizing it, as well as having new reimbursement models (Gill et al. 2008).

The Spanish model was implemented at the beginning of the 1990's and is still in place. In addition to their model, Spain has a presumed consent legislation and at the start of the millennium the refusal rate was around 20% (Miranda, Vilardell & Grinyó 2003), but has been lowered to around 15% ten years later (Deffains, Mercier Ythier 2010). To motivate and make the staff accountable there are staff at all hospitals, usually ICU specialists, that has the procurement of organs and to increase organ donation as their main objective and are by law responsible for the donation and retrieval process. As a quality control registry of ICU deaths and a brain death registry has been created. National and regional offices support the organ and transplant programs by managing waiting lists, arrange organ or team shifts and are responsible for all official statistics. They are also responsible for public education about organ donation and transplantation, are involved in training and research and any activity that can facilitate organ donation and transplantation can be promoted through the network of offices. The system change that lead to the new Spanish Model resulted in more possible donors referred, mainly by increasing the number of older possible donors (Miranda, Vilardell & Grinyó 2003).

Presumed Consent legislation is often used as an explanatory factor as to why different countries have different rates of organ donation, but countries with similar legislation can have different donation rates, while countries with opposite legal system can have similar donation rates. An estimated 3% of all patients dying in hospitals have the potential to become organ donors and the rate of donation in a country is dependent on the efficiency of converting possible donors to actual donors and the participation of hospitals in organ retrieval activities. There is recent research that points out the importance of organizational aspects of organ donation for the donation rates, it is even pointed out as the most influential factor (Deffains, Mercier Ythier 2010).

Deffain and Ythier (2010) claimed that economic analysis lack a model of efficient allocation of deceased organ transplants and therefore tries to rectify this by creating a model. This model characterizes the organization of the transplant care system as a

> '… production economy of the non-market sector operating on the background of incomplete markets of inputs. The collection and circulation of [organ] transplants by the transplant agency induce public good interactions between hospitals. […] Production optimum is attained by eliminating the public good interactions between hospitals through the optimal control of both the distribution and the production of transplant inputs by the agency' (Deffains, Mercier Ythier 2010).

The data used with this model by Deffain and Ythier (2010) suggested that more than half of the difference between Spain and other countries' donation rates were due to differences in the managing of the public good problem their model describes. Spain manages this better than other countries with their national transplant organization and enjoyed a higher donation rate as a result. The authors therefore suggested that the most efficient and what should be the primary way to improve donation rates was to improve the coordination between hospitals' production of transplants, followed by lowering donation refusal rates (Deffains, Mercier Ythier 2010).

That the organization of organ donation and transplantation is important is shown by Deffain and Ythier (2010). How smoothly cooperation between organizations, such as different hospitals cooperating on organ donation and transplantation, depends on what terms the cooperation is built. The cooperation needed between hospitals for organ donation and transplant activities can be described as a transaction between two parties and the theory of transaction costs could help to shed light over possible barriers there are for hospitals to cooperate.

4.7 Transaction costs

To better understand the process of organ donation and transplantation it is important to understand how different hospitals cooperate and what possible barriers there could be. To better understand the interaction of two cooperating organizations the theory of transaction costs is used to explain what could make cooperation harder between two separate entities and how the structure surrounding the cooperation process is affected by the attributes of the transaction.

A transaction is an exchange of a good or a service which takes place between two parties in a technically separable interface. In a well-functioning interface the transaction runs smoothly. However, if there is some sort of friction in the transaction that makes the transaction difficult it is referred to as a transaction cost. Examples of transaction costs that make a transaction difficult are frequent misunderstandings and conflicts that lead to delays, breakdowns or any type of malfunction (Williamson 1981). If a transaction cost is low, the purchase of the goods or services will be more cost effective than producing it within their own organization. Generally there are three different kinds of transactions; non-specific transactions where the goods or services are standardized, highly specific transaction where the goods or services are tailored for the specific needs of the buyer in the transaction, and semi-specific which are between non-specific and highly specific. Depending on the transaction type the governance structure which surrounds the transaction differs. If the transaction is non-specific and the goods or services are standardized the transaction does not need a specialized governance structure. A governance structure is defined as '… the institutional framework within which the integrity of a transaction is decided' by Williamson (1979). Two central alternatives for governance structures are markets and hierarchies. For a specialized governance structure to occur there need to be recurrent transactions. Occasional transactions of a non-standardized kind will not support a specialized governance structure, but will require special attention (Williamson 1979).

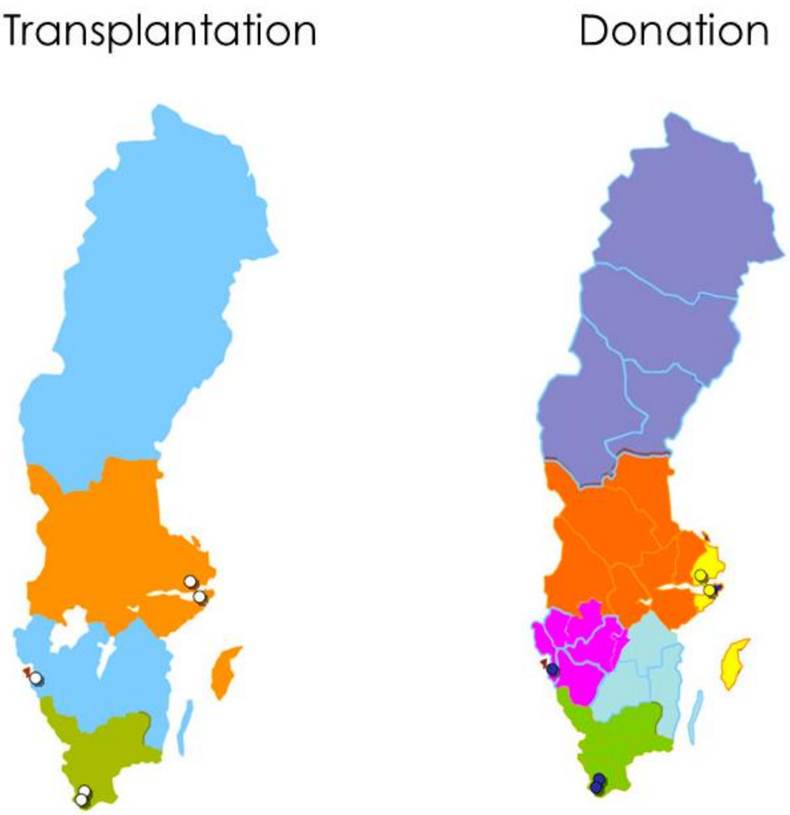
The transaction costs are of importance to any transaction taking place, such as the procurement of an organ donor in a hospital, which then sends the organs donated to another hospital where they are transplanted. The transaction costs will be lower for a hospital which regularly performs this compared to a hospital which seldom procure a deceased organ donor. This means that the hospital with reoccurring organ transactions can sustain a specialized governance while hospitals with irregular organ transactions have to perform the transaction with additional attention. The increased transaction costs in some hospitals could possibly make the organ transaction as costly for the hospital procuring the organ donation that it does not make the effort to initiate the organ transaction. It could also be the case that the additional attention required to make the organ transaction is not available and the transaction is not initiated as a consequence of this.

5. Organ transplantation in Sweden

Healthcare is provided by each county (län) for its citizens and are responsible for making quality healthcare available for all its citizens. There are 21 different counties each responsible for healthcare and to organize it (Government Offices of Sweden 2015). In addition to the 21 healthcare counties there are six healthcare cooperation areas (Gillving 2015), these areas have been formed to coordinate more advanced and specialized care between counties and to make sure that the need of specialized care is meet (Jedlert 2013, Landstinget i Uppsala län no date, Eriksson 2015, Norrlandstingens regionsförbund no datea). The southern healthcare cooperation area is made up by Skåne, Blekinge, Kronoberg and the southern part of Halland (Halmstad, Laholm and Hylte) (Jedlert 2015). The western healthcare cooperation area is the northern part of Halland and Västra Götaland region (Gillving 2015). The southeast healthcare cooperation area is Kalmar, Jönköping region and Östergötland region (Eriksson 2015), Stockholm collaborates with Gotland (Samverkansnämnden Stockholm - Gotland no date), the healthcare cooperation area of Uppsala-Örebro comprises Uppsala, Örebro, Gävleborg, Dalarna, Sörmland, Västmanland and Värmland (Landstinget i Uppsala län no date). The northern cooperation area consists of Jämtland-Härjedalen region, Västernorrland, Västerbotten and Norrbotten (Norrlandstingens regionsförbund no dateb).

Each healthcare cooperation area collaborate in organ donation issues and coordination and there are doctors and nurses that have a regional responsibility for organ donation in each healthcare cooperation area. In each healthcare cooperation area there is one hospital capable of neurosurgery, resulting in that patients may receive care in another county. Most organ donors come from patients with serious head trauma, who are often treated at the more specialized hospitals. Therefore it is may be more relevant to compare donation rates on a healthcare regional level rather than county level (National Board of Health and Welfare 2014, June). Organ transplantation, however, is organized in three areas with their own catchment area. Sahlgrenska hospital in Gothenburg has the west healthcare cooperation area, the southeast healthcare cooperation area and the north healthcare cooperation area as their catchment area. The southern region has their transplantation operations in two university hospitals in Malmö and Lund. The last catchment area is OFO Mellansverige which consists of Stockholm-Gotland and Uppsala-Örebro cooperation areas, with Karolinska hospital in Stockholm cooperating with Uppsala University Hospital. The three transplantation cooperation areas and the responding catchment area can be seen in figure 1. Transplantation area Sahlgrenska is the blue area in the transplantation map, the southern transplantation area is the green, and OFO Mellansverige is shown in orange. In the Donation map the southern healthcare cooperation area is green, the southeast area blue, western area pink, Uppsala-Örebro area orange, Stockholm-Gotland area yellow, and the northern area is purple (Council of Organ and Tissue Donation no date).

Figure 1. Swedish organ transplantation areas and healthcare and donation cooperation areas.



Source: National Board of Health and Welfare (2014).

The organization of waiting lists in Sweden has been criticized, and comparisons have been made with regards to how patients in different transplant areas waiting for a kidney are treated and how long the waiting time is. The reason for this is that there are different waiting lists, and the four hospitals that perform organ transplantation have their own waiting lists instead of a common national waiting list (Omar et al. 2014, Lille 2015, Larsson 2015). When assessing patients' needs for a kidney transplant each transplant unit have their own criteria and procedures. The transplant areas also transplant the kidneys donated in their area for patients in their area on their waiting lists, with few exceptions (Omar et al. 2014). For kidney patients there are different waiting lists for patients with different blood types and other possible factors, which affect how long a patient has to wait for a kidney transplant. It also depends on in which transplant area the patient lives, since in some healthcare regions there are higher donation rates than in others. In 2013 the length of the period on the waiting list differed a year between the fastest and slowest transplantation area (Lille 2015). The healthcare regions which work with Sahlgrenska Hospital are regions with lower donation rates, making the time on a waiting list there longer (Larsson 2015). Having national guide lines in how to asses a patient’s need and to have national waiting lists would contribute in making the risk of unjust differences between different transplant areas and the time patients have to wait for a transplant (Omar et al. 2014).

6. Framework

In their paper Abadie and Gay (2006) create a simple model of presumed consent in the context of organ donations, where they come to the conclusion that presumed consent laws may result in higher consent and donation rates even if registration costs are low in countries with informed consent. As Sweden has the same legislative regime over the whole of the country, this cannot be the reason for the differences in organ donation rates between regions as previously described. Instead we propose that the organizational differences between the regions could lead to additional transaction costs, especially in cases where the areas cooperating are disseminated or there is a lack of a transplantation hospital in the county. While our intent is not to develop a full model of the transaction costs, we describe the logic.

Following a similar logic as Abadie and Gay (2006), we reason that each patient that dies are deemed, by the doctor, to have a probability of being able to donate their organs. Rationally, a doctor acting as an agent for either the hospital, or the people who need organs, would further look into if the person could actually donate their organs if the cost for the hospital is smaller than the utility derived from the organs multiplied with the probability. If we assume that the organization has an impact on the cost, it follows that the organization must have an impact on the likelihood of a doctor initiating the procedures for determining whether a deceased person is a possible donor. This increased threshold causes potential donors to be overlooked, leading to a lower donor rate. While these costs can be general transaction costs related, for example costs related to the distance or communication problems between cooperation areas, Deffain and Ythier (2010) developed a model over the market of organ transplantations in Spain and found that the national agency in charge of coordinating transplantation activities optimized the distribution and production of transplant inputs. This finding suggests that less unified organizational structures in public good interactions are detrimental to donation rates in this case.

Due to other factors also influencing the probability of a deceased person becoming a donor, it is not reasonable to assume that the probability distribution for the population of deceased people having the potential to become a donor being the same for each county. However, our intention is to control for other effects, and investigate if there is a negative effect for having a disseminated organization in relation to donor rates.

7. Research Question

As described earlier, the three main factors contributing to creating a setting which facilitates a larger number of organ donations are; a population with a positive attitude toward organ donations, a satisfactory legal framework and a competent and sufficiently funded organization in the healthcare sector. As shown earlier, Sweden has both the population with the highest share of the population with a positive attitude toward organ donations in Europe, as well as presumed consent legislation, meaning that at least two of these factors should be favorable for organ donations. Regardless, the average rate of organ donations from deceased donors remains at a low level each year in Sweden, with some regions heavily underperforming (See Table 1).

In this study, our intention is to explain the differences in the rate of deceased organ donors between the Swedish counties. As the legal framework does not differ between these regions and Sweden being a relatively homogenous nation and having the highest share of people positive to donating their organs, we believe that the differences in attitudes do not seem to be the main cause of the large differences between regions. Instead we will try to examine the effects caused by additional transaction costs for counties that do not have the necessary medical infrastructure, such as hospitals that cannot care for people with certain types of injuries or perform transplantations, and differing organizational structures.

As donors need to have been established brain dead, it is natural to assume that many of the donors are a result of head injuries, or diseases. While donors can originate from any intensive care unit, it would be expected that a larger share of donors come from the units that are specialized in brain damages. Sweden has six of these specialized units, the neurosurgery units, and each healthcare cooperation area has one. A neurosurgery unit should lead to two main effects, a concentration of dying people suited for donations at these locations as well as a concentration of concentration and experience with the procedures required to prepare a person for becoming a deceased donor. We thus expect that the counties where these reside have a higher rate of deceased donors than a comparable one without one of these units, and is thus necessary to explore to understand the other effects of the regional distribution of donors. This leads to our first hypothesis.

Hypothesis 1: Counties with a neurosurgery unit have a higher rate of deceased organ donors.

As in the case with the hospitals that have a neurosurgery unit, hospitals that are able to perform transplantations do not exist in every county, instead there are three transplantation cooperation areas, with four hospitals able to perform these procedures. As some of these transplantations coordination areas are larger than the normal healthcare cooperation areas, practices may vary more than between the counties of the healthcare cooperation areas. The four counties where transplantation hospitals reside could reasonably be assumed to have the best communication with the transplantation hospitals. Therefore, we believe that these counties should have a relative advantage, with less transaction costs to ensure that proper procedures are followed due to the cross-county border interaction is removed, and resulting in a higher number of deceased donors. This is our second hypothesis:

Hypothesis 2: Counties with hospitals that are able to transplant organs have higher rates of deceased organ donors.

While a large number of other factors might affect the rate of donors, which we control for as far as possible, we believe that a large part of the variation in the organ donation rate between counties is a result of differences in the counties' healthcare organizations. The variation could be a result of the public good interaction resulting in a failed market in the transplantation regions with a lack of coordination, perhaps due to regional dissemination. However, these differences in procedures and practices in each organization are hard to quantify, while differences in the rates of organ donors might still show up. Therefore we investigate the effects of organizational time-invariant variables and therefore our last hypothesis is:

Hypothesis 3: There should be a significant difference between the different healthcare cooperation areas and transplantation coordination areas in organ donation rates after controlling for non-organizational effects.

In essence, the intent of this study is to explore the factors that are not related to attitudes, legislation, nor demographics to see what effect transplantation organization and infrastructure has.

8. Empirical Method

In this section we describe the empirical method used to explore whether the organizational effects, and transaction costs, are one of the core reasons for the differing organ donor rates between counties in Sweden.

The model applied is similar to Abadie and Gay's (2006) model that they used to assess the impact of presumed consent legislation on organ donor rates. As in their case, many of our variables are time-invariant; the cooperation regions, both the transplantation and healthcare regions, have not changed during the time-period investigated. This is similar to their case of having only one change over their sample of countries. To properly estimate any effects of these regions need to use a model that allows us to estimate the effect the counties and regions have, even if they are time-invariant. This means that a fixed-effect regression model is not able to satisfy our requirements.

As in Abadie and Gay (2006), we therefore intend to use the panel data compiled in a pooled OLS model, which allows us to estimate an effect of these time-invariant variables, although with the risk of resulting in inconsistent estimates if there are specific effects for each region we cannot take into account. To account for this deficiency, we use the same approach as they did, comparing the pooled OLS estimates to a fixed effects model which does not estimate the time-invariant variables, but instead averages out the effect of each individual county, resulting in more consistent, but less efficiently than a well-specified model. Therefore it is highly important for us to specify the model in a manner where any inconsistencies does not lead to uninterpretable results.

To specify the model properly, we need to take into account all possible effects that cause the differences between the counties. The previously mentioned factors that are a prerequisite for a high number of donors is our starting point for building the regression model; legislation supporting organ donation, a population with a positive attitude toward organ donation and a properly funded and set up organization. In addition to these factors, the demographics of each county are taken into account, to not penalize for example a county with a younger population on average, which results in fewer deaths.

Hence, we set up the model as:

$$DonorsPerMilion = \alpha + \beta_1 * Organization_i + \beta_2 * demographics_{i,t} + \beta_3 * behavior_{i,t} + e_{i,t}$$

Where our dependent variable is the number of donators PMP, which is commonly used when comparing donation rates across nations (Rithalia et al. 2009). As explanatory variables we have three vectors of regressors. The first vector includes the regressors related to the organizational structures. These regressors are the time-invariant dummy variables for each healthcare cooperation region and transplantation region, as well as dummies for the existence of a neurosurgery unit and a transplantation hospital in the county. The second vector includes the demographic variables, these include the average age, average age of the deceased, the number of cerebro-vascular deaths and traffic accident deaths. These are variables which are not decided by the population nor the organizational structures of the healthcare sector, but are still likely to affect the rates of donation. Thirdly, we have the behavioral variables. As there are no regional studies for the attitudes to organ donation within Sweden, we instead use variables for which there is evidence that they are correlated with a positive attitude to organ donation. For this we use education as well as a political index measuring progressiveness of the parties that where voted into the national parliament in each region. If it is the case that these variables explain a large part of the rates of donation, a well-specified model can be achieved, and the effects can be interpreted. In relation to our framework, our model has a possible drawback, which is that we do not identify the donors that were overlooked. However, as such data must be collected manually from medical records, and even then it is unreliable, it would be beyond the scope of our work.

The test used to ensure the consistency of the model is a simple Hausman test for every model specification. The estimates of the pooled OLS model is compared to the estimates of a fixed effects model without the time-invariant model is compared, and if they are jointly significantly different, it would suggest that our pooled OLS estimates are inconsistent (Hausman 1978). Due to many variables of interest being time-invariant, we rely on specifying the model in such manner that the model is consistent. For additional robustness, each specification is also run with a restricted sample on the number of donors per death at each ICU. This independent variable is slightly less sensitive to demographics, but the direction and impact of other estimates should not be severely affected. Otherwise that would suggest a flawed model, or perhaps highly inconsistent criteria for ending up in an ICU in different regions.

9. Data

In this section we describe the data set and the variables we are using in our model. The data set spans from year 2008 to 2013, with all of the 21 Swedish counties being included.

Perhaps the most important variables we are using are the number of actual donators in each county from the Possible Donator Reports from the Swedish National Board of Health and Welfare. Together with the population statistics from Statistics Sweden, these two variables will be used to create our main dependent variable; donors per million population, which is used to compare the rate of organ donation between the counties (Statistics Sweden 2015d). Additionally, the possible donor reports provides us with information about the number of deaths at each ICU, however only to 2012, resulting in us being able to use the number of donors per ICU death as a point of comparison and a robustness check. In the regression the number of donors and the population variables will be used in conjunction as the logarithm of donors per million population, named Log(dpm) (National Board of Health and Welfare 2014, June, The National Board of Health and Welfare 2011, The National Board of Health and Welfare 2012, Donationsrådet 2009, Donationsrådet 2010, The National Board of Health and Welfare 2013).

To make sure that our model yields us with good results we use demographic statistics from Statistics Sweden. This was done to ensure comparability between the regions, as demographical differences could have an effect on the rate of donation, for example the quality of organs fall with age. The two variables we use from statistics Sweden are the number of people in age cohorts of 5-years within each county, as well as the number of people who have died in each of these 5-year cohorts. We in turn average out these to create our explanatory variables for demographics. These are added into the model as Average Age and Average Age of Deceased (Statistics Sweden 2015a, Statistics Sweden 2015c).

As the causes of death might vary between counties, we include the number of people dying from cerebro-vascular diseases, data which has been collected from the National Board of Health and Welfare, and the number of people dying in traffic accidents, data which has been collected from Transport Analysis. Both of these have been previously proven significant in models of rates of deceased donation (Abadie, Gay 2006). However, considering the broader literature, cerebro-vascular disease deaths have an ambiguous effect on the donation rate, while the number of traffic fatalities is a consistently significant predictor of higher rates of donation (Rithalia et al. 2009). Both of these variables are normalized with regards to the population of each county. The regression results show these variables as CVD deaths Per Pop, Traffic Deaths Per Pop, and CVD+Traffic Deaths Per Pop, and are per 1000 population (The National Board of Health and Welfare 2015, Transport Analysis 2009, Transport Analysis 2010, Transport Analysis 2011, Transport Analysis 2012, Transport Analysis 2013, Transport Analysis 2014).

The gross regional product per capita is also included in our model, with the data being gathered from Statistics Sweden. While we believe that the impact is more significant between countries, due to the likelihood of national guidelines impacting healthcare spending and structure, it is important to take into account that the productivity of the counties differ significantly. While there is doubt if any effect is present in our context, there are some indications that it does have a positive impact in cross-country comparisons, and could possibly have the same effect on regions (Rithalia et al. 2009). This variable is simply called Gross Regional Product in the results, and is based on 2008 fixed prices (Statistics Sweden 2014).

Eurobarometer surveys have shown a significant correlation between education and a positive attitude toward organ donation within Europe, there is no explicit evidence that the same relationship holds in Sweden. However, as there is a lack of regional studies of attitudes toward organ donation in Sweden, we include the average educational level in Sweden. It is possible that more educated people are better at communicating their preferences, as well as having a better understanding of what brain death entails, we believe that is include education (Rodrigue, Cornell & Howard 2006). With data from Statistics Sweden, we group the educational achievements into four levels, non-completion of upper secondary school, completion of upper secondary school, completion of three years of post-upper secondary school and five years of post-upper secondary school education. We call this variable Average Educational Level (Statistics Sweden 2015b).

Due to the previously mentioned non-existence of studies on regional attitudes, we include an experimental Progressive-Conservative index. This includes data on voting patterns from the Election Authority in the 2006 and 2010 parliamentary elections within each county and the election compass from Aftonbladet. The election compass being a survey of the Swedish Parties' representatives, asking them about policies and classifying their answers as economically right or leftwing, as well as progressive or conservative. The parties are then assigned a score of +100 to -100 in each dimension based on the answers (Aftonbladet 2014). The number of each vote is then weighted by the parties' progressiveness on the election compass and then the average value for the region is calculated. It has previously been shown that there is some evidence that people with socially conservative opinions are more repulsed by markets for kidneys, while this is not exactly analogous to the general organ donation case, it is possible that a similar, but probably smaller, relationship exists to the organ donation case (Leider, Roth 2010). Similarly to this, data on religion is included in many studies to include a proxy for attitudes. This variable is called Election Index (Rithalia et al. 2009, Aftonbladet 2014, Election Authority 2006, Election Authority 2010).

For the organizational aspect we include a wide array of dummies in our data set which we create based on the location of transplantation hospitals and neurosurgery units, transplantation coordination areas and donor regions. The existence of a hospital able to perform transplantations in the region should lead to a smaller organizational distance and less transaction costs for the ICUs in the same region, hence it could lead to higher rates of organ donation. Neurosurgery units often take care of severe head injuries and as most regions do not have one, people with severe head injuries are often transferred over to these ICUs. As organ donation is only possible when a person has been deemed dead from brain death, these counties should be likely to have a higher organ donation rate. The donor regions are named Area and their respective name of the region, and the transplantation coordination regions are called Transplantation with the name of the region following (National Board of Health and Welfare 2014, June).

As there are three separate transplantation coordination areas in Sweden, and a highly varying rate of donation between the counties, one should expect that differences show up even when accounting for the other variables in these dummies. The varying degree of dissemination of the transplantation coordination areas should contribute partly to this, with regions with a smaller number of areas to coordinate as well as those which are less spread having an advantage, leading to a higher rate of deceased donators (National Board of Health and Welfare 2014, June).

Due to some problems with the data set, all observations will not be possible to use. In total we are using 116 observations, after dropping 12 observations. Halland County is dropped due to there being inconsistency in the data presentation, as the county is divided with parts of it belonging to one region and the other to another region, while still being presented as a single unit up to 2011. The rest of the dropped observations are dropped due to the data being censored, with some ICUs not reporting on the number of actual donors. Comparing our data set we find that around 3% of the donations are missing compared to the Scandiatransplant statistics for the whole country in the three first years, until all ICUs started reporting data. This should not be a large point of concern, as the data missing seems to be mainly from the hospitals which have not performed more than one organ donation (Scandiatransplant 2009, Scandiatransplant 2010, Scandiatransplant 2011, Scandiatransplant 2012, Scandiatransplant 2013, Scandiatransplant 2014).

10. Results

In this section we intend to simply present the result, while the following analysis section will put the results into the context of our framework and research questions.

10.1 Descriptive statistics

Starting out with examining the means of the time-variant variables will give us a general idea of the differences between the counties in Sweden. We examine the total sample, as well as the differences between counties with and without transplantation hospitals, as that should be the most clear cut example of an organizational advantage. The mean of each variable for each group is presented in table 4, with standard errors in parenthesis, as well as the difference between counties with a transplantation hospital and the counties that do not have a transplantation hospital and the p-value of the differences to show whether or not the differences are statistically significant.

First off we observe that the mean of donors PMP is 15 in our sample of the whole country. One thing to notice is that it is not the actual rate of donors for the whole country, as it is simply an average of the rate of each individual county, not taking into account the population differences. As expected, the counties with transplantation hospitals have a significantly higher number of donors per million, these four counties have an average rate of 20.5 donors PMP, compared to the counties without transplantation hospitals with an average rate of 13.6 donors PMP. However, this does not tell us whether transplantation hospitals are the cause for these differences. We also see that each of the transplantation hospital counties have a neurosurgery unit, while only 13%, or two, of the non-transplantation hospital counties have a neurosurgery unit.

Examining the other variables we believe we can explain some of the differences. The sample of people dying in the counties is slightly different between those who have and do not have a transplantation hospital. More people in the non-transplantation hospital areas die in traffic accidents, and the proportion of the population dying from either cerebro-vascular causes or traffic accidents is also higher. The traffic accidents are likely to be explained by the fact that the density of the regions differs significantly, as the areas with transplantation hospitals are more urbanized meaning that it is likely that a traffic accident victim will receive care faster as the distances to a hospital is shorter. The areas with transplantation hospital regions are about six times more densely populated, which should facilitate access to hospitals and ensure that the right procedures are done in a timely manner to prepare for organ donation. It might also be that a more densely populated area have more specialized care as there is a larger population in the area. This is because with a larger population specialized healthcare is possible to provide without too high costs as the need for specialized care is larger in a larger population.

The demographic variables, average age and average age of deceased, show little evidence for any large differences between the two groups. While the means are slightly lower for both average age and the average age of death in the group with transplantation hospitals, they are not significantly different. This points toward differences in demographics being a large contributor to the differences in organ donor rates. The average education differs slightly, with areas with a transplantation hospital having a higher average education, but the difference for areas that do and don not have transplantation hospitals is not significant.

Counties with a transplantation hospital appears to be slightly more productive by having a significantly higher gross regional product per capita. However, the population do not seem have significantly higher education on average, so the higher gross regional product does not seem to be because of differences in average education. Therefore, a more well-funded organization healthcare system could possibly be one of the causes of the slightly higher donation rates of the transplantation hospital counties. The other behavioral explanatory variable, the Progressive-Conservative political index, shows practically no difference with a p-value extremely close to one. This suggests that values are not that different in different parts of the country, and provides additional evidence that Sweden is in fact quite homogenous.

Table 4. Descriptive statistics from the data set compiled. Year 2008-2013.

Transplantation Hospital	**(0) 92 observations**	**(1) 24 observations**	**Total, 116 observations**	**Difference (1-0)**	**p-value**
Donors PMP	13.61 (10.9507)	20.46 (12.3347)	15.03 (11.5367)	6.85	0.0000
Traffic Deaths Per 1000 Pop	43.27 (17.6328)	29.16 (11.1969)	40.35 (17.4381)	-14.12	0.0000
Average Educational Level	1.86 (0.06651)	2.10 (0.10879)	1.91 (0.12139)	0.23	0.4396
Average Age of Deceased	16.59 (0.11603)	16.48 (0.09284)	16.56 (0.11994)	-0.11	0.8948
Average Age	9.02 (0.18079)	8.53 (0.16486)	8.92 (0.26893)	-0.50	0.4080
Election Index	2.32 (0.356)	2.38 (0.439)	2.33 (0.373)	0.066	0.9838
Neurosurgery	0.13 (0.33863)	1.00 (0)	0.31 (0.46464)	0.87	0.0000
Density	23.81 (16.33222)	134.63 (111.304)	46.74 (68.7152)	110.83	0.0000
Gross Regional Product / Capita	314.14 (24.6163)	348.39 (83.2331)	328.67 (51.7877)	70.25	0.0000

10.2 Regression results

To present the regression results we will follow the structure outlined in the empirical method section. The first regressions (1) and (2) simply contain our time-invariant dummy variables containing the information about the counties and their organizational structure. In regression (3)-(5), we add variables describing the sample of traffic accidents and deaths from cerebro-vascular diseases. Regressions (6) and (7) contain additional information about the demographics and the gross regional product. In the last regressions, (8)-(11), we add variables trying to explain any possible behavioral differences between the counties. In order to describe the results we first consider the validity of the time-variant and consistency of our model, then continue on to consider the time-invariant variables, which are of our main interest in this study. The estimates for the time-variant coefficients are shown in table 5 while the estimates for the time-invariant coefficients are shown in table 6.

To interpret the results in table 6, the baseline of the regression is Gotland in the OFO Mellansverige transplantation coordination area, this ensures that we have results for all transplantation areas and healthcare cooperation areas.

One of the factors that is significant in every model specification is the logarithm of number of traffic fatalities per 1000 population. The effect is highly significant, with a 1% increase in number of traffic fatalities leading to about a 0.5% increase in the donation rate. This result seems to be quite robust as the traffic fatality coefficient does not change a lot, regardless of model specification. Surprisingly though, the coefficient which combined the traffic accident deaths and cerebro-vascular death variables in specification (3), and the cerebro-vascular death variable in specification (4) do not seem to affect the rate of donors. Therefore, we do not believe the addition of the cerebro-vascular variable contribute anything to our model. While the first two specifications cannot be compared to a fixed effect model due to only containing time-invariant variables, specification (3) and (4) result in a small negative Hausman test statistic, which is a result of more variation in the pooled OLS model that is assumed to be the more efficient model compared to the consistent fixed effects model, which results to a faulty statistic. However, one remedy in cases of a small negative test statistic is using the absolute value, which suggests that the coefficients can be interpreted in the pooled OLS models unless other problems are present (Schreiber 2008). Regression (5) contains a large negative specification test statistics, which suggests that the estimations are unreliable.

Adding the demographic variables, average age, average age of the deceased and density, to our model increases the explanatory power of the model. The demographic variables show significance in every specification of the model where they are included, with the exception of average age in regression (9). In the more comprehensive model in regression (11) the demographic variables are significant at a 10% significance level. The average age of the population of a county has a negative coefficient of between -1 and -1.7, and the average age of death has a positive significant impact between 1.3 and 1.8. In contrast to our expectations, the density variable is significantly negative at least at the 10% level in every specification it is included, with small differences in the coefficient.

The inclusion of gross regional product or education, does not seem to add a lot of explanatory power to the model. The gross regional product is only significant when removing the demographic variables in regression (8), while the education variable is never significant and the coefficient varies between the model specifications. However, adding the education variable reduces the effect of the age variable, which is possibly related to older generations being less educated on average.

In the last two regressions (10) and (11), we add our experimental proxy for attitudes, the Progressive-Conservative election index. The variable is statistically significant at the 1% level in both specifications. As the differences are not huge between the minimum and maximum values of these variables, the largest difference between these counties should amount to below

1% due to this variable. This suggests that indeed might be some differences in attitudes to donorship, which are correlated to other progressive opinions, between the counties in Sweden.

While the specification test statistic vary between the different pooled OLS specifications, our two most detailed models gives us no reason to reject the Hausman hypothesis of the coefficients being the same as their Fixed Effects equivalents. In these models, regressions (10) and (11), we should be able to use the pooled OLS results to interpret the time-invariant dummy coefficients as well. While being less detailed, regression (6) and (8) also gives us no evidence to reject the Hausman null hypothesis of similar coefficients in the Pooled OLS and the Fixed Effects model.

To additionally test the robustness of the model, the results of the model specifications with donors per million can be compared to a model with actual donors per ICU death. In Table 8 in the Appendix, it is shown that most of the time-variant variables that are significant in the normal specification are also significant in the alternative model. The signs of the coefficients are also in the same direction whenever they are significant in both models. A few differences are present, the number of cerebro-vascular disease deaths per population is negative and significant in the alternative model, while being insignificant in the original model. Average educational level also carries a significant positive effect in regression (8) in the alternative model, while becoming insignificant when adding the demographic variables again. The consistency between the models provides some evidence of the validity of our original specification, as similar patterns arise even when removing partly removing the effect of some ICUs ending up taking care of more patients.

Table 5. Regression results, time-variant variables.

VARIABLES	(1) regr1 Log(dpm)	(2) regr2 Log(dpm)	(3) regr3 Log(dpm)	(4) regr4 Log(dpm)	(5) regr5 Log(dpm)	(6) regr6 Log(dpm)	(7) regr7 Log(dpm)	(8) regr8 Log(dpm)	(9) regr9 Log(dpm)	(10) regr10 Log(dpm)	(11) regr11 Log(dpm)
Log(Traffic				0.499***	0.478***	0.450**	0.482***	0.477***	0.484***	0.491***	0.501***
Deaths Per Pop)				(0.167)	(0.166)	(0.173)	(0.178)	(0.177)	(0.175)	(0.167)	(0.162)
Average Age						-1.005**	-1.241**		-1.182	-1.686***	-1.475*
						(0.491)	(0.556)		(0.754)	(0.592)	(0.751)
Average Age						1.806**	1.801**		1.798**	1.352*	1.318*
of Deceased						(0.880)	(0.850)		(0.852)	(0.769)	(0.757)
Density						-0.00611***	-0.00447*		-0.00449*	-0.00414*	-0.00418*
						(0.00124)	(0.00234)		(0.00235)	(0.00224)	(0.00223)
Log(CVD				-0.291							
Deaths Per Pop)				(0.438)							
Log(CVD+Traffic			0.146								
Deaths Per Pop)			(0.484)								
Gross Regional							-0.00288	-0.00583***	-0.00299	-0.00173	-0.00215
Product							(0.00301)	(0.00219)	(0.00308)	(0.00292)	(0.00294)
Average								3.112	0.401		1.585
Educational Level								(1.894)	(2.463)		(2.485)
Election-Index										0.5892***	0.6162***
										(0.2061)	(0.2122)
Constant	2.481***	2.415***	2.422***	1.279	-2.504	-21.89	-19.12	-6.003	-20.33	-9.616	-13.94
	(0.190)	(0.309)	(0.314)	(6.065)	(1.724)	(15.04)	(14.33)	(3.875)	(16.79)	(13.33)	(15.40)
Observations	116	116	116	116	116	116	116	116	116	116	116
R-squared	0.109	0.350	0.351	0.407	0.405	0.517	0.522	0.442	0.522	0.557	0.560
Specification test			-0.34	-3.9	-29.45	0.2202	0.0811	0.8901	0.0725	0.2105	0.3072
FE-Model F-Test			0.5095	0.0725	0.0469	0.0718	0.0995	0.0809	0.1029	0.1012	0.1150

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Specification test given in p-values unless negative.

Regarding the time-invariant coefficients the estimates in table 6 suggests that there is quite a bit of variation not attributable to the explanatory variables accounted for by demographics or behavior. The different counties have different combinations of these time-invariant variables, and to get a perception of the different effects of the impact of organizational structure on donation rates different time-invariant variables have to be considered. An overview of which time-invariant is relevant for each county is shown in table 7.

Contradictory to our hypothesis 2, there does not seem to be a significant effect of having a transplantation hospital in the county. Only in the first specification, without any controls nor any other time-invariant variables, we find statistically significant coefficient of the transplantation hospital dummy. In the more detailed specifications, the effect varies between positive and negative, while not showing any significance, suggesting that no such effect exists.

The baseline transplantation coordination is OFO Mellansverige, meaning that the other transplantation regions are in comparisons with this. Both the Southern transplantation coordination area as well as the Sahlgrenska transplantation coordination area have negative coefficients in every specification. However, while the only healthcare cooperation area in the Southern transplantation area is the Southern one, Sahlgrenska transplantation cooperation area consists of three healthcare cooperation areas where the southeast healthcare cooperation area being the baseline for the Sahlgrenska transplantation area. While varied, the effect of Sahlgrenska is significant in each case. The Southern transplantation area is not significant in every specification, but only from regression (6) and onward. As the southern transplantation cooperation area and the southern healthcare cooperation area are the same the variable for the southern healthcare area is not included in among the time-invariant variables.

In addition to the southeastern healthcare cooperation area the other healthcare cooperation areas which are included within the Sahlgrenska transplantation area is the western and northern healthcare areas. Both the western and northern healthcare areas have positive coefficients, meaning that the southeastern area has a lower rate of donation than them. However, the coefficient estimates for the western and northern healthcare areas are not large enough to erase the large negative effect of the Sahlgrenska transplantation area itself. The coefficient estimate for the western healthcare area is somewhat smaller than the coefficient for the northern region, except for regression (8). However, that cooperation area is one big county, Västra Götaland, which has a transplantation hospital and a neurosurgery unit.

In the more detailed specifications healthcare area Uppsala-Örebro appears to underperform, as all the statistically significant variables for the Uppsala-Örebro variable are negative and large compared to the estimates for other healthcare areas. The Uppsala-Örebro coefficient is only statistically significant when the demographic variables are included in the model. This means that the counties in the Uppsala-Örebro healthcare cooperation area performs poorly although the county of Uppsala has a better performance as there is a neurosurgery unit and a transplantation hospital in that county.

The neurosurgery unit variable is statistically significant and positive in every specification with the exception of the most detailed one. This is however, not very surprising as most of the neurosurgery units are in cities with universities and there might be some sort of correlation between the existence of a neurosurgery unit, average education and Election-Index that makes the neurosurgery variable unnecessary in regression (11).

Comparing the results with regard to the time-invariant dummy variables to the results in the alternative specification with the number of actual donors per ICU death as the dependent variable (Table 9 in the Appendix), shows some inconsistency in the model. While all but one, neurosurgery, coefficients carry the same signs in both specifications, the variables are all insignificant in the most detailed regressions. This is possibly a cause for concern, as the differences could possibly have been explained by our other variables.

Table 6. Regression results, time-invariant variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	regr1	regr2	regr3	regr4	regr5	regr6	regr7	regr8	regr9	regr10	regr11
VARIABLES	Log(dpm)	Log(dpm)	Log(dpm)	Log(dpm)	Log(dpm)	Log(dpm)	Log(dpm)	Log(dpm)	Log(dpm)	Log(dpm)	Log(dpm)
Transplantation	0.566***	-0.351	-0.309	-0.419	-0.334	0.0225	0.0243	-0.300	0.00230	-0.159	-0.255
Hospital	(0.130)	(0.254)	(0.300)	(0.286)	(0.250)	(0.253)	(0.255)	(0.275)	(0.281)	(0.248)	(0.280)
Transplantation		-0.145	-0.171	-0.213	-0.258	-1.330***	-1.415***	-0.578**	-1.395***	-1.042***	-0.948**
Region South		(0.270)	(0.297)	(0.238)	(0.227)	(0.282)	(0.313)	(0.274)	(0.358)	(0.321)	(0.372)
Transp. Region		-0.759**	-0.784**	-0.924***	-0.961***	-2.068***	-2.109***	-1.082***	-2.074***	-1.730***	-1.573***
Sahlgrenska		(0.320)	(0.338)	(0.289)	(0.283)	(0.312)	(0.318)	(0.276)	(0.403)	(0.341)	(0.432)
Area West		0.744***	0.708**	0.800***	0.727***	0.646**	0.740**	0.912***	0.758**	0.808***	0.885***
		(0.254)	(0.278)	(0.270)	(0.256)	(0.256)	(0.284)	(0.274)	(0.298)	(0.284)	(0.299)
Area North		0.917***	0.903***	0.799***	0.780***	0.926***	1.043***	0.776***	1.022***	0.987***	0.900***
		(0.206)	(0.202)	(0.203)	(0.206)	(0.213)	(0.239)	(0.205)	(0.278)	(0.232)	(0.272)
Area Uppsala		0.162	0.140	-0.0630	-0.0920	-1.059***	-1.124***	-0.377	-1.102***	-0.903***	-0.805**
		(0.282)	(0.305)	(0.263)	(0.256)	(0.254)	(0.258)	(0.228)	(0.310)	(0.272)	(0.327)
Neurosurgery		0.980***	0.996***	1.035***	1.063***	0.878***	0.777***	0.577*	0.738**	0.533**	0.368
		(0.169)	(0.173)	(0.170)	(0.168)	(0.222)	(0.233)	(0.324)	(0.301)	(0.267)	(0.337)
Constant	2.481***	2.415***	2.422***	1.279	-2.504	-21.89	-19.12	-6.003	-20.33	-9.616	-13.94
	(0.190)	(0.309)	(0.314)	(6.065)	(1.724)	(15.04)	(14.33)	(3.875)	(16.79)	(13.33)	(15.40)
Observations	116	116	116	116	116	116	116	116	116	116	116
R-squared	0.109	0.350	0.351	0.407	0.405	0.517	0.522	0.442	0.522	0.557	0.560

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

Table 7. Time-invariant variables applicable for each county.

	Transp. Region South	Transp. Region Sahlgrenska	Area West	Area North	Area Uppsala	Neuro-surgery	Transp. Hospital
Gotland							
Stockholm						X	X
Skåne	X					X	X
Blekinge	X						
Kronoberg	X						
Kalmar		X					
Jönköping		X					
Östergötland		X				X	
Västra Götaland		X	X			X	X
Uppsala					X	X	X
Örebro					X		
Gävleborg					X		
Dalarna					X		
Sörmland					X		
Västmanland					X		
Värmland					X		
Jämtland-Härjedalen		X		X			
Västernorrland		X		X			
Västerbotten		X		X		X	
Norrbotten		X		X			

11. Analysis

11.1 Validity

If we first consider the validity of the model, we cannot reject that the coefficients are the same in the pooled OLS as in the Fixed Effects model, which provides some evidence that the model is well-specified. However, this is not true for all specifications. Even though the coefficients added are not significant in regression (7) and (9), the Hausman hypothesis can be rejected at the 10% significance level, lessening the interpretational value of those specifications. Additional problem arises with the Fixed Effects specifications, the joint significance of the models is on the lower end, with only being significant at a 10% level in some specifications. This can lead to the Hausman hypothesis not being rejected due to the large variance of the coefficients in the Fixed Effects model, even though the pooled OLS estimates are inconsistent.

Therefore it is important to show that the F-statistic of the Fixed Effects model, as it is of importance to us to correctly estimate of the value of our models, as it is important to be careful when interpreting the results due to the potential downsides of a pooled OLS model.

The coefficient estimates show considerable consistency in size and if they have either a positive or negative sign over different specifications with the exception of education. This could be interpreted as a sign of the validity of these estimates and they should be reasonable and are interpretable. While some estimates show some variation in the size of the coefficient between different specifications, the magnitude of the variation does not reach levels where the estimates should be disregarded. Overall, the model explains slightly more than half of the variation in donors PMP in the last regressions. With an R-squared of 0.560 in regression (11), it is likely to still be some additional variation that could be modeled, possibly with more exact information on attitudes toward organ donation as well as more detailed organizational variables. As shown by regressions (2), (5) and (7), the time-invariant organizational dummies, the logarithm of the number of traffic accident deaths per population and demographic variables are the variables explaining the majority of the variation in the dependent variable.

As we do not know the mechanics of how the average age and average age of the deceased affects donor rates, their interpretation should be done more carefully. The correlation between the variables could possibly cause problems, as the coefficients have the opposite signs in the Fixed Effects model compared to the pooled OLS model. The estimations of the coefficient of education are insignificant in all pooled OLS specifications they are included. The organizational dummies and the number of traffic accident deaths per population variables appear to have been estimated in such manner that their validity is good.

Comparing our main model with the logarithm of donors PMP as the dependent variable to a model using the number of actual donors per ICU deaths provides similar results as having the logarithm of donors PMP as the dependent variable. This could act as a robustness test of the model and validation that donors per million is a serviceable variable when comparing the donor rates between counties, and perhaps also countries. In the alternate model the signs of the coefficient estimates are the same in most cases, however, some time-invariant organizational dummies are no longer significant or become less significant. One should note that this alternative model specification uses a limited sample, removing year 2013 due to lack of data on the number of ICU deaths. Additionally, the lack of previous literature using the number of donors per ICU deaths causes the differences to be hard to explain.

Overall, the internal validity of the model appears to be good, and the consistent and more significant coefficient estimations are likely quite accurate.

Considering the external validity of the model it might be hard to apply exactly the same model to another country. While the framework could be applied the estimations are not very likely to be the same for other countries, as differences in organization of organ donation and transplantation give rise to different transaction costs. For example, education might have a higher impact in some countries with higher variation the years of education among the population, which is not present in Sweden due to the relative homogeneity of the level of education in Sweden. If one were to adjust the time-invariant variables for the organizational structure and applying the same method with other relevant variables to another country it seems reasonable to believe that a similar approach would work for other countries. However, as our results are intended to explore the effects of the organizational structure within Sweden, the estimated effects cannot be extrapolated to any other country.

11.2 The estimates of the coefficients

Regressions (3)- (5) show that the number of cerebro-vascular deaths per population does not yield a statistically significant coefficient, which is in contrast with Abadie and Gay (2006), instead we get a small negative and insignificant coefficient estimate similarly to Ugur (2014). There are two reasonable interpretations for this result, either cerebro-vascular deaths are not especially apt for donations, or that there is a general efficiency problem that causes them to not be used for donations.

Continuing on to the average age and average age of the deceased variables, the coefficient estimates are hard to interpret due to the lack of us knowing the mechanics behind them. Potentially, younger people are less likely to veto the donation of organs from a deceased older relative, perhaps due to being less of a taboo and it being considered normal or that the depiction of donating organs in media, such as TV shows depict the act as generous. The same logic applies in reverse for a lower age of death leading to less donations, older people could possibly veto the donations of a younger deceased relative, for example due to more conservative views on organ donation. As we have no measurement of attitudes toward organ donation for the different counties it is hard to do more than speculate in what attitudes could affect willingness to donate organs and how/if attitudes toward organ donation differs over different age groups.

As density affects the organizational structure, it is surprising that it has a negative sign. As more densely populated areas are closer to the more specialized healthcare units, such transplantation hospitals and neurosurgery units, we would have expected that the more densely populated regions have other organizational advantages that could be associated with higher donor rates. On the contrary, however, it is also possible that density has an effect on the population of deceased people, as the distance to hospitals could cause people to not get treatment in time, leading to additional deaths or that patients in need of care are physically closer to hospitals and get treated quicker. As most deceased that could become organ donors are brain dead and on respirator, patients who have farther to travel for care might not survive long enough to arrive to a hospital and be put on a respirator.

The main reasoning for adding the demographic variables were to try to make sure that the population of a county, and the population of deceased people, not influence the results of the organizational variables, which is our main interest. By thoroughly including different demographic variables, we reduce the possibility of biasing the estimates of the organizational time-invariant coefficients. As the alternative specification with actual donors per ICU death showed similar results for our estimated coefficients as using the logarithm of donors PMP as the dependent variable, we have additional support that the coefficient estimations should not be greatly affected by bias due to demographic differences.

As the gross regional product per capita variable is insignificant when demographics are accounted for, it suggests that the productivity of a county is not important within Sweden, contrasting to the effect of including GDP as a variable when comparing organ donation between countries, such as in the model used by Abadie and Gay (2006). This could be a result of Sweden being a small country population-wise, and cooperation is needed for donors and transplantations and the resources available for each county is not as relevant. It could also be that the transfer of wealth between different areas in Sweden makes the gross regional product per capita an inaccurate measure of what resources a county has available for healthcare.

The behavioral variables are used as an attempt to account for the effects of how attitudes toward organ donations affect the rate of organ donation, as there are no direct measurements of attitudes. As opposed to the correlation between a positive attitude and educational level that has been seen in Eurobarometer surveys, our results do not provide evidence that the educational level of a population affects the number of donations. Perhaps attitudes to donations are not related to education in Sweden due to a homogeneity of opinions across educational levels, which might be possible to achieve with public information campaigns, or that the level of education is homogenous in Sweden when compared to other EU countries. Another possible explanation is that it is considered to be appropriate to be positive toward donations, with more highly educated people feeling a larger obligation to say the right thing.

Our Election-Index is a statistically significant and positive coefficient estimate, suggesting that more progressive political opinions is related to higher donation rates. This could possibly be a source of heterogeneity in opinions that captures differences in attitudes toward organ donations in Sweden. However, the crudeness and relatively low variation of the variable makes the statistical significance quite surprising. As the intention was to find something to replace the variable capturing the role of religion used by Abadie and Gay (2006) and Ugur (2014), it is possible that we succeeded, but it could also be that we captured another factor affecting donation rates. To know whether or not the Election-index captured the effect of religious beliefs is to have a model which includes religious variables as well as political variables. This is not possible for us to do as data on religion is not available on a county level in Sweden.

11.3 Analyzing the hypotheses

For the results regarding our hypothesis and organizational structures, we surprisingly find that hypothesis 1 can only be ambiguously answered. As most specifications point toward us being able to confirm that neurosurgery units have a positive significant effect on donation rates as expected. The only exception is our most detailed specification, regression (11) where the estimated coefficient for a neurosurgery unit is not statistically significant. As many people with head injuries are transferred to hospitals with a neurosurgery unit, and when these types of injuries lead to death it often possible for a patient to become an organ donor, the probability of a higher donation rate increases with the presence of a neurosurgery unit. Disregarding the insignificance of the coefficient estimation in the last specification, it would be reasonable to take the existence of neurosurgery units, and similar hospitals affecting the probability of a deceased becoming an organ donor, into account when comparing donor rates between regions within a Sweden or in another country. This could be especially important when trying to improve the rates of donation, as direct comparisons and trying to reach the same levels in all regions would be unreasonable as the circumstances are not the same in different counties when it comes to the underlying healthcare infrastructure. If the presence of a neurosurgery unit increases the donation rate, as we are inclined to believe, it is in line with the idea that the organization and infrastructure of healthcare has an effect on organ donation rates. However, as previously discussed, this effect could be attributed to both redistribution of potential donors and also an absolute increase from the expertise of donor procedures in these hospitals, with a combination seeming to be the most likely. This means that the mechanisms needs to be explored further.

Surprisingly, we cannot reject our second hypothesis, as our results suggest that the lack of a transplantation hospital in a county does not lead to a lower donor rate. This suggests that the contact between hospitals with the organ donor and the transplantation hospital, and the coordinators, is not the main problem. Instead the variation in donor rates that is not related to demographics or behavior is found elsewhere. This suggests that the transaction cost for a hospital with an organ donor are not too high to be overcome in the current organization of organ donation and transplantation. However, in order to make this conclusion probable variables capturing the effect of communication between hospitals and to see if it differs between counties. It could also be that this finding could be a result of more regular contact with the transplantation coordinators, to ensure that procedures are followed.

For our last hypothesis (Hypothesis 3), we provide evidence that healthcare cooperation areas and transplantation coordination areas do have an impact on donation rates after controlling for other factors, such as the demographic and behavioral factors. While there is likely to be some variation not related to the organization of the areas left due to omitted variables, we believe that we capture a substantial amount of the organizational effect we were interested in. Stockholm is the county with the smallest area to cover and with only one additional small area to cooperate with, Gotland, is showing the best results after controlling for other factors. The southeastern healthcare area performs the worst after controlling for the variables, similarly to what the absolute number of donors PMP show. The Uppsala-Örebro healthcare area has a significantly lower rate of donation than the baseline even if the presence of a neurosurgery unit is included, but Uppsala County is a top performer in the observed absolute number of donors PMP. If our possible explanation described above is to be credible, this could be due to the other counties in the Uppsala-Örebro healthcare area having additional transaction costs when trying to procure organ donations. This is perhaps due to less effective procedures due to the lack of expertise or that communication is harder or other transaction costs between counties are hard to overcome, especially when a large number of counties are trying to coordinate. It might also be that the cooperation within the Uppsala-Örebro healthcare area when specialized care is needed, such as a neurosurgery, are better at transferring patients to hospitals in another county, resulting in that patients from other counties become organ donors in Uppsala which has a neurosurgery unit**.** The only unexpected result is the northern healthcare area having nearly the same coefficient as the western area, as it is a very disseminated healthcare cooperation area, both covering a large share of Sweden as well as including many counties, and is far from the transplantation hospital in the transplantation coordination area it belongs to. Either the northern healthcare area has solved some of the difficulties that some of the other healthcare areas have with the transaction costs of organ donation. Despite the positive effects in the western and northern area the Sahlgrenska transplantation area coefficient estimates have large negative coefficients which results in both the western and northern area having fewer organ donors when comparing to the baseline, Gotland. The southern transplantation area, which is the same area as the south healthcare cooperation area, also has coefficient estimates which suggests that it underperforms compared to the baseline. This is surprising as the transplantation and healthcare area are the same geographical area, which should make transfer costs lower as they are likely to not have to build an extra organization to handle organ donation, but only extend the other existing healthcare cooperation. This underperformance may be there because there are large transaction costs within the healthcare cooperation area generally, making the transaction costs for handling organ donors higher in this area than in other transplantation and donation areas. It could also be other area specific inefficiencies or other unaccounted variables that have a strong effect in this specific area.

12. Conclusions

The regressions performed suggest that the first hypothesis is correct. In all but one regression where the coefficient for neurosurgery unit is included it has a statistically significant and positive effect on the rate of organ donations in a county. We find no evidence for our second hypothesis, as our results show no statistically significant effect of having a hospital capable of performing organ transplantation in a county. Our third hypothesis proposes that there are important organizational effects that affect organ donation rates. When interpreting the time-invariant organizational coefficient estimates, we find that there is considerable variation in the organ donation rates that are not explained by behavior nor demographics. Overall, the answers to the hypotheses suggest that the infrastructure surrounding organ donation and transplantation has an impact on donation rates in Sweden, and the strong variation between counties and regions suggests that there is a lack of optimization of transplantation processes which are likely to be detrimental to the donation rates.

In addition to answering the hypotheses, variables affecting county donation rates in Sweden have been found. Some variables that have been relevant in previous studies such as the effect from traffic fatalities, while factors that have had an impact in other studies were not significant in our model, for example the gross product, cerebro-vascular disease mortality and education. A new variable which has not been included in previous studies is a conservative-progressive index variable, which is significant when included in our model. As it is a new variable it would be beneficial to study the effect of the variable on donation rates in other settings in order to confirm our finding, but in our results a more progressive county has a higher donation rate.

A policy implication from these conclusions is that the donation rates might be improved in transplantation coordination areas which are disseminate by improving the organization of organ donation procurement. A clear example in Sweden would be the Sahlgrenska transplantation coordination area which appears to be the most underperforming in our model. Given the number of counties the region covers, as well as not being geographically connected, additional resources are possibly needed to form a coherent organization. By scrutinizing the time-invariant organizational estimates the healthcare area with the biggest potential for improvement appears to be the southeastern healthcare area, which is closer to the hospital responsible for coordinating organ donation and transplantations than the northern healthcare area yet still has a larger organizational disadvantage.

Our results are in line with recent research that stresses the effect of the organizational infrastructure surrounding transplantation activities on donation rates. Our approach tries to quantify these effects within Sweden by using methods usually reserved for country comparisons in the context of organ donations.

12.1 Future research

Future research that would continue on the findings of this thesis would be to add variables of the attitude toward organ donation on a county level. As we did not have this information we could only try using variables that indirectly captures the attitude, but to have a direct attitude variable would naturally be more accurate. It would also be beneficial to try our model in other countries. As the organizational time-invariant variables are specific for Sweden they would have to be adapted to another country. By repeating our model in other countries it would be possible to compare what factors effect organ donation and what the size and sign of the relevant effects are. If the wish is to improve the donation rates in Sweden, the next step is to investigate the organization of organ donation and transplantation activities and try to find any transaction costs that hinder higher donation rates.

Another aspect which we have not explored as it is not directly linked to our model is the organization of the waiting lists in Sweden. At present each transplantation hospital has its own waiting lists, but as there has been discussions about the differences in how long a patient has to wait for an organ transplant between the different transplantation coordination areas and suggestions that there should be national waiting lists instead. National waiting lists could help mitigate the public goods problem by creating an agency to optimally allocate organs, and thus could potentially reduce cross-county variation.

13. Summary

Organ donations have been proven to be a cost-efficient way of increasing the life expectancy and the quality of life of people in need of an organ. Meanwhile, many countries suffer from a lack of organs, while demand is rising. Sweden suffers from this problem to a large extent, as the rate of deceased donors is lower than most other European countries. This is puzzling due to the favorable legislation concerning deceased organ donation and the Swedish people having the highest share of positive attitudes toward donating their organs after their death in Europe. Consequently, there is some other factor causing these low donation rates. In recent literature the impact of the organization of organ donation and transplantation activities on donation rates have been suggested.

Within Sweden, some counties have donation rates that are comparable to well-performing European countries, whereas many other counties are performing substantially worse. Sweden is organized into three transplantation coordination areas and six healthcare cooperation areas. These vary both in size and number of citizens. Additionally, there are four hospitals able to perform organ transplantations and six hospitals which have neurosurgery units. We believe that these factors affect the rate of donation and could be part of the explanation to the varying rates of donation between counties.

To investigate these effects, we construct a panel data set of the number of donators per million population in each Swedish county over the years 2008 to 2013 and a number of other variables believed to affect donation rates. In addition to this we create time-invariant dummy variables over the organizational structures that we regarded as relevant. This data set is then used in a pooled OLS regression model to examine the impact of the variables on the number of donators per million population. To ensure that our model is correctly specified, it is compared to a fixed effect model and a pooled OLS model using the number of actual donators per intensive care unit death as the dependent variable.

We find evidence that the presence of a transplantation hospital in a county does not have an effect on the donation rates. Meanwhile, the presence of a neurosurgery unit appears to have a positive significant effect in all but one model specification. In all pooled OLS model specifications with donators PMP as the dependent variable, the transplantation coordination areas and healthcare cooperation areas are shown to have a highly significant effect. In the case of our more complex regressions we reject the case that the pooled OLS estimates differ significantly from their fixed effects regression counterparts. When comparing the original pooled OLS estimation with donors per million population to another pooled OLS specification using the actual number of donors per intensive care unit death as the dependent variable with a restricted sample, we find that the time-invariant variable coefficients are not significant, but carry the same sign in most cases. This could be a cause of concern for the validity of these estimates, as we do not know if it is due to the smaller sample or some other property of the variable. However, most time-variant variable coefficients have similar significance levels and carry the same sign. Overall, the internal validity of the model appears to be good. While our time-invariant variables are specific for Sweden, and there is reason to believe that the coefficient estimates for the time-varying variables are not universal, the external validity for the estimates is low in contexts other than Sweden. If adjustments are made, we see no reason for a similar model not being applicable to the context of other countries.

The time-invariant organizational coefficients suggest that there is a considerable variation in organ donation rates not related to demographics and behavior. We believe that this effect is related to the organizational structure, requiring cooperation between many hospitals and counties. A possible policy to counter this effect would be to provide more resources for some areas that need to strengthen their coordination and cooperation. Overall, the findings in this thesis are in line with previous literature which emphasizes the importance of the organization of organ donation and transplantation activities on the rate of organ donation.

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Appendix

Appendix A

Regressions with the number of actual donors per ICU death as dependent variable.

Table 8. Regression results, Actual donors per ICU death as dependent variable. Time-variant variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	regr1	regr2	regr3	regr4	regr5	regr6	regr7	regr8	regr9	regr10	regr11
VARIABLES	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD
Log(Traffic				0.0173***	0.0138**	0.0154**	0.0158**	0.0181**	0.0166**	0.0164**	0.0176***
Deaths Per Pop)				(0.00638)	(0.00679)	(0.00694)	(0.00742)	(0.00735)	(0.00731)	(0.00687)	(0.00659)
Average Age						-0.0596***	-0.0622***		-0.0485*	-0.0799***	-0.0602**
						(0.0195)	(0.0223)		(0.0270)	(0.0233)	(0.0268)
Average Age						0.0850**	0.0851**		0.0836**	0.0650*	0.0607*
of Deceased						(0.0424)	(0.0423)		(0.0418)	(0.0370)	(0.0352)
Density						-0.000231***	-0.000212*		-0.000216*	-0.000201*	-0.000206*
						(7.95e-05)	(0.000116)		(0.000117)	(0.000108)	(0.000106)
Log(CVD				-0.0413**							
Deaths/Pop)				(0.0194)							
Log(CVD+			-0.0257								
Traffic D/Pop)			(0.0227)								
Gross Regional							-3.28e-05	-0.000202*	-5.89e-05	1.49e-05	-2.13e-05
Product							(0.000112)	(0.000103)	(0.000114)	(0.000111)	(0.000108)
Average								0.216**	0.0918		0.142
Educ. Level								(0.0975)	(0.110)		(0.110)
Election-Index										2.459**	2.688***
										(0.999)	(1.002)
Constant	0.0395***	0.0204*	0.0186	0.411	-0.120*	-0.961	-0.933	-0.490**	-1.200	-0.525	-0.901
	(0.00735)	(0.0122)	(0.0116)	(0.275)	(0.0685)	(0.733)	(0.725)	(0.193)	(0.791)	(0.637)	(0.688)
Observations	96	96	96	96	96	96	96	96	96	96	96
R-squared	0.112	0.275	0.288	0.338	0.305	0.460	0.461	0.352	0.466	0.505	0.517

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

Table 9. Regression results, Actual donors per ICU death as dependent variable. Time-invariant variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	regr1	regr2	regr3	regr4	regr5	regr6	regr7	regr8	regr9	regr10	regr11
VARIABLES	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD	APerICUD
Transplantation	0.0219***	0.0101	0.00333	-0.000520	0.0105	0.0199	0.0198	-0.000333	0.0148	0.0133	0.00497
Hospital	(0.00733)	(0.0145)	(0.0155)	(0.0156)	(0.0150)	(0.0162)	(0.0164)	(0.0147)	(0.0158)	(0.0152)	(0.0144)
Transplantation		0.00644	0.0116	0.00997	0.00282	-0.0401***	-0.0410***	0.00125	-0.0364**	-0.0261	-0.0175
Region South		(0.00936)	(0.0103)	(0.00958)	(0.00929)	(0.0135)	(0.0143)	(0.0132)	(0.0150)	(0.0159)	(0.0165)
Transp. Region		0.00108	0.00612	-0.000595	-0.00635	-0.0525***	-0.0530***	0.00110	-0.0448**	-0.0379**	-0.0238
Sahlgrenska		(0.0121)	(0.0126)	(0.0130)	(0.0132)	(0.0142)	(0.0146)	(0.0161)	(0.0171)	(0.0172)	(0.0195)
Area West		-0.00627	-0.000322	0.00384	-0.00612	-0.00444	-0.00329	0.00921	0.000869	-0.00107	0.00559
		(0.0130)	(0.0129)	(0.0128)	(0.0134)	(0.0133)	(0.0150)	(0.0125)	(0.0144)	(0.0145)	(0.0136)
Area North		0.0240**	0.0263***	0.0230**	0.0205**	0.0287***	0.0300**	0.0144	0.0249*	0.0281**	0.0199
		(0.00951)	(0.00956)	(0.00967)	(0.00964)	(0.0107)	(0.0126)	(0.00953)	(0.0136)	(0.0124)	(0.0134)
Area Uppsala		0.0202*	0.0249**	0.0163	0.0116	-0.0277**	-0.0285**	0.0101	-0.0234	-0.0198	-0.0112
		(0.0112)	(0.0119)	(0.0124)	(0.0125)	(0.0120)	(0.0126)	(0.0139)	(0.0141)	(0.0144)	(0.0157)
Neurosurgery		0.0250**	0.0218**	0.0221**	0.0268***	0.0136	0.0125	-0.00471	0.00369	0.00303	-0.0115
		(0.00978)	(0.00954)	(0.00973)	(0.0100)	(0.0109)	(0.0112)	(0.0169)	(0.0153)	(0.0130)	(0.0169)
Constant	0.0395***	0.0204*	0.0186	0.411	-0.120*	-0.961	-0.933	-0.490**	-1.200	-0.525	-0.901
	(0.00735)	(0.0122)	(0.0116)	(0.275)	(0.0685)	(0.733)	(0.725)	(0.193)	(0.791)	(0.637)	(0.688)
Observations	96	96	96	96	96	96	96	96	96	96	96
R-squared	0.112	0.275	0.288	0.338	0.305	0.460	0.461	0.352	0.466	0.505	0.517

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