Project on organ donations

Studying the effects of UAGA 1987

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1. Introduction

First successful transplantation of solid organs brought new treatment opportunities for patients with the end stage diseases. Since then the supply of organ donors has increased dramatically, nonetheless, the huge gap between supply and demand still remains (Keenan et al., 2002; Sung et al., 2008). In 2006 the number of organ transplantations in the US reached 29,000, while the number of patients on the waiting lists was three times greater - 97.000 people (Steinbrook,2007).

Even though demand is short of supply, the pool of potential donors is more than adequate to fill in the gap (Raymond & Horton, 1990). Since 75% of organ supply comes from the deceased donors, the mainspring to rising the number of donors lies in increasing the conversion ratio of potential to actual deceased donors by increasing the rate of consent (Steinbrook, 2007). Thus the shortage originates from the lack of consent of potential deceased donors and next-to-kin (Wolf et al., 1997).

Keenan S. et al. (2002) argue that the organ shortage is caused by the organ donation paradox: majority of population agrees on effectiveness of the cadaveric organ donations and confirms that it is a necessary procedure, but they still do not take necessary steps to indicate their will to becoming donors. A survey conducted by Wolf at al. (1997) in 1994 showed that 89% of respondents recognized that there was a shortage of organs but only 36% of them claimed to be donors, while the rest 64 % who did not indicate themselves as donors said that it was because they were never asked to become one.

Given a current shortage of organs and lack of conversion from potential to actual donors, there is a high need in a policy implementation for countering those problems. The two types of policies which are available to increase the donation rates include broadening the criteria for potential donors and increasing the rate of consent by insuring that the next-to-kin of the deceased (potential) donor agrees to donate descendants' organs (Howard ,2007). Mehmed et al. (2003) found that increasing the consent is found to be 80% more effective.

Starting from 1968 several attempts were made in order to increase the number of deceased donors in the US. In 1968 the National Conference of Commissioners on Uniform State Laws (CUSL) drafted a Uniform Anatomical Gift Act (UAGA) with an aim to create a uniform legal framework for organ donations and reduce the existing diverging legislations between the states. UAGA 1968 allowed all individuals older that 18 to donate their organs and tissues. If in case of death an individual did not give his permission, next-to-kin could do it, where the will of next-to-kin has the priority over the will of the descendent. It also created a nationwide pool of tissue typing and organ matching system and established the uniform donor card system.

Second attempt to narrow the gap between supply and demand of organ donations was UAGA 1987 which prohibited the sale of human organs and strengthened the priority of the decedents' wishes over the next-to-kin will. UAGA 1987 simplified the process of filling in all the necessary documents to becoming an organ and mandated hospital staff to provide information about organ donations for patients and their families upon admission to the hospitals. The revised UAGA raised debates concerning priority of the deceased donors' will over the will of next-to-kin and the right given to examiners and coroners to extract deceased's organs if they had custody. Also, doubts were raised about the language and the manner of "routine inquiry/required requests" which has to be performed by the hospital staff upon patients' admission to the hospital. As a results the revised UAGA was opposed in many states to and enacted only in 26 States, what created disparity between the legislations across the US and raised the requirement of a new reform to sustain harmonization. [2]

The second revision of the UAGA came in 2006 and like the UAGA 1987 substantially strengthened personal consent over the will of next-to-kin. It encouraged registries and facilitated the coordination and cooperation between procurement organizations and medical examiners.   It has also simplified the documents of the gift and improved the access to the donor registries for the procurement organizations.

Apart from the legislations several institutions were established to combat the shortage of donors. A National Organ Transplant Act was established in 1984 which created the Organ Procurement and Transplantation Network responsible for matching the organs. It also established funds for Organ Procurement Organizations which were responsible for increasing and coordinating donor registries in their service areas.

Organ Donation Breakthrough Collaborative was established in 2003, granting permission to clinical care nurses and physicians to participate in the donation process. Also, Donor Designation Collaborative (DDC) was established in 2006 by the Donate Life America

[2] USLegal, Uniform Anatomical Gift Act of 1987, Retrieved from: http://healthcare.uslegal.com/organ-donation/legislation/uniform-anatomical-gift-act-of-1987/

with a purpose of sharing the most efficient practices and creating high-functioning state donor registries to facilitate organ donations.

The statistical analysis measuring the success of the established institutions and enacted legislation is quite limited. Sung at al. (2008) analyzed the effect of the Organ Donation Breakthrough Collaborative and found that the number of available organs increased by 24% after the establishment.

The effect of the creation of the OPOs is rather diverging as found by Howard (2007). The author discusses that OPOs had an intention to increase the efficiency of matching the donors and organs. The acquired organs by the OPOs are later distributed by the United Network for Organ Sharing to the patients on the waiting lists. The OPOs are allowed to remove the organs from deceased donors, but it is of a common practice to ask the family for permission to proceed. In case the family declines, majority of the OPOs will not proceed with the organ removal, even though they are legally allowed to do so (Beard et al., 2004).Thus the consent of the family of the descendant puts the effectiveness of the OPOs network in jeopardy.

The statistical analysis of the initial legislation of the UAGA was conducted by Emile J. Farge et al. (1994) in 1994, where they examined how the UAGA 1968 affected the number of eyes and corneoscleral tissues in Texas from 1961 till 1990. The legislation was enacted in Texas in 1970. They found that before 1970 the mean number of donors was 72, while after the legislation was enacted the number increased to 215. The effect of the revision of legislations, UAGA 1987 and 2006, is not documented in any of the available literature.

The primary focus of this paper is the UAGA 1987. We focus on it because it brings a new concept of asking all patients and their families about organ donations upon admission to the hospital and simplifies the process of completing the necessary documents for becoming a donor. That is expected to reduce the "costs" and toil of becoming a donor under the informed consent [3] system and is expected to increase the number of donors in the US. The legislation of 1987 was also selected for analysis since majority of the States which enacted it done so in the mid 90's, thus the time frame before any other legislation is enacted is large enough for the statistical analysis. The current research tries to determine whether the legislation had an intentional positive effect on the number of organ donors. Apart from the effect of the legation the effects

[3] Under informed consent system an individual is not a donor unless necessary steps have been taken to identify him as being a donor. The opposite hold in the presumed consent system. In the US an informed consent system is used.

other key determinants drawn from literature are also analyzed. In this study we focus only on deceased donors since they represent the major share of the supply of organs and the legislation is mostly focused on the issues concerning the deceased donors.

2. Legislation

After the first successful transplantation in 1950 each state in the US started drafting donation legislations which allowed individuals to make anatomical gifts. By 1965, 44 states enacted some kind of donation laws. All legislations concerning the organ donations were heterogeneous - some had no information about the will of next-to-kin, some required three witnesses while others none. To reduce the disparity and create a uniform legal framework CUSL drafted and later enacted the Uniform Anatomical Gift Act. It was meant to foster organ donation by creating a nationwide pool of tissue typing and organ matching system. By 1971 all states and District of Columbia enacted the legislation. The Act allowed all individuals older that 18 to donate their organs and tissues. If in case of death the individual he did not give his permission, next-to-kin could do it, as the will of next-to-kin has the priority over the will of the descendent. After the Act came to existence the uniform, donor cards were created. It was expected that the donor cards would increase the awareness of the will of donors among their family members. Since individuals who signed the card would discuss it with their family members, the next-to-kin would be aware of the will of the individual and in case the donor card will not be found next-to-kin would inform about the will of the descendent.(Sadler A. et al., 1984; Edinger, 1990)

Basic provisions of the UAGA 1968

I) Any individual over eighteen may give all or part of his body for educational, research, therapeutic, or transplantation purposes. 2) If the individual has not made a donation before his death, his next of kin can make it unless there was a known objection by the deceased. 3) If the individual has made such a gift it cannot be revoked by the relatives. 4) If there is more than one person of the same degree of kinship the gift from relatives shall not be accepted if there is known objection by one of them. 5) The gift can be authorized by a card carried by the individual or by written or recorded verbal communication from a relative.

Box 1: Provisions of the UAGA 1987

Source: Muyskens , L. T. (1978). An alternative Policy for Obtaining Cadaver Organs for Transplantation. *Philosophy & Public Affairs*, Vol. 8, No. 1 (Autumn, 1978), pp. 88-99

The American Council on Transplantation declared that the UAGA of 1968 succeeded in harmonizing the organ donation legislations between the states, but failed to increase the number of donors. A survey conducted by American Council on Transplantation in 1985 showed that 95% of the individuals who completed the survey knew about the organ donations, and 75 % of them favored organ donations. Nonetheless, only 27 % of those who favored were willing to donate their organs and even less, 17 %, were the actual donors (CUSL, 1987) . Contrary to the findings of the American Council on Transplantation Emile J. Farge et al. (1994) found that UAGA had a positive impact on the number of eyes and corneoscleral tissues. The divergence of results can be explained by the difference in the samples used in the analysis, where American Council on Transplantation conducted the survey across entire US and Emile J. Farge et al. (1994) analyzed only donations of eyes and corneoscleral tissues in Texas.

Since the enactment of the UAGA 1968 the progress in the medical technologies increased the number of patients who could benefit from the organ donations what dramatically increased the demand for organ (Zawitski & DeVita, 2003). The supply of organ donations at that time could not catch up with the sudden rise in the demand what created a gap and increased the need for a policy reform which would stimulate the supply of organs. CUSL proposed implementation of UAGA 1987 as a solution to organ donation shortage. The key to stimulation of the supply was the simplification of the manners of performing the anatomical gift and enforcement of the deceased donors will to becoming a donor. Box 2 provides details on the major implementations of the UAGA 1987.

Major Implementations of the UAGA 1987

1)Explicitly prohibited the sale of human organs **2)** Guaranteed the priority of a decedent's wishes over the decedent's family members with respect to their objections to organ donation **3)** Streamlined the process of completing the necessary documents to effect organ donation(no witnesses were required on the donors card) **4)** Requires hospital staff to ask patients, upon admittance to the hospital, or their families, at patient's death, about becoming a donor. **5)** Permitted medical examiners and coroners to provide transplantable organs from subjects of autopsies and investigations within certain conditions(if they have custody).

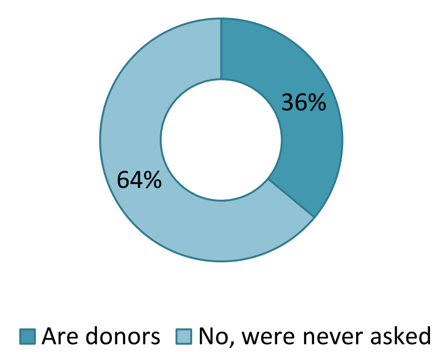
Box 2: Implementations of the UAGA 1987

Source: CUSL (1987). UNIFORM ANATOMICAL GIFT ACT 1987

From the five new implementations second, third and fourth are of major interest.

As conducted in the study of Wolf et al. (1997), 64 % of individuals who were not donors indicated a reason of not being one as: ”Because I was never asked”. Figure 1 shows the results of the Wolfs' et al. (1997) study. It is expected that in the states which implement the legislation the proportion of individuals which were not asked to become a donor would decrease what is expected to have a positive effect on the number of deceased donors.

Figure 1: Donation Paradox



Sourse: Wolf, J.S., Servino, E.M., Nathan, H.N. (1997). National Strategy to Develop Public Acceptance of Organ and Tissue Donation. *Transplantation Proceedings, 29, 1477-`1478.*

Rithalia et al. (2009) argue that bad default consent rules can create the gap between available organs and transplants, just as in the case of the US. The study showed that majority of people chose the default option assigned to them. One of the reasons comes from the fact that it requires less physical effort to use to the default option. Since with UAGA 1987 all individuals are provided with the information about becoming a donor upon the hospital admission at no physical effort and no costs we expect that it would have similar positive effect as the default legislations.

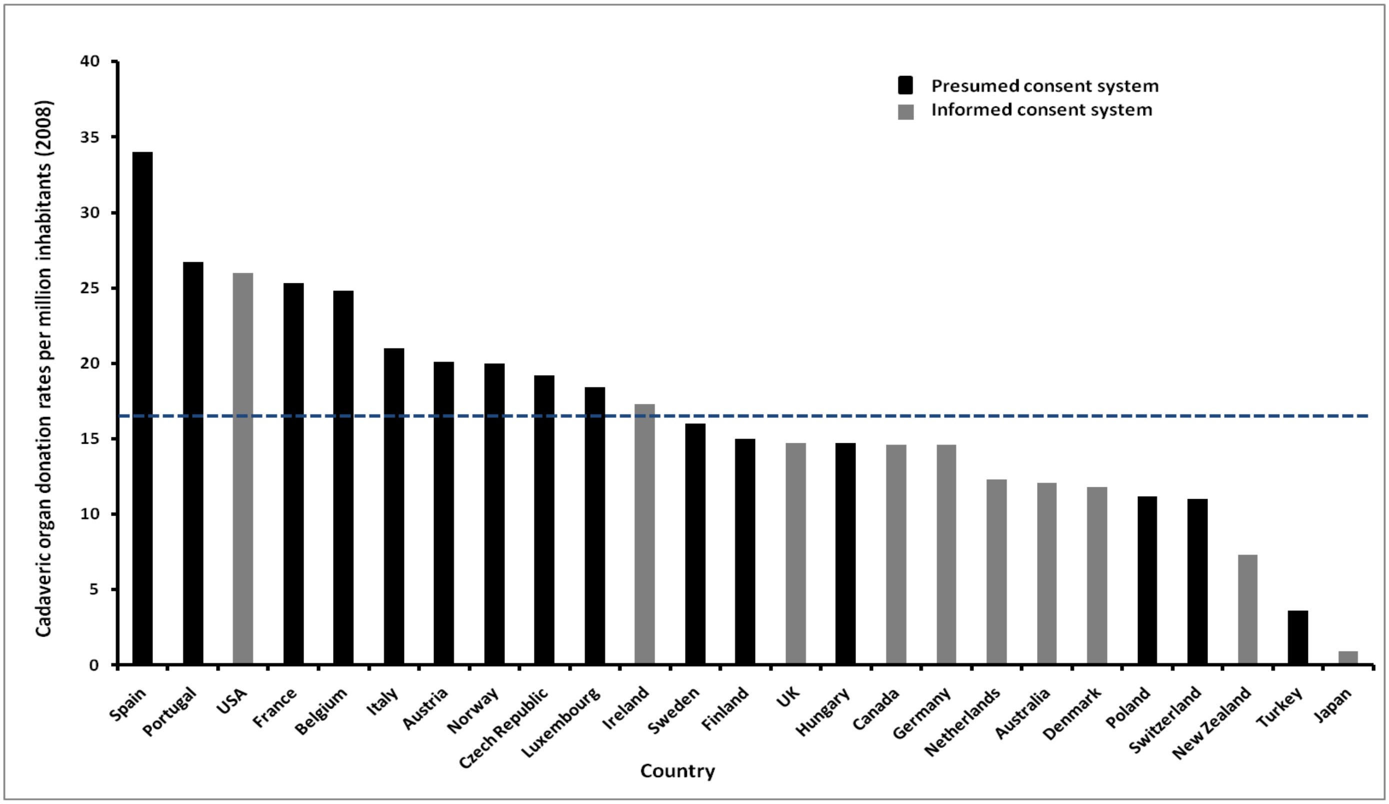
The OPOs are allowed to remove the organs from the deceased donors if the deceased agreed to donate, but it is of common practice to ask the family for permission to proceed with organ removal (Howard, 2007). If the family declines, majority of the OPOs will not proceed with the organ removal even though they are legally allowed to do so. This tendency holds across entire US (Beard et al., 2004). Such action wastes the organs which could be transposed to another body and goes against the legislation of 1987. This paper attempts to analyze whether strengthening the consent of the decedents' over the consent of the family had an effect on the number of organ donations. We expect to find a positive effect.

3 Literature review

In the majority of studies which were conducted using samples of the US, EU, UK and Swedish populations, Whites were found to be most willing to donate as compared to Hispanics and Blacks. Blacks were found to donate the least as compared the Whites and Hispanics, while Hispanics were in the middle. Negative attitude of the African Americans towards donations was found to be caused by the lack of awareness, distrust to the medical personnel, racism, access to medical care and religious beliefs (Minniefield et al., 2001). Contrary to other findings, a retrospective study of Delmonico et. al (2004) found that Blacks account for about 11-13%, Whites 82 – 86% and others, including Hispanics, account only for 2 – 4 % of the deceased donor pool for the period 1944 – 2003. The disparity in findings is caused by the use of different exogenous variables, where other studies used willingness to become a donor and Delmonico et. al. used the actual data of the registered donors. Not all individuals who are willing to donate will eventually register themselves. Also, the analysis of the histories of 722 actual donors did not show any significant racial differences (Olson & Cravero, 2009).

There are four consent systems, namely: informed consent, routine removal, presumed consent and mandated choice. Mostly applied include presumed consent (opt out) and informed consent (opt in). The informed consent system states that individuals have to make certain steps in order to indicate their willingness to become a donor. Presumed consent differs from the informed consent by shifting the default rules. Under the presumed consent all citizens are presumed to be organ donors, unless they stated otherwise. There, the presumed consent (opt out) system was advised as a more effective tool than the explicit consent (opt in) since it does not require individuals to follow any procedures for becoming a donor (Rithalia et al., 2009) . Majority of the states in the US use the informed consent system, while other OECD counties like Spain, Portugal, France use presumed consent system and Ireland, UK, Canada, Australia informed consent system. The research conducted by Johnson and Goldstein (2003) showed that in opt out consent system rates of consent to becoming a donor were 40% higher than in opt in system. The research on the effects of the consent systems shows that practice of opt out system has a positive effect on the number of donors (Rithalia et al., 2009). Abadie and Gay (2004) suggest that deceased donation rates are 25% to 30% higher countries with presumed consent system. Also, 39% of the International Society and Lung Transplantation indicated presumed consent as a major improvement which could increase the number of organ donors (Mehmet et al., 2003). As indicated in Figure 2 most of the OECD countries which are above the average number of deceased donors per million population in 2008 are using presumed consent system.

Figure 2: Presumed vs Informed consent systems.



Source: Stevens, L. (2010). Determinants of Organ Donation. Explanation of Variables Influencing Cross-Country Differences.

Mortality from the road traffic accidents and cerebrovascular deaths are the major causes of death among the deceased donors, which account for 80% (Coppen et al., 2008). The analysis of the effects of the number of traffic accidents and cerebrovascural death showed that there is a strong positive relation between the two (Rithalia et al., 2009; Abadie & Gay, 2004).The study conducted using the UK population confirmed the strong positive relation between cerebrovascural deaths and number of deceased organs while the number of traffic accidents had a negative effect (Wight et al., 2004).

The studies on the effects of religious believes on the number of deceased donors are less generalizable since each study uses different reference groups. Some compared the effects of Protestantism against all other religions, others compared the effects of Christianity against Islam and other religions. Catholicism was found to have a positive effect on organ donations as compared to other religions(Rithalia et al., 2009; Abadie & Gay, 2004). Similar results were found for EU Eurobarometer Data (Mocan & Takin, 2007). A study on a sample of 400 citizens of Sweden, religion was found to have mixed results as some individuals referred to religion as a barrier to donations while others referred to it as a motive for further altruistic actions, including donation of organs (Sanner, 1994).

Income was found to have a positive effect on the amount of organ donors and willingness to become a donor, just as health expenditures and education of respondents (Rithalia et al 2009; Beard et al., 2004). These results hold not only for the data from the US but also from Iran and Spain (Conesa et al., 2004; Shahbazian et al., 2006). Based on the results of the survey conducted on the members of the International Society of Heart and Lung Transplantation, 18% indicated that increase in the public education levels would be the best method to increase the number of organ donors (Mehmed et al., 2003). Contrary to those findings, Ramdolph et al. (2004) found that the effect of education is not statistically significant.

Other factors which were analyzed and had a significant positive effect including the access to information, blood donations and practice of the common law (Abadie & Gay, 2004). A study conducted using the data from UK showed that number of intensive care units had a positive effect on the number of cadaveric organ donation rates (Wight et al., 2004). The analysis of Spanish and Iranian population samples showed an effect of age and sex on preference of individuals towards organ donors (Shahbazian et al, 2006; Conesa et al., 2004). Also, families and next-to-kin of the deceased donors have significant impact on the number of deceased organ donations. Several studies showed that timing and framing of the request to perform the organ removal influence the outcome of the request (Beard et al., 2004) .

The study of Byrne and Thomson (2000) suggests that the financial incentives to become a donor may lead to a decline in the number of donors. One of the reasons is that financial incentives distort the signal about the true preferences of the deceased donor. It raises a question if an individual agreed because of the monetary discount or for sake of becoming a donor. Thus the family of the descendent will be more likely to decline the removal of the organs. Byrne and Thompson found that the effect is the same for both families of registered and not registered donors. The study was performed using mathematical derivations and no empirical analysis was performed. A survey conducted by Mehmed C. et al (2003) showed that 70% of the International Society for Heart and Lung Transplantation members supported use of indirect compensation to increase the number of organ donations and 60% supported direct compensations.

Howard (2007) analyzed the effects of the establishment of the Organ Donation Breakthrough Collaborative on the number of organ donations. Organ Donation Breakthrough Collaborative, established in 2003, intended to increase the organ donation rates through encouraging hospitals and organ procurement organizations to become more efficient in identifying potential donors and obtaining their consent through educational sessions (Howard, 2007). Thought only 95 hospitals in the US participated and supported the program, studies showed that there was a positive effect on the conversion rates in the 95 Collaborative hospitals by 8%. The second phase of the Collaborative had a positive one time effect on the number of deceased donors in all hospitals in the US while the number of donors continued to rise in the 95 collaborative hospitals which participated in the Collaborative. That reflects the positive effect and success of the Collaborative actions (Howard 2007).

Fage et al (1994) estimated the effect of three legislations enacted in Texas: Uniform Anatomical Gift Act 1968, Texas Justice of the Peace/Medical Examiner Law of 1977, and the Texas Routine Inquiry Law of 1988. The Texas Justice of Peace/Medical Examiner law "permits the removal of corneal tissue from any deceased person when an inquest is performed into the cause and manner of death." [4]Also, next- to-kin cannot object against the transplantation. The Texas Routine Inquiry Law put a mandatory obligation on hospitals to inform next-to-kin about the possibility to donate organs and tissues of deceased's' relatives. The analysis was conducted using data on the number of donations of the whole eyes and corneoscleral tissues from cadaveric donors coveting 1961-1990 period. The data was collected from the Lions Eye Bank of Texas. The results showed that before introduction of the UAGA 1968 the mean number of donors was 72 per year and after the UAGA enactment in 1970 the number increased to 215. After the enactment of the Justice of the Peace/Medical Examiner Law in 1977 the number of donors further increased to 1329 per year. After 1988, the implementation of the Routine Injury Law, the average number of donors further increased to 1958 per year. According to their study, an effective legislation can improve the ability to retrieve more corneas.

[4] Farge, E., et al. (1994). The impact of State Legislation on Eye Banking. *Socioeconomics of ophthalmology, Vol. 112*

The current research tries to contribute to existing papers by analyzing the effect of the fatal car incidents, cerebrovaclural deaths, smoking, alcohol consumption, education, religion, age, health insurance, ethnicity, income and UAGA 1987 on the number of deceased donors in the US during 1988 – 2002 period. The main goal of the paper is to determine whether UAGA 1987legislation had an intentional positive effect on the number of organ donors. No empirical analysis of the UAGA 1987 was conducted earlier.

4. Methods

4.1.1. Sample

The initial sample for the analysis consisted of 41 states including Puerto Rico and District of Columbia. States Alaska, Delaware, Idaho, Maine, Montana, New Hampshire, North Dakota, Rhode Island, South Dakota, Vermont and Wyoming were excluded from the analysis sample because no data on organ donations could be found for them. States Hawaii and Puerto Rico were also excluded later due to issues associated with data availability on exogenous variables. The final sample consists of 39 states.

Table 1: Years of enactment of the UAGA 1987

State	Year When Enacted	State	Year When Enacted
Arkansas	1989	Washington	1993
California	1989	Indiana	1995
Nevada	1989	Iowa	1995
Utah	1990	New Mexico	1995
Virginia	1990	Oregon	1995
Wisconsin	1990	Pennsylvania	1995
Minnesota	1991	Arizona	1996
		Alabama	2003

Source: The Organ Procurement and Transplantation Network, Retrieved from : http://optn.transplant.hrsa.gov/

Table 1 above indicates the sequence of UAGA 1987 enactment among the States. By 2003, 15 States enacted the legislation, starting from Arkansas, California and Nevada in 1989 and ending with Alabama in 2003.

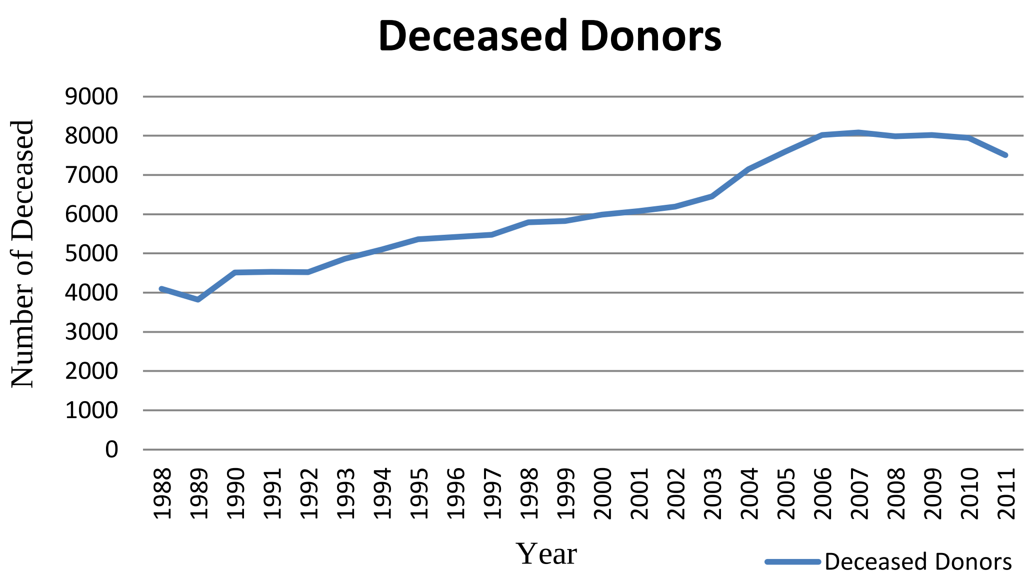
The data for the number of organ donors is available staring from 1989 onward. The next reform after UAGA 1987 aiming to increase the number of donors was enacted in 2003 – Organ Donation Breakthrough Collaborative 2003. To separate the effects of those events we analyze only 1989 - 2002 period where no macro policies on organ donation, apart from UAGA 1987, were enacted.

The entire sample of states is split into two sub-samples. The first sample is a duplicate of the initial sample with 39 states. The second sub-sample excludes states which enacted the legislation before 1995, namely: Arkansas, California, Nevada, Utah, Virginia, Wisconsin, Minnesota and Washington. Second sub-sample is created especially for synthetic control group analysis. The method constructs a synthetic control group for a pre- and post -enactment stages by taking the assigned weights to the values of the states in the control group. Since the weights are based on the pre-enactment values, short pre-enactment period would result in lower convergence level between the actual and synthetic groups in the pre-enactment period. That is why only states which enacted the legislation in 1995-1996 are analyzed. By analyzing the states which enacted the legislation in 1995 or 1996 the length of the pre- and post- enactment periods allows us to achieve better convergence between the synthetic control and treatment groups in the pre-enactment period. For this reason two samples are used: 39 state sample for the first part of the analysis and 30 state sample for the second part.[5]

4.1.2 Data Description

The endogenous variable in the analysis is the number of deceased organ donations per million population. As indicated in the Figure 1 both deceased is increasing in numbers through time in the US. The growth of deceased donors slows down after 2006 and stays almost constant till 2010.

Figure 3: Number of deceased donors in the US



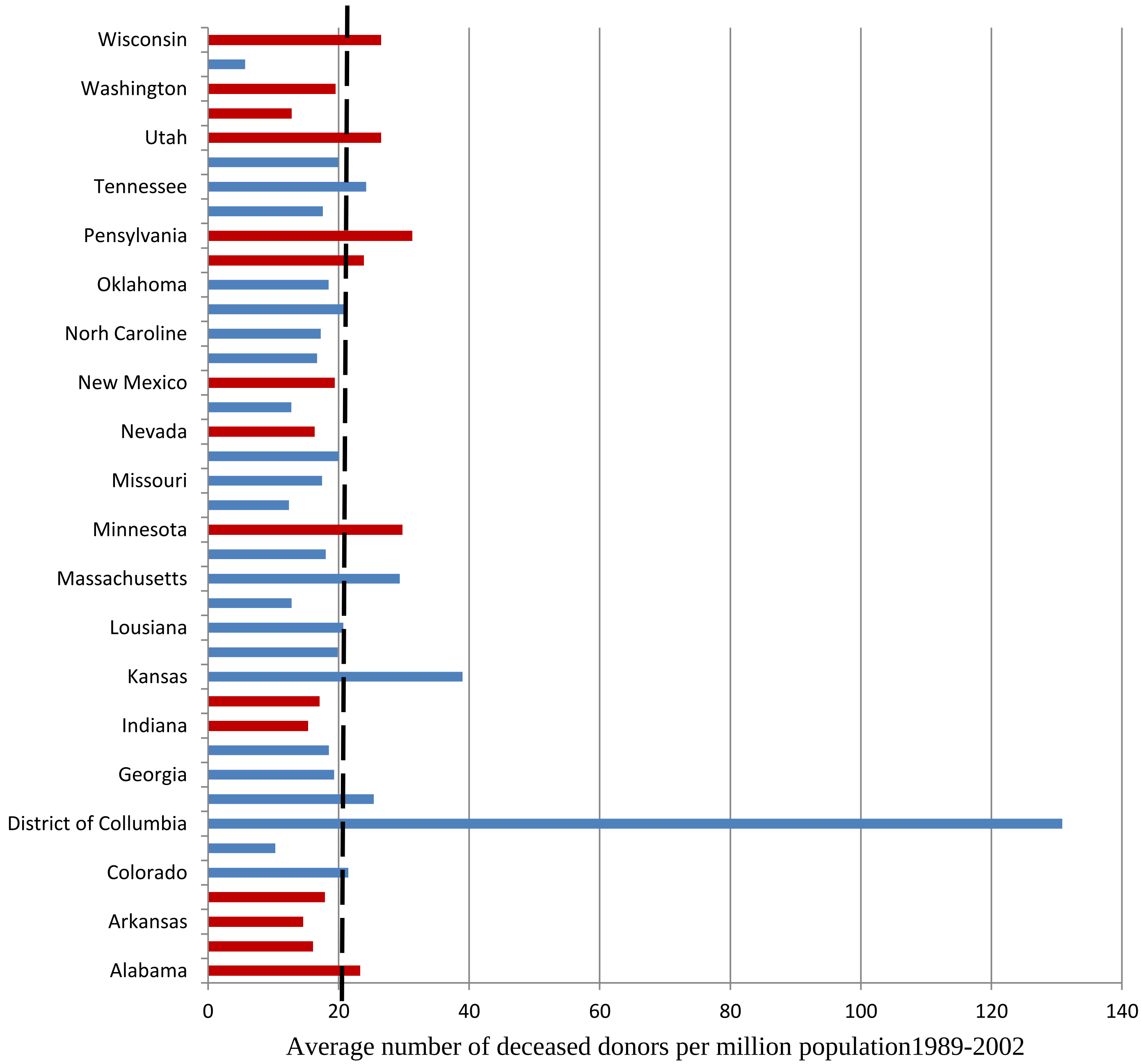
Source: The Organ Procurement and Transplantation Network, Retrieved from : http://optn.transplant.hrsa.gov/

[5] West Virginia is also excluded because of the missing observations for the second analysis sample

Figure 3 visualizes the pathway of the number of Deceased donors in the US for the period of 1988-2011. Starting from 1988 there was a stable growing trend continued up till 2003. In this period the number of deceased donors increased from 4095 to 6457. In a relatively short three year period between 2003 and 2006 there was a steady increase in the number of deceased donors by almost 24%. Howard (2007) suggests that such a sudden increase of deceased donor in 2003 was caused by the creation of the Organ Donation Breakthrough Collaborative.

Figure 4 shows the average number of deceased donors per million population in 39 states for 1989-2002 period. States marked in the red color are the ones with enacted the legislation and those in blue are otherwise. The dotted black line indicates the US average for the same period which is equal to 22 deceased donors per million population. The states are above the average include Wisconsin, District of Columbia, Kansas, Florida, Alabama, Massachusetts, Minnesota, Pennsylvania, Utah and Oregon. Only half of those states enacted the legislation. The District of Columbia outperforms the average by 122 deceased donors per million population. Such high value can be explained by the smaller population in the District of Columbia. Due to such high value of deceased number of donors per million population the regression analysis and synthetic group analysis are checked for robustness by excluding District of Columbia.

Figure 4: Average number of deceased donors per million population



Source: The Organ Procurement and Transplantation Network, Retrieved from : http://optn.transplant.hrsa.gov/

The list of explanatory variables in the analysis was based on the literature review presented in the section 2. Table 2 summarizes these variables by providing their full name, years for which the data was available, years for which the data was interpolated or extrapolated as well as the source.

Table 2: Variable list and Sources

Variable Name Units of measurement in parentheses	**Years available**	**Interpolated/Extrapolated for years**	**Source**
Deceased Donor (N)	1988-2002	-	Organ Procurement and Transplantation Network
GDP per capita (thousand $)	1988-2002	-	Bureau of Economic Analysis
Fatal car incidence (N/million population)	1994-2009	1990-1993	National Hightway Traffic Safety Administration
Percentage of population smoking (%)	1990-2002	-	America's Health Rankings
Excessive Alcohol Consumption as percentage of population (%)	1994-2010	1990-1994	Centers of Disease Control and Prevention
Population in millions (N)	1988-2002	-	Infoplease
Percentage of population who are Christians (%)	1990 & 2001	1990-2001	American Religious Identification Survey
Percentage of population who belong to other religions (%)	1990 & 2001	1990-2001	American Religious Identification Survey
Percentage of population younger than 65 years old (%)	1990 & 2000	1990 - 2000	American Religious Identification Survey
Cerebrovascular deaths in thousands (thousand N/million population)	1988-2002	-	Centers of Disease Control and Prevention
Percentage of population with lack of health insurance (%)	1990-2002	-	America's Health Rankings
Percentage of population with high school diploma of higher (%)	1990 & 2000 & 2004	1990-2002	U.S. Census Bureau
Asians as Percentage of population (%)	1990 & 2000-2002	1990 - 2000	CensusScope
Whites as Percentage of population (%)	1990 & 2000-2002	1990 - 2000	CensusScope
Hispanics as Percentage of population (%)	1990 & 2000-2002	1990 - 2000	CensusScope
Blacks as Percentage of population (%)	1990 & 2000-2002	1990 - 2000	CensusScope

Due to the lack of available data some of variables are interpolated or extrapolated. Religious groups, age distribution, education and ethnicity variables were interpolated using linear interpolation method. Fatal car crashes, alcohol consumption were extrapolated using average growth rate during the period for which the data was available. The periods of time for which those variables were interpolated or extrapolated are listed in the Table 2.

Tables three and four provide summary statistics of the variables used in the model. Table 3 provides summary statistics for the sample with 39 states and Table 4 for the sample with 30 states.

Table 3:Descriptive Statistics sample with 39 states

Sample with 39 states					
Variable	Obs	Mean	Std. Dev.	Min	Max
smoking	503	24.16658	3.633164	12.9	35.7
alcohol	351	3.780813	1.398177	1.2	8.7
alcohol(interpolated)	507	3.304848	1.574031	0.364801	8.7
christians	468	84.12553	6.005615	65.60333	96.19215
other_religions	468	3.625608	2.115184	0.6444054	10.98901
pop_under_65	429	87.36906	1.796316	81.7	91.5
health_insurance	507	14.28207	4.21391	6.4	25.8
education(interpolated)	507	79.57455	16.48908	64.3	412.9411
asian	507	2.080662	1.833625	0.15	12
white	507	75.34354	13.94855	27.37	95.93
hispanic	507	7.596311	8.88111	0.47	42.08
black	507	12.92984	11.98955	0.63	65.12
donors	574	22.85858	19.15173	1.111729	157.8947
death_by_pop	581	0.5432007	0.1121013	0.2923795	0.8503466
Car_crashes	351	150.4311	48.23646	60.07968	299.9644
gdp_capita	585	28.51672	11.47548	13.77287	118.6287
corrected_donors	574	22.74617	19.40633	1.111729	157.8947
car_crashes(interpolated)	507	151.7156	47.32131	60.07968	299.9644

In the sample with 39 states, on average 24% of population are smoking. The average percentage of population with excessive alcohol consumption equals to 3.77%. The mean extrapolated alcohol consumption is 3.3%. In this sample 84% of population are Christians, 4% individuals belonging to other religions. Eighty-seven percent of population are younger than 65 years old and 14.3% of population lack health insurance. On average, 80 % of population have high school diploma or higher. Data on racial composition suggests that 2% of population are Asians, 75% are Whites, 7.6% are Hispanic and 13% are African Americans. The mean value of the diseased donors per million population equal to 23. There are 0.541 thousand (or 541) cerebrovascular deaths per million population and there are 150 fatal car crashes per million population, on average. The average extrapolated car crashes per million population equal to 152. The average GDP per capita is equal to 28,4 thousand dollars.

Table 4:Descriptive Statistics sample with 30 states

Sample with 30 states

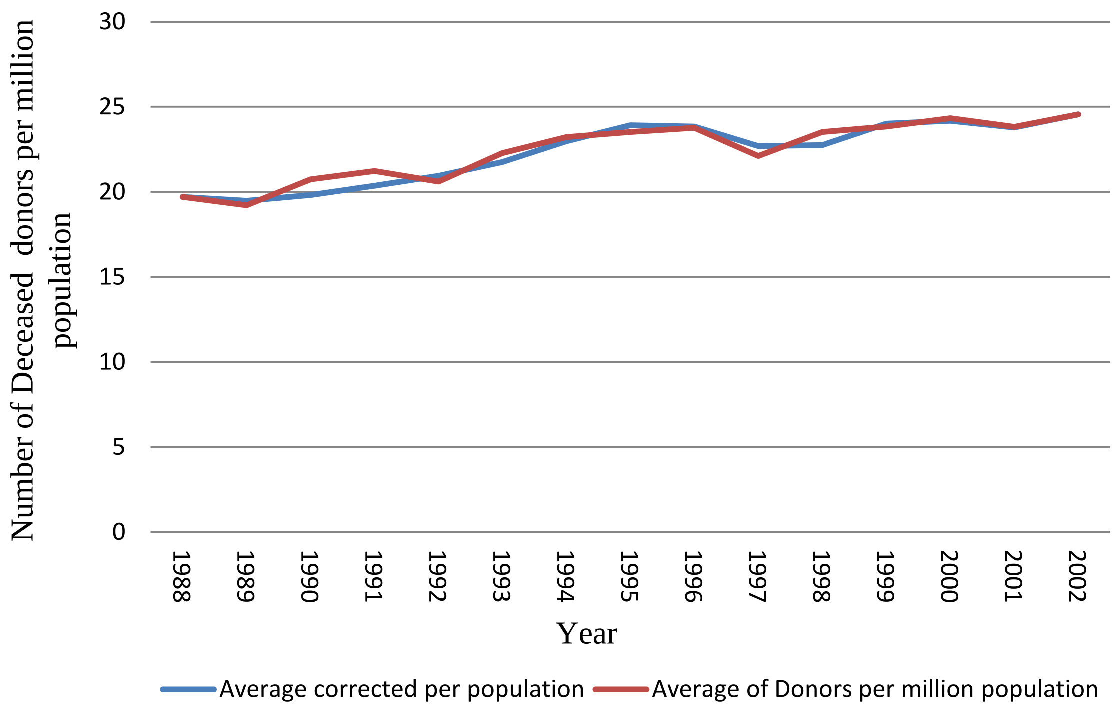
Variable	Obs	Mean	Std. Dev.	Min	Max
smoking	386	24.41526	3.087615	16.4	35.3
alcohol	270	3.699748	1.299573	1.2	8.7
alcohol(interpolated)	390	3.168361	1.421055	0.364801	8.7
christians	360	84.86841	5.566297	65.60333	96.19215
other_religions	360	3.706748	2.19406	0.6444054	10.98901
pop_under_65	330	87.22983	1.639306	81.7	90.4
health_insurance	390	14.31994	4.199097	6.4	25.8
education(interpolated)	390	78.33925	5.09377	64.3	88.90868
asian	390	1.737509	1.169362	0.15	6
white	390	73.90011	13.94807	27.37	95.93
hispanic	390	7.597712	8.934233	0.6	42.08
black	390	14.73413	12.75334	1.56	65.12
donors	450	23.65328	21.2558	4.578754	157.8947
death_by_pop	446	0.545036	0.1031921	0.305921	0.8249337
car_crashes	270	153.0331	50.5263	60.07968	299.9644
gdp_capita	450	28.97324	12.53104	13.77287	118.6287
corrected_donors	450	23.56849	21.55336	4.517222	157.8947
car_crashes(interpolated)	390	153.793	49.54391	60.07968	299.9644

In the sample with 30 states, on average, 24% of population are smoking and 3.7% of population are excessive alcohol consumers. Mean extrapolated alcohol consumption equals to 3.2%. On average there are 85% Christians, 4% individuals belonging to other religions. 87% of population are younger than 65 years old and 14.2% lack health insurance. On average, 78 % of population have high school diploma or higher. Two parcent of population are Asians, 74% are white, 7.6% are Hispanic and 15% are African Americans. The mean value of the diseased donors per population equals to 23,7%. There are 0.545 thousand (or 545) cerebrovascular deaths per million population and there are 153 fatal car crashes per million population, on average. The average extrapolated car crashes per million population equals to 154. The average GDP per capita is equal to 29 thousand dollars.

The second sample has fewer observations due to excluded states. The percentage of individuals with high school diploma or higher is higher by 1% in the sample with 39 states. The percentage of White individuals in the sample with 30 states is lower by almost 1.5% . There are more Blacks in the second sample by almost 2%. There are 3 less fatal car accidents per million population in the sample with 39 states. The extrapolated crashes per million population differ by 2. The difference between other variables is minor (less than 1%). The GDP per capita is higher by 1 thousand dollars in the sample with 30 states.

4.1.3 Smoothening

Figure 5:Corrected number of deceased donors per million population



The data on the number of deceased donors is extremely volatile for some of the states. For state Wisconsin the number of deceased donors per million population in 1991 was equal to 125 while in 1992 the number plummeted to 92 and then increased to 144 in 1993. As of 1993 the number of deceased donors was increasing with no extreme swings. In Texas the number of deceased donors was 319 per million population in 1988, while in 1989 it dropped to 129 severely and increased 314 in 1990.

The population in all states is increasing with no extreme swings, thus the swings in number of deceased donors per million population cannot be caused by the fluctuations in number of population. To correct for extreme swings in the data a parabolic interpolation method is used. By using parabolic interpolation the predicted values are adjusted in a way to produce the best possible fit with the actual data and to reduce the extreme swing by as much as possible.[6] To distinguish between the values which were corrected and the actual values we will refer the interpolated values as the corrected and actual data as actual through the text. Later, two models are estimated using both corrected and actual number of deceased donors to evaluate the robustness of the results.

Figure 5 above plots the values of the actual and corrected average values of the deceased donors per million population. Two lines almost coincide and follow the same trend.

Table 5: Difference between corrected and actual values

Variable		Mean	Std. Dev.	Min	Max
Dataset with 39 states					
Actual deceased donors per population	overall	22.85858	19.15173	1.111729	157.8947
	between		1.980167	19.21171	25.20171
	within		19.05505	2.750626	156.2897
Corrected deceased donor per population	overall	22.74617	19.40633	1.111729	157.8947
	between		2.075356	19.48059	25.20171
	within		19.30147	3.503703	155.9973
Dataset with 30 States					
Actual deceased donors per population	overall	23.65328	21.2558	4.578754	157.8947
	between		2.174657	19.85228	26.22259
	within		21.15149	6.494184	156.1257
Corrected deceased donor per population	overall	23.56849	21.55336	4.517222	157.8947
	between		2.318351	19.81202	26.22259
	within		21.43642	6.308293	155.8164

Table 5 provides the magnitude of the difference between the actual and corrected values. In the sample with 39 states the actual average number of deceased donors per million population was 22.86 while the corrected number was 22.75. The number of deceased donors per million population differs only by 0.1 in the sample with 30 states. The difference between overall, between and within minimum and maximum values are small. Same holds for the sample with 30 states.

[6] Formulas and manuals were taken from : http://www.xlxtrfun.com/XlXtrFun/XlXtrFun.htm

4.2. Model

To evaluate the effect of the legislation in the number of organ donations two following econometric techniques are used: difference in difference estimation and synthetic group analysis.

4.2.1 Difference in Difference

In the difference in difference model we compute the effect of the legislation by analyzing the difference between trends of states which did not impellent the legislation (the control group) and the states which did implement it (the treatment group). Here, the critical assumption has to be made that both control group and treatment group have the same trend before implementation of the legislation. That assumption will be later omitted in further analysis. The fixed effects and random effects models are estimated, where in fixed effects models we account for state specific time invariant characteristics. The Hausman test is performed to identify if the difference between the estimated coefficients of fixed and random effects model is systematic. If the difference between the estimates is systematic, then a fixed effects model estimators are preferred (Verbeek M., 2011). We first estimate the models with no covariate. Later we expand the model by adding other exogenous variables which influence the number of deceased donors.

The following models are estimated to compute the effect of the legislation:

<u>Fixed Effects</u>:

$$y_{it} = \alpha_i^F + \beta_1 * X_{it} + \beta_2 * Trend_t + \beta_3 * Trend_t * Legislation_{it} + \beta_4 * Trend_t^2 + \beta_5 * Trend_t^2 * Legislation_{it} + \beta_6 * Legislation_{it} + \varepsilon_{it}^F$$

<u>Random Effects</u>:

$$y_{it} = \mu^R + \beta_1 * X_{it} + \beta_2 * Trend_t + \beta_3 * Trend_t * Legislation_{it} + \beta_4 * Trend_t^2 + \beta_5 * Trend_t^2 * Legislation_{it} + \beta_6 * Legislation_{it} + \beta_7 * Treatment_i + \alpha_i^R + \varepsilon_{it}^R$$

Where:

X - vector of explanatory variables which vary through time

Trend - time trend which is allowed to be nonlinear since the quadratic term of time trend is also included in the model.

ε^F_{it} - the error term which is assumed to be i.i.d over individuals and time (Verbeek M. 2011).

α^F_i - the individual intercept which captures all the time-invariant differences across states (Verbeek M. 2011).

E^R_{it}- a remainder error term which is assumed to be uncorrelated over time (Verbeek M. 2011).

α^R_i- is an individual specific error term consisting of random factors independently and identically distributed over individuals and does not vary over time (Verbeek M. 2011).

μ^R-overall intercept (Verbeek M. 2011).

Treament- is a dummy variable which is equal to 1 if the states enacted the legislation in any year between 1988 and 2002.

Legislation- dummy which takes a value of 1 if the state i is in the treatment group and the time period t is at of after the year of the enactment of the legislation or:

$$\begin{cases} Legislation = 1 \ if \ Treament = 1 \ and \ Trend_t \geq Trend_i^* \\ Legislation = 1 \ if \ Treament = 0 \ and \ Trend_t \leq Trend_i^* \end{cases}$$

Two interaction terms between the quadratic trend and the trend are included to measure the difference between the treatment group and the control group.

Full effect of the legislation is following:

Fixed effects Model:

$$\frac{dy_{it}}{dLegislation_{it}} = \beta_6 + \beta_3 * Trend_t + \beta_5 * Trend_t^2$$

Random Effects Model:

$$\frac{dy_{it}}{dLegislation_{it}} = \beta_6 + \beta_3 * Trend_t + \beta_5 * Trend_t^2 + \beta_7$$

The legislation has two effects on the number of the deceased donors through change in the level and slope of the trend. The level effect is captured by β_6 and β_7, which moves the trend line up or down depending on the sing of the β_6 and β_7 coefficients. With a positive sum of β_6 and β_7 the enactment of the legislation will increase the number of deceased donors by a fixed number of donors for all years after enactment. The opposite holds for a negative sum of the β_6 and β_7 . The coefficients β_3 and β_5 capture the second effect of the legislation which changes the slope of the trend upwards or downwards depending on the sing of the coefficients. With the positive values of ($\beta_{3}*Trend_t + \beta_{5}*Trend_t^2$) there will be an upward bend of the slope of the trend. The opposite holds for negative values of ($\beta_{3}*Trend_t + \beta_{5}*Trend_t^2$).

The estimated models with no covariates take the following form:

Fixed Effects:

$$Donors_{it} = \alpha_i^F + \beta_1 * Trend_t + \beta_2 * Trend_t * Legislation_{it} + \beta_3 * Trend_t^2 + \beta_4 * Trend_t^2 * Legislation_{it} + \beta_5 Legislation_{it} + \varepsilon_{it}^F$$

Random Effects:

$$Donors_{it} = \mu^F + \beta_1 * Trend_t + \beta_2 * Trend_t * Legislation_{it} + \beta_3 * Trend_t^2 + \beta_4 * Trend_t^2 * Legislation_{it} + \beta_5 Legislation_{it} + \beta_{20} * Treatment_i + \varepsilon_{it}^R$$

The final models used for the analysis consists of:

Fixed Effects:

$$Donors_{it} = \alpha_i^F + \beta_1 Car\_crashes_{it} + \beta_2 Education_{it} + \beta_3 Smoking_{it} + \beta_4 Alcohol_{it} + \beta_5 Death\_by\_pop_{it} + \beta_6 Chistians_{it} + \beta_7 Other\ Religions_{it} + \beta_8 Pop\_under\_65_{it} + \beta_9 Health\_insurance_{it} + \beta_{10} Trend_t + \beta_{11} * Trend_t * Legislation_{it} + \beta_{12} * Trend_t^2 + \beta_{13} * Trend_t^2 * Legislation_{it} + \beta_{14} GDP\_capita_{\ it} + \beta_{15} Asian_{\ it} + \beta_{16} White_{\ it} + \beta_{17} Black_{\ it} + \beta_{18} Hispanic_{\ it} + \beta_{19} Legislation_{it} + \varepsilon_{it}^F$$

Random Effects:

$$Donors_{it} = \mu^F + \beta_1 Car\_crashes_{it} + \beta_2 Education_{it} + \beta_3 Smoking_{it} + \beta_4 Alcohol_{it} + \beta_5 Death\_by\_pop_{it} + \beta_6 Chistians_{it} + \beta_7 Other\ Religions_{it} + \beta_8 Pop\_under\_65_{it} + \beta_9 Health\_insurance_{it} + \beta_{10} Trend_t + \beta_{11} * Trend_t * Legislation_{it} + \beta_{12} * Trend_t^2 + \beta_{13} * Trend_t^2 * Legislation_{it} + \beta_{14} GDP\_capita_{\ it} + \beta_{15} Asian_{\ it} + \beta_{16} White_{\ it} + \beta_{17} Black_{\ it} + \beta_{18} Hispanic_{\ it} + \beta_{19} * Legislation_{it} + \beta_{20} * Treatment_i + \alpha_i^R + \varepsilon_{it}^R$$

Table 6 below provides full information on the variable used in the models mentioned above.

Table 6: List of variables used in the analysis

Variable name in the model:	Description:
Donors	Number of deceased donors per million population
Trend	Trend
Legislation*Trend	Interaction term between Legislation dummy and trend
Trend^2*Legislation	Interaction term between Legislation dummy and trend squared
Trend^2	Trend squared
Legislation	Legislation dummy which takes a value of 1 if the state is in the treatment group and the observation is in the period after the implementations of the legislation
Treatment	Treatment dummy variable which is equal to 1 if the states enacted the legislation in any year between 1988 and 2002
Death_by_pop	Thousand brain death in medical facilities per million population
Car_crashes	Interpolated number of fatal traffic accidents per million population
Gdp_capita	GDP per capita
Smoking	Percentage of population smoking
Alcohol	Interpolated percentage of population with excessive alcohol consumption
Christians	Percentage of population who are Christians
Other_religions	Percentage of population who have other than Christian believes
Pop_under_65	Percentage of population under 65 years old
Health_insurance	Percentage of population who lack health insurance
Education	Interpolated percentage of population with high school diploma of higher
Asian White Hispanic Black	Ethnical variables which measure the percent of population who are black, white or Hispanic.

4.2.2 Synthetic group analysis

Suppose we have J+1 states which in the sample and only the first state is affected by the legislation/implemented legation. All other J states did not implement it, thus they are potential control states. Let Y^N_{it} denote the outcome from the model (number of deceased donors per million population) for the state i in period t ranging from 0 to T with absence of the intervention. Let T_0 be the number of periods before the intervention, with $1<T_0<T$. Let Y^I_{it} denote the outcomes for states i in period t if the state is exposed to the intervention in periods T_0+1 to T. We assume that the intervention has no effect before the implementation period, $1<t<T_0$. Thus in the period before the implantation $Y^N_{it}= Y^I_{it}$, or outcome in the state which implemented the legislation is equal to the outcomes of the states which did not implement the legislation. (Abadie A. et al., 2010; Machado M. & Sonz-de-Galdeano A., 2011)

Let $\alpha_{it} = Y^I_{it} - Y^N_{it,}$ which measures the effect of the legislation and D_{it} be the dummy which is equal to 1 if the state i is effected by the state at period t, and zero otherwise. Then the general formula for all outcomes takes a form $Y_{it} = Y^N_{it} + \alpha_{it} * D_{it.}$ Since only the first state is exposed by the legislation, the effect of legislation which we are trying to estimate is $\alpha_{1t} = Y^I{}_{1t} - Y^N_{1t}= Y_{1t} - Y^N_{1t}$. Y_{1t} is the output we observe, while the Y^N_{1t} is the one we have to estimate by construction a synthetic control group from the pool of states which did not implement the legislation. Synthetic group analysis constructs this synthetic control group by searching for a weighted combination of control States chosen to approximate the unit affected by the intervention in terms of the outcome predictors. (Abadie A. et al. 2010, Machado M. & Sonz-de-Galdeano A. 2011) The list of predictors used in the current analysis are: number of deceased donors lagged by one period, number of thousand of cerebrovasculat deaths by million population, number of fatal incidents by million population, GDP per capita, prevalence of smoking in the population, alcohol consumption, percentage of Christians in the population, percentage of individuals in the population who belong to other religions , age distribution, percentage of population with health insurance, education and ethnicities.

5. Results

5.1 Difference in Difference Analysis

Table 7: Hausman Test

39 states				30 states			
(I) Actual number of donors		(II) Corrected number of donors		(I) Actual number of donors		(II) Corrected number of donors	
No Covariates	With Covariates	No Covariates	With Covariates	No Covariates	With Covariates	No Covariates	With Covariates
Random Effects	Random Effects	Random Effects	Fixed Effects	Random Effects	Fixed Effects	Random Effects	Fixed Effects

To estimate the effect of the legislation on the number of deceased donors per million population a fixed effects and random effects models are estimated. Later a Hausman test was performed to evaluate whether the difference between the coefficients of the fixed and random effects models was systematic. The results of the Hausam tests are summarized in the Table 7. For models with systematic difference between the fixed and random effects estimates the fixed effects estimates are preferred. With no systematic difference – random effect. Estimated coefficients from both models are presented and the difference between them are discussed.

The analysis starts from 1988 as that is the earliest data available and ends in 2002 because the next reform to increase the number of donors was enacted in 2003 – Organ Donation Breakthrough Collaborative 2003. To separate the effects of the legislations we analyze only the 1989 - 2002 period where no major macro economical policies, apart from UAGA 1987, were enacted.

We estimate eight models, both fixed and random effects for: 1) the sample with 39 states using actual values of the deceased donors per million population 2) the sample with 39 states using corrected values of the deceased donors per million population 3) the sample with 30 states using actual values of the deceased donors per million population 4) the sample with 30 states using corrected values of the deceased donors per million population.

The regression results for the models are provided in the Tables 8 and 9 below. All estimated coefficients are interpreted by rounding the number to the nearest integer, so 8.78 would be interpreted as an increase in deceased donors per population by 9.

Model estimated with 39 states and no covariates

Models with Actual and Corrected number of deceased donors

The legislation dummy is statistically significant and positive in all models. The implementation of the legislation increased the number of deceased donors per million population by four.

Models estimated with 39 states and with covariates

Model with Actual number of deceased donors – Random Effects model

Here for the model with actual number of deceased donors all coefficients are interpreted from the random effects model, unless stated otherwise. We compare the results with the fixed effects estimations.

The regression results show that an increase in one thousand cerebrovascular deaths per million population will bring 10 extra deceased donors per million population, ceteris paribus. The estimated effect is statically significant. The fixed effects model estimates coefficient with the same magnitude and statistical significance..

Number of fatal traffic accidents per million population has a positive effect on the number of deceased donors and the effect is statistically significant. An increase in one fatal traffic accidents per million population will results in less than one extra deceased donors per million population, ceteris paribus. The magnitude and significance of the estimate does not differ a lot between the models.

Income of the individuals is statistically significant and has a positive impact on the amount of deceased donors. Here an increase in GDP per capita by one thousand dollars is assonated with one extra deceased donor per million population. The fixed effects estimator is lower that the random effects estimator by 0.36.

Education has a predicted positive effect and is statistically significant. In both models a one percentage point increase in share of individuals with high school diploma or higher will results in one extra deceased donor per million population, ceteris paribus.

Excessive alcohol consumption has a negative effect on the number of deceased donors per million population. The effect of one percentage point increase in share of population who are excessive alcohol consumers will reduce the number of deceased donors per million population by less than one. The fixed effects model estimates less negative coefficient which is statistically insignificant.

The Legislation dummy is statistically significant using 10% significance level and has a positive effect. Legislation dummy indicates the level effect of the legislation. It is estimated that the implementation of the UAGA brings almost 5 extra deceased donors per million population. Same effect is estimated in the random effects model.

Model with Corrected number of deceased donors – Fixed Effects model

Here for the model with corrected number of deceased donors all coefficients are interpreted from the fixed effects model, unless stated otherwise. We compare the results with the random effects estimations.

Number of cerebrovascular deaths per million population has a statistically significant positive effect. An increase in a thousand cerebrovascular deaths per million population increases the number of deceased donors per million population by 12, ceteris paribus. The magnitude increases by almost 2 deceased donors if the random effect model is used.

Number of fatal traffic accidents per million population has a positive effect on the number of deceased donors and is statistically significant. In both regressions the magnitude of an increase in number of fatal traffic accidents per million population is less than one, ceteris paribus. Random effects model estimates slightly lower coefficient.

Income of the individuals is statistically significant in both models and has a positive impact on the amount of deceased donors. Here an increase in GDP per capita by one thousand dollars is assonated with one extra deceased donor per million population. The random effects estimator is slightly higher.

Education has a predicted positive effect and is statistically significant in both models. In the fixed effects model a one percentage point increase in share of individuals with high school diploma or higher will results in almost 2 more deceased donors per million population, ceteris paribus. The random effects mode estimates the coefficient which is lower by 0.35

African Americas are the ethnicity with the highest magnitude among other ethnicities groups. The estimated effect is statistically significant. A one percentage point increase in the share of African Americas in the population will increase the number of deceased donors per million population by 2, ceteris paribus. Results contradict the findings in the literature. The diverging estimates of the ethnicities can be caused by data interpolation. The estimated coefficient in the random effect model is two times lower.

The Legislation dummy is statistically significant using 10% significance level and has a positive effect. Legislation dummy indicates the level effect of the legislation. It is estimated that the implementation of the UAGA brings almost 5 extra deceased donors per million population. In the random effect model the magnitude of the legislation decreases to 4 deceased donors per million population.

Models estimated with 30 states and with covariates

Model with Actual number of deceased donors – Fixed Effects model

Here for the model with actual number of deceased donors all coefficients are interpreted from the fixed effects model, unless stated otherwise. We compare the results with the random effects estimations.

Number of cerebrovascular deaths has a positive effect on the number of deceased donor per million population. A one thousand increase in cerebrovascular death would increase the number of deceased donors per million population by 11. In the random effects model that effect is increased by 1. Also, the statistical significance of the estimate increases.

The estimated magnitude of the fatal car incidence is positive and small, were extra 100 accidents per million population would increase the number of deceased donors per million population by 7. The estimated effects are almost identical in both random and fixed effects models. Also, both estimated coefficients are statistically significant.

An increase in income by one thousand would bring one extra deceased donor per million population. The estimated coefficient in random effects model is higher by 0.5. Both estimates are statistically significant.

Education has a predicted positive effect and is statistically significant in both models. A one percentage point increase of share of individuals with high school diploma or higher will results in 2 extra deceased donor per million population, ceteris paribus. In the random effects model that magnitude is reduced by one.

In the random effects model excessive alcohol consumption decreases the number of deceased donors per million population by one. That magnitude decreases in the fixed effects model and becomes insignificant.

Model with Corrected number of deceased donors – Fixed Effects model

Here for the model with corrected number of deceased donors all coefficients are interpreted from the fixed effects model, unless stated otherwise. We compare the results with the random effects estimations.

Number of cerebrovascular deaths has a positive effect on the number of deceased donor per million population. A one thousand increase in cerebrovascular death would increase the number of deceased donors per million population by 16. In the random effects model that effect is increased by 2.

The estimated magnitude of the fatal car incidence is positive and small, were extra 100 accidents per million population would increase the number of deceased donors per million population by 5. The estimated effects are almost identical in both random and fixed effects models. The statistical significance is reduced in the random effects model.

In both models, an increase in income by one thousand would bring one extra deceased donor per million population. Both estimates are statistically significant.

Excessive alcohol consumption has an expected negative effect but is only statistically significant using 10% significance level. One percentage point increase in the share of population who are excessive alcohol consumers will decrease the number of deceased donors per million population by 1, ceteris paribus. The random effects estimator has a larger coefficient.

Education has a predicted positive effect and is statistically significant in both estimated models. A one percentage point increase in share of individuals with high school diploma or higher will results in two more deceased donors per million population, ceteris paribus. The fixed effects model estimates a coefficient which is lower by 0.5.

Based on all difference in difference models the following predictors were found to be significant and have a positive effect: Education, GDP per capita, Fatal car accidents and number of cerebrovascular deaths per million population. Also, the significance and magnitude of those variables are not sensitive to model specifications: be it fixed or random effects, with corrected or actual number of deceased donors per million population. The effect of legislation is not certain, since only Legislation dummy has statistically significant positive effect in the models estimated with 39 states. The interaction between legislation dummies and trends are statistically insignificant in all estimated models.

Table 8: Regression results of Fixed effects and Random effects model for sample with 39 states

	Fixed Effects				Random Effects			
VARIABLES	Actual number of donors		Corrected number of donors		Actual number of donors		Corrected number of donors	
Trend	0.83**	-0.30	0.86**	-0.68	0.83**	-0.49	0.86**	-0.29
	(4.31)	(-0.35)	(4.38)	(-0.93)	(4.32)	(-0.78)	(4.396)	(-0.51)
Legislation*Trend	-0.83	-1.03	-0.82	-0.72	-0.83	-1.09	-0.82	-0.73
	(-1.61)	(-1.40)	(-1.57)	(-1.16)	(-1.60)	(-1.482)	(-1.58)	(-1.15)
Trend^2*Legislation	0.02	0.06	0.02	0.03	0.02	0.06	0.02	0.03
	(0.7)	(1.27)	(0.64)	(0.78)	(0.70)	(1.35)	(0.64)	(0.77)
Trend^2	-0.02+	-0.07*	-0.02	-0.09**	-0.02+	-0.07*	-0.02	-0.20**
	(-1.66)	(-2.29)	(-1.62)	(-3.38)	(-1.67)	(-2.39)	(-1.62)	(-3.63)
Legislation	3.83+	5.03+	3.83+	4.77+	3.82+	4.93+	3.82+	4.37+
	(1.67)	(1.65)	(1.64)	(1.85)	(1.67)	(1.63)	(1.63)	(1.70)
Treatment					-1.82	3.10	-1.96	2.75
					(-0.28)	(-0.80)	(-0.28)	(0.70)
Death_by_pop		10.15*		12.29**		10.38*		13.91**
		(1.93)		(2.78)		(2.04)		(3.19)
Car_crashes		0,06**		0.05**		0.06**		0.04*
		(3.13)		(3.09)		(2.99)		(2.50)
Gdp_capita		0,77**		0.98**		1.13**		1.13**
		(4.02)		(6.04)		(-8.67)		(9.58)
Smoking		0.07		0.09		0.06		0.08
		(0.58)		(0.97)		(0.52)		(0.80)
Alcohol		-0.39		-0.39		-0.58+		-0.60*
		(-1.14)		(-1.36)		(-1.72)		(-2.10)
Christians		0.47		0.36		0.38		0.20
		(1.48)		(1.35)		(1.41)		(0.83)
Other_religions		-0.21		-0.66		-0.42		-0.97
		(-0.24)		(-0.86)		(-0.56)		(-1.47)
Pop_under_65		1.29		0.80		-0.92		-1.02
		(1)		(0.74)		(-1.19)		(-1.40)
Health_insurance		-0.07		0.06		-0.06		0.05
		(-0.57)		(0.61)		(-0.47)		(0.53)
Education		1.48**		1.79**		1.36**		1.44**
		(3.14)		(4.51)		(5.39)		(6.18)
Asian		2.37		0.41		0.24		0.09
		(1.17)		(0.24)		(0.23)		(0.08)
White		0.53		-0.24		0.14		0.09
		(0.5)		(-0.27)		(0.20)		(0.16)
Hispanic		1.38		1.09		0.58		0.65
		(1.38)		(1.28)		(0.81)		(1.00)
Black		1.74		1.97*		0.89		1.01+
		(1.54)		(2.07)		(1.40)		(1.71)
Constant	18.44	-351.23*	18.14**	-264.89*	18.81**	-97.44	18.57**	-77.33
	(29.88)	(-2.31)	(28.90)	(-2.07)	(4.70)	(-1.02)	(4.58)	(-0.86)
Observations	574	414	574	414	574	414	574	414
Number of id	39	39	39	39	39	39	39	39
R-squared	0.19	0.23	0.20	0.33	0.19	0.21	0.20	0.32
Notes:	T-statistics in parentheses . ** p<0.01, * p<0.05, + p<0.1				Z-statistics in parentheses . ** p<0.01, * p<0.05, + p<0.1			

Table 9: Regression results of Fixed effects and Random effects models for sample with 30 states

	Fixed Effects				Random Effects			
VARIABLES	Actual number of donors		Corrected number of donors		Actual number of donors		Corrected number of donors	
Trend	0.87**	-0.86	0.93**	-0.59	0.87**	-0.53	0.92**	-0.12
	(4.12)	(-0.82)	(4.21)	(-0.65)	(4.13)	(-0.76)	(4.21)	(-0.19)
Legislation*Trend	-2.20	-2.85	-4.71	-2.57	-2.21	-4.43	-4.71	-3.67
	(-0.68)	(-0.55)	(-1.40)	(-0.56)	(-0.67)	(-0.81)	(-1.40)	(-0.76)
Trend^2*Legislation	0.08	0.16	0.18	0.12	0.08	0.24	0.18	0.17
	(0.56)	(0.65)	(1.22)	(0.54)	(0.56)	(0.91)	(1.22)	(0.74)
Trend^2	-0.02+	-0.07*	-0.02*	-0.10**	-0.02+	-0.08*	-0.02+	-0.11**
	(-1.70)	(-1.94)	(-1.74)	(-3.10)	(-1.70)	(-2.27)	(-1.75)	(-3.52)
Legislation	11.69	12.57	27.01	13.83	11.71	19.67	27.03	18.81
	(0.64)	(0.47)	(1.42)	(0.59)	(0.63)	(0.68)	(1.43)	(0.75)
Treatment					-2.43	4.17	-2.74	4.23
					(-0.25)	(1.06)	(-0.27)	(1.09)
Death_by_pop		11.34+		16.21**		12.23*		17.77**
		(1.82)		(2.97)		(1.97)		(3.23)
Car_crashes		0.07**		0.05*		0.06**		0.04+
		(2.73)		(-2.16)		(2.66)		(1.86)
Gdp_capita		0.85**		1.10**		1.35**		1.38**
		(3.75)		(5.53)		(10.00)		(11.05)
Smoking		0.02		0.10		0.08		0.13
		(0.16)		(0.82)		(0.53)		(1.05)
Alcohol		-0.54		-0.71+		-0.82*		-0.97+
		(-1.21)		(-1.83)		(-1.92)		(-2.57)
Christians		0.51		0.51		0.40		0.27
		(1.16)		(1.31)		(1.32)		(0.97)
Other_religions		-0.94		-1.50		-0.12		-0.69
		(-0.79)		(-1.44)		(-0.15)		(-0.93)
Pop_under_65		0.98		0.52		-1.34+		-1.48+
		(0.58)		(0.35)		(-1.65)		(-1.91)
Health_insurance		-0.03		0.10		0.04		0.14
		(-0.17)		(0.71)		(0.28)		(0.99)
Education		2.04**		1.97**		1.36**		1.42**
		(3.25)		(3.59)		(4.68)		(5.25)
Asian		1.87		-0.83		-0.94		-1.36
		(0.77)		(-0.39)		(-0.72)		(-1.12)
White		0.15		-0.20		-0.04		0.027
		(0.11)		(-0.17)		(-0.06)		(0.046)
Hispanic		1.14		1.06		0.27		0.45
		(0.90)		(0.96)		(-0.38)		(0.67)
Black		1.06		1.72		0.64		0.83
		(0.75)		(1.38)		(-1.03)		(1.40)
Constant	18.82**	-326.52+	18.42**	-266.18	19.31**	-51.62	18.96**	-42.48
	(26.35)	(-1.66)	(24.76)	(-1.55)	(-4.30)	(-0.52)	(-4.17)	(-0.45)
Observations	450	324	450	324	450	324	450	324
Number of id	30	30	30	30	30	30	30	30
R-squared	0.20	0.24	0.20	0.35	0.20	0.21	0.21	0.33
Notes:	T-statistics in parentheses . ** p<0.01, * p<0.05, + p<0.1				Z-statistics in parentheses . ** p<0.01, * p<0.05, + p<0.1			

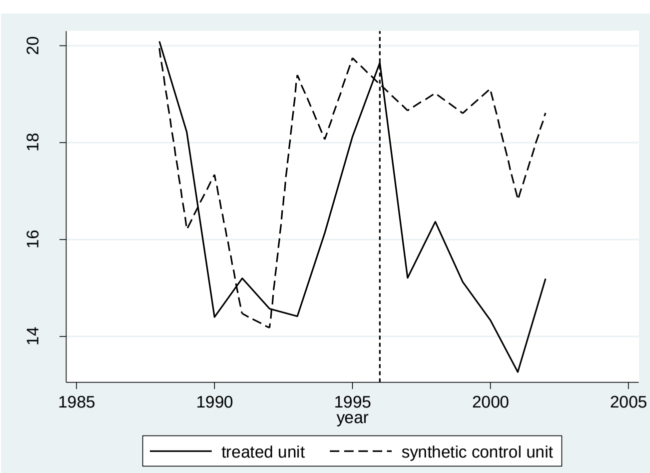
5.2 Synthetic control group

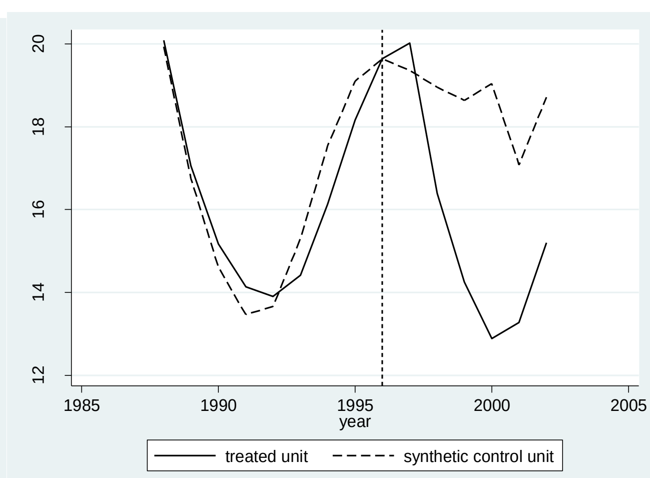
To deepen the analysis of the effect of the legislation a synthetic control group method is conducted. Here a synthetic control group is constructed from the pool of control states. The states in the control pool are those which did not implement the UAGA 1987 at all, or enacted in later than 2002. The list of controls include: Alabama, Arizona, Colorado, Connecticut, District of Columbia, Florida, Georgia, Illinois, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Nebraska, New Jersey, New York, North Caroline, Ohio, Oklahoma, South Carolina, Tennessee and Texas. Each State gets a weight based on the value of the predictors. Predictors used in the analysis include: lagged donors per population, carebrovascular deaths per million population, fatal traffic accidents per million population, gdp per capita, smoking, excessive alcohol consumption, religion groups, age distribution, lack of health insurance, education and ethnical groups.

The analysis was again conducted for the period 1989 – 2002 with 1995 as the event year. Alabama was also analyzed using 1996 as the event year, since Alabama enacted the legislation in 1996. Left graphs show the results of the synthetic control group analysis using values for the deceased donors per million population which are not smoothened. Dotted line represents the synthetic control which shows what would have happened if the state would have not enact the legislation. The right graphs incorporates the corrected values of the donor rates.

For most of the states when using actual number of deceased donors to construct control group it does not coincide with the treatment group in the pre enactment period. Thus no conclusions can be drawn from those results. That problem is overcame by using the corrected number of deceased donors. That is why we interpret the results only from synthetic control group analysis with corrected number of deceased donors.

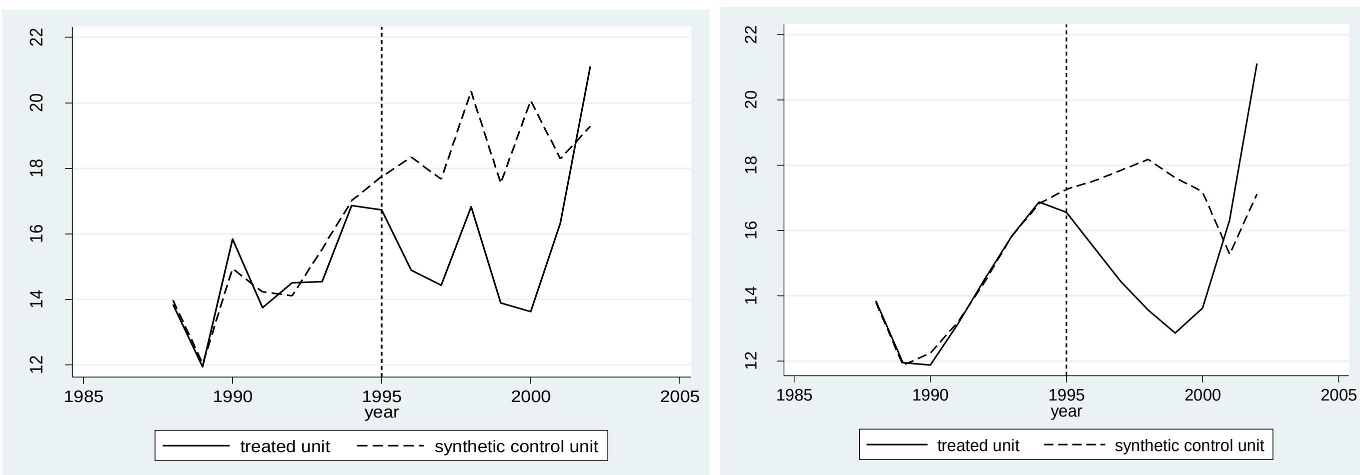
Arizona





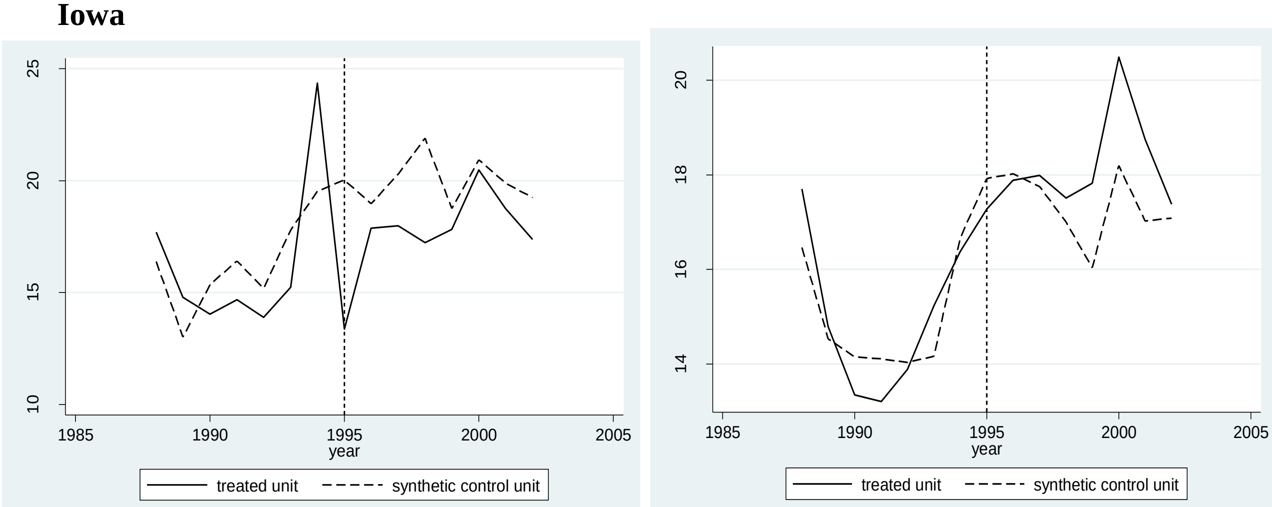
The lines almost perfectly coincide in the pre enactment period and diverge in the post enactment period, where the synthetic control group shows higher number of donors. Thus in this case, Arizona would have had higher number of donors if it would have not enacted the legislation.

Indiana



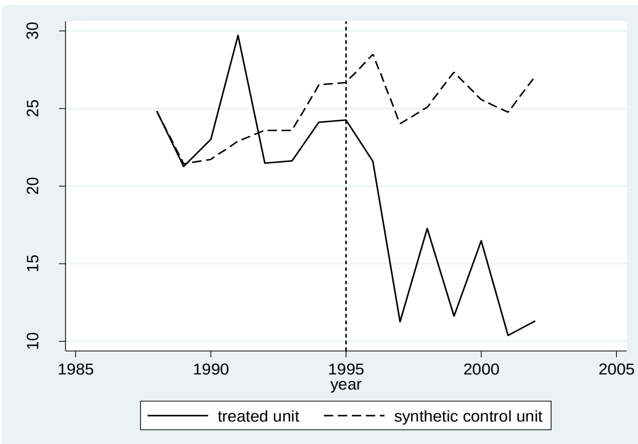
Smoothened values produce a synthetic control which is almost identical to the values of the Indiana in the pre-enactment period. Two groups start diverging one year prior to enactment. After 1994 the number of corrected deceased donors per million population is higher in the control group than in the treatment group. By 2001 both lines converge again. It is difficult to conclude that the divergence between the control and the treatment groups is caused by the legislation since the divergence begins one year before the enactment of the legislation.

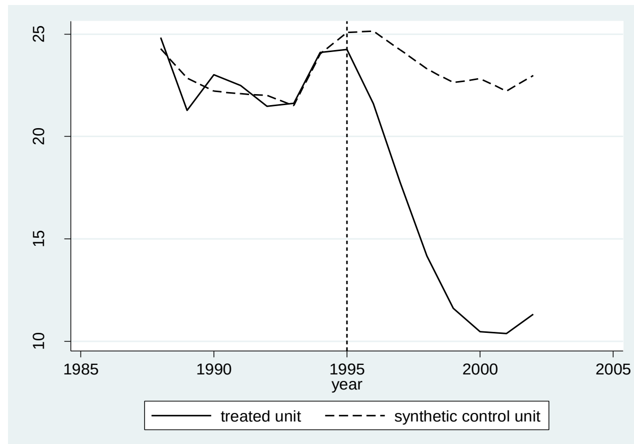
Iowa



In case of Iowa, after 1996 the treatment group has higher values than the synthetic control group. By 1995 the difference between the treatment and control group is equal to 2 donors per million population. By 2002 the lines almost converge.

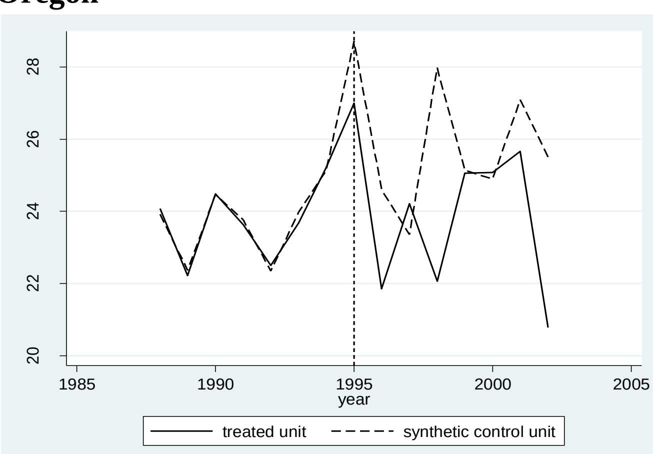
New Mexico

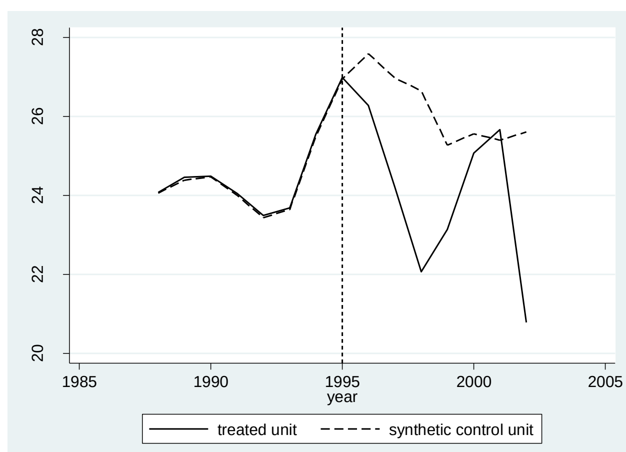




The control group has higher results starting from 1994. The divergence between the synthetic control and treatment groups are increasing rapidly after 1995. By 2000 the difference between the two is almost 10 deceased donors per million population.

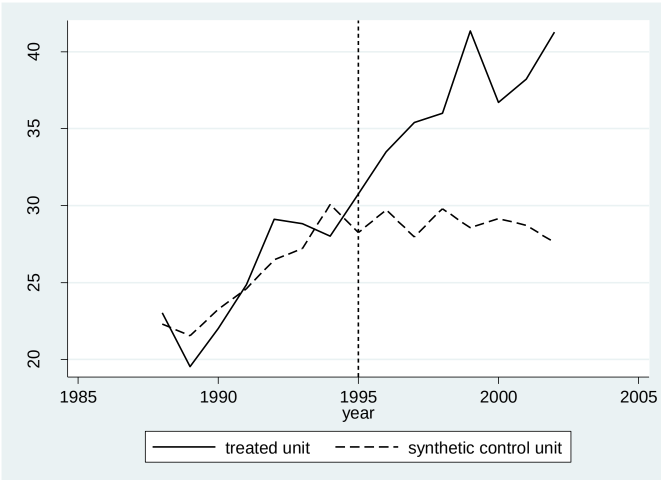
Oregon

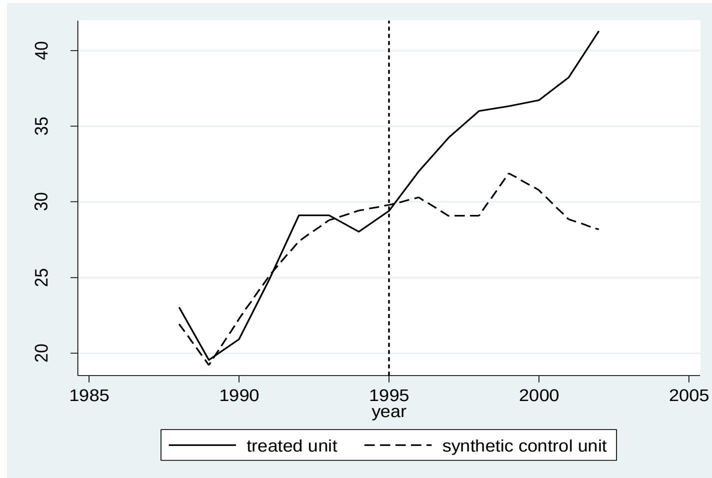




Here it is clear that the synthetic control group has higher number of donors per million population if corrected values are used.

Pennsylvania





Pennsylvania is the only state where we can observe a clear increase in number of decease donors per million population after 1995 as compared to synthetic control group.

Based on the results from the synthetic control group analysis it is possible to conclude that legislation has diverging effects on the number of deceased donors per million population. In case of Pennsylvania and Iowa the effect was positive, where for Oregon, New Mexico, Arizona and Indiana the effect was negative. Also, it is difficult to draw conclusion since for New Mexico ,Indiana and Iowa the divergence between the control and treatment groups start 1 or 2 years before the implementation of the legislation. In previous section no effect of the legislation was estimates, apart from variable Legislation in the sample with 39 states. The effect of Legislation dummy was positive but with low statistical significance-only if a 10% significance rate is used. Synthetic group analysis explains why no statistical significant results were found. Thus, both methods find no empirical evidence that UAGA had an effect on the number of deceased donors per million population. Only weak positive effect of the Legislation dummy was found.

6 .Discussion

The gap between the supply and demand of the organ donations is increasing through time not just in the US, but also worldwide. In the US, different measures were implemented to reduce the gap.

UAGA 1987 was proposed as a tool to combat the shortage of the organ donors by stimulating the supply of the organs. The key to stimulation of the supply was the simplifying the manners of performing the anatomical gift and enforcing the deceased donors will to becoming a donor.

Current analysis showed that based on difference in difference model estimations legislation had only a positive effect on the number of deceased donors. It was only statistically significant in the sample with 39 states. No statistically significant effect on the slope of the trend was found. The synthetic control group analysis produces mixed results, where Arizona, Indiana, New Mexico and Oregon have lower donation rates than the control. Iowa has slightly higher number of organ donations per million population than the control group. Only Pennsylvania has a wide gap between the control and the treated group.

One of the possible explanations why the legislation had no statistically significant effect lies in the OPO's organ removal procedure. Since it is of common practice for OPOs to ask for the consent of the family before performing the removal of the organs, it is possible that even if there was an increase in the consent of the deceased donors, the families still denied the donation act. Thus further investigation is necessary. If it is the case, there should be a new legislation legally punishing OPOs for not acting according to the will of the descendant. Also further "family educational" sessions should be implemented to increase the consent rates of the families.

After revising the mandatory form which has to be filled after the removal of the organs by the transplantations office it is not clear whether the data on deceased donors is related to the number of donors registered in the state or donors gave in the state. It is required to fill in the state where the donor used to live, but it is not stated if this exact same state is used in the data base as the source of the deceased donation. [7]Thus it can be the case that states which implemented UAGA and have high registration rates can have lower number of deceased donors

[7] Office of Information and Regulatory Affairs, Retrieved from : http://www.reginfo.gov/public/do/DownloadDocument?documentID=40274&version=0

in the data base simply because all deceased donors from that sate died in the nearby state where the transplantation took place and the address of the nearby state was used as the reference. Further research is proposed to determine which state is being referred when the data is recoded.

The effect of some variables like alcohol consumption, smoking and the implementation of the legislation can have a lagged effect on the number of deceased donor per million population. It can be the case that high level of alcohol consumption and smoking would have a negative effect in 5 year, or even more, once the individuals actually dies. Further analysis using lagged variables is proposed.

Pennsylvania was the only state which had higher number of deceased donors per million population as compared to synthetic control group. In 1994, one year prior to implementation of the UAGA, a trust fund was established in Pennsylvania which reimbursed donor families up to 3000 for funeral expenses, later it was established that the fund could reimburse only food and lodging (Howard, 2007) . The establishment of the Trust fund was part of the Act 102 which was enacted in December 1994. Box 3 provides short content of the Act 102.

Box 3:Content of the Act 102

Act 102

"Act 102 was signed into law in December of 1994 and became effective March 1, 1995. This legislation, among its many provisions, provides for the creation of a 15-member Organ Donation Advisory Committee; the creation of the Governor Robert P. Casey Memorial Organ and Tissue Donation Awareness Trust Fund; and the assignment of specific responsibilities to the Departments of Health, Transportation, Education, and Revenue. The main thrust of the Act is to increase organ and tissue donation by means of education and public awareness activities. The Act provides for a program that may provide some coverage of donor family expenses. Also, the Act provides for compliance reviews of Pennsylvania's hospitals to ensure that families of the deceased are given the opportunity to donate the deceased's organs and tissues."

Source: Pennsylvania Department of Health, Retrieved from: http://www.portal.state.pa.us/portal/server.pt/community/organ_donation_awareness/18861

A further research on the State level has to be performed to identify local legislations, like in case of Pennsylvania, to determine what influenced the number of organ donations.

6.1 Limitations

Current analysis incorporates some of the variables which were interpolated or extrapolated through time assuming constant linear growth. Those include: percentage of smoking population, excessive alcohol consumption, religious believes, age distribution, percentage of population who has high school diploma or higher and ethnicities.

Also, the period of the analysis is between 1989 and 2002 and assumes that no major global implementations were done in that time frame. Though some legislation could have implemented legislation on the state level, like on case of Pennsylvania.

6.2 Robustness test

District of Columbia had the highest number of deceased donors per million population in the sample. The value exceeded the average donors rate by almost 122 donors per million population. We provide a robustness test of the findings from the difference in difference and synthetic control group analysis by excluding the District of Columbia from both data samples with 30 and 39 states. The analysis are redone and new results are compared with the previous findings from the section 5. Tables 10 and 11 provide the results from the fixed and random effects models with District of Columbia excluded from the sample with 39 and 30 states.

Once District of Columbia is excluded from the sample the significance of the Legislation dummy slightly improves. The magnitude of the Legislation dummy is reduced in all the models, where the reduction of magnitude is equal to 0.5 an average for the sample with 38 states and an average to 3 for the sample with 29 states.

The significance and coefficients of the cerebrovacluar deaths per million population decrease in all the models. The average decrease in the magnitude is equal to 5 for the coefficients estimated with the sample with 38 states and 7 for the estimates with 29 states.

The effect of GDP per capita has lower statistical significance and is insignificant in some of the models. The magnitude of the GDP is also reduced across all models, where the average reduction for the sample with 38 states is equal to 0.7 and 1 for the sample with 29 states.

In all models the coefficient of Smoking becomes negative after the exclusion of District of Columbia. Also, in most of the models the effect of the Asian ethnicity becomes statistically significant with a magnitude varying from 1.786 to 4.7.

The magnitude of the percentage of individuals with high school diploma or higher is reduced in all models.

In the fixed and random effects models estimated with 28 states with no covariates and corrected values of deceased donors the legislation dummy, interactions between legislation and trend , and interaction between legislation and trend squared become statistically significant. The estimated coefficients of the legislation and interactions between legislation and trend and legislation and trend squared are almost the same between random and fixed effects models estimated with 28 states. Same holds for the models estimated with fixed and random effects for 38 states with no covariates and actual values of deceased donor.

Other ethnical groups become statistically significant in the fixed effects models estimated with 38 states.

The robustness test of the regression results shows that the effects of fatal car accidents and education is consistent and does not change with the exclusion of one state, District of Columbia. Also, the effects of those variables are not sensitive to model specification: fixed or random effects; and use of corrected or actual number of deceased donors per million population.

Below, after the regression tables, we prove the robustness test for the synthetic control group analysis. Figures on the left were constructed using actual number of donors per million population and the figures on the right were constructed corrected values. All figures in the second row were constructed without using District of Columbia.

The results of the synthetic control group analysis remain the same after exclusion of the District of Columbia for all states apart from Pennsylvania and Iowa. In case of Iowa it becomes more clear that the synthetic control group outperforms the Iowa if the corrected number of donors are used. By excluding District of Columbia from the controls pool of Pennsylvania the synthetic control group does not coincide with the treatment group in the pre enactment period. Thus no conclusions can be drawn from the findings. Thus, the only state which had a clear positive effect of the legislation does not pass the robustness test.

Table 10: Regression results of Fixed effects and Random Effects models for sample with 38 states

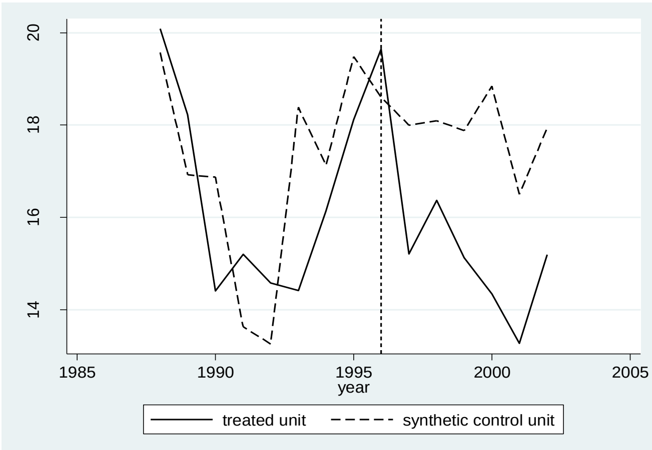
	Fixed effects				Random Effects			
VARIABLES	Actual number of donors		Corrected number of donors		Actual number of donors		Corrected number of donors	
Trend	0.70**	0.15	0.53**	-0.19	0.71**	0.44	0.53**	0.54
	(4.75)	(0.22)	(4.00)	(0.34)	(4.77)	(0.90)	(4.03)	(1.31)
Legislation*Trend	-0.71+	-0.91	-0.52	-0.6	-0.71+	-0.94	-0.51	-0.54
	(-1.83)	(1.56)	(-1.47)	(1.28)	(-1.81)	(-1.62)	(-1.47)	(-1.15)
Trend^2*Legislation	0.02	0.05	0.01	0.02	0.02	0.05	0.01	0.02
	(0.81)	(1.41)	(0.27)	(0.77)	(0.79)	(1.40)	(0.26)	(0.57)
Trend^2	-0.02+	-0.05+	-0.01	-0.07**	-0.02+	-0.03	-0.01	-0.06**
	(-1.84)	(-1.84)	(-0.70)	(3.27)	(-1.85)	(-1.36)	(-0.74)	(-2.85)
Legislation	3.51*	4.56+	3.09*	4.27*	3.46*	4.51+	3.05*	3.78+
	(-2.03)	(1.9)	(2.00)	(2.22)	(2.00)	(1.88)	(1.96)	(1.94)
Treatment					2.26	-1.94	1.96	-1.81
					(1.08)	(-0.74)	(0.94)	(-0.70)
Death_by_pop		4.57		7.67*		4.98		8.78**
		(1.07)		(2.26)		(1.27)		(2.61)
Car_crashes		0.07**		0.06**		0.06**		0.05**
		(4.06)		(4.33)		(4.15)		(3.86)
Gdp_capita		0.20		0.47**		0.21		0.40**
		(1.22)		(3.5)		(1.46)		(3.34)
Smoking		-0.05		-0.02		-0.07		-0.05
		(0.57)		(0.31)		(-0.80)		(-0.72)
Alcohol		-0.29		-0.35		-0.40		-0.48*
		(1.06)		(1.6)		(-1.52)		(-2.20)
Christians		0.28		0.23		0.40+		0.30+
		(1.06)		(1.1)		(1.85)		(1.64)
Other_religions		-0.13		-0.41		-0.29		-0.53
		(0.18)		(0.68)		(-0.50)		(-1.04)
Pop_under_65		1.77+		1.22		-0.03		-0.10
		(1.74)		(1.51)		(-0.05)		(-0.20)
Health_insurance		-0.05		0.08		-0.01		0.09
		(0.5)		(1.09)		(-0.14)		(1.22)
Education		1.13**		1.42**		0.77**		0.81**
		(3.01)		(4.74)		(4.00)		(4.68)
Asian		4.39**		2.46+		2.15**		1.82**
		(2.74)		(1.92)		(2.80)		(2.57)
White		1.14		0.39		0.68		0.62
		(1.38)		(0.58)		(1.49)		(1.47)
Hispanic		1.7*		1.36*		0.77		0.77+
		(2.13)		(2.15)		(1.50)		(1.68)
Black		1.74+		1.75*		0.50		0.54
		(1.81)		(2.28)		(1.11)		(1.31)
Constant	16.18**	-388.74**	16.48**	-300.71**	15.10**	-153.07**	15.52**	-142.27**
	(34.17)	(-3.25)	(39.10)	(-3.15)	(11.42)	(-2.20)	(11.74)	(-2.27)
Observations	559	407	559	407	559	407	559	407
Number of id	38	38	38	38	38	38	38	38
R-squared	0.23	0.29	0.25	0.43	0.23	0.27	0.25	0.40
Notes:	T-statistics in parentheses . ** p<0.01, * p<0.05, + p<0.1				Z-statistics in parentheses . ** p<0.01, * p<0.05, + p<0.1			

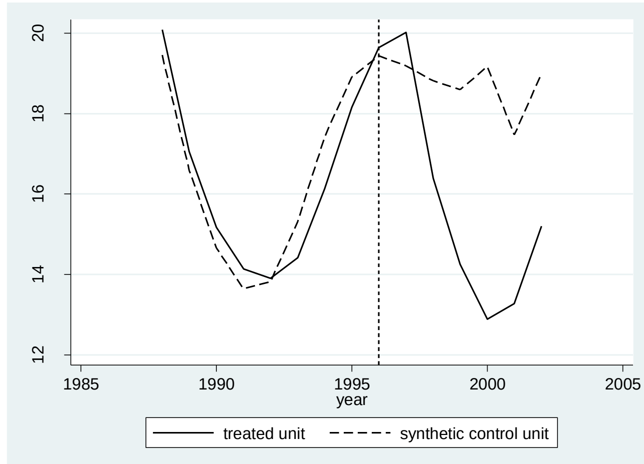
Table 11: Regression results of Fixed effects and Random effects models for sample with 29 states

	Fixed Effects				Random effects			
VARIABLES	Actual number of donors		Corrected number of donors		Actual number of donors		Corrected number of donors	
Trend	0.72**	-0.66	0.57**	-0.20	0.73**	0.57	0.57***	0.79
	(4.72)	(-0.84)	(4.03)	(-0.3)	(4.72)	(1.01)	(4.03)	(1.61)
Legislation*Trend	-2.06	1.67	-4.37*	1.64	-2.09	-2.61	-4.38*	-2.18
	(-0.89)	(0.43)	(-2.03)	(0.5)	(-0.88)	(-0.66)	(-2.04)	(-0.64)
Trend^2*Legislation	0.07	0.09	0.16+	0.06	0.07	0.13	0.16+	0.08
	(0.74)	(0.5)	(1.75)	(0.39)	(0.75)	(0.71)	(1.77)	(0.52)
Trend^2	-0.02*	-0.03	-0.01	-0.06**	-0.02*	-0.03	-0.01	-0.06**
	(-1.94)	(-1.22)	(-0.97)	(-2.68)	(-1.94)	(-1.06)	(-0.97)	(-2.62)
Legislation	11.23	8.01	25.94*	10.39	11.33	12.95	26.01*	13.39
	(0.84)	(0.4)	(2.16)	(0.61)	(0.85)	(0.65)	(2.17)	(0.78)
Treatment					1.87	-1.11	1.49	-0.17
					(0.65)	(-0.28)	(0.51)	(-0.05)
Death_by_pop		3.87		10.07*		5.13		10.97**
		(0.82)		(2.48)		(1.11)		(2.74)
Car_crashes		0.07**		0.05**		0.06**		0.04**
		(3.74)		(2.99)		(3.67)		(2.72)
Gdp_capita		0.08		0.44**		0.03		0.35*
		(0.43)		(2.73)		(0.16)		(2.26)
Smoking		-0.16		-0.07		-0.12		-0.06
		(1.5)		(0.79)		(-1.18)		(-0.69)
Alcohol		-0.23		-0.55*		-0.59*		-0.80**
		(0.69)		(1.95)		(-1.91)		(-3.00)
Christians		-0.01		0.22		0.48*		0.48*
		(0.02)		(0.69)		(1.81)		(2.02)
Other_religions		-1.32		-1.45+		-0.46		-0.66
		(1.37)		(1.76)		(-0.65)		(-1.06)
Pop_under_65		2.37+		1.68		0.43		0.29
		(1.89)		(1.57)		(0.59)		(0.43)
Health_insurance		0.03		0.14		0.061		0.16+
		(0.27)		(1.46)		(0.53)		(1.66)
Education		1.87**		1.63**		0.81**		0.84**
		(3.83)		(3.89)		(3.20)		(3.63)
Asian		4.7**		1.79		3.45**		2.01*
		(2.6)		(1.15)		(2.95)		(1.91)
White		1.15		0.66		0.94*		0.82
		(1.17)		(0.78)		(1.73)		(1.61)
Hispanic		1.80+		1.42+		0.99		0.94+
		(1.85)		(1.7)		(1.60)		(1.63)
Black		1.27		1.42		0.66		0.65
		(1.1)		(1.44)		(1.19)		(1.24)
Constant	15.88**	-454.76**	16.16**	-366.56**	15.49**	-225.06**	15.85**	-211.76**
	(30.29)	(3.11)	(33.72)	(2.93)	(11.29)	(-2.65)	-11.58	(-2.70)
Observations	435	317	435	317	435	317	435	317
Number of id	29	29	29	29	29	29	29	29
R-squared	0.26	0.35	0.33	0.47	0.26	0.33	0.30	0.46
Notes:	T-statistics in parentheses . ** p<0.01, * p<0.05, + p<0.1				Z-statistics in parentheses . ** p<0.01, * p<0.05, + p<0.1			

Arizona

With District of Columbia





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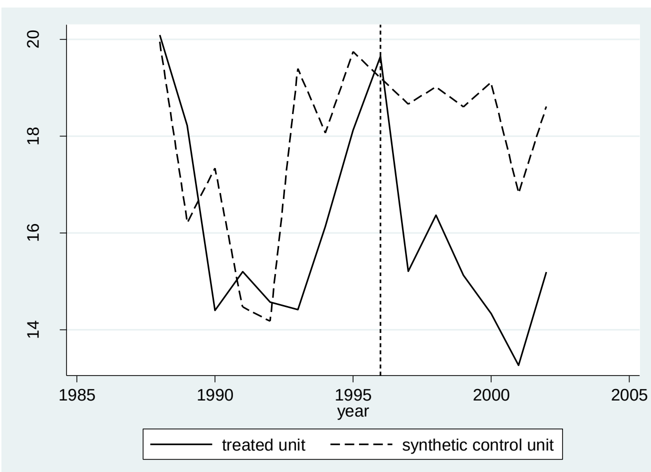

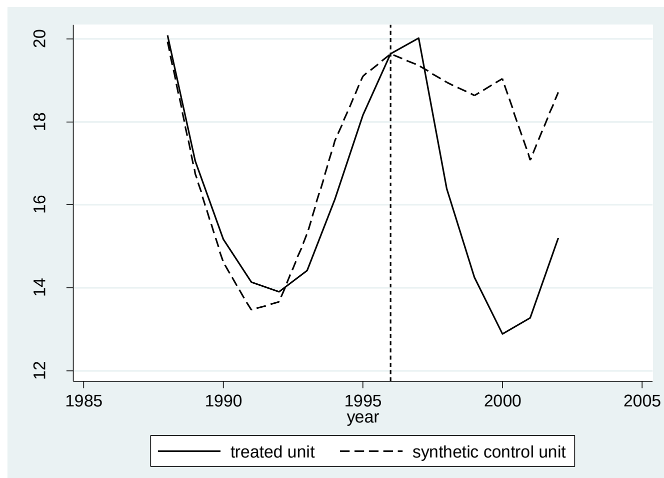

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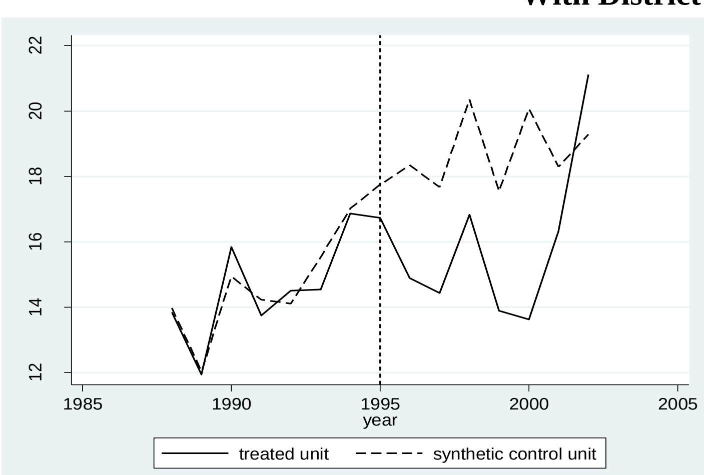

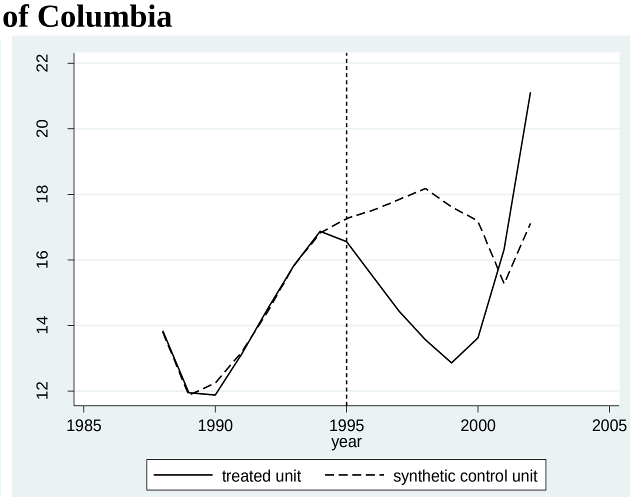

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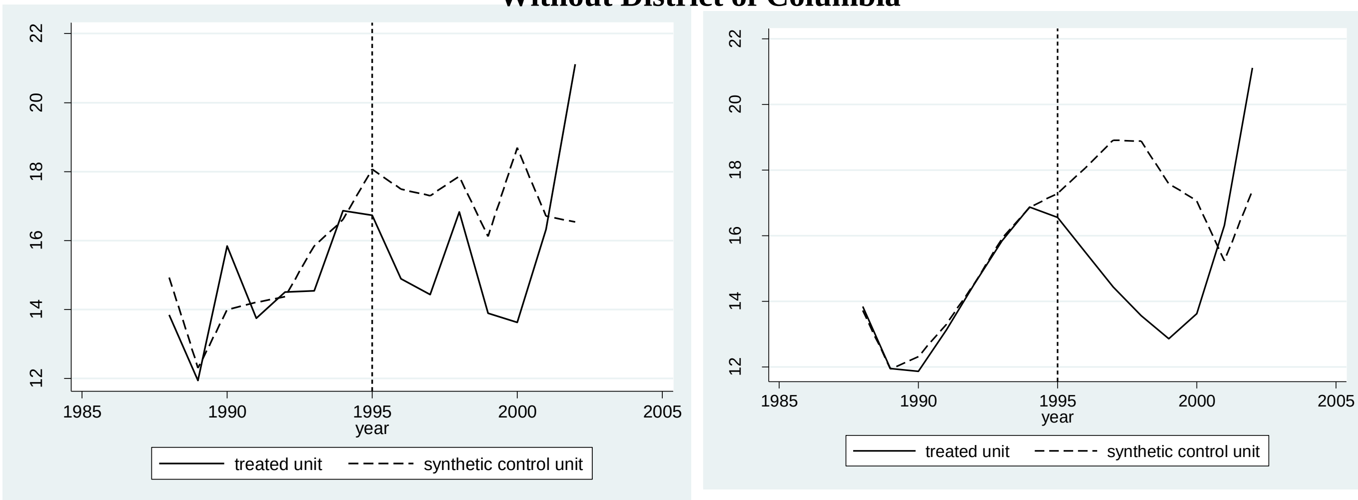

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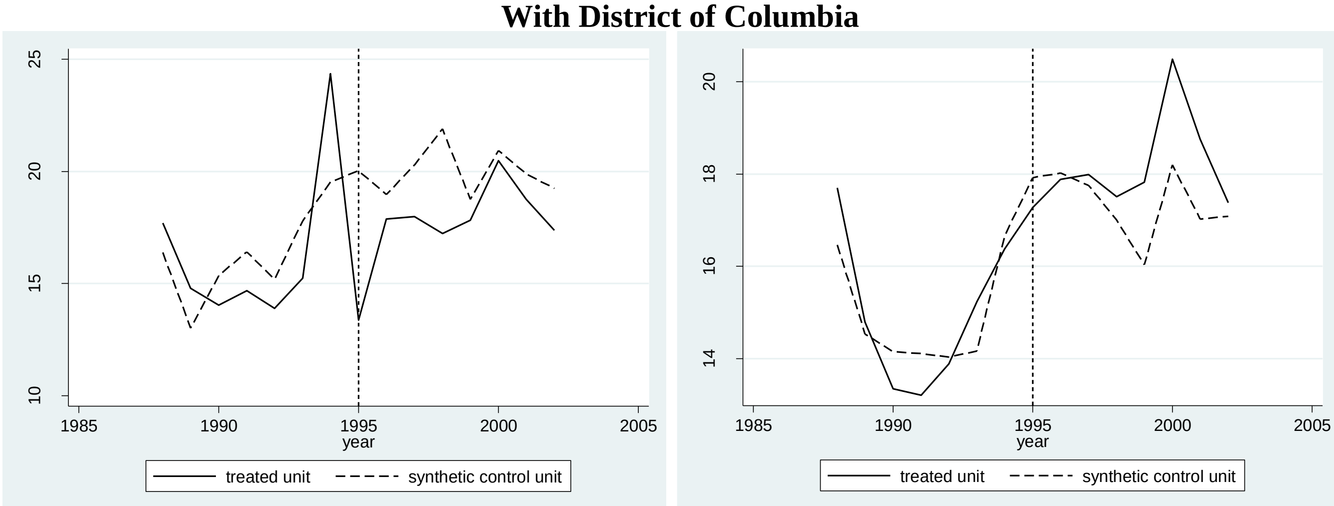

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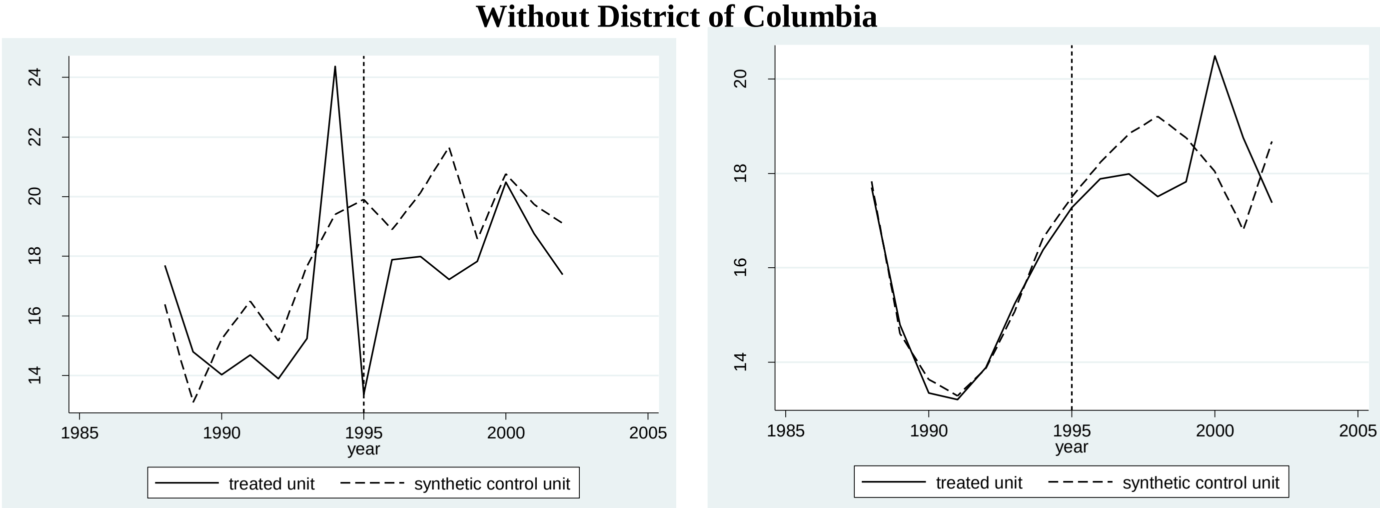

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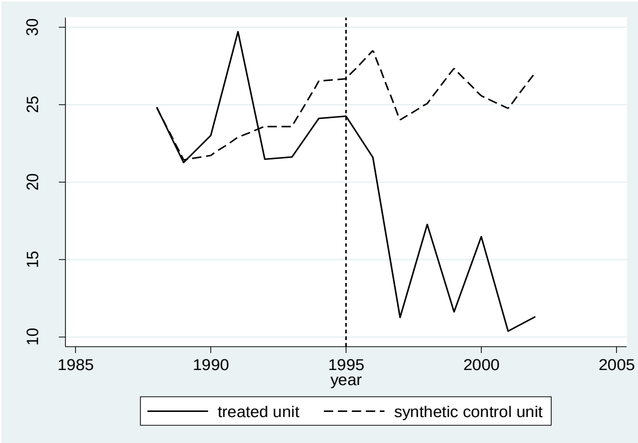
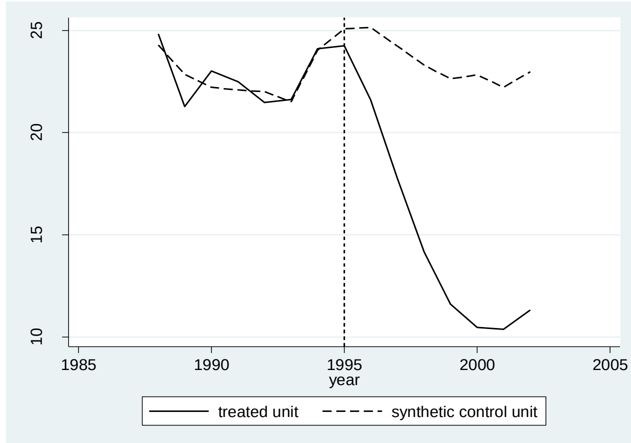
With District of Columbia





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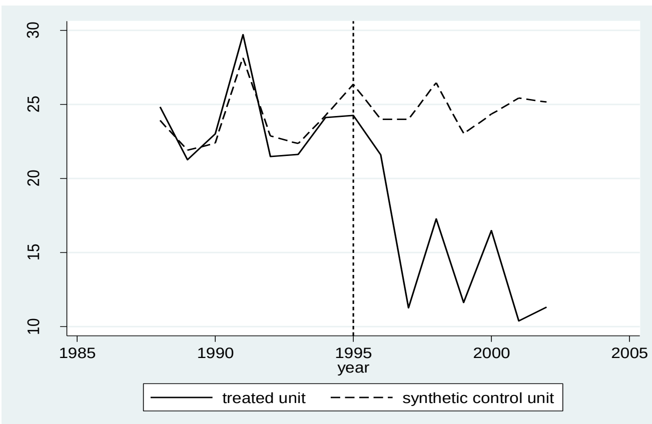

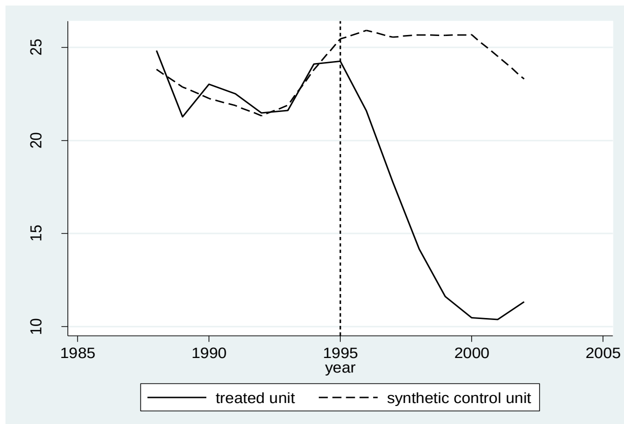

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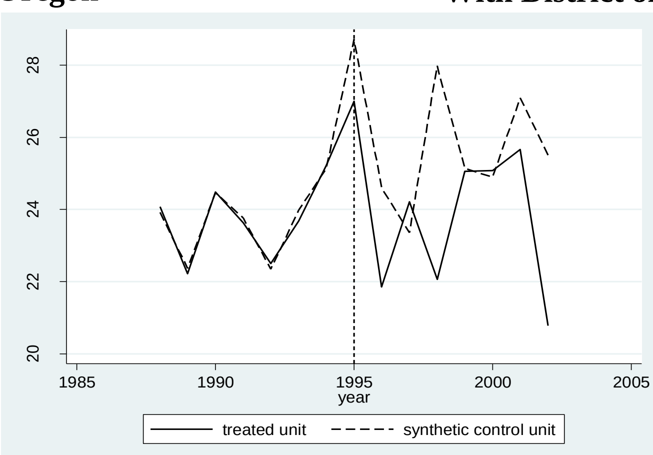

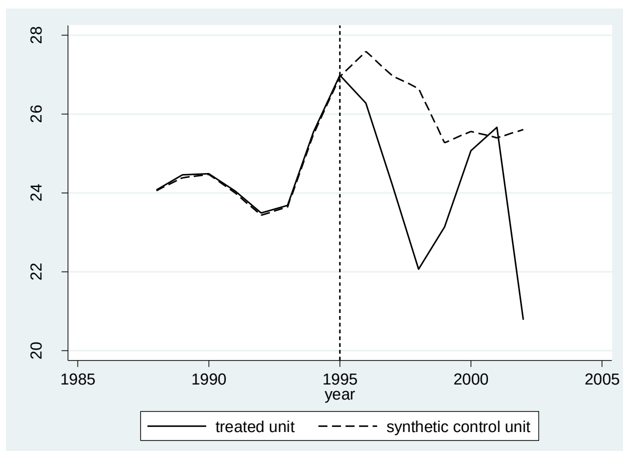

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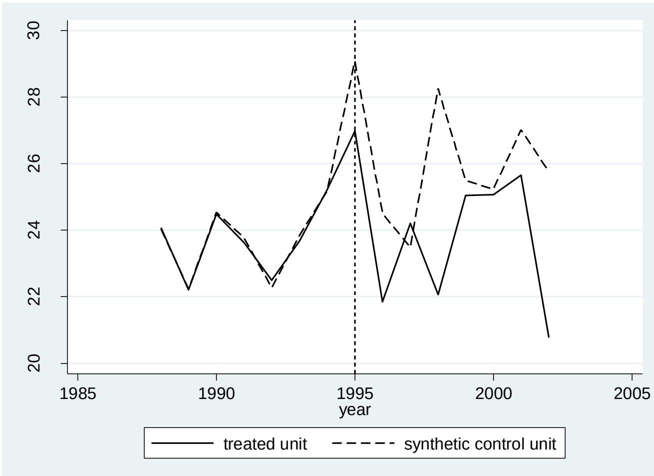

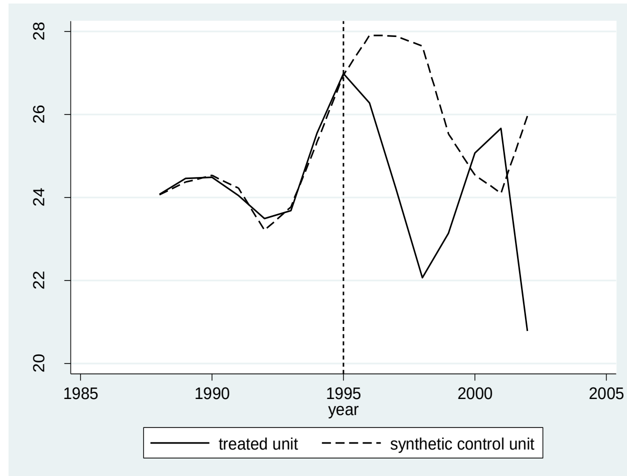

Pennsylvania

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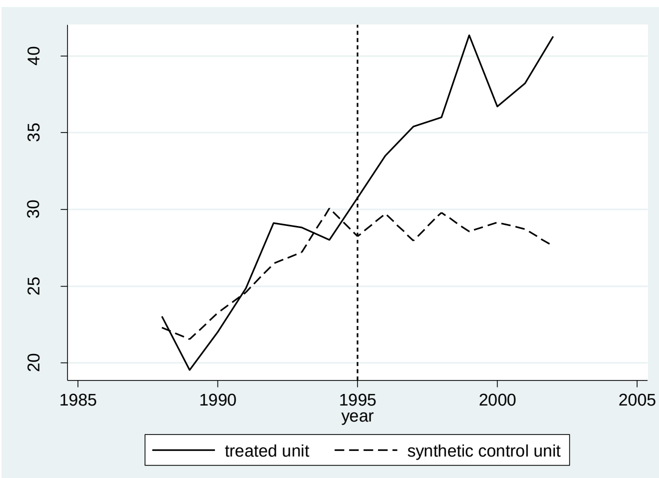

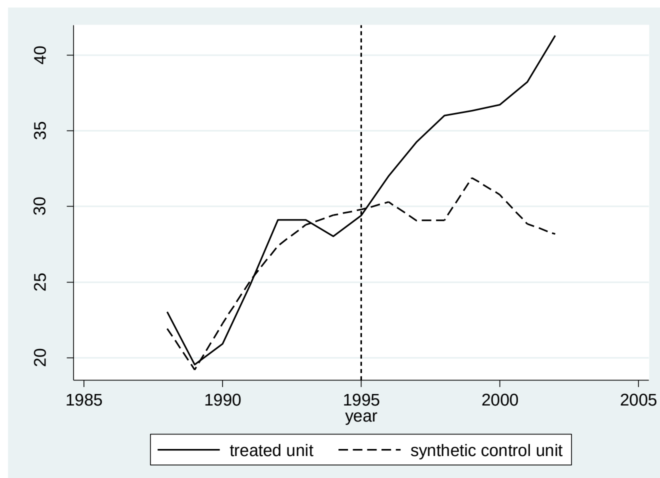

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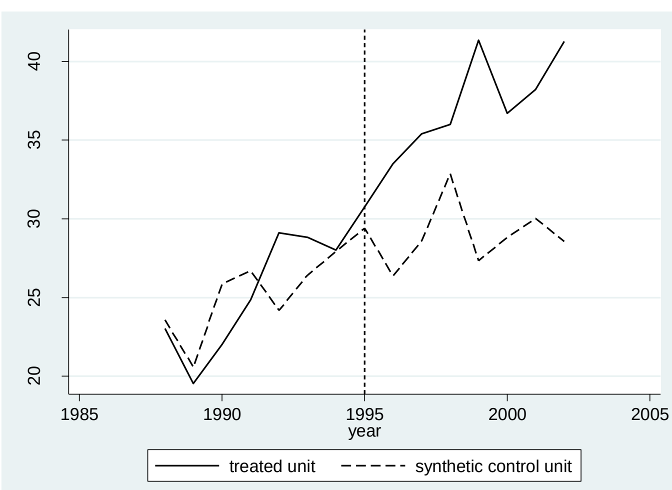

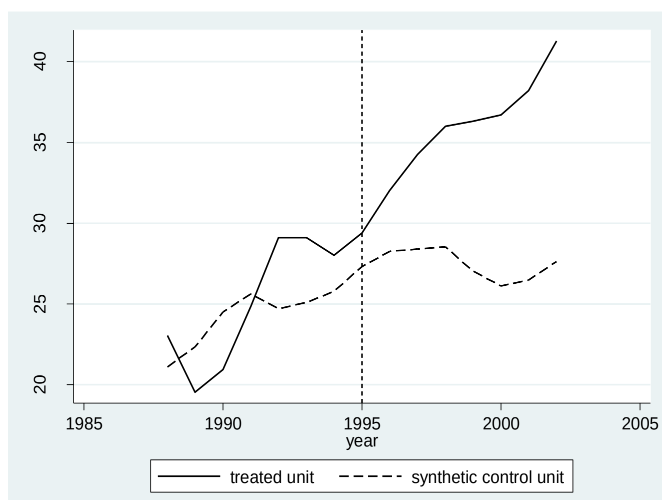

7. Conclusion

After the first successful organ transplantation the number of organ donations has increased dramatically. Nevertheless the gap between supply and demand of organs increased throughout time and remains present. Different measures in the United Stated were taken to reduce the supply. Those measures include: UAGA, National Organ Transplant Act, Organ Donation Breakthrough Collaborative and Donor Designation Collaborative.

The current study contributes to the topic of the organ donation by analyzing if the Uniform Anatomical Gift Act (UAGA) 1986, introduced by National Conference of Commissioners on Uniform State Laws (CUSL) in the United States, succeeded in increasing the number of donors. In the paper we analyzed 39 states using difference in difference models and synthetic control group methods. The results suggest that there is no statistical evidence that UAGA increased the number of deceased donor. This can be partially explained by the lack of data available for analysis. For a more comprehensive view we suggest conducting a more detailed analysis on a state level, which is necessary since some states like Pennsylvania have implemented their own legislation to fight the organ donor shortage.

Another reason of insignificance of the legislation is provide by Howard (2007). He states that the consent of next-to-kin plays the biggest role in increasing the number of deceased donors. The issue arises because it is common practice for OPO's to ask for next-to-kin consent even if the deceased's consent is available. If next-to-kin declines, majority of the OPOs will not proceed with the organ removal procedure, even though they are legally allowed to do so. Thus it is crucial to promote the education of the families on the positive effect of organ donations. Also, OPO's should be liable for not acting according to deceaseds' will.

The effect of some variables, like alcohol consumption, smoking and implementation of the legislation, can have lagged effect on the number of deceased donors. Further research is proposed which would analyze the lagged effect of legislation, smoking, alcohol and other variables.

While obtaining the data for the analysis it was not clear whether the data on deceased donors is related to the number of donors registered in the state or donors gave in the state. It is required to fill in the state where the donor used to live, but it is not stated if this exact same state is used in the data base as the source of the deceased donor. Thus it can be the case that states which implemented UAGA and have high registration rates can have lower number of deceased donors in the data base simply because all deceased donors from that sate died in the nearby state where the transplantation took place and the address of the nearby state was used as the reference. Further research is proposed to determine which state is being referred when the data is recoded.

Throughout the analysis several other factors influencing number of deceased donors were estimated. Those factors include: GDP per capita, education, number of fatal car accidents and number of cerebrovascular deaths. The effect of GDP per capita and number of cerebrovascular deaths does not pass the robustness test with exclusion of District of Columbia. The estimated magnitudes of fatal cat accidents and education are robust. The effect of other variables was insignificant and in some of the models unexpected. That can be explained by lack of data which was extrapolated or interpolated. Further research a more complete data set is proposed.

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