THE IMPACT OF PRESUMED CONSENT LAW ON ORGAN DONATION: AN EMPIRICAL ANALYSIS FROM QUANTILE REGRESSION FOR LONGITUDINAL DATA

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Resumo
Órgãos humanos para transplantação são bens extremamente valiosos e sua escassez é um problema verificado na maioria dos países que realizam transplantes. A conseqüência direta desta escassez é o aumento das listas de espera por transplante. Para tentar contornar esse problema, alguns pesquisadores têm sugerido alteração na lei que regula a doação de órgãos, de consentimento informado para consentimento presumido. Entretanto, poucas evidências empíricas têm sido feitas para estimar a relação entre consentimento presumido e o número de doações de órgãos de doadores mortos. O objetivo deste trabalho é estimar este impacto, usando um novo método desenvolvido por Koenker (2004): regressão quantílica para dados de painel. A amostra é composta por 34 países para os anos de 1998-2002. Os resultados sugerem que a lei de consentimento presumido tem um efeito positivo na distribuição do número de doações de órgãos, o qual varia entre 21-26% para os quartis (0,25; 0,50 e 0,75), sendo este impacto maior na cauda esquerda da distribuição. O gasto total em saúde também apresentou um efeito positivo na distribuição da variável resposta, variando entre 42-52%.

Palavras-Chave: consentimento presumido, doação de órgãos e regressão quantílica para dados de painel

Abstract
Human organs for transplantation are extremely valuable goods and their shortage is a problem that has been verified in most countries around the world, generating a long waiting list for organ transplants. This is one of the most pressing health policy issues for governments. To deal with this problem, some researchers have suggested a change in organ donation law, from informed consent to presumed consent. However, few empirical works have been done to measure the relationship between presumed consent and the number of organ donations. The aim of this paper is to estimate that impact, using a new method proposed by Koenker (2004): quantile regression for longitudinal data, for a panel of 34 countries in the period 1998-2002. The results suggest that presumed consent has a positive effect on organ donation, which varies in the interval 21-26% for the quartiles {0.25; 0.5; 0.75}, the impact being stronger in the left tail of the distribution. Health expenditure has an important role on the response variable as well, the coefficient estimate varying between 42-52%.

Keywords: presumed consent; organ donation; quantile regression for panel data

JEL: I18, C01

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1. Introduction

The demand for organ transplants is large and has been increasing over time, and the shortage of human organs is a pressing issue to policy makers and governments. This issue has motivated researchers to study the determinants of organ donation rates and the magnitude of their impact on the supply of organs. However, the literature in this field is still scarce and further empirical studies are needed for informing this debate and to try to shed some light on the controversies surrounding the shortage of organ donation.

A particular debate has arisen in this context: the matter of legislative default on cadaveric organ donation. Following this debate, some researchers have investigated the relationship between the type of legislation on organ donation and the number of available cadaveric organs for transplantation, mainly after the successful experiences of Spain, Austria, Italy and Belgium, which have adopted presumed consent law for organ donation[1]. Under presumed consent law, all deceased people are considered potential donors in the absence of explicit opposition when alive to donation. However, under informed consent law, the donors must give formal agreement to potentially becoming donors before they die.

As it has been stressed by some authors (Fevrier and Gay (2004) and Gill (2004), for example), neither presumed consent nor informed consent respects the will of population as a whole, particularly for people that do not register their will[2]. On the one hand, defenders of presumed consent have argued that there are more donations when presumed consent takes place. But on the other hand, opponents of presumed consent have pointed out that this system is neither morally nor ethically acceptable. In fact the huge majority of countries that have presumed consent in practice allow the family to make the final decision about donation, which weakens the argument of the informed consent defenders. Healy (2005) argued that the advantage in "having a presumed consent law might mean, in effect, that the question put to donor families is assumed to be something like 'do you have any reason to think the donor would have objected?' rather than something like 'can we have your permission to go ahead?'". It is easier to get the family's agreement to donate the organs of a loved one, since the collective expectation is to become a donor under presumed consent law. However, under an informed consent law, a special decision must be taken by the family, since the default is not to donate the organs of a loved one.

There is ample discussion about this topic, both in medical and political communities and in international health organizations. Recently the UK parliament held a debate about the possibility of implementing presumed consent in Britain. Argentina, in 2005 changed its law on organ donation to presumed consent. After three years of presumed consent law experience, Brazil[3] returned to informed consent in 2001.

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[1] Gundle (2004), Gnant et al. (1991), Michielsen et al. (1996), Matesanz and Miranda (2001), Kaur (1998) and Kennedy et al. (1998).

[2] Following Gill (2004): "no matter how well the current system (informed consent) is instituted, there will still be cases in which people who would have preferred to donate their organs will be buried with all their organs intact; call these mistaken non-removals. And no matter how well presumed consent is instituted, there will still be some cases in which people who would have preferred to be buried with all their organs intact will have some of organs removed, call these mistaken removals."

[3] The Brazilian case will be discussed in more detail in section 3.1.

Despite the importance of this matter, few studies focus on measuring the relationship between presumed consent and cadaveric organ donation. A multivariate model is required to analyze this relationship in order to control some observed heterogeneity, such as income, religious belief, type of legal system, besides others specifically related to organ donation, such as potential donors (from traffic accidents and celebro-vascular disease). Abadie and Gay (2004) and Healy (2005) found a positive relationship between presumed consent and cadaveric organ donation. However, they had just used OECD countries[4]. Our paper has the advantage of analyzing a large sample, which also includes Latin countries and other countries with low cadaveric organ donation. Furthermore, we can verify whether the positive relationship between presumed consent and organ donation remains when we analyze a more heterogeneous sample of countries.

In order to proceed with the analysis, we have applied a new method developed by Koenker (2004): quantile regression for panel data. This method combines the panel data approach with a focus upon estimation of effects on the quantiles of the response variable distribution. This technique works better with outliers present. Notably, our sample has some outliers, such as Spain[5], well-known in the literature as the most efficient model of organ procurement.

The main goal of this article is to analyze the impact of presumed consent on organ donation rates, using a quantile regression for panel data approach with a sample of 34 national states over 5 years (1998-2002). This paper follows the model proposed by Abadie and Gay (2004). Following this introduction, section II discusses the organ shortage problem; section III describes the data and method applied; the main empirical results are given in section IV and the conclusions in Section V.

2. The Organ Shortage Problem

The first successful kidney transplant was in 1954 (Boston - USA), and many improvements have been made since that event. Nowadays, kidney transplants have become the most cost-effective treatment for people suffering end-stage renal disease (ESRD)[6]. That means a longer life and better quality of life for patients, and an efficient way to spend health resources. However, for some terminal diseases (heart, lung, liver and pancreas) transplant is the only way to keep a patient alive, once there is no substitute treatment[7].

In 2005 more than 28,000 transplants had been carried out in the USA, an increase of around 20% relative to 2000 (UNOS, 2006). Brazil had undertaken 14,740

[4] Their sample sizes were 22 and 17 countries, respectively.

[5] Abadie and Gay (2004) and Healy (2005) have run their models including and excluding Spain. The model without Spain fitted better than otherwise. Methods based on conditional mean, as the case of these authors (panel data), are especially affected by outliers. Quantile regression is robust to outliers (Koenker and Basset, 1978).

[6] Garner and Dardis (1987), Karlberg (1992), Karlberg and Nyberg (1995), Evans (1986), Roberts et al. (1980), Schersten et al. (1986), Kasiske (1998), Campbell and Campbell (1978) and Evans and Kitzmann (1998).

[7] This explains the reason why waiting lists are shorter for heart, lung, liver and pancreas transplantation; because many people die before getting a transplant. This is not the case with ESRD patients, since dialysis can replace the kidney functions.

transplants in 2004, an increase of 30% relative to 2002 (MS, 2006). In Australia, 649 transplants were performed in 2004, an increase of 20% compared to 2003 (ANZOD, 2006). These transplantation rates could be higher still except that there is a serious constraint: the organ donation shortage. The supply of organs is smaller than required to keep up with the demand. Due to this gap, the waiting list for a transplant has increased in most countries around the world.

Several points are worth noting which have contributed to increase the demand for organ transplantation. First, many improvements have been made on immunosuppressive drugs, especially after the use of cyclosporine in the 1980's, which have tremendously improved graft survival in all types of transplantation. Second, there has been an increase in the number of surgeons and physicians with specialized knowledge, improving medical awareness of techniques about transplantation. Third, incidence and prevalence of diseases have increased around the world, particularly ESRD[8]. Finally, the graft is set at zero price, as the law in most countries does not permit paying for organs[9], which means an infinite demand from an economic point of view.

Another point to highlight is the nature of the supply side of organ transplantation. For an organ to be removed, several requirements need to be met. First of all, the potential donor must have healthy and well-functioning organs and be free of infection and cancer. Second, in most of the cases the cadaveric donation comes from a donor that is declared brain dead, i.e. the donor had suffered complete and irreversible loss of all brain functions. To be declared brain dead, a full range of tests is carried out by more than one physician, and at least one of them must be not related to the transplantation proceedings. After that, the hospital must then communicate the organ procurement to find the recipient that best matches with the available organ. Third, the consent for donation needs to be obtained, which often comes from the donor's family. Finally, if consent is given, the organ from the donor must be removed and allocated to the recipient.

The above process typically breaks down at one or more stages, resulting in a failure to collect the organs. Brain death may not be confirmed given the absence of staff or hospital's infrastructure[10], the hospital may not communicate fast enough that there is an organ available, the request for consent may not be made in a competent way, and the organ procurement may not be efficient in the logistics of matching the donor to the recipient. Because of these problems, it has been estimated that only about 1% of all deaths in the USA occur under circumstances that would allow the organs of the deceased to be used in transplantation (Kaserman and Barnett, 2002).

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[8] The ESRD prevalence rate has increased drastically, particularly in North America. In the USA, it was reported an increasing of 70% in the number of people on chronic maintenance dialyse from 1991 (573 per million population -pmp) to 2000 (977 pmp) (Renal Network, 2006). In Europe, this rate was 1360 pmp in 1991 and 1393 in 2001 (USRDS, 2006). The lowest prevalence rate of replacement therapy was reported in Latin America, which increased from 119 pmp in 1991 to 352 pmp, a huge increase of 295% over ten years. It is not just the prevalence rate of ESRD patients that is increasing, but also the incidence rate. It means that more people are diagnosed as having ESRD, aggravating even more the problem.

[9] Just in Iran and the Philippines organ sales are legal.

[10] Faults in the detection process of brain death are the main reason for losing potential donors (Matesanz, 2001). The main recommendations to improve that problem are: i) increase the number of intensive care beds, especially in neurosurgical units; and ii) increase the number of nurses and physicians available (Cameron and Forsythe, 2001).

Because of the inadequate organ supply, the organ shortage is increasing worldwide, with a few exceptions such as Spain. In Brazil, the organ shortage rose 54% from 2001 to 2005. In the UK, it increased 43% in 8 years (1998-2005). In the same period, the USA reported an increase of 56% in organ shortage. As a consequence, the length of waiting times is increasing, causing further suffering to patients and considerable expense to keep them alive, as well as deterioration of the patients' health throughout the time, which can cause them to be too debilitated to undergo the transplant operation.

Living donors are another option for reducing the gap between demand and supply of organs. However, it is still seen as a controversial issue in the medical community. Either related donors (parental) or unrelated donors (altruist) are considered with suspicion by a representative number of transplant centres, since the donation could be influenced by family pressure and psychiatric disorder, respectively (Hou, 2000). Another concern about using a living donor is that someone can offer some kind of monetary benefit for a potential donor, especially for poor and less educated people who have a weak bargaining power, to donate a kidney (Anbarci and Caglayan, 2005). Based on this, some specialists believe that the priority should be placed on cadaveric donor.

3. Data and Methods

3.1 Data: Source and Description

The data come from the Transplant Procurement Management Organization (TPM), the World Health Organization (WHO), World Bank (WB) and the Sociedad Latinoamericana de Nefrología e Hipertensión (SLANH). The sample contains 34 countries[11] over 5 year period (1998-2002). The choice of the countries is related to availability of data[12].

The variables used in this paper follow Abadie and Gay (2004), Healy (2005) and Anbarci and Caglayan (2005). They are: number of deaths by traffic accident per 100,000 population; number of deaths by brain vascular disease per 100,000 population, GDP per capita; total health expenditure per capita; percentage of population that has access to the Internet; dummy for catholic country (=1 if 50% or more of population are catholic); and dummy for legal system (=1 if the country has common law). The dependent variable is the rate of cadaveric organ donation per million population (pmp) and the variable of interest is a dummy for countries that have presumed consent as law on organ donation.

[11] The 34 countries we have analyzed in this paper are reported in Table 1.

[12] There is a well-known problem in health empirical works which is the presence of some missing values, particularly when the analysis uses countries over time. Our sample has 4% missing values, related to two variables: number of deaths from celebro-vascular diseases and number of deaths from traffic accidents. If we drop these missing values, 20% of the sample information would be missed. To avoid this loss, we imputed values from an OLS trend, using the previous four years. We believe that this method is a good way to treat the problem, since there are very small variations over years for brain diseases and traffic accident.

Figure 1: Cadaveric organ donation per million population (pmp) by country (1998-2002)

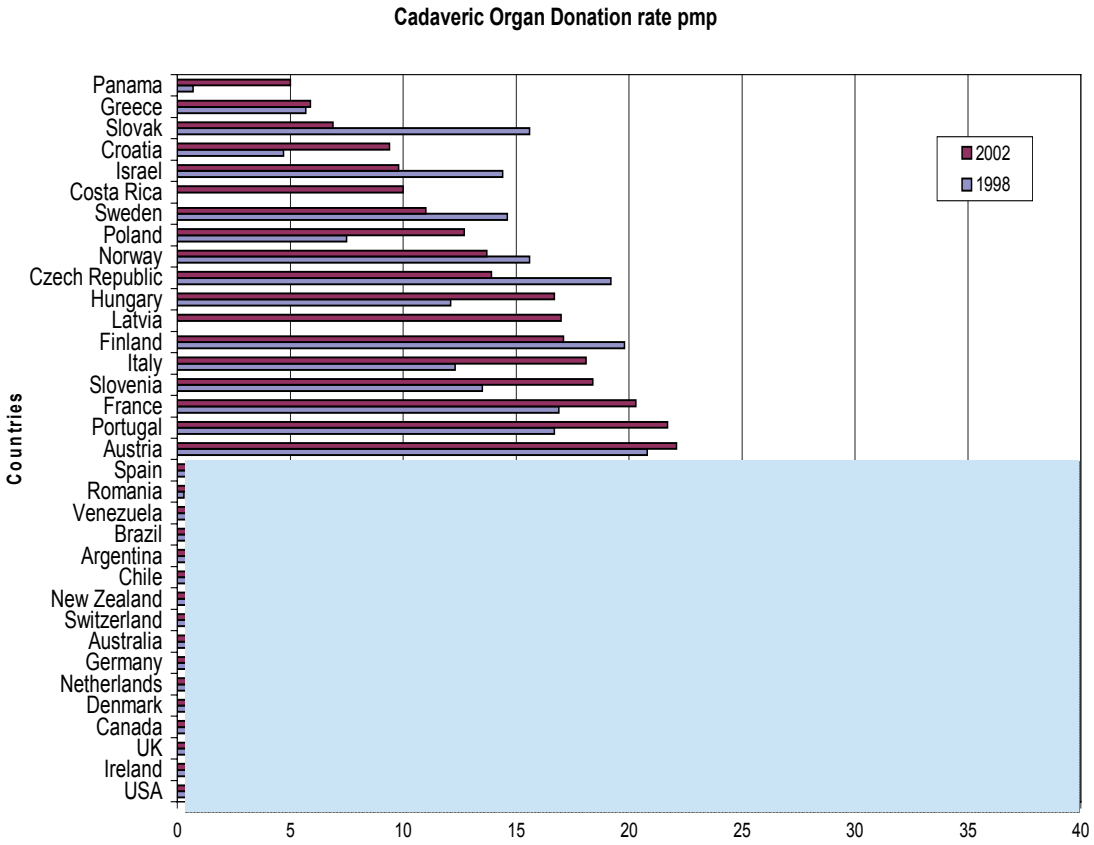

Figure 1 shows a panoramic view of cadaveric organ donation in the sample. In the upper half of the Figure are countries with presumed consent law on cadaveric organ donation and the other half in blue are countries with informed consent. Spain has the highest donation rates, followed by Austria and Portugal, these three countries having presumed consent law. In 2002 the USA had the highest donation rate of the countries with informed consent law, and which was also close to the rates achieved by Austria and Portugal that year. In 2002, on average, cadaveric organ donation rate by countries that have presumed consent was 14.91 pmp, and 10.51 for countries with informed consent. Countries with presumed consent had an increase of 12% in their rates from 1998 to 2002, while the others a decrease of 12%. In absolute value, Italy was the country that improved its cadaveric donation most, with an increase of 5.8 (12.3 in 1998 to 18.1 in 2002). Brazil is one of the countries that do most transplants in the world, but its cadaveric organ donation pmp is one of the lowest (4.16 on average among 1998-2002).

Table 1: Descriptive statistics - average values (1998-2002).

Country	*[1]*	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*	*[7]*	*[8]*	*[9]*
Argentina	6.94	1	62.43	9.80	12163.80	1080.80	6.55	1	0
Australia	9.88	0	64.35	9.20	26375.60	2411.80	35.91	0	1
Austria	22.92	1	108.30	10.52	27394.80	2112.60	30.57	1	0
Brazil	4.16	0	49.71	16.90	7394.40	568.60	3.88	1	0
Canada	13.94	0	50.85	8.92	27961.40	2581.20	39.67	0	1
Chile	8.66	0	50.19	11.74	10456.60	612.60	13.28	1	0
Costa Rica	10.40	1	26.18	15.64	7623.60	647.80	8.15	1	0
Croatia	5.78	1	190.90	6.78	7819.20	639.20	8.88	1	0
Czech Rep.	16.56	1	163.75	6.03	14910.00	1005.20	12.15	0	0
Denmark	12.66	0	93.98	9.05	27819.00	2378.80	37.34	0	0
Finland	18.06	1	95.15	7.56	25070.60	1745.80	37.78	0	0
France	17.64	1	40.19	8.04	26063.00	2455.40	17.53	1	0
Germany	12.84	0	101.44	7.54	24720.60	2645.00	28.41	0	0
Greece	4.50	1	173.91	20.56	16878.80	1609.20	8.39	0	0
Hungary	13.36	1	185.10	13.36	12109.80	896.20	9.53	1	0
Ireland	19.23	0	69.03	12.81	28018.60	1862.20	17.66	1	1
Israel	10.96	1	40.78	5.60	20656.80	1827.00	20.24	0	1
Italy	15.30	1	117.83	13.43	24515.40	1985.40	20.80	1	0
Latvia	19.57	1	274.20	26.38	7750.20	429.40	6.86	0	0
Netherlands	12.06	0	76.19	6.26	26966.00	2206.60	40.95	0	0
New Zealand	10.60	0	69.35	12.88	20332.80	1629.20	36.36	0	1
Norway	15.36	1	103.24	7.25	33048.00	2857.60	35.87	0	0
Panama	2.08	1	39.80	16.58	6335.60	546.60	3.57	1	0
Poland	10.10	1	107.80	14.69	10166.80	602.00	9.92	1	1
Portugal	19.44	1	204.90	17.71	16992.20	1529.60	19.47	1	0
Romania	0.68	0	241.46	10.19	6671.00	390.80	4.61	0	0
Slovak Rep.	10.08	1	89.77	15.18	10823.40	627.40	9.21	1	0
Slovenia	13.48	1	103.71	14.41	17217.00	1382.40	21.07	1	0
Spain	33.04	1	93.61	15.10	20070.20	1508.00	12.54	1	0
Sweden	12.14	1	115.29	5.68	25863.00	2239.40	45.87	0	0
Switzerland	13.48	0	65.98	8.50	29597.60	3159.40	25.71	1	0
UK	12.96	0	109.23	5.62	25475.80	1868.60	27.25	1	1
USA	22.36	0	59.60	15.33	34085.00	4616.00	43.38	0	1
Venezuela	1.72	0	33.32	17.30	5946.80	324.00	3.47	1	0
Average	12.73	0.59	102.10	11.84	18979.22	1617.11	20.67	0.56	0.24

Note: [1] number of cadaveric organ donations per million population; [2] country has presumed consent law; [3] number of deaths by brain vascular disease per 100,000 population; [4] number of deaths by traffic accident per 100,000 population; [5] GDP per capita (US$); [6] Total health expenditure per capita (US$); [7] percentage of population that access the Internet; [8] Catholic country (>50% population); and [9] Common law as legal system.

Brazil was the only country that changed the law on organ donation during the years analyzed in this paper, as presumed consent commenced in 1998. At this time, every Brazilian citizen became a potential donor after death, unless he/she had registered an objection against donation in personal documents. However, this law was highly criticized by different institutions. Due to this pressure, the Brazilian government abolished presumed consent in 2000. The main problems related to the Brazilian

experience with presumed consent were: i) lack of ample discussion about organ donation, especially about the concept of brain death, which had caused fear in some of the population that organs would be removed before they were clinically dead; ii) hesitation of surgeons to remove organs without family authorization; iii) as most poor Brazilians do not have personal identification (ID or driver license), it meant they had no way of objecting to donation while alive.

Unfortunately, the Brazilian organization responsible for collecting data on issues related to transplantation (Sistema Nacional de Transplantes) began only in 1997, which means there is no official data on cadaveric organ donation before that. However, there is a common belief in the Brazilian medical community that presumed consent had a negative impact on organ donation in Brazil. In 1998 Brazil had the lowest cadaveric organ donation rate (2.6 pmp). As a result, in the same year, the Brazilian government added a new paragraph to the presumed consent law, stating that physicians should get permission from the deceased's family to remove organs (Gsillag, 1998). The following year, the cadaveric organ donation had an expressive increase, which was 4.1 pmp. A small increase was verified in the later years analyzed in this paper and in 2002 the cadaveric organ donation was 5.4 pmp.

Table 1 gives us an overview of the sample descriptive statistics. Approximately 60% of countries have presumed consent for organ donation. Of presumed consent countries, 65% are catholic and only 10% have common law as legal system. For the same group, 40% have GDP per capita above the sample average (US$ 1879.22). Only three counties had spent more than 10% of their GDP in the health sector: USA (13.54%), Germany (10.70%) and Switzerland (10.67%); the lowest rates were observed in Venezuela (5.45%), Latvia (5.54%), Slovak Republic (5.80%), Chile (5.86%) and Poland (5.92%). All of these data are related to average values from 1998 to 2002.

The number of deaths by brain failure is larger in OECD countries, with females the most affected. However, Latin American countries have more deaths by traffic accident when compared to other countries, males being responsible for most of them. These two variables are important for organ donation, because a representative part of cadaveric donations come from them.

Internet access has increased in all countries between 1998 and 2002, except in Norway. Almost half of the Swedish population had access to the Internet for the period 1998-2002. The USA was the second in terms of access to the Internet and the lowest rates came from Latin America, being Venezuela, Panama and Brazil the lowest. We use this variable as proxy for information, since it is one of the most effective ways to spread information about donations. We expect to see a positive correlation between them.

As Anbarci and Caglayan (2005) point out in their paper, institutional aspects seem to have some effect in organ donation, such as the rule of law and religious belief. Based on this, we add to our model dummies for 'catholic country' and 'common law'. From our sample, 56% of countries are catholic and a quarter has common law as the legal system. Religious belief can affect the organ donation since it influences people's attitudes toward the way of life. As cadaveric donation is a topic that involves spiritual beliefs for the integrity of the human being, religion can play an important role in this subject. There are two main legal systems taking place in the sample analyzed in this paper: common law and civil law. The main difference between them is that the first

system places more emphasis on individual rights and the second one on the state rights. Based on this, these features can affect the way people feel concerned about donation.

3.2 Quantile Regression for Panel Data Approach

Baltagi (2001) points out some of the main benefits of using panel data: i) controls for individual heterogeneity; ii) more informative data (more variability) can be analyzed; iii) less collinearity among covariates; and iv) it is a good way to investigate dynamics of adjustment. However, panel data is a method based on the conditional mean. That is, it assumes that covariates affect only the location of the conditional distribution of the dependent variable, and not its scale or any other aspect of its distributional shape.

Koenker and Basset (1978) developed a method called quantile regression (QR) that deals better with the conditional mean problem, since it extends the regression model to conditional quantiles of the response variable. This means that more information can be obtained, particularly when the estimated coefficients depend on each quantile, i.e. when there are asymmetric effects throughout the conditional distribution of the response variable. Other advantages in using QR are: i) it does not make any distributional assumption about the error term; ii) it is robust to outliers; and iii) it uses the entire data to estimate each quantile coefficient. The main limitation associated with QR is that it is a cross-sectional approach, which does not account for individual-specific effects. So researchers must choose which characteristics are more important for studying and after that, opt for a method that is more appropriate to their studies.

Koenker (2004) introduced a new method to solve this trade-off: quantile regression for longitudinal data. For this, a class of penalized quantile estimators is suggested to obtain distributional estimates, even controlling for unobserved individual heterogeneity. The penalty serves to shrink a vector of individual-specific effects toward a common value, and the degree of this shrinkage is controlled by a tuning parameter λ (Lamarche, 2005).

Following Koenker (2004), consider the classical linear random effects model:

$$(1) \qquad y_{it} = x'_{ij}\beta + \alpha_i + u_{ij} \qquad j = 1 \ldots m_i, \qquad i = 1, \ldots, n$$

where the subscript i indexes individuals and the subscript j indexes the m_i distinct measurements made on the ith individual; y_{it} is the response variable; x'_{ij} is the vector of covariates; α_i measures the individual unobserved heterogeneity; and u_{ij} is the error term related to observed variables. This model can be extended to conditional quantile functions, which assumes the following form:

$$(2) \qquad Q_{y_{ij}}(\tau \mid x_{ij}) = \alpha_{ij} + x'_{ij}\beta(\tau) \qquad j = 1, \ldots, m_i \qquad i = 1, \ldots, n.$$

An important feature of this formulation is that the effects of the covariates, x_{ij}, depend upon the quantile (τ) of interest, which enables a scale shift throughout the conditional distribution of the response variable. However, α's have a pure location shift effect. Koenker (2004) has pointed out that this limitation comes from the nature of empirical applications, which generally have a small number of observations on each individual (m_i). Based on this, following Koenker (2004), it is quite unrealistic to attempt

to estimate the effect of α conditional on each quantile. Because of that, α is set to have only a location shift effect: one value for the entire conditional distribution.

To solve model (2), Koenker (2004) has considered a class of penalized estimators to estimate several quantiles simultaneously, which can be stated as:

$$(3) \qquad \min_{(\alpha,\beta)} \sum_{k=1}^{q} \sum_{j=1}^{n} \sum_{i=1}^{mi} \omega_k \rho_{\tau_k} (y_{ij} - \alpha_i - x'_{ij} \beta(\tau_k)) + \lambda \sum_{i=1}^{n} | \alpha_i |$$

where $\rho_\tau(u) = u(\tau - I(u \leq 0))$ is the quantile loss function and ω_j is a relative weight given to the *j*th quantile. The last one controls the influence of the quantiles on the estimation of individual effects (α_i). When the penalty is bigger than zero ($\lambda > 0$) penalized fixed effects are estimated, while $\lambda = 0$ means that no penalty is applied, so a simple fixed-effects estimator is obtained.

Due to the recent developments in this field, there are a few papers that have used this method in applied econometrics. Some examples are: Koenker (2004), Abrevaya and Dahl (2005), Pianto et al. (2005) and Lamarche (2005). However, this method has a huge potential, with many attractive features, so we believe that the number of publications using this approach will increase exponentially in the next few years.

4. Application and Results

Just to compare the main results from quantile regression for panel data (QR for PD), we have run a conventional analysis of the panel data (PD). The model used in the last one was by feasible generalized least squares (GLS), with a heteroscedastic error structure and no cross-sectional correlation. Data sets like the one analyzed in this paper (data from countries) generally do not have constant variance for each individual. As the estimates from QR for PD have shown, in the case of this sample, the quantile coefficients are asymmetric throughout the conditional distribution of response variable. All the estimates from the panel data are statistically significant at the 1% level and bigger than others from quantile regression for panel data.

The main specification of the model sets the log of cadaveric organ donation as a function of a dummy for presumed consent, log of: number of deaths from celebro-vascular disease; number of deaths from traffic accident; GDP per capita; the percentage of population that has the Internet access, a dummy for catholic countries and a dummy for common law. The same model is used including the log of total health expenditure per capita and excluding GDP per capita. We do not put health expenditure and GDP into the same model because they are highly collinear. Tables 2 and 3 report the main results.

Table 2: The effect of presumed consent law on cadaveric organ donation: Estimates from panel data and quantile regression for panel data

Dependent variable: Log cadaveric organ donation	**PD**	**25th**	**50th**	**75th**
Presumed Consent	**0.4039**	**0.2230**	**0.2440**	**0.2150**
	(0.000)	(0.000)	(0.000)	(0.000)
Log Brain	**0.1417**	**-0.0030**	**0.0590**	**0.0390**
	(0.003)	(0.479)	(0.160)	(0.262)
Log Traffic	**0.3078**	**0.2350**	**0.2170**	**0.2390**
	(0.000)	(0.000)	(0.000)	(0.000)
Log GDP per capita	**0.9546**	**0.8180**	**0.7420**	**0.6420**
	(0.000)	(0.000)	(0.000)	(0.000)
Log Internet access	**0.1156**	**0.0680**	**-0.0116**	**0.0200**
	(0.004)	(0.009)	(0.196)	(0.033)
Catholic Country	**0.1722**	**0.1550**	**0.0480**	**0.0240**
	(0.001)	(0.000)	(0.054)	(0.235)
Common Law	**0.1281**	**0.0700**	**0.1230**	**0.1230**
	(0.001)	(0.001)	(0.000)	(0.000)
Constant	**-8.9367**	**-6.6620**	**-5.7550**	**-4,706**
	(0.000)	(0.000)	(0.000)	(0.000)

Note: Coefficients in bold and *p*-values in parentheses.

The estimates from quantile regression for panel data show a positive effect of presumed consent on cadaveric organ donation, even controlling for other determinants of the response variable. The same qualitative predictions are verified with different specifications[13], which can be viewed as a measure of robustness of the model. All coefficients are statically significant at the 1% level. The magnitude of the coefficients lies between 21-24% when the GDP per capita is used as proxy for income, and 24-26% when health expenditure per capita is used instead. There is a slight variation among the quantile coefficients, with the median (50th quantile) as the biggest one. These estimates are smaller than the one from panel data, which is about 40%.

From the model analyzed in Table 2, the GDP per capita has the biggest impact on cadaveric organ donation. Countries situated in the lowest quantiles were the most affected (81% at the 25th quantile and 74% at the 50th quantile). That pattern could be interpreted as decreasing returns of scale, since the marginal contribution of income is lower when we go through the upper side of the distribution. The coefficients of health expenditure per capita also show the same pattern (see Table 3).

[13] The other specifications set the vector of covariates as: i) presumed consent (PC), celebro-vascular disease (brain) and traffic accident (traffic); ii) same as (i), plus GDP per capita; iii) same as (i), plus health expenditure; iv) same as (i), plus catholic and common law dummies; v) same as (iv), plus internet dummy; vi) PC, catholic and common law dummies; and vii) PC. The estimates from these models are available upon request.

Table 3: The effect of presumed consent law on cadaveric organ donation: Estimates from panel data and quantile regression for panel data

Dependent variable: log cadaveric organ donation	**PD**	**25th**	**50th**	**75th**
Presumed Consent	**0.3829**	**0.2540**	**0.2630**	**0.2370**
	(0.000)	(0.000)	(0.000)	(0.000)
Log Brain	**0.1990**	**0.1430**	**0.1430**	**0.1020**
	(0.000)	(0.017)	(0.012)	(0.044)
Log Traffic	**0.1772**	**0.2260**	**0.1830**	**0.2200**
	(0.001)	(0.000)	(0.000)	(0.000)
Log Health Expenditure per capita	**0.6180**	**0.5210**	**0.4710**	**0.4240**
	(0.000)	(0.000)	(0.000)	(0.000)
Log Internet access	**0.1812**	**0.1220**	**0.0250**	**0.0400**
	(0.000)	(0.000)	(0.053)	(0.001)
Catholic Country	**0.2439**	**0.1110**	**0.0460**	**-0.0010**
	(0.000)	(0.000)	(0.011)	(0.480)
Common Law	**0.1970**	**0.1100**	**0.1740**	**0.1520**
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	**-4.2819**	**-3.1480**	**-2.2660**	**-1.7370**
	(0.000)	(0.000)	(0.002)	(0.004)

Note: Coefficients in bold and *p*-values in parentheses.

Analysing the potential donor coefficients, only the traffic accident coefficients are statistically significant at the conventional levels, having a positive effect on cadaveric variable, as one would expect. However, in model 2 (Table 3), both of them are statistically significant at least at the 5% level, showing a positive impact on the response variable.

Religious belief seems to play a role in organ donation as well, at least in the left tail of the distribution. Predominately Catholic countries show a positive effect of around 11-15% in the 25th quantiles in both models, while in the 50th quantiles they are practically the same, 5%. Anbarci and Caglayan (2005) found a negative effect for religious belief, but their dummy was set for Islam and Judaism. We were not able to test their variable, since our sample has only one country that follows that religious belief (Israel - Judaism). While most countries with Islam and Judaism as the prominent religions do not stimulate the population to become potential donors, catholic countries recognize organ transplantation as a new way of serving the human family. Pope John Paul II (1991) in his speech to the medical community expressed his agreement to cadaveric organ donation, since it takes place in a context of love, communion, solidarity and absolute respect for the dignity of the human person.

We also tested the impact of the legal system on cadaveric organ donation, using a dummy for the existence of common law. It was statistically significant at the 1% level in all quantiles. The biggest coefficients were in model 2 (Table 3), varying between 11-17%. Based on this, people from countries that place more emphasis on individual rights tend to donate more their organs. However, further research must be done to understand the link between common law and cadaveric organ donation.

5. Conclusion

The aim of this paper was to discuss some issues related to the presumed consent law, and to bring up empirical evidence of the supposed impact of this legislation on cadaveric organ donation. In order to do this, a review of related works was carried out. For the empirical part, a sample of 34 countries over 5 years was analyzed. The method applied was quantile regression for panel data, which we believe is an appropriate way to investigate such a heterogeneous sample as there has been criticism of results obtained by conditional mean approaches due to some outliers (especially the Spanish case, which has the biggest cadaveric organ donation rate by far). This paper is the first to apply this method of investigation to this subject.

As it has been stressed, in this paper and others, the two kinds of legislation on cadaveric organ donation are imperfect, because there are always people whose true wills are not executed. In this way, policy makers must weigh the pros and cons of each piece of legislation. The results reported in this paper could be used to clarify the benefits of adopting presumed consent, which has a positive effect of 21-26% on cadaveric organ donation related to informed consent countries. Also, the methodology applied in this paper was able to provide evidence against a common belief in related literature that presumed consent has a positive effect only because of the outstanding Spanish donation rate. The left tail of distribution (countries with lower organ donation rate) has shown a positive impact on the response variable, which contradicts this common belief.

Organ shortages can be worse since both celebro-vascular disease and traffic accident rates have presented decreasing rates over the years (-5.2% and -8.6%, respectively, from 1998 to 2002), as a consequence of specific public health policies in these areas. Based on this, the trend for the contribution from these variables on organ donation can be lower over time. So health policy makers must be aware of that problem. The presumed consent law could be an alternative, not to solve the problem completely, but at least to reduce the gap between demand and supply of organ donation.

There are other ways that the policy maker can improve the organ supply: increasing health expenditure and intensifying the dissemination of information about organ donation. A strong relationship was found between health expenditure and donation rates, especially in countries that are situated in the lower quantiles of the conditional distribution. This seems to be the most effective way of increasing organ donation for countries that do not want to change the law to presumed consent or even for those that already have one, because the health policy maker has control of health expenditure, unlike other factors such as religious belief and the legal system (which also have a positive effect on the organ donation rate).

Although educational campaigning has not been explicitly tested in this paper, it seems to play an important role in organ donation, since a representative part of the population has little knowledge about legislation on organ donation. As our proxy for information (access to the Internet) has shown, there is a positive impact between it and the response variable. Based on this, more information must be made available on different media. Educational campaigns also can avoid some problems as verified in the Brazilian experience with presumed consent. Some authors have pointed out that presumed consent was unsuccessful in Brazil because there was not a huge discussion

about the law and related issues with transplantation, such as the strict proceedings to diagnose brain death and the coordination of the waiting list.

Finally, if these recommendations are followed by health policy makers a significant increase in organ donation should be achieved and more transplants could be carried out, generating better quality of life for patients, particularly in cases when such transplants are the only way to keep them alive. In this way, efficiency and equity could be achieved as well; the main goals for public health policies.

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