

THE DETERRENT EFFECTS OF BRAZILIAN CHILD LABOR LAW

Gabriel Costeira Machado
(*Professor of Economics – FURG*)
Cristiano Aguiar de Oliveira
(*Professor of Economics – PPGE/FURG*)

ABSTRACT

Brazilian law prohibits all forms of work for children with age under 14 years old. Therefore, work done by children under 14 years of age are subject to sanctions as work done for over 14 years of age does not. We use this quasi-experiment generated by Brazilian law to test its deterrence effect. To this end, we use 2013 PNAD data to estimate the Local Average Treatment Effects (LATE) using the regression discontinuity approach. The results show that this law reduces on average 3.5 weekly working hours when all individuals living in all areas are considered, 2.7 hours in urban areas and inconclusive effects in rural areas. The paper concludes that the law has a deterrent effect and inhibits child labor in Brazil, but with ambiguous effects in rural areas, where there is less law enforcement and more children working.

Keywords: Law, Child Labor, Quasi-experiment, Regression discontinuity
JEL Classification: D9, K4

RESUMO

A lei brasileira proíbe qualquer forma de trabalho para menores de 14 anos. Portanto, trabalhos realizados por menores de 14 anos estão sujeitos a punições enquanto trabalhos realizados por maiores de 14 anos não. Nós utilizamos este quase experimento gerado pela legislação brasileira para testar os efeitos dissuasórios desta lei. Para este fim, utilizamos dados da PNAD de 2013 para estimar os efeitos médios de tratamento local (LATE) obtidos em regressões com descontinuidade. Os resultados mostram que esta Lei reduz em média 3,5 horas semanais de trabalho quando todos os indivíduos são considerados, 2,7 horas nas áreas urbanas e que a Lei gera efeitos inconclusivos para a área rural. Estes resultados permitem concluir que a Lei tem efeitos dissuasórios e inibe o trabalho infantil no Brasil, porém com efeitos difusos nas áreas rurais, onde a fiscalização é menor e o trabalho infantil mais frequente.

Classificação JEL: D9, K4

Palavras-Chave: Leis, Trabalho Infantil, Regressão com Descontinuidade.

ÁREA 13 – ECONOMIA DO TRABALHO

1 Introduction

Analyzing the deterrent effect of any law is a difficult task due to the complexity of the mechanism in itself. Laws can make an article illegal (weapons) can increase the harshness of a punishment (death penalty) or alter the way in which the punishment takes place (three strikes laws), etc. A Law, although relevant, is just an element within the set of elements that agents take into consideration for their decision-making. Not by chance many laws end up having the opposite effect intended by their proponents, since they generally ignore these other factors: the reactions of the agents towards the new institutional framework and the chain of consequences which arises with new rules. In other words, many times only the impacts on the partial equilibrium are taken into account but the general equilibrium is ignored. Empirical researchers willing to identify the global effects of a law have many challenges that, unfortunately, cannot be overcome.

A recurrent empirical challenge is to find ways in order to control the other elements that affect the decisions considering that these might be unavailable or non-existent information. This omission, of relevant independent variables, is always a source of worry for the researcher who intends to obtain non-biased estimators of the impacts of institutional changes. This problem can, in part, be overcome with the use of panel data, since it allows controlling this not observed heterogeneity through the estimations that exclude the fixed effects, that is, those characteristics of the unit analysis that do not alter with time. But this is not the only problem to be solved. In order for it to be possible to identify the deterrent effects of the Law, a counterfactual analysis is necessary, that is, it is necessary to answer which would be the result in terms of violations in the case such Law were not sanctioned.

It is not always easy to obtain this counterfactual scenario¹, the most common strategy is to divide the units into two groups (treated and control). The treated represent those units under the new Law while the control refers to those units where there was no change in the Law. This process is facilitated when there are differences in the legislation between states, such as in the USA. In Brazil, this task is more difficult still since, all criminal laws are applied throughout the whole national territory, although they are applied by independent Justice Systems². Therefore, it is impossible to obtain the deterrent effect of a Law through regional variations and it is only possible to evaluate the various efforts in applying it, that is to say, regional differences in the likelihood of the punishment resulting from the local Justice System's efficiency.

Yet, the use of panel data is not the definitive solution for the problems caused by endogeneity, since simultaneity problems and measurement errors in the independent variables, included in the empirical models, will continue imposing difficulties to whosoever proposes to perform causality inferences. The use of instrumental variables, although disseminated, is far from being a solution for the violation of the strict exogeneity condition problems, necessary to obtain non-biased estimates. It is always very complicated to obtain exogenous variations, capable of identifying a model of simultaneous equations and, in this way, to have a research work immune to criticism.

Methodological criticism and arguments without a definitive conclusion can be seen in several attempts of assessing the deterrent effects of laws. These are the cases of "three strikes laws" (Marvell and Moody, 2001; Shepherd, 2002; Iyengar, 2008), death

¹ A recent strategy, gaining in popularity, is the synthetic control technique proposed by Abadie and Gardeazabal (2003) allowing the construction of a counterfactual vector from the time series of other geographic units to be compared with time series of a certain region.

² Each state has its own police, public ministry and judiciary.

penalty (Dezhbakhsh et al., 2003; Katz et al. 2003; Donohue and Wolfers, 2005; Berk, 2005; Fagan, 2006; Fagan et al., 2005; Zimring, 2008; Cohen-Cole et al., 2009; Donohue and Wolfers, 2009; Hjalmarsson, 2009; Kovandzic et al., 2009; Zimring et al., 2010), laws about weapons (Kleck and Patterson, 1993; Lott and Mustard, 1997; Lott, 1998; Lott, 2010; Black and Nagin, 1998; Hemenway, 1997; Ludwig, 1998; Duggan, 2001; Ayres and Donohue, 2003; Dezhbakhsh and Rubin, 2003; Moody and Marvel, 2005; Aneja et al., 2014).

In these subjects there exist contradictory results and with significant differences in the estimated coefficients. In common to all these works is the difficulty of the researcher in dealing with the violation problems of strict exogeneity hypothesis that an estimation of a regression model imposes³. The ideal scenario from the scientific point of view to overcome these difficulties would be the performance of randomized experiments, with the selection of treatment and control groups being obtained randomly. Although some experiences exist in terms of public policy (Munnell, 1986; Larson, 1976; Kling et al., 2007; Ludwig and Kling, 2007), their use to assess laws is impracticable. This because a law cannot be applied randomly for groups of individuals. The law, as a principle, must be the same for all. Therefore, in a more realistic vision, there remain few alternatives for empirical researchers of law.

One of the alternatives is the use of natural experiment that alter the treatment and that are capable of performing the separation of the control and treatment groups without the influence of the researcher, that is, takes place what is called a natural experiment or quasi-experiment. Researchers in the area of crime, for instance, have used this procedure to analyze the effect of the police on crime (Di Tella and Schargrodsky, 2004; Klick and Tabarol, 2005; Draca et al., 2011; Machin and Witt, 2011; Machin and Olivier Marie, 2009). In the empirical analysis of Law, Lee and McCrary (2005) call our attention to a quasi-experiment that takes place with the passage to the age of criminal responsibility, when the punishment abruptly alters for the individuals. As the individuals near the threshold age (18 years of age) they possess similar characteristics and it is possible that there exist a discontinuity in the criminal recidivism. According to the authors, their methodology allows overcoming the recurring endogeneity problems that take place that use added data from cities since these units tend to answer to the increase of criminality with higher punishments. Besides, the model allows isolating the deterrent effects from the traditional combination of incapacitation and deterrence. Using longitudinal information from the State of Florida, where the criminal majority is reached at the age of 18, the authors estimate there being a 2% reduction of criminality with a punishment increase of approximately 230%.

A similar situation takes place with child labor in Brazil, because there is a cutoff under Law according to the ages of individuals. Any form of work is forbidden for children under the age of 14. From 14 onward, working is allowed as a trainee minor, as long as the activity is not considered unhealthy, which is only allowed for individuals above 18 years of age. Assuming that there are no significant differences in physical and intellectual capacity of individuals with ages close to 14 years and the only difference between them is the different costs (of expected punishment) that their employers and parents/guardians are subject to, their use as workers, it is possible to conclude that it is a quasi-experiment. In this way, the deterrent effects of the Law which prohibits child

³ An innovative intent to overcome these more common problems can be seen in Helland and Tabarrok (2002), who use a survival function using non-parametric methods to assess the impact of the *three strikes laws* in the States of California, New York, Illinois and Texas.

labor in Brazil can be obtained by identifying the existence or not of a discontinuity in the hours worked per week when around the age of 14 years old.

Therefore, the aim of this article is to identify the deterrent effects of the Law that forbids child labor in Brazil. For this purpose, it uses information from the Pesquisa Nacional de Amostra por Domicílios (PNAD), National Household Sample Survey, of 2013, to observe if there is or there is not a discontinuity in the amount of weekly hours worked among individuals around 14 years of age. Although it uses alternative methodologies, the paper puts more emphasis on the results obtained for the Local Average Treatment Effect (LATE) using the methodology for the choice of bandwidth in regressions with discontinuity proposed by Cattaneo, Calonico and Titiunik (2014). We believe that the article contributes to the literature by bringing a more robust methodology (based upon a quasi-experiment) to assess the deterrent effects of laws than those of traditional methods. Besides, it uses a large sample that covers the whole national territory of an underdeveloped country, known for the difficulty of applying its Laws – be it due to the inefficiency of its Justice Systems, be it due to its large territory, what hampers its surveillance capacity. In order to capture these difficulties, different estimations are performed for the urban and rural areas of the country.

The article is organized in the following way: the following section presents in more detail, the legislation of child labor in Brazil, bringing its history and defining its current feature. The third section details the strategy of identification used. The fourth section presents the results. At the end of the article, the final considerations are presented.

2. Brazilian child labor Law

The Brazilian legislation adopts, in its composition, a receptive conduct towards the international norms, above all when they deal with issues regarding human rights. The 1988⁴ Federal Constitution (FC) is the supreme and fundamental law of Brazil, which brings the basic precepts with which all other rules (laws, statutes, codes, etc.) must be in accordance. Regarding the protection of children and adolescents, the implementation of the FC represented a rupture of a reality of under age children, until then in force, in dealing in an unprecedented way: children and adolescents as subjects of law - not more objects of intervention.

The Convention about the Children's Rights, adopted by the United Nations' General Assembly in 1989, recognized the need for special care and assistance to the family, the fundamental group of society, in order for them to fully assume their responsibilities in the community, ensuring the growth and well-being of its members, most important, children. The document was ratified by 193 countries in Brazil in 1990. The Convention demands, with the force of international Law, that the signing countries adequate their legislations to these rules, committing themselves not to violate them. In that current, the Brazilian legislator was guided to establish the basis of the Doctrine by defining the basis of the Integral Protection Doctrine, contemplated in FC in Art. 227 proclaiming a set of rights, of an individual nature, diffuse, collective, economic, social and cultural, recognizing that children and adolescents are subjects of rights and, given their vulnerability, need special care and protection.

In accordance with the FC, the Estatuto para Crianças e Adolescentes (ECA), Statute for Children and Adolescents, was created, established by Law Number 8.609 / 1990. The ECA represents a synthesis of encodings, specifying and deepening the

⁴ The 1988 Federal Constitution is the seventh Constitution of Brazil, currently applied.

juridical issues, within the sphere of the social and legal treatment for minors, more specifically, provides for the integral protection of children and adolescents, internalizing, even, a number of international standards.

According to Art. 2 of the ECA, in Brazil, the definition of child is all individual between the ages of zero and twelve incomplete years of age and an adolescent is that between the ages of twelve and eighteen years of age. To these, they ensure as a priority all the fundamental rights inherent to the human person, with fitting punishments under the law to any suffered attempt or attacks.

Concerning the object of study of this paper, in what situation the rights of children and adolescent are infringed? In order to answer this question, a definition of child labor must be searched to have a knowledge of which forms it must be abolished – although there are divergences regarding a definitive concept. According to the International Labor Organization (ILO), not even all the works performed by children and adolescents, fit this definition, and then, do not demand being eliminated. In general, activities that give them skills and experience, preparing them for the future, to become productive individuals in society, are considered beneficial.

The main reasons to restrain child labor are linked to the damaging activities for performance and school attendance, school dropout being an aggravating factor. Such consequences, generally, are triggered by physical and psychological fatigue. Since poverty is always pointed out as one of the main determinants of child labor, the deterrent to formal education represents the permanence in the condition of social vulnerability, seen that the human capital is, perhaps, the only factor capable of breaking this paradigm – known as intergenerational factor of poverty. Besides, child labor involves the violation of legislation that presages the minimum age admitted for work.

Convention N° 138 of the ILO, in force since 1976 and ratified by Brazil in 2002, adopted several proposals with regard to minimum age for obtaining employment. In its Art.2, it establishes that each signing country will specify the minimum age for admission to work. In this sense the ECA in its Art. 60, in consonance with the FC in its Art. 7, Inc. XXXIII, defines the minimum limit to work at the age of 16, except in the capacity of apprentices starting at the age of 14.

Although the Brazilian Legislation protects and, also prohibits the employment of children under 16 years of age, except for trainees from the age of 14, the exploitation of child labor is not configured as a crime, but as an administrative offence, which certainly bounds its capacity of dissuasion. There are no punishment mechanisms delimited for the practice, leaving some forms of coercion and mild supervision, both in the general legislation as in the special ones. The main reason for this is that with the exception of the punishments foreseen for companies that use child labor, the punishments applied to the parents/guardians, end up by harming the children, the victim. The payment of fines reduces the family income and become difficult to apply in the cases in which the child labor is precisely used in order to complement an insufficient income for the family's subsistence.

The Decree-law N° 5.452 of 1943 that approved the Consolidation of Labor Laws (LLC), devotes a chapter to the norms of protection of minors who work. In consonance with the FC, the LLC foresees, according to article 404, that the jobs of minors cannot be performed in environments that attempt to her physical or emotional development or formation, or her morality. In case such situation being found or confirmed, article 407 grants the competent authorities to oblige the minor to abandon the job, allowing the company to provide all the facilities to change the functions. If that is not complied with, the termination of the contract will be considered. The person responsible for the minor also possesses the prerogative of pleading the contract

termination if he considers the work performed as harmful. For the case of apprentices, article 424 confers on the parents/guardians the obligation of removing them from jobs that diminish their time for studying or necessary rest. While employers must guarantee a suitable environment.

According to article 435, the offending companies are subjected to fines, the value of each equal to one regional minimum wage, “applied as many times as there are underage employees in violation of the law - being able, yet, the sum of the fines exceeding five times the minimum wage, except in the case of recidivism, in which case that total may be increased to double the price.”

Although child labor not being typified as a criminal conduct, its practice may be framed as a crime in cases of ill-treatment or reduction to a condition analogous to slavery, provided for in the Penal Code. The first case, set in Article 136, predicts exposure to dangerous persons in authority, custody or supervision, among other purposes, being subjected to excessive or inappropriate work with detention from two months to a year, if resulting in injury of a serious nature and, may reach from four to twelve years if resulting in death, aggravating the sentence by one-third when committed against children under 14 years of age.

The second aspect, foreseen in article 149, refers to submitting the victim to degrading work conditions, forced labor or exhaustive working hours, with imprisonment from two to eight years and a fine, in addition to the penalty corresponding to violence. The penalty is increased in half more reclusion time if the crime were committed to a child or adolescent.

Besides these, the ECA provides a set of administrative infractions with according punishments. In its Article 249, it says that noncompliance, fraudulent or with intent, of the duties of the parents or guardians (guardianship or custody) generates offense with a fine of three to twenty times the minimum wage, applying double the amount for repeat offenders. Repeat offenses can lead to the maximum punishment, the loss of the child or adolescent’s custody. Another form of punishment that can harm the child or adolescent. Excluding the cases in which ill-treatment takes place and slave work exploitation, the legislator, as well as the Justice System, possess a dilemma in the application of punishment, since the forms of punishment foreseen in the legislation also punish the victim. This generates a certain skepticism regarding the capacity of the Law that forbids child labor to generate some deterrent effect. Besides this, the situations that are not foreseen in the penal code are not supervised by the police. For the effect of supervision of child labor, and protection of teenage workers, the Normative Instruction of the Secretary of Work Inspection Nº 102 of 2013, was published, according to the principles, rules and limits foreseen in the FC and in the ECA. In it, the annual supervision planning is defined and fighting activities towards child labor under the responsibility of the Superintendência Regional do Trabalho e Emprego (SRTE), Regional Superintendence of Work and Employment, working articulately together with the organizations and entities that compose the network of children and adolescents⁵ protection, that is to say, institutions with a very low coercion power when compared to the police.

3 Identification Strategy

⁵ The protection network for children and adolescents is composed by international, federal, state and municipal organizations; employers and workers; civil society; tutelary council; child and adolescent council of rights; etc.

3.1 Data

Until the decade of 1960, Brazil only had the Demographic Census of the Brazilian Institute of Geography and Statistics (IBGE), which took place every ten years. Faced with insufficient information about the main aspects of the socioeconomic and demographic growth of Brazil, the National Household Sample Survey (PNAD) appeared in 1967 in order to collect information from inter-censal periods and investigate specific topics, not covered by the census.

At the beginning, research was performed every quarter. From 1971 onward its implementation began being yearly, conciliating with a progressive expansion process, the scope of its collection – since 1990, the PNAD covers the whole country, with the exception of the rural areas of six states of the northern region. In them, issues such as general characteristics of the population (age, gender, race, etc.), education, work, income, habitation are approached regularly, besides specific subjects treated sporadically – supplementary research.

To fulfill the purpose of this study, that is, check the deterrent effect of Brazilian legislation on the incidence of child labor, the 2013 PNAD was adopted. In order to delimitate the sample, for it to fulfill its purpose, the analysis of this article concentrates on individuals within the age range between 10 and 18 years of age⁶.

The PNAD uses a probabilistic sample method of homes, adopting a stratified and conglomerate design, with up to three selection stages – which confers it the *status* of a complex sample. Besides, the research adjusts the weights of the sample units for calibration with the known population totals⁷. When implementing the calibration, the sample in the interval in question, now relies on 25.460.964 individuals. Yet, the estimation of the non-parametric model with this sample size, exhaust the capacity of any personal computer. Therefore, in order to obtain a sample, capable of obtaining consistent estimates and that allows the estimation of the econometric model proposed, random sub-samples are extracted with 100.000 thousand individuals.

From the PNAD the information used are those regarding people's age and the amount of weekly hours worked. For the construction of this variable, information is used regarding year, month and day of birth and compared with those of the PNAD data collection of information, which possesses as date of reference the 29th of September 2013. Starting from there, the age is generated in its continuous form. For example; an individual who is 12 years and 6 months old, is 12,5 years old. The amount of hours worked represent the amount of hours worked at the date (week) of reference of the research.

Table 1: Frequency and relative frequency of child labor by age (completed years) and dweller area.

Total	Urban	Rural
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⁶ Since 2002, the minimum limit for investigation on the subject of work and income went from 5 to 10 years of age.

⁷ For that expansion, estimators of likelihood ratio for the projection of the resident population in each State, according to the area being censused (metropolitan or non-metropolitan).

	Child workers	%	Child workers	%	Child workers	%
10	51 778	1.75	14 593	0.62	37 185	6.32
11	74 701	2.41	29 801	1.18	44 900	7.83
12	118 120	3.61	49 485	1.85	68 635	11.31
13	201 268	5.49	90 327	3.03	110 941	16.15

Source: PNAD 2013. Note: The % column refers to the ratio of child workers and child with the age in the sample.

Table 1 shows that in Brazil there is a significant number of working children and, therefore, breaking the Law that forbids child labor in Brazil. In 2013, there were around 450.000 children who worked and received some type of payment, which can be monetary or in products. The incidence grows with age and it is higher in rural areas, in rural areas the incidence rate is practically double the amount than in urban areas. Yet, the numerical existence of child labor does not necessarily mean that the Law is totally inefficient. Since, to reach that conclusion it is necessary to have a counterfactual scenario where the prohibition does not exist. In other words, what would be the number of children working if the Law did not exist?

In this sense, it is useful to remember Becker's idea (1968) that zero crime equilibria are almost impossible to occur. According to him, the society, within the economic perspective, will be condescending with the occurrence of crimes taking into account a cost-benefit analysis. This means, a situation in which there is no incidence of crime would only be conceivable when the social gains overcome the costs of inhibition, otherwise, it is plausible that the society will not agree to bear such costs. Since, such situation is unattainable. It is necessary to point out that such paradigm can only be applied to the pecuniary costs of the prevention of violations. Yet, the core questioning is: What is the liquid value in terms of well-being, of zero crime society compared with a society where there is a low (therefore positive) level of violations to established rules?

If it is considered that all forms of child labor is noxious for society, its negative impacts can be measured by the amount of hours worked. When analyzing the relation between age and average weekly hours worked, it can be observed, as expected, an ascending relationship. Table 2 provides an intuition regarding the results which we wish to prove in this paper: the incidence rate of child labor is higher from the age of 14, which suggests, in turn, that the Law possesses some relevance in the reduction of working hours offered.

Table 2: Mean weekly working hours in urban and rural areas by age (completed years)

Age	Total	Urban	Rural
10	0.19	0.04	0.77
11	0.29	0.15	0.92
12	0.58	0.32	1.71
13	0.94	0.60	2.44
14	2.05	1.52	4.40
15	3.31	2.85	5.43
16	6.63	6.26	8.42
17	10.05	9.80	11.34

Source: PNAD 2013.

Besides, table 2 shows that the employment of child labor is accentuated when observed, separately, to the average hours worked weekly in the rural area, since the amount of hours worked by children are, at least, three times as many as those worked in

the urban area. There are several explanations for these differences. One possible explanation is a market failure that ultimately generates a culture of child labor in rural areas. There is a difficulty in hiring manpower due to restrictions in the offer (generated, for instance, by the working legislation), that rise their prices and, consequently, reduce the amount of manpower hired. One way of overcoming these obstacles, to the expansion of production, is to use family manpower out of labor and criminal law. This situation has remained for generations, which makes child labor be considered normal, because it is treated as an initiation to the family business that will guarantee continuity to the family business that will guarantee the continuity for another generation of the production in the property. Further on, in the discussion of the results of the model proposed, some other possible explanations for these differences.

3.2 Methodology

To attain the objectives of this study, the *Regression Discontinuity Design* – RDD) method was employed. Within the context of impact assessment, the RDD consists in a non-experimental approach where an individual's attribution as a candidate to treatment, this is to say, the participation or not in a particular program or treatment, but is linked to an exogenous numerical value that this assumes, defined under an observable variable, called "classification variable", and has, as a reference, a cut-off point that will characterize the group of those treated and a control group.

One of the advantages that made the RDD an attractive approach is the possibility of working with designs of already established programs, eliminating the need for the study to be conducted, *a priori*, randomly. In the present paper the relationship between hours worked weekly (the interest variable), the continuous age⁸ (classification variable) and the treatment, in this case, of the Brazilian legislation that prohibits any type of work for children under 14 years of age.

For the method to be successful, providing non-biased estimates and, mainly because it is a non-experimental method, that seeks to reproduce a randomized experiment, basic conditions are demanded that guarantee the internal validity of the study. In the first place, it is necessary that the classification variable not be caused or influenced by the treatment. Besides this, it must be guaranteed that the cutting point be exogenous and the attribution to the treatment be based on the *score* that the candidate obtains (in relation to the cutting point). Then, it is conceivable to say that the age of any individual, is an exogenous variable, incapable of generating a self-selection bias – in this case, receive the treatment – this is, the legal prohibition of working for individuals less than 14 years old being alien to their will.

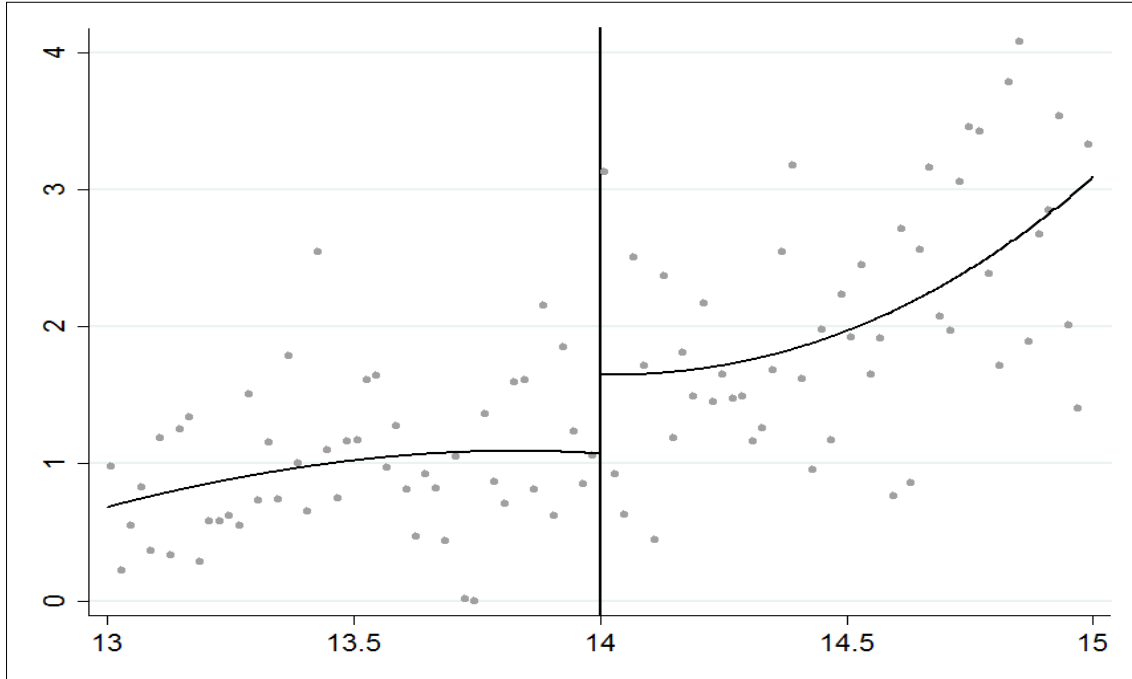
It must be supposed, besides, that the discontinuity at the cutting point is due only to the change of *status* of the treatment and that the other variables, in the case of being covariates, must present an understated (and continuous) behavior throughout the observations. This is equivalent to saying that, in no other way there must exist differences among the individual in the surroundings of this threshold, beyond receiving or not of this treatment. Parting from this, what physical or psychological differences could be pointed out in order to legally forbid working, of an individual about to be 14 years old and, therefore in the surroundings of this threshold. Intuitively, figure 1 illustrates the relationship between the continuous age of the individuals and the number of hours worked every week. In this figure can be observed a growing of patterns in the

⁸ One of the conditions for the implementation of the RDD is to warranty that the classification variable be continuous, discarding, in this way the possibility of using the mean age variable in years.

variable results, indicating that the number of hours worked is quite sensitive to age. Besides, it is possible to observe the occurrence of a jump at the age of 14, that is to say, the discontinuity of the cutting point. Since it complies with the premise that the discontinuity is caused solely by the classification variable, it is feasible to conceive that this break in the continuity or otherwise, this abrupt increase in the number of hours worked being an effect of the law that forbids child labor.

The visual analysis of graphs, such as the plotting of the variable of results against the classification variable, makes the contrast treatment degree more perceptible, besides determining the type of cutoff that the data expresses or, observations of the behavior in relation to the cutting point will define the type of discontinuous regression design: *fuzzy* or *sharp*. In the first case, more common in economics' applications, the treatment is partially by discontinuity, in such a way that it produces a change in the probability of receiving the treatment. Besides, this design may be compared to the strategy of a randomized experiment where some observations of the group of those being treated do not receive intervention while some observations of the control group receive it (formally, *no shows* and *crossovers*, respectively).

Figure 1: Local linear polynomial regression of weekly working hours on age



Notes: Local linear polynomial regression with a forth degree using Calonico, Cattaneo and Titiunik (2014) methodology to choose the bandwidth. Cutoff at 14 years old. Sample with individuals from 13 to 15 years old from PNAD 2013.

The second type, which adequate itself to the data of this paper, characterizes itself by the complete attribution of the observations in some of the groups –this is, observations were the classification variable possesses a higher value than the cutting point will receive the treatment, while those that do not exceed this threshold, will not receive it. In this case, the probability of receiving the treatment will vary from 0 to 1, differently to the *fuzzy* case, were the probability is a value within this interval. In the *sharp* design, the treatment attribution variable possesses a deterministic relation with the variable.

Besides, the graphic analysis still provides some evidence regarding the ideal functional form for the relation between the classification and result variables in the

absence of treatment, suggesting which of the specifications will be most appropriate for the data. Identifying the correct functional form of the relation between the classification and the result variables in the absence of treatment is one of the major challenges of the regression discontinuity models. The choice of a functional form that does not correspond to the real one will imply a biased estimator of the LATE of the intervention on the cutting point.

There are two strategies to specify correctly the functional forms of a discontinuous regression. The parametric strategy (or global strategy) uses all the observations of the sample to model the result as a function of the classification variable and treatment *status*, estimating the average result for observations near the cutting point. Alternatively, there is the non-parametric strategy (or local strategy), in which the estimate of the treatment effect functions as a local randomization, limiting the analysis to the observations nearest to the cutting point – such neighborliness is commonly called window. It is understood that, in this neighborhood, it is possible that the functional form assumed is linear. However, the major challenge when implementing the non-parametric approach is in the correct choice of the bandwidth. Once chosen, the next step is to estimate the linear model with the observations contained in that interval, on both sides of the cutting point.

As it is already known by empirical researchers, the parametric approach seeks to choose the correct model for a certain data base while the non-parametric approach seeks to choose the correct data for a given model. Nonetheless, the choice of one of the approaches, implies, necessarily, a trade-off between bias and precision: once the global strategy uses all the observations the sample confers a precision gain, therefore, increasing the bias chances, given the difficulty of specifying correctly the functional form. The opposite reasoning describes the non-parametric method.

According to Imbens and Lemieux (2007), in practice, for the estimate of the Local Average Treatment Effect (LATE) of a regression discontinuity design it is customary to apply a non-parametric methodology. Calonico, Cattaneo and Titiunik (2014) point out that the local polynomial regression method as being appropriate, given the “local” structure and nature of an RDD, since this method fulfills a great performance within the proximity of a limit. Besides, it attributes certain rigidity to the handling of the parametric method, in what regards its functional form, being susceptible to the bias of, for example, considering as discontinuity a non-linearity of the model. The non-parametric approach allows that flexibility, once it seeks the functional form that better adjusts itself to the data.

3.3 Discontinuous regression: non-parametric approach

In a non-parametric regression, the estimator is built according to the information obtained through the data, not taking a pre-determined form, that is, instead of estimating the parameters of a regression, the own functional form is estimated. Of the existing procedures, the use of a local linear regression is indicated, which can be equated to a linear estimate in two intervals adjacent to the cutting point – this is, like estimating impacts in a sub-sample within a certain bandwidth at the left or at the right of the cutting point.

The non-parametric method allows the construction of robust parameters parting from Cattaneo, Calonico and Titiunik’s (2014) proposal, making use of a local polynomial regression that suits the structure of the data and to its assessment proposal in injunctions, softening dispersions and modeling functions.

Framing the discussion to the RDD language, it is understood that the potential impact of the law that forbids child labor in force in Brazil, acts as a treatment, which should be evaluated. The treatment group is composed by children and adolescents less than 14 years old, while their counterfactual will be composed by adolescents that are already 14 years old. The triage between those treated and control is a deterministic function of the classification variable, (continuous) of the individuals' age.

Formally, consider $\{Y_i(0), Y_i(1), X_i\}': i = 1, 2, \dots, n$ as being a random sample of $\{Y(0), Y(1) \in X\}'$, in which $Y(1)$ and $Y(0)$ denote the potential results with and without treatment. In that case, the number of hours worked weekly by individuals less than 14 years old and from 14 years old onward, respectively. The treatment will be determined by the following rule: the unit i will be allocated to the treatment group if $X_i < \bar{x}$ or to the control group if $X_i \geq \bar{x}$, for $\bar{x} = 14$. In this way, the result observed will be:

$$Y_i = \begin{cases} Y(1) & \text{if } X_i < \bar{x} \\ Y(0) & \text{if } X_i \geq \bar{x} \end{cases} \quad (1)$$

While the observable random sample will be $\{(Y_i, X_i)': i = 1, 2, \dots, n\}$. The average effect of treatment on the threshold of a sharp design is given by:

$$\tau = E \{Y_i(1) - Y_i(0) | X_i = \bar{x}\} \quad (2)$$

This estimate is non-parametrically identifiable under certain continuity conditions. Specifically,

$$\tau = \lim_{x \downarrow \bar{x}} E(Y_i | X_i = x) - \lim_{x \uparrow \bar{x}} E(Y_i | X_i = x) \quad (3)$$

An τ estimator, based on the Kernel method is used following, with local polynomials on both sides of the cutting point. The polynomial regression of p considered as order for units treated and control units, respectively, is presented as follows:

$$\hat{\tau}_p(h_n) = \mathbb{e}_0' \hat{\beta}_{+,p}(h_n) - \mathbb{e}_0' \hat{\beta}_{-,p}(h_n) \quad (4)$$

Com

$$\hat{\beta}_{+,p}(h_n) = \arg \min_{\beta \in \mathbb{R}^{p+1}} \sum_{i=1}^n I(X_i \geq \bar{x}) \{Y_i - r_p(X_i - \bar{x})' \beta\}^2 K_{h_n}(X_i - \bar{x}) \quad (5)$$

$$\hat{\beta}_{-,p}(h_n) = \arg \min_{\beta \in \mathbb{R}^{p+1}} \sum_{i=1}^n I(X_i < \bar{x}) \{Y_i - r_p(X_i - \bar{x})' \beta\}^2 K_{h_n}(X_i - \bar{x}) \quad (6)$$

Where $r_p(x) = (1, x, \dots, x^p)'$, $\mathbb{e}_0 = (1, 0, \dots, 0) \in \mathbb{R}^{p+1}$ is the first unit vector, $K_h(u) = K(u/h)/h$ with $K()$ a kernel function, h_n a positive sequence of bandwidth and $I()$ denotes the indicator function.

Under conditions of simple regularity, the local polynomial estimators are known for satisfying:

$$\beta_{+,p}(h_n) \rightarrow_p \beta_{+,p} \text{ e } \beta_{-,p}(h_n) \rightarrow_p \beta_{-,p} \quad (7)$$

with

$$\beta_{+,p} = \left(\mu_+, \mu_+^{(1)}, \frac{\mu_+^{(2)}}{2}, \dots, \frac{\mu_+^{(p)}}{p!} \right)' \quad (8)$$

$$\beta_{-,p} = \left(\mu_-, \mu_-^{(1)}, \frac{\mu_-^{(2)}}{2}, \dots, \frac{\mu_-^{(p)}}{p!} \right)' \quad (9)$$

$$\mu_+^{(s)} = \lim_{x \downarrow \bar{x}} \frac{\partial^s}{\partial x^s} \mu_+(x) \quad (10)$$

$$\mu_+(x) = \mathbb{E}\{Y(1)|X_i = x\} \quad (11)$$

$$\mu_-^{(s)} = \lim_{x \uparrow \bar{x}} \frac{\partial^s}{\partial x^s} \mu_-(x) \quad (12)$$

$$\mu_-(x) = \mathbb{E}\{Y(0)|X_i = x\} \quad (13)$$

Where $s = 1, 2, \dots, p$. So, offering a set of estimators consistent of τ . A reason why the local linear estimator of $\hat{\tau}_1 = h_n$ probably is the most common choice for the implementation of a regression with discontinuity.

4 Results

Although the regression with discontinuity being very attractive, it is quite challenging, since it is necessary to deeply assess the robustness of its estimates. Therefore, to guarantee more robustness to the methodology proposed, some strategies have been adopted. According to what has been talked about before we work with a sub-sample of a reasonable size, with 100.000 observations. To take advantage of the flexibility provided by the non-parametric model chosen, four different functional forms are estimated, in order to adjust the data to a polynomial that can have until the fourth order. Besides, the estimations are conducted in different windows, that is to say, considering symmetrical age intervals of 3, 6 and 9 months.

Alternative methodologies for obtaining the bandwidth are also used, that is, the neighborhood in which the observations will be considered in the estimation of the functional form – being that the greatest challenge of the implementation of a model with a non-parametric approach. For such purpose, this estimate is conducted by the process called *data-driven*, that is, parting from their own data (*input*), operating through an algorithm, the result is reached (*output*), without there being any interference based upon “empirical intuitions”. We use the three different methods available for the bandwidth selection, that are: the Cattaneo, Calonico and Titiunik (2014) method, CCT from here on, the Imbens and Kalyanaraman (2012) method, IK from here on and, finally, the Ludwig and Miller method (2007), CV from here on.

Table 3: *LATE* of child labor law in weekly working hours

		± 9 months	± 6 months	± 3 months
Polynomial order	n	19328	12975	6381

1	β	2,7793*** (0,6662)	3,0548*** (0,7437)	3,4891*** (0,9187)
2	β	2,8399*** (0,6989)	3,2783*** (0,8114)	3,7011*** (0,9918)
3	β	3,1121*** (0,7613)	3,681*** (0,9193)	3,8093*** (1,0848)
4	β	3,1742*** (0,7559)	3,5609*** (0,9080)	4,0319*** (1,1511)

Notes: entrances are the Local Average Treatment Effect obtained using Calonico, Cattaneo and Titiunik (2014) methodology to bandwidth selection. The time intervals indicated at the top of columns refer to age intervals below and above 14 years old cutoff. At the first column are indicated the polynomial order of estimated models. The second line shows the sample count. The standard errors showed between brackets are clustered by Brazilian states. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3 shows the results of the β'_s coefficients, that represent the “jump” that takes place in the average of weekly hours worked when the individual becomes 14 years old, considering the observations at different intervals of individuals at a certain age (the windows). The interpretation of the results concentrates on the ± 3 months windows, this is, the observations where the ages are between 13 years and 9 months of age and 14 years and 3 months, since although there is a loss in the number of observations, a sufficiently large sample is still constructed (6.381 individuals) to guarantee non biased results and sufficiently near the age of 14 to allow the control of possible differences in the characteristics of the individuals. In this way, it can be inferred that the Federal Law that forbids any type of work for children and adolescents below the age of 14, inhibits, in average, 3,5 working hours per week. In other words, it can be said that the law fulfills its objective to deter the work of children and adolescents. In comparison to results obtained by other methods of selecting the bandwidth, there is not too much divergence in relation to the IK method, however, there is, in the CV method, a tendency to overestimate the results which although warranting statistical significance, makes the interpretation hardly feasible⁹.

For the analysis of individuals residing in urban areas, we again believe it better to use the narrowest window, and having as a result a local average treatment effect of 2,7 hours of work per week. Similar results are found when other methods are applied for the selection of the bandwidth. Although it seems that the impact of the Law is lower in urban areas than in the total of the country, it is worth remembering that the amount of hours worked in urban areas is quite lower than in the average of the whole population. The impact of the Law is 22,8% lower, but the quantity of hours worked, for who is 13 years old, residing in urban areas is, in average, 36% less.

Thus, the impact of the law is higher in urban areas. This result was somewhat expected since the monitoring in urban areas is facilitated and consequently, there is a greater likelihood of punishment, mainly of companies.

Table 4: *LATE* of child labor law in weekly working hours in urban areas

		± 9 months	± 6 months	± 3 months
Polynomial order	n	15.809	10.585	5.169

⁹ The results obtained with the other methodologies can be found in the appendix of this article.

1	β	2,4738*** (0,68038)	2,593*** (0,75635)	2,6861*** (0,8324)
2	β	2,5116*** (0,71524)	2,4603*** (0,77485)	2,5367** (1,0193)
3	β	2,7014*** 0,76657	2,6094*** (0,79855)	2,7496*** (1,069)
4	β	2,9837*** (0,77415)	2,7405*** (0,94758)	2,848*** (1,1118)

Notes: entrances are the Local Average Treatment Effect obtained using Calonico, Cattaneo and Titiunik (2014) methodology to bandwidth selection. The time intervals indicated at the top of columns refer to age intervals below and above 14 years old cutoff. At the first column are indicated the polynomial order of estimated models. The second line shows the sample count. The standard errors showed between brackets are clustered by Brazilian states. *** p<0.01, ** p<0.05, * p<0.1.

On the other hand, the estimated models will present results not statistically significant for the analysis of individuals who reside in dwellings of the rural area. Therefore, it is understood that the results for the analysis of the individuals that reside in the rural zone are not conclusive.

Table 5: *LATE* of child labor law in weekly working hours in rural areas

Polynomial order		\pm 9 months	\pm 6 months	\pm 3 months
	n	3.519	2.390	1.214
1	β	1,1676 (1,5586)	0,55836 (2,0022)	3,0575 (4,3864)
2	β	1,3779 (1,9307)	1,0374 (2,7879)	2,8869 (4,9395)
3	β	0,37245 (2,8227)	2,0014 (4,5091)	4,1199 (5,8638)
4	β	0,23518 (3,0552)	2,9571 (4,862)	4,9484 (6,5274)

Notes: entrances are the Local Average Treatment Effect obtained using Calonico, Cattaneo and Titiunik (2014) methodology to bandwidth selection. The time intervals indicated at the top of columns refer to age intervals below and above 14 years old cutoff. At the first column are indicated the polynomial order of estimated models. The second line shows the sample count. The standard errors showed between brackets are clustered by Brazilian states. *** p<0.01, ** p<0.05, * p<0.1.

Certainly, inspection is more complicated in rural areas because of the great distances involved and hence the significant increase in monitoring costs. But, other factors certainly contribute to this result. The fact that child labor is disseminated in family agriculture, is certainly one of these factors. In this case, it is not possible to punish companies remaining only the punishment for the parents/guardians. However, these are the ones responsible for the sustenance of this family and a punishment could generate a higher cost for the child than the evil caused by child labor. This dilemma to which the Justice System is faced with, according to what was commented in section 2, is probably the major cause of impunity for violations the Law that prohibit child labor in Brazil. But, as it has been previously discussed, the Law is only one element considered by the parents/guardians and businesses in the hiring of illegal workforce.

Beyond juridical and economic factors, which are characteristic of transition economies, it cannot be ignored that there are social factors and cultural norms that confer

to the exploitation of child labor a condition of acceptability in the eyes of society. Within this perspective, the use of child labor is characterized in rural jobs, mainly agriculture, where in many cases money is not a determining factor, but, the cultural aspects of the production and moral values in the family agricultural, in which, ordinarily, early work confer a *status* of dignity.

5 Final Considerations

Following the order proposed by Donohue (2015) quasi experiments are superior to other econometric models, such panel data or cross-section data, and also superior to time series. This, of course, when correctly applied, as highlighted by the author. In this sense this paper presents an alternative form and, up to a point, innovative for the assessment of laws, a regression with discontinuity. If on one hand, the methodology proposed allows the estimation of the average treatment effects without the recurring worry of violating the strict exogeneity hypothesis, common to other methods, on the other hand, it presents some limitations.

In the first place, it does not allow dissociating the effects of the change in the probability of punishment and severity of the punishment. This is because the passage to the age of 14 alters both. In the second place, the method proposed estimates an average treatment effect comparing just the individuals around this cutting point. Therefore, its result cannot be extrapolated to the rest of the sample. That is to say, the effect of the Law on the quantity of weekly worked hours can be different for children who are 10 or 11 years old than those obtained at the cutting point (14 years of age).

In spite of these limitations, the results obtained bring interesting contributions to the debate regarding the empirical assessment of Laws and policies that aim at reducing child labor. It becomes evident in this paper that the eradication of child labor strategy through prohibition is not efficient. Although there is an average reduction of 3,5 hours of work per week, there still are around 450 thousand children working in Brazil and, in this way, violating the Law. The dilemmas faced by the Justice System to punish this crime certainly weaken the effects of this Law. Moreover, the weakness of the prohibition is more evident when considering rural areas, where supervision is less and incentives for child labor are different from urban areas.

Cultural factors, difficulties of access to school, short supply of manpower, among other factors help explain the ineffectiveness of the Law which prohibits child labor in these areas. After all, the Law is only one factor considered by agents involved in their decisions. The eradication of child labor requires complementary strategies to their prohibition.

Beyond repression and punishments, mainly of enterprises, the Brazilian government takes action with advertising campaigns informing the population that child labor is forbidden and has a cash transfer program known as PETI, Program for the Elimination of Child Labor. The program consists in the transference of a monthly income to families who have received an admonishment due to the use of child labor. This program, assessed in the work by Machado and Oliveira (2014), parts from a mistaken diagnosis of child labor in Brazil, as strongly associated with insufficient family income. The authors show that the program is not capable of reducing the supply of child labor in one of Brazilian states, Rio Grande do Sul. However, the program showed being capable of increasing the school attendance.

Certainly the subject demands the performance of more research to assess not only the public policies adopted, but also the efficiency of the agents responsible for the application of the Law. In this sense, a research that disaggregates the individuals by

Brazilian states will allow assessing the performance of the Local Justice Systems in the attempt of reducing child labor.

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Appendix

Table A.1: LATE of child labor law using IK method for bandwidth selection

Polynomial		± 9 months			± 6 months			± 3 months		
		Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
	n	19.328	15.809	3.519	12.975	10.585	2.390	6.381	5.169	1.214
1	β	2,2412*** (0,5439)	2,4067*** (0,59102)	0,60154 (2,2247)	2,4665*** (0,60241)	2,3164*** (0,61356)	1,3883 (2,517)	3,3721*** (0,80296)	2,7284*** (0,7992)	1,5178 (2,5427)
2	β	2,233*** (0,55051)	2,3169*** (0,55765)	0,59497 (2,2085)	3,3978*** (0,87799)	2,4579*** (0,8594)	1,3041 (2,9755)	4,2355*** (1,1072)	2,6919*** (1,1896)	29,508 (22,314)
3	β	4,58*** (1,0994)	3,0568*** (1,0586)	5,5331 (5,1981)	3,4149*** (0,84973)	2,5785*** (0,83913)	3,4291 (4,4619)	3,4074*** (1,2684)	2,8175*** (1,0366)	11,266 (17,991)
4	β	4,5733*** (1,7798)	2,3822** (1,1693)	0,40595 (3,0522)	- (-)	2,7188*** (0,94987)	-3,1983 (7,5998)	- (-)	6,3001** (2,8454)	6,3857 (8,0046)

Notes: Empty cells means that the model did not achieved convergence. *** p<0.01, ** p<0.05, * p<0.1.

Table A.2: LATE of child labor law by CV method for bandwidth selection

Polynomial		± 9 months			± 6 months			± 3 months		
		Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
	n	19.328	15.809	3.519	12.975	10.585	2.390	6.381	5.169	1.214
1	β	3,526*** (0,83425)	3,5575*** (1,0981)	1,9649 (3,1313)	3,0479*** (0,73365)	2,6516*** (0,88579)	1,264 (3,6233)	2,9382*** (0,70207)	2,4931*** (0,7957)	0,6015 (2,172)
2	β	2,2532*** (0,55583)	2,6076*** (0,6281)	0,677 (1,4135)	3,1652*** (0,78307)	2,6754*** (0,83668)	2,4746 (3,8182)	3,3508*** (0,82399)	2,5431*** (0,76883)	2,2627 (4,9424)
3	β	2,6227*** (0,6476)	2,7765*** (0,67998)	1,5841 (1,9203)	3,1818*** (0,77756)	2,7556*** (0,75459)	1,4687 (4,824)	3,5321*** (0,8939)	2,7065*** (0,89917)	0,9108 (5,2376)
4	β	2,861*** (0,70102)	2,7907*** (0,72855)	1,5006 (2,5189)	- (-)	2,687*** (0,75459)	2,5382 (4,7395)	- (-)	2,7318** (1,0994)	1,0154 (5,6694)

Notes: Empty cells means that the model did not achieved convergence. *** p<0.01, ** p<0.05, * p<0.1.