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Credit Constraint and Human Capital Investment in Brazil: Evidences from return to Education

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CREDIT CONSTRAINT AND HUMAN CAPITAL INVESTMENT IN BRAZIL:
Evidences from Returns to Education

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ABSTRACT

This paper aims to gauge the role of credit constraint on fostering human capital in Brazil. For this purpose, we use the hypothesis that direct costs and opportunity costs of schooling affect credit constrained and unconstrained persons differently. While the opportunity costs affect everyone similarly, the direct costs affect more the credit constrained individuals. Using different instrumental variables to estimate the returns to education one can measure the role of credit constraint on education decisions. These impacts can be observed when different instruments are used, such as relative teachers offer (proxy for direct costs) and median wage of young workers (opportunity costs variable). We find a considerable difference in point estimation returns on education when using different instruments, suggesting the existence of credit constraint affecting the schooling decisions. However, the poor performance of the opportunity cost variable on the second stage turns any interpretation problematic.

Keywords: *Educational credit constraint, instrumental variables, returns to education.*

RESUMO

Este artigo procura identificar o papel de restrição ao crédito sobre a decisão de investimento em capital humano no Brasil. Para tanto é usada a hipótese de que custos diretos e de oportunidade de estudar afetam pessoas restritas e não restritas por crédito de forma diferente. Enquanto o custo de oportunidade afeta a todos de forma similar, o custo direto afeta mais fortemente aqueles restritos ao crédito. A partir da estimação de taxas de retorno à educação com o uso de diferentes variáveis instrumentais é possível lançar luz sobre o papel da restrição ao crédito sobre escolaridade. Ao comparar as taxas de retorno utilizando como instrumento a oferta relativa de professores (proxy dos custos diretos) e salário mediano dos jovens (variável de custo de oportunidade), encontramos uma acentuada diferença no ponto estimado, indicando a existência de efeito da restrição sobre escolaridade. Entretanto, o mau desempenho do segundo instrumento no segundo estágio torna problemática a comparação.

Palavras chave: *Restrição ao crédito educativo,variáveis instrumentais, retornos à educação.*

JEL: I22, I21, O12

CREDIT CONSTRAINT AND HUMAN CAPITAL INVESTMENT IN BRAZIL:
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1. Introduction

The fact that there is a large portion of the Brazilian population with low education despite of the high returns on education in the Country[1], coupled with the fact that young people born in poorer families tend to complete fewer years of schooling, raises the possibility that imperfections in the credit market may affect the decisions concerning investment in human capital. However, this pattern can also be explained by the possibility that young people raised in families with different resources have differences in learning ability or preferences relating to education.

The aim of this paper is to estimate empirically the role of the credit constraint on the educational investment decision in human capital in Brazil. Following the methodology proposed by Cameron and Taber (2004), we use the idea that the direct costs (monthly fees, books, transportation, etc.) and opportunity costs (non received wages) related to the decision to study affect differently people with or with no credit constraint. On one hand, the direct costs must be funded during the stay of young people in school and, therefore, they represent an additional hindrance for those with credit constraint, on the other hand, the opportunity costs need not to be funded, affecting more homogeneously the entire population.

The used methodology involves the estimation of returns on education through the use of instrumental variables. If the impact of education on the wages in the population is heterogeneous, the use of instrumental variables captures the effect of schooling on the wages of the individuals affected by the variation of the instrument[2].

[1] Menezes-Filho (2001).
[2] Card (1995, 1999) and Lang (1993).

Assuming that the returns on education are decreasing with the increasing in educational level, in case the group affected by the instrument has a high proportion of people with few years of schooling, it is expected that the return should be found higher as compared to the result found when using a instrument that affects more homogeneous the population.

Based on the submitted logic, we estimate the rate of return on education in Brazil with the use of two different instruments: a *proxy* of direct costs and another one that captures the opportunity cost as for studying. If the rate of return while using the first instrument is higher than while using the second one, there is evidence that the credit constraint affects the decision to foster the human capital.

This work is divided into six sections, including this introduction. The next one discusses the relationship between the credit constraint on education and reviews the empirical literature that seeks to identify it. The third one explains the used methodology, while the fourth one explores the data used for estimation. The fifth section, finally, presents the empirical results and the last one concludes the paper.

2. Decision to foster human capital

The existence of a large portion of the population with low education, despite the large wage differentials arising from the education in Brazil, is a *puzzle* that deserves to be understood. Notably, we observe that people born in wealthy families tend to have a higher educational level. The economic literature emphasizes two main explanations for this pattern, and they are namely: (a) credit constraint and (b) issues related to family income that influence the learning capacity of the young people (*background)* [3]

The first one is quite intuitive, given that a number of characteristics of the market for educative credit[4] hamper the development of this operation. The second interpretation, though not being mutually exclusive with respect to the first one, is based on the fact the children have their capacity for learning and formation of preferences in relation to education, influenced by family issues.

The first interpretation may be supported starting from the model of optimal accumulation concerning human capital, developed by Becker (1993), where the young people decides to study until the return from education be equal to the interest rate with which they are faced. If the young people does not have sufficient resources to bear with all direct costs for studying (monthly fees, books, transportation, etc.), it will be necessary to purchase loans, working while studying or deferring consumption. This set of possibilities affects the investment decisions in education (attendance, quality, time spent, etc.). To such an effect, it is true that young people from wealthy families have

[3] Kaene and Wolpin (2001), Carneiro and Heckman (2001) and Cameron and Taber (2004)
[4] The difficulty of guaranteeing the payment to the creditor through a flow of future earnings, the great possibility of agency problems and pain and suffering, difficulty to provide collateral on the part of poorer youths, high monitoring costs, inalienability of human capital, among other characteristics. For a deeper analysis of these issues, albeit in a more general context, see Tirole (2006).

better access to financial resources[5] that facilitate their conditions for acquisition of human capital while compared to the poorest ones. In short "Limited access to credit markets means that the costs of funds are higher for the children of the poor and this limits their enrollment…"[6]

What supports the second interpretation, the importance of the *background,* is the hypothesis that long-term factors, as well as the environment in which the young people is created[7], play a fundamental role in both learning ability as well as in the formation of preferences with respect to the education, a fact that influences the decision to foster human capital. In short, young people growing up in families with more resources tend to have more ease and greater interest in studying, both for being able to get access to a greater amount of learning stimulus (books, travels, computer, etc.), as well as by the possibility that more educated parents tend to better value education, transmitting such a preference to the children.

2.1 Review of empirical literature

Despite the relevance of the topic, few empirical studies have been carried through in order to identify the importance of the credit constraint on investment decisions in human capital. Notably, we do not find any study that it looks to answer to this question for developing countries or same for other them United States. The main empirical works on this subject are commented below.

Kaene and Wolpin (2001) seek to understand to what extent and by what transmission mechanisms, different behaviors of income transfer between parents and children explain the strong positive correlation between their education levels, in other words, the low intergenerational mobility of the education. For such, the authors

[5] Including resources of the proper family.
[6] Carneiro and Heckman (2002), page 708.
[7] Different types of abilities are developed at different stages of children and youth development. This question is herein treated in general, for further discussion on this topic, see Heckman (1995, 1999).

develop and estimate a structural model of dynamic optimization on the decision concerning work, education and savings. For the empirical research, they use a panel database, the National Longitudinal Survey of Youth[8] (NLSY), and the analysis focused on decisions made by young people at the age that is compatible with the admission in the college. To measure the impact of transfer from parents on the schooling of the children, the authors simulate a situation in which choice does not depending on the educational level of the parents. As a result, they find that investment in human capital would be reduced significantly for the children whose parents have higher education, but would grow only marginally among the children of parents with lower education level. In addition, the authors estimate the impact that a relaxation of credit constraints would have on the education of young people. The results indicate that there could be no expressive response on the education, however, there should be a higher level of consumption and lower employment offer on the part of the young people. By the study's findings, the authors conclude that there is no evidence that the intergenerational transmission of education is a consequence of the credit constraint.

Cameron and Heckman (2001) also use NLSY, seeking to understand the sources of such disparity in college attendance among white young people and two ethnic minority groups - Afro-American and Hispanics. To answer the question about which factors, on the short or long run, are more important in determining these educational disparities, the authors analyze the role of family resources when variable of ability[9] and *background*[10] are taken in consideration or not. The remark that the inclusion of the aforementioned variables greatly diminish the influence of family

[8] National Longitudinal Survey of Young People.
[9] As a measure of ability we use the result in the Armed Forces Qualification Test (AFQT).
[10] As background variables the authors use the number of siblings, education of father and mother, the absence of at least one biological parent in the creation of young people, urban residence and geographic region. Wherte all of them are taken when the individual was 14 year old.

income on educational disparities lead the authors to conclude that long-term factors, rather than the credit constraint, are the main determinants of the noted disparity.

Carneiro and Heckman (2002) attempt to gauge the importance of the role of short-term cash availability restrictions (credit constraint) and long-term factors (*background*) in determining the relationship between family income and educational level[11] in the United States. The authors compare the rate of college enrollment of young people from families from different income quartiles and different tertiles of ability[12]. In principle, there is a pattern, for each of the three tertiles, that the richer the family is, higher is the probability of the young to be enrolled in a college. However, when controlling with family background variables[13], the family income is no more significant to explain the difference in the enrollment rate. In addition, the authors find that only about 8% of the young population of the United States is affected as for their decision to attend college by the credit constraint.

Cameron and Taber (2004) develop a theoretical model that starts from the idea that direct and opportunity costs for studying affect differently people with credit constraint and with no credit constraint. Notably, direct costs represent a greater challenge for students with credit constraint, because they need to be funded during the formation of human capital. On the other hand, the opportunity cost needs not be funded, affecting students more smoothly. The authors use four econometric methodologies to test the importance of the credit constraint in the formation of human capital, for such they use the NLSY data. The first one is based on the use of instrumental variables, using the fact that different instruments capture the return on

[11] The authors focus the analysis with respect to decisions concerning higher education.
[12] See note 8.
[13] See note 9.

education of persons with different characteristics[14]. Later on, the authors analyze the interaction between the direct cost, captured from the existence of college in the district where the respondent lived as a youth[15], and observable variables that would be associated with availability of credit and educational level. The third method starts from a structural econometric model and assumes that the heterogeneity of the ability to obtain credit is generated by observable characteristics. In contrast, the latter considers that it is made up by unobservable characteristics. All used methods converge to the conclusion that the credit constraint is not an important aspect in determining the decision to study.

[14] This methodology is discussed further below, since it is adopted in this work.
[15] In fact, the opposite of direct costs, since that the existence of nearby college reduces this cost.

3. Methodology

The methodology adopted in this study to identify the role of credit constraint on investment in human capital is based on the analysis of the identification of returns on education through the mincerian equation[16]. For this reason, with the intention to make easier the understanding, we opt to present a discussion concerning the challenges involved in the estimation of such returns.

For some time, the econometric problem created by the existence of an omitted variable in regressions of wages and education is discussed in the literature. Griliches (1977) argued that it is very likely that immeasurable abilities affect both wages as well as the level of education attained by an individual. This fact breaks one of the hypotheses so that ordinary least squares estimator (OLS) is not biased. Moreover, it is expected that the bias generated in the estimates should be positive. This is because the ability of an individual should positively affect both the level of schooling as well as wages. This problem has been referred to as in the literature as ability bias (Griliches, 1977).

A model fairly used to deal with this kind of situation is the use of instrumental variables. Basically, a good instrument must be strongly correlated with the variable to be instrumentalized (in this case, education) and have no correlation with the residues of the original equation (wage equation). An extensive literature was devoted to seek good instruments to solve this problem in the case of the equation concerning the logarithm of wages. [17]

An expedient rather exploited by the labor economists is the use of institutional characteristics related to the educational system (Angrist and Krueger, 1991; Harmon

[16] The mincerian equation has as a variable to be explained the (log) wage as the main explanatory variable to schooling. Its name is due to the imminent economist Jacob Mincer.
[17] For a survey of this literature see Card (2001)

and Walker, 1995) as well as conditions concerning offer of education as a way for dealing with problems as for the identification of the returns (Card, 1995, Duflo, 2001, Gonzaga and Machado, 2006; Souza and Emerson, 2007). [18]

Even with the expected positive bias of the OLS estimators of minimal ordinary squares, many empirical works using instrumental variables found coefficients above the OLS coefficients (Card, 1995, 2001, Souza and Emerson, 2007). This result has often been interpreted as an evidence for the existence of the credit constraint (Lang, 1993, Card, 1995, 2001). This interpretation is substantiated by the relationship between a theoretical result and another, which is econometrical.

Theoretically, the individuals invest in human capital until the marginal return from education equals its marginal cost. From the econometric point of view, the use of instrumental variable does not generate, necessarily, an unbiased estimator of the average return on education of the population. In this case the coefficient captures the return on education of the people whose education was affected by the variation of the instrument[19] (Imbens and Angrist 1994, Card 1999).

At first, the bias of instrumental variable estimator can be both positive as well as negative[20]. Assuming an instrument that affects the poorest people, the possibility of a positive bias arises from the assumption that the marginal return from education is decreasing in relation to the increase in the level of schooling. As a consequence, if the group affected by the instrument has a high proportion of people with low education, it is expected that the found return should be larger than the average population. This

[18] As examples for the used instruments we can cite the following items, as they are described below: distance to the nearest school, number of schools, two months' period of birth, construction of schools, presence of college in the home city, among others.
[19] If the variation in schooling perpetrated by the variation of the instrument is dichotomous (in other words, the change of schooling is zero or unitary), one can interpret the coefficient as the "local average treatment effect" (local average treatment effect - LATE). Result submitted in Imbens and Angrist (1994)
[20] One notes that this bias is with regard to the “true” coefficient and not with regard to the OLS that can be biased.

effect was referred to as by Lang (1993) as the discount rate bias. On the other hand, a negative bias is possible if people with higher marginal costs are also those with lower return on education. In this case, the variation would alter the decision concerning the education of a certain group with a large proportion of people with low return on education, so it is expected that the estimated return should be lower than that of the average population. (Becker, 1993; Card, 1999).

In short, because that the coefficients found using the two-stage least squares estimate the return for those who alter their behavior in response to the variation in the used instrument, a high coefficient may indicate some degree of credit constraint if the instrument affects the poorest people. In this context, the fact that the estimates of returns on education made with instrumental variables, notably regarding the offer of education, are larger than those made by OLS justifies the interpretation concerning the existence of the credit constraint. Intuitively, a young man with a high marginal cost for obtaining resources (with credit constraint) would need to obtain a higher marginal return on education in order to decide to continue education in comparison with another young man of equal ability who do not face cash availability problems.

Despite the above interpretation, there are instances where the comparison between the OLS and VI coefficients do not identify people with credit constraint. Carneiro and Heckman (2001) point out some reasons why such a comparison may lead to interpretation errors: a) an instrument may not be adequate (it can be little correlated with the variable to be instrumented - weak instrument), b) auto-selection models and comparative advantages in the education could generate the same standard ($\beta_{IV} > \beta_{OLS}$) and c) a possible manifestation of credit constraint could be the choice for schools of lesser quality, that couldn't be identified using this methodological expedient.

The methodology used in this work, based on the one submitted by Cameron and Taber (2004), circumvents the problem submitted by Carneiro and Heckman to the extent that it compares the found coefficient using two distinct instruments[21]. From the idea that there are two main forms of costs related to the decision to study, under the opportunity cost (made up basically by the income that one does not get for deciding to study) and under the direct costs (monthly fees, books, transportation, etc.), the identification strategy is based on the hypothesis that these costs differently affect people with or without credit constraint. Assuming individuals with the same abilities in the labor market, the opportunity cost of attending a school is the same for individuals with or with no credit constraint, and not needing to be funded directly during school attendance. On the other hand, the direct costs need to be financed during the school period and, therefore, they represent a major challenge to the young people with higher credit constraint.

If this hypothesis is true, variations in the direct costs have a greater impact, or affect proportionately more, the subgroup of the population of youths with credit constraint. Because the credit is more expensive for them, the rate of return that they expect to get for studying must be greater than that of another person with the same ability. As a result, if the problem of credit constraint affects the decision to foster human capital, it is expected that the use of instruments that capture the direct costs should generate a relatively high rate of return (high bias discount rate). Alternatively, when using variables of opportunity costs, it is expected that the return rate should be relatively low, since that its variation should affect young people with and without credit constraint in a more homogeneous way (low bias discount rate).

[21] Therefore, it does not compare the coefficient of minimums squared with the one of instrumental variables.

In short, under the assumption that the instruments are valid, if the rate of return estimated with instrumental variable of direct costs is greater than that estimated with opportunity cost, there is evidence that the credit constraint affects the decision to foster human capital formation.

3.1 Econometric model

In order to apply the described methodology, we will use the following econometric model[22]:

a) First stage:

$$S_i = \alpha_o + \lambda_1 Z_i + \alpha_1 X_i + \varepsilon_i \qquad (1)$$

b) Second stage:

$$\ln(w_i) = \beta_0 + \gamma_1 \hat{S}_i + \beta_1 X_i + u_i \qquad (2)$$

Where:

S_i = schooling of the individual "i",

w_i = wage of the individual "i",

Z_i = educational instrument to be used,

X_i = vector of control variables,

The main objective of this model is to estimate the impact of education on wages, identified by the parameter γ_1. We will use two different instruments in the first stage, a proxy of opportunity cost and another one of direct costs for studying. The used control variables (matrix *X*) are the traditional ones in the literature of returns on education and they vary according to the used specification, as it is discussed below.

[22] The regressions were performed using the CMA's as cluster. This specification considers that the remarks are independent among the groups (clusters), although they are not so within each group.

4. Data

Six databases are used to empirically test the found hypothesis, as they are described below: National Survey by Household Sampling (PNAD), 1996, and the Population Censuses of 1970, 1980, 1991 and 2000, all made available by the Brazilian Institute of Geography and Statistics (IBGE), in addition to the compatibility of geographic areas organized by the Institute of Applied Economic Research (IPEA).

Firstly, it falls to emphasize that the option to use PNAD 1996 and not a more recent one due to the fact that this first is owning a supplement with retrospective information on the reference people and spouses (*background*). This fact is of particular importance for making it possible to identify education and occupation characteristics concerning the parents of the interviewed persons - data used as controls in the wage regressions.

From PNAD we extract information on wage (dependent variable), education (variable to be instrumentalized), some control variables (age, race, status, parental education and father's occupation), the state and the municipality of the respondent. Despite the PNAD not having municipal representativeness, the information on the municipality of the respondent is important for the construction and use of the instruments in some cases, as it will be seen later on. With the use of geographic information it is possible to relate the PNAD with the Censuses. However, in the case of municipalities, the fact that there were between 1970 and 2000 a series of modifications of political division within the national territory – notably, the creation of several municipalities from other pre-existent municipalities - the use of municipal information is compromised. However, the Institute of Applied Economic Research (IPEA) made compatible those geographical areas over the years into comparable minimum areas (CMA´s).

As a dependent variable we use the monthly wage of the main work. Education is measured through the years of complete formal schooling, truncated in 15 years of study. To control the effect of race, we use a binary variable (*dummy*) that identifies whether the individual considers himself white (or yellow). Another dummy variable is added to identify if the individual lives in an urban area. The individuals living in the same city where they were born are also identified by a *dummy*. With references to *background* variables, it is necessary to make a small clarification having in view that they can be obtained in two different ways, depending on the condition of the individual in the family. If they are related to the head or spouse, the information is given directly, through the questionnaire supplement. However, if the person is a child of the household head, we considered as a mother or father the head or his / her spouse, depending on the gender of each. In addition, as there may be an absence of a parent within the family, a specific *dummy* was used for such specific cases. Moreover, there is still the possibility that the individual is not fit in any of the three previously - mentioned categories (head, spouse or child), in this case there is no information about their parents, however, they also enter the sample and the variables related to the information of their parents are deemed as missing. With that said, twelve categories of schooling are defined for both parents and ten occupations for the father[23], in addition to the 26 states of the Federation and Federal District, where for each a *dummy*[24] variable is created

PNAD data were restricted in some dimensions to adapt to the work objectives. The selected sample consists of men who were between 25 and 31 year old (cohort 1980) and between 35 and 41 year old (1970 cohort) and had positive income in 1996. The sample is restricted to men in order to avoid the problem of selection bias related to

[23] No information about the occupation of mothers, heads and spouses
[24] The used categories used set out in Appendix A.

the fertility of women. The age group was chosen to select the people that were 9 to 15 year old in the Censuses of 1970 or 1980, because we wanted to study the investment related decisions in human capital of the youths, with low schooling, this is because the low educational level in the Country in the respective years (the average of education in the sample is about 6 years of study). In addition, we use a sub-sample that is composed by the individuals that, besides the characteristics described above, live in the same municipal district in which they were born.

The following table shows the loss of individuals in the sample as a consequence of the stages concerning their selection.

Table 1. Sample Selection

	Sample	***%***
Number of individuals	331.263	100,0%
Identification of municipalities with the CMA's	330.115	99,7%
Men born in Brazil	159.724	48,2%
Aged between 25 and 31 or 35 and 41	32.400	9,8%
With valid information on wage and education	27.834	8,4%
Not migrated	12.859	3,9%

Source: IBGE

The used instrumental variables are calculated from the Censuses of 1970 and 1980. As an instrument for the (inverse) of direct costs, we use the number of teachers (from first grade until the third year of high school[25]) for each thousand youths, from 7 to 17 year old[26], by geographical unit[27] [28] and cohort. Regarding the opportunity costs, we use the median income of men aged from 10 to 15 years by geographical unit and cohort. In addition to the instruments, the said Censuses were used in order to calculate

[25] The incompatibility of data between the censuses of 1970 and 1980 occurred by the changing in the educational system in 1971 prevented the breakdown of teachers by educational strata. For a discussion of the changes, see IBGE (2003) and Teixeira (2006).
[26] We opted for considering youths between 7 and 17 year old because they are competing with those from 9 to 15 for the offer of teachers.
[27] State or CMA.
[28] Because the 1970 Census has no information on the city where the individual works, in case it is not in the same of residence, we just considered the teachers working in the same county where they live. As a matter of compatibility, the same criterion was maintained for the 1980 Census.

the condition in the labor market for the adults. For such, we use the median wage of men between 25 and 55 year old by cohort and geographical unit, a variable that is used as a control parameter in wage regressions. The median wage is used because of having a lesser effect of *outliers* and, therefore, is slightly smaller with relation to the average wage, having in view that wage distribution in the Country is skewed toward the right. In this case study, this is a desirable property to the extent that people potentially with credit constraint tend to have a lower opportunity cost than the average population. The instruments are calculated based on the two geographic units, states and CMA's.

The 1991 and 2000 Censuses are considered in order to estimate the proportion of non-migrants by CMA in 1996. Therefore, one calculates the average proportion of this variable by cohort and CMA between Censuses. This variable is used in some specifications, when the sample is restricted to those men who live in the city where they were born.

To consolidate the full database, each individual of PNAD was related to the assembled variables using the information from the Censuses. To men who do not live in the city where they were born were related instruments based on their home state, since that in PNAD there is no information about the birth municipality. People who live in the city where they were born were related the instruments and the proportion of non-migrants calculated based o their CMA.

The descriptive statistics for the key variables are submitted in Table 2. The selected PNAD's sample has 27,834 men who were born in Brazil, of which 54% are white or yellow, 47% are from the 1970 cohort, 83% live in urban areas, about 46% live in the birth municipality, have average schooling of six full years of formal education

and average wages of $ 582[29]. With respect to the Censuses of 1970 and 1980, the most interesting data are related to the economic environment mutation and education offer between the two researches. The average median wage among CMA's adults and children went up respectively, 87% and 67% between the two periods. This significant increase is consistent with the 129% growth of the country's GDP in the period, which was part of the so called "Brazilian Economic Miracle". In contrast, the average offer of teachers for each thousand youths by CMA had just increased in 9%, rising from 26.4 to 28.7.

Table 2. Descriptive Statistics

Variable	*Base*	*Obs.*	*Average.*	*D.P.*	*Min*	*Max*
Wage	PNAD 1996	27834	582.2	812.2	2	20000
Ln of wage	PNAD 1996	27834	5.882	0.943	0.693	9.903
Education	PNAD 1996	27834	6.612	4.356	0	18
Age:	PNAD 1996	27834	32.69	5.316	25	41
White	PNAD 1996	27834	0.538	0.499	0	1
Urban	PNAD 1996	27834	0.835	0.371	0	1
Wage of adults (salmd)	Census 70	13174	191	93.72	30.62	510.4
Wage of adults (salmd)	Census 80	14660	357.7	149.9	70.06	840.7
Wage of adults (salmd)	Total	27834	278.8	151.4	30.62	840.7
Wage of children	Census 70	13166	67.05	20.2	15.31	159.2
Wage of children	Census 80	14651	112.3	38.78	37.37	233.5
Wage of children	Total	27817	90.89	38.68	15.31	233.5
Teachers per thousand youths	Census 70	13174	26.42	9.92	2.289	79.65
Teachers per thousand youths	Census 80	14660	28.72	10.72	2.222	69.75
Teachers per thousand youths	Total	27834	27.63	10.41	2.222	79.65
Cohort 1970	Census 70	27834	0.473	0.499	0	1
Non- migrant	PNAD 1996	27834	0.462	0.499	0	1

Source: IBGE; IPEA.

[29] All variables of monetary values are in 1996 values, aligned according to the methodology proposed by Corseuil and Fogel (2002).

5 Empirical Results

This section submits the empirical results found from the database and methodology set forth above.

Two different samples are used. The first one is the most complete, composed as described in the fourth section. In addition, we use a sub-sample of the first one, considering only the people who live in the county in which they were born.

5.1 Complete sample

In order to review the sensitivity of the results for the econometric model at issue, we used three alternative specifications whose difference lies in the choice of the variables that make up the matrix *X*, the regression controls. In model 1, the included variables are the 1970 cohort, urban area, race (white), state of housing, age and its square and a *dummy* that identifies whether the individual lives in the city where he was born. In model 2, the schooling levels of the parents were added and, finally, the third model includes the category of father's occupation.

5.1.1 First stage

This subsection aims to submit the results of the first stage, in other words, the impact of the instrumental variables on the individuals' schooling.

The expected effect of a higher relative offer of teachers on the education of the young people is positive. A larger number of teachers is associated with a greater number of schools, which tends to diminish the difficulties involved in attending the school, or in a lower ratio of students per teacher in the classroom, a fact which should also stimulate the attendance.

Regarding the opportunity cost variable, the expected effect is ambiguous. Therefore, there should be a more careful discussion about its expected effect on the schooling of individuals. There are two existing effects found in the variation of labor

market conditions for children on the decision to study: the substitution effect (an improvement in labor market conditions negatively affects schooling) and income effect (an improvement in the market positively affects schooling).

The substitution effect is justified to the extent that an improvement in the conditions of employment for young people tends to make them to choose to work instead of the studies. The income effect, in its turn, can be justified in two ways. If the measurement of opportunity cost for young people captures labor market conditions that are related to family income, especially the condition of the labor market for the parents, it is possible that in a favorable scenario, the family may opt for fostering its members' education, especially the children. Alternatively, it is possible that an improvement in the market conditions for young people's work may enable them to earn a sufficient income so that they may bear with the cost of studies or to work less time, dedicating part of it to the school.

Table 3 submits the results of the first stage for the two instrumental variables used for each of the three adopted models.

The first column of each model shows the results when using as an instrument the opportunity cost of the individuals when of their childhood. The coefficient found between the opportunity cost and schooling is positive and significant, this indicates that an increase in youth wages would positively affect their education, indicating a primacy of income effect on the substitution. With reference to the impact's magnitude, we is estimate that an increase of R$100 in the monthly wage would change the education level between 7 and 20 months (models 3 and 1, respectively).

However, this result may be contaminated by the correlation between the condition in the labor market for young people and the adults. In order to deal with this problem, we added in the second column of each model, the median wage for

individuals between 25 and 55 year old. As a result, the coefficient of the instrument becomes negative and significant: an increase of R$ 100 on the opportunity cost results in a loss of 6 to 8 months in schooling (models 3 and 1, in this order). In addition, we have the median wage for adults (salmd) positively impacting the education of young people. An increase of R$ 100 in this variable results in an increase in schooling between 6 to 12 months (models 3 and 1, respectively). This fact indicates that the income effect occurs primarily via the family income. If the income effect were generated by increased earnings of young people, the opportunity cost coefficient would remained positive even after the inclusion of adult labor market's variable.

Another possible explanation for the negative signal of the opportunity cost coefficient when controlling it by the employment of adults may be the fact that young people living in a city who are on a positive long-term economic path tend to study more. This result is possible given that the market of working adults in 1970 and 1980 is positively correlated with the labor market in 1996 (Cameron and Taber, 2004).

The third column of each model shows the results of the first stage when using the relative offer of teachers as an instrument, considering the same specification of the second column, in other words, controlled by the market of working adults. As expected, the coefficient of interest is positive and significant, an increase of one unit for hundred students per teacher ratio generates an increment of 2 to 5 months (models 3 and 1, respectively)[30].

One result that stands out is the fact that the *dummy* variable that identifies the 1970 cohort shows a positive signal, indicating that the previous generation tends to have higher education. This result is counterintuitive, since that a positive temporal trend is expected in the educational level. However, it is possible to interpret the result

[30] Note that the unit of the regression is one teacher for every thousand students.

as being an evidence that the fact most accountable for the increase in schooling during the 1970s is the growth of income and not a mere natural trend. Moreover, the table shows that people living in the same city in which they were born have a lower educational level in relation to the migrants.

Table 3. First stage (full sample)

Dependent variable: Education									
	Model 1			*Model 2*			*Model 3*		
Variable	**OC***	**OC**	**DC**	**OC***	**OC**	**DC**	**OC***	**OC**	**DC**
Instrument	0.0165**	-0.0064**	0.0409**	0.007**	-0.005**	0.0209**	0.0057**	-0.0046**	0.0199**
	[0.0011]	[0.0013]	[0.0037]	[0.001]	[0.0012]	[0.0033]	[0.001]	[0.0012]	[0.0032]
wage-adults	-	0.0107**	0.0081**	-	0.0058**	0.0042**	-	0.005**	0.0036**
		[0.0003]	[0.0003]		[0.0003]	[0.0003]		[0.0003]	[0.0003]
d70	0.6493**	1.3991**	1.377**	0.3066**	0.7263**	0.7573**	0.2219**	0.5921**	0.617**
	[0.1364]	[0.1361]	[0.1333]	[0.1193]	[0.1206]	[0.1184]	[0.1174]	[0.119]	[0.1168]
non migrant	0.1215**	-0.1885**	-0.2371**	-0.0297	-0.1901**	-0.2171**	-0.0862**	-0.2205**	-0.2456**
	[0.0495]	[0.0496]	[0.0496]	[0.0434]	[0.044]	[0.0441]	[0.0429]	[0.0434]	[0.0435]
age	yes	yes	yes	yes	yes	yes	yes	yes	yes
age ^{2}	yes	yes	yes	yes	yes	yes	yes	yes	yes
urban	yes	yes	yes	yes	yes	yes	yes	yes	yes
white	yes	yes	yes	yes	yes	yes	yes	yes	yes
state	yes	yes	yes	yes	yes	yes	yes	yes	yes
cons	yes	yes	yes	yes	yes	yes	yes	yes	yes
educ. father	no	no	no	yes	yes	yes	yes	yes	yes
educ. mother	no	no	no	yes	yes	yes	yes	yes	yes
occup. father	no	no	no	no	no	no	yes	yes	yes
nº de obs	27817	27817	27834	27817	27817	27834	27817	27817	27834
nº de CMAs	714	714	714	714	714	714	714	714	714
R^2	0.1839	0.2123	0.2150	0.3765	0.384	0.3848	0.3968	0.404	0.4030

Note: * Significant at 10%, ** Significant at 5%.

5.1.2 Second stage

This subsection submits the results of the second stage as for the above cited econometric model, namely, the impact of education on wages. From the comparison of the return rate on education obtained through the use of the different instruments, it is possible to shed light on the importance of credit constraint on the decision to foster human capital in Brazil, which is the main purpose of this study.

Table 4 submits the econometric results for three different models, whereas each one is estimated using three methods. The first column of each model submits the results of the estimations using ordinary least squares (OLS) [31]; on the second and third one, there are the results of a two-stage least squares using as instruments the relative offer of teachers (DC) and the median wage for young people (OC) [32], respectively.

The coefficient of interest, the return on education is submitted in the first row of results. In the first model (not controlled by the family *background*), the coefficients found for each one for the first two methods (OLS and DC) are positive and significantly different from zero.

The coefficient found using the direct cost is 0.090, in other words, the wage increases in, approximately, 9% for every additional schooling year. This result is about 11% lower than the estimated by OLS.

The coefficient found using the opportunity cost had negative signal, indicating that the increased education reduces the wage, though this was not statistically significant.

When controlling by family *background* (models 2 and 3), the interest coefficients decrease for the three methods. In models 1 and 2, the coefficients found using OLS are statistically significant at usual levels, although this does not happen to the coefficients found using instruments.

The results submitted by the control variables are those expected. The median wage for adults in the geographical region of the sample population when children (wage-adults) are positively correlated with their current wage. Regarding the impact of

[31] Following Cameron and Taber (2004), the results obtained by OLS are submitted just for comparison ends, since that the chosen methodology deals only with the difference between the two instruments in the regressions in two stages.
[32] Constructed as described in Section 4.

the individual's experience[33] on the wage, data show a positive relationship, however, this relationship is concave, as suggested by the negative coefficient of the square of age. Men who live in urban areas tend to have a wage significantly higher as compared with those who inhabit rural areas. White individuals also tend to have higher pay. The coefficient found for the people of the 70s generation is positive, however, it is not significantly different from zero in six of the nine submitted models.

It is interesting to note that people living in the municipality where they were born tend to get a lower wage as compared to the migrants. This result indicates that it is possible that more able people are those that are most likely to migrate in search for higher wage.

According to the methodology described in the third section, the fact that the point estimated for return on education with the use of an instrument of direct cost is much higher than the estimated with the use of opportunity cost, is an evidence that the credit constraint affects the investment in human capital. However, it is worth noting that, despite this major difference, the fact that the coefficient found with the use of opportunity cost is negative makes this comparison problematic.

[33] We use age as a proxy of experience.

Table 4. Second stage (full sample)

Dependent variable: Natural logarithm of hourly wage									
	Model 1			*Model 2*			*Model 3*		
Variable	**MQO**	**CD**	**CO**	**MQO**	**CD**	**CO**	**MQO**	**CD**	**CO**
educ.	0.101**	0.0898**	-0.0362	0.0881**	0.0352	-0.0921	0.0862**	0.0287	-0.1030
	[0.0018]	[0.0217]	[0.0691]	[0.0016]	[0.0431]	[0.0951]	[0.0016]	[0.0449]	[0.0936]
wage-adults	0.0007**	0.0008**	0.002**	0.0006**	0.0008**	0.0015**	0.0006**	0.0008**	0.0014**
	[0.0001]	[0.0002]	[0.0007]	[0.0001]	[0.0002]	[0.0005]	[0.0001]	[0.0002]	[0.0004]
age	0.0602**	0.0627**	0.0906**	0.0513**	0.0662**	0.1016**	0.0463**	0.0624**	0.0987**
	[0.0146]	[0.016]	[0.0225]	[0.0147]	[0.0204]	[0.0328]	[0.0148]	[0.0208]	[0.0326]
age ^{2}	-0.0004*	-0.0005*	-0.0009*	-0.0003	-0.0005*	-0.0011**	-0.0003	-0.0005	-0.001**
	[0.0002]	[0.0002]	[0.0004]	[0.0002]	[0.0003]	[0.0005]	[0.0002]	[0.0003]	[0.0005]
urban	0.3303**	0.3623**	0.7207**	0.3377**	0.448**	0.7149**	0.3283**	0.4295**	0.6624**
	[0.0214]	[0.0643]	[0.1952]	[0.0215]	[0.0933]	[0.1972]	[0.0215]	[0.0828]	[0.1644]
white	0.2136**	0.2337**	0.4585**	0.188**	0.2431**	0.3755**	0.1858**	0.2448**	0.3794**
	[0.0149]	[0.0428]	[0.1259]	[0.0148]	[0.0494]	[0.0997]	[0.0149]	[0.0507]	[0.0983]
d70	0.0280	0.0454	0.2388**	0.0195	0.0638	0.1693*	0.0216	0.0616	0.1517*
	[0.0275]	[0.0455]	[0.1155]	[0.0278]	[0.0482]	[0.0904]	[0.0276]	[0.044]	[0.0782]
non migrant	-0.2026**	-0.2048**	-0.2288**	-0.197**	-0.2073**	-0.2317**	-0.1918**	-0.2047**	-0.2339**
	[0.0207]	[0.0215]	[0.0331]	[0.0203]	[0.0235]	[0.0331]	[0.0205]	[0.0247]	[0.0345]
state	yes	yes	yes	yes	yes	yes	yes	yes	yes
cons	yes	yes	yes	yes	yes	yes	yes	yes	yes
educ. father	no	no	no	yes	yes	yes	yes	yes	yes
educ. mother	no	no	no	yes	yes	yes	yes	yes	yes
occup. father	no	no	no	no	no	no	yes	yes	yes
nº de obs	27834	27834	27817	27834	27834	27817	27834	27834	27817
nº de CMAs	714	714	714	714	714	714	714	714	714
R^2	0.4373	0.4352	0.120	0.4560	0.4194	0.029	0.4624	0.4202	0.006

Note: * Significant at 10%, ** Significant at 5%.

An important limitation of the submitted model is that the variables that identify people who have not migrated from their hometown have been regarded as exogenous. This is a hypothesis which may involve errors in the estimates. Aiming to analyze and overcome the effects of this hypothesis, in the next subsection we estimate very similar econometric models, nevertheless, with a sub-sample, leaving only the men who live in the same county where they were born.

5.2 Sub-sample of non-migrants

The results of more six alternative specifications are submitted, much similar to the ones shown in the previous sub-section. As a result of the change of the sample, we no longer use a variable that identifies the non-migrant individuals. The models 4 to 6

are identical to the above cited models, taking into account the provided exception. In addition, three more models are estimated (from 7 to 9), where we add a variable that measures the proportion of non-migrant people by CMA and cohort in 1996[34]. With this in mind, the models 7 to 9 are also similar to those from 1 to 3, respectively.

5.2.1 First stage – models 4 to 6

Table 5 shows the first stage of the regressions, in other words, the impact of the variables on the schooling of individuals. The quantitative results are very similar to those discussed above. The qualitative conclusions remain the same, showing that the first stage of the model remains robust despite the change in the sample.

Table 5. First stage (non-migrants)

	Dependent variable: Education								
	Model 4			*Model 5*			*Model 6*		
Variable	**OC***	**OC**	**DC**	**OC***	**OC**	**DC**	**OC***	**OC**	**DC**
Instrument	0.0186**	-0.008**	0.0383**	0.0082**	-0.0062**	0.0204**	0.0066**	-0.0059**	0.02**
	[0.0012]	[0.0014]	[0.0037]	[0.0011]	[0.0013]	[0.0033]	[0.0011]	[0.0013]	[0.0033]
wage-adults	-	0.0115**	0.0087**	-	0.0066**	0.0049**	-	0.0059**	0.0042**
		[0.0004]	[0.0003]		[0.0003]	[0.0003]		[0.0003]	[0.0003]
d70	0.5772**	1.3445**	1.3512**	0.3161*	0.7838**	0.8391**	0.2055	0.6389**	0.688**
	[0.1924]	[0.1865]	[0.1836]	[0.1676]	[0.1666]	[0.1645]	[0.1654]	[0.1653]	[0.1632]
age	yes	yes	yes	yes	yes	yes	yes	yes	yes
age ^{2}	yes	yes	yes	yes	yes	yes	yes	yes	yes
urban	yes	yes	yes	yes	yes	yes	yes	yes	yes
white	yes	yes	yes	yes	yes	yes	yes	yes	yes
state	yes	yes	yes	yes	yes	yes	yes	yes	yes
cons	yes	yes	yes	yes	yes	yes	yes	yes	yes
educ. father	no	no	no	yes	yes	yes	yes	yes	yes
educ. mather	no	no	no	yes	yes	yes	yes	yes	yes
occup. father	no	no	no	no	no	no	yes	yes	yes
nº of obs	12842	12842	12859	12842	12842	12859	12842	12842	12859
nº de CMAs	702	702	702	702	702	702	702	702	702
R^2	0.2539	0.312	0.3142	0.4351	0.455	0.4528	0.4506	0.466	0.4641

Note: * Significant at 10%, ** Significant at 5%.

[34] See page 26.

5.2.2 Second stage – models 4 to 6

In model 4, without the inclusion of family *background* variables, the education coefficients for the first two methods (OLS and DC) are positive and non zero. The found returns were close, ranging between 10% and 8.6%, respectively. Once again the coefficient found using the opportunity cost as an instrument for education was negative and non-significant.

When adding the background variables, the return coefficient on education are reduced. While the returns measured by OLS are slightly reduced, to around 8.5%, remaining significant, those identified with the use of direct cost as an instrument, become non-significant in both models (5 and 6), orbiting around 2.4%.

In addition, it should be noted that the control variables have the expected behavior and in line with the results found with the full sample.

Table 6. Second stage (non-migrants)

Variável dependente: Logarítimo natural do salário horário									
	Modelo 4			*Modelo 5*			*Modelo 6*		
Variável	**MQO**	**CD**	**CO**	**MQO**	**CD**	**CO**	**MQO**	**CD**	**CO**
educa	0.0995**	0.0859**	-0.0056	0.0849**	0.0259	-0.0488	0.083**	0.0211	-0.0532
	[0.002]	[0.0239]	[0.0564]	[0.0019]	[0.0466]	[0.0755]	[0.0019]	[0.0473]	[0.074]
wage-adults	0.0009**	0.001**	0.002**	0.0008**	0.0011**	0.0015**	0.0007**	0.001**	0.0014**
	[0.0001]	[0.0003]	[0.0006]	[0.0001]	[0.0003]	[0.0004]	[0.0001]	[0.0003]	[0.0004]
age	0.0567**	0.0592**	0.0751**	0.0453**	0.0557**	0.0681**	0.0422**	0.0538**	0.067**
	[0.0205]	[0.0211]	[0.0247]	[0.0203]	[0.0222]	[0.0271]	[0.0202]	[0.0223]	[0.0267]
age2	-0.0003	-0.0004	-0.0006*	-0.0002	-0.0004	-0.0006	-0.0002	-0.0004	-0.0005
	[0.0003]	[0.0003]	[0.0004]	[0.0003]	[0.0003]	[0.0004]	[0.0003]	[0.0003]	[0.0004]
urban	0.2563**	0.2952**	0.5584**	0.2605**	0.3843**	0.5427**	0.2369**	0.3462**	0.4793**
	[0.0244]	[0.0714]	[0.1595]	[0.0248]	[0.1004]	[0.1563]	[0.0249]	[0.0873]	[0.1289]
white	0.194**	0.2194**	0.3892**	0.1616**	0.2262**	0.3074**	0.1593**	0.2255**	0.3047**
	[0.018]	[0.0464]	[0.1069]	[0.0165]	[0.0535]	[0.0834]	[0.0162]	[0.0535]	[0.0808]
d70	0.0586	0.0795	0.218**	0.0517	0.1067*	0.1737*	0.0475	0.0956*	0.1508*
	[0.0368]	[0.0534]	[0.1048]	[0.0358]	[0.0593]	[0.0889]	[0.0364]	[0.0547]	[0.0786]
% no migrants	não	não	não	não	não	não	não	não	não
state	sim	sim	sim	sim	sim	sim	sim	sim	sim
cons	sim	sim	sim	sim	sim	sim	sim	sim	sim
esc. father	não	não	não	sim	sim	sim	sim	sim	sim
esc. mother	não	não	não	sim	sim	sim	sim	sim	sim
occup. fatheri	não	não	não	não	não	não	sim	sim	sim
nº of obs	12859	12859	12842	12859	12859	12842	12859	12859	12842
nº de CMAs	702	702	702	702	702	702	702	702	702
R^2	0.4843	0.4816	0.326	0.5062	0.4669	0.304	0.5134	0.4712	0.308

Note: * Significant at 10%, ** Significant at 5%.

The fact of the sub-sample being restricted to individuals that were born in the municipality where they were in 1996 (year of the used PNAD) may generate a bias in the estimators due to the phenomenon of self-selection (selection related bias). This problem occurs because the individuals choose between migrating or not migrating, changing the structure of wages and, therefore, income distribution (Roy 1951) [35].

On account of this fact, the results of models 4 to 6 should be interpreted as conditional for the individuals that have opted by themselves to remain in the hometowns. They cannot, therefore, be extrapolated to a major portion of the population.

[35] In the original article the author is concerned in analyzing the self-selection in occupation, but the logic applies to many cases.

In order to deal with the problem of selection bias, we use the methodology developed by Dahl (2001). It is the inclusion of a variable that captures the effect of self-selection - in this case the participation of non-migrants by CMA for each cohort. [36] Models 7 to 9 include this variable in their specifications, and then it is possible to extrapolate the results for the male population in general, respecting, however, the limitations in temporal terms of the sample.

5.2.3 First stage – models 7 to 9

The results for the first stage are very close to the other samples and econometric specifications. Both instruments robustly influence the education level of the individuals. The magnitude orders of the effects is similar to the one previously found. With this in view, the qualitative conclusions are the same as submitted in subsection 5.1.

However, it is worth noting that the signal for the coefficient for the proportion variable of non-migrants by CMA is significant. This fact indicates that it influences the estimated result of the first stage, in other words, there is evidence that there is a selection bias.

[36] This device was also used in Curi and Menezes (2006) and Souza, Ponczek, Oliva and Saito (2008)

Table 7. First stage (non-migrants)

	Dependent variable: Education								
	Model 7			*Model 8*			*Model 9*		
Variable	**CO***	**CO**	**CD**	**CO***	**CO**	**CD**	**CO***	**CO**	**CD**
Instrument	0.0155**	-0.008**	0.046**	0.0063**	-0.0062**	0.0263**	0.0052**	-0.0059**	0.0248**
	[0.0012]	[0.0014]	[0.0037]	[0.0011]	[0.0013]	[0.0034]	[0.0011]	[0.0013]	[0.0033]
salmd	-	0.0109**	0.0075**	-	0.0061**	0.004**	-	0.0055**	0.0036**
		[0.0004]	[0.0004]		[0.0003]	[0.0003]		[0.0003]	[0.0003]
d70	0.2113	1.1211**	1.0087**	0.0789	0.6042**	0.5874**	0.0280	0.5077**	0.4944**
	[0.1925]	[0.1887]	[0.1864]	[0.1683]	[0.1687]	[0.167]	[0.1663]	[0.1672]	[0.1657]
% of non mgr	-3.1099**	-1.5309**	-2.1023**	-1.9876**	-1.2407**	-1.5692**	-1.6001**	-0.9497**	-1.2631**
	[0.2147]	[0.2144]	[0.2184]	[0.3927]	[0.1917]	[0.1961]	[0.1891]	[0.1914]	[0.196]
age	yes	yes	yes	yes	yes	yes	yes	yes	yes
age ^{2}	yes	yes	yes	yes	yes	yes	yes	yes	yes
urban	yes	yes	yes	yes	yes	yes	yes	yes	yes
white	yes	yes	yes	yes	yes	yes	yes	yes	yes
state	yes	yes	yes	yes	yes	yes	yes	yes	yes
cons	yes	yes	yes	yes	yes	yes	yes	yes	yes
educ. father	no	no	no	yes	yes	yes	yes	yes	yes
educ. mother	no	no	no	yes	yes	yes	yes	yes	yes
occup. father	no	no	no	no	no	no	yes	yes	yes
nº de obs	12842	12842	12859	12842	12842	12859	12842	12842	12859
nº de CMAs	702	702	702	702	702	702	702	702	702
R^2	0.268	0.315	0.321	0.443	0.457	0.458	0.456	0.467	0.469

Note: * Significant at 10%, ** Significant at 5%.

5.2.4 Second stage – models 7 to 9

As in the models 1 and 4, model 7 shows OLS and DC coefficients significantly different from zero. However, in this case the estimated return rate using OLS (9.9%) is lower than that found when using the direct cost as an instrument (11.2%), although they are not statistically different.

When controlled by all background characteristics - model 9 - the coefficients decrease. The first one shows a decrease of 16.5%, the second 35.5%. With this the OLS return rate becomes larger than it is with the use of direct cost as an instrument. One more time the coefficient found with the use of opportunity cost shows a negative signal, but not significantly different from zero in all specifications.

The behavior of the traditional control variables is as expected and in accordance with other models already submitted. Additionally, it is worth mentioning that the fact that the coefficient found for the variable percentage of non-migrants shows a significant coefficient, just confirms the importance that the selection bias has in the sample.

Table 8. Second stage (non-migrants)

Dependent variable: Natural logarithm of hourly wage

	Model 7			*Model 8*			*Model 9*		
Variable	**MQO**	**CD**	**CQ**	**MQO**	**CD**	**CQ**	**MQO**	**CD**	**CQ**
educ.	0.0988**	0.1121**	-0.0043	0.0841**	0.0819**	-0.0457	0.0825**	0.0756**	-0.0487
	[0.002]	[0.0188]	[0.0545]	[0.0019]	[0.0331]	[0.0721]	[0.0019]	[0.0354]	[0.0712]
salmd	0.0008**	0.0006**	0.0018**	0.0006**	0.0006**	0.0013**	0.0006**	0.0006**	0.0012**
	[0.0002]	[0.0002]	[0.0002]	[0.0002]	[0.0002]	[0.0002]	[0.0002]	[0.0002]	[0.0002]
age	0.0566**	0.0542**	0.0745**	0.0455**	0.0459**	0.0676**	0.0424**	0.0437**	0.0662**
	[0.0205]	[0.021]	[0.0247]	[0.0203]	[0.0213]	[0.0269]	[0.0202]	[0.0215]	[0.0266]
age ^{2}	-0.0003	-0.0003	-0.0006	-0.0002	-0.0002	-0.0005	-0.0002	-0.0002	-0.0005
	[0.0003]	[0.0003]	[0.0004]	[0.0003]	[0.0003]	[0.0004]	[0.0003]	[0.0003]	[0.0004]
urban	0.2311**	0.195**	0.5124**	0.2355**	0.2399**	0.4953**	0.2179**	0.2296**	0.4425**
	[0.0242]	[0.0545]	[0.1483]	[0.0245]	[0.0687]	[0.1437]	[0.0247]	[0.0638]	[0.121]
white	0.1988**	0.1738**	0.3917**	0.1662**	0.1687**	0.3097**	0.1631**	0.1706**	0.3045**
	[0.0179]	[0.0383]	[0.1047]	[0.0164]	[0.04]	[0.0816]	[0.0161]	[0.0415]	[0.0793]
d70	0.0170	-0.0005	0.1504*	0.0088	0.0105	0.1041	0.0094	0.0138	0.0919
	[0.0371]	[0.0452]	[0.0905]	[0.0359]	[0.0443]	[0.075]	[0.0365]	[0.0432]	[0.0687]
% of non mgr	-0.2941**	-0.3354**	-0.4504**	-0.3039**	-0.3067**	-0.4636**	-0.2826**	-0.2891**	-0.4054**
	[0.0576]	[0.0213]	[0.0996]	[0.0583]	[0.0707]	[0.1027]	[0.0587]	[0.0675]	[0.0859]
state	yes	yes	yes	yes	yes	yes	yes	yes	yes
cons	yes	yes	yes	yes	yes	yes	yes	yes	yes
educ father	no	no	no	yes	yes	yes	yes	yes	yes
occup. father	no	no	no	yes	yes	yes	yes	yes	yes
educ. mother	no	no	no	yes	yes	yes	yes	yes	yes
occup. mother	no	no	no	yes	yes	yes	yes	yes	yes
n obs	12859	12859	12842	12859	12859	12842	12859	12859	12842
nº de CMAs	702	702	702	702	702	702	702	702	702
R^2	0.486	0.484	0.335	0.508	0.508	0.318	0.515	0.515	0.325

Note: * Significant at 10%, ** Significant at 5%.

An important fact in these three specifications is the continuing significance of the return rate found with direct costs. This fact coupled with the large difference in the estimated point between the two coefficients found using instrumental variables, causes this sub-sample, controlled by the share of non-migrants, to indicate the possibility of an

impact as for the credit constraint in schooling. However, the wide variance of the estimators does not allow them to be considered statistically different.

6. Conclusion

This article aims to identify the role of credit restriction on the decision of investment in human capital in Brazil. For such, we exploit the hypothesis that direct costs and of opportunity to study affect credit restricted and non restricted people in a different form. While the opportunity cost affects everyone in a similar way, the direct cost affects most strongly those restricted to obtain credit.

From the estimation of return rates on education using different instrumental variables it is possible to shed light on the role of the credit restriction on education. By comparing the return rates using as an instrument the relative supply of teachers (proxy of direct costs) and the median wage for young people (variable concerning opportunity cost), we find a accentuated difference in the estimated point in some models[37], indicating the existence of an effect between restriction and schooling . However, the fact that the coefficient found with the use of opportunity cost is negative makes this comparison problematic. Such being the case, although there are indications that the credit constraint affects the decision to foster human capital, they are not overwhelming.

The results found in this study are more favorable to the interpretation that failures in the credit market may influence the decision of the young people to study than the works cited in the second section. This may be due to at least two cumulative effects. First place, the strongest evidence found in the exercises done for the United States focused on young people in age to begin higher education studies. At this development stage, it is likely that the intellectual and preference development in front of the education are already in a mature stage. In other words, in this stage, it is expected that the *background* of the individual has already played a key role, leaving little room for flaws in the credit market to affect the decisions concerning schooling.

[37] Especially those whose results are not conditional to the sample being of non - migrant individuals.

In contrast, the work herein submitted takes into account decisions of younger individuals, which may be decisive in the results. In addition, in the United States, there is a structure that offers credit for students[38] for a good time, especially as for higher education. This aspect may also have influenced the results found through the works carried out with USA data.

This work represents an initial effort to understand the reasons why Brazil has a low educational level coupled with extreme inequality of income and education[39]. A more adequate understanding of this phenomenon is necessary in order to guide the public policies more efficiently and, thus, saving resources for the society.

[38] Lochner and Monge-Naranjo (2002).
[39] Barros and Mendonça (1995).

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Appendix A:

Table 9. Occupation categories

Occupation
Technical, scientific, artistic and assimilated
Administrative
Farming and cattle raising and extractive plant and animal production
Processing and civil construction industry
Trade and auxiliary activities
Transport and communications
Service rendering
Another occupation, ill-defined or non reported occupation
Variable is missing
Head or spouse not present

Table 10. Levels of education

Education
Never attended school or did not complete the first series of the first grade
Incomplete elementary school or first to third series completed of the first grade
Incomplete elementary school or fourth series completed of the first grade
High school – first cycle - incomplete or fifth to seventh series completed of the first grade
High school – first cycle - complete or eight series completed of the first grade
High school – second cycle incomplete or high school incomplete
High school - second cycle compete or complete high school
Some college
Under graduation and graduation
Ignored or not applicable
Variable is missing
Head or spouse not present

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