

# **“Knowledge” or “Privilege”: Which is the Best Investment? Analyzing the Impact of Affirmative Action Policies on Household Educational Investments”**

**Andreza D. P. Lucas**

**Universidade Federal de Pernambuco/Centro Acadêmico do Agreste (UFPE/CAA)**

## **ABSTRACT**

Education has a central role in most development strategies. However inequality may increase when only wealthy individuals are able to access high education levels. In many countries, for instance, entrance to public universities is subject to an entrance exam. The fact that wealthy families are able to invest in children's education more than poor families do, can set a situation in which education access for the wealthy may be paid for through taxation to the poor. In order to avoid this kind of problem, affirmative action (AA) policies have been implemented in some countries to improve educational opportunities for disadvantaged people. In Brazil, for example, there is a given number of places at public universities reserved for students from the public basic schools. However, instead of granting access to the poor in public universities, this policy makes possible for the wealthy to access also public basic school. This paper investigates this problematic. It provides a brief literature review on this topic, and proposes a model using a game theoretical approach where Government decides the size of its policy and individuals decide whether or not to pay for private basic education. It then provides an empirical application using Brazilian data. Finally, it concludes that public policy on education may have a positive effect on equality up to a certain point; if the size of the policy is too big, the effect might be negative.

**Keywords:** Education, Affirmative Action, Equality of opportunity.

## **RESUMO**

A educação tem um papel central na maioria das estratégias de desenvolvimento. Porém, quando apenas indivíduos ricos conseguem ter acesso a altos níveis de educação, ela pode contribuir para aumentar a desigualdade. Em muitos países, por exemplo, o ingresso em universidades públicas está sujeito a um exame de entrada. Se famílias ricas têm mais condições de investir na educação das crianças que famílias pobres, pode se chegar a uma situação onde o pobre paga educação, através de impostos, para o rico. De modo a evitar este tipo de problema, políticas de ações afirmativas (AA) têm sido implementadas em alguns países para melhorar as oportunidades das pessoas desvantajosas. No Brasil, por exemplo, há um dado número de vagas nas universidades públicas reservadas para estudantes da escola básica pública. Porém, ao invés de incluir o pobre na universidade pública, esta política pública pode incluir o rico na escola básica pública. Este artigo investiga esta problemática. Ele fornece uma breve revisão da literatura neste tópico. Depois, ele propõe um modelo usando uma abordagem da teoria dos jogos onde o Governo decide o tamanho da política pública e os indivíduos decidem se adquirir ou não educação básica privada. O artigo também fornece uma aplicação empírica usando dados brasileiros. E, finalmente, ele conclui que a política pública tem um efeito positivo até certo ponto, se o tamanho da política é excessivamente grande, o efeito pode ser negativo.

**Palavras-chave:** Educação, Ação afirmativa, igualdade de oportunidade.

**Área 5:** Economia do Setor Público

**JEL Classification:** I2, I3

## 1. Introduction

The role of education is central to most development strategies. From a theoretical perspective, the economic literature recognizes that investments in human capital are important to sustain growth for different reasons. Hanushek and Woessmann (2007) list the most important: investments in human capital increase labor productivity (Mankiw, Romer and Weil, 1992), improve the innovative capacity of the economy (Lucas, 1988; Romer, 1990; and Aghion and Howitt, 1998) and facilitate the spread and transmission of knowledge (Nelson and Phelps, 1966; Benhabib and Spiegel, 2005). From the equity point of view, higher investments in education are positively correlated with: better public health, lower population growth, democratization, human rights, political stability, lower crime rates, lower deforestation, etc. (see McMahon, 2005).

However, if education is not distributed uniformly among the population it can contribute to increase inequality. In many countries, for instance, entrance to public universities is subject to an admission exam. Places are allocated to students with the best scores. If wealthy students achieve more points, they are more likely to gain a university place. Moreover, if public investment financed by taxation is biased in favor of advanced levels of education, a situation can be reached in which the poor pays for education for the wealthy.

According to Garrison-Wade and Lewis (2004), “[s]ince its beginning, the affirmative action policies’ objective has been to provide opportunities for minorities to advance in society. These policies, mostly race-sensitive, have since opened many doors for minorities especially in higher education.” The term Affirmative Action was used for the first time in the US in the 1960’s to refer to public policies aiming to combat race discrimination in society.

According to Merriam-Webster(2010) Dictionary, AA can be defined as “an active effort to improve the employment or educational opportunities of members of minority groups and women sought to achieve a multicultural staff through affirmative action” or “a similar effort to promote the rights or progress of other disadvantaged persons”.

In the last decades an increasing number of AA policies have been implemented in many countries around the World, including Brazil, Canada, India and United States, Nigeria, Malaysia, etc. AA policies were first implemented with the scope of eliminating race discrimination in society. With passage of time, this kind of policy was used to improve the situation of other minorities, like social disadvantaged people, for instance. In order to differentiate race-based AA from social-based AA, literature uses the terms **color-conscious affirmative action** and **color-blind affirmative action** respectively.

In Brazil the implementation of AA at public universities started in 2001. AA policies at Brazilian universities are based in two main criteria: social and racial. There is a great controversy about which is the most appropriate criterion. Moehlecke (2002) explains that, on one hand, social criteria defenders argue that when you focus in color-blinded AA, you necessarily help the races in disadvantaged position in society; on the other hand, defenders of racial criteria argue that social criterion may lead to the forgetfulness of the racial problem.

Cestau, Epple and Sieg (2015) analyzed the effects of the different criteria: “We develop an econometric model that provides a unified treatment of affirmative action and profiling. Implementing the model for an [American] urban district, we find profiling by race and income, and affirmative action for low income students. Counterfactual analysis reveals that these policies achieve more than 80% of African American enrollment that could be attained by race-based affirmative action.” while Fryer, Jr., Loury and Yurek(2003) show that the short-run efficiency losses of implementing color-blind AA (in their sample) are four to five times as high as color-conscious AA.

Another important issue regarding the beneficiaries of an AA policy is endogeneity. Race or gender are criteria that cannot be changed by individuals, while income, address and type of basic school attended are characteristics that individuals may have incentive to manipulate in order to be

included in the group considered by the AA policy. This paper aims to analyze the effectiveness of a color-blind AA with endogeneity problem.

In Brazil, Government offers primary and secondary education for the whole population, while the number of places at public universities are limited. Wealthy families, in order to guarantee vacancies at public universities, send their children to private basic school, which are better than the public ones. With a higher level of education, wealthy students have higher chances of reaching better scores at the public university entrance exam. Private market offers private universities as well, but generally with lower quality. Thus, public universities have higher quality without tuition fee. As wealthy have higher chances of entering public university, we have an inequality trap where public resources are used to increase human capital of wealthy students, i.e., we have a situation where inequality reinforces itself.

As mentioned before, in the last decades many AA policies were implemented by Brazilian Government, some of them with the scope of including more disadvantaged students at public universities. For more information about Brazilian Educational system, see Machado and Sberman (2016). One of these policies consists in the establishment of quotas at public university for public school students. The scope of this policy is to increase participation of disadvantaged students at public university, but, as pointed by Herskovic and Ramos (2014), it may increase participation of wealthy children in public basic school and offset the effect of the policy.

Which is the best choice for households: to invest in ‘knowledge’ (pay private basic school and prepare their children to ‘fight’ for a lower number of positions at public university) or ‘privilege’ (send their children to basic public school and include them in AA policy group)? From the point of view of Government, which is the optimal number of places at public university that must be devoted to public school students, since, if this number is too low, it does not improve much the situation of public school students? However, if this number is too high, wealthy students may send their children to public school and the policy does not affect disadvantaged students.

This paper analyzes these questions using game theory framework. The originality of this study consists in focusing specifically in this AA policy and analyzing it in detail, both, theoretically and empirically. In Section 2 it analyzes previous studies on this topic and correlated issues. Section 3 is dedicated to the model. Section 4 provides an empirical application. In Section 5 the main results are discussed. And, finally, conclusions are in Section 6.

## **2. Previous Literature**

Since AA policies started, many studies were made in the direction of analyzing their impacts. From the theoretical point of view, when implementation of AA policies at Brazilian universities started, Andrade (2004) proposed a model aiming at analyzing their effects on the efficiency of expenditures in higher education. According to him, the effects on the overall efficiency of total investments (public and private) can be beneficial, nonexistent, or detrimental, depending on the liquidity constraint degree of low-income families and the quality of public universities in comparison with private ones. Four of his results are highlighted here: (1) If the beneficiaries of quotas are families who could actually pay for a private education, the AA policy will simply be a way of transferring income to low-income families. (2) If the correlation between students’ admission score and academic ability is strong, some individuals who have performed better lose their place at public university and the efficiency of the public expenditures in higher education is reduced, since there is a decrease in the quality of the labor force produced by these public investments. (3) If private universities are better than the public ones, quotas would push individuals with greater abilities to attend the more qualified universities and the overall efficiency of the system will increase. (4) If quality of public universities is higher, individuals with the greatest abilities will be taken away from the universities with greater quality, decreasing efficiency of educational system.

Hickman (2010) used a Bayesian game where heterogeneous students compete for places at universities with different prestigious levels and compared alternative AA policies on college admissions. In his model, he shows that there is a tradeoff between equality and academic performance incentives. He also found that the process of levelling some minority students, make worse the situation of some disadvantaged non-minorities. However, he affirms that the theoretical analysis is not enough to evaluate if the results are a socially desirable change.

Another, more recent, theoretical work focusing on Brazilian educational system is Herskovic and Ramos (2014). It investigates the effects of color-blind AA on economic outcomes like welfare, inequality, GDP, investment and intergenerational correlation of income. They proposed an overlapping generation model with four periods in which parents decide whether to send their child to public or private institutions and how much to invest in it. They compared two different AA models, the introduction of quotas and the introduction of bonus points on the admission exam, and concluded: *"We find that both policies can reduce the intergenerational correlation of earnings, but the final effect on inequality, welfare and GDP depends on the magnitude of the policy."* As we can observe, their results are in line with Andrade (2004).

Herskovic and Ramos (2014) underline also the limitations of AA policies in the presence of endogeneity: *"The bonus to students from the public school system makes parents enroll their children in the public school (even if it's inefficient), because it increases the likelihood of college admission."*

The main entrance gate to public universities in Brazil is the ENEM (National Secondary School Exam). It was created in 1998 with the scope of evaluating secondary education in Brazil. At that time, each university had its own selection process for students' admission. Over the years, the ENEM replaced the selection process of universities, and public tertiary education migrated from a decentralized to a centralized admission system. Machado and Szerman (2016) founded that *"institutions under the centralized assignment are able to attract students with substantially higher test scores and [...] geographical mobility of admitted students increases."*

There is a great debate on the effect of AA policies on effort incentives of disadvantaged groups. Some studies sustain that AA policies motivate minorities to perform better. Cotton, Hickman and Price (2014) made an experiment to verify if AA increases average study effort and exam performance of disadvantaged groups targeted by the policy. They paid students based on relative performance on a national mathematics exam in US. The results suggest that AA can both promote greater equality of market outcomes and narrow achievement gaps at the same time. Akhtari and Bau (2016) analyzed data from a large, urban school district in Texas and found the following result: *"the reinstatement of affirmative action narrowed the achievement gap between minority (black and Hispanic) and white high school students in standardized test scores, course grades, and the likelihood of taking advanced courses."* Similar results were found by Saeme (2014), when she analyzed Brazilian data: *"on average, Black students from public schools in São Paulo scored 1.54% higher on the ENEM as a result of the introduction of quotas in UFSCar admissions, and the estimate for all public school students (unconditional on race) was 1.16% on average."* Also Francis and Tannuri-Pianto (2012) analyzed Brazilian data: *"[W]e compare displaced and displacing applicants and find that racial quotas helped promote equity to some extent. Nevertheless, the scale and scope of redistribution were highly limited, and the vast majority of Brazilians had little chance of attending college, suggesting that more still needs to be done."*

However, there are also studies which results follow a different direction. Ferman and Assunção (2005) used 'difference in difference' estimates to evaluate the effect of the quota system in the admission to Brazilian public universities. They affirm: *"Our findings show that favored groups attained lower scores, suggesting a negative link between affirmative action and incentives for effort and skill acquisition."*, while Estevan, Gall and Morin (2016) show that an AA policy applied to a large Brazilian university increased representation of minorities, but have not increased their effort to perform better.

As it can be observed the majority of studies, involving AA policies, focus on the impact of policies and on effort decisions of favored groups. Some of them consider that wealthy families are able to offer a better basic education for their children, but investment decisions of households is a topic that deserves more attention. The aim of this paper is to contribute to this debate with both theoretical and empirical elements. In the next section, a model is proposed considering these issues.

### 3. The Model

A given country is considered to be composed by  $N$  households indexed by  $i$ , where each household is composed of one parent and one child. Households differ only in parents' human capital,  $h_i$ , and child innate ability,  $a_i$ . The Cdf of  $h_i$  is given by  $H$ , and  $h_1 \leq h_2 \leq \dots \leq h_N$ . Child innate ability is a random variable normally distributed,  $a_i \sim N(0, \sigma^2)$ . Parents work, receive income and consume, while children study. Households' income is determined by parents' human capital, and it is increasing on it. For the sake of simplicity, we consider that the minimal income of this economy is  $h_{min}$ , which is the minimal amount necessary to supply the basic needs of a family. We normalize  $h_{min}$  to zero and suppose that household's  $i$  post-taxation income is  $h_i \geq 0$ . There is no credit market in this economy.

Household's utility is quasilinear and depends on parent's consumption and child's education. It can be expressed as:

$$u_i = x_i + g(e_i)$$

where  $x_i$  is consumption of parent  $i$ , and  $g(e_i) \geq 0$  represents the impact of child  $i$  education in the utility of household  $i$ . We suppose also that  $g'(e_i) \geq 0$  and  $g''(e_i) \leq 0$ , i.e.,  $g(e_i)$  is increasing and concave in  $e_i$ , child's education. If the family does not invest in private education, then  $x_i = h_i$ .

In our model, educational system is divided in two levels: basic school ( $s$ ), which comprises primary and secondary education, and university ( $f$ ), or, tertiary education. Basic education is compulsory, and we suppose that if a child does not attend university, then  $g(e_i) = 0$ .

There are two types of basic school: the one provided by government,  $s_G$ , and the one provided by private market,  $s_P$ . Attendance to  $s_G$  is tuition free, and the Government offers as many places at  $s_G$  as required by population. To attend  $s_P$ , it is necessary to pay  $c_S$ . The quality of  $s_G$  is lower than the quality of  $s_P$ .

Tertiary education can be of two types as well: Public university,  $f_G$ , provided by government is tuition free, while private sector provides  $f_P$ . To attend  $f_P$ , families must pay  $c_F$ . The quality of  $f_G$  is higher than the quality of  $f_P$ . However, there are only  $v_G < N$  vacancies at  $f_G$ . To join  $f_G$ , student must take an admission exam. Students with the best scores win a place at  $f_G$ . Private sector offers as many places at  $f_P$  as required by households.

Student mark at university entrance exam,  $m_i$ , depends on parent's human capital, basic education and innate ability:

$$m_i(h_i, s_i, a_i),$$

with  $\frac{\partial m_i}{\partial h_i} \geq 0$  and  $\frac{\partial m_i}{\partial a_i} \geq 0$ . Since the quality of  $s_G$  is lower than the quality of  $s_P$ , then:

$$m_i(h_i, s_P, a_i) \geq m_i(h_i, s_G, a_i) \quad \forall i.$$

If parents invest in  $s_P$  they increase the probability of their child entering public university. Thus, a wealthy child has two sources of advantage: (1) parent's human capital, since parents with a higher level of education share their knowledge at home, buy books, frequent museums, etc.; and (2) formal education, given that families can pay for high quality private school education.

In order to decrease the degree of inequality of tertiary educational system opportunity, the Government can stipulate that a given number of places at  $f_G$  must be occupied by public school students.

The problem can be modelled as a sequential game were, initially, Government decides  $\beta \in [0,1]$ , the percentage of places at  $f_G$  devoted to public basic school students. If  $\beta = 0$ , it means that there is no affirmative action supporting public school students. Whereas if  $\beta = 1$ , we have an economy where only public school students can apply for public universities. In the second step of the game, households observe  $\beta$  and decide whether to send their child to public or private basic school.

It is considered that the aim of Government is to maximize tertiary education enrollment, and it is known that all places at public universities will be filled. If a family does not win a place at  $f_G$ , they decide whether or not to pay  $c_F$  to send their child to  $f_P$ . If a family, whose child did not get a place at public university, does not have enough money to pay  $c_F$ , their child will not attend tertiary education, while wealthy families in the same situation will be able to pay for private universities for their child. Thus, the higher the number of poor at public universities, the higher total enrollment on tertiary education. The scope of government is to maximize production of human capital in the economy; the higher the number of students enrolled in tertiary education, the higher the total amount of human capital produced. Thus, Government utility function can be expressed with the following equation:

$$W = v_G + v_P(\beta, H, M),$$

where  $v_G$  is a constant expressing the number of vacancies at  $f_G$ , and  $v_P(\beta, H, M)$ , the number of students enrolled at private tertiary institutions, depends on  $\beta$  and on the distribution of human capital( $H$ ) and scores( $M$ ) among the households.

Considering a family with enough resources to pay for private university, if their child does not get a place at public university, and  $g(f_P) \geq c_F$ , households expected utility is given by:

$$Eu_i = x_i + \rho_i(\beta, m_i(h_i, s_i, a_i)) \cdot g(f_G) + (1 - \rho_i(\beta, m_i(h_i, s_i, a_i))) (g(f_P) - c_F)$$

where  $x_i$  is consumption and is given by  $x_i = h_i - c_i$ ; and  $c_i$  is the household spending with private education. The probability of a household to win a position at public university is  $\rho_i$ , and it depends on  $\beta$  and  $m_i$ . The increment in household utility function, if a child goes to public university, is  $g(f_G)$ . With probability  $(1 - \rho_i)$ , a child does not go to public university. In this case, it is optimal to the family to pay for private university if and only if  $g(f_G) \geq c_F$ . We suppose that private university is provided by a competitive market that set prices such that  $c_F = g(f_G)$  (we discuss the results when this assumption is relaxed in Appendix A.2). Thus, the expected utility function can be simplified to the following equation:

$$Eu_i = h_i + \rho_i(\beta, m_i(h_i, s_i, a_i)) \cdot g(f_G)$$

After observing  $\beta$ , families decide whether or not to pay for private school. Considering again a family with enough money to invest in private education, the expected utility if they pay  $c_S$  to send the child to  $s_P$  is:

$$Eu_i = h_i - c_S + \rho_i^P(\beta, m_i(h_i, s_P, a_i)) \cdot g(f_G)$$

where  $\rho_i^P$ , is the probability of entering  $f_G$  if the child attended private school. If the family does not pay  $s_P$  the expected utility is:

$$Eu_i = h_i + \rho_i^G(\beta, m_i(h_i, s_G, a_i)) \cdot g(f_G).$$

with  $\rho_i^G$  expressing the probability of child entering public university after attending  $s_G$ .

As affirmed before, the Government utility function is given by  $W = v_G + v_P(\beta, H, M)$ . A household whose human capital is  $h_i < c_S$ , is not able to pay for private school and send their child

to public school. A household whose human capital is  $h_i \geq c_S$ , must decide whether to invest or not in private basic school. Figure 1 represents the game in the extensive form.

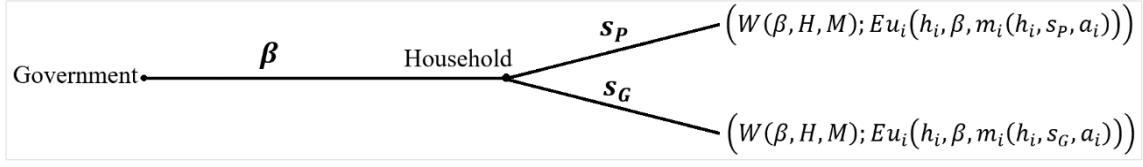


Figure 1: Game in the extensive form.

Source: Made by the author.

Household pays for private basic school if (The proof is in Appendix A.1):

$$h_i \geq c_S \quad (1)$$

and

$$[\rho_i^P - \rho_i^G] \cdot g(f_G) \geq c_S \quad (2)$$

However,  $\frac{\partial \rho_i^G}{\partial \beta} \geq 0$  and  $\frac{\partial \rho_i^P}{\partial \beta} \leq 0$ , thus, the higher  $\beta$ , the lower the number of families who send their child to private basic school. The higher  $g(f_G)$ , the higher the number of families interested in sending their child to private basic school.

If condition (2) holds, families whose

$$h_i \geq c_S + c_F, \quad (3)$$

are able to send their child to private university. If condition (2) does not hold, families whose

$$h_i \geq c_F, \quad (4)$$

are able to send their child to private university. Then, household's decision depends on a set of factors. Table 1 resumes the best decision for a given household in each situation:

Table 1: Household's decision.

Household human capital	Basic school decision ( $s_G$ or $s_P$ )	Tertiary education decision (whether pay or not private university)
$h_i < c_S$ and $h_i < c_F$	$s_G$	No
$c_S < h_i < c_F$	$s_G$ if $[\rho_i^P - \rho_i^G] < \frac{c_S}{g(f_G)}$	No
	$s_P$ if $[\rho_i^P - \rho_i^G] \geq \frac{c_S}{g(f_G)}$	No
$c_F < h_i < c_S$	$s_G$	Yes
$h_i > c_S$ ; $h_i > c_F$ and $h_i < c_S + c_F$	$s_G$ if $[\rho_i^P - \rho_i^G] < \frac{c_S}{g(f_G)}$	Yes
	$s_P$ if $[\rho_i^P - \rho_i^G] \geq \frac{c_S}{g(f_G)}$	No
$h_i > c_S + c_F$	$s_G$ if $[\rho_i^P - \rho_i^G] < \frac{c_S}{g(f_G)}$	Yes
	$s_P$ if $[\rho_i^P - \rho_i^G] \geq \frac{c_S}{g(f_G)}$	Yes

Source: Made by the author.

As mentioned before, Government aims to maximize the function  $W = v_G + v_P(\beta, H, M)$ . Let us denote with  $R$  the families that, after basic school choice, are able to pay for private university. The number of families in this situation is  $N_R$ , and the share of families in this group whose child goes to public university is  $mean(\rho_i^R)$ . Thus,  $W$  can be expressed as:

$$W = v_G + N_R \left( 1 - \text{mean} \left( \rho_i^R(\beta, H, M) \right) \right). \quad (5)$$

The effect of  $\beta$  in  $W$  is ambiguous, since the higher  $\beta$  is, the higher the proportion of public school students at public university is, but, at the same time, the higher the proportion of wealthy students at basic school is.

**Proposition 1.** If there is  $\beta$  such that the difference function  $[\rho_i^P - \rho_i^G]$  is increasing in  $h_i$  and there is a value of  $h_i = \bar{h}$  such that  $[\rho_i^P - \rho_i^G] = \frac{c_S}{g(f_G)}$  and  $\bar{h} \geq c_S + c_F$ , then  $W = v_G + N[1 - H(\bar{h})][1 - \int_{i=\bar{h}}^N \rho_i^P dH]$ .

## 4. Empirical Application

For the sake of getting the probability of a student (with a given household income and who attended a given type of basic school) to win a place at university, we will analyze ENEM results. Thus, we first describe briefly ENEM history and then do the probability estimations.

### 4.1 ENEM's History

As mentioned before, in Brazil at the end of secondary school, students take an exam called ENEM (Secondary School National Exam). The exam was created in 1998 with the scope of evaluating secondary school. It is optional and subject to payment. Some universities used it as part of their student selection process. It was composed of 63 multiple choices questions and one composition. The idea was to evaluate 21 different abilities of candidates. Since 2001, public secondary school students, private secondary school students with full scholarship and people living in economic vulnerability are entitled to exemption from the registration fee.

Beyond quotas, another government policy to favor participation of poor people in Brazilian tertiary education is the PROUNI (University for All Program). In this program, government offers scholarships in private universities for public school students; students may receive full scholarship or half scholarship based on family per capita income. In order to provide the vacancies to PROUNI, Government and private universities do a mutual agreement, and scholarships are financed through tax exemptions. Only students who took ENEM exam and who reached at least 450 points (the score can varies from 0 to 1000) are allowed to participate in PROUNI program.

The ENEM exam was reformulated in 2009, becoming more complex and more in line with secondary education curriculum. It is now composed of four exams (languages, human sciences, natural sciences and mathematics), comprising 180 multiple choice questions and a composition.

Nowadays this exam is considered the main entrance gate to public universities. The exam is also used to apply for private universities (although most of them have their own candidates' selection system) and to request financing or aid from government to study at private universities. On August 29, 2012, Brazilian Government promulgated a law determining that all federal educational tertiary institutions must designate at least 50% of their vacancies to secondary public school students, and, at least a half of this amount must be devoted to the poor. It is considered poor those whose per capita income is equal or lower than 1.5 minimal income. In 2017, Government established that ENEM exam can no longer be used as secondary school completion certificate. In Figure 2 we can observe a timeline resuming ENEM's history.



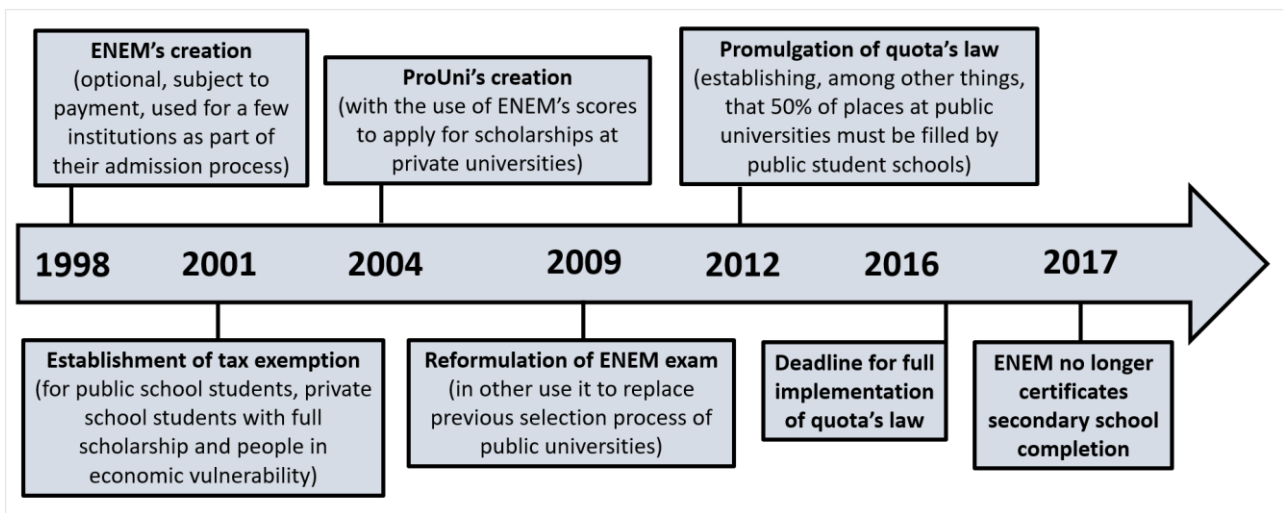


Figure 2: Timeline ENEM exam.  
Source: Made by the author.

As we can see, ENEM exam increased its importance across the years. Thus, the number of test registrations has increased as well. Figure 2 shows the approximate number of ENEM registrations in millions of candidates at each year. As we can notice, in the last year this number decreased to 6.1 million. This reduction is the result of a set of factors: the exemption criterion became stricter, ENEM exam can no longer be used to certificate conclusion of secondary school and its price increased 20%.

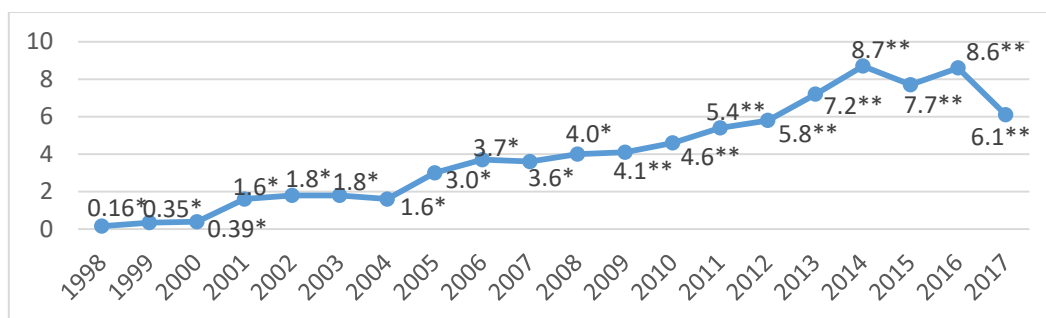


Figure 3: Confirmed registrations in millions of candidates.  
Source: Made by the author using data from G1(2017)\*\* and Wikipedia(2017)\*.

## 4.2 Probability Estimations

The model presented in the previous section shows that policies favoring public school students may stimulate families to invest less in high school education, sending their child to public high school. Figure 4 shows the percentage of secondary school students enrolled in private institutions. It can be observed that before the creation of ENEM and the implementation of AA policies, the percentage of high school students enrolled in private institutions used to be higher.

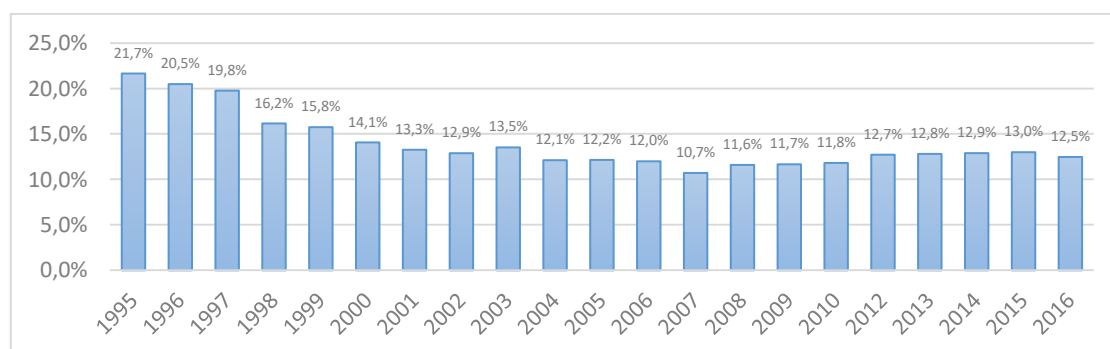


Figure 4: Percentage of secondary school students enrolled at private institutions.  
Source: Made by the author using data from INEP (2017).

In order to analyze the impact of AA policies in households decision we focus on ENEM exam results of a specific year. The most recent available dataset is from 2015. Candidates who took the exam this year could use their score to apply for positions in public universities in 2016, the first year in which Quota's Law (Brasil, 2012) was fully implemented by all public universities. Upon registration, candidates answer a socioeconomic questionnaire. The number of registrations in 2015 reached 8,478,096. When we exclude missing candidates, not confirmed candidates and eliminated candidates, the remaining candidates are 4,369,371. In our analysis, we have considered only the candidates who have informed the type of high school attended and, as shown in Table 2, they were 1,450,388. Upon registration, candidates informed the approximate household income and the number of components of the household; with this data we can calculate the approximate household per capita income,  $I$ . The unit of  $I$  is Brazilian minimum wage. As we can observe, there is a high concentration of households at lower income levels, this is the reason why the first income intervals have a lower amplitude in comparison to the last ones.

The percentage of private secondary school students on our dataset is 20,6%, it is higher than the percentage of students enrolled on private secondary school in the same year showed by Figure 4.

In 2016, the number of positions offered at public universities was 284,422. Which means that approximately 6.5% of valid candidates would have been able to get a place at public university. To apply for public universities, students observe their ENEM exam result and the cut points of previous years for each university and course, and decide which ones to apply for. In Brazil, the higher scores are the ones of medical school candidates. To simplify, we considered that there was only one course and university and that all candidates applied for it. Considering, that 6.5% of the candidates won a position at public university, we have estimated the probability of entrance by type of school and per capita income.

Table 2: Number of households by income group.

Household income	N	$N_G$	$N_P$
$I \leq 0.2$	91,651	88,414	3,237
$0.2 < I \leq 0.4$	456,729	431,264	25,465
$0.4 < I \leq 0.6$	234,218	209,323	24,895
$0.6 < I \leq 0.8$	181,414	151,097	30,317
$0.8 < I \leq 1$	149,176	113,217	35,959
$1 < I \leq 1.5$	105,978	66,231	39,747
$1.5 < I \leq 2$	70,660	32,167	38,493
$2 < I \leq 3$	52,962	15,863	37,099
$3 < I \leq 4$	21,990	4,041	17,949
$4 < I \leq 6$	18,936	2,159	16,777
$I > 6$	21,674	1,537	20,137
TOTAL	1,405,388	1,115,313	290,075

Source: Made by the author using data from INEP (2017a).

The cut point is defined as follows. Considering that a given percentage of students goes to public university, for example, 10%, we order the scores and consider that the better 10% will win a place at public university. Then we identify the worst score in the 10% group, and define it as the cut point. Thus, individuals with score equal or higher to it go to public university, and individuals below it are out of public university. Although this is a very simple estimation process, it seems to be adequate to do it since candidates usually make decisions considering previous years' results.

Figure 5 illustrates the results estimated for public high school students (Figure 5a) and private high school students (Figure 5b), considering five different policies, where  $\beta$  represents the percentage of places in public school devoted to public high school students. As we can see, the higher  $\beta$ , the higher  $\rho_G$ , and the lower  $\rho_P$ . We can observe, in addition, that the higher  $h_i$ , the higher the

probability of entering in university, which is consistent with our model. The only exceptions are the wealthiest individuals of public school and the poorest individuals of private school. In Table 2, we can notice that these are the groups with lower representation on our data set.

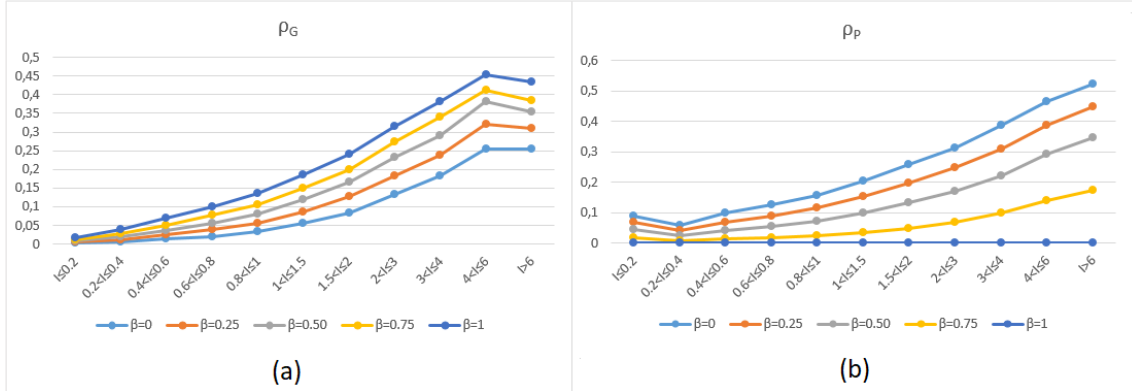


Figure 5: Probability of entering university: (a) Public high school students, (b) Private high school students. Source: Made by the author using data from INEP (2017a).

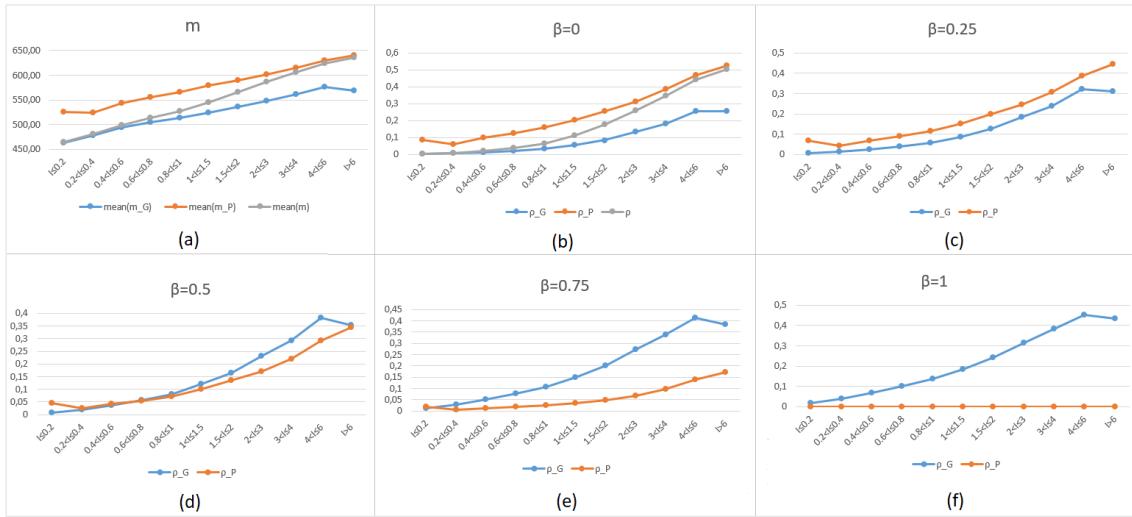


Figure 6: Comparison between public and private students: (a) Average score at ENEM exam, (b) Probability of entering university when  $\beta=0$ , (c) Probability of entering university when  $\beta=0.25$ , (d) Probability of entering university when  $\beta=0.5$ , (e) Probability of entering university when  $\beta=0.75$ , (f) Probability of entering university when  $\beta=1$ .

Source: Made by the author using data from INEP(2017a).

At all income groups, the average score of private high school students is higher than the average score of public high school students; and the higher the income, the higher the average score, which can be observed in Figure 6a. Without affirmative action policies,  $(\rho_i^P - \rho_i^G)$  is positive and increasing in  $h_i$  if  $I > 0.2$ , as reported by Figure 6b and Table 3. If at least 25% of public university positions must be filled by public school students, the probability of entrance at each income level increases for public high school students and decreases for private high schoolers; however, at each income level, private high school students still have a higher probability of entering public university than public high school students. These results are present on Figure 6c and Table 3. When 50% of public university positions are devoted to public high school students we have a surprising result, the probability of entering public university is higher for the wealthy who attends public high school, and for the poor who attends private school (see Figure 6d). We can observe in Table 3 that  $(\rho_i^P - \rho_i^G)$  is positive if  $I \leq 0.6$  and negative if  $I > 0.6$ . The results are similar when  $\beta = 0.75$ ; however, in this situation  $(\rho_i^P - \rho_i^G) > 0$  only if  $I \leq 0.2$  (see Figure 6e and Table 3). When only public high school students can attend public university  $(\rho_i^P - \rho_i^G) > 0$  for all income levels as showed in Figure 6f. We can notice, as well, that the wealthiest public school

students ( $I > 6$ ) achieve worse results than students whose families have income  $4 < I \leq 0.6$ . This fact deserves more attention, and investigating it goes beyond our scope; however, since this is a group who should not have great difficulty to pay for private school, it may indicate that there is a share of households on this group which does not give much importance to education, since they have money, but does not pay for private education.

Table 3: Difference between entrance probability of public and private high school students.

Income	$\rho_P - \rho_G$				
	$\beta=0$	$\beta=0.25$	$\beta=0.50$	$\beta=0.75$	$\beta=1$
$I \leq 0.2$	0,085	0,063	0,038	0,006	-0,017
$0.2 < I \leq 0.4$	0,052	0,029	0,005	-0,021	-0,039
$0.4 < I \leq 0.6$	0,085	0,044	0,004	-0,038	-0,069
$0.6 < I \leq 0.8$	0,105	0,051	-0,002	-0,059	-0,101
$0.8 < I \leq 1$	0,124	0,058	-0,010	-0,082	-0,136
$1 < I \leq 1.5$	0,149	0,066	-0,020	-0,116	-0,186
$1.5 < I \leq 2$	0,174	0,072	-0,031	-0,152	-0,241
$2 < I \leq 3$	0,181	0,065	-0,061	-0,204	-0,315
$3 < I \leq 4$	0,203	0,069	-0,071	-0,241	-0,382
$4 < I \leq 6$	0,211	0,066	-0,088	-0,272	-0,453
$I > 6$	0,270	0,136	-0,008	-0,212	-0,435
<b>TOTAL</b>	0,216	0,151	0,080	-0,011	-1,704

Source: Made by the author using data from INEP(2017a).

In the next section, we discuss the results found in the empirical application and its implications for the proposed model.

## 5. Discussion

The model of Section 3 showed that if  $[\rho_i^P - \rho_i^G] \geq \frac{c_s}{g(f_G)}$  households increase their expected utility if they invest in private high school education. The empirical application showed us that the higher  $\beta$ , the lower the difference  $[\rho_i^P - \rho_i^G]$ . Which means that if Government offers places at university to public school students, it may discourage private investments in private secondary education institutions. If  $g(f_G)$  is very high in comparison with  $c_s$ , a small positive difference between  $\rho_i^P$  and  $\rho_i^G$  is enough to convince a family to invest in private high school education, since the utility of having a child in public university is much higher than the cost of paying basic school.

As confirmed by the data, the score reached by the students is higher when they attend private basic school, and the higher the income level of the family, the higher the child achievement. Consequently, the probability of entering public university is higher for private school students, and the higher the household income level, the higher this probability. When Government books places at public university to public school students, it increases the probability of entering university for public school students, and decreases it for private school students at all income levels. If the percentage of places devoted to public school students is small enough, like  $\beta = 0.25$  in the case of the data analyzed, it is possible to increase the chances of public school students entering university without motivating private school students to change the type of school attended. If  $\beta$  is such that, for a group of households, it is worthwhile to send their child to public school in spite of paying for private school for them, the policy loses effectiveness. Moreover, wealthy families are the ones with higher motivation to no longer pay for private school. The intuition behind it is that, since education acquired by the child depends on both formal (school) and informal (parents' human capital) education, and the production of education has declining marginal returns, the effect of private education is higher to households whose parent has a lower level of human capital. Thus, in the case

of our dataset, if  $\beta = 0.5$ , it is better for families whose  $I \leq 0.6$  to pay for private school if conditions (1) and (2) holds, while families whose  $I < 0.6$  increase their expected utility sending their child to public basic school.

Brazilian Quotas' Law (Brasil, 2012) determines that 50% per cent of the positions at public universities must be filled by public school students, but it also determines that a half of them are booked to poor students, i.e. students whose  $I \leq 1.5$ ; thus, for students with  $I > 1.5$ ,  $\beta = 0.25$ . The law also stipulates that public basic school students' positions at public university must be shared between different races according to the share of races in that region. The reference for the share of races in the region is the one estimated by official national statistics. Analyzing how these criteria together affect each income group goes beyond the scope of this paper; however, we can observe that these additional criteria increase motivations in the poor and those whose race used to have lower representation at universities, to send their child to public school; and in the wealthy, to send their child to private school.

It is important to mention too, that booking places at public university is not the only governmental action to improve access of underprivileged groups to higher levels of education. During university, many students receive governmental aid for transport, food, etc. There is also the possibility of receiving full or partial scholarship to attend private universities. Thus, there is a set of other factors that may stimulate a family to send their child to public basic school.

## 6. Conclusion

This study has analyzed the effect of AA policies when the definition of the underprivileged group is endogenous. The use of a game theoretical framework showed that if the advantage offered by the AA policy is big enough, it will stimulate households to migrate from one group to the other, and the policy will not reach its scope. In this case, in spite of investing in a higher quality basic school, in order to provide more knowledge for their offspring, parents send their child to a lower quality public school in order to give them the possibility of being contemplated by the AA policy.

The data analyzed underscored our main result, as well as indicated that if the size of the policy exceeds the adequate level, the main beneficiary of the AA policy may be the wealthy. According to the data, parents' background is more important than formal education in the definition of a child's achievement.

This paper calls attention to the fact that AA policies may lead to undesirable results if the determination of the disadvantaged group is exogenous. However, if wealthy decides to use public services in order to be included in the AA policy, considering the higher level of human capital due to parents background, they are also able to know and demand their rights, thus, in this way, they can contribute to improve public school.

In future research, it would be interesting to analyze the probability of these groups entering university in different years, comparing the results before and after the implementation of AA policies. Another topic to be deepened is the joint effect of poor and race based AA policies and those comprising public school students. Finally, it would be interesting to analyze the same problem, considering that the wealthy and the poor attribute different utility levels to education.

## References

- AGHION, Philippe; HOWITT, Peter W. **Endogenous Growth Theory**. Cambridge: MIT Press, 1997.
- ANDRADE, E. C. **Quotas in Brazilian Public Universities: Good or Bad Idea?** Revista Brasileira de Economia, 58(4): 453-84, 2004.
- AKHTARI, M. ; BAU, N. **Race-based Affirmative Action and Student Effort**. Working paper, February, 2016. Available at : < <https://scholar.harvard.edu/makhtari/publications/race-based-affirmative-action-and-student-effort>>.

- BENHABIB, Jess; SPIEGEL, Mark M. Human capital and technology diffusion. In: **Handbook of Economic Growth**. Amsterdam: North Holland, 2005. p. 935-966.
- BRASIL. **Lei nº. 12.711**. Dispõe sobre o ingresso nas universidades federais e nas instituições federais de ensino técnico de nível médio e dá outras providências. Brasília, 29 de ago. 2012. Available at: <[http://www.planalto.gov.br/ccivil\\_03/\\_Ato2011-2014/2012/Lei/L12711.htm](http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12711.htm)>. Consulted in: 06/10/2017.
- CESTAU, Dario; EPPLE, Dennis; SIEG, Holger. **Admitting students to selective education programs: merit, profiling, and affirmative action**. NBER working paper series, Working Paper 21232, 2015. Available at: <<http://www.nber.org/papers/w21232>>.
- COTTON, C.; HICKMAN, B. R.; PRICE, J. P. **Affirmative action and human capital investment: Evidence from a randomized field experiment**. Working Paper 20397, National Bureau of Economic Research, 2014.
- ESTEVAN, F.; GALL, T.; MORIN, L.-P. **Redistribution without Distortion: Evidence from an Affirmative Action Program at a Large Brazilian University**. Ottawa, Working paper, n. 1608E, Jul, 2016.
- FERMAN, B.; ASSUNÇÃO, J. **Affirmative action in university admissions and high school students' proficiency**. Working Paper, Department of Economics, PUC-Rio, 2005.
- FRANCIS, A. M.; TANNURI-PIANTO, M. **Using Brazil's racial continuum to examine the short-term effects of affirmative action in higher education**. Journal of Human Resources, v. 47, n. 3, p. 754-784, 2012.
- FRYER, R.; LOURY, G. C.; YURET, T. **Color-Blind Affirmative Action**. NBER Working Paper n. 10103, 2003. Available at: <<http://www.bu.edu/econ/files/2012/11/dp131Loury.pdf>>.
- G1. **Enem 2017 tem o menor número de inscritos confirmados desde 2013**. Available at: <http://g1.globo.com/educacao/enem/2017/noticia/enem-2017-teve-pelo-menos-61-milhoes-de-inscricoes-confirmadas.ghtml>>, consulted in: 06/15/2017.
- GARRISON-WADE, D. F.; LEWIS, C. W. **Affirmative action: history and analysis**. The Journal of College Admission, p. 23-26, 2004.
- HANUSHEK, E. A.; WOESSMANN, L. The Role of Education Quality in Economic Growth. **Policy Research Working Papers**. Paper 4122, February, 2007.
- HERSKOVIC, B.; RAMOS, J. **Affirmative Action in College Admission: long-run implications for efficiency and inequality**. Working paper, 2014). Available at: <<http://www.econ.puc-rio.br/biblioteca.php/trabalhos/show>>.
- HICKMAN, B. R. **Student effort, race gaps, and affirmative action in college admissions: theory and empirics**. PhD (Doctor of Philosophy) thesis, University of Iowa, 2010.
- INEP. O Instituto Nacional de Estudos e Pesquisas Educacionais. **Sinopses estatísticas 1995-2016**. Available at: <<http://portal.inep.gov.br/web/guest/sinopses-estatisticas>>, consulted in : 06/20/2017.
- INEPa. O Instituto Nacional de Estudos e Pesquisas Educacionais. **ENEM 2015**. Available at : <<http://portal.inep.gov.br/web/guest/microdados>>, consulted in : 05/20/2017.
- INEP. O Instituto Nacional de Estudos e Pesquisas Educacionais. **Sinopses estatísticas 1995-2016**. Available at :<<http://portal.inep.gov.br/web/guest/micr>>.
- LUCAS, R. On the Mechanics of Economic Development. **Journal of Monetary Economics**. North-Holland, v. 22, p. 3-42, 1988.
- MACHADO, C.; SZERMAN, C. **Centralized Admission and the Student-College Match**. IZA DP No. 10251, September, 2016.

MANKIW, N. G.; ROMER, D.; WEIL, D. N. A contribution to the empirics of economic growth. **Quarterly Journal of Economics**. v. 107, n. 2, p. 407-437, may, 1992.

MCMAHON, Walter W. The social and external benefits of education. In: JOHNES, Geraint; JOHNES, Jill. **International Handbook on the Economics of Education**. Massachusetts: Edward Elgar Publishing Ltd, 2004, p. 211-259.

MERRIAM-WEBSTER. Available in: <https://www.merriam-webster.com>. Consulted in: <15th, June, 2010>.

MOEHLECKE, S. **Ação afirmativa: história e debates no Brasil**. Cadernos de Pesquisa, n. 117, p. 197-217, November, 2002.

NELSON, R. R.; PHELPS, E. S. Investment in Humans, Technological Diffusion, and Economic Growth. **The American Economic Review**. v. 56, n. 1/2. p. 69-75, mar, 1966.

ROMER, Paul M. Endogenous Technological Change. **Journal of Political Economy**. v. 98, n. 5, p. S71-S102, 1990.

SAEME, D. **Does the Implementation of Affirmative Action in a Competitive Setting Incentivize Underrepresented Public School Applicants' performance? Evidence from São Paulo**. The Yale Journal of Economics, New Havens, v. 2, n. 2, p. 93-114, Sep, 2014.

WIKIPEDIA. **Inscritos no ENEM por ano**. Available at: [https://pt.wikipedia.org/wiki/Predefini%C3%A7%C3%A3o:Inscritos\\_no\\_Enem\\_por\\_ano](https://pt.wikipedia.org/wiki/Predefini%C3%A7%C3%A3o:Inscritos_no_Enem_por_ano)>, consulted in: 06/15/2017.

## Appendix

### A.1 Household decision when $c_F = g(f_G)$

If  $h_i < c_S$ , the family send child to public basic school.

If  $h_i \geq c_S$ , the family compares expected utility with public and private basic school. Household send child to basic private school if:

$$Eu_i(s_P) \geq Eu_i(s_G)$$

$$h_i - c_S + \rho_i^P(\beta, m_i(h_i, s_P, a_i)) \cdot g(f_G) \geq h_i + \rho_i^G(\beta, m_i(h_i, s_G, a_i)) \cdot g(f_G)$$

In order to simplify the notation, we use the small form of  $\rho_i^P(\beta, m_i(h_i, s_P, a_i)) = \rho_i^P$  in the demonstration.

$$-c_S + \rho_i^P \cdot g(f_G) \geq \rho_i^G \cdot g(f_G)$$

$$[\rho_i^P - \rho_i^G] \cdot g(f_G) \geq c_S$$

### A.2 Household decision when $c_F < g(f_G)$

Let us consider initially the situation where  $h_i \geq c_S + c_F$ . Household invests in private basic education if:

$$Eu_i(\beta, m_i(h_i, s_P, a_i)) \geq Eu_i(\beta, m_i(h_i, s_G, a_i))$$

In order to simplify the notation, we use the small form of  $\rho_i^P(\beta, m_i(h_i, s_P, a_i)) = \rho_i^P$  in the demonstration.

$$x_i - c_S + \rho_i^P \cdot g(f_G) + (1 - \rho_i^P)(g(f_P) - c_F) \geq x_i + \rho_i^G \cdot g(f_G) + (1 - \rho_i^G)(g(f_P) - c_F)$$

$$x_i - c_S + \rho_i^P \cdot g(f_G) + g(f_P) - c_F - \rho_i^P \cdot g(f_P) + \rho_i^P \cdot c_F$$

$$\geq x_i + \rho_i^G \cdot g(f_G) + g(f_P) - c_F - \rho_i^G \cdot g(f_P) + \rho_i^G \cdot c_F$$

$$-c_S + \rho_i^P \cdot g(f_G) - \rho_i^P \cdot g(f_P) + \rho_i^P \cdot c_F \geq \rho_i^G \cdot g(f_G) - \rho_i^G \cdot g(f_P) + \rho_i^G \cdot c_F$$

$$-c_S + \rho_i^P(g(f_G) - g(f_P) + c_F) \geq \rho_i^G(g(f_G) - g(f_P) + c_F)$$

$$(\rho_i^P - \rho_i^G)(g(f_G) - g(f_P) + c_F) \geq c_S$$

$$(\rho_i^P - \rho_i^G) \geq \frac{c_S}{g(f_G) - g(f_P) + c_F}$$

We have  $c_F < g(f_G)$ , then:

$$\frac{c_S}{g(f_G) - g(f_P) + c_F} < \frac{c_S}{g(f_G)}$$

Thus, if  $c_F < g(f_G)$  the minimal amount of human capital,  $\bar{h}$ , necessary to a family decide to invest in private basic school is lower than in the case  $c_F = g(f_G)$ .