The impact of the Expansion of the Brazilian Federal System of Professional Education and Technology on the Human Capital and Migration variables

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Resumo

A expansão do Sistema Federal de Educação Profissional e Tecnológica (FSE), entre 2000 e 2010, criou mais de 214 novos Institutos Federais. O presente estudo investigou se algumas das propostas do governo foram alcançadas e, principalmente, o impacto da criação de um Instituto Federal (IF) em nosso conjunto de variáveis de migração e de capital humano. Assim, um novo IF afeta a proporção de imigrantes de curto prazo nesses municípios, mais precisamente; houve um aumento de 2,59% na proporção de imigrantes de curto prazo nos municípios com um novo IF. Assim, este efeito foi grande, porque a proporção de imigrantes de curto prazo diminui nos municípios tratados de 33%, em 2000, para 26,4%, em 2010. Isso significa que houve aumentos na proporção de pessoas que migram que vivem a menos de cinco anos nos municípios com um novo IF e isso reforça o papel das Instituições Federais como um atrator da imigração de curto prazo. Outras contribuições importantes da expansão do FSE foi o aumento de 0,8% na proporção de imigrante de curto prazo que cursa ensino superior.

Palavra-Chave: Educação, Política Pública, Capital Humano e Migração.

Abstract

The expansion of the Brazilian Federal System of Professional Education and Technology (FSE), between 2000 and 2010, created more than 214 new Federal Institutes. This present study investigated whether some of the government's proposals were accomplished and, specially, the impact of the creation of a Federal Institute (FI) on our set of Migration and Human Capital variables. Thus, a new FI impact the proportion of short-term immigrant in these municipalities, more precisely; there was an increase of 2.59% in the proportion of short-term immigrant in the municipalities with a new FI. Thus, this effect was large, because the proportion of short-term immigrants decreases in the treated municipalities from 33%, in 2000, to 26.4%, in 2010. This means that there was increases in ratio of people whom migrate that live less than five years in the municipalities that had a new FI and this strengthens the role of FIs as an attractor of short-term immigration. Other important contributions of the expansion of the FSE were enhancing 0.8% the proportion of the short-term immigrant of college education.

Keyword: Education, Public Policy, Human Capital and Migration.

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1. Introduction

The amount of Human Capital in a region is one of the strongest predictors of sustained economic vitality. Studies of regional economies have linked higher levels of Human Capital to increases in population and employment growth, wages, income and innovation (Glaeser et al., 1995 and Florida et al., 2008). Moreover, larger amounts of Human Capital within a region have been shown to lead to more rapid reinvention and long-run economic growth (Glaeser et al., 2004; Glaeser, 2005). These empirical findings are explained by the fact that Human Capital increases individual-level productivity and idea generation (Becker, 1964). Thus, by extension, a higher level of Human Capital within a region raises regional productivity. In addition, the concentration of Human Capital within a region may facilitate knowledge spillovers, which further enhance regional productivity, fuel innovation and promote economic growth (Lucas, 1988; Romer, 1990 and Moretti, 2004).

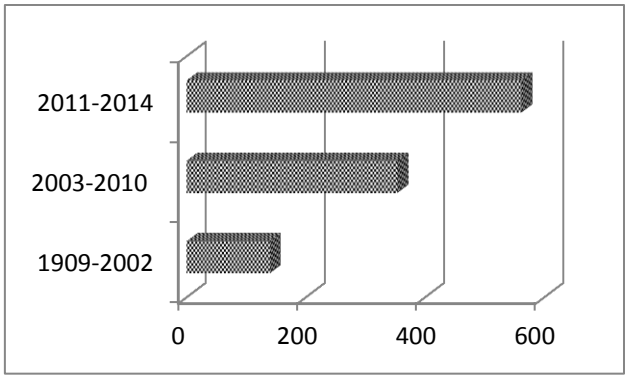
State and regional economic development agencies in the United States as well as in other nations are increasingly driven toward strategies designed to leverage the emerging knowledge-based economy of their respective regions (Drucker and Goldstein, 2007). Many of these strategies have focused on public universities as the primary public producers of knowledge. Technology transfer programs, university-industry partnerships and educational curricula tailored to match the skill demands of local knowledge-based industries provide just a few examples of such economic development programs. These university activities, along with others such as conducting basic research and serving as a regional repository of expertise, heavily influence the abilities of regions to attract and retain technology-intensive firms, to provide the regional labor force with modern knowledge skills and to respond flexibly to uncertain and rapidly changing economic circumstances (Drucker and Goldstein, 2007).

According to the IBGE, the Brazilian Institute of Geography and Statistics, in 2011, the literacy rate of the population was 90.4%, meaning that 13 million (9.6% of population) people are still illiterate in the country; functional illiteracy has reached 21.6% of the population. The illiteracy is highest in the Northeast, where 19.9% of the population is illiterate. Menezes-Filho (2001) argued that income inequality is largely the consequence of a poor existing educational distribution, both interpersonal and between groups of people with similar characteristics. So, there is a dense concentration of masses with low qualifications among afro-descent or mulattos, living in non-metropolitan areas, especially on the North and Northeast of the country.

With this concern, in the 2000s, the Brazilian Federal Government conducted a process of amplification of the Federal System of Professional Education and Technology with the aim of bringing quality vocational and collage education in the areas of the country with low levels of education. Specially, between 2003 and 2010, more than 240 new Federal Institutes (FIs) were created (BRAZIL, 2016a). As noted in Figure 1, there was an increase of over 250% in the creation of institutions with this type of vocational training. This expansion process continued in the following decade by lifting the significant number of 562 Federal Institutes and covering all of the micro regions in the country (BRAZIL, 2016a).

The institutional mission of the Federal Institutes (BRAZIL, 2016a) must, as regards the relationship between training and work, be guided by the following objectives: offering vocational and technological education, as an educational and research process in all levels

and modalities; guide the provision of courses in line with the consolidation and strengthening of the Local Production Arrangements (LPAs); stimulate applied research, cultural production, entrepreneurship and cooperatives, supporting the educational processes leading to the generation of jobs and income, as well as promoting the retention of skilled labors and attracting qualified workforce to the region. Half of the vacancies shall be set aside for the provision of technical courses of high school level, in particular integrated curriculum courses (BRAZIL, 2016a).



Note: Data are from the Ministry of Education and the Federal Institutes.

Figure 1 – Evolution the Federal System of Professional Education and Technology (1909-2015)

The first studies of the economic impact of universities began to appear in the 1980's in the United States, Canada and, more occasionally, Europe (for example, Ciriaci and Muscio, 2010; Monsalvez, Peraita and Pérez, 2015). They all present a common approach, based on one central idea: since the everyday activities of universities have positive effects on the local economy, they attempt to quantify the impacts of teaching and research activities on the variables traditionally used to measure the regional economic development (Drucker and Golstein, 2007). As well as the impacts attributable to universities' current spending on staff and infrastructures, studies of the effects of universities on economic development have focused on the following types of impacts: knowledge creation, creation of human capital, transfer of existing technical knowledge, technological innovation, capital investment, leadership, creation of infrastructures for the production of knowledge – Human Capital– and, finally, influence on the economy (Monsalvez, Peraita and Pérez, 2015).

In large part, the impact-study framework is limited by information availability in providing quantitative estimates for the range of regional economic effects. Most case studies estimate the direct and indirect impacts of university spending, investment, and employment in a region through growth accounting, regional input-output modeling, estimation of Keynesian multipliers, or occasionally a broader economic forecasting model (Candell and Jaffe, 1999). For example, Harris's (1997) analysis of the University of Portsmouth finds an employment multiplier between 1.55 and 1.79 and an output multiplier of 1.24 to 1.73, and Glasson (2003) estimates an output multiplier of 0.70 to 1.12 for Sunderland University. Felsenstein (1996) uses an econometric model based on input-output relationships to estimate that Northwestern University added more than 10,000 jobs (an employment multiplier of 1.55) and half a billion dollars in output to the Chicago region in 1993.

In Brazil, Kureski and Rolim (2009) showed that Brazilian Federal Universities have employment multiplier of 3.15 and income multiplier of 1.94. Otherwise, promising

quantitative frameworks such as benefit-cost analysis or calculation of return on investment to public expenditures are often unworkable in practice because of the lack of appropriate data or the impossibility of attributing impacts to particular universities or programs (Bessette, 2003).

On the other hand, there have been numerous attempts made to assess the impacts of the activities undertaken by institutions of higher education. The approaches and methodologies have varied widely, and have produced a wide range of estimates regarding the impacts of universities on their regional economies. The education is the most easily measured form of the Human Capital (Faggian and Mccann, 2009). Universities have come under increasing pressure to become key drivers of economic development in the age of the knowledge economy (European Commission, 2010). While the importance of education has long been recognized over recent decades, individuals, governments and international organizations have become increasingly aware of the importance of college education to the performance of the economy (OECD, 2006). Research on regional impacts indicates that universities contribute to their host regions in several ways: directly impacting the economy (Armstrong, 1993), upgrading the quality of local economies and political systems (Benneworth et al., 2010), and contributing to knowledge creation and transfer (Faggian and Mccann, 2009; Power and Lundmark, 2004; Breschi and Lissoni, 2003) and to human capital accumulation (Lucas, 1988 and Faggian and Mccann, 2009).

However, some researchers also have focused on quantifying outputs rather than attempting to translate them into economic variables (Drucker and Goldstein, 2007). Examples include counting spin-off firms (Adams, 1991), assessing the number and quality of university-industry linkages (Jones-Evans et al. 1999; Rip 2002; Walshok et al. 2002), and measuring technology transfer outcomes such as patents and licensing agreements and income (Azzone and Maccarrone, 1997 and Glasson, 2003). Candell and Jaffe (1999) use patent citations as a proxy for approximating the sectoral distribution of technology innovations arising from public research that encourage further private-sector spending on applied research and product development.

While the pathways through which these higher education activities can act to raise local Human Capital levels are clear, systematic empirical evidence documenting the existence and magnitude of such relationships is scarce. State governments are an important source of established higher education institutions and much of the existing literature has attempted to examine the relationship between the production of degrees and stock of college graduates, hence, from that perspective, most of those exercises were focusing in the return on the government investment (Bound et al., 2004; Groen, 2004).

As evidenced by Liu (2015), the presence of universities can lead to two types of local spillovers: direct local spillovers from research and education activity and indirect spillovers – general agglomeration economies – from a larger population that universities bring to the area. Direct spillovers can happen through two possible mechanisms, direct interaction between faculty and local business establishments and training of students – attraction of skilled workers – who remain in the area and enhance the quality of the labor pool.

Regarding immigration, Machin, Salvanes and Pelkonen (2012) show that one year of education increases the annual mobility rates by 15 percent. The extent to which universities perform as talent magnets depends, in turn and ceteris paribus, on their quality and on its effect on the decisions of students and graduates to migrate (Niedomysl, 2006). A student may decide to migrate to study in search of a better university and after graduation, the quality of the university from where he graduated will act as a signal to firms (Spence, 1973)

and it will influence his decision on where to live (Ciriaci and Muscio, 2010). To the extent that the decision of individuals about where to study and to work is influenced by the supply (and quality) of local universities, these institutions contribute to the process of regional Human Capital accumulation (Mixon and Hsing, 1994). Knowledge ultimately rests within individuals (Boschma et al., 2009); however, universities contribute to regional growth, competitiveness (Lucas, 1988) and structural change (Boschma et al., 2009).

Drucker and Goldstein (2007) highlights that public investments naturally generate questions concerning the magnitude and distribution of their impacts as well as their effectiveness in achieving desired objectives. Finally, the notion of a university influence on regional milieu encompasses the range of distinctive contributions that universities deliver to their surrounding areas, be they intellectual, social, cultural, or recreational, by attracting a concentration of highly educated and creative professionals and establishing a particular locational dynamic (Luger and Goldstein 1997). These effects are usually imparted unintentionally as a side product of university presence and activity, with such externalities often valued highly by residents, businesses, and other regional stakeholders. Nevertheless, negative externalities may also arise, such as labor-cost increases that may accompany growth in university employment.

According to the best of our knowledge, there is no study of impact of the expansion of the Federal Technological System of Education in Brazil. Specifically, using a Differences-in-Differences identification strategy and the country´s census data, we simulated an experiment to find a causal relationship between the expansion of the Federal Technological System of Education – the creation of 165 new Federal Institutions – and our set of dependent variables of Human Capital and Migration. This set of variables includes thirteen Human Capital and Migration variables that possibly may be affected by the expansion of the Federal System of Technological Education. Ours results imply that just two variables were impacted by the expansion of the Federal System: the short-term immigrant and the immigrant of college education – student of higher education that is also short-term immigrant. Therefore, the outcomes show that those municipalities that had a new Federal Institute demonstrate an increase in the proportion of short-term immigrant of 2.59% and a growth of 0.8% of the ratio of short-term immigrant of college education. The results are robust to the consideration of different control groups and forms of the model misspecification.

The paper is organized as follow: section 2 presents the institutional background of the Federal System of Professional Education and Technology; section 3 describes the identification strategy and methodological aspects of the work; section 4 presents the data and descriptive statistics; section 5 describes the results; section 6 shows the falsification and robustness tests, and section 7 presents the discussion and final considerations.

2. The Brazilian Federal System of Professional and Technology Education and its Recent Expansion

From the year 2003, the Lula government initiated actions toward the democratization of the offer of vocational education in the nation, through a plan for expansion of the Federal System of Professional and Technological Education (BRAZIL, 2015). The first stage of the plan, 2003 to 2007, included the building of 64 new teaching units in order to add to the 140 which already existed. Soon afterwards, the Ministry of Education began the second stage, 2008 through 2010, expanded to more than 150 news schools and totaling 354 new institutions between 2002 and 2010. Specially, between 2003 and 2010, more than 240 new

Federal Institutes (FIs) were created (BRAZIL, 2015). As Figure 1 highlighted, there was an increase of over 250% in the creation of institutions with this type of vocational training.

Figure 2a shows how the distribution of the Federal Education System was in 2000. There was little national coverage, with most of the FIs spread over the Brazilian coastal areas. There were also a few schools in the rural inland, mainly in the North and Midwest. The expansion process that happened in the 2000s – Figure 2b – shows an internalization of the Federal Education System. Unlike the previous figure, the new map of the Federal System shows that there was an increase into the interior of Brazil. All Brazilian micro regions include at least one Federal Institute.

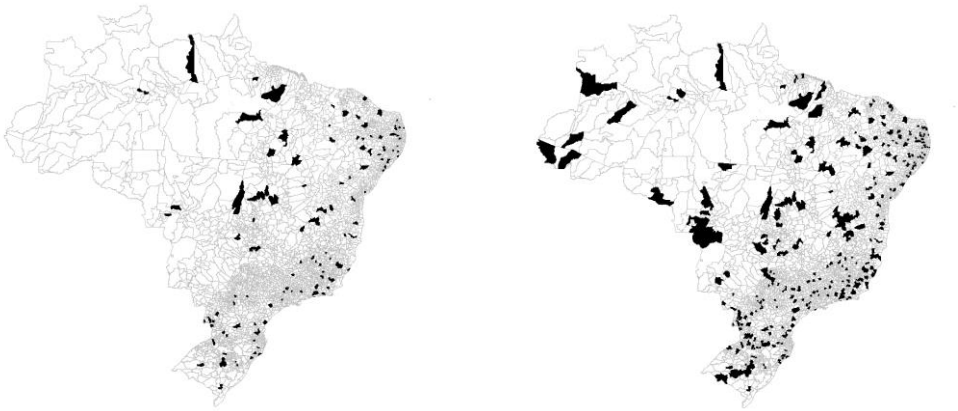


Figure 2a – 2000 Figure 2b – 2010

Figure 2 – Expansion the Federal System of Professional Education and Technology in the Brazilian Municipalities

The criteria established by the Ministry of Education regarding the expansion of the Federal Technological System of Education satisfy three dimensions: social, geographical and development (BRAZIL, 2008). As regards to the social dimension, It should be emphasized that the universalization of the services of the Territories of Citizenship (Territórios da Cidadania), a Federal Government program, launched in 2008, whose goal is to promote economic development and universalize basic citizenship programs; as well as the attendance to the populous and low per capita revenue municipalities, members of the G100, group of 100 Brazilian cities with per capita revenue of less than R$ 1000 and with more than 80.000 inhabitants; and also must prioritize the municipalities with high percent of extreme poverty. Regarding the geographical dimension, priority assistance is for municipalities with more than 50.000 inhabitants or micro regions not covered by any Federal School (Federal Institute or Federal University). Finally, with regard to the development dimension, the new campuses should be in the municipalities with well-known LPA's (Local Productive Arrangements) and the vocational training must be integrated with large industrial investments (BRAZIL, 2016a).

Between 2011 and 2014, the MEC has invested more than R$ 3.3 billion in the expansion of professional education (BRAZIL, 2016a). Of the 208 new units for the period, all went into operation, with a total of 562 schools in activity. Currently, there are 38 Federal Institutes present in all states, offering qualification courses, high school integration, vocational classes, bachelor´s degrees and also postgraduate program.

3. Empirical Strategy

We are interested in measuring the causal impact of the expansion process of the new Federal Institute for Technological Education on the Human Capital and the Migration variables more likely to be impacted by the building of a new FI. Regarding Human Capital, we will analyze the effect of the expansion of the Federal System on the proportion of the students enrolled in high school, measured by the ratio between the people attending high school and the people within school age, 15 to 18 years old. The second variable is the people attending college education and it is measured by the ratio between the people attending college education and the people within college age, 18 to 25 years old. We will also study the effect on the proportion of the graduates of high school and college education in each municipality.

We will similarly verify if there were changes in the proportion of professions that are possibly more affected by new FIs as Agricultural Sciences, Biological Sciences and Technological Sciences – including engineering – degree programs, which are formed by a percentage of the employed labor force in the respective areas. We will also consider the sum of these variables above, which we denote by skilled labor, and we will identify if there was any change in the qualified work force and we will finally consider if there has been any effect on the stock of years of study in these municipalities.

Regarding immigration, we will analyze the profile of the short-term immigrants due to a construction of a new Federal Institute. This is significant, because the FI could attract people from other municipalities or regions seeking a study opportunity. And as this process of expansion is recent, the majority of immigrants that possibly could be affected by a Federal Institute must live less than five years in the municipality, hence, they are considered short-term immigrants. Thus, the first variable of migration is the short-term immigrant, that is, a ratio between short-term immigrant, people who lived less than five years in that municipality, and immigrant.

We will also analyze the impact on the skilled short-term immigrant labor force, for this, we will consider the amount of short-term immigrant workers in the specific graduation areas we used before – Agricultural Sciences, Biological Sciences and Technological Sciences – divided by the total number of the short-term immigrants in the employed labor force in each municipality. We also will analyze the effect of the expansion of the Federal System on the proportion of short-term immigrant students enrolled in high school; and the proportion of short-term immigrant scholars attending college education. The people attending high school or college education measure both proportions and they were short-term immigrants divided by the people within high school age, 15 to 18 years old, and college age, 18-25 years old, respectively.

Thus, the ideal method would be to compare our dependent variables of the municipalities that experienced the implementation of a new FI to what the dependent variables of the same units would have been if the creation of a new FI did not occur. However, it is impossible to get such counterfactuals. So we use a quasi-experiment approach and consider the Difference-in-Differences estimator (DiD). This estimator seeks to compare the change in the outcome of the treated group (municipalities that experienced a creation of a new Federal Institute) before and after the intervention with the change in the outcome of the

control group (municipalities that did not experienced a building of a new Federal Institute), in the same two periods[1] – 2000 and 2010.

The DiD estimator seeks to compare the change in the outcome of the treated group (municipalities that had a new Federal Institute) before and after the intervention with the change in the outcome of the control group (municipalities that did not have a new FI), in the same two periods. The change of outcome in the control group is an estimate of the true counterfactual, i.e., what would occur with the treatment group if there were no intervention – in this case, the creation of a new Federal Institute. For this purpose, a common trend is necessary in the trajectory of the outcome variable for both the untreated and treated municipalities (Angrist and Pischke, 2008). This is the key identification assumption of DiD and is known as the common trend assumption. An appropriate way to obtain an estimate is the following Difference-in-Differences regression with two periods and two groups as:

$$Y_{it} = \theta + \gamma FI_i + \lambda d_t + \beta FI_i * d_t + \delta x_{it} + \theta_i + \varepsilon_{it} \quad (1)$$

The FI_i is a dummy variable that assumes 1 if municipality "i" has received a new Federal Institute, and 0 otherwise, θ_i is a geographic fixed effect that depending on the specification of the regression, can be state fixed effect, micro region fixed effect or both, d_t is a time dummy that assumes 1 in the post-intervention period and 0 in pre-intervention, x_{it} is a vector of time-varying controls and ε_{it} is the error term. The parameter γ measures the initial difference in our dependent variables between the municipalities that have new Federal Institutes and those that have not; the parameter λ measures the impact of time on the untreated group of municipalities and β it is the parameter of interest, which measures the ATT, the average effect on the treated sample.

There are some advantages in using a DiD model with two periods and two groups instead of using a multi-period DiD. Beatty and Shimshack (2011) highlight that this kind of model provides a more transparent econometric analysis, and the common trend assumption can be tested in a more clear and direct way. Furthermore, as equation (1) is a saturated model, it is not necessary to impose any linearity hypothesis (Angrist and Pischke, 2008). Given these advantages and because of the impossibilities of constructing a panel with multiple time periods or including a relevant set of time-varying controls, we decided to use a DiD with two groups and two periods, since most of the control and the dependent variables do not have an annual basis.

Nevertheless, there are some caveats that we should be aware. For example, prior to the expansion of the Federal System that had occurred in the 2000s, other municipalities had FIs; hence, as they are older, it is likely to have received a greater sum of government resources. Thus, it is important to take this issue in consideration, because our set of dependent variables might be affected by the FI that had before and as our goal is to evaluate the expansion of the Federal System, we dropped those municipalities from the sample. Therefore, municipalities that had Federal Institutes before the 2000s were removed from the sample. Later, we will reinclude them in the sample for the robustness check.

Another concern is that, jointly with the expansion of the Federal Technological System of Education, there has also been an expansion in the number of Federal Universities in the period, by REUNI, Support Program for the Restructuring and Expansion of Federal

[1] These specific years were chosen based on data availability. A large part of the variables are only available in census years (every ten years).

Universities (BRAZIL, 2015). This expansion began in 2003 with the integration of rural areas into professional and college education. Hence, the number of municipalities covered by the universities rose from 114 in 2003 to 237 by the end of 2011 (BRAZIL, 2015). Since the beginning of the expansion, 14 new universities were created and more than 100 new campuses endorsed the creation of new vacancies and new degree courses. Thus, in order to eliminate the effect of this expansion on our results, the municipalities that had the creation of a new Federal Universities, between 2000 and 2010, were also removed from the sample.

It's also important to highlight that there was an expansion in the vocational training in the States High Schools via the Initiative of National Program of Access to Technical Education and Employment (PRONATEC) (BRAZIL, 2016b). This Program seeks to strengthen high school vocational training in State Systems of Education and it was launched in 2007. The PRONATEC works in the development of actions aimed the expansion and the modernization of schools in the State Systems of Vocational and Technological Education, in order to expand and increase the provision of technical courses at the secondary level. From 2007 until January 2016, the program has met vocational training institutions from 24 states.

We also have to point out that, in addition to these aforementioned factors, there was also an expansion of private higher education in the country in the 2000s. The Prouni aims to grant full and partial scholarships to undergraduates in private higher education establishments. The Federal Government also created other programs such as FIES (Student Financing Fund) which enables the partial scholarship fund up to 100% of tuition not covered by the program grant. The Prouni added to FIES; the Unified Selection System (SISU), the Support Program for the Restructuring and Expansion of Federal Universities (REUNI), the Open University of Brazil (UAB) and the expansion of the Federal System of Professional Education and Technology significantly expanded the access to higher education, contributing to greater youth access to college education in the country. And this is really important, since we are working with variables that affect Human Capital, these government programs may also have impacted our treatment variables and we should be aware about it. Thus, we will take a series of robust and falsification tests intended to verify it the outcomes found, in fact, resulted from the expansion of the Federal System or from some other governmental programs.

Although the municipality does not have full control over the process of the creation of a new Federal Institute (BRAZIL, 2015) – it is conducted by the Federal Government – the process is far from being assigned randomly. A common concern in DiD analysis is the possible existence of time-varying, confounding factors, here meaning variables that are simultaneously explaining the process of the expansion of the Federal System Education and the trajectory of our dependent variables. In such a case, the endogeneity problem comes into play, and the coefficients cannot be interpreted causally (Angrist and Pischke, 2008).

For this reason, we added a number of controls in equation (1); based on what was discussed in the previous section and that could generate selection bias. These controls belong to two different kinds of potential influence: Socioeconomics (per capita income, Gini coefficient, economically active population, metropolitan area, urbanization rate and manufacturing workers), and Demographics (people with age 25 years or more and a higher education, population density, immigrant, unemployment, elderly population, male, afro-descent, foreigner, young population and households with waste collection, electric power and water and bathroom facilities fully completed).

In addition, we built a series of robustness tests to ensure that there is no relationship between treatment status and the error term of the regression. First, we are working with

MCAs[2], Minimum Comparable Areas, due to several secessions had occurred in Brazil (Lima and Silveira-Neto, 2015). Nonetheless, it can happen that a city that had a new FI, but the other cities, that composed the MCA, did not have a new Federal Institute. Thus, we will consider only municipalities that all cities have a new FI, in other words, the MCA had 100% of its territory covered by a new FI. The goal at this point is to verify if there is any variation in the results when we consider that municipalities are fully met by the Federal System.

Second, it may happen that the Federal Universities, even the oldest ones, which was not withdrawn from the sample, can affect our dependent variables, and so, we eliminate all municipalities containing any Federal Universities. Third, we will test if there is any effect on our dependent variables when considering the possibility of having a Federal University in the its micro region, so we included a dummy, which it equals one if in a certain micro region there is a Federal University and zero, otherwise.

Next, we reinclude all municipalities that were dropped from the sample – if they had FI prior the expansion of the Federal System or they had a new Federal Universities building in the 2000s, The goal of this point is to verify if, even we include these municipalities in the sample, the final results were still statistically significant. Finally, we use the Propensity Score Matching with the DiD strategy, because it compares municipalities with more similar characteristics. As argued by Ho et al. (2006), when done it properly, the matching before the estimation can reduce model dependence and variance, lower mean square error, and also generate less potential for bias.

4. Data and Descriptive Statistics

With the purpose of analyze the effect of the expansion of the Federal System of Education, that had occurred in the 2000´s, on our set of Human Capital and Immigration variables, through a two-group and two-period Difference-in-Differences model (equation (1)), we built a panel data containing the pre-expansion period (2000) and the post-expansion period (2010). We used data from 4,154 municipalities, of which 165 (3.97%) had a new Federal Institute built. It is important to highlight that for our analysis, it does no matter how many FIs there are in the municipality, provided that at least one Federal Institute exists, it will be considered as treated.

As discussed in the previous section, to reduce concerns about endogeneity, we included two sets of time-varying controls variables. The first set of controls corresponds to the Socioeconomics variables of the municipalities: per capita income, the Gini coefficient to measure income inequality, the economically active population (proportion), the metropolitan area (if the municipality is within a metropolitan area), the urbanization rate (ratio of population living in urban areas and total population) and the manufacturing workers (proportion of population that works in industry). The second set of controls corresponds to the Demographics variables: the population density (population within area), the immigrant

[2] As common when studying regional growth in Brazil utilizing as observation unit the Minimum Comparable Areas (MCAs), because these are areas have constant borders over time (Lima and Silveira-Neto, 2015 and Reis et al., 2008). This is important because in Brazil there were several secessions of municipalities since 1991 and we will use the MCAs as a geographical unit comparison in our exercise. From now on, we will use the term municipalities as a synonym for MCAs.

proportion (ratio of immigrant population), the unemployment rate (ratio of unemployed population and economically active population), the proportion of people with age 25 years or more and a higher education, the elderly population (proportion of population over 65 years old), male (proportion of male population), afro-descent (proportion of ethnic afro-descent population), foreigner (proportion of foreign population), young people (proportion of young people population), the waste collection (proportion of households with waste collection), the electric power (proportion of households with electric power), the water and bathroom facilities fully completed (proportion of households with water and bathroom facilities fully completed).

All these sets of variables were constructed using data from the Brazilian Demographic Census obtained by the IBGE. The set of independent variables includes the main socioeconomic and demographic characteristics of municipalities and reflects their potential attributes and attractiveness. These variables are important because they have a potential impact on the program's response variables.

The first set of controls shows the socioeconomics characteristics of municipalities, for example, greater per capita income and less inequality, could affect the decision of an individual to migrate and also indicates the capacity of the municipality has to keep these individuals in town. The demographic features of the cities display the main characteristics of cities in relation to its population and play a key role in our Human Capital and Migration variables.

Table 1 presents descriptive statistics for treated and untreated subsamples in the pre-intervention period and post-intervention period. Additionally, mean difference statistics are reported.

Some numbers of Table 1 should be highlighted. First, there are significant differences between the characteristics of the two groups of municipalities (treated, municipality that had received a new FI and not-treated, municipality that had not received a new FI), a natural consequence of the nonrandomness of the treatment. First of all, it is important to emphasize that this is not an accurate portrayal of the Brazilian reality, since many municipalities were removed from the sample, as stated before.

For both post and pre-treatment period, the treated subgroup has the highest rate of people attending and graduates in both high school and college education. They also had higher percentage of people with degrees on Agricultural Sciences, Biological Sciences and Technological Sciences. In addition, they had a higher number of skilled labor and years of study. On the other hand, the non-treated group had a higher rate of short-term immigrants and a skilled labor short-term immigrant. All other migration dependent variables are greater on the treated municipalities.

Table 1 – Summary Statistics for Pretreatment and Posttreatment Period

	Pretreatment Period (2000)			PostTreatment Period (2010)		
Variable	Not Treated	Treated	Mean Difference	Not Treated	Treated	Mean Difference
High School Students (%)	0.406	0.462	-0.056***	0.562	0.607	-0.045***
	(0.175)	(0.152)		(0.115)	(0.0815)	
College Students (%)	0.0565	0.0799	-0.0234***	0.143	0.189	-0.046***
	(0.0501)	(0.0593)		(0.0753)	(0.0814)	
Complete High School (%)	0.548	0.628	-0.08***	0.654	0.705	-0.051***
	(0.236)	(0.201)		(0.143)	(0.107)	
Complete College (%)	0.0663	0.0988	-0.0325***	0.184	0.251	-0.067***
	(0.0592)	(0.0704)		(0.0965)	(0.108)	
Agricultural Sciences Graduation (%)	0.000531	0.000706	-0.000175***	0.00184	0.00234	-0.0005*
	(0.000818)	(0.000739)		(0.00226)	(0.00218)	
Biological Sciences Graduation (%)	0.000179	0.000325	-0.000146***	0.00122	0.00158	-0.00036***
	(0.000412)	(0.000408)		(0.00150)	(0.00149)	
Technological Sciences Graduation (%)	0.000558	0.00115	-0.000592***	0.00119	0.00256	-0.00137***
	(0.00105)	(0.00139)		(0.00229)	(0.00291)	
Skilled Labor (%)	0.00127	0.00218	-0.00091***	0.00426	0.00648	-0.00222***
	(0.00170)	(0.00208)		(0.00402)	(0.00443)	
Years of Study	8.389	8.663	-0.274**	9.450	9.593	-0.1431*
	(1.714)	(1.500)		(1.081)	(0.818)	
Short-Term Immigrants (%)	0.353	0.330	0.023***	0.259	0.264	-0.005
	(0.0857)	(0.0837)		(0.103)	(0.0772)	
Skilled Labor Short-Term Immigrants (%)	0.00261	0.00482	-0.00221***	0.00369	0.00697	-0.00328***
	(0.00466)	(0.00458)		(0.00554)	(0.00537)	
Short-Term Immigrant High School (%)	0.0272	0.0359	-0.0087***	0.0270	0.0363	-0.0093***
	(0.0182)	(0.0134)		(0.0188)	(0.0147)	
Short-Term Immigrant College Education (%)	0.00667	0.0122	-0.00553***	0.0131	0.0299	-0.0168***
	(0.00956)	(0.0109)		(0.0147)	(0.0218)	
Per Capita Income (R$)	340.3	450.3	-110***	486.8	614.8	-128***
	(189.8)	(212.2)		(232.4)	(252.5)	
Gini Coefficient	0.546	0.570	-0.024***	0.490	0.525	-0.035***
	(0.0641)	(0.0496)		(0.0632)	(0.0551)	
Industry Workers (%)	0.0631	0.0788	-0.0157***	0.0801	0.0905	-0.0104**
	(0.0457)	(0.0421)		(0.0546)	(0.0456)	
Economically Active Population (%)	0.390	0.405	-0.015***	0.437	0.454	-0.017***
	(0.0671)	(0.0594)		(0.0792)	(0.0667)	
Urbanization (%)	0.608	0.769	-0.161***	0.654	0.798	-0.144***
	(0.215)	(0.192)		(0.201)	(0.172)	
Metropolitan Region (0 or 1)	0.0710	0.100	-0.029	0.120	0.176	-0.056**
	(0.257)	(0.301)		(0.325)	(0.382)	
Population Density (Population/Area)	0.105	0.112	-0.007	0.0955	0.0927	0.0028
	(0.311)	(0.302)		(0.275)	(0.233)	
Immigrant (%)	0.312	0.365	-0.053***	0.340	0.374	-0.034***
	(0.156)	(0.153)		(0.155)	(0.144)	
Pop. with more than 25 Years old and Higher Education (%)	0.0244	0.0421	-0.0177***	0.0542	0.0824	-0.0282***
	(0.0227)	(0.0305)		(0.0299)	(0.0379)	
Unemployment (%)	0.106	0.133	-0.027***	0.0643	0.0726	-0.0083**
	(0.0557)	(0.0450)		(0.0353)	(0.0256)	
Elderly Population (%)	0.0667	0.0556	.0111***	0.0861	0.0705	.0155***
	(0.0179)	(0.0166)		(0.0226)	(0.0200)	
Male (%)	0.507	0.499	0.008***	0.504	0.496	0.008***
	(0.0127)	(0.0125)		(0.0145)	(0.0122)	
Afro-Descent (%)	0.0586	0.0596	-0.001	0.0644	0.0726	-0.0082**
	(0.0473)	(0.0370)		(0.0501)	(0.0476)	
Foreigner (%)	0.00123	0.00179	-0.00056**	0.00109	0.00172	-0.00063**
	(0.00322)	(0.00313)		(0.00368)	(0.00362)	
Young People (%)	0.130	0.137	-0.007***	0.120	0.126	-0.006***
	(0.0123)	(0.0103)		(0.0135)	(0.0103)	
Waste Collection (%)	0.823	0.845	-0.022	0.948	0.952	-0.004
	(0.217)	(0.192)		(0.0955)	(0.0700)	
Electric Power (%)	0.879	0.904	-0.025**	0.975	0.977	-0.002
	(0.155)	(0.132)		(0.0520)	(0.0437)	
Water and Bathroom Facilities Fully Completed (%)	0.651	0.699	-0.048**	0.819	0.828	-0.009
	(0.299)	(0.277)		(0.207)	(0.194)	
Observations	3,984	170		3,891	165	

Note: SD corresponds to the standard deviation. The t-values are in parentheses; *** p<0.01, ** p <0.05, * p <0.1. Brazil's currency is the Real (R$). Over the study period of this paper, the exchange rate with the dollar fluctuated in an interval between approximately R$ 1.9 and R$ 3.65 US$, with a rough average of R$ 2.69 US$.

In the pre-treatment period, municipalities that were treated had a larger per capita income, urbanization rate, immigration, unemployment rate, similar proportion of men, afro-

descent population, foreigners and young people, a higher population with more than 25 years of age and higher education among their inhabitants, higher level of economically active population, income inequality and elderly population than non-treated group. This grouping likewise had more households with waste collection, electric power and water and bathroom facilities fully completed. Most of non-treated municipalities were in metropolitan area. In the post-treatment period these relations keep the same. Municipalities that were treated had a larger per capita income, similar urbanization rate, higher immigrants, higher unemployment rate, elderly population, similar proportion of men, afro-descent population, foreigners and young people, a higher population with more than 25 years of age and higher education among their inhabitants, higher level of economically active population and a higher level of income inequality. They also had more households with waste collection, electric power and water and bathroom facilities fully completed.

As the Table 1 makes clear, Brazil has evolved considerably in many aspects during the decade of 2000. In this way, there is an improvement of people attending higher education, higher proportion of people with college education, as well as, there was an increase in labor-skilled workers and years of study. Not simply that, Brazil became a richer country, older, with more workers in the industry, with lower unemployment and inequality.

5. Results

As argued in the initial section, it is likely that the process of expansion of the Federal System in Brazil, by creating new Federal Institutes (treated group) compared to the municipalities that did not receive a new FI (not treated group), affects our set of dependent variables. In this section, we will test this hypothesis. The question will be answered in parts. In subsection 5.1, we will investigate if the expansion of the Federal Technological System of Education indeed generates an impact on Human Capital variables, and in subsection 5.2 we check if that expansion affects Migration variables. This section shows benchmark results for equation (1). To facilitate the interpretation of the parameters, all variables are in logarithmic format.

5.1 Human Capital Variables

One of the main targets of the expansion of the Federal System is to increase the number of people who attend higher education (BRAZIL, 2008). But, as there is also an addition in the number of vacancies for high school, we also expect that the proportion of people attending high school or college education might be affected by this program. So, the first variable are the proportion of students enrolled in high school, measured by the proportion of people attending high school and people within school age, 15 to 18 years old. The college education is measured by the proportion of people attending higher education and people within college age, 18 to 25 years old. Table 2 presents the results.

As shown in Table 2, there is no impact on the attendance of high school pupils. In column (1), there are only municipality features and there was no impact due to the expansion of the Federal System in the proportion of people attending high school, because the outcome is not statistically significant. When we add state fixed effect, column (2), and micro region fixed effect, column (3), the effect of the Federal System in the proportion of people attending high school changed the signal, now are positive, but still not statistically significant. That is an indication that the expansion of the Federal System does not impact the high school attendance.

Differently from the results we had found before for high school presence, the ATT is a significant and positive effect on the attendance of higher education scholars. The column (4) shown that the impact of the expansion of the Federal System in the proportion of people attending college education is positive and statistically significant at 1% and has an effect of 1.01% if we just considered the characteristics of the municipality. When we add the state fixed effect, column (5), the outcome keeps positive and statistically significant. The same occurs when we add micro regional fixed effects, there was a decrease in the ATT measured, but it is still positive and statistically significant at 1% and suggests there is an increase in people attending higher education with approximate ATT of 0.89%, compared to municipalities that did not have a new Federal Institute. That is, a municipality that had a new FI had an increment of 0.89% in the proportion of students attending higher education. Nevertheless, this effect is small. In 2000 the ratio of students attending higher education was 7.99% and in 2010 was 18.9%, i.e., the proportion of people attending college education more than doubled. And this indicates that a new FI has a very small effect, 0.89%, in this Human Capital variable.

Table 2 – Effects of the Expansion of the Federal System of Professional Education and Technology: Individuals Attending High School and College

	High School Students	High School Students	High School Students	College Students	College Students	College Students
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.1052*	0.1668***	0.2244***	0.3657***	0.2994***	0.3182***
	(0.0542)	(0.0615)	(0.0645)	(0.0254)	(0.0270)	(0.0294)
Year	0.0609***	0.0592***	0.0548***	0.0321***	0.0290***	0.0331***
	(0.0025)	(0.0028)	(0.0033)	(0.0012)	(0.0014)	(0.0016)
Federal System	0.0137***	0.0104**	0.0103**	0.0025	-0.0021	-0.0008
	(0.0051)	(0.0048)	(0.0045)	(0.0028)	(0.0025)	(0.0022)
Federal System * Year	-0.0031	0.0004	0.0003	0.0101***	0.0097***	0.0089***
	(0.0057)	(0.0053)	(0.0054)	(0.0031)	(0.0031)	(0.0031)
Municipalities Features	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	Yes	Yes	No	Yes	Yes
Micro Region Fixed Effects	No	No	Yes	No	No	Yes
Adjusted R^2	0.5821	0.6420	0.7083	0.7522	0.7812	0.8276
Observations	8,209	8,209	8,209	8,209	8,209	8,209

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. In all estimation there were a relevant set of time-varying controls: Socioeconomics variables of the municipalities: per capita income, Gini coefficient, economically active population, metropolitan area, urbanization rate and manufacturing workers; and Demographics variables: people with age 25 years or more and a higher education, population density, immigrant, unemployment, elderly population, male, afro-descent, foreigner, young population, households with waste collection, electric power and water and bathroom facilities fully completed.

The following step is to focus on the accumulation of the Human Capital. We will verify if there is an impact on the proportion of the people that concluded high school or college education and both variables are the number of graduates at each level of education divide by the population of each municipality and Table 3 displays the results. It follows that if a certain percentage of these graduates stay in the region of origin after graduation, its stock of Human Capital would increase (VIDAL, 1998 and BEINE et al., 2001).

Table 3 – Effects of the Expansion of the Federal System of Professional Education and Technology: Accumulation of the Human Capital

	Complete High School	Complete High School	Complete High School	Complete College Education	Complete College Education	Complete College Education
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.2528***	0.0067	0.0557	0.4622***	0.3769***	0.3908***
	(0.0651)	(0.0808)	(0.0838)	(0.0301)	(0.0319)	(0.0346)
Year	0.0158***	0.0110***	0.0039	0.0470***	0.0430***	0.0467***
	(0.0031)	(0.0035)	(0.0042)	(0.0013)	(0.0015)	(0.0019)
Federal System	0.0229***	0.0177***	0.0167***	0.0049*	-0.0006	0.0002
	(0.0061)	(0.0058)	(0.0054)	(0.0027)	(0.0023)	(0.0022)
Federal System*Year	-0.0087	-0.0039	-0.0029	0.0135***	0.0129***	0.0119***
	(0.0073)	(0.0067)	(0.0069)	(0.0033)	(0.0032)	(0.0033)
Municipalities Features	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	Yes	Yes	No	Yes	Yes
Micro Region Fixed Effects	No	No	Yes	No	No	Yes
Adjusted R^2	0.4882	0.5635	0.6400	0.7884	0.8147	0.8514
Observations	0.4866	0.5626	0.6396	0.7881	0.8129	0.8509

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. For more information about the time-varying controls, see Table 2.

Table 3 shows there is no impact on the proportion of people with a high school degree. All the outcomes are negative and not statistically significant, what indicates no effect on the ratio of people that completed high school. On the other hand, there is an effect on the proportion of people who are trained in college education. The variable that measures the impact reveals that the municipalities that experienced an implementation of a new FI increased their proportion of people with higher education about 1.35% compared to the ones that did not if we consider only the characteristics of cities, column (4). When we add the state fixed effect column (5), and the micro region fixed effect column (6), the result keeps statistically significant at 1% with impact of 1.19%, for the last situation. The outcomes found in Table (3) are consistent with the outcomes found in the previous Table. And, again, this effect is very modest. Initially, the proportion of people with higher education was 9.88% and, in 2010, it was 25.1%. And the outcome shows that a new FI has a very small impact, 1.19%, in the proportion of people with college degree.

The Federal Education System aims to vocational training (BRAZIL, 2016a) in areas such as Agricultural Sciences, Biological Sciences and Technological Sciences – including engineering – degree programs, which are formed by the proportion of the labor force employed in these respectively areas, that is, the proportion of people trained and employed in these areas divided by the number of people who are employed. We test the effect of the creation of a new FI in the proportion of graduates in these fields. We also estimate the effect on our last two Human Capital variables possibly impacted by the creation of the new FIs: qualified work force - is the sum of the three bachelor degrees we had used on previous columns – agricultural, technology and biological sciences – and years of study. The results are shown in the Table 4 and, to facilitate the interpretation, we will just consider the estimations with features of the municipality and state and micro region fixed effects.

Table 4 – Effects of the Expansion of the Federal System of Professional Education and Technology: The Proportion of Graduates, Qualified Work Force and Year of Study

	Agricultural Sciences Graduation	Biological Sciences Graduation	Technological Sciences Graduation	Qualified Work Force	Years of Study
	(1)	(2)	(3)	(4)	(5)
Intercept	-0.0029**	-0.0007	0.0025**	-0.0011	1.8537***
	(0.0012)	(0.0009)	(0.0011)	(0.0016)	(0.0734)
Year	0.0008***	0.0006***	-0.0005***	0.0008***	0.0367***
	(0.0001)	(0.0000)	(0.0001)	(0.0001)	(0.0041)
Federal System	-0.0001	0.0000	-0.0002***	-0.0003**	0.0100*
	(0.0001)	(0.0000)	(0.0001)	(0.0001)	(0.0054)
Federal System*Year	0.0001	0.0001	0.0003	0.0004	0.0015
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0067)
Municipalities Features	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Micro Region Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.4808	0.3882	0.6307	0.7138	0.7974
Observations	8,209	8,209	8,209	8,209	8,209

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. For more information about the time-varying controls, see Table 2.

The outcome found in the table 4 shows that all these specialties have positive effects, but none of them were statistically significant. It means, for our set of dependent variables, there is no impact on these specific skilled labors – columns (1), (2) and (3) – on the municipality due to the amplification of the Federal System. And, this also indicates that there has been no impact in labor-skilled workers in the municipalities and there was no effect on the years of study due to the implementation of a new Federal Institute.

To sum up, regarding the education variables, only college education students' attendance and people with college degrees were impacted by the expansion of the Federal System and they have been statistically significant and they had a small impact of 0.89% and 1.19%, respectively, for the most complete specification, Nevertheless, these effects are small compared to the evolution of these variables, see Table 1. All other Human Capital variables were not robust to different specifications of the equation (1). This may indicate that, at first, there is an addition in the proportion of people attending college education and the proportion of individuals with a college diploma in those municipalities that had the creation of a new FI.

5.2 Migration Variables

With the spread of the Federal Education System into the interior of Brazil, it originates a new possibility of education in areas that lacked in vocational training. And this could affect the migration to these municipalities with new Federal Institutes. A student may decide to migrate to study in search of a better university (Ciriaci, 2014). Thus, the quality of the university will influence his decision on where to live (Ciriaci and Muscio, 2010). To the extent that the decision of individuals about where to study and to work is influenced by the supply (and quality) of local universities, these institutions contribute to the process of regional Human Capital accumulation (Mixon and Hsing, 1994). Eventually, the possibility of improving the standard of living through migration might stimulate Human Capital accumulation (Ciriaci, 2014).

The possibility to migrate may increase the incentive to acquire education in the source economy fostering local universities' enrolments. As such, if university quality affects students' and graduates' migration choices, investing in it, especially in source regions, may enhance brain circulation (Ciriaci, 2014). Then, we will take the issue of creating a new FI, as magnets attract talent (Brazil, 2015). Thus, the implementation of a new FI could also impact the proportion of short-term immigrant (short-term immigrant divided by immigrant), that is, people who lived less than five years in that municipality. And, we also believe that more qualified people may migrate to these cities in search of new employment opportunities (Ciriaci, 2014). This variable is the same qualified work force that we used in the last section, that is, the sum of the short-term immigrant, employed, that were trained in Agricultural Sciences, Biological Sciences and Technological Sciences divided by the number of people who are employed and are short-term immigrant too. Table 5 shows the results for the short-term immigrant and qualified short-term immigrant.

Table 5 – Effects of the Expansion of the Federal System of Professional Education and Technology: Short-term Immigrants and Qualified Short-Term Immigrants

	Immigrants	Immigrants	Immigrants	Qualified Immigrants	Qualified Immigrants	Qualified Immigrants
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.3373***	-0.4646***	-0.3904***	0.0010	-0.0001	0.0010
	(0.0523)	(0.0625)	(0.0658)	(0.0029)	(0.0032)	(0.0034)
Year	-0.0570***	-0.0752***	-0.0751***	-0.0008***	-0.0010***	-0.0011***
	(0.0021)	(0.0024)	(0.0030)	(0.0002)	(0.0002)	(0.0002)
Federal System	-0.0153***	-0.0200***	-0.0221***	0.0005	0.0005	0.0005
	(0.0043)	(0.0045)	(0.0041)	(0.0003)	(0.0003)	(0.0003)
Federal System*Year	0.0258***	0.0241***	0.0259***	0.0001	0.0000	0.0001
	(0.0046)	(0.0046)	(0.0047)	(0.0004)	(0.0004)	(0.0004)
Municipalities Features	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	Yes	Yes	No	Yes	Yes
Micro Region Fixed Effects	No	No	Yes	No	No	Yes
Adjusted R^2	0.3466	0.4619	0.5494	0.2528	0.2637	0.3241
Observations	8,209	8,209	8,209	8,209	8,209	8,209

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. In all estimation there were a relevant set of time-varying controls: Socioeconomics variables of the municipalities: per capita income, Gini coefficient, economically active population, metropolitan area, urbanization rate and manufacturing workers; and Demographics variables: people with age 25 years or more and a higher education, population density, immigrant, unemployment, elderly population, male, afro-descent, foreigner, young population, households with waste collection, electric power and water and bathroom facilities fully completed.

As Table 5 makes clear, there was an increase in the proportion of short-term immigrants in municipalities that had new FIs. If we considered only the city features, there was an impact of 2.58% in the proportion of short-term immigrant and it was statistically significant at 1%, column (1). In the adjacent column, we add the fixed effect of state, column (2), and fixed effect of the micro region, column (3), the result remained statistically significant at 1% and there was an increase in the proportion of short-term immigrant of 2.59%. Regarding the qualified short-term immigrants, the result of just considering the characteristics of the municipalities, column (4), was not statistically significant. In the other columns the outcomes are still not statistically significant. That is, there was no effect due to the building of a new FI in the qualified short-term immigrants compared to other cities that were not had a new Federal Institute.

The following step is to understand if there was any change in the short-term immigrant student profile. We have already ascertained there was an increase in the proportion of the short-term immigrants. Still, we will analyze the effect specifically for high school and college education immigrants – the first is the proportion of short-term immigrant of high school, measured by the proportion between the people that are within school age, 15 to 18 years old, attending high school and are also short-term immigrant. The second variable the proportion of short-term immigrant of college education and it is measured by the proportion between the people attending college education, and is also short-term immigrant by the people within college age, 18 to 25 years old, and is also short-term immigrant. The Table 6 displays the results.

The table 6 indicates that is no effect on short-term migration of high school students, even when we take in consideration the fixed effect of state and micro-region. On the other hand, the expansion of the Federal System impacted by 0.85% the Immigrant of College Education and presents a positive and statistically significant at 1%, when we consider merely the characteristics of municipalities, column (4). With the addition of the state fixed effect, column (5), the ATT remained statistically significant at 1% and the outcome is 0.83%. In the last column (6), with the addition of the fixed effects of micro region, the results remained statistically significant at 1%. These results indicate that the municipalities with a new Federal Institutions presented an increase of 0.8% of the proportion of college education scholars that are also short-term immigrant compared to municipalities that were not part of the expansion of the Federal System. In social and economic terms, this represents a small change in the profile of immigrants from municipalities with new FIs. Now, in municipalities where the expansion of the Federal System happened has a greater ratio of immigrants living less than five years in these municipalities.

Table 6 – Effects of the Expansion of the Federal System of Professional Education and Technology: Short-Term Immigrants of High School and Higher Education

	Immigrant of High School	Immigrant of High School	Immigrant of High School	Immigrant of Higher education	Immigrant of Higher education	Immigrant of Higher education
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.0380***	0.0543***	0.0791***	0.0715***	0.0496***	0.0440***
	(0.0130)	(0.0130)	(0.0152)	(0.0086)	(0.0089)	(0.0096)
Year	0.0004	-0.0022***	-0.0029***	0.0020***	0.0008*	-0.0000
	(0.0006)	(0.0007)	(0.0008)	(0.0004)	(0.0004)	(0.0005)
Federal System	0.0045***	0.0032***	0.0026**	0.0004	-0.0010	-0.0011
	(0.0010)	(0.0010)	(0.0011)	(0.0007)	(0.0007)	(0.0007)
Federal System*Year	0.0011	0.0013	0.0015	0.0085***	0.0083***	0.0080***
	(0.0016)	(0.0016)	(0.0016)	(0.0013)	(0.0013)	(0.0013)
Municipalities Features	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	Yes	Yes	No	Yes	Yes
Micro Region Fixed Effects	No	No	Yes	No	No	Yes
Adjusted R^2	0.0717	0.1915	0.2636	0.3229	0.3995	0.4575
Observations	8,209	8,209	8,209	8,209	8,209	8,209

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. For more information about the time-varying controls, see Table 5.

Our initial results indicate that the cities that had a new Federal Institute had more short-term immigrants and have received more short-term immigrants who are also enrolled in the college education. Other variables related to immigration as qualified short-term immigrants and short-term immigrants of high school were not impacted by the expansion of the Federal Technological System of Education. Anyway, these effects were significant. In fact, the proportion of short-term immigrants decreases in the treated municipalities from 33% to 26.4%, however, for municipalities with new Federal Institutes; there were an increase of 2.59% in this ratio. And this strengthens the role of FIs as an attractor of short-term immigration. On the other hand, the proportion of the short-term immigrants of higher education increased from 1.22% to 2.99% and the outcome of 0.8% found in Table 6 explains just a little part of this growth.

It is important to highlight that there were in the same period of the extension of the Federal System other government policies associated with schooling expansion in Brazil (FIES and Expansion of the Federal Universities, for example). In addition, we had presented in Table 1, there were important difference between the group of municipalities that received a new FI and those that had not. These differences could probably be associated with non-observable time-varying characteristics of the municipalities. In the next pages we perform a set of robustness test for these initial results.

6. Falsification and Robustness Checks

It is important to highlight, as shown in section four; the treated municipalities, which had a new FI, had different socioeconomic backgrounds than the control municipalities, which not received a new FI. From here, we will follow only with the variables that were statistically significant in section five[3], i.e., high school students, complete college education, short-term immigrant, and short-term immigrant of college education. To facilitate the interpretation, all estimation on this section shows results for equation (1) with municipality features and state and micro region fixed effect.

The first test of this section is to investigate the existence of divergences in the temporal trend of pre-treatment of our dependent variables that are subject to the expansion of the Federal System. In this practice, we will falsely assume that the expansion happened a decade earlier, in the 1990s. Thus, we will execute the falsification test. For this, we will use the 1991 and 2000 census data. Therefore, all municipalities treated in 2010 were considered treated on 2000 and will use the DiD strategy with two periods (1991 and 2000) to do the estimation with the same database we used before, removing all municipalities that had a new Federal University after 2000 and the municipalities that had FI prior the expansion in the 2000s. The estimates for these coefficients are shown in Table 7.

[3] All of the other variables were statistically significant in the falsification check. In the robustness checks, just technological sciences graduation and qualified work force were statistically significant more than 5% in two tests – FI covered all the MCA and when we eliminated all Federal Universities from the sample – but the outcomes were very small, less than 0.006. All other estimates for the dependent variables were not statistically significant. Results are available upon request.

Table 7 – Falsification Check of the Expansion of the Federal System of Professional Education, Science and Technology: The Common Trend Assumption

	College Students	Complete College Education	Immigrant	Immigrant of College Education
	(1)	(2)	(3)	(4)
Intercept	0.1947***	0.2274***	-0.0013	0.0262***
	(0.0203)	(0.0234)	(0.0012)	(0.0062)
Year	0.0164***	0.0195***	-0.0005***	0.0015***
	(0.0011)	(0.0012)	(0.0001)	(0.0003)
Federal System	-0.0031**	-0.0043***	-0.0001	-0.0007
	(0.0013)	(0.0014)	(0.0001)	(0.0005)
Federal System*Year	0.0079***	0.0123***	0.0000	0.0020
	(0.0025)	(0.0025)	(0.0001)	(0.0021)
Municipalities Features	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Micro Region Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.7538	0.7676	0.4292	0.3759
Observations	8,295	8,295	8,295	8,293

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. For more information about the time-varying controls, see Table 2 and Table 5.

The results suggest that the effect of the false expansion of the Federal Education System are not statistically significant for only two dependent variables: the short-term immigrants and the short-term immigrant of higher education. In summary, the results indicate that there is no difference in the change in those dependent variables between the treated and untreated period (Angrist and Pischke, 2008). So, this is a strong evidence to discard different trends before the expansion of the Federal System. And it is important, because a common trend is necessary in the trajectory of the outcome variable for both the untreated and treated municipalities (Angrist and Pischke, 2008) to confirm the causal effect of the expansion of the Federal System. This is the key identification assumption of DiD and is known as the common trend assumption.

Notwithstanding, for the higher education and people who complete higher education were impacted by the falsification treatment which indicates that the results we had found before possibly do not come from the implementation of a new Federal Institute. As we stated before, jointly with the creation of FIs there was an increase in the number of higher education places by other government programs (e.g. REUNI, SISU, FIES, PROUNI and UAB) and by the private sector. And it is probably why these variables failed on the falsification test.

In the previous section, our benchmark outcomes, we eliminate all the municipalities which the FI were created before 2000, as well as all the municipalities that received a new Federal Universities, via REUNI. And the goal of it is to eliminate the possible consequence that these programs can impact on our dependent variables. Thus, in this section we present a set of evidence associated with robustness tests that focus on the different control groups of the municipalities. With this concern, we will continue with five robustness tests. In the first test, due to several secessions had occurred in Brazil (Lima and Silveira-Neto, 2015), we will consider only municipalities that all cities have a new FI, in other words, the MCA had 100%

of its territory covered by a new FI. The goal at this point is to verify if there is any variation in the results when we consider that municipalities are fully met by the Federal System.

In the second test, we will eliminate all Federal Universities from the database, because this existence can indicate that non-observables variables could also be associated with the results. The third test will be reinclude all municipalities that were dropped from the sample before, municipalities that had a new Federal after the 2000s and Federal Institutes before the 2000s, the point of it, one more time, it is since the existence of the previous Federal Schools might indicate that non-observables variables could also be associated with the results, so we have to take this issue in consideration. The fourth test we will consider the effect of a Federal University in the micro region in ours results, and this is important, because a Federal University in the micro region could impact the decision of where to study and also the possibility of migration. And the last robustness test we will use a Propensity Score Matching approach with DiD strategy to verify if the outcomes are robustness for municipalities with closer characteristics.

As common when studying regional growth in Brazil utilizing as observation unit the Minimum Comparable Areas (MCAs), because these are areas have constant borders over time (Lima and Silveira-Neto, 2015 and Reis et al., 2008) due to the several secessions of municipalities since 1991. Thus, it is possible to consider treating some MCA, consisting of more than one municipality, which only one of these cities had met a new Federal Institute, while the other cities in this MCA has not received a new FI. Therefore, we will now take only those MCAs that all their cities received a new FI. The others one – 71 municipalities – that were partially covered by a FI were eliminated from the sample. And this is important, because it controls for non-observable variables that could affected the expansion of the Federal System. The results are shown in table 8.

Table 8 – Robustness Check of the Expansion of the Federal System of Professional Education and Technology: All municipalities in the MCA covered by a Federal Institute

	College Students	Complete College Education	Immigrant	Immigrant of College Education
	(1)	(2)	(3)	(4)
Intercept	0.2683***	0.3263***	-0.2708***	0.0411***
	(0.0303)	(0.0357)	(0.0680)	(0.0099)
Year	0.0333***	0.0469***	-0.0750***	0.0001
	(0.0016)	(0.0019)	(0.0031)	(0.0005)
Federal System	0.0001	0.0014	-0.0222***	-0.0011
	(0.0022)	(0.0022)	(0.0042)	(0.0007)
Federal System*Year	0.0093**	0.0088**	0.0207***	0.0078***
	(0.0039)	(0.0044)	(0.0056)	(0.0017)
Municipalities Features	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Micro Region Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.8251	0.8487	0.5491	0.4442
Observations	8,138	8,138	8,138	8,138

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. For more information about the time-varying controls, see Table 2 and Table 5.

When we only consider municipalities that were 100% covered by a FI, there was an impact in the proportion of college school students of 0.93% and it was statistically significant at 5%, with a quite similar result found our benchmark estimation. The proportion of people who complete college education also was affected by the expansion of Federal System with an impact of 0.88% and it was statistically significant at 5%. The creation of a new FI also impacted the proportion of short-term immigration by 2.07% and it was statistically significant at 1%. Finally, the short-Term immigration of college education was impacted by the expansion of the Federal System and the effect was 0.75% and it was statistically significant at 1%. That is, even we consider the possibility of a MCA is whole covered by a FI; all outcomes were statistically significant and robust for these different specifications of the sample.

Even without considering the possibility of a MCA 100% covered by a Federal Institute, we need to check for the possibility of a Federal University's influence on the dynamics of our dependent variables. So, it is possible that there is a Federal University in the micro region of the municipality that enhances the Human Capital of nearby towns, as well as having an effect on migration in this region. So we introduce a dummy to try to capture this effect, that has value one when there is a federal university in the micro region and zero otherwise. The result is shown in Table 9.

Table 9 – Robustness Check of the Expansion of the Federal System of Professional Education and Technology: Federal University in the Micro Region

	College Students	Complete College Education	Immigrant	Immigrant of College Education
	(1)	(2)	(3)	(4)
Intercept	0.3167***	0.3890***	-0.3905***	0.0432***
	(0.0293)	(0.0344)	(0.0658)	(0.0095)
Year	0.0335***	0.0472***	-0.0751***	0.0002
	(0.0016)	(0.0019)	(0.0031)	(0.0005)
Federal System	-0.0020	-0.0012	-0.0222***	-0.0017**
	(0.0022)	(0.0023)	(0.0042)	(0.0007)
Federal System*Year	0.0090***	0.0121***	0.0259***	0.0081***
	(0.0031)	(0.0033)	(0.0047)	(0.0013)
Municipalities Features	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Micro Region Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.8279	0.8517	0.5494	0.4601
Observations	8,209	8,209	8,209	8,209

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. For more information about the time-varying controls, see Table 2 and Table 5

The outcomes remain closer to our benchmark estimation, even when we take into account the possibility of a Federal University in the micro region of the municipality. Thus, the expansion of the Federal System impacted in 0.90% the enrollment students in college education and it was statistically significant at 1% and also affected the proportion of people with college education by 1.12% and it remained statistically significant at 5%. The building

of a new FI also impacted the proportion of Short-term immigrant by 2.59% and the short-term immigrant of higher education by 0.81% and all of these outcomes were statistically significantly at 1%.

In concurrence with the expansion of the Federal Education System, there was an expansion of the Federal Universities (BRAZIL, 2015). As stated in section 3, we had dropped the new Federal Universities from the sample. However, in that respect, there are other Federal Universities that were prior to this expansion and these were kept in the sample and this might affect the outcome found in the previous estimation. Now, we will remove all 130 municipalities that had federal universities before the 2000s in our practice. The goal is to wipe out any overall effect on our dependent variables that can also be affected by the universities that previously existed. The results are shown in table 10.

Table 10 – Robustness Check of the Expansion of the Federal System of Professional Education and Technology: Without all Federal Universities

	College Students	Complete College Education	Immigrant	Immigrant of College Education
	(1)	(2)	(3)	(4)
Intercept	0.2924***	0.3602***	-0.3009***	0.0387***
	(0.0303)	(0.0355)	(0.0681)	(0.0098)
Year	0.0330***	0.0467***	-0.0757***	0.0004
	(0.0016)	(0.0019)	(0.0031)	(0.0005)
Federal System	-0.0007	0.0010	-0.0232***	-0.0010
	(0.0024)	(0.0024)	(0.0045)	(0.0007)
Federal System*Year	0.0069**	0.0092***	0.0266***	0.0063***
	(0.0033)	(0.0035)	(0.0052)	(0.0013)
Municipalities Features	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Micro Region Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.8246	0.8487	0.5481	0.4424
Observations	8,079	8,079	8,079	8,079

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. For more information about the time-varying controls, see Table 2 and Table 5.

In this way, the expansion of the Federal System impacted in 0.69% the enrollment of students in the college education and it was statistically significant at 5%, but the outcome was smaller than the benchmark estimation. The expansion also affected the proportion of people with college education by 0.69% and it remained statistically significant at 5%, and, one more time, the outcome was smaller than we found previously. The building of a new FI also impacted the proportion of Short-term immigrant by 0.0266%, and it is slightly bigger than the results we found in the section four and it was statistically significantly at 1%. And the short-term immigrant of higher education was impacted by 0.0063% due to a building of a new FI and it was statistically significantly at 1%. That is, the outcomes were positive, statistically significant and they also were aligned with the Results Section, even when we eliminated all Federal Universities from the sample.

Finally, trying to improve the balance between the treated and untreated units, we will use a matching strategy for the municipalities before the estimation of equation (1), which is

implemented through the method of the three nearest neighbors[4]. Smith (1997) suggested using more than one nearest neighbor, because this form of matching involves a trade-off between variance and bias; it trades reduced variance, resulting from using more information to construct the counter-factual for each participant, with increased bias that results from on average poorer matches (Smith, 1997).

Hence, we use a logistic regression model and considering only the pretreatment period, we obtain the propensity scores of the municipalities (defined as the probability of being treated, conditional to the control variables[5]). Then, for each treated municipality, the method chooses the control municipality with the closest propensity score, generating a new sample where the control municipalities are three times bigger than the treated municipalities. As discussed by Ho et al. (2006), when done properly, the matching before the estimation can reduce model dependence and variance, lower mean square error, and also generate less potential for bias. Results are shown in table 12.

When comparing municipalities with closer characteristics, via the propensity score matching strategy with three neighbors combined with the DiD estimation, just two of the four dependent variables were statistically significant. That is, the effect for the students in college education and the people with college education were not statistically significant. The column (3), the impact of a new FI in the short-term immigrants is statistically significant at 1% with effect of 2.28%, smaller than the baseline estimation. The last column shows that there was an impact in the short-term immigrant students of college education of 0.42%, also smaller than the baseline estimation, due to the expansion of a Federal Technological System of Education and it was 5% statistically significant, compared with municipalities that not had a new FI.

Table 11 – Robustness Check of the Expansion of the Federal System of Professional Education and Technology: The Propensity Score Matching

	College Students	Complete College Education	Immigrant	Immigrant of College Education
	(1)	(2)	(3)	(4)
Intercept	0.3137**	0.3854***	-0.6185**	0.0956**
	(0.1252)	(0.1413)	(0.2600)	(0.0419)
Year	0.0410***	0.0536***	-0.0729***	0.0019
	(0.0056)	(0.0064)	(0.0108)	(0.0024)
Federal System	-0.0029	-0.0015	-0.0120	-0.0014
	(0.0039)	(0.0041)	(0.0079)	(0.0014)
Federal System*Year	0.0055	0.0071	0.0228***	0.0042**
	(0.0043)	(0.0048)	(0.0078)	(0.0018)
Municipalities Features	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Micro Region Fixed Effects	Yes	Yes	Yes	Yes

[4] We also implemented through the method of Kernel estimation. The results are different than we found with three neighbors, because the matching only eliminate 3 observations from the sample and the outcome were closer of our baseline estimation. The results are available upon request.

[5] The control variables are: per capita income, the Gini coefficient, the proportion of people with age 25 years or more and a higher education; the population density, the immigrant proportion, the unemployment rate, the urbanization rate, the rate of elderly population, industry workers, male, afro-descent, foreigner, economically active population, the metropolitan area, young people, and the proportion of households with waste collection, electric power and water and bathroom facilities fully completed.

Adjusted R^2	0.9184	0.9413	0.7072	0.7423
Observations	966	966	966	966

Note: ***p <0.01, ** p <0.05, * p <0.1. We used robust standard errors that were clustered at the municipal level. The t-values are in parentheses. For more information about the time-varying controls, see Table 2 and Table 5.

According to the results of the robustness and falsification tests just the short-term immigrants and the short-term immigrant of college education were robust to different compositions of the sample and they had not failed on the falsification check, indicating that only those two variables were impacted by the expansion of the Federal Technological System of Education. The other two variables that were also statistically significant in the result section – College Students and Complete College Education – failed in both robustness and falsification tests. Thus we can not infer any impact of a new FI in these both variables.

7. Discussion and Final Remarks

The expansion of the Federal Technological System of Education, between 2000 and 2010, created more than 214 new Federal Institutes. The goal of the FI is to promote the training of qualified professionals, promoting regional development, as well as to stimulate the permanence and attracted qualified professionals in the interior of Brazil (BRAZIL, 2015). It also seeks to expand, extend to the country side the Federal Technological System of Education, democratizing and expanding access to jobs in vocational and technological education; as well as to reduce social and regional inequalities in Brazil (BRAZIL, 2008).

This present study investigated whether some of the government's proposals were accomplished and, specially, the impact of the creation of a Federal Institute on our set of Migration and Human Capital variables. The first point is the expansion of the Federal Institutes within to the interior of the country with the aim of promoting greater access to vocational training in Brazil. And this goal was achieved, all Brazilian micro regions had, at least, one Federal Institute and this is now part of the larger Brazilian territory, as shown in Figure 2.

In this way, we found some important contributions of the expansion of the Federal System Education in the Migration Variables. Thus, when a new Federal Institute was built in some municipality that did not have a FI before, there was a growth in the proportion of short-term immigrant in these municipalities, more precisely; there was an increase of 2.59% in the proportion of short-term immigrant in the municipalities with a new FI. Thus, this effect was large, because the proportion of short-term immigrants decreases in the treated municipalities from 33%, in 2000, to 26.4%, in 2010. This means that there was an increase in ratio of people whom migrate that live less than five years in the municipalities that had a new Federal Institute and this strengthens the role of FIs as an attractor of short-term immigration.

Other important contributions of the expansion of the Federal Technological System of Education was enhancing 0.8% the proportion of the short-term immigrant of college education, when it compares with municipalities without a new FI. Consequently, this program has increased the proportion of short-term immigration able to attend universities. Despite the impact of a new FI was small, that is really important. Brand and Xie (2010) argue that less likely college students attend a higher education benefit more from their education than typical college students.

The building of a new university must take some time to impact the Human Capital variables (Lucas, 1988). Hence, it is expected that the process of expansion of the Federal Technological System of Education did not affect immediately the Human Capital variables, since it demands time to implement a new FI, since the process of expansion started in 2003. And, after the building of a new FI it was still necessary to graduate the student, and, just after that, it should impact the Human Capital variables. But it will be expected that not such a long time the Human Capital must be affected by the expansion of the Federal Technological System of Education.

Higher education is therefore seen nowadays as playing an increasingly crucial role in a country's economic well-being and development, because only higher level education and skills are perceived as being sufficient to allow countries to compete in these globalized knowledge sectors (Faggian and Mccann, 2009). Despite the small impact we found about the expansion of the Federal Technological System of Education, the importance of the foundation of new Federal Institutes in such an unequal country is very important, thus it raises the proportion of short-term immigrant attending college education. As stated by Lucas (2001), Lareau (2011) and Hout and Janus (2011) inequality in educational opportunity persists, but it would be still more unequal if we did not have schools (Pfeffer 2008).

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