Evaluating the Regional Expansion of the Federal System of Vocational Education and Technology: Evidence from the Brazilian Experience

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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.

JEL: I28

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 local Human Capital 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). 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).

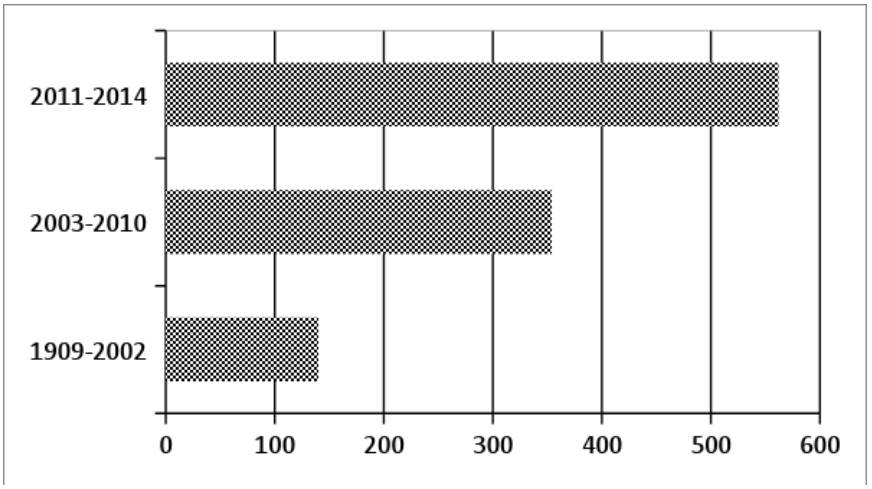
State and regional economic development agencies in the United States as well as in other nations are increasingly driven toward strategies designed to leverage the emerging knowledge-based economy of their respective regions. Many of these strategies have focused on public universities as the primary 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 (Lucas, 1988; Drucker and Goldstein, 2007 and Florida et al., 2008).

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.

In fact, Brazilian workers experience one of the largest differences in earnings according to the level of education. Tertiary-educated adults earn over 2.5 times more than those with upper secondary education. That is considerably higher than the OECD average multiplier of about 1.6, and is the second highest of all OECD (OECD, 2014). In addition, adults without an upper secondary education suffer the greatest penalty in their wages, earning 42% less than people with that qualification.

With this scenario, in the 2000s, the Brazilian Federal Government conducted a process of amplification of the Federal System of Vocational Education and Technology (hereinafter: Federal System of Education or just FSE) with the aim of bringing quality vocational and college education in the areas of the country with low levels of education. Particularly, 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).



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

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

The criteria defined by the Ministry of Education (MEC) to establish a new FI satisfied three dimensions: social, geographical and economic development (BRAZIL, 2008). And it should prioritize cities that have low per capita income, limited access to the Federal University system and focus on LPA's (Local Productive Arrangements). The Institutes should have strong insertion in the area of research and extension, aiming to stimulate the development of technical and technological solutions and extending its benefits to the community.

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; 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).

Actually, it is still an open question if this Brazilian strategy will improve local Human Capital. In this regard, 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 (Ciriaci and Muscio, 2010; Monsalvez, Peraita and Pérez, 2015). They all present a common approach, based on one central idea: assuming that 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; Thanki, 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).

Unlike the multiplier calculation, 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. Particularly, 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), contributing to knowledge creation and transfer (Faggian and Mccann, 2009; Power and Lundmark, 2004; Breschi and Lissoni, 2003), also contributing to regional growth, competitiveness (Lucas, 1988), structural change (Boschma et al., 2009) and to human capital accumulation (Lucas, 1988; 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; Steffensen, Rogers, and Speakman 2000; Feller, Ailes, and Roessner 2002), 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, 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).

According to the best of our knowledge, there is no study of impact of the expansion of the FSE, the focus of this research. 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 FSE – the creation of 165 new Federal Institutions – and the set of dependent variables of Human Capital and Migration. This set of variables includes twelve Human Capital and Migration variables that possibly may be affected by the expansion of the FSE. Ours results imply that just two variables were impacted by the expansion of the Federal System of Education: the short-term immigrant and the college migrant – student of higher education that is also short-term immigrant. Therefore, the outcomes show that those municipalities that had a new Federal Institute present an increase in the proportion of short-term immigrant of 2.59% and a growth of 0.8% of the ratio of short-term college migrant. Despite the positive and small impact, the results are robust to the consideration of different control groups and forms of the model misspecification.

In addition to this Introduction, this paper is organized as follow: section 2 presents the institutional background of the Federal System of Education; 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 Vocational Education and Technology and its Recent Expansion

According to the Brazilian Ministry of Education, the FSE began on September 1909, creating 19 Apprentice Craftsmen Schools (Escolas de Aprendizes Artífices). These schools were more focused on the social inclusion of disadvantaged youth than skilled labor work force. Between the 1930s and 1940s, in the government of Getúlio Vargas, technical education began to be understood as strategic for the development of the economy. The Apprentice Craftsmen Schools have been transformed into the Industrial Lyceum – secondary education establishments - and later came to be called Federal Technical Schools (BRAZIL, 2016a). Lasting until the end of the decade of 1960, where they managed the pedagogical and administrative autonomy, transforming itself in the Federal Technical Schools.

In 1978, the Federal Centers of Technological Education (Cefets) became a reference in technological education and turned the standard unit of the FSE with the aim of forming engineers and technological trained specialists, absorbing the Technical and Federal Agrotechnical Schools (BRAZIL, 2016a). During the 1980s, a new economic and productive scenario was established with the development of new technologies. To meet this demand, the professional education institutions sought to diversify programs and courses to raise the education quality offered in Brazil (BRAZIL, 2016a).

More recently, in 1997, the president Fernando Henrique Cardoso, FHC, regulates the article of the Law of National Education Bases and Guidelines (Lei de Diretrizes e Bases da Educação Nacional) regarding the organization of vocational education. This decree became more rigid to the FSE to expand and open new schools, because it was a necessary partnership with private foundations. The decree also determined that the technical training must be performed separately for the general formation of students, that is, the first parallel to high school, while the second, later. The most controversial part of the decree was the termination of integrated technical formation in high school (BRAZIL, 2016a). As a resolution, these policies have guided this modality of education, mainly, with the separation of high school education from vocational instruction.

In the following decade, between 2003 and 2010, less than ten years since the beginning of the reforms of the 1990s, under a new government, a new legislation was promulgated for

the regulation of vocational education. The decree of FHC was repealed in 2004, and replaced by the Decree no. 5.154, as one of the promises of the new Lula´s government to expand and further distribute the professional and college education throughout rural Brazil (BRAZIL, 2016a). So, in 2008, the then President, Luiz Inácio Lula da Silva, signed the Project of Law which creates 38 Federal Institutes of Education, Science and Technology (FI) in the country. In this way, 31 federal centers of technological education (Cefets), 75 decentralized units of teaching (Uneds), 39 schools, 7 federal agrotechnical schools and 8 schools linked to Federal Universities were ceased to exist to form the Federal Institutes of Education, Science and Technology (BRAZIL, 2016a).

From the year 2003, the Lula government started actions to increase the offer of vocational education in the nation, through a plan for expansion of the Federal System of Vocational 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. Nowadays, All 558 Brazilian micro regions include at least one Federal Institute.

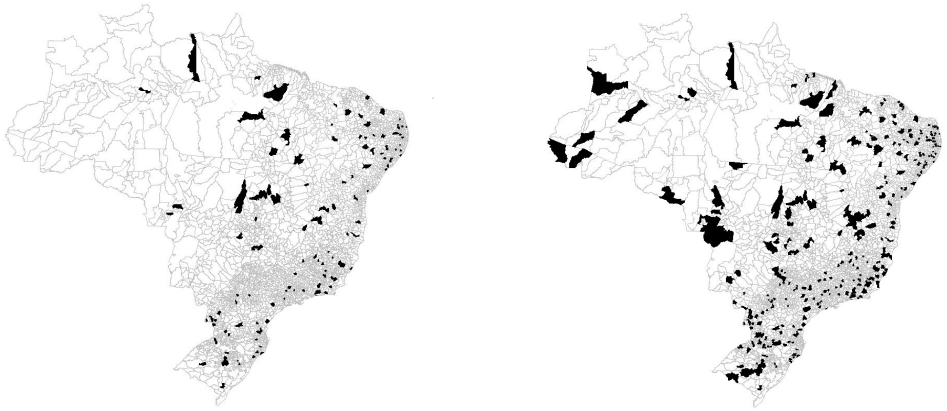


Figure 2a – 2000 Figure 2b – 2010

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

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 impact of the expansion of the Federal System of Education on the variables of Human Capital and Migration. Regarding Human Capital, we will analyze the effect of the expansion of the FSE on the proportion of the students enrolled in high school. This variable is measured by the ratio between the people attending high school and the people within school age (15 to 18 years old). The second Human Capital 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). Finally, we will also check the impact on the proportion of graduate students in high school and higher instruction due to the expansion of the FSE.

The Federal institutes have focused on training of professionals engaged in applied science and focusing on LPAs. This way, we will verify if there were changes in the proportion of professions that are possibly more prone to be affected by a new FI. Thus, we

expect that areas such as Agricultural Sciences, Biological Sciences and Technological Sciences should be affected by the expansion of the FSE. These variables are formed by the percentage of the employed labor force in those respective areas. We 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 in the municipalities with a new FI. Finally, we will check if there has been any effect on the acquired education level, measured as years of study, in these municipalities.

Regarding immigration, we analyze the changes in the proportion 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.

In addition, we investigate the effect of the expansion of the Federal System on the proportion of short-term migrant students enrolled in high school and college education. The high school migrant variable is the people attending high school that are also short-term immigrant, divided by the people within school age, 15 to 18 years old. The college migrant variable is the people attending college education that are also short-term immigrant, divided by the people within college age, 18 to 25 years old.

In an ideal situation, we 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 it 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).

[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).

Given these advantages and because of the impossibilities of constructing a panel with multiple time periods and 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 and might generate selection bias. 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 FSE, 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 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 Federal 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 received new campuses, between 2000 and 2010, were 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 FSE significantly expanded the access to higher education, contributing to greater youth access to college education in the country. 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.

To sum up, we have removed from the sample municipalities with a previous FI, before 2000, and municipalities with a new Federal University, between 2000 and 2010. The point here is to avoid any contamination that might come into play in our set of dependent variables, because our Human Capital and migration variables could be affected by these government policies.

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 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, manufacturing workers and households with waste collection, electric power and water and bathroom facilities fully completed), and Demographics (people with age 25 years or more and a higher education,

population density, immigrant, unemployment, elderly population, male, afro-descent, foreigner and young population).

In addition, we built five 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 the several secessions had occurred in Brazil (Lima and Silveira-Neto, 2015). Thus, the MCA can consist of more than one municipality and this open up a possibility that, in the same MCA, a municipality had a Federal Institute, but another municipality, in the same MCA, did not. If this is verified, we will remove these MCAs from the sample. In short, for this robustness test, we will only consider those MCAs that all of its municipalities have a new FI.

Second, it may happen that the Federal Universities, even the oldest ones, which was not withdrawn from the sample, might affect our dependent variables, and we will eliminate all municipalities containing any Federal University campuses. Third, a Federal University in the micro region may affect the Human Capital and migration variables. Thus, for test this possibility, we let in a dummy, which it equals one if in a certain micro region there is a Federal University and zero, otherwise.

Next, we will reinclude all municipalities that were dropped from the sample – if they had FI prior the expansion of the Federal System of Education or they had a Federal Universities. 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.

[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.

4. Data and Descriptive Statistics

With the purpose of analyzing 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), the manufacturing workers (proportion of population that works in industry), 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). The second set of controls corresponds to the Demographics variables: the population density (population within area), the immigrant 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) and young people (proportion of young people population). 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. 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, if the municipality is in a metropolitan area and the proportion of houses with waste collection and electric power could affect the decision of an individual to migrate or stay and enhance the local Human Capital. The demographic features of the cities display the main characteristics of cities in relation to its population and also play a key role in our Human Capital and Migration variables. All of these variables indicate the capacity of the municipality has to keep these individuals in town. 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.

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)	
High School Migrant (%)	0.0272	0.0359	-0.0087***	0.0270	0.0363	-0.0093***
	(0.0182)	(0.0134)		(0.0188)	(0.0147)	
College Migrant (%)	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$.

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.

In the pre-treatment period, municipalities that were treated had a larger per capita income, urbanization rate, immigration, unemployment rate, a similar proportion of males, 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 group likewise has more housing 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.

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. All other migration dependent variables are greater for the treated municipalities.

As the Table 1 makes clear, in general, 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 FSE in Brazil, by creating new Federal Institutes in some municipalities (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 FSE 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 FSE 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 dependent variable is the ratio of students enrolled in high school, measured by the proportion of people attending high school and within school age (15 to 18 years old). The dependent college education variable is measured by the ratio of people attending higher education and 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, controls, and there was no impact due to the expansion of the Federal System of Education in the proportion of people attending high school (outcome is not statistically significant). When we add state fixed effect, and micro region fixed effect, column (2), the effect of the FSE 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 FSE did not impact the high school attendance.

Differently from the results we had found before for high school presence, we found a significant and positive effect on the attendance of higher education scholars. The column (3) of Table 2 shown that the impact of the expansion of the Federal System of Education on the proportion of people attending college education is positive and statistically significant at 1% and has an effect of 1.01% on the proportion of people attending college education if we just considered the characteristics of the municipality. When we add the state fixed effect and the micro regional fixed effects, column (4), 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% on the proportion of people attending college education, compared to municipalities that did not have a new Federal Institute. 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 FSE: Individuals Attending High School and College

	High School Students	High School Students	College Students	College Students
	(1)	(2)	(3)	(4)
Intercept	-0.1052*	0.2244***	0.3657***	0.3182***
	(0.0542)	(0.0645)	(0.0254)	(0.0294)
Year	0.0609***	0.0548***	0.0321***	0.0331***
	(0.0025)	(0.0033)	(0.0012)	(0.0016)
Federal System	0.0137***	0.0103**	0.0025	-0.0008
	(0.0051)	(0.0045)	(0.0028)	(0.0022)
Federal System * Year	-0.0031	0.0003	0.0101***	0.0089***
	(0.0057)	(0.0054)	(0.0031)	(0.0031)
Municipalities Features	Yes	Yes	Yes	Yes
State Fixed Effects	No	Yes	No	Yes
Micro Region Fixed Effects	No	Yes	No	Yes
Adjusted R^2	0.5821	0.7083	0.7522	0.8276
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. 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[3]. 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 FSE: Accumulation of the Human Capital

	Complete High School	Complete High School	Complete College Education	Complete College Education	Years of Study	Years of Study
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.2528***	0.0557	0.4622***	0.3908***	1.7594***	1.8537***
	(0.0651)	(0.0838)	(0.0301)	(0.0346)	(0.0662)	(0.0734)
Year	0.0158***	0.0039	0.0470***	0.0467***	0.0189***	0.0367***
	(0.0031)	(0.0042)	(0.0013)	(0.0019)	(0.0031)	(0.0041)
Federal System	0.0229***	0.0167***	0.0049*	0.0002	0.0125*	0.0100*
	(0.0061)	(0.0054)	(0.0027)	(0.0022)	(0.0064)	(0.0054)
Federal System*Year	-0.0087	-0.0029	0.0135***	0.0119***	-0.0032	0.0015
	(0.0073)	(0.0069)	(0.0033)	(0.0033)	(0.0072)	(0.0067)
Municipalities Features	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	Yes	No	Yes	No	Yes
Micro Region Fixed Effects	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.4882	0.6400	0.7884	0.8514	0.6684	0.7974
Observations	0.4866	0.6396	0.7881	0.8509	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.

[3] In this section, we also checked the impact of the expansion of the FSE on work-force areas more prone to be affected due to the building of a new FI, Agricultural Sciences, Biological Sciences, Technological Sciences and the sum of them, the qualified work-force. None of them were statistically significant and there was no effect on these areas due to the expansion of the FSE. The results are available upon request.

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 (3). When we add the state fixed effect and the micro region fixed effect column (4), the result keeps statistically significant at 1% with impact of 1.19%. The outcomes found in Table 3 are consistent with the outcomes found in the previous Table 2. 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. In the last two columns of Table 3 show 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 FSE and they have been statistically significant and they had a slight 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).

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 a new Federal Institutes. For example, the 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 might potentially 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 of migrating 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 total immigrant), that is, people who lived less than five years in that municipality. Table 4 shows the results for the short-term immigrant and qualified short-term immigrant.

As Table 4 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 and fixed effect of the micro region, column (2), the result remained statistically significant at 1% and there was an increase in the proportion of short-term immigrant of 2.59%.

Table 4 – Effects of the Expansion of the FSE: Short-term Immigrants and Student Immigrants

	Immigrants	Immigrants	High School Migrant	High School Migrant	College Migrant	College Migrant
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.3373***	-0.3904***	0.0380***	0.0791***	0.0715***	0.0440***
	(0.0523)	(0.0658)	(0.0130)	(0.0152)	(0.0086)	(0.0096)
Year	-0.0570***	-0.0751***	0.0004	-0.0029***	0.0020***	-0.0000
	(0.0021)	(0.0030)	(0.0006)	(0.0008)	(0.0004)	(0.0005)
Federal System	-0.0153***	-0.0221***	0.0045***	0.0026**	0.0004	-0.0011
	(0.0043)	(0.0041)	(0.0010)	(0.0011)	(0.0007)	(0.0007)
Federal System*Year	0.0258***	0.0259***	0.0011	0.0015	0.0085***	0.0080***
	(0.0046)	(0.0047)	(0.0016)	(0.0016)	(0.0013)	(0.0013)
Municipalities Features	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	No	Yes	No	Yes	No	Yes

Micro Region Fixed Effects	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.3466	0.5494	0.0717	0.2636	0.3229	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. 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 understand if there was any change in the short-term immigrant student profile. For this, we will analyze the effect specifically for high school migrant student and college immigrant student – 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 and the second variable corresponds to the proportion of short-term migrant 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 4, columns (3) through (6), displays the results.

The column (3) and (4) of Table 4 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 of Education impacted by 0.85% the proportion of college migrant student, columns (5) and (6), and presents a positive and statistically significant at 1%, when we consider merely the characteristics of municipalities. With the addition of the state fixed effect and the fixed effects of micro region, the results remained statistically significant at 1% with an impact of 0.8%. 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 FSE. 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 of Education happened has a greater ratio of immigrants living less than five years in these municipalities.

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. The short-term immigrants of high school were not impacted by the expansion of the FSE. Actually, the proportion of short-term immigrant decreases for all municipalities in the country, in the treated municipalities there was a reduction of 33% to 26.4%, so, for municipalities with new Federal Institutes this ratio fell less than for municipalities without a new FI. 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 college 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 FSE other government policies associated with schooling expansion in Brazil (FIES and Expansion of the Federal Universities, for example). In addition, as 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. Although we control of a great variety of time-varying city´s characteristics, these differences can potentially be associated with non-observables factors.

6. Falsification and Robustness Checks

In this section, we present a set of robustness checks together with a falsification test, in order to verify the validity of the obtained results. From here, we will follow only with the variables that were statistically significant in section five[4], 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

[4] 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.

the Federal System of Education. In this practice, we will falsely assume that the expansion happened a decade earlier, in the 1990s. Thus, we will execute a 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 obtain 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 5.

Table 5 – Falsification Check of the Expansion of the FSE: The Common Trend Assumption

	College Students	Complete College Education	Immigrant	College Migrant
	(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 4.

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 of Education for these two variables. 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 FSE.

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 was 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 proceeded 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 FSE.

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, because the non-inclusion of these municipalities might generate a sample selection bias. 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. Finally, 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 we stated before, Brazil had several secessions of municipalities since 1991 (Lima and Silveira-Neto, 2015 and Reis et al., 2008). Thus, the observation units usually used in the country are the Minimum Comparable Areas (MCAs), because these areas have constant borders over time. In this way, 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 of Education. The results are shown in table 6.

Table 6 – Robustness Check of the Expansion of the FSE: All municipalities in the MCA covered by a Federal Institute

	College Students	Complete College Education	Immigrant	College Migrant
	(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 4.

Now, we only consider municipalities that were 100% covered by a FI and the results are, in general, quite similar that we have found on our benchmark estimation. Thus, there

was an impact in the proportion of college school students of 0.93% and it was statistically significant at 5%. The proportion of people who complete college education also was affected by the expansion of Federal System of Education 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 FSE 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 7.

Table 7 – Robustness Check of the Expansion of the FSE: Federal University in the Micro Region

	College Students	Complete College Education	Immigrant	College Migrant
	(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 4.

The results 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 FSE 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 8.

Table 8 – Robustness Check of the Expansion of the FSE: Without all Federal Universities

	College Students	Complete College Education	Immigrant	College Migrant
	(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 4.

All the results were positive, statistically significant and they also were closer to the outcomes in the Results Section, according to the numbers of Table 8. The expansion of the FSE 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 2.66%, 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 0.63% due to a building of a new FI and it was statistically significantly at 1%.

In the next robustness check, we will consider the whole sample; we reinclude municipalities that had FI previous to the 2000s and the municipalities that had a building of a new Federal University after the year of 2000. Thus, we will use the whole database, keeping all municipalities. The results are depicts in table 9. Again, we want to identify the sensitivity of the outcomes to different combinations of the sample, because it is possible that municipalities with previous Federal Universities and Federal Institutes show more similar non-observable characteristics with the municipalities that had a new FI. All results were slightly smaller, but very similar to those found in the benchmark result, when all dependent variables were statistically significant.

Table 9 – Robustness Check of the Expansion of the FSE: Whole Sample

	College Students	Complete College Education	Immigrant	College Migrant
	(1)	(2)	(3)	(4)
Intercept	0.3056***	0.3743***	-0.3095***	0.0408***
	(0.0310)	(0.0365)	(0.0680)	(0.0109)
Year	0.0333***	0.0473***	-0.0725***	-0.0009*
	(0.0015)	(0.0018)	(0.0029)	(0.0005)

Federal System	-0.0016	-0.0003	-0.0201***	-0.0023***
	(0.0022)	(0.0022)	(0.0041)	(0.0007)
Federal System*Year	0.0076**	0.0103***	0.0254***	0.0067***
	(0.0030)	(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	0.8246	0.8487	0.5481	0.4424
Observations	8,550	8,550	8,550	8,550

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.

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[5]. 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, considering only the pretreatment period and obtain the propensity scores of the municipalities (defined as the probability of being treated, conditional to the control variables[6]). 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 10.

Table 10 – Robustness Check of the Expansion of the FSE: The Propensity Score Matching (Three Neighbors)

[5] We also implemented through the method of Kernel estimation and the outcomes were closer of our baseline estimation. The results are available upon request.

[6] 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.

	College Students	Complete College Education	Immigrant	College Migrant
	(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
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.

When comparing municipalities with closer characteristics, via the propensity score matching strategy with three nearest 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 migrant students of college education of 0.42%, also smaller than the baseline estimation, due to the expansion of a FSE and it was 5% statistically significant, compared with municipalities that not had a new FI.

According to the results of the robustness and falsification tests, thus, only the short-term immigrants and the short-term migrant of college education were robust to different compositions of the sample and had not failed on the falsification check, indicating that only those two variables were impacted by the expansion of the FSE. 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.

7. Discussion and Final Remarks

The higher education is 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). In this way, the expansion of the FSE, 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 FSE, 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 a set of Migration and Human Capital variables. From the set of evidence we have presented, it is possible to conclude that the objective of the expansion of Federal Institutes to the interior of Brazil was achieved. Nowadays, all Brazilian micro regions present a FI. In Addition, we found some contribution of the FSE on the migration of people, but not on the local Human Capital.

Specially, when a new Federal Institute was built in some municipality that did not have a FI before, there was an impact of 2.59% on the proportion of short-term immigrant in these municipalities. Thus, this effect was not large, because the proportion of short-term immigrants decreases in the treated municipalities from 33%, in 2000, to 26.4%, in 2010. This means for municipalities with new Federal Institutes this ratio fell less than for municipalities without a new FI, indicating that the expansion of the FSE only avoid greater falls on this ratio.

In addition, we also found that the expansion of the FSE was enhancing by 0.8% the proportion of the college short-term migrant student. Part of this small impact can be explained by the difficulty of the student to continue in the new city, due to the high costs of migration. Some other possible explanation for this, it is the mismatch between the offering of

the FIs courses and the local needs. Not just that, the presence of a new university must take some time to impact the local Human Capital variables (Lucas, 1988). Hence, this expansion is recent, it had initiated in 2003, it is expected that the process of extension of the FSE did not affect immediately the Human Capital variables in Brazil.

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