

Barufi, Ana

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Expansion of undergraduate courses positions impacting the migration of students in Brazil: an analysis with the Demographic Census of 2010

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Expansion of undergraduate courses positions impacting the migration of students in Brazil: an analysis with the Demographic Census of 2010

Ana Maria Bonomi Barufi

Abstract

This paper advances in the literature on the migration of college students, which is not very large in Brazil evaluating in to what extent does the uprising in the offer of undergraduate courses in a certain municipality affect the migratory net balance (over the municipality young population). The recent significant evolution of the offer of places in undergraduate courses in Brazil may provide a new instrument of regional development. In this sense, if this process happens in less favored municipalities, there will be a new element of attraction of students that will be qualified and may stay there afterwards. Considering Demographic Censuses (1991, 2000 and 2010) and Undergraduate Courses Censuses (1998 and 2007), indicators of attraction and repulsion of families are constructed for Brazilian municipalities. Therefore, migration decision may be taken by the youngster (if he migrates alone) or by his family (in the pursuit of job opportunities and higher quality of life). As the analysis is done over time for municipalities, Minimum Comparable Areas (2000-2010) are built and the spatial dependence of the residuals in the regressions is taken into account by spatial econometrics models. Two models are estimated in this preliminary analysis: spatial error model and spatial autocorrelation model, both of them applied in a first difference setting. This kind of approach seems adequate for the issue analyzed, as spatial autocorrelation coefficients are significant and test statistics also show this problem. The main results show that there is a positive impact of the offer of places in undergraduate courses, of the population and of life quality measures (life expectancy and infant mortality rate) over the net migration index. This preliminary result has a very important policy implication, which is the fact that an investment by the private or the public sector to increase the number of positions in higher education courses may impact on migratory flows. If such offer grow in most deprived places (which seems to have been the case in recent years), it is possible to reduce regional inequality. Moreover, it is possible that the results presented here are more associated to a correlation than to a true cause-consequence effect.

Keywords: migration, college students, spatial econometrics.

JEL: R23, C21, I25

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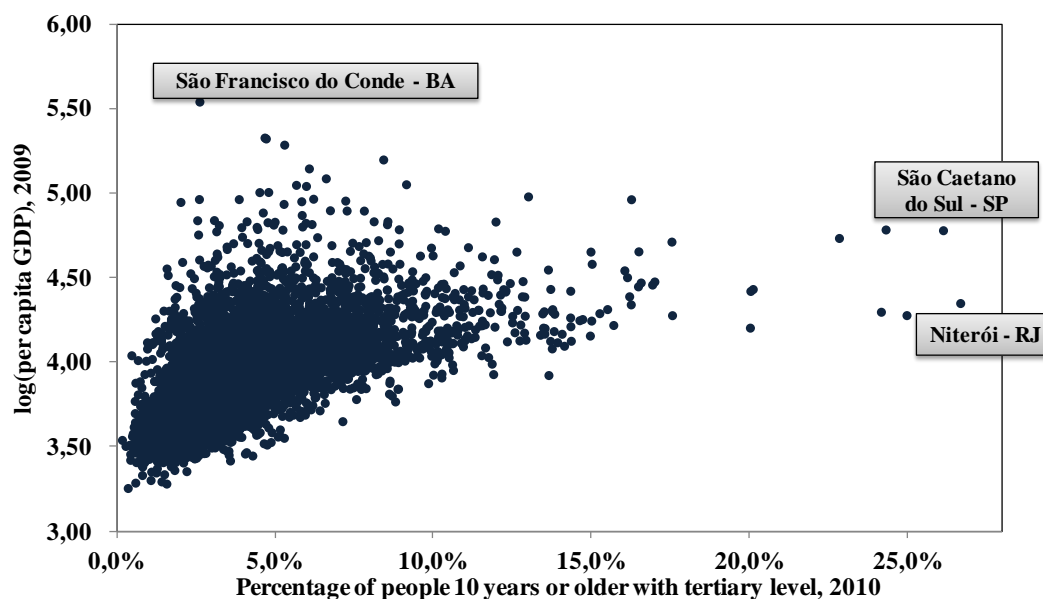
1. Introduction

The educational level evolution of the population of a certain country is an essential element in the promotion of its development. Under a macroeconomic perspective, advances in education have a strong relation with productivity growth and can be identified as one of the main factors to promote the sustainable growth of an economy¹. On the other hand, even in the individual standpoint there are potential benefits from obtaining a higher level of education, especially because the possible increase in the productivity that follows from this investment is related to higher wages, as has been largely explored in the literature.

Considering such impacts of education, Graph 1 below presents the positive relationship that exists among the percentage of people with tertiary level of education in the population (10 years or older) and the logarithm of per capita GDP in Brazilian municipalities. Excluding outliers (municipalities in which there is a special situation that generates an extremely high value of per capita GDP, due for instance to oil prospection – like São Francisco do Conde - BA), it is noticeable that there is a positive relationship among these two variables. Moreover, two other municipalities that show an extremely high percentage of people with tertiary educational level (Niterói – RJ and São Caetano do Sul – SP) also have higher development levels when analyzed by other indicators (such as the Human Development Index).

¹ The basic growth model by Solow (1956) and all the literature that followed it are strongly related with this view.

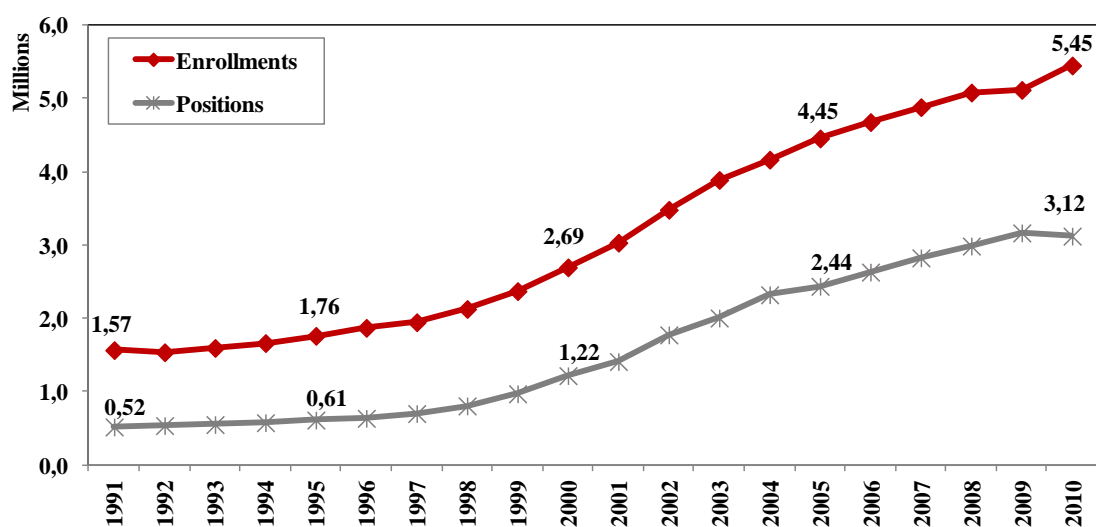
Graph 1. Relationship between the percentage of people aged 10 years or more who completed tertiary level (2010) and per capita GDP of Brazilian municipalities (2009).



Source: Demographic Census (IBGE) and municipal GDP (IBGE).

Given all these arguments, a basic development policy of a country should include the expansion of the access and quality of education. In this sense, in the last decade it is possible to identify in Brazil an accelerated expansion of the number of openings in undergraduate courses. The main numbers show that enrollments increased from 2.69 in 2000 to 5.45 millions in 2010, while the number of openings in the first year went from 1.22 million to 3.12 millions in the same period.

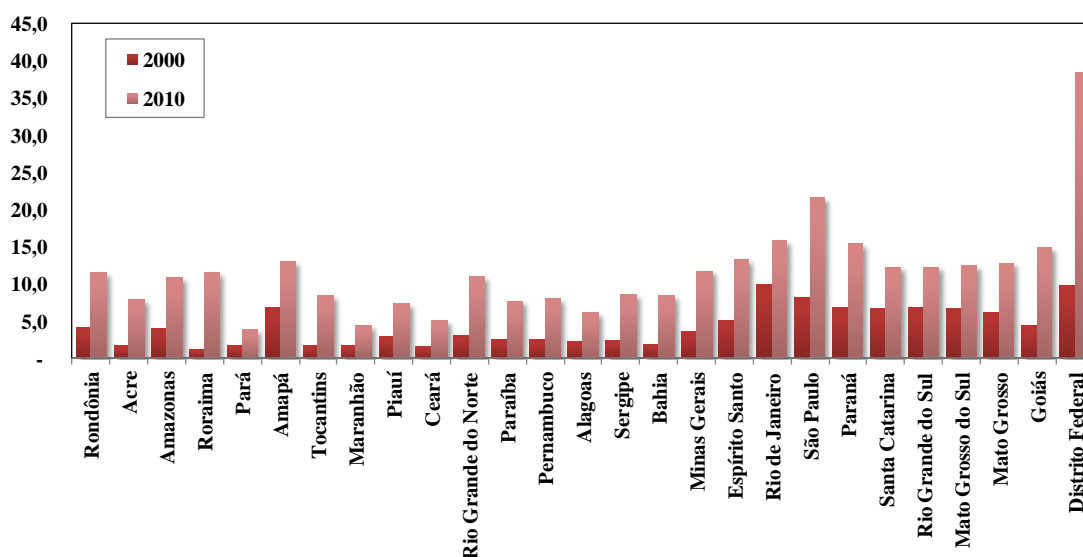
Graph 2. Evolution of enrollments and positions in undergraduate courses, 1991 to 2010.



Source: INEP/MEC

It is important to notice that this process has been heterogeneous among the territory, in such a way that some states faced a faster evolution in the number of openings in undergraduate courses over 100 people aged 18 to 24 years (ideal age interval to attend College). As can be seen in the following graph, Distrito Federal, São Paulo, Rio Grande do Norte, Bahia, Roraima, Acre and Goiás are some examples of this favorable dynamic in the last decade.

Graph 3. Number of positions available in undergraduate courses for each 100 inhabitants aged 18 to 24 years old, by state, 2000 and 2010.



Source: INEP/MEC

In the literature of migration it has been an issue of concern the identification of the factors that make people decide to move from one place to another. As it will be shown in the next section, the regional heterogeneity of labor supply and demand make people with different qualification levels to look for new opportunities in a different municipality, leading to a better matching in the labor market. However, the decision of migration based on schooling opportunities is not widely explored in the literature, even more considering studies applied to Brazil. Taking schooling opportunities into account as decisions factors do not preclude the possibility that young university students had migrated previously because of a family decision (based mainly in labor market factors), but on the other hand families may include in their cost-benefit analysis of migration the offer of undergraduate courses in the origin and in the destination.

Departing from the arguments exposed above, this paper will evaluate in to what extent the heterogeneous advances in the supply of undergraduate courses openings among

municipalities is associated with changes in the migratory flows of people that in the moment of the Census were undergraduate students. This discussion is extremely relevant because it allows the inference of how this investment in tertiary education may enhance municipal development, reducing the departure of hereafter qualified people.

The remaining of this text is organized as follows: section 2 presents a literature review of migration; in section 3 the methodology and the model to be estimated are presented; then, in section 4 there is a discussion over the data used and descriptive statistics are exposed; finally, section 5 brings the results and section 6 delivers the main conclusions and perspectives of future advances.

2. Literature review

There are many factors that affect the previous decision of migration of college students. Among those, it is possible to emphasize the ones associated with the attraction of people to certain municipalities due to labor market aspects (affecting the student himself, who wants to work and study at the same time, or his family). Additionally, there are factors that are specific to the migration decision based on the options of study. The following subsections aim to identify some studies related to these factors. It is also important to notice that up to what is of the knowledge of the author, there are no studies that explore the Brazilian migration flow of college students with this regional perspective based on push-pull factors.

2.1 Migration

The studies of migration can be grouped in three main frameworks according to Sahota (1968): (i) the neoclassic theory of investment, according to which there are costs (moving to another city, changes in life costs) and benefits (expected income flow in the destination, given the opportunities that the migrant sees) associated to this decision, that can be understood as a form of investment in human capital; (ii) the Harvard School framework, which points out the existence of a positive relationship between migration and economic growth because of the selection of people, meaning that in general those who migrate are risk-takers and are more dynamic; (iii) the English framework, which defends the existence of migration laws, defined by push and pull forces, meaning that not only the expected return may influence this decision, but also the existence of certain factors in the origin and in the destination.

Considering the first strand mentioned above, Golgher et al. (2005) state that the human capital model can be understood on the basis of a macroeconomic perspective (migration is a result of the regional heterogeneity of labor supply and demand) or, alternatively, under a microeconomic perspective (the migration process is an investment made by workers aiming to improve their position in the labor market and increase their life quality). The authors also mention the third framework, highlighting the fact that push factors affect more intensively poorer individuals (who end up being expelled from their origins), while pull factors are supposed to have a stronger impact in the migratory decision of richer individuals (destinations attract them).

Measured in different ways, migration can be an explanatory variable for (a) income differentials among individuals, (b) different regional performances related to economic growth, and (c) can be the variable to be explained (what is the case of the present study).

Relating to (a), Santos Júnior et al. (2005) analyze the possibility of the existence of positive selection of migrants in Brazil, identifying significant wage differentials between migrants and non-migrants, both in the state of destination and of origin, controlling for a large group of variables. These results could be an indication of the validity of the framework (ii) mentioned above, indicating that migrants are on average more motivated and enterprising.

On the other hand, Santos and Ferreira (2007) find a result that is up to a certain point opposite to Santos Júnior et al. (2005). They show that migration contributes to reduce income differentials inside the states. This is so because the departure of positively selected migrants may result in an increase in the productivity of the remaining workers (from the neoclassical growth model standpoint). Then, the authors find σ -convergence applying a counterfactual methodology.

Still considering analyzes based on (a) type, Justo and Silveira Neto (2006) try to explain migratory flows in Brazil with PNAD (National Household Sample Survey) data for three years, highlighting the role of the expected income in the destination as a relevant factor (average wage multiplied by the probability of finding a job), conditioned by distance. According to the authors, following Ramos and Araújo (1999) and based on the model proposed by Harris and Todaro (1970), the migration decision is based not only in the income differential, but also in the differential of the expected

value of that income (therefore, each individual maximizes an intertemporal utility function with risk and the equilibrium among the regions is obtained by the equivalence in the expected income weighted by the unemployment rate), what can be achieved by weighting the expected income by the cost of life and the probability of being unemployed.

As an example of (b), Menezes and Ferreira-Júnio (2003) discuss the migration impact over the speed of convergence among Brazilian states from 1992 to 1999, finding that migratory flows were not so important in this process. Finally, Da Mata et al. (2007) employ the (c) approach, trying to assess which are the relevant factors for the attraction of qualified workers (with secondary or tertiary level completed) in Brazilian municipalities. Their dependent variable is an index of qualified migration, obtained by:

$$(QI - QE) / TP$$

QI = Qualified Immigration, QE = Qualified Emigration, and TP = Total Population

This index is similar to the variable of interest of the present study. Da Mata et al. identify the main characteristics of the municipalities which attract a positive net flow of qualified migrants in a unique point of time (2000, with explanatory variables from 1991). Thus, the authors explain the net migratory flow considering characteristics of the labor market and the social capital (1995-2000) in each municipality.

Following this idea, Sabbadini and Azzoni (2006) verify that income and life quality in a gravitational model are more relevant to explain migratory flows of highly qualified people among states in Brazil.

It is also important to mention the work by Sachsida et al. (2009), that conducts a comprehensive analysis of origin and destination migratory flows between Brazilian states, identifying the main characteristics of people who have migrated in the previous decade.

2.2 Migration of undergraduate students

The literature on the analysis of migratory flows of undergraduate students in Brazil is not significantly spread, at least considering what is of the knowledge of the author. However, in other regions like Europe and the United States there are a few studies in this area. One of the possible explanations for this fact is that Brazil is still at the beginning of an expansion process of university courses.

Nonetheless, it is noticeable that there is a relevant difference among undergraduate students in Brazil and in the United States. While in the later it is quite common that the student migrate by himself, in the former that phenomena is more unusual.

Explaining the migration decision of undergraduate students, Mixon Jr (1992) highlights the importance of amenities of the university or college (price, quality, localization, climate, among others). Tuition fees are also analyzed by Tuckman (1970) in the locational decision of students.

Alms and Winter (2009) defend the importance of understanding intrastate migratory flows of undergraduate students (while most studies in this area restrict their analyzes to interstate migratory flows, because of the lack of data at the municipal level). More than just cost and quality, the authors find that the distance from the original place of residence and the university is relevant to determine the decision of migration.

3. Methodology

Based on all the contributions mentioned before, this study tries to explain migratory flows of Brazilian undergraduate students among the municipalities. The variable of interest is the net migratory index, which weights the net migratory flow in the last 5 years by the population aged 18 to 24 in each municipality.

The advances proposed here in relation to previous studies are the following: on the one hand, variables that try to capture the decision of migration of the parents are included in the model; additionally, other aspects that may affect the decision of the student himself (for instance, the supply of undergraduate positions in the origin and in the destination) are also considered. In this way, it is possible to test the hypothesis that the impressive expansion of universities and colleges in Brazil in the last decade may have kept more families in their original municipalities. This analysis is extremely relevant for the proposition of regional development policies.

Moreover, the unity of analysis will be the municipality (or Minimum Comparable Area, as it will be discussed in Section 4). Thus, it will be possible to understand not only interstate but also intrastate migratory flows. Regarding the explanatory variables, most of them were suggested by the study of Da Mata et al. (2007), especially the ones related to the familiar migratory decision based on labor market conditions. In addition, in order to understand the decision of the student, the expansion of the supply of

undergraduate positions is also included in the model (the referential time period for this variable is the moment right before the decision – almost five years before the Census, when migration in the previous five years is investigated)².

Finally, as the period to be analyzed comprises 2000 and 2010, it is necessary to include socio-demographic explanatory variables lagged in time (from 1991 and 2000, respectively). In order to avoid the problem of the creation of municipalities in this period, Minimum Comparable Areas for 2000 and 2010 were built based on the methodology proposed by REIS et al. (2008), and data for 1991 are aggregated in the municipal division of 2000 by IPEAdata (see DA MATA et al., 2007).

According to Golgher (2004), there are two main classes of migration, the one with a fixed date (where the person lived in a certain date) and of last step (where was the last place the person lived before coming to the present one). In this study, it was necessary to consider the migration of fixed date, mainly because of data availability.

The population of interest is composed by individuals who are studying in undergraduate courses and who lived in another municipality five years before of the reference date of the Demographic Census. If the previous municipality of residence was not informed (informing just the state) or if the migratory flow happened from a foreign country, these cases were excluded from the analysis. Then, under these restrictions the migratory net flow of undergraduate students was calculated, controlling for the size of the population aged 18-24 years old, in order to avoid scale problems.

Considering the literature mentioned above, the model to be estimated is the following:

$$Y_{it} = \alpha + X_{it-1}\beta + \delta V_{it} + S_i\gamma + u_{it} \quad (1)$$

Where Y_{it} refers to the net migratory flow of undergraduate students on municipality I on time t , X_{it-1} is a matrix with the explanatory variables that aim to measure attraction factors lagged in time for workers and other people beyond the students, V_{it} is a vector with the number of positions in undergraduate courses over the population aged 18 to 24 years old in the municipality, S_i is a set of characteristics of the municipality that do not change in time (altitude, for instance), and u_{it} is the residual.

² Unfortunately, due to problems in the microdata files of the Censuses of Higher Education of 1995, 1996 and 1997, were considered here data from 1998 and 2007 Censuses (which are related to the Demographic Censuses of 2000 and 2010, respectively).

As $T = 2$, the model will be estimated in first differences³ and can be rewritten in the following way:

$$\Delta Y_i = \Delta X_{i,-1}\beta + \delta\Delta V_i + \Delta u_i \quad (2)$$

In which time constant elements are eliminated and the other variables will be in the structure $\Delta Y_i = Y_{it} - Y_{it-1}$.

However, given that the i dimension refers to spatial units (minimum comparable areas), their proximity may affect the relation among the observable variables, what leads to the need of applying spatial econometrics methods (ANSELIN, 1988, and ANSELIN and GRIFFITH, 1989). The procedure to be followed is:

- a. The regression (2) is run by Ordinary Least Squares (OLS);
- b. Tests of spatial autocorrelation are conducted (Moran's I, LM-lag and LM-error);
- c. If a significant spatial autocorrelation is found, it is necessary to adopt the most indicated models, according to robust statistics of LM-lag and LM-error;
- d. If necessary, spatial models are estimated.

In this study two different models will be considered, the Spatial Error Model and the Spatial Autocorrelation Model. They can be summarized by:

- (i) Spatial Autocorrelation Model

$$\Delta Y_i = \rho W\Delta Y_i + \Delta X_{i,-1}\beta + \delta\Delta V_i + \Delta \varepsilon_i \quad (3)$$

Where W is a spatial weights matrix (in this study only the *Queen* matrix was considered⁴) and ρ is the spatial autoregressive coefficient. The hypothesis to identify this model are that $E(\Delta \varepsilon_t) = 0$ and $E(\Delta \varepsilon_t \Delta \varepsilon_t') = \sigma^2 I_N$, solving inconsistency and inefficiency issues that existed in the original model.

- (ii) Spatial Error Model

³ See Wooldridge (2002).

⁴ A possible expansion of this work would include testing different formulations of spatial weights matrices.

In this case,

$$\Delta Y_i = \Delta X_{i,-1}\beta + \delta\Delta V_i + \Delta\varphi_i \quad (4)$$

$$\Delta\varphi_i = \lambda W\Delta\varphi_i + \Delta\varepsilon_i \quad (5)$$

Where once again W is a spatial weights matrix, λ is the spatial autocorrelation coefficient and $\Delta\varphi_i$ are the residuals showing spatial autocorrelation. The underlying hypothesis for identification are that $E(\Delta\varepsilon_i) = 0$, $E(\Delta\varepsilon_i\Delta\varepsilon_i') = \sigma^2 I_N$, solving inefficiency issues.

4. Data sources and descriptive analysis

The data used in this study were obtained from the following sources: IBGE's Demographic Censuses⁵ of 1991, 2000 and 2010, INEP's Higher Education Census and IPEAdata, (who compiled some information of the Demographic Census for different regional aggregations), as described on Table 1.

This study follows the recommended methodology for comparing spatial units in different time periods, allowing for the possibility that some municipalities may have been created along the decade. Then, Minimum Comparable Areas (MCAs) between 2000 and 2010 were built, taking into account a description by IBGE of all laws that created these new municipalities and following the procedure proposed by Reis et al. (2008). It is important to notice that information for 1991 were already compatible with the 2000 geographic division (as mentioned before). The process of creation of MCAs aggregated 5.507 municipalities in 2000 and 5.565 in 2010 into 5.979 MCAs (2000-2010)⁶.

⁵ The information from 1991's and 2000's Demographic Censuses were acquired at ipeadata.gov.br, where an information compatibility was developed from 1991 to the 2000 municipalities division, as mentioned in Da Mata et al. (2007), resulted from A partnership of IPEA with UNDP.

⁶ The aggregation criteria can be obtained with the author.

Table 1. Variables and data sources.

Variable	Source
Net migratory flow of college students / population aged 18 to 24 years old	Microdata of the Demographic Censuses / IBGE
Net migratory flow of college students who live alone / population aged 18 to 24 years old	Microdata of the Demographic Censuses / IBGE
Population aged 18 to 24 years old	Microdata of the Demographic Censuses / IBGE
Population	Ipeadata
Positions in undergraduate courses / population aged 18 to 24 years old	Microdata of the Higher Education Censuses (INEP/MEC)
Positions in undergraduate courses / population aged 18 to 24 years old	Microdata of the Higher Education Censuses (INEP/MEC)
Average per capita income	Ipeadata
Inequality Theil Index (L)	Ipeadata
Average completed schooling year of people aged 25 years or more	Ipeadata
Physicians / 100 inhabitants	Ipeadata
% of people in households with water facilities	Ipeadata
% of people in households with access to electricity	Ipeadata
Altitude (in meters)	Ipeadata
Distance to the state capital	Ipeadata
Child mortality rate (up to 5 years) / 1.000 born alive	Ipeadata
Life expectancy (years)	Ipeadata

Source: Author's elaboration.

A descriptive analysis of the variables used here is presented in Table 2. Some aspects can be highlighted: the results presented refer to the mean values of each variable for the AMCs, i.e., counterintuitive values may arise, but that is due to the aggregation (usually these averages are calculated over individual information, not over geographical areas). However, it is worth noticing the inequality increase as measured by the Theil index, the growth in average income and life expectancy, the decrease of the mortality rate under 5 years and the increase of the access to water and electricity. However, more important than these aspects is the fact that the net migration of university students grew on average and there was a significant increase in the average number of students in undergraduate courses (accompanied by an increase in the standard deviation). Considering the undergraduate course positions for the population of age 18 to 24, there was also an increase, which highlights the previously mentioned expansion of higher education.

Table 2. Descriptive statistics of the variables.

	Initial period / Final period	Initial period				Final period			
		Mean	Standard deviation	Max.	Min.	Mean	Standard deviation	Max.	Min.
Net migratory flow of college students / population aged 18 to 24 years old	2000/2010	-0.004	0.017	0.222	-0.218	-0.017	0.036	0.267	-0.483
Net migratory flow of college students who live alone / population aged 18 to 24 years old	2000/2010	-0.004	0.014	0.206	-0.218	-0.016	0.033	0.281	-0.483
Population aged 18 to 24 years old	2000/2010	4,267	25,965	1,440,726	101	4,358	24,538	1,328,138	83
Population	1991/2000	26,798	169,437	9,649,519	618	30,991	187,231	10,434,252	795
Positions in undergraduate courses / population aged 18 to 24 years old	1998/2007	0.006	0.026	0.564	0.000	0.018	0.072	1.475	0.000
Positions in undergraduate courses / population aged 18 to 24 years old	1998/2007	147	2,125	127,606	0	515	9,232	624,289	0
Average per capita income	1991/2000	R\$ 123	R\$ 73	R\$ 583	R\$ 25	R\$ 170	R\$ 96	R\$ 955	R\$ 28
Inequality Theil Index (L)	1991/2000	0.490	0.116	1.180	0.200	0.522	0.109	1.270	0.190
Average completed schooling year of people aged 25 years or more	1991/2000	3.03	1.27	8.84	0.15	4.04	1.29	9.65	0.81
Physicians / 100 inhabitants	1991/2000	0.231	0.493	6.870	0.000	0.270	0.519	7.270	0.000
% of people in households with water facilities	1991/2000	53.2	31.6	100.0	0.0	68.7	29.2	100.0	0.0
% of people in households with access to electricity	1991/2000	69.4	26.1	100.0	2.0	86.6	16.8	100.0	16.9
Altitude (in meters)	1991/2000	413.0	293.4	1,628.0	0.0	413.0	293.4	1,628.0	0.0
Distance to the state capital	1991/2000	253.2	163.7	1,476.3	0.0	253.2	163.7	1,476.3	0.0
Child mortality rate (up to 5 years) / 1.000 born	1991/2000	67.4	38.5	174.6	12.5	44.8	29.7	134.8	6.2
Life expectancy (years)	1991/2000	63.4	5.2	74.6	50.2	67.7	4.9	78.2	54.4

Source: Author's elaboration.

5. Results

Before performing the estimation of the model in first differences, a model for each year (2000 and 2010) in the level was estimated, in order to enlighten the main correlations between the analyzed variables. Tables 3 and 4 exposed such results.

It is noticeable that the number of undergraduate course positions over the young population is positive and significantly correlated to the index of the net flow of college students in any specification. However, this effect seems to be halved between 1991 and 2000. On the other hand the log of per capita income and the log of the population show a positive correlation with that index, what indicates that larger cities with higher average income may be more interesting for young migrants and their families.

Table 3. Regression results by OLS for the net migration index in 2000 compared to the explanatory variables in 1991.

	REG0	REG1	REG2	REG3	REG4	REG5	REG6	REG7	REG8
positions/pop18-24 in t=1	0.088***	0.088***	0.088***	0.091***	0.091***	0.088***	0.087***	0.089***	0.084***
log(per capita income) in t=0	0.000	0.000	0.001	0.002**	0.002**	0.004***	0.004***	0.004***	0.005***
schooling years in t=0	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.002***	-0.002***
log(population) in t=0	0.001***	0.001***	0.001***	0.001***	0.001***	0.000	0.000	0.000	0.000
Theil index in t=0			-0.019***	-0.016***	-0.016***	-0.017***	-0.017***	-0.017***	-0.018***
Distance to the state capital				-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
Altitude					-0.000	-0.000	-0.000	-0.000	-0.000
Child mortality in t=0						0.000***	0.000***	0.000***	0.000***
Life expectancy in t=0							0.000	0.000	0.000
Physicians per 1.000 inhab in t=0								-0.000	-0.001
% of people with water in t=0									-0.000
% people with electricity in t=0									-0.000***
Constant	-0.006	-0.006	-0.002	-0.001	-0.000	-0.010**	-0.015	-0.015	-0.023**
Adjusted R2	0.034	0.034	0.048	0.054	0.054	0.057	0.057	0.057	0.060
AIC	-29082	-29082	-29162	-29196	-29197	-29214	-29212	-29211	-29222
BIC	-29049	-29049	-29122	-29150	-29144	-29154	-29146	-29138	-29137

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Author's elaboration.

Table 4. Regression results by OLS for the net migration index in 2010 compared to the explanatory variables in 2000.

	REG0	REG1	REG2	REG3	REG4	REG5	REG6	REG7	REG8
positions/pop18-24 in t=1	0.038***	0.038***	0.040***	0.042***	0.043***	0.041***	0.041***	0.041***	0.040***
log(per capita income) in t=0	-0.011	-0.011	-0.009	-0.008**	-0.007**	-0.002***	-0.002***	-0.002***	0.002***
schooling years in t=0	0.002***	0.002***	0.000***	-0.000***	-0.001***	-0.000***	-0.000***	-0.000***	0.000***
log(population) in t=0	0.006***	0.006***	0.007***	0.006***	0.006***	0.006	0.006	0.006	0.006
Theil index in t=0			-0.032***	-0.028***	-0.028***	-0.032***	-0.032***	-0.032***	-0.036***
Distance to the state capital				-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
Altitude					-0.000	-0.000	-0.000	-0.000	-0.000
Child mortality in t=0						0.000***	0.000***	0.000***	0.000***
Life expectancy in t=0							-0.000	-0.000	-0.000
Physicians per 1.000 inhab in t=0								-0.000	-0.001
% of people with water in t=0									-0.000
% people with electricity in t=0									0.000***
Constant	-0.023	-0.023	-0.021	-0.018	-0.020	-0.046**	-0.022	-0.024	-0.023**
Adjusted R2	0.055	0.055	0.064	0.070	0.071	0.074	0.074	0.074	0.076
AIC	-21084	-21084	-21133	-21170	-21173	-21188	-21188	-21186	-21200
BIC	-21051	-21051	-21093	-21124	-21120	-21129	-21122	-21113	-21114

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Author's elaboration.

The distance to state capital has a negative sign and is significant (although its coefficient being close to 0), indicating that municipalities with less access to major markets and with less infrastructure (usual case in cities farther away from state

capitals) tend to attract fewer immigrants. A further result is that a greater inequality has a negative effect on the index, what means that more unequal places attract less migrant undergraduate students.

However, it is important to use the entire information set available in the database. Thus, a model in first differences is proposed, which will ensure that each municipality fixed effect is controlled in the regression (i.e., municipal heterogeneities that do not change over time become implicitly controlled, since the first difference transformation causes them to be subtracted from the regression). The results of the models in differences are shown in Tables 5 and 6:

Table 5. OLS Results of the first difference model

	MQO
log(per capita income) in t=0	-0.008 ***
log(population) in t=0	0.017 ***
positions/pop18-24 in t=1	0.051 ***
Theil index in t=0	0.005
schooling years in t=0	0.007 ***
Physicians per 1.000 inhab in t=0	-0.002 **
% of people with water in t=0	-0.000 ***
% people with electricity in t=0	-0.000 *
Child mortality in t=0	-0.000 *
Life expectancy in t=0	-0.001 ***
Constant	-0.016 ***
Adjusted R2	
Moran's I (error)	0.039 ***
Lagrange Multiplier (lag)	33.176 ***
Robust LM (lag)	32.168 ***
Lagrange Multiplier (error)	23.552 ***
Robust LM (error)	22.544 ***
Lagrange Multiplier (SARMA)	55.720 ***
AIC	-21,090
BIC	-21,017
N	5.479

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Author's elaboration.

As mentioned in the third section, the existence of spatial autocorrelation in the residuals can generate inconsistent and/or inefficient estimators. In fact, the simple OLS model presents this problem residuals, which prevents an analysis of its coefficients. Thus, in Table 6 two alternative models seek to correct this problem.

Using models of spatial lag and spatial error, the inequality and the percentage of people living in households with electricity are no longer significant. On the other hand, the negative coefficient of the logarithm of income per capita is unexpected. One possible explanation is that the flow of migration of undergraduate students is more related to the existence of university courses than with good employment opportunities.

Table 6. Models in differences of spatial lag and spatial error.

	Spatial Autocorrelation Model	Spatial Error Model
log(per capita income) in t=0	-0.007 ***	-0.008 ***
log(population) in t=0	0.016 ***	0.017 ***
positions/pop18-24 in t=1	0.050 ***	0.050 ***
Theil index in t=0	0.004	0.005
schooling years in t=0	0.007 ***	0.007 ***
Physicians per 1.000 inhab in t=0	-0.002 **	-0.002 **
% of people with water in t=0	-0.000 ***	-0.000 ***
% people with electricity in t=0	-0.000	-0.000
Child mortality in t=0	-0.000 ***	-0.000 ***
Life expectancy in t=0	-0.001 ***	-0.001 ***
Constante	-0.015 ***	-0.016 ***
ρ	0.124 ***	
λ		0.108 ***
AIC	-21,121	-21,114
BIC	-21,041	-21,041
S.E.	0.035	
LR test	32.580 ***	23.550 ***

Note: *** p<0.01, ** p<0.05, * p<0.1
Source: Author's elaboration.

Moreover, the increase of undergraduate courses positions has a positive impact on the net migration index (greater attraction of students), same result seen for the logarithm of the population size. Life expectancy (in years) becomes significant (in comparison to the models presented before, when it was not significant) and child mortality start having the expected negative sign. Another result opposite to what was expected refers to the number of physicians per 1,000 inhabitants. In fact, the negative sign may indicate that maybe this is not a strong factor to explain the attraction of undergraduate students (and it can even be related to the increased cost of living in the city).

6. Conclusion

This study sought to analyze an aspect of migration that has not been widely explored in Brazil until now, the migration flow of undergraduate students. This theme becomes more relevant considering the possibility that more college students in a particular location may (or may not) be associated with a higher level of future development (depending on whether they stay there after finishing university).

Of all the proposed specifications, the number of positions in higher education institutions in the cities seems to be relevant to explain the attraction of a greater number of young people. This preliminary result has a very important policy implication, which is the fact that an investment by the private or the public sector to increase the number of positions in higher education courses may impact on migratory flows. If such offer grow in most deprived places (which seems to have been the case in recent years), it is possible to reduce regional inequality.

However, it is important to notice that there are significant improvements to be made in this study: the models seem to have low explanatory power, which requires a more careful analysis to include other relevant variables; the characteristics of positions (public or private sectors) could also be added to the model; additional specifications of the models can be proposed, among others. Moreover, it is possible that the results presented here are more associated to a correlation than to a true cause-consequence effect.

Given the preliminary nature of this work, there are many improvements to be made. Still, as a discussion starter on the topic, somehow it has achieved its goal.

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