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Bruno Kawaoka Komatsu,

Naercio Menezes-Filho, Pedro Gandra

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Bruno Kawaoka Komatsu

Naercio Menezes-Filho

Pedro Gandra

Bruno Kawaoka Komatsu
Insper Instituto de Ensino e Pesquisa
Cátedra Ruth Cardoso
Rua Quatá, nº300
04546-042 - São Paulo, SP - Brasil
brunokk@insper.edu.br

Naercio A. Menezes Filho
Insper Instituto de Ensino e Pesquisa
Cátedra Ruth Cardoso
Rua Quatá, nº300
04546-042 - São Paulo, SP - Brasil
naercioamf@insper.edu.br

Pedro Gandra
Insper Instituto de Ensino e Pesquisa
Cátedra Ruth Cardoso
Rua Quatá, nº300
04546-042 - São Paulo, SP - Brasil
pedrojccg@insper.edu.br

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Bruno Kawaoka Komatsu

Naercio Menezes Filho

Pedro Gandra

Ruth Cardoso Chair – Insper e FEA-USP

Abstract

In this paper, we investigate if the expansion of Higher Education in Brazil in the early 21st century has affected the GDP per capita of its municipalities. We applied different economic models on panel data of 5559 municipalities from 2002 to 2017. Our results show that doubling the number of just-graduates in a municipality causes an increase of approximately 0.4% in the GDP per capita 3 years later. We have noticed that the Quota Policy and the ProUni (a public policy that concedes full and partial scholarships on private universities) bring productivity gains to the municipalities, just like private Higher Education Institutions. The impact on GDP was positive too for courses in the areas of Social Sciences, Business, Law, Engineering, Production, Construction, Mathematics, Computation, Sciences and Services.

Resumo

Neste artigo, investigamos se a expansão do Ensino Superior no Brasil no começo do século XXI afetou o PIB per capita de seus municípios. Nós aplicamos diferentes modelos econômicos em um painel de dados de 5559 municípios entre 2002 e 2017. Nossos resultados mostram que dobrar o número de recém-graduados em um município causa um aumento de aproximadamente 0.4% do PIB per capita três anos depois. Verificamos que a política de cotas e o ProUni (uma política pública que oferece bolsas de estudo em universidades privadas) geram ganhos de produtividade aos municípios, do mesmo modo que instituições privadas de Ensino Superior. O impacto no PIB também foi positivo para cursos nas áreas de Ciências Sociais, Negócios, Direito, Engenharia, Produção, Construção, Ciências, Matemática, Computação e Serviços.

JEL classification I23; I25; I26; I28; H52.

Key-words - Educational Economics; Higher Education; GDP Per Capita; Municipalities; Panel Data.

Palavras chave - Economia da Educação; Ensino Superior; PIB per capita; Municípios; Painel.

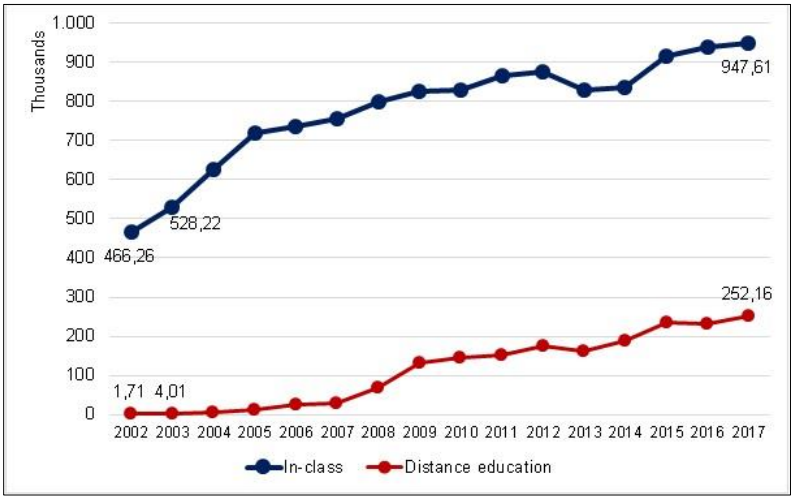
Area 12 – Social Economics and Economic Demography.

1. Introduction

In the past two decades, Brazilian Higher Education has undergone profound changes. The number of students enrolled in graduation courses has risen at an unprecedented rate. Furthermore, the access to university has increased due to programs aimed at expanding vacancies in public universities, as well as policies of student financing and scholarships in private Higher Education Institutions (Andrade, 2017).

One implication of this process is a growth in the number of just-graduated on Higher Education courses in the country. Figure 1 shows this increase through in-class and distance education courses, considering the period between 2002 and 2017. In 2002, only 1712 people graduated from distance courses. In 2017, 252163 people graduated this way - a growth in the order of 1938,69%. Considering in-class courses, the rise is of approximately 103,24%.

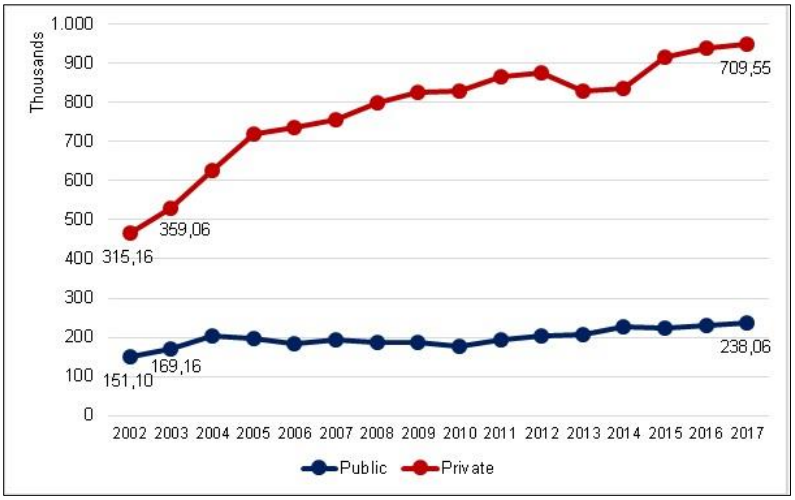
Figure 1 - Graduates in Higher Education Courses



Source: Inep. Self elaboration.

Figure 2 shows the increase in the number of just-graduates in private and public in-class courses through the same period. It is remarkable that the growth was greater in private institutions (+ 169.41%) than in public ones (+ 79.50%).

Figure 2 - Graduates from In-class Higher Education Courses



Source: Inep. Self elaboration.

According to Menezes-Filho et al. (2016), the creation of colleges and universities can boost regional economies. One reason for this is the injection of resources and the creation of jobs, such as those for teachers and researchers. Another reason is the increased productivity of worker's. The authors still point out that there are few studies on the effects of Higher Education in Brazil, probably because its expansion is still relatively recent.

This study considers these aspects and seeks to contribute to the empirical literature that investigates the relationship between Higher Education and economic growth. Based on panel data from Brazilian municipalities between 2002 and 2016, we estimated econometric models relating the number of graduates in face-to-face courses to the GDP per capita. The main question of analysis is how the growth in the number of people with Higher Education has affected the GDP per person of the municipalities.

In our analysis, we investigated the different impacts over the GDP driven by public and private Higher Education Institutions, as well as by the institutions types of academic organization (Universities, University Centers, Colleges, Federal Institutes of Education, Science and Technology, and Federal Technological Education Centers). We also studied the impacts related to different groups of graduation courses. Herein we used the International Standard Classification of Education (ISCED), produced by the United Nations

Organization. It divides the graduation and sequential specific training courses in eight areas (INEP, 2017).

Besides that, we considered the impacts related to some public policies conducted by the Brazilian government in order to expand the access to public universities. The policies considered were the Higher Education Financing Fund (FIES), the University for All (ProUni) and the quota policy. FIES is a program created in 2001 to finance the graduation from students enrolled in paid courses, and serves people with a family income of less than three minimum wages. ProUni is a policy from 2005 with the objective of conceding full and partial scholarships on private universities. The Quota Policy is official in Brazil since 2012 - even though many public universities in the country had already adopted this kind of affirmative action before.

We divided the text into seven sections, counting with this introduction. In the second, we made a review of the literature concerned on the gains in economic growth associated with Higher Education. In the third, we explain the regression models specified to analyze the impact from the expansion of the number of graduates of Higher Education over the GDP per capita of the municipalities. The fourth section describes the prepared database and its main variables. On the fifth, there are the results obtained and a brief analysis of them. The sixth one brings our conclusions and the seventh, the detailed bibliography.

2. Conceptual Background

Our main hypothesis is that the expansion on the number of graduates from Higher Education in a municipality may induce an increase in its GDP per capita. This idea is a consequence of empirical works and theoretical formulations that suggest a positive relationship between this stage of education and economic growth.

Valero and Reenen (2016) list four channels through which this occurs. The first consists of the human capital factor: universities are producers of human capital, and better-prepared workers are the most productive. The second is the innovation, which can have a direct effect (when university researchers produce it) or indirect (in which case graduates enter the workforce

and innovate). The third is that universities can promote strong institutions, providing a platform for democratic dialogue and the sharing of ideas that results in greater product growth. The fourth channel, the "demand", is mechanical. Increased consumption by students and university employees, as well as the purchase of local goods by them, can have an effect on GDP per capita.

Florax (1992) also deals with the positive repercussions of universities on economic growth. That author divides the impacts from the expansion of Higher Education between the "spent" and "knowledge" effects. The short-term "spent" effect involves the injection of resources and the creation of jobs in local economies due to the creation or expansion of educational institutions. The long-term "knowledge" effect involves the contributions for the increase in human capital of Higher Education Institutions.

Valero and Reenen (2016) affirm that few empirical studies explicitly work with the relationship between universities and economic growth. Menezes-Filho et al. (2016) also suggests this. For these authors, when coming from a more general analysis (of social returns from education) to a more specific one (of returns from Higher Education), the number of studies drops a lot.

Considering international empirical works about the theme, we can initially mention the one by Aghion et al. (2009), which analyzes the impact of research activity at universities on North American states. The authors use the instrumental variable method and their results show that exogenous increases in the level of investment in universities affect the growth of the product and the number of registered patents.

With a similar focus, Moretti (2004), using data from the North American Demographic Census, make estimates by ordinary least squares that show a positive relationship between the percentage of graduates in a city and individual wages. This study has also captured externalities from the increase in Higher Education over the rest of the local labor market. According to the author's estimates, an increase of one percentage point in the supply of university graduates increases the wages of those who dropped out of High School by 1.9%; the salaries of High School graduates by 1.6%; and graduates salaries by 0.4%.

While the studies by Aghion et al. (2009) and Moretti (2004) focus on the United States of America, Kantor and Whalley (2014) estimate the local repercussions from agglomerations of university research activities in a sample of urban countries. To this end, they consider the values of donations received by these universities and shocks in the stock market as an instrument for university spending. They have detected evidences of spillover effects for firms - more intense in the case of research-intensive universities and firms close to universities from a technological point of view.

The study held by Valero and Reenen (2016) also deals with international data. These authors use a database with more than 15 thousand universities located in 78 different countries and estimate a fixed effects model at the subnational level between 1950 and 2010. Their results indicate that doubling the number of universities per capita is associated to gains of 4% of GDP per capita in the future. Part of the effect of universities on growth is due to an increase in the supply of human capital and innovations.

Moving on to studies of Brazilian authors, there is one from Petterini et al. (2015). It suggests a method to investigate the impacts over time of new Federal University campuses on the production and income of municipalities in the interior. The authors verified that, among the municipalities of smaller economic and population size, the implantation of new campuses was able to increase the income per capita, mainly because of the effect of the multiplier of expenses. Among the larger municipalities, the new campuses promoted long-term gains for economies, possibly related to productivity gains.

Barbosa Filho and Pessôa (2008), in turn, seek to estimate the internal rate of return to education in Brazil by teaching stages. They found that the returns to education in Brazil are very high (above 10% per year) and that Higher Education is the level of education with the highest awards for those who complete it.

Menezes-Filho et al. (2016) examine how the expansive process of public and private Higher Education in Brazilian municipalities between 2000 and 2010 has related to labor market and average income variables. With panel data and using different econometric specifications, their results indicate that the growth

of Higher Education is associated with an increase in the average salary, occupancy rate and per capita income.

The present work seeks to contribute to this literature, using panel data from 2002 to 2016 and different econometric models. Our intention is to assess the impact over the municipal GDP per capita related to the increase in the number of graduates from Higher Education courses in Brazil.

3. Econometric Methodology

It is reasonable to suppose the existence of a time interval until the effects from the expansion of the number of graduates in a municipality appears on its GDP per capita. Because of this, in our first econometric specification, we included lagged values of the ratio between the number of graduates and the local population. We initially estimated the following equation between 2009 and 2016:

$$ln(GDP)_{i,t} = \alpha + \beta\, ln(\frac{grad}{pop})_{i,t-3} + \delta\, ln(pop)_{i,t-3} + \theta_t + \gamma FU_i + \rho_{i,t} + \varphi_{i,t} + \varepsilon_{i,t} \quad (1)$$

In which $GDP_{i,t}$ is the municipality i GDP per capita in the year t. In turn, $grad_{i,t}$ is the amount of graduates in face-to-face courses in this local plus 1 (to include municipalities without graduates in the analysis). $Pop_{i,t}$ is the population from the municipality; θ_t is an year *dummy;* and $FU_{i,t}$ is a *dummy* for the federative unit from the municipality. The percentage of graduates from the male sex ($\rho_{i,t}$) and the percentage of graduates who declared themselves white ($\varphi_{i,t}$) were also included as controls, meanwhile $\varepsilon_{i,t}$ is the error term.

It is important to point that the population has been included as a control because populous regions tend to demand more universities. Besides that, it was included lagged because, as Valero and Reenen (2016) show, an elevation on the number of graduates could simply reflect a bigger demand by university vacancies due to a precedent population growth.

Given that there are many individual characteristics of the municipalities, which are unobserved, invariant on time and can drive impacts over the GDP

per capita, we have recurred to a second specification, including three-year differences to eliminate fixed effects. The estimated equation was:

$$\ln(GDP)_{i,t} - \ln(GDP)_{i,t-3} = \alpha + \beta \left[\ln\left(\frac{grad}{pop}\right)_{i,t-3} - \ln\left(\frac{grad}{pop}\right)_{i,t-6}\right] + \delta\left[\ln(pop)_{i,t-3} - \ln(pop)_{i,t-6}\right] + \theta_t + \gamma FU_i + \rho_{i,t} + \varphi_{i,t} + v_{it} \quad (2)$$

In which, in the controls, we have the lagged population growth, defined by $\ln(pop)_{i,t-3} - \ln(pop)_{i,t-6}$. The new error term is set as v_{it}.

Also in order to control for specific trends of each municipality, a model with fixed effects was built, in a specification similar to (2). This equation is:

$$\ln(GDP)_{i,t} - \ln(GDP)_{i,t-3} = \alpha + \beta \left[\ln\left(\frac{grad}{pop}\right)_{i,t-3} - \ln\left(\frac{grad}{pop}\right)_{i,t-6}\right] + \delta\left[\ln(pop)_{i,t-3} - \ln(pop)_{i,t-6}\right] + \theta_t + \rho_{i,t} + \varphi_{i,t} + b_{it} \quad (3)$$

In which b_{it} is the error term and β is the fixed effects estimator.

We prepared a variant of the model (3) with the purpose of understanding the impacts over the GDP per capita related to specific groups of graduates. In this model, we used the natural logarithm of the ratio between the number of graduates from specific categories and the population.

As stated earlier, the categories considered were the number of graduates with Fies, ProUni and quotas, the number of graduates by areas of knowledge, by Higher Education institution administrative category (public or private) and by type of academic organization from the institution. In all these cases, we added the number one to the variables of graduates. We can generalize this model according to the following equation, for each category of graduates j:

$$\ln(GDP)_{i,t} = \alpha + \beta \ln\left(\frac{grad}{pop}\right)_{i,t,j} + \delta\left[\ln(pop)_{i,t-3} - \ln(pop)_{i,t-6}\right] + \theta_t + \rho_{i,t} + \varphi_{i,t} + c_{it} \quad (4)$$

The eight major areas of knowledge from the ISCED classification are in Table 1 below, as well as the specific areas that correspond to each one of

them. This will serve for a better interpretation of the results shown in section 5 of this work.

Table 1. Knowledge Areas (ISCED)

General Areas	Specific Areas
1. Education	Teacher training; Education Sciences.
2. Humanities and Arts	Arts; Humanities and Letters.
3. Social Sciences, Business and Law	Social and behavioral sciences; Journalism and Information; Commerce and Administration; Law.
4. Sciences, Mathematics and Computation	Life Sciences; Physical Sciences; Mathematics and Statistics; Computing.
5. Engeneering, Production and Construction	Engineering and related professions; Production and Processing; Architecture and Construction.
6. Agriculture and Veterinary	Agriculture, forests and fisheries resources; Veterinary.
7. Health and Social Warfare	Health; Social Service.
8. Services	Personal services; Transport services; Environmental Protection; Security services.

Source: Inep, 2017. Self elaboration.

Besides that, it is important to consider two issues. First, an endogeneity problem might arise from our specifications. Second, the migration from people who graduated on Higher Education courses may also generate problems in our results.

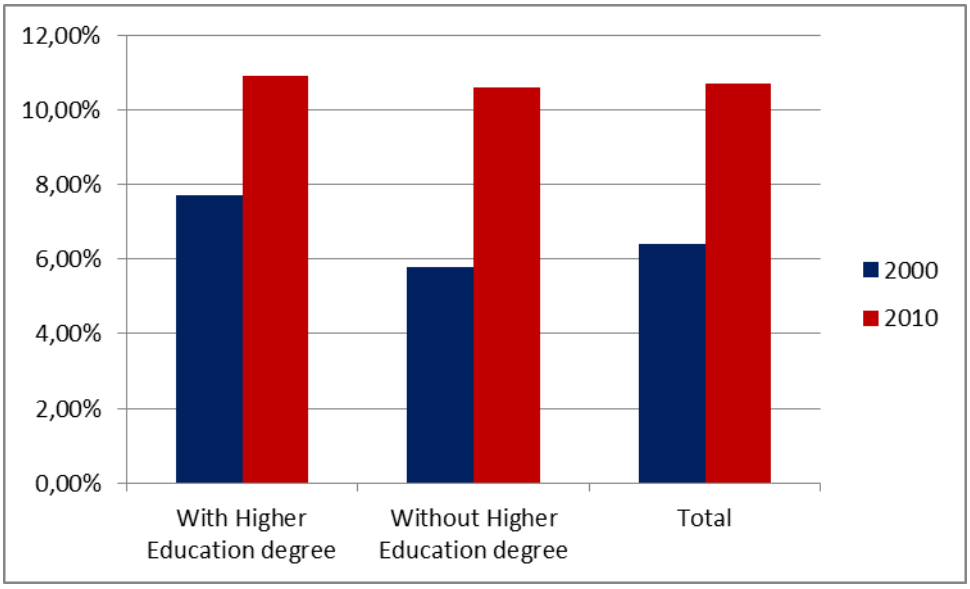
With regard to the first problem, our identification hypothesis is that changes in the demand for Higher Education students follow a linear trend. Establishing this is necessary because if universities open new courses in the municipalities anticipating a sudden and local demand change by Higher Education vacancies, we would only be controlling for specific trends from each municipality. Thus, without this identification hypothesis, our estimations would be biased.

The second problem is related to the fact that there is a high percentage of people with a Higher Education degree that emigrate after concluding its course. If our models are correct, these migrants will raise the GDP per capita

of the municipalities for where they go, and decrease the GDP of where they leave. Unfortunately, we cannot obtain information about the percentage of migrants on the Brazilian Higher Education Census. Thus, we have not used this as a control on our regressions.

Figure 3 shows the trend of the percentage of people who migrate, according to the Brazilian Demographic Census in its 2000 and 2010 editions. This figure shows that between these two dates this number has increased.

Figure 3 – Percentage of Migrants



Source: Brazilian Demographic Census 2000 and 2010.

4. Data

The databases used (all public and annual) were the Higher Education Census, the Demographic Census, the Brazilian municipalities GDP series and the series of population of the municipalities. While the first is available on the website of the National Institute of Educational Studies and Research Anísio Teixeira (Inep), the others we found on the website of the Brazilian Institute of Geography and Statistics (IBGE).

The Higher Education Census is a research tool that presents information about Higher Education institutions, graduation courses and the students and teachers involved in them. From 2009, it started to present its information's with the student as the basic unit of investigation. This made it possible to

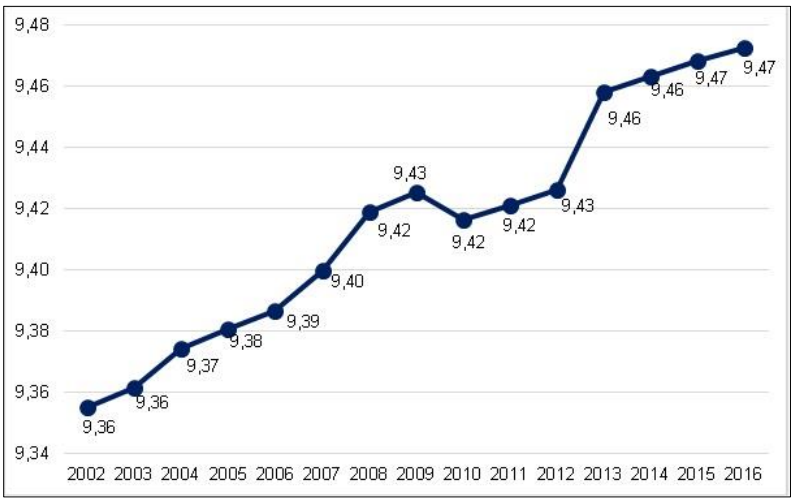
obtain important data about the graduates, such as the percentage of those who used Fies, ProUni and who entered Higher Education institutions through vacancy reservation policies.

The GDP series of the municipalities, made available by IBGE, presents, at 2010 prices (and multiplied by one thousand), the GDP values of each municipality. The population of the municipalities is available through the series of population of the municipalities, also made available by IBGE. There are years in which the estimation has not been made, in which case the data were obtained from other bases: the counting years (2007) and the Demographic Census (2010).

The final sample presents information from 5559 of the 5570 Brazilian municipalities, namely, those who presented complete data of GDP per capita and population between 2002 and 2016. With this, information was lost on some municipalities, however, there is the number of units constant between regressions.

Previously in this work, we mentioned that we used population as a control in the regressions because an increase in the level of graduates could simply reflect a greater demand for universities due to an increase in population. It appears that a population growth has really occurred (figure 4).

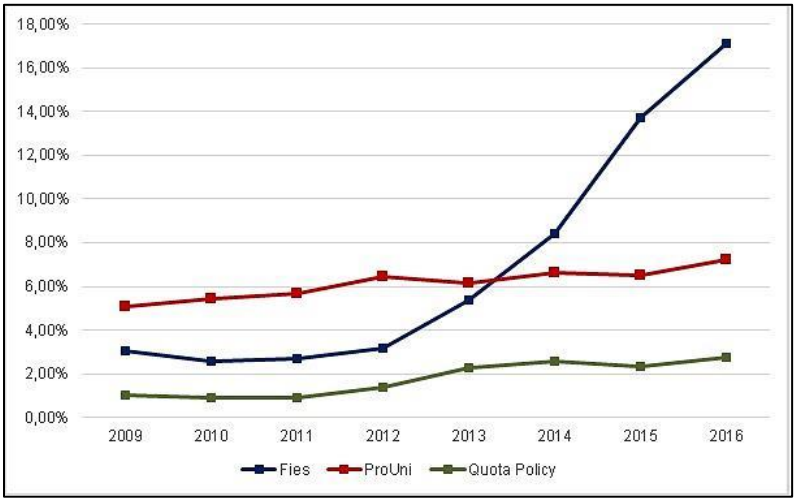
Figure 4 - ln(average population) by municipality



Source: IBGE. Self elaboration.

The behavior of the annual percentage of graduates with Fies, ProUni and quotas is in Figure 5 below. This figure shows a significant increase in the percentage of graduates from these categories - in particular, those who had Fies. In principle, this can generate effects on the municipalities' GDP per capita.

Figure 5 - Percentage of graduates benefited from public policies



Source: Inep. Self elaboration.

5. Empirical Evidence

Table 2 shows the results obtained for the initial regressions of this work, which consider the years from 2009 to 2016 and include lagged values of graduates and population. In (1), we have the results for the specification with only time lags; in (2), with differences; and, in (3), differences with fixed effects.

We noticed evidences that the number of graduates in Higher Education institutions per capita relates with the GDP per capita of the municipalities. Using the population as a control, we found coefficients positive and statistically significant (at the level of 1%) for the logarithm of the number of graduates and for the lagged growth in the number of graduates. The results from specifications (1) to (3) suggest that doubling the number of graduates per capita in a municipality generates an increase of about 0.4% of the GDP per person in three years.

Table 2 - Regressions between 2009 and 2016

Model	(1)	(2)	(3)
Dependent variable	ln (GDP per capita)	GDP growth per capita	GDP growth per capita
Graduates	0.0402*** (0.00195)	0.00419*** (0.000855)	0.00424*** (0.00106)
Population	0.0926*** (0.00276)	0.0521*** (0.0135)	0.274*** (0.0182)
Constant	2.154*** (0.0326)	0.153*** (0.00287)	0.144*** (0.00282)
N	44,472	44,472	44,472
N municipalities	5,599	5,599	5,599
R^2	0.553	0.104	0.139
FU dummies	Yes	Yes	No
Year dummies	Yes	Yes	Yes
% white graduates	Yes	Yes	Yes
% men graduates	Yes	Yes	Yes

Notes: robust standard errors for heteroscedasticity in parentheses. Significance: *** p<0.01, ** p<0.05, *** p<0.1.

Table 3 shows the results of the other regression model, which include the variables mentioned in the econometric methodology section. This table shows that the ProUni has a positive impact on the GDP per capita growth of the municipality, since the coefficient reported for this policy is positive (0.182) and statistically significant at the level of 1%. The same is true for the Quota Policy, which has reported a positive coefficient (0.0889) at the 5% level, but is not true for the Fies, which reported a negative coefficient (-0.0468) at the 1% level.

The productivity gains of the municipalities seem to be more associated with the increase in the number of graduates in private institutions than in public ones. The coefficient reported for the ratio between graduates and population in private Higher Education institutions is 0.0344 and significant at the 1% level. Table 3 indicates that increasing the number of graduates in the area of Social Sciences, Business and Law brings positive impacts on the product of the municipalities, as well as courses in the areas of Engineering, Construction, Production, Sciences, Mathematics, Computation and Services. It also shows that Higher Education Universities, University Centers and Colleges drive positive impacts over the GDP per capita.

Table 3 - Regression for specific categories of graduates from 2009 to 2016

Variables	GDP growth per capita
Graduates – ProUni	0.182***
	(0.00558)
Graduates – Fies	-0.0468***
	(0.00518)
Graduates – Quota Policy	0.0889**
	(0.00422)
Graduates – public institutions	-0.0289***
	(0.00393)
Graduates – private institutions	0.0344***
	(0.00475)
Graduates – Education	-0.0419***
	(0.00405)
Graduates – Humanities and Arts	-0.0124*
	(0.00506)
Graduates – Social Sciences, Business and Law	0.113***
	(0.00473)
Graduates - Sciences, Mathematics and Computation	0.0359***
	(0.00518)
Graduates - Engineering, Production and Construction	0.00580***
	(0.00427)
Graduates - Agriculture and Veterinary	-0.00495
	(0.00369)
Graduates - Health and Social Werfare	-0.00289***
	(0.00387)
Graduates – Services	0.0277***
	(0.00473)
Graduates – Universities	0.0220***
	(0.00377)
Graduates – University Centers	0.00943***
	(0.00311)
Graduates – College	0.0173***
	(0.00366)
Graduates – Federal Institutions	-0.0122***
	(0.00477)
Graduates – Federal Centers	-0.0477***
	(0.00548)
Lagged population growth	0.321***
	(0.0374)
Constant	3.561***
	(0.0351)
N	44,472
N municipalities	5,559
R^2	0.157
Year dummies	Yes
% white graduates	Yes
% men graduates	Yes

Notes: the variables of graduates correspond to the natural logarithm from the ratio between the number of graduates (plus 1) and the population. Robust standard errors for heteroscedasticity in parentheses. Significance: *** p<0.01, ** p<0.05, *** p<0.1.

6. Conclusion

In this article, we sought to investigate the relationship between Higher Education and the GDP per capita of Brazilian municipalities. For this purpose, we made estimates for the relationship between the proportion of people with Higher Education and the GDP per capita, using a panel of municipalities from 2002 to 2016. We were expecting to verify positive effects on the product, due to the injection of resources into the economy, the generation of jobs and the increase in human capital by the increase in the number of graduates.

The results for the specified regressions corroborate this thesis, suggesting that the number of graduates in Higher Education institutions in a municipality positively correlates with its GDP per capita. More than that, the data indicate that the growth in the number of graduates generates GDP gains in the future. In general, we noted that doubling the number of graduates was associated with an increase of around 0.4% of GDP per person in three years.

We found that courses in the area of Social Sciences, Business and Law have positive and significant impacts on the productivity of the municipality. This might relate to the fact that this is the area with the highest number of graduates in Brazil (Menezes-Filho et al., 2016). We also captured positive impacts for courses in the areas of Engineering, Production and Construction, Sciences, Mathematics and Computation and Services. The percentage of graduates who used the ProUni and the Quota Policy seems positively related with the municipal GDP per capita.

In addition, the greatest productivity gains are associated with private Higher Education Institutions. As Menezes-Filho et al. (2016) attest, it is possible that the contents of private courses relate more directly to the skills required in the job market. Finally, Colleges, Universities and University Centers also had positive and significant effects on GDP per capita.

We understand that the debate on Higher Education (especially in Brazil) is still incipient. In this sense, we sought to contribute marginally to this debate, showing the relationship which can be verified between the number of graduates and the GDP per capita of the municipalities. However, we could have addressed numerous other relevant issues, such as the relationship

between the proportion of people with Higher Education and the number of patents registered, or between this proportion and average wages. Further studies on how Higher Education impact a country can help in understanding a number of relevant issues.

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