The Expansion of Higher Education in Colombia: Bad Students or Bad Programs?*

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Abstract

A rapid expansion in the demand for post-secondary education triggered an unprecedented boom of higher education programs in Colombia, possibly deteriorating quality. This paper uses rich administrative data matching school admission information, socio-economic characteristics of the young graduates, standardized test scores pre- and post-tertiary education and entry wages, to assess the heterogeneity in the value added generated by new higher education programs. Our findings show that once we account for self-selection the penalty of attending a recently created program, which initially appeared to be quite large, becomes close to zero.

JEL codes: I23, I24, I26

Keywords: Returns to Tertiary Education, Heterogeneity, Value Added of Higher Education, Colombia

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1 Introduction

Latin America experienced a rapid expansion of high school enrollment, which together with falling dropout rates resulted in a surge of secondary graduation during the last two decades. High school graduation increased by 45 percent, from 31 percent in the early 1990s to 45 percent in the late 2000s (Bassi, Busso, & Muñoz, 2015). Such a rapid expansion in the coverage and graduation rate of secondary schooling mechanically induced higher demand for tertiary education.

To cope with increasing demand, the number of new universities and new degrees in existing universities increased steadily during the 2000s. Between 2005 and 2010, 308 new universities were created in Mexico (a 14 percent increase), 308 in Brazil (6.8 percent increase) and 74 in Peru (6.5 percent increase), (CINDA, 2011). In Colombia and Chile the supply expansion took place through a boost in the programs offered by existing institutions.

This rapid (and often disordered) expansion in the supply of higher education has raised concerns about the quality of new programs and institutions. Low wages and employment rates of college graduates are often linked to the proliferation of so-called *"garage universities"*. Moreover, increasing enrollment can also result in lower average quality graduates if the marginal student that access higher education is of lower quality than the average student. A careful examination of the value added of new programs and institutions needs to consider who accesses such programs.

In this paper we identify how the rapid expansion in the supply of higher education system in Colombia affected heterogeneity in the value added of a tertiary degree and labor market outcomes across programs. Our study uses very rich administrative data from Colombia that contains key information to answer this question. In particular, our data has detailed information of student background at the end of high school, in addition to the results on the standarized test score. This information, together with employment, wages and test scores after graduation, allows us to assess the value added of different programs purged by selection issues. To our knowledge, this is the first paper that assesses heterogeneity across programs in their value added and labor market prospects in a context of rapid introduction of new programs and institutions.

Colombia constitutes an excellent case study for the purpose of our study for two additional reasons: First, the country experienced the highest increase in high school graduation rates in the region. Specifically, high school graduation among individuals in secondary schooling age went from 20 percent in the early 1990s to 47 percent in the late 2000s. Second, the raise in the number of higher education programs was unprecedented. In one decade, the number of programs almost doubled, growing from 3,600 in 2001 to 6,276 programs in 2011.

Our units of observation are individuals that graduated from tertiary education and entered into the formal labor market after finishing their professional, technical or technological studies. The information includes i) standardized test scores for high school and college, together with socio-demographic characteristics collected at the time of the exam; ii) labor market conditions after graduation, including employment, sector and wages; and iii) the institution and higher education program attended. With this information, we run a reduced form model to identify the effect of attending a new program on college standardized test scores, wages and the probability of being a formal employee. Given the rich set of covariates included in our dataset, we are able to control for baseline quality/ability of the student (proxied by the high school standardized test score), the high-school attended, some socio-demographic characteristics including the individual and parental background. Following Oster (2015), we show that once we include a rich set of observable baseline characteristics of students, selection based on unobservables remains fairly limited.

We find a 15 percent unconditional difference of wages between the graduates from new and existing programs. Under our preferred specification this wage differential almost disappears once we control for self-selection. We obtain similar results when we examine test scores at college exit and the probability of being formal. Hence, the evidence suggests that the new programs created in the 2000s are of similar quality of existing programs. Two types of selection are behind differences in unconditional means. Lower returns of recently created higher education degrees are, for the greater part, due to lower quality of the marginal student accessing those programs. The remaining share of the penalty is related to the fact that the new programs are created in areas of study with traditionally low returns in the labor market.

The paper is organized as follows. Section 2 summarizes the related literature. Section

3 discusses the institutional background of the higher education system in Colombia and provides some stylized facts. Section 4 describes in detail the administrative data sets used in this study. Sections 5 and 6 discuss the empirical strategy and present the main results, respectively, including a sub-section with robustness checks. Finally, Section 7 provides some policy recommendations and concluding remarks.

2 Related Literature

A number of studies establish that the expansion in the demand for tertiary education in the US may have resulted in lower quality of the marginal graduate, and hence lower returns to schooling. Evidence by Carneiro, Heckman, and Vytlacil (2011) and Moffitt (2008) argue that the marginal returns to college fell with the increase in college attendance. Looking at a longer period of time, Carneiro and Lee (2011) study the years between 1960 and 2000 and Juhn, Kim, and Vella (2005) study the years between 1940 and 1990, showing that the increase in college enrollment reduced the quality of college graduates and their premiums mostly for the younger cohorts. In the paper by Carneiro and Lee the reduction accounts for 6 percent of the college premium.

When the higher education system expands, reductions in quality may be driven by demand and/or supply forces. On the demand side, increasing the pool of students might be associated with a raising share of low ability students, if the marginal student is less able than the average attendant. On the supply side, a rapid expansion in demand may generate congestion effects in the classroom, lowering the quality of the services provided. Similarly, existing institutions may need to expand, or new institutions may need to be created to cope with new demands. Recruiting good quality teachers and staff, creating new high quality labs and infrastructure is costly. In this context, the deterioration of supply may lead to more heterogeneous and potentially lower returns of higher education. Our paper contributes to the literature by disentangling the supply and demand channels.

Our paper is related to a literature that examines the recent evolution of returns to schooling in Latin America. Latin America witnessed a rapid increase in demand for tertiary education, as many policies implemented in the last two decades provided incentives for high school attendance and completion[1]. The subsequent decline in the education premium during the 2000s was interpreted as a sign of the demand-supply framework in operation. However, Gasparini, Galiani, Cruces, and Acosta (2011) and Fernandez and Messina (2016) show that the increase in college graduates is not enough to explain the decline in the college premium.

Some authors have postulated that this decline could instead reflect a reduction in the quality of the marginal graduate. Castro and Yamada (2013) show that the decline in the college premium in Peru is related to a "deconvexification" in the returns to education over the past 15 years, a feature consistent with the declining quality hypothesis. Lopez-Calva (2016) discuss evidence in Argentina, Brazil and Mexico that is suggestive of a degraded quality among recent higher education cohorts.

Recent studies highlight the immense heterogeneity in the returns to schooling, and how this hegerogeneity may reflect differences in value added across programs or student selection. In the US, Cunha and Miller (2014) use administrative data from Texas to estimate the value added of different schools on several labor market outcomes. They find that the large differences in the returns to different colleges almost disappear after self-selection has been accounted for. In Latin America. Reyes, Rodriguez, and Urzua (2013) and González-Velosa, Rucci, Sarzosa, and Urzúa (2015) find significant heterogeneity in the returns to post-secondary education in Chile and Colombia. Moreover, they find that the returns to higher education are negative for a large number of students. Our paper complements these studies by focusing on the value added of new vs. traditional programs in a period of rapid expansion of the higher education system. As such, we disentangle the role of supply and demand forces in the observed heterogeneity.

Our paper is also related to a recent literature that highlights the importance of institution (or program) reputation in student selection and outcomes. Hastings, Neilson, and Zimmerman (2013), Hoekstra (2009) and Saavedra (2009) use regression discontinuity approaches based on a standardized college entry tests, to identify the causal effect of attending a type of degree in Chile, a flagship state university in the United States, and a better quality school in Colombia, on a set of final outcomes including wages. A closely

[1] Fiszbein, Schady, and Ferreira (2009) documents how conditional cash transfer (CCT) affected high school attendance in the region. For the specific case of *Familias en Acción*, the Colombian CCT program, see Baez and Camacho (2011).

related study by MacLeod, Riehl, Saavedra, and Urquiola (2015) also examines the case of Colombia to test how school reputation, measured by the average admission test score of its graduates, is correlated with the students' wages. One advantage of our approach is that we examine both, test scores at exit of higher education and wages. Possible reputation effects will affect wages, but not test scores in standardized exit exams. Hence, by comparing the impact of new programs on these two outcomes we can assess if reputation effects may be behind some of the observed labor market penalty for the young graduates receiving these new programs.

3 Background: description of higher education in Colombia and some stylized facts

3.1 Description of the System

The tertiary education system in Colombia is divided into undergraduate and graduate programs[2]. A program is a degree offered by a specific Higher Education Institution (HEI) registered in the *National Information System for Higher Education* (SNIES)[3]. There are 359 Institutions of Higher Education registered in the SNIES, around 30 percent of them are public. Some Institutions have more than one branch in other geographic locations. For the purpose of our study, we will assume that HEI branches are part of the same HEI[4].

The tertiary education institutions can be of four types and their type determines the kind of programs and level of degree they can offer. These are: 40 Professional Technical Institutions, 60 Technological Institutions, 125 University Institutions which offer specializations as its highest degree, and 134 Universities that are the only ones that can offer masters or PhD degrees. Starting in 2003, the Ministry of Education regulated some minimum quality requirements for all higher education programs to operate[5].In addition to this required *Qualified Registry* for each program, a Higher Education Institution can

[2]Regulated by *Ley 30* of 1992

[3]Programs are registered under the SNIES with a code. The code of a program may change over time if changes in the curriculum required to get a new certification or accreditation. We treat programs that change codes as an exit of the original program and the entry of a new program.

[4]If a new branch is given the same institutional code it will be considered as the same HEI.

[5]Articles 58 to 60 of the Law 30 of 1992 regulate the creation of public institutions and the act 1478 of 1994 regulate the creation of private institutions. The act 2566 of 2003 and the law 1188 of 2008 creates parameters related to the minimum quality required by a higher education system to offer a new program.

apply for a non-mandatory certificate of higher quality accreditation. This certificate requires a longer process of auto evaluation and an evaluation by peers. HEI with higher quality accreditation do not need to get the *Qualified Registry* to offer a new program. [6]

3.2 Evolution of the Higher Education System in Colombia

During the last decade, Colombia witnessed a large and rapid expansion of secondary education coverage, a feature shared with most Latin American countries. The net enrollment rate in Latin America grew from 58 percent in 2004 to 74 percent in 2012 (OECD/CAF/ECLAC, 2015). Figure 1 shows that the number of high-school graduates in Colombia increased by 30 percent in a decade. [7] Even larger increase in college enrollment followed; during the same period, college enrollment increased by 48 percent[8].

Figure 2 shows an increase in the number of graduates from three different types of tertiary education programs (or institutions) during the last decade. We use the record of graduates at the program level reported in the SNIES to define a new program or institution. We define new programs (or institutions) as those whose first graduates finished school in 2002 or after. We have two types of new programs: the programs that were opened in an existing institution, and the programs offered by a newly created institution. Hence, new graduates are divided according to the type of program studied into three groups: those students graduated from a new program in an existing institution (light red), those students graduating from new institution (dark red) and those graduating from an existing programs in an existing institution (gray).

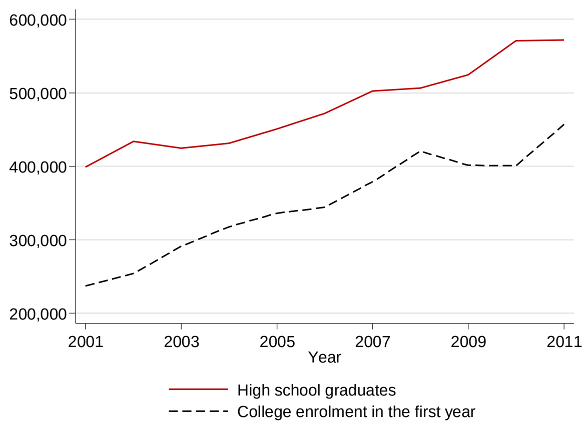
The rapid surge in college enrollment is matched with the type of programs (or institutions) of origin. The figure makes apparent that the existing programs did not grow in the number of graduates and that most of the new demand for tertiary education was met by creating new programs in existing higher education institutions. By 2011, around 220,000 students graduated from a higher education institutions: 8 percent obtained their degree from a new institutions and 52 percent from new programs offered by an existing

[6] More information about the accreditation process can be find in the following link. http://www.cna.gov.co

[7] High school graduates are calculated with the number of students taking the ICFES Saber 11 standardized test excluding duplicates and students suspicious of fraud or without answers).

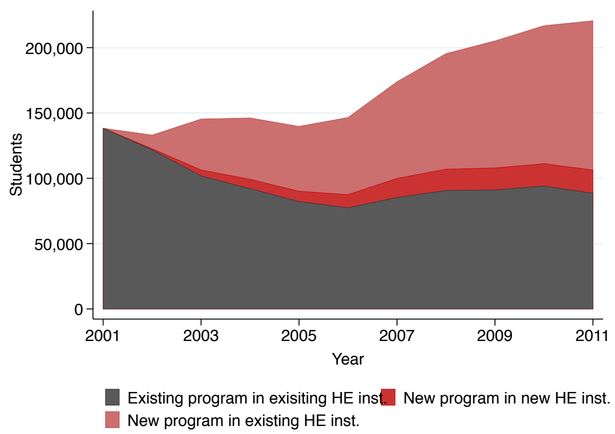
[8] Information of college enrollment in the first year comes from the National System of Higher Education Institutions (SNIES).

Figure 1: Evolution of the Demand of Higher Education



Notes: High school graduates is calculated with the number of students taking the ICFES Saber 11 standardized test. This test is required to enroll in most higher education institutions (the data presented here excludes the students suspicious of fraud).College enrollment in the first year includes all the students reported in the National System of Higher Education Institutions (SNIES). The figure excludes all the students from graduate programs and from the National Apprenticeship Service (SENA).

Figure 2: Evolution of the number of graduates



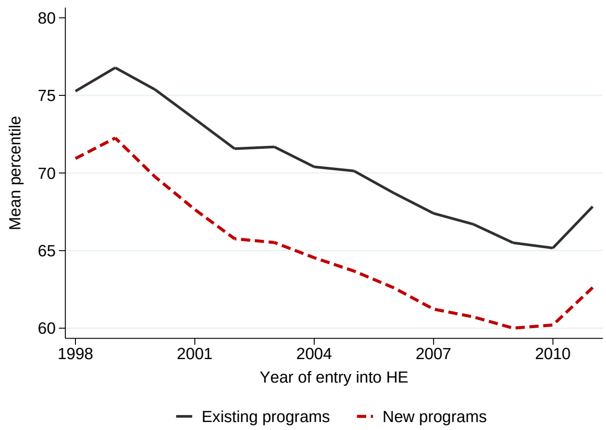
Notes: The figure shows the number of students that graduated from a Higher Education Institution (HEI) as reported in the National System of Higher Education Institutions (SNIES). Graduates from the National Apprenticeship Service (SENA) are excluded from this figure. New institutions (or programs) are those whose first graduate finished school in 2002 or after.

institution. The number of higher education programs doubled in just one decade.[9]

The previous two figures describe the evolution in the number of graduates and their characteristics. Now we focus on the evolution of the quality of students accessing the higher education system. Quality will be measured by the percentile in a standardized cognitive test (Saber 11) that is administered to all high school graduates. The results are shown in Figure 3. There is a clear reduction of 10 percentage points in the quality of students that access tertiary education during the previous decade.

Once we divide the scores into the group of students that enter into the new and existing programs, the pattern of lower quality appears. More importantly, new programs receive lower quality students. The average percentile in Saber 11 is 5 percentage points lower than the average of students enrolled in existing programs. Moreover, these differences are persistent over time.

Figure 3: Test scores at entry into higher education by type of program



Notes: The Figure shows the evolution in the mean percentile in the SABER 11 standarized test for the students entering the higher education system. New institutions (or programs) are those whose first graduate finished school in 2002 or after. Source: Sistema de Prevención y Análisis a la Deserción en las Instituciones de Educación Superior (SPADIES).

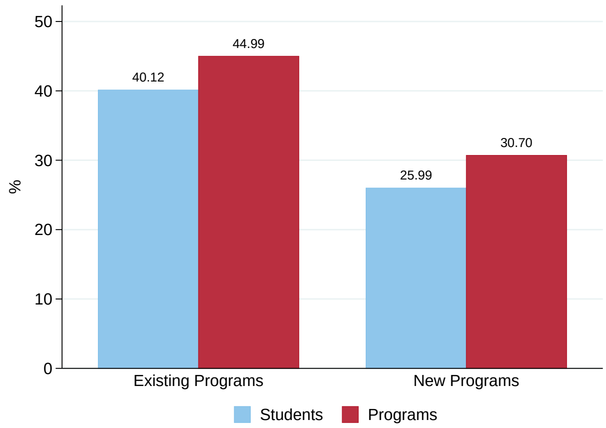
The new programs, not only receive students of lower average quality, but these programs were created in institutions with lower quality standards. As mentioned previously, starting in 2003 Colombia introduced a minimum quality requirement for all higher education programs. In addition to this requirement by program, a Higher Education Institution could opt to have a (non-mandatory) certificate of higher quality accreditation, which is

[9]This figures include all the graduates, not only undergraduate degrees. However, the pattern is very similar if we restrict only to professional, technical and technological degrees.

the most demanding to obtain, and is thus of higher recognition and reputation.

As shown in figure 4 almost 50 percent of the existing programs belong to a HEI with certificate of higher quality accreditation, compared to 30.7 percent in the case of new programs. This indicates that the recent supply expansion in Colombia may have been accomplished by reducing the quality of the marginal program.

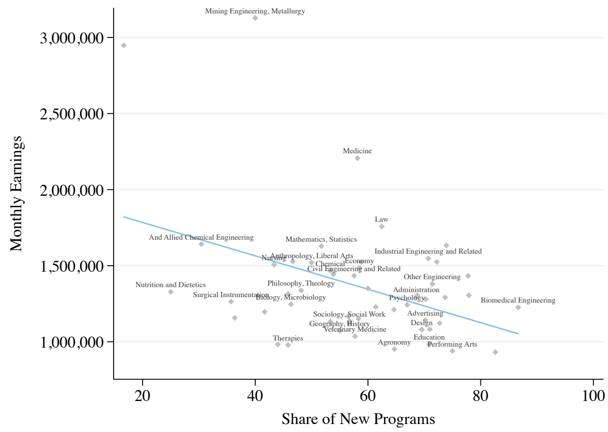
Figure 4: % of Programs/Students in Institutions with Accreditation.



Notes: This Figure shows the percentage of new or existing Programs/Students in a university with higher quality accreditation.

Up to this point, we have documented some stylized facts that complement the anecdotal evidence regarding the big expansion and low quality of the higher education in Colombia; this consistently explains the smaller contribution of higher education in terms of the returns to schooling overtime. In this sense, trying to understand and quantify this phenomenon, this paper will assess the heterogeneity in the value added generated by new programs. Figure 5 shows suggestive evidence of the negative correlation that exists between wages and the share of new programs by degree. It is important to consider that this simple correlation does not account for self-selection that might explain a portion of this apparent negative return. As our empirical section will show, the returns to higher education of new programs, that initially appear to be strongly negative as presented in figure 5, become smaller and close to zero once the model includes a big set of controls.

Figure 5: Share of New programs by Degree vs Monthly Earnings



Note:

4 Data

4.1 Data sources

This study uses three sources of administrative data from the Colombian Government, including information on, standardized test scores taken by students at the end of high school and tertiary education, wages for those students that graduated from tertiary education, and a list of all tertiary education institutions and programs available in the period of study with their characteristics.

4.1.1 Standardized test scores

The Colombian Institute for the Assessment of Education (ICFES) is in charge of measuring the quality of education at all educational levels. For this purpose, ICFES evaluates the students with standardized test scores and collects individual characteristics in several stages, 3rd, 5th, 9th, 11th grade and at the end of college. In this paper we use information on the tests administered during the last year of high-school (11th grade) and after finishing college, known as Saber 11 and Saber Pro, respectively[10]. Students also fill out a questionnaire at the time of taking these tests that includes detailed socio-demographic information of their households such as: socioeconomic status, number of syblings, housing

[10]Before 2010 the Saber 11 was called ICFES and the Saber Pro was called ECAES.

characteristics, father's and mother's education, among others.

Saber 11 exam was first administered in 1968. It was designed to help in the admission processes of tertiary education institutions in Colombia. Starting in 1980, the Saber 11 test and a high school diploma were required for admission and registration into a higher education institution. Even if some institutions have an additional entry exam, the students need to present the Saber 11 test in the process of application and this is required to fulfill the admission´s process. In our empirical exercise, we use the score of the Saber 11 test, the school were the individual graduated from, and the socio-demographic characteristics of the individual and his family which are included in the registration form at the time of the exam.

Saber Pro is a standardized test evaluating last year college students in generic and specific competences. In 2007, all the degrees were evaluated for the first time; however, the exam was not mandatory as a pre-requisite for graduation until 2009[11]. Students who have completed at least 75% of a higher education program (technical, technological or professional) may register to take the exam. We use the test score as a measure of the quality of the higher education program. Once we control for test scores at admission (Saber 11), the scores in Saber Pro become a measure of the value added of the higher education program. In our study we only use data from this exam for the years between 2011 and 2013. Even though there is data for 2009 and 2010, we do not include it as there might be self-selection of the students that decide to present the exam when it was not mandatory.

4.1.2 Graduates' Wages

The *Integrated Contribution Liquidation Form -PILA* [12] collects information on wages and economic sector for all formal workers that pay their contributions to the social security system. This system of information exists since July 2007, but during the first year of operation the coverage was incomplete. Thus, we use information from the PILA starting in 2008. To check the reliability of our data, we did some comparisons with similar population from the household surveys (workers who are 26 year old or younger and have

[11] Law 1324 of July 2009

[12] See the following links for more details in http://www.mineducacion.gov.co/1621/w3-article-270404.html and http://www.minsalud.gov.co/sites/rid/1/CARTILLA%20-PILA.pdf

at least a higher education degree). We found that formal wage employees represent 51.6 percent of the population in the household surveys compared to 52.2 percent in our estimating sample, which gives us confidence in terms of the quality of the data that we are using. At the same time, the low shares show the importance of informality in a country such as Colombia, an issue to which we return later.

4.1.3 Higher Education Institutions

The *National System of Higher Education Institutions (SNIES)* collects information of the higher education system in Colombia. This system integrates a database with information about the tertiary education institutions, programs, and the students enrolled and graduated from all the different programs. With this data it is possible to identify the institution attended, the degree earned, and the graduation year of all the individuals.

The Ministry of Education constructs the *Labor Observatory* by combining the records of the graduates from higher education collected by the SNIES with social security records from PILA. It is important to note that we exclude from our analysis the Servicio Nacional de Aprendizaje (SENA), a public vocational training institution. In the SNIES there are 359 HEI registered and we observe 289 in our data. There are 55 different degrees and approximately 4,600 programs.

4.2 Estimating sample

With the data previously described, we are able to create two databases that allows us to identify the effect of the "new programs" on cognitive tests measures at the end of college, the probability of being a formal worker, and wages received in the formal labor market. Our outcomes of interest will be the percentile in the standardized test score at the time of graduation from a HEI (Saber Pro), the probability of being formal or being a wage employee, and the wage.

The first sample combines data from students who took the Saber Pro and Saber 11. The sample includes students who completed Saber Pro between the second semester of 2011 and the second semester of 2013 and Saber 11 between 2001 and 2011. Our working sample includes 303,916 students. s A1 **??** in the appendix provides details on the number of Saber Pro observations and the merge with Saber 11.

The second sample used in the empirical analysis matches the information from the *PILA*, the records of graduates from the SNIES and data containing the standardized test scores from high school, Saber 11. Our sample includes all students who took the Saber 11 exam between 2002 and 2003 and graduated from higher education between 2007 and 2011. We observe their labor market outcomes between 2008 and 2011.

Our sample is representative of individuals in the formal sector who completed tertiary education and took the Saber 11 exam after 2000. This restricts it in terms of age, education and employment type. Given the matching rates between the three administrative data sets, we drop individuals below the age of 18 and above 30, as 95 percent of the matched sample is between the ages of 23 and 27. The ages observed in this matching are reasonable once we take into account that, on average, at the age of 18 students are entering into tertiary education. In addition our sample includes only individuals who have graduated from a higher education degree, which at least takes two years and at most 5 or 6 years to complete. We also restrict the upper tail of the distribution of age by excluding individuals above 30. This last restriction comes from the fact that we would only have individuals in our sample who have taken the *Saber 11* after 2000 and the average age to present the exam is 17. Regarding wages, we have wages for employees only, and not for the self-employed available from *PILA*. We drop individuals who are employed by the army, given that they are outside of the traditional labor market.

Even though we acknowledge that this is a study with a selected sample, it is also unique in the sense that we can follow individuals during their very first stages of professional career, which is a very important stage that determines long term labor market outcomes, such as future wages (Oyer, 2006).

The estimating sample has 257,002 observations including formal workers, self employed that contribute to social security, and all other graduates for whom we are not able to get social security records.

That could be, individuals in the informal sector, unemployed or who are not in the labor force. We have 127,073 observations for individuals employed in the formal sector. See table A2 in the Appendix for more details on the number of observations and the details on the merge process of the dataset. [13]. The sample with all the students for whom we

[13]In cases where individuals have more than one degree we take the highest level obtained or the one

have the covariates used as controls in our regressions includes 102,025 individuals who graduated from higher education, 69,727 of them are in the formal sector.

5 Empirical Strategy

This section presents a reduced-form model to analyze the impact of attending a new HE program on education and labor market outcomes described in the previous section. We estimate the value added of new versus old HE programs by analyzing standardized test scores after graduation from Higher Education, conditioning on test scores at entry. We also assess the relative labor market returns of new programs. Labor market outcomes include wages in the formal sector, and the probability of having a formal job. Consider the following reduced form model:

$$Y_{ist} = \delta + \Omega NP_s + \alpha X_{it} + \beta Z_s + \varepsilon_{ist} \tag{1}$$

where Y_{ist} denotes education and labor market outcomes of student i who attended educational program s at time t. Our variable of interest is denoted by NP_s, which indicates whether the HE program is defined as a New Program, as described previously. Education and labor outcome variables are potentially affected by fixed and time-varying individual characteristics (X_{it}) such as gender, parental background, high school attended and region of residence, among others. Similarly, they are determined by characteristics of the HE program (Z_s). Some of these characteristics are the area of study, the degree level obtained, and whether the HE provider is private or public. The individual characteristics and the information related to the program allow us to isolate the effect of sorting into the new programs from the effect of the new program itself.

New programs may yield lower wages for various reasons. New programs are likely to be less known by employers. If students chose highly reputed programs to signal their ability, newer programs with less established reputations lower the expected return of the investment. As shown in Table 1, new programs compared to existing programs have a higher proportion of students in areas such as fine arts and social and human sciences and a lower proportion of students in education sciences, health sciences and engineering.

finished more recently. If an individual takes more than one Saber 11 test, we use the last grade.

Establishing the former programs is less costly than opening the latter, which require high investments in labs and infrastructure. In the face of rapidly rising demand for HE, universities have an incentive to expand those programs that can be easily expanded, and open new programs that are less costly to establish and operate. In addition we are able to identify that the new programs yield, on average, lower returns. We calculated the weighted average of wages by using the distribution of areas of study for existing and new programs. In order to isolate the effect of reputation and keeps the true return of the area of study, we use wages of students that graduated from existing institution. Using Our calculations suggest that wages in areas of new programs are X percent lower than wages in areas of existing programs.

Of course, new programs may also be of genuine lower quality, because of lower quality teachers, infrastructure or the adaptation of the curricula. Finally, new programs may attract lower quality students, and student background (proxied by the test scores in Saber 11) determine the choice set students have. Non random assignment to programs presents indeed a major challenge to infer the causal impact of attending a new program through the model presented in eq. (1).

Student baseline ability is proxied in our empirical study by test scores in the standardized exams Saber 11, which all students must take in order to access to higher education. We include in the regressions standardized test scores in biology, math, philosophy, physics, chemistry, language and social science. In each of these exams we create categorical variables for the student decile in each of the different areas evaluated. This flexible specification allows for potential non-linear effects of the test scores on Y_{ist}[14].

Although the scores in Saber 11 are frequently used by HE institutions to choose among the student pool, some institutions have their own exams. In addition, credit constraints may limit student choice even if they pass the required thresholds. Tuition in some private universities is high, while student loans and financial aid is fairly limited or difficult to access in Colombia. This prevents the HE system in Colombia from a perfect sorting equilibrium (MacLeod et al., 2015). We add to the regressions household income (divided in 7 brackets) and the highest level of education of the parents. In the Colombian context of

[14] We have used different specifications, including high order polynomials and ventiles, and the results are robust.

high variability in fees across programs, household socio-economic background is likely to shape student choice. We also include high school fixed effects[15]. In Colombia, as in other high inequality countries, the high school attended is a good predictor of socioeconomic status.

Our regressions include 55 detailed indicators of degree or area of study (e.g. economics, administration, civil engineering), whether the HE institution is private or public, and 4 HE institutions types: universities, university institutes, technology schools and technical/professional institutes. We also controls for the institutional duration of the programs. Bachelors diplomas typically last 4 or 5 years, technological 3 and technical/professional 2 years. Finally, some specifications include regional dummies (28) for the location of the HE institution.

The rich set of covariates included in the regression allow us to compare the outcomes of very similar students who attended existing and new programs. In our most flexible specifications we use matching estimators to avoid functional-form assumptions, thus fully accounting for selection based on observable characteristics. However, we cannot rule out selection based on unobservables. In Section 6 we discuss possible sources of unobserved heterogeneity, and discuss selection biases under different assumptions following the methodology proposed by Oster (2015).

6 Results

Attending a recently created HE program in Colombia is quite common, as 60% of the existing programs in 2011 could be considered as new programs. Among those students who we observe in the labor market between 2008 and 2011, more than 50 percent attended a new program (Table 1). Consistent with the public concern raised by new programs in the country, students of newly created programs in Colombia perform worst at the exit exams Saber Pro. Differences in test scores range from 0.22 standard deviations (written communication test) to 0.33 standard deviations (quantitative reasoning). Similarly, graduates from new programs have worst labor market outcomes. Their probability of having a formal job is 4 percentage points lower (0.71 vs. 0.75 of graduates from existing

[15] We have 6276 schools in our sample.

programs. Among those employed in the formal sector, they earn about 15 percent less.

Table 1: Summary Statistics

	Existing Program	New Program	Difference
Demographics			
Age	22.93	22.93	-0.00
Male	0.42	0.41	0.01
Maximum Level of Education of the Parents			
Highschool drop out or less	0.21	0.29	-0.08
Secondary Complete and some college	0.40	0.44	-0.03
College complete or higher	0.39	0.28	0.11
Income Level of the Familly			
Less than 2 Min. Wage	0.35	0.44	-0.08
Between 2 and 5 Min. Wage	0.43	0.43	-0.01
More than 5 Min. Wage	0.22	0.13	0.09
High School Characteristics			
Academic	0.61	0.56	0.04
Academic-Technical	0.21	0.22	-0.01
Normalista	0.03	0.03	-0.00
Technical	0.15	0.18	-0.02
Saber 11 (Percentiles)			
Math	62.06	54.14	7.92
Language	66.64	58.72	7.92
Type of HE Institution			
Tech School	0.00	0.02	-0.02
Technological Institution	0.02	0.07	-0.05
College	0.16	0.25	-0.09
Technical Professional	0.02	0.07	-0.05
University	0.79	0.60	0.20
Public HE Institution			
Public Institution	0.43	0.35	0.08
Area of Studies			
Unclassified	0.02	0.01	0.01
Agriculture and Veterinary	0.05	0.05	0.00
Fine Arts	0.05	0.09	-0.04
Education Sciences	0.14	0.08	0.06
Health Sciences	0.18	0.16	0.02
Social and Human Sciences	0.26	0.33	-0.07
Economy, Administration and Accounting	0.26	0.26	0.00
Engineering, Architecture and Urbanism	0.03	0.01	0.02
Saber Pro (Score)			
Written Communication	10.25	10.03	0.22
Critical Reading	10.39	10.09	0.30
Quantitative Reasoning	10.38	10.04	0.33
Observations	111,491	145,511	257,002
Labor Market			
Wage employee	0.58	0.57	0.01
Formality	0.75	0.71	0.03
Observations	104,885	97,493	202,378
Wage Employee			
log of monthly income (2011 pesos)	14.01	13.85	0.15
Monthly income (2011 pesos)	1,457,217.56	1,234,836.14	222,381.42
Observations	60,253	54,741	114,994

Notes: All the statistics showed in the table with the exception of the Characteristics in the Labor Market are based in a sample of the students from the higher education system obtaining the standardized test ICFES Saber pro in 2011-2 to 2013-2. The Characteristics in the Labor Market are obtained with a sample of graduates from the higher education system in Colombia between 2007 and 2011 that obtained the standardized test ICFES saber 11 between 2002 and 2003. Other restrictions in the two samples are discussed in the text. In the Saber Pro sample we use the estimating sample for the writing communication test.

It is also quite noticeable that students attending new programs are substantially different from students who attend existing programs. In particular, they come from lower socioeconomic status families. The share of high income students (those whose families make 5 times the minimum wage or more) is 13 percent, compared to 22 percent for those who attend an existing program (table 1). Furthermore, 28 percent of students have parents who's highest education level is college; this figure is 11 percentage points lower compared to students who attend existing programs. As a result, it is also perhaps not surprising that their skills before HE are lower. Their average percentile in the Saber 11 exam in math(language) is 54(59) , against 62(67) for those students attending an existing program. Interestingly, 65% of new programs belong to a private institution, compared to 56% of the existing programs. This implies that students enrolled in new programs are paying for their education and they are apparently receiving a lower quality of education. Thus, there is important selection into HE programs based on socioeconomic status and skills that needs to be tackled in a regression framework to assess the relative value added of new HE programs.

Table 2 shows the impact of attending a new HE program in Saber Pro, that is, in test scores after graduation. Table 2 includes three panels that consider the following exams: written and communication score, critical reading and quantitative reasoning. Column 1 presents differences in means for all observations available in Saber Pro and column 2 restricts the sample to those students for which we have a full set of non-missing covariates. If anything, the penalty associated to new HE programs is higher in the restricted sample, ranging from -0.33 standard deviations in quantitative reasoning to -0.22 in written communication. Adding demographic characteristics and semester of Saber pro exam to the regressions does not alter the results significantly (column 3).

The penalty associated with new HE programs is less than a third in column 4 of table 2, where we control for the decile in Saber 11 exams in biology, math, philosophy, physics, chemistry, language and social sciences. Thus, self-selection associated to skills before accessing tertiary education accounts for a substantial fraction of the penalty of new programs. There is however still a small gap in value added between new and existing HE programs, now ranging from -0.05 standard deviations in critical reading to -0.08 in written communication. Adding family income and parental education (column 5), and

Table 2: The Effect of New Program on the Saber Pro

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) PSM
Written Communication Score									
New program	-0.20***	-0.22***	-0.21***	-0.08***	-0.07***	-0.06***	-0.04***	-0.02***	-0.03***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.006]
Constant	10.21***	10.25***	3.34***	4.65***	5.00***	5.87***	8.34***	8.68***	
	[0.003]	[0.003]	[0.198]	[0.191]	[0.193]	[0.210]	[0.212]	[0.214]	
Critical Reading Score									
New program	-0.28***	-0.30***	-0.28***	-0.05***	-0.04***	-0.04***	-0.04***	-0.02***	-0.01*
	[0.003]	[0.004]	[0.004]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.005]
Constant	10.33***	10.39***	4.05***	6.36***	6.64***	6.73***	7.27***	7.75***	
	[0.002]	[0.003]	[0.178]	[0.143]	[0.145]	[0.158]	[0.161]	[0.162]	
Quantitative Reasoning Score									
New program	-0.30***	-0.33***	-0.32***	-0.07***	-0.07***	-0.06***	-0.06***	-0.04***	-0.02***
	[0.003]	[0.004]	[0.004]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.006]
Constant	10.31***	10.38***	5.44***	7.20***	7.36***	7.26***	8.04***	8.47***	
	[0.003]	[0.003]	[0.182]	[0.148]	[0.150]	[0.158]	[0.159]	[0.160]	
Exam Calendar	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deciles in ST Saber 11	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Familly Inc. and Parents Edu.	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Highschool FE	No	No	No	No	No	Yes	Yes	Yes	No
Degree	No	No	No	No	No	No	Yes	Yes	Yes
Level of Education	No	No	No	No	No	No	Yes	Yes	Yes
Institution Characteristics	No	No	No	No	No	No	No	Yes	Yes
HEI Region FE	No	No	No	No	No	No	No	Yes	Yes
$R^2_{WrittenCommunication}$	0.01	0.01	0.03	0.13	0.14	0.19	0.22	0.22	.
$R^2_{CriticalReading}$	0.02	0.02	0.05	0.40	0.41	0.44	0.45	0.46	.
$R^2_{QuantitativeReasoning}$	0.02	0.02	0.10	0.42	0.43	0.46	0.50	0.50	.
Observations	374,718	257,002	257,002	257,002	257,002	257,002	257,002	257,002	253,812

Robust Standard Errors in Brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Notes: The Colombian State Examination of the Quality of Higher Education (Saber pro) is a standardized test measuring common abilities across degrees. Test scores have a mean of 10 and standard deviation of 1. The regressions include the students from the higher education system obtaining the standardized test ICFES Saber pro in 2011-2 to 2013-2 who took the end-of-high school standardized test ICFES Saber 11 between 2001 and 2011. Additional sample restrictions are discussed in the text. Included controls are: Exam calendar: Set of dummies for semester in which the Saber pro was taken. Demographics: age, age2 and gender. Deciles in ST Saber 11: Decile in standardize end-of-high school exams in the following subjects: biology, math, philosophy, physics, chemistry, language and social sciences. High school FE: fixed effects for the school attended by the student. Degree: 55 categories describing the type HE degree attended (e.g., economics, administration, civil engineering). Level of education: dummies for technical, technological and bachelors diploma. Institution characteristics: dummy for public institution and type of institution (technological institution, technical institution, college, university) set of dummies. Region FE: 28 dummies for the geographic location of the HE institution. Family income and parents education: 7 dummies for household income brackets and maximum level of education of the two parents (none, incomplete primary, primary complete, secondary (high school) incomplete, secondary (high school) complete, technical or technological education incomplete, technical education or technology complete, college incomplete, college complete, postgraduate. The PSM is calculated using the 5 neirest neighbors. The results using other matching technics are really similar.

Table 3: The Effect of New Program on Log Earnings in 2011 Pesos

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) PSM
New program	-0.16***	-0.15***	-0.14***	-0.08***	-0.07***	-0.06***	-0.03***	-0.03***	-0.03***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.006]
Constant	14.01***	14.01***	8.46***	10.20***	11.75***	12.23***	13.13***	13.16***	
	[0.002]	[0.002]	[0.360]	[0.349]	[0.346]	[0.370]	[0.347]	[0.347]	
Employment Region	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Graduation Date FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deciles in ST Saber 11	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Familly Inc. and Parents Edu.	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Highschool FE	No	No	No	No	No	Yes	Yes	Yes	Yes
Degree	No	No	No	No	No	No	Yes	Yes	Yes
Level of Education	No	No	No	No	No	No	Yes	Yes	Yes
Institution Characteristics	No	No	No	No	No	No	No	Yes	Yes
HEI Region FE	No	No	No	No	No	No	No	Yes	Yes
R^2	0.02	0.02	0.07	0.14	0.16	0.25	0.33	0.33	.
Observations	134,826	114,994	114,994	114,994	114,994	114,994	114,994	114,994	108,591

Robust Standard Errors in Brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Notes: This table shows the effect of a new program in the log of monthly wage in 2011 pesos. The wage is the reported wage in the social security records (Planilla Integrada de Liquidacion de Aportes-PILA-). The regressions include the students graduated from the higher education system of Colombia between 2007 and 2011. The sample only includes the students for whom we are able to get their score in the standardized test ICFES saber 11 between 2002 and 2003. The individuals below 18 and above 30 years old and the army are dropped. The wages are available for the employees but not for the self-employed. The included controls are: Year and Graduation date FE: This includes a control for the year in the labor market and the year of graduation from higher education. Age, Age2 and Gender. Percentile in the ST Saber 11: We include dummies for the decile of the student in each topic in the standardized test. The topics evaluated are: biology, math, philosophy, physics, chemistry, language and social science. High School FE: fixed effects for the school attended by the student. Degree: Includes 55 categories that describe the type of degree. (E.g. economics, administration, civil engineering etc.). Level of Education: technical, technological, bachelors, masters, Ph.D. Institution Characteristics: including private or public and type of institution (technological institution, technical institution, college, university) Department FE: Fixed effects of the department where the institution is located. Family Income and Parents Education: dummies for the brackets of income in terms of minimum wages. The parent education includes dummies for the maximum level of education (None, Incomplete primary, primary complete, Secondary (high school) Incomplete, Secondary (High School) Complete, technical or technological education Incomplete, technical education or technology Complete, College Incomplete, College Complete, postgraduate. Institution FE: We include institution fix effect excluding the degree Fixed effects. This allows testing if a new program within the same institution has a negative premium. Area FE: Fixed effects of area of study. The area includes 9 categories. (E.g. Economy, administration, accounting, or Mathematics and Natural Sciences). The PSM is calculated using the 5 neirest neighbors. The results using other matching technics are really similar.

a full set of high school fixed effects (column 6) further reduce the estimated impact of a new HE program, but only marginally. This is because most of the impact of socio-econonomic background on test scores in Saber Pro is captured by the Saber 11 test scores. Regressions excluding the Saber 11 test scores, not reported in the table, show that parental background explain a large part of the Saber Pro gap between students accessing new and existing programs.

Column 8 in table 2 presents our preferred specification, which adds to the controls a set of high school FE and a set of variables capturing the type of HE education attended. In particular, we add 55 field of study dummies (e.g., medicine, economics, accounting), 5 dummies for the type of institution attended (e.g., university, technology school, technology institution), the level degree obtained (e.g., university level, technological and technical professional), a public institution dummy, and 28 region FE. Thus, we compare now new and existing programs of the same duration, within the same field and in the same region. The results suggest that a small penalty persists, ranging from 0.02 standard deviations

Table 4: The Effect of New Program on te Probability of Beeing Formal and Wage Employee

	(1)	(2)	(3)	(4)	(5)	(6)
		Formality			**Wage Employee**	
New program	-0.010***	0.004	-0.007**	-0.030***	-0.013***	-0.009***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Constant	-1.807***	-1.335***	-1.319***	-2.408***	-1.731***	-1.527***
	[0.225]	[0.238]	[0.234]	[0.201]	[0.219]	[0.217]
Year and Graduation Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Deciles in ST Saber 11	No	Yes	Yes	No	Yes	Yes
Familly Inc. and Parents Edu.	No	Yes	Yes	No	Yes	Yes
Highschool FE	No	Yes	Yes	No	Yes	Yes
Degree	No	No	Yes	No	No	Yes
Level of Education	No	No	Yes	No	No	Yes
Institution Characteristics	No	No	Yes	No	No	Yes
HEI Region FE	No	No	Yes	No	No	Yes
R^2	0.01	0.10	0.14	0.01	0.10	0.13
Observations	202,378	202,378	202,378	202,378	202,378	202,378

Robust Standard Errors in Brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Notes: This table shows the effect of a new program in the probability of being formal and being salaried worker. The estimates showed in the table are the marginal effects calculated with a LPM with robust standard errors. An individual is considered as formal if it contributes to the health system as an independent worker or as an employee. The information on contribution comes from the social security records (Planilla Integrada de Liquidacion de Aportes-PILA-). The regressions include the students graduated from the higher education system of Colombia between 2007 and 2011. The sample only includes the students for whom we are able to get their score in the standardized test ICFES saber 11 between 2002 and 2003. The sample does not take into account the army or the individuals below 18 and above 30 years. The included controls are: Year and Graduation date FE: This includes a control for the year in the labor market and the year of graduation from higher education. Every year two possible test are available one in the fall and the other in the spring. Age, Age2 and Gender. Percentile in the ST Saber 11: We include dummies for the decile of the student in each topic in the standardized test. The topics evaluated are: biology, math, philosophy, physics, chemistry, language and social science. High School FE: fixed effects for the school attended by the student. Degree: Includes 55 categories that describe the type of degree. (E.g. economics, administration, civil engineering etc.). Level of Education: technical, technological, bachelors, masters, Ph.D. Institution Characteristics: including private or public and type of institution (technological institution, technical institution, college, university) Department FE: Fixed effects of the department where the institution is located. Family Income and Parents Education: dummies for the brackets of income in terms of minimum wages. The parent education includes dummies for the maximum level of education (None, Incomplete primary, primary complete, Secondary (high school) Incomplete, Secondary (High School) Complete, technical or technological education Incomplete, technical education or technology Complete, College Incomplete, College Complete, postgraduate. Institution FE: We include institution fix effect excluding the degree Fixed effects. This allows testing if a new program within the same institution has a negative premium. Area FE: Fixed effects of area of study. The area includes 9 categories. (E.g. Economy, administration, accounting, or Mathematics and Natural Sciences).

in reading and written communication scores to 0.04 in quantitative reasoning. Finally, column 9 includes a specification that uses a propensity score matching. Our results are very stable and comparable to the OLS models just described above.

Table 3 shows the impact of attending a new program in the logarithm of wages in the formal sector. Column 1 shows unconditional differences, suggesting a wage penalty of attending a new program of 16 percent. Limiting the sample to those individuals for which we have a full set of covariates (column 2) and adding demographic characteristics, year FE, year of graduation FE and region of employment (column 3) does not change much the results. The resulting wage penalty is 14 percent. As before, controlling for

Saber 11 test scores (column 4), socioeconomic background (column 5) and high school attended (column 6) reduce the wage penalty substantially. Controlling for a full set of student characteristics reduces the penalty to 6 percent.

Controlling for field and level of education (columns 7 and 8) in the wage regression is important, as it reduces the estimated wage penalty of attending a new HE program by half, from 6 to 3 percent[16]. This is consistent with our previous discussion, that shows that new programs are concentrated in fields of study that are dominated by lower labor market returns.

Our wage regression results may be biased due to informality. As we showed in Table 1, the share of graduates from new HE programs working in the formal sector is 4 percentage point lower than the share of graduates from existing programs. If those workers out of the formal sector are unemployed or inactive, or employed at lower wages in the informal sector, this selection bias may invalidate our regressions results. Independently of this mechanism, it is interesting to understand if graduates from new HE programs are indeed under-represented in the formal sector, once we control for individual and school characteristics.

Table 4 shows the results of linear probability models of the probability of being formal t[17] (columns 1 to 3) or being a wage employee (columns 4 to 6) who contributes to social security. In other words, we estimate the impact of a new HE program on the probability of being selected into the sample that we used for the wage analysis in table 3.

Attending a new HE program barely impacts the probability of being a formal worker. When a full set of controls is included in the regressions, the estimated effects are negative and significant, but estimated magnitudes are below 1 percentage point (Table 4). In particular, attending a new program reduces the probability of being a wage employee in 0.7 percentage points, and increases the probability of being outside the formal sector in 0.9 percentage points. We cannot rule out that the composition of the pool of workers outside the formal sector may vary across the two types of graduates we are analyzing (e.g. a higher proportion of unemployed among the graduates of new HE programs). However, there are very little differences in the type of employment obtained between graduates

[16]Results are identical in column 9 that uses propensity score matching.

[17]Formal workers are defined as all wage employees plus self-employed workers who contribute to social security.

from new and existing HE programs.

6.1 Robustness

6.1.1 Unobserved heterogeneity

Students that attend new HE programs are fundamentally different from those attending existing programs. They belong to less wealthy households, their parents are less educated, they attended different schools, and enroll into Higher Education with less skills. Not surprisingly, accounting for these factors changes dramatically the estimated impact of attending a new program. Controlling for differences in a rich set of observable characteristics the scores on exit from HE (Saber Pro) and the wages of students from new programs are only slightly lower than the test scores and wages of students from existing programs. However, we cannot rule out that some unobserved factor may bias the estimated effects of interest.

Oster (2015) proposes a method to assess the importance of potential omitted variable bias based on the changes in the R^2 and the coefficient of interest across specifications with different sets of control variables. Intuitively, the omitted variable bias would be proportional to coefficient movements when controls are added to the regression, but only to the extent that those movements are accompanied by changes in the R^2. In other words, assessing the stability of the coefficient of interest when controls are added is informative about potential bias only when the new specification has a greater explanatory power of the outcome.

To simplify the discussion, suppose wages or test scores at the end of HE just depend on ability and the type of program attended (new vs. existing). Ability has two components. One component is captured by the test scores in Saber 11 (X_1). The other is unobserved by the econometrician (X_2). Thus, consider the following linear model:

$$Y = \Omega NP + \beta_1 X_1 + \beta_2 X_2 + \varepsilon \tag{2}$$

Define the proportional selection relationship as

$$\frac{Cov\left(X_2, NP\right)}{Var\left(X_2\right)} = \delta \frac{Cov\left(X_1, NP\right)}{Var\left(X_1\right)}$$

where δ is a coefficient of proportionality. Thus, selection on the unobservable X_2 is proportional to selection on the observable test score (X_1). A value of $\delta = 1$ suggests that selection on observables is at least as important as selection on unobservables. Further, define $\tilde{\Omega}$ and $\tilde{R}^2$ as the coefficient of interest and R^2 in a regression that includes X_1 and NP; and $\mathring{\Omega}$ and $\mathring{R}^2$ as those of the regression that only includes NP. In this simple setting, Oster (2015) shows that the omitted variable bias Π is defined by $\Pi = \left[\mathring{\beta} - \tilde{\beta}\right] \frac{R_{\max} - \tilde{R}}{\tilde{R} - \mathring{R}}$. In regressions with more than one covariate the derivation is more involved, but the intuition discussed here carries through.

Thus, we need to define a values for $R_{\max}$ and δ. $R_{\max}$ is the potential maximum R^2 in a regression that includes treatment and both, observed controls and unobserved factors. If the outcome can be fully explained by these factors, then $R_{\max} = 1$. However, this is unlikely to be the case in most applications including ours, for instance due to measurement error in the outcome variables. Oster (2015) analyzes published RCT studies in top economic journals and concludes that $R_{\max} = 1.3\tilde{R}^2$ is a reasonable threshold. If results are different from zero at this threshold they can be considered to be robust.

Deciding upon the right value of δ is also subject to discussion. Oster (2015) proposes $\delta = 1$ as a reasonable starting point. As she argues, researchers are selecting a control set guided by economic theory, and hence select variables that *ex-ante* are believed to be the most important to explain the outcome. Thus, assuming that selection based on unobservables is as important as selection based on observables is reasonable. A higher value of δ would imply that selection on unobservables needs to be more important than selection on observables to produce a treatment effect of zero. In our case, this seems unlikely given the have a rich set of controls and the possibility of including the initial ability proxied by the Saber 11 standarized test score. Considering this, it seems more plausible that $0 \leq \delta \leq 1$.

We assess the robustness to selection on unobservables for the test scores in Saber pro and wages analyses. We consider four values of $R_{\max}$: $1.15\tilde{R}^2$, $1.3\tilde{R}^2$, $1.5\tilde{R}^2$, $2\tilde{R}^2$ and two values of δ: 0.5 and 1. We allow for movements in the R^2 between two models, that we label "partially controlled"and "fully controlled". The partially controlled model includes year effects, region dummies, basic demographics and a full set of HE descriptors: the field of study, level and type of institution. The fully controlled specification adds to the set of

Table 5: Robustness. Selection on unobservables

	Simulated Ω_{NP}			
	Test Scores		Wages	
	$\delta = .5$	$\delta = 1$	$\delta = .5$	$\delta = 1$
$1.15\tilde{R}^2$	-0.02	-0.01	-0.02	-0.01
$1.3\tilde{R}^2$	-0.01	0.02	-0.01	0.02
$1.5\tilde{R}^2$	0.01	0.06	0.00	0.05
$2\tilde{R}^2$	0.04	0.09	0.02	0.11
	Estimated $\hat{\Omega}_{NP}$ and R^2			
	Test Scores		Wages	
	$\hat{\Omega}_{NP}$	R^2	$\hat{\Omega}_{NP}$	R^2
No Covariates	-0.30	0.02	-0.16	0.02
Partially Controlled	-0.13	0.24	-0.08	0.21
Fully Controlled	-0.04	0.47	-0.04	0.26

covariates socioeconomic background of the student (i.e., family income and highest level of education of the parents) and her test scores in Saber 11.

The results are similar for test scores (first two columns of table 5) and wages (last two columns of table 5). First note that moving from the partial to the fully controlled model has a significant impact on the estimated coefficient of attending a new program. In the case of test scores(wages) coefficient of interest, $\hat{\Omega}$ moves from -0.13(-0.08) to -0.04(-0.04). If selection on unobservables is of similar importance as selection on observables, this sharp movements in the estimated coefficients may be indicative of a relatively large omitted variable bias. However, note also that the R^2 is also moving dramatically between the two specifications. In particular, for the scores in Saber pro, which is the specification where $\hat{\Omega}$ varied most, the R^2 almost doubles between the partial and fully controlled specifications, from 0.24 to 0.47. Thus, the omitted variable is likely to be smaller than anticipated by coefficient movements.

The impact of selection on unobservables on the estimated coefficient of new program is small, but sufficient to cross the threshold of zero. For $\delta = 1$ and $R^2 = 1.3\tilde{R}^2$ the impact of a new program becomes 0.02, both in the case of test scores and wages. If instead we assume that selection on unobservables is less important than selection on observables, presumably a reasonable assumption in our case, $\hat{\Omega}$ becomes -0.01. Thus, we conclude that in the presence of selection on unoservables the estimated impact on test scores and wages of attending a new program is economically small.

6.1.2 Different Definitions of New Program

We defined new programs as those programs (or institutions) whose first graduate finished school in 2002 or after. This definition captures the bulk of the HE expansion of the 2000s, including 2 year programs. We assess how robust results are to alternative definitions. Table 6 shows robustness checks for Saber pro and wages to different ways of defining a new program. Regressions of the test score are shown in columns 1 to 4, and columns 5 to 8 show results for wages. To facilitate the comparisons, baseline specifications are shown in columns 1 and 5. Columns 2 and 6 define a new graduation threshold: 2003. Next, we take enrollment as the basis for identifying a new program. In columns 3 and 7 new programs are those that had no students enrolled in 2001 or earlier. Finally, we define new programs as those that were registered in SNIES in 2000 (columns 4 and 8). Results are quantitatively similar across specifications.

Table 6: The Effect of New Program Using Different Definitions of New Program

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SB Pro Quantitative Reasoning				**Monthly Earnings**			
New Program	-0.04***	-0.03***	-0.01***	-0.02***	-0.03***	-0.03***	-0.01***	-0.02***
	[0.003]	[0.003]	[0.004]	[0.004]	[0.003]	[0.004]	[0.004]	[0.004]
Constant	8.47***	8.47***	8.45***	8.45***	13.16***	13.14***	13.17***	13.06***
	[0.160]	[0.160]	[0.161]	[0.160]	[0.347]	[0.347]	[0.348]	[0.350]
Employment Region	No	No	No	No	Yes	Yes	Yes	Yes
Year and Graduation Date FE	No	No	No	No	Yes	Yes	Yes	Yes
Exam Calendar	Yes	Yes	Yes	Yes	No	No	No	No
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deciles in ST Saber 11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Familly Inc. and Parents Edu.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Highschool FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Degree	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of Education	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Institution Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HEI Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.50	0.50	0.50	0.50	0.33	0.33	0.33	0.33
Observations	257,002	257,002	255,435	257,002	114,994	114,994	114,353	113,617

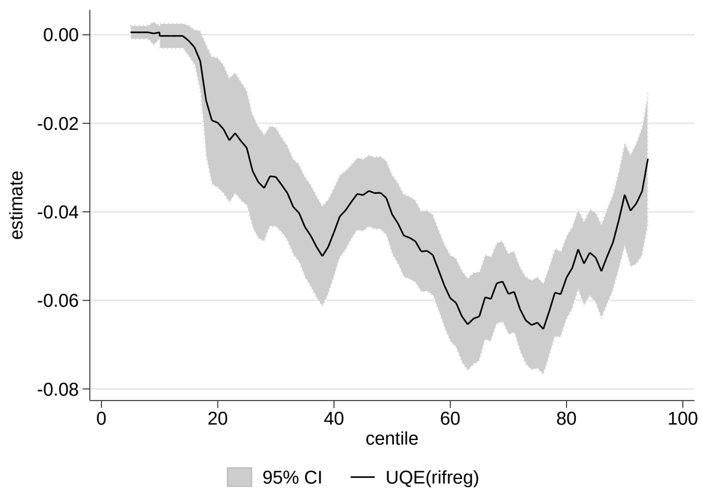
Robust Standard Errors in Brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Notes: This table shows the effect of a new program in the log of monthly wage in 2011 pesos. The column 1 and 5 shows the column 8 of table 2 and table 3 respectively , columns 2-4 and 6-8 show different ways to measure new program. In the column 2 and 6 a new program is one with the first graduate in 2004. In columns 3 and 7 we use a similar strategy to define new program but instead of graduates we use enrollment. A new program is one with the first enrolled student in 2002. In columns 4 and 8 we use the registration in the SNIES as the measure of new. We define a program as new if it was not registered in the system before 2000. All the specifications include the same controls. See notes of table 2 and table 3 for details.

6.2 Heterogeneity

6.2.1 Distributional Effects

The small wages penalty of attending a new program may hide substantial heterogeneity across the distribution. There is an emerging literature that highlights the large heterogeneity in the returns to HE programs in Latin America. Reyes et al. (2013) show that the returns to high education in Chile are positive on average, even when tuition fees and the opportunity cost of forgone earnings are considered in the analysis. However, a large fraction of students have negative returns on their investments. Similar results are obtained for Colombia (González-Velosa et al., 2015). It is plausible that some of these negative

Figure 6: Unconditional Quantile Regressions



Note: The Figure shows the effect of new programs on the unconditional distribution of (log) monthly wages in 2011 pesos. The regression includes the same set of controls as that of column 8 in table 3. The solid line represents the estimate in each centile, and the grey area represents the 95% confidence interval.

returns are concentrated among a handful of new programs with large wage penalties.

To investigate this hypothesis we analyze the wage impact of a new program across the distribution of wages, and not only at the mean. We follow the methodology introduced by Firpo, Fortin, and Lemieux (2009), which allows for a simple approximation in the estimation of unconditional quantile regressions. Unconditional quantile treatment effects are informative about the effects of attending a new program on the entire population, and hence are the most interesting from a policy perspective. The regression includes the same set of controls as that of column 8 in table 3. Results are displayed in Figure 6.

Contrary to expectations, the penalty of attending a new program is larger in the middle of the distribution than in the tails, peaking at around the 70th percentile with an estimated penalty of -6 percent. The penalty is much lower in the bottom half of the distribution, not being different from zero in the first two deciles. While this is not direct evidence of what may be causing some students to incur on negative returns in their investments, given the results it seems unlikely that the emergence of new programs are behind this pattern.

6.2.2 The Value of Accreditations

There is a literature that studies the returns to selective/quality programs. In order to identify what is driving the effect of new programs we will use the measure of accreditation as a proxy of selectivity/quality to see if the effect of new program has an heterogeneous effect depending on the selectivity/quality of the university. This is important because we will abstract of the signaling effect and we will see the effect of new program depending on the quality of the university. A university is of quality if it has the high quality accreditation certificate. In Colombia 33 Institutions have the certificate of high quality.

Table 7 shows the effect of new program by accreditation status for Saber pro (quantitative reasoning) and wages. Columns 1 to 3 show regressions for test scores, and columns 4 to 6 show results for wages. We differentiate the existing programs for those with quality and those without quality. We include dummy variables for the programs grouped in the following five categories: 1) The omitted category, existing programs in institutions with high quality accreditation. 2) New program in existing HEI with quality 3)Existing Program without quality 4) New program in existing HEI without quality 5)New program in new HEI . The baseline category will take the value of 0, and the value added of each type of institution is -0.28, -0.7, -0.79, -0.95 respectively and relative to the baseline category. We can conclude that the most important condition is to have a high quality certificate and then to be an existing program.

Table 7: The Effect of New Program by Acreditation Status

	(1)	(2)	(3)	(4)	(5)	(6)
	SB Pro Quantitative Reasoning			**Monthly Earnings**		
1) New program in new HEI	-0.95***	-0.26***	-0.15***	-0.38***	-0.19***	-0.12***
	[0.008]	[0.007]	[0.008]	[0.008]	[0.008]	[0.009]
2) New program in existing HEI with quality	-0.28***	-0.07***	-0.03***	-0.08***	-0.03***	-0.02**
	[0.008]	[0.007]	[0.007]	[0.006]	[0.006]	[0.006]
3) New program in existing HEI without quality	-0.79***	-0.19***	-0.16***	-0.34***	-0.16***	-0.12***
	[0.005]	[0.006]	[0.006]	[0.004]	[0.005]	[0.006]
4) Existing program without quality	-0.70***	-0.17***	-0.14***	-0.29***	-0.13***	-0.10***
	[0.006]	[0.006]	[0.006]	[0.005]	[0.005]	[0.006]
Constant	8.28***	7.71***	8.60***	10.43***	12.46***	13.18***
	[0.176]	[0.158]	[0.160]	[0.354]	[0.371]	[0.349]
Employment Region	No	No	No	Yes	Yes	Yes
Year and Graduation Date FE	No	No	No	Yes	Yes	Yes
Exam Calendar	Yes	Yes	Yes	No	No	No
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Deciles in ST Saber 11	No	Yes	Yes	No	Yes	Yes
Familly Inc. and Parents Edu.	No	Yes	Yes	No	Yes	Yes
Highschool FE	No	Yes	Yes	No	Yes	Yes
Degree	No	No	Yes	No	No	Yes
Level of Education	No	No	Yes	No	No	Yes
Institution Characteristics	No	No	Yes	No	No	Yes
HEI Region FE	No	No	Yes	No	No	Yes
R^2	0.17	0.47	0.50	0.12	0.25	0.34
Observations	257,002	257,002	257,002	113,721	113,721	113,721

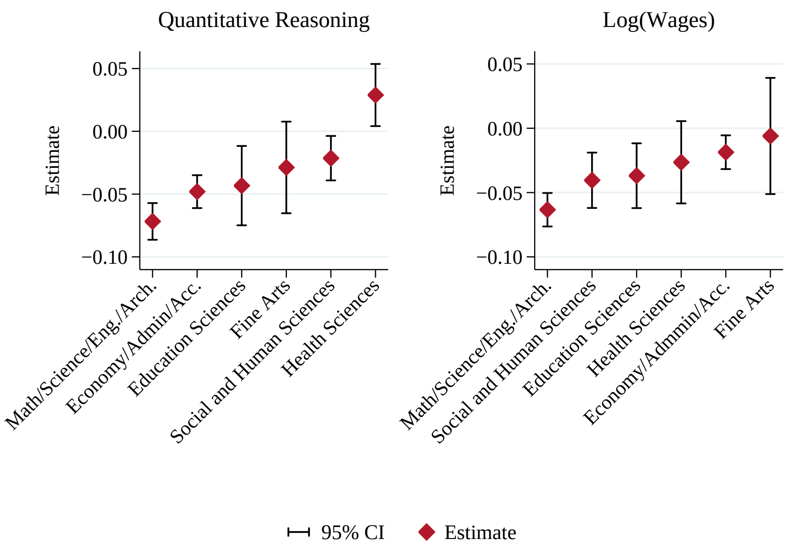
Robust Standard Errors in Brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Notes: This table shows the effect of a new program in the Critical Reading Score in the SBPro (panel a) and log of monthly wage in 2011 pesos (Panel b). We differentiate the existing programs for those with quality and those without quality . The new programs are grouped in five categories. 0) The omitted category, existing programs in institutions with high quality accreditation.1) New program in new HEI 2) New program in existing HEI with quality 3) New program in existing HEI without quality 4) Existing Program without quality. [HEI=Higher Education Institution]. For the descriptions of the controls see notes Tables 2 and Table 3. A quality accreditation requires an auto evaluation and an evaluation by peers proposed by the National Comity of Accreditation (Consejo Nacional de Acreditacion CNA). More information about the accreditation process can be find in the following link. http:\www.cna.gov.co.

6.2.3 Areas and Institutions

González-Velosa et al. (2015) find that the negative returns of investments in higher education are more likely to occur in areas such as education, nursing and design, and vary also by type of institution, much more concentrated in technical institutes than in universities.

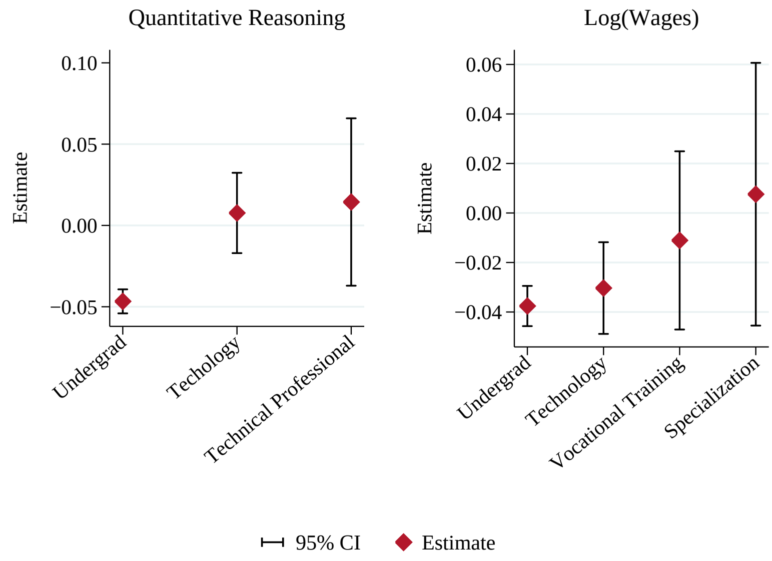
We estimate the models with all the controls and by area of studies, we present the estimates of each area in the figure 7, and the estimates by level of education in figure 9.

Figure 7: Heterogeneity Across Areas



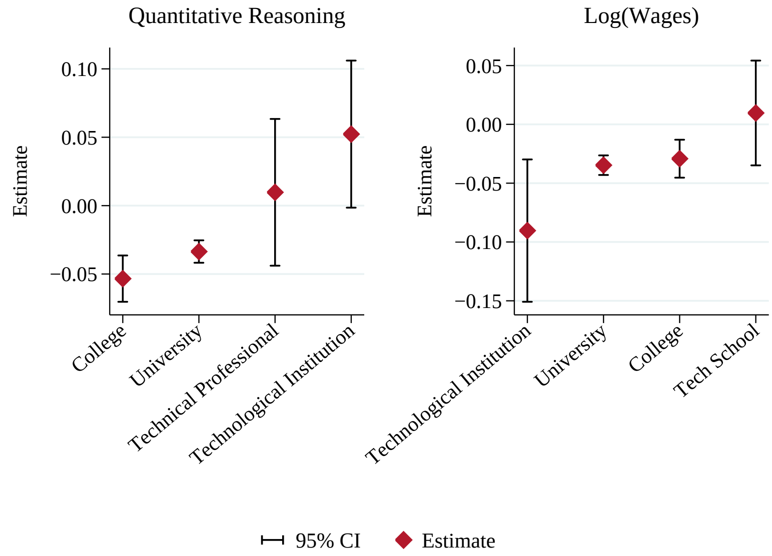
Note: The dots are the coefficients of the effect of new program on log wages (left graph) and the quantitative standardized score in the test Saber Pro (right graph) from a regression including only the individuals corresponding to each area of study. The regression includes all the controls of the column 8 of table 3 and table2 respectively (see the table notes for details). The the range lines represent the 95% confidence interval.

Figure 8: Heterogeneity Across Educational Level



Note: The dots are the coefficients of the effect of new program on log wages (left graph) and the quantitative standardized score in the test Saber Pro (right graph) from a regression including only the individuals corresponding to each educational level (for wages we exclude masters degree). The regression includes all the controls of the column 8 of table 3 and table2 respectively (see the table notes for details). The the range lines represent the 95% confidence interval.

Figure 9: Heterogeneity Across Institution Type



Note: The dots are the coefficients of the effect of new program on log wages (left graph) and the quantitative standardized score in the test Saber Pro (right graph) from a regression including only the individuals corresponding to each type of institution (for wages we exclude masters degree). The regression includes all the controls of the column 8 of table

7 Conclusions

The rapid expansion in the demand for HE in Colombia was met by an equally fast increase in supply. This rapid growth in the the number of programs has raised concerns about the quality of higher education institutions. Indeed, test scores in exit exams and wages of graduates from programs created in the 2000s are substantially lower than exit test scores and wages of graduates attending existing, well-established programs. However, a large fraction of the wage penalty between these new programs and existing programs is explained by student sorting. Lower ability students, as measured by a large set of cognitive test scores administered before admission, are more likely to attend newly created programs. The remaining fraction in the differences in average test scores and wages between new and existing programs is due to the choices made by higher education institutions. New programs tend to be concentrated on areas of study that exhibit lower returns, such as accounting, design or veterinary medicine.

Improving the information of high school graduates about their best career choices given their potential may be beneficial, as our evidence suggests a proliferation of new programs in areas where the schooling premium is low. Our results also show that acknowledging student sorting is key to assess the value added of higher education institutions, so it is fundamental that information campaigns take into account differences in student characteristics across programs and institutions. This is potentially challenging, because student sorting is likely to respond to observable and unobservable characteristics. However, our results show that collecting standardized test scores before and after graduation and standard socio-economic background characteristics of the student may be sufficient. After controlling for student socio-economic background and test scores at entry, we find that selection based on unobservables is fairly small for plausible assumptions.

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Appendix

Table A1: Merge between Saber 11 and Saber Pro by age

Age	Without Saber 11		With Saber 11		Total	
	N	%	*N*	%	*N*	%
18	338	11.6	2,583	88.4	2,921	100
19	1,442	14.4	8,538	85.6	9,980	100
20	3,344	13.8	20,838	86.2	24,182	100
21	7,591	13.7	47,672	86.3	55,263	100
22	10,566	14	65,122	86	75,688	100
23	9,804	14.7	56,716	85.3	66,520	100
24	8,536	16.8	42,123	83.2	50,659	100
25	9,856	25.9	28,206	74.1	38,062	100
26	13,294	44.4	16,618	55.6	29,912	100
27	15,985	64.7	8,735	35.3	24,720	100
28	16,866	81.5	3,818	18.5	20,684	100
29	16,210	90	1,798	10	18,008	100
30	14,898	92.8	1,149	7.2	16,047	100
Total	128,730	29.8	303,916	70.2	432,646	100

Table A2: Observations Merge saber 11 -Observatorio

Year	Observatorio-MEN	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2007	163,199												
2008	216,720	216,720	132,829	20,001	19,279	18,959	13,154	11,379	11,265	9,764	9,703	9,586	9,703
2009	365,021	365,021	281,143	57,092	55,143	53,982	37,099	29,614	29,367	28,538	28,212	27,891	28,212
2010	554,818	554,818	529,808	144,718	139,850	135,527	91,941	71,916	71,389	71,389	70,164	69,246	70,164
2011	659,830	659,830	586,758	183,028	175,827	167,472	123,263	103,964	103,423	95,194	93,476	92,201	93,476
Total	1,959,588	1,796,389	1,530,538	404,839	390,099	375,940	265,457	216,873	215,444	204,885	201,555	198,924	201,555
Droped obs	3,601	163,199	265,851	1,125,699	14,740	14,159	110,483	48,584	1,429	10,559	3,330	2,631	0

(1) Drop if 2007; (2) Drop if year of graduation is<2007; (3) Drop if does not have icfes ; (4) Keep people between 18 and 30 years old ; (5) Drop the army; (6) Drop non contributors; (7) Drop self employed ; (8) Drop income in 0 ; (9) Drop income in . ; (10) Drop age in . ; (11) Eliminate duplicates obs in a year ; (12) Drop if does not have additional covariates.