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# The Dynamic Market for Short-Cycle Higher Education Programs*

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**Abstract**

Short-cycle higher education programs (SCPs) form skilled human capital in two or three years and could be key to upskilling and reskilling the workforce, provided their supply responds fast and nimbly to local labor market needs. We study determinants of SCP entry and exit in Colombia for markets defined by geographic location and field of study. We show greater dynamism in the market for SCPs than bachelor's program, with greater turnover or "churn" of programs. Exploiting data on local economic activity and employment by field of study, we find that higher education institutions open new SCPs in response to local labor market demand as well as competition and costs. SCPs are more responsive to local labor market demand than bachelor's programs; among SCP providers, private and non-university institutions are the most responsive. While private SCP entry is deterred by the presence of competitors and responds to cost considerations, these responses are weaker among public SCPs. Further, institutions often open and close programs simultaneously within a field, perhaps reflecting capacity constraints. These findings have implications for the regulation and funding of SCP providers. *JEL codes*: E24, I21

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# 1. Introduction

Short-cycle higher education programs (SCPs) are an important vehicle to form skilled human capital. These programs, which typically last two or three years, are shorter than bachelor's programs, have a clear labor market focus, and are usually oriented towards specific occupations. They capture about a quarter of higher education students worldwide and a third in the U.S., where they provide associate's degrees and are mostly taught at community colleges (Ferreyra et al., 2021).[1] A growing literature shows their positive (albeit heterogenous) returns.[2] Their ability to form skilled human capital fast and efficiently has come to the forefront with the recent COVID-19 pandemic, which has accentuated the demand for technical and analytical skills and has shown the urgent need to upskill and reskill the workforce.

By responding to this need, the higher education institutions (HEIs) that provide SCPs can contribute to local economic development.[3] Little is known, however, about the responsiveness of SCP supply to local economic conditions. Thus, in this paper we study program entry (opening) and exit (closing) in the SCP market in Colombia. We document the relatively frequent entry and exit of programs in the market and investigate institutions' decisions to open new programs and close existing ones.

Colombia's setting is interesting for several reasons. The worst health and economic outcomes of the pandemic accrued to Latin America and the Caribbean countries (World Bank, 2021), where workforce development is thereby critical for employment recovery. Although SCPs only attract nine percent of higher education students in the region, they attract about a third in Colombia. Unlike the U.S., where one type of provider—community colleges—attracts the vast majority of students, the SCP supply

[1] These programs have different names in different countries. UNESCO labels them all as "short-cycle programs" and classifies them as ISCED 5.

[2] Most of the existing literature focuses on community colleges in the U.S. and generally shows positive returns, although with significant heterogeneity across fields and institutions (Jepsen et al., 2014; Dadgar and Trimble, 2015; Stevens et al., 2019; Liu et al., 2015; Grosz, 2020). Outside the U.S., Aucejo et al. (2020) show large returns for Further Education Colleges (a mix of private and public institutions) in the U.K. and, on average, returns are high for most fields in Chile (Ferreyra et al., 2017) and Peru (Ferreyra et al., 2021) but less so in Colombia (Ferreyra et al., 2020, 2021). Returns also vary depending on students' outside option, both in the U.S. (Mountjoy, 2022) and developing countries (Ferreyra et al., 2022).

[3] In the U.S. and Canada, a primary mission of community colleges is to respond to local economic conditions and to serve the economic and social needs of the community (Cohen and Brawer, 2003; Asian Development Bank, 2015). At the same time, community colleges are sometimes criticized for their inability to keep pace with changes in the labor market (National Academies of Sciences, Engineering and Medicine, 2017).

in Colombia encompasses a greater variety of institutions and yields a rich setting to investigate market dynamics. Colombia providers include public and (non-profit) private HEIs as well as SENA (National Learning Service). The latter is a decades-old public workforce training institution (not an HEI) with branches throughout the country, that only recently has begun providing SCPs. Since SENA's decisions are made at the national level, outside the education domain, we focus on public and private HEIs' supply, taking SENA's offerings as given. Further, Colombia boasts rich higher education and labor market administrative data. We use data from the universe of SCPs and bachelor's programs offered between 2003 and 2019, as well as individual-level data for all higher education graduates working in the formal sector between 2007 and 2013.[4] We study program entry and exit at the market level, defined as a combination of geographic location and field of study.[5] This definition captures entry and exit variation across locations and fields, and over time.

We show that SCPs have a high turnover rate—higher, in fact, than that of bachelor's programs. In our sample, SCPs have a shorter average life than bachelor's programs, as well as higher entry and exit rates. This leads to the question of whether the SCP "churn" might be in response to local labor market changes. Answering this question poses two problems. First, higher education indicators are typically reported by field of study whereas labor market indicators are reported by economic sector. Second, the correlation between the local SCP supply and the local demand for graduates might not be causal but rather driven by unobserved shocks to the local SCP market.

To bridge the gap between fields and economic sectors, we construct two measures of local labor demand by field of study. The first is a shift-share variable that measures local GDP by field. The underlying assumption is that aggregate, national shocks to a sector affect the local demand for field-specific graduates only to the extent to which the sector employs those graduates locally.[6] The second measure is a field's relative employment by location, equal to the share of SCP graduates employed in a location who have a degree in that field. To address the endogeneity concern, our measures are based on the SCP graduates who are employed in a location rather than those who

[4]As described in detail below, a program is defined as the combination of an institution, program code, and location. Program examples are graphic design technician at *Corporacion Escuela de Artes y Letras* in Bogota, and telecommunication and electronics technologist at *Corporacion Universitaria Centro Superior* in Cali.

[5]Market examples are health in Medellin, business in Medellin, health in Bogota, and business in Bogota. Note that "entry" and "exit" always refer to programs and not to HEIs.

[6]Shift-share variables are commonly used to alleviate endogeneity problems (Bartik, 1991). For their use in the context of short-cycle programs, see Armona et al. (2022) and Grosz (2022).

obtained their degree in it, thereby reflecting developments in the local labor market as opposed to the local SCP market. To check robustness, we also construct more stringent measures based exclusively on the SCP graduates employed in a location who did *not* obtain their degree in it (henceforth, "movers" to their work location). Our results are practically unchanged when using these alternative measures.

We find that SCP openings are indeed responsive to local labor demand shocks. Responsiveness, however, varies across institution types. Consider, for instance, a 10-percent increase in the demand for data scientists in Bogota. According to our preferred estimates, the probability that a private HEI opens a new data science SCP in Bogota rises between 5 and 9 percent, but only between 1 and 2 percent at a public HEI. The greater responsiveness of private HEIs might be due not only to their more flexible management but also to their greater reliance on tuition revenues, which forces them to offer market-relevant products. Although both universities and non-university HEIs can offer SCPs, non-university HEIs are more responsive than universities, possibly because they are nimbler, smaller, and more specialized in SCPs than universities. Further, SCP entry is more responsive than bachelor's program entry, which helps explain the greater turnover among SCPs than bachelor's programs. Longer and more theoretical than SCPs, bachelor's programs may be harder to set up and slower to produce graduates in response to labor market changes.

SCP openings are also affected by cost considerations. Institutions are more likely to open new programs in locations where they already have some infrastructure or in fields in which they are relatively specialized. Further, SCP entry is affected by competition. Regressing entry decisions on a measure of competition (number of programs offered by competing institutions in the market) would yield biased estimates because market structure is endogenous, as HEIs in a given market open and close programs in response to unobserved common shocks. We build instruments for the number of competing programs using proxies of competitors' costs of opening new programs as well as SENA's budget, which is determined at the national rather than local level. We find that institutions respond to the presence of same-type competitors (public HEIs respond to public HEIs, and similarly for private HEIs), thereby suggesting a pattern of segmented competition. Further evidence of segmentation is that SENA's competition does not elicit a response from either public or private HEIs, likely because SENA's programs are not viewed as close substitutes to those offered by the HEIs.[7]

[7]Our finding that entry is affected by the presence of competitors is consistent with results from the Industrial Organization literature (Mazzeo, 2002; Seim, 2006). Similarly, our finding that entry

SCP closings encompass two distinct decisions—whether to close any program at all in a market, and which one to close. We find that the first decision is correlated with the decision to open new programs in the same market. We interpret this as evidence of capacity constraints, as institutions may need to close a program in a market to liberate resources for a new one. As for the second decision, we find that private HEIs close programs with low enrollment growth; we do not find a similar response among public HEIs. Perhaps surprisingly, private HEIs are more likely to close programs in fields and locations where local labor demand has risen. In other words, private HEIs not only open but also close programs in response to positive labor demand shocks. This turnover echoes well-known empirical evidence from other industries (Dunne et al., 1988) showing that positive demand shocks generate firm turnover.

Overall, our findings suggest that SCPs might indeed succeed at responding to the changing skill needs in today's economy. Since their responsiveness varies across HEI types, our findings entail two policy implications for countries wishing to expand SCPs. First is the need to regulate SCPs in an agile fashion, without stifling their dynamism yet carefully monitoring quality and outcomes.[8] Second is the role of public funding design—the more an institution's funding relates to enrollment or student labor market outcomes, the more it responds to student and labor market demand.

To our knowledge, this is the first paper to investigate the dynamics of SCP supply in a developing country.[9] Even for developed economies, the literature is scarce. Cellini (2009) finds that a funding increase for community colleges raises their enrollment and lowers that of for-profit schools. Nevertheless, for-profits in the U.S. have entered growing fields much faster than community colleges (Deming et al., 2012; Armona et al., 2022). Similar to our findings on private HEI's greater responsiveness to local conditions, Deming et al. (2012) and Gilpin et al. (2015) find that for-profits in the

is more likely in locations where HEIs already have infrastructure is consistent with Jia (2008), who shows that firms tend to locate stores close to each other to exploit scale economies. In the K-12 education sector, Ferreyra and Kosenok (2018) find that charter schools open in neighborhoods with greater demand and lower costs.

[8]On accountability in higher education, see Deming and Figlio (2016), Matsudaira and Turner (2020) and Cellini and Blanchard (2020). In the U.S., past regulations succeeded at limiting the activities of low-performing programs and institutions (Darolia, 2013; Looney and Yannelis, 2022; Cellini et al., 2020). Even if not fully implemented, the more recent Gainful Employment Rule might have provided a threat leading many low-performing programs to close (Kelchen and Liu, 2022).

[9]Carranza and Ferreyra (2019) study the supply of bachelor's programs in Colombia. In contrast, the current paper focuses on the SCP market and the supply-side responses to economic activity and competition, which are not studied in that paper.

U.S. are faster in program (or field) opening and closing than community colleges.[10]

Studies on the relationship between SCPs and labor market conditions usually focus on students' demand for SCPs, showing higher community college enrollment during recessions (Kane and Rouse, 1999; Mullin and Phillippe, 2009; Hillman and Orians, 2013; Barr and Turner, 2015). Less is known, however, about HEIs' response to the local economy or about competition among providers. Gilpin et al. (2015) study the effect of labor market conditions on enrollment and degree completion for associate's degrees in the U.S.. In line with our results, they find a much stronger response at for-profit than community colleges. Grosz (2022) studies whether local employment changes relates to changes in the community college programs completed by students, an outcome that could be driven either by students or institutions. He finds that most of this correlation is explained by student enrollment rather than by colleges altering their capacity, which is consistent with our finding of public HEIs' low responsiveness to local labor market conditions. Nonetheless, using enrollment or graduation as the dependent variable confounds supply and demand responses because they are equilibrium outcomes, reflecting both student and HEI decisions. When an institution operates below capacity, for example, enrollment changes might be completely driven by student rather than institution decisions. In contrast, our supply-side measures—program entry and exit—unequivocally capture institution decisions.

The remainder of the paper is organized as follows. Section 2 describes our data and institutional framework, Section 3 presents descriptive statistics, and Section 4 describes our empirical strategy. Section 5 presents the estimation results, and Section 6 concludes.

# 2. Institutional Background and Data

## 2.1 SCPs in Colombia

In Colombia, the share of higher education students enrolled in SCPs has grown substantially since the early 2000s and reached 31 percent in 2019. SCPs encompass technical and technological programs (two and three years long, respectively) and are

[10]Despite their nimbleness, for-profits have been controversial in the U.S. because they cost more yet generate lower earnings, higher debt, and lower repayment rates than comparable programs at other institutions, even after controlling for confounding factors (see, for instance, Armona et al. (2022), Cellini and Turner (2019), and the references therein).

provided by public and private HEIs, and by SENA—which is not an HEI. The latter has provided workforce training since its inception in the 1950s, and added SCPs to its menu of offerings in 2003. While HEIs are overseen by the Ministry of Education, SENA is under the purview of the Ministry of Labor. It has a dedicated funding source (payroll taxes), with budgetary allocations determined at the national level.

SENA programs are free, yet the HEIs charge tuition. Public HEIs receive some local public funding and are therefore able to charge a subsidized tuition; tuition is substantially higher at private HEIs, which do not receive any type of public funding. On average, academic selectivity is highest at public HEIs, followed by private HEIs and SENA (which, in fact, does not use test scores for admission). As a result of tuition and admission practices, students sort across institutions (Figure A.1). The poorest, least-prepared students attend SENA; among the remaining students, those with the higher income and lower academic readiness attend private HEIs.

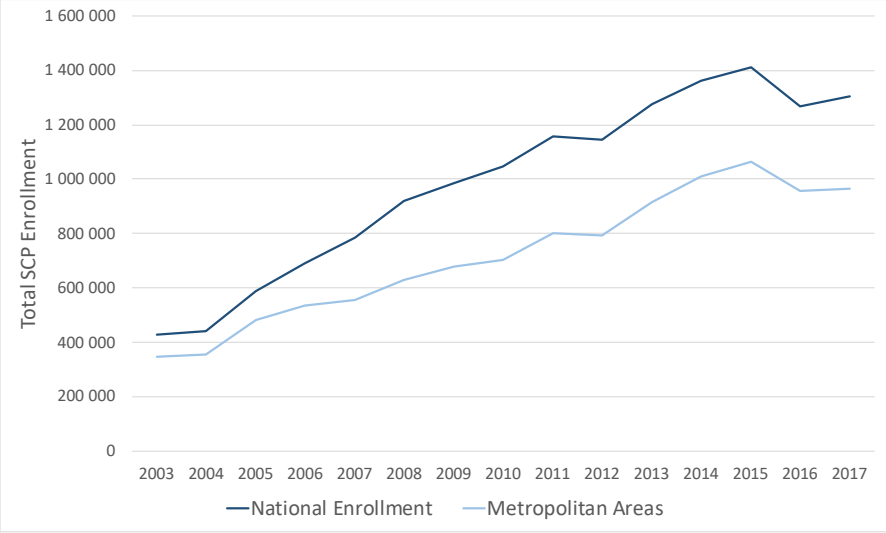
In contrast with private providers, which are mostly located in urban areas, SENA is spread throughout municipalities of all sizes. While SENA captures about 60% of total enrollment, no other institution attracts more than 4%. On average, HEIs have approximately 1.7 branches each; most HEIs are local, and very few have branches in multiple cities. We focus on programs located in the country's thirteen metropolitan areas, which concentrate most of the national enrollment (panel (a) of Figure 1).[11] Much of their enrollment growth is explained by SENA (panel (b) of Figure 1). Total enrollment in public and private HEIs has also risen—particularly at private HEIs—albeit at a lower rate.

Table 1 shows descriptive statistics for the departments (akin to U.S. states) where the metropolitan areas are located. The number of SCPs and HEIs varies substantially across departments, but the percentage of higher education students attending SCPs is about 30% in most of them. Three types of HEIs offer SCPs: technological and technical institutes (only allowed to offer SCPs), technological schools (*Instituciones Universitarias*, allowed to offer short-cycle and bachelor's programs but not graduate programs) and universities (the most prestigious institutions, allowed to offer the whole range of undergraduate and graduate programs). Since each metropolitan area is located in a different department, in what follows we use the term "department" to designate locations, and use it interchangeably with "location". Given SENA's pecu-

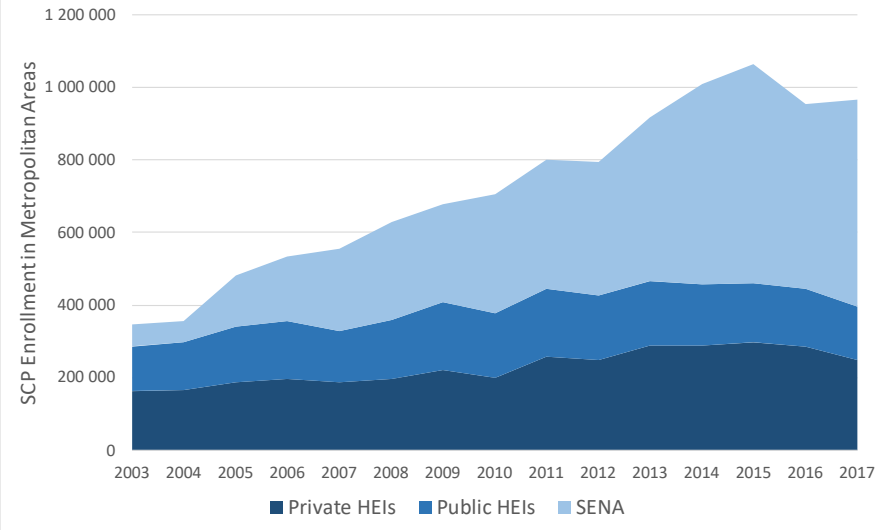
[11] We define metropolitan areas as in Duranton (2015), where municipalities are aggregated into metropolitan areas based on commuting patterns. This definition yields 13 metropolitan areas, all of which are included in our analysis.

Figure 1: SCP Enrollment Growth in Colombia

(a) Total SCP Enrollment




(b) Enrollment in Metropolitan Areas




Note: Panel (a) shows total number of students enrolled in SCP programs by year for Colombia ("national enrollment") and metropolitan areas ("metropolitan areas"). Panel (b) focuses exclusively on SCP enrollment in metropolitan areas and shows the fraction of those students enrolled in private HEIs, public HEIs, and SENA by year.

liarities, we focus on the SCP supply from public and private HEIs while taking the supply of SENA's programs as given.

To open a new program, HEIs need an authorization (or operating license) from the Ministry of Education, which can take a year or two to arrive and must be renewed periodically. In contrast, they do not need an authorization to close a program.

## 2.2 Data Sources

We leverage multiple Colombian data sources. First is the National Higher Education Information System (SNIES), which covers the universe of higher education programs (bachelor's and SCP) and contains program-level information on institution, geographic location, field of study, length, and enrollment. We use SNIES data between 2003 and 2019. We define a program as a combination of institution, program code, and department; when an institution offers the same program in two different departments, it counts as two different programs. We focus on in-person SCPs located in metropolitan areas; we exclude online programs because we cannot assign them a geographic location. This yields an SCP sample that accounts for 73% of the national SCP enrollment.

Our second data source is the Labor Observatory for Education (OLE). For the 2007-2013 period, OLE tracks individuals who graduated from higher education beginning in 2001 and work in the formal sector. For each graduate, it includes program identifiers that allow us to find the program in SNIES, and also labor market information such as work location and economic sector of work. Third, we use use annual GDP data by department and economic sector from the National Statistics Agency (DANE) between 2003 and 2019. Fourth, as an instrument for competition we use information on SENA's department-level budget, which quantifies SENA's resources by department and year.) All monetary values are expressed in Colombian pesos (COP).

Overall, our data includes 13 departments, 279 HEIs, 3,463 SCPs, and 4,392 bachelor's programs (the latter are included for some comparisons with respect to SCPs). Programs are classified into 24 fields of study. In some of our analyses, we aggregate these into four "field categories" (Table A.1 lists all fields and field categories). We analyze entry between 2004 and 2019 and exit between 2004 and 2018 (since our last available year is 2019, we cannot identify which programs closed that year).

Table 1: SCPs by Departament in Colombia

| Department | Number of Programs | Number of HEIs | % Total Enrollment in SCP | % SCP Enrollment by Type of Institution | | | |
|---|---|---|---|---|---|---|---|
| | | | | SENA | Technological and Technical Institutes | Technological Schools | Universities |
| Antioquia | 371.2 | 44.26 | 40.39 | 64.37 | 4.98 | 23.99 | 6.66 |
| Atlantico | 180.24 | 19.82 | 27.54 | 46.36 | 28.58 | 18.83 | 6.22 |
| Bogota | 621.61 | 74.8 | 32.72 | 41.7 | 32.39 | 20.42 | 5.5 |
| Bolivar | 143.8 | 14.9 | 43.79 | 64.08 | 15.13 | 15.55 | 5.25 |
| Caldas | 81.94 | 12.49 | 26.7 | 78.12 | 11.22 | 0.88 | 9.78 |
| Cordoba | 57.23 | 9.39 | 22.55 | 84.42 | 11.6 | 1.69 | 2.29 |
| Meta | 71.18 | 13.25 | 29.49 | 79.51 | 12.3 | 7.32 | 0.86 |
| Nariño | 77.84 | 12.18 | 23.28 | 84.68 | 2.2 | 9.06 | 4.06 |
| N. de Santander | 106.94 | 12.35 | 20.83 | 61.22 | 22.44 | 0.2 | 16.14 |
| Risaralda | 97.46 | 12.31 | 33.84 | 62.99 | 14.88 | 11.03 | 11.09 |
| Santander | 185.16 | 21.52 | 40.6 | 66.41 | 20.54 | 8.08 | 4.96 |
| Tolima | 111.19 | 11.78 | 44.89 | 59.77 | 29.88 | 1.75 | 8.6 |
| Valle | 262.29 | 33.81 | 34.77 | 53.76 | 23.01 | 9.06 | 14.16 |

Note: This table displays information for the 13 departments that contain the metropolitan areas included in our empirical analysis. For each variable, it shows average over years between 2003 and 2019. Percentage of enrollment in short-cycle programs is relative to total higher education enrollment in the department. The last four columns correspond to the percentage of SCP enrollment by institution type (they add up to one by department).

## 2.3 Economic Activity Measures

We study program entry and exit at the market level, defined as a combination of location and field of study. Our sample include 312 markets (13 locations times 24 fields of study). By definition, an HEI that offers programs in multiple fields of study participates in multiple markets; in a given year, it might open or close programs in some markets but not others.

Given our market definition, we construct explanatory variables at the location-field level. To study the responsiveness of SCP supply to changes in local economic activity, an challenge is the lack of a direct mapping from higher education fields of study to economic activity sectors. We overcome it by constructing two measures of the local demand for graduates from a given field, GDP by field and field relative employment. Below we describe the measures; in Section 4 we justify their exogeneity.

**GDP by field**. We construct a Bartik-style (Bartik, 1991), shift-share variable using OLE and DANE data to measure shocks to the local economic activity associated with a field of study. For a given year, we interact sector-level aggregate activity at the national level with local time-invariant employment shares by field and economic sector as follows:

$$GDP_{dkt}^{Bartik} = \sum_{s \in \mathrm{S}} (GS_{dks} * GDP_{st}) \tag{1}$$

In this expression, $S$ is the set of economic activity sectors reported by DANE, and $GDP_{st}$ is sector $s$'s national GDP in year $t$. $GS_{dks}$ is the share of SCP graduates who work in sector $s$ in department $d$ and have graduated from a field-$k$ program relative to all SCP graduates employed in sector $s$ across the 13 departments:

$$GS_{dks} = \frac{\text{\# of SCP graduates from field } k \text{ employed in sector } s \text{ and dept } d}{\text{total \# of SCP graduates employed in sector } s} \tag{2}$$

These shares sum to one by sector when adding over all fields and departments in our sample. They are time-invariant and are calculated by pooling all years available in OLE (2007 through 2013).[12] Our GDP-by-field variable captures the notion that exposure to the aggregate, national shocks experienced by an economic sector varies across SCP graduates depending on their field of study, work location, and work sector (Bartik, 1991; Goldsmith-Pinkham et al., 2020). The aggregate shock to sector $s$ is captured by $GDP_{st}$. Although this sector-specific shock is common to all departments and fields, the degree of exposure for field-$k$ graduates who work in department $d$ is determined by the time-invariant employment share, $GS_{dks}$. In the simplest case, if all SCP graduates employed in sector $s$ in the country had graduated from the same field and worked in the same department, then that department and field would absorb the full shock to the sector.

**Field relative employment.** Similar to the construction of employment shares for GDP by field, we use OLE data from 2007 to 2013 to obtain the total number of SCP graduates employed in a given department, independently of the department where they studied. Among them, for a given year we calculate the proportion of graduates with a field-$k$ degree as follows:

$$RE_{dkt} = \frac{\text{\# of SCP graduates from field } k \text{ employed in department } d \text{ in year } t}{\text{\# of SCP graduates employed in department } d \text{ in year } t} \tag{3}$$

The GDP-by-field and relative employment variables seek to capture local labor market

[12] If we had used time-invariant shares from a single year rather than pooling all available years, this would have yielded shares equal to zero or one for some small departments. Among the years with OLE availability, 2013 is the one where these issues are least concerning. When we use shares for 2013 rather than pooling 2007 through 2013, results are virtually unchanged. While we would have preferred to have used shares from some year prior to the beginning of our study period (2003), OLE is only available beginning in 2007. Note, however, that our regressors include a rich set of time, location, and field-category fixed effects.

developments by focusing on graduates who work in a given location—independently of where they studied—rather than those who studied there. Further, these variables focus on SCP graduates—as opposed to all types of workers—thereby focusing specifically on their labor demand. For robustness, we also construct a version of these variables in which the employment shares focus on SCP graduates who work in a given location but did *not* obtain their degree in it (namely, on "movers").

# 3. Descriptive Statistics

## 3.1 Programs, Entry, and Exit

In our sample, 77 percent of SCPs are provided by private HEIs (Table A.1). Most programs are in business and social sciences, followed by engineering (which includes computer- and technology-related fields). Public and private HEIs specialize in different fields: 51 percent of private HEI students are enrolled in business and social sciences programs, whereas an almost equal percentage (48 percent) of public HEIs students are in engineering. This is consistent with the fact that public HEIs—which receive public funding—are better equipped than private HEIs to provide high-cost programs.

For the average year, our sample includes 156 institutions providing 1,209 SCPs, with 137 SCP openings and 127 closings (Table A.2, top and middle panel). It also includes, on average, 606 HEI-field-location combinations with at least one active SCP. These combinations are important because, as described below, we examine program opening on the part of HEIs at the market (field-location) level. On average, 124 HEI-field-location combinations have at least one new SCP per year (the number is 113 for SCP closings). Since some of our analysis compares SCPs to bachelor's programs, Table A.2 also shows descriptive statistics for bachelor's programs. Although bachelor's programs outnumber SCPs and a greater number of HEIs offer bachelor's programs than SCPs, on average bachelor's programs have about the same number of openings as SCPs and a substantially lower number of closings. This leads us to compare below entry and exit *rates* between SCPs and bachelor's programs.

## 3.2 Turnover and Entry Types

A distinctive aspect of SCPs is their high turnover—much higher, on average, than that of bachelor's programs. In any given year, 11.2% of the SCPs offered are new—

having opened just that year—while 10.6% of SCPs exit (or close) that year (panel A of Table 2). These percentages, which are quite similar for public and private HEIs, are much higher than for bachelor's programs, for which they equal 6.1 and 4.2 percent respectively. Similarly, SCPs have a much shorter average life than bachelor's programs (6.2 v. 9.5 years).[13] In our empirical analysis we examine whether this greater "churn" of SCPs than bachelor's program is indicative of a greater responsiveness to local labor market demand.

Table 2: Program Turnover and Entry Type

| | Panel A: Program Turnover | | | |
|---|---|---|---|---|
| | All SCPs | Private SCPs | Public SCPs | Bachelor's |
| Avg. Program Life (in Years) | 6.2 | 6.1 | 6.5 | 9.5 |
| Avg. Percent of New Progrs. per Year | 11.2 | 11.1 | 11.5 | 6.1 |
| Avg. Percent of Progrs. Closing per Year | 10.6 | 11.2 | 8.6 | 4.2 |

| | Panel B: Entry Type | | | |
|---|---|---|---|---|
| | All SCPs | Private SCPs | Public SCPs | Bachelor's |
| Existing HEI, Existing Loc., Existing Field | 60.8% | 63.3% | 53.9% | 53.1% |
| Existing HEI, Existing Loc., New Field | 20.2% | 18.3% | 25.5% | 27.2% |
| Existing HEI, New Loc., Existing Field | 9.7% | 9.7% | 9.9% | 10.7% |
| Existing HEI, New Loc., New Field | 0.3% | 0.4% | 0.2% | 0.9% |
| New HEI | 8.9% | 8.4% | 10.5% | 8.2% |

Note: Averages are calculated for the 13 metropolitan areas included in the empirical analysis for 2004-2019. For a given year, the percent of new and closing programs are relative to all programs offered that year (from 2004 to 2019 for new programs, and from 2004 to 2018 for closing programs). Panel A shows averages across years. Short-cycle programs include those offered by public and private HEIs but exclude SENA programs. Panel B shows percentages relative to the total number of programs that opened across all markets and years. "Loc." indicates location. "Existing" and "new" location indicate whether the HEI already operates or not, respectively, in that location.

Following Dunne et al. (1988), we look at different entry types for SCPs and bachelor's programs (panel B of Table 2). We distinguish entry of new institutions from entry of new programs at existing institutions. Among the latter, an institution may open new programs either in an existing location or a new one. Similarly, it may open new programs either in a field where it was already operating or a new one. As it turns out, about 80% of entry among both SCP and bachelor's programs takes place in existing locations, and about half in existing locations with other offerings in the

[13] We view this difference as a lower bound of the actual difference in program average life between SCPs and bachelor's programs. The reason is that we do not observe program entry date for programs that opened before 2000, and assume they opened in 2000. This underestimates average program length for bachelor's programs *vis-a-vis* SCPs because almost half of bachelor's programs opened before 2000, relative to only 30 percent of SCPS.)

same field. These rates are similar for private and public HEIs, although public HEIs are more likely to open programs in new fields.

When studying entry, it is important to define the universe of potential entrants, whose decisions are our object of study. Regardless of the definition, only some potential entrants actually enter and constitute the observed entrants. We explore two definitions. In the broad one, we assume all existing institutions can potentially open programs in any location and field regardless of whether they already operate in that location. In the narrow one, institutions can potentially open programs in any field but only in locations where they already operate. These definitions reflect different expansion strategies for an institution: in the broad definition, the institution considers opening programs even in locations where it does not currently operate; in the narrow definition, it only considers opening programs in locations where it already operates. These definitions, of course, only affect the set of potential entrants; the set of actual entrants is the same in both cases. For SCPs, we have about 4,900 potential entrants under the narrow definition and 67,600 under the broad one (Table A.2, bottom panel).

Since we study HEI decisions to enter in a given market, we compute entry probabilities as the ratio between the number of HEI-field-locations with at least a new program and the number of potential entrants. Given that the latter is much larger under the broad definition, the corresponding entry probabilities are much lower (Table A.3, top panel). In our empirical analysis we present results using both definitions but focus on those based on the narrow one, since most openings take place in existing locations. As shown below, findings are robust under both definitions.

# 4. Empirical Strategy

## 4.1 General Framework

To study HEIs' decision to open or close programs, we focus on how they respond to local labor market demand, costs, and competition. Our empirical approach is based on the following equation:

$$I^c_{jkdt} = f(M_{jdt}, L_{kdt}, X_{jkdt}) + \varepsilon_{jkdt} \tag{4}$$

where $I^c_{jkdt}$ is a binary indicator for activity $c$ on the part of institution $j$ in field $k$, department $d$ at time $t$. Activity $c$ refers to program entry or exit (opening or closing a

program, respectively). It depends on a set of observed endogenous variables for market structure and competition, $M_{jdt}$; a set of market-level observed variables related to labor demand, $L_{kdt}$; and other observed variables, $X_{kjdt}$, including department, field, and HEI characteristics. The error term, $\varepsilon_{jkdt}$, captures unobserved shocks such as cost or financial aid heterogeneity among HEIs and fields.

This equation is consistent with a number of underlying structural models. Regardless of a structural model's stance on the HEI objective function (e.g., profits, prestige, student placement), this equation presents HEIs as responding to expected student demand (which is presumably correlated with local labor market demand), market structure and competition, and costs. As a result, the entry and exit probabilities delivered by equation 4 are consistent with a variety of plausible structural models.

In this equation, endogeneity might arise due to possible correlation between $\varepsilon_{jkct}$ and the measures of local labor demand in $L_{kdt}$ or market structure in $M_{jdt}$. We address this concern in two ways. First, we construct measures of labor demand that are uncorrelated with unobserved factors affecting the local SCP market. Second, we construct instruments for variables related to market structure. Below we provide further details and present our entry and exit estimation equations.

## 4.2 Entry

We implement the following linear probability model to study how HEIs respond to local labor demand when making entry decisions:

$$Entry_{jkdt} = \alpha_L L_{kdt-1} + \alpha_X X_{jkdt-1} + \alpha_M M_{kdt-1} + \alpha_t + \alpha_d + \alpha_f + \varepsilon_{jkdt} \qquad (5)$$

where $Entry_{jkdt}$ is an indicator for whether institution $j$ opens a new program in field $k$, department $d$, and year $t$. Note that the dependent variable measures entry on the extensive margin (whether the HEI opens or not a program) rather than the intensive margin (how many programs it opens). In this and other regressions, the explanatory variables are lagged to account for the fact that it takes HEIs some time to open or close programs in response to market conditions. When opening programs, for instance, institutions need time to develop the curriculum, recruit faculty, set up infrastructure, and obtain authorization from the regulatory authority. All our specifications include year, department, and field-category (denoted by $f$) fixed effects.[14]

[14]In the dependent and independent variables in this and other regressions, field $k$ refers to the

Our main explanatory variable of interest is $L_{kdt}$, which measures the local, field-specific labor demand for graduates. We also control for institution- and market-level variables, $X_{jkdt}$ and $M_{jdt}$ respectively, as well as department, field-category, and year fixed effects. Institution-level controls in $X_{jkdt}$ include cost proxies, namely the institution's relative size in the department (its share of the department's total SCP enrollment) and the institution's degree of specialization in the field (the field's enrollment share within the institution). We expect institutions with a large share of SCP students in the department (i.e.,"large" HEIs) to have low entry costs by virtue of their infrastructure and popularity. Similarly, we expect institutions that are more specialized in a field to have lower entry costs into it by virtue of already having field-specific resources (e.g., facilities and faculty). Market-level controls $M_{jdt}$ include the number of SCPs in the field and department provided by each of the following three types of competitors: public HEIs, private HEIs, and SENA. These variables seek to capture the effect of competition and market structure on entry decisions.

## Identification

### Effect of local labor demand on entry

As explained in Section 2.3, we construct two variables to measure local labor demand, $L_{kdt}$: local GDP by field and field relative employment. Our GDP-by-field measure is a shift-share variable that captures the differential exposure of departments and fields to sector-specific national shocks. Although a sector's shock is common to all departments, the exposure of a particular field and department to the shock is proportional to the sector's importance for that field and department, as given by the sector's time-invariant employment share. For identification purposes, the key feature of these shares is that they are based on the graduates employed in a department independently of where they studied. Similarly, our relative employment variable measures the proportion of SCP graduates from a field who work in a department independently of where they studied. If these two variables were based on the SCP graduates who obtained their degree in the department rather than those who work there, they might be correlated with local SCP demand and supply and might not be exogenous. As a

24 fields listed in Table A.1 yet the field-category fixed effects, $\alpha_f$, refer to the four *aggregate* field categories from that table. We use field-category fixed effects for a more parsimonious model—particularly given the inclusion of year and department fixed effects—and because some of the 24 fields have very few observations.

robustness check, we also construct the employment shares for the GDP-by-field and relative employment *excluding* workers that graduated in the same department where they work (namely, only based on "movers"). Results are the same with this alternative measure.

**Effect of competition on entry**

Since the variables in $M_{jdt}$ include the number of competing programs from three provider types (public HEIs, private HEIs, and SENA), we construct four instruments. The main ones draw on the fact that HEIs tend to open programs in markets where their entry cost is low. Indeed, Table 2 panel B shows that HEIs are most likely to open programs in locations where they already operate. We use the number of programs from competitors in the baseline year of 2004 as a proxy for their entry costs. For instance, if public HEIs had offered a large number of programs in Bogota in 2004, they would have had the infrastructure required to open additional programs in later years. Moreover, institutions' market presence and infrastructure in 2004 are arguably predetermined and uncorrelated with current supply-side shocks.

We interact the baseline number of programs with our GDP-by-field variable, which allows the instrument to vary over time and across fields. In other words, the effect of the baseline number of competitors on the contemporaneous number of competitors varies over time and across fields depending on our local economic activity measure, which is exogenous by construction. These interactions give us three instruments, based on the baseline supply of each of the three types of competitors (public HEIs, private HEIs, and SENA). For institution $j$ in department $d$, field $k$, at time $t$, the three interactions are as follows:

$$IV^{H}_{jdkt} = \#\text{ of Prog}^{H}_{-j,d,2004} \cdot GDP^{Bartik}_{dkt-1} \tag{6}$$

where $\#$ of $\text{Prog}^{H}_{-j,d,2004}$ is the total number of programs offered in 2004 (first year of our entry analysis) by *other* providers of type $H$ (public, private, and SENA) in department $d$.

Our fourth instrument is SENA's budget by department and year. Since SENA's budget is largely a political matter and is determined at the national rather than local level, it constitutes a valid instrument. We make the caveat that, since we do not observe SENA's budget by field, this additional instrument varies over time and across

departments but not across fields.

## 4.3 Exit

We examine exit at two levels. In the first one (program level), the HEI decides whether to close a specific existing program—for instance, whether *Politecnico de Medellin* closes its Lab Technician program in 2010. In the second (market level), the HEI decides whether to close any program at all in a given field and department. In the first case we explore what leads to the closing of a specific program; in the second, what leads to close any program at all in a specific market.

To analyze *program-level* closings, we estimate a variant of equation 5 in which the dependent variable is $Exit_{ijkdt}$, an indicator for whether institution $j$ closes (existing) program $i$ in field $k$ and department $d$ in year $t$. In addition, to explore whether institutions close programs with declining enrollment, we estimate the following specification:

$$Exit_{ijkdt} = \sum_{\tau=t-2}^{t-1} \eta_\tau \Delta Enrollment_{i\tau} + \eta_L L_{kdt-1} + \eta_X X_{jkdt-1} + \eta_t + \eta_d + \eta_f + \varepsilon_{ijkdt} \quad (7)$$

where the explanatory variables include the program's proportional enrollment change between $t-2$ and $t-1$, and $t-3$ and $t-2$; a vector of (lagged) market- and institution characteristics including local labor demand, $L_{kdt-1}$ and cost proxies, $X_{jkdt-1}$; year fixed effects; department fixed effects; and field-category fixed effects.

Our *market-level* exit analysis is motivated by the fact that, when opening a new program in a market, 35% of the times the institution also closes a program in that market (own calculations). To capture this phenomenon of an HEI's simultaneous entry and exit in a given (location-field) market, we estimate the following exit specification:

$$Exit_{jkdt} = \delta_E Entry_{jkdt} + \delta_L L_{kdt-1} + \delta_t + \delta_d + \delta_f + \varepsilon_{ijkdt} \quad (8)$$

where $Exit_{jkdt}$ is an indicator for whether institution $j$ closes any program in field $k$ and department $d$ in year $t$; and $Entry_{jkdt}$ is an indicator for whether $j$ opens any program in the same field, department, and year. As usual, we control for department, field-category, and year fixed effects.

An institution's simultaneous entry and exit in a given market has several possible explanations. Mechanically, a program's SNIES code could change even if the program

itself did not, which would create fake entry and exit. We filter out these cases, which generally consist of programs that keep their name but change code. A more interesting explanation is that, in order to open a new program in a location and field, the institution may need to close another one in order to liberate capacity. In this case, entry and exit might happen contemporaneously or a few periods apart. We explore correlation between exit and entry in the same period as well as one-period apart.

Before discussing our estimates, it is useful to examine descriptive statistics for the independent variables in the regressions. On average, an HEI considering whether to open a new program in any field in its existing location (e.g., an entrant per the narrow definition) faces considerable competition in that location—164 programs taught by private HEIs, 39 by public HEIs, and 121 by SENA (panel A of Table A.3, bottom portion). Further, the field captures about 5 percent of the SCP graduates employed in that location. Potential entrants among public HEIs capture, on average, 11 percent of the location's total SCP enrollment relative to only 3.5 percent among private HEIs, consistent with the fact that public HEIs are larger, on average, than private HEIs. Private HEIs, in turn, are more specialized than their public counterparts: on average, a field captures 36 percent of the institution's enrollment among private HEIs but only 29 percent among public HEIs. Similar statistics are presented for the main variables used to analyze exit.

# 5. Results

## 5.1 Entry and local labor demand

We estimate several specifications of Equation 5 using both the broad and narrow definitions of entry, and including different sets of controls. Table 3 presents the estimates of Equation 5 without institution- or market-level controls (namely, setting $\alpha_X = \alpha_M = 0$). These estimates show the relationship between between an HEI's decision to open a program in a market and the market's local economic activity, as measured by the GDP-by-field and field relative employment variables. Our main results are those using GDP by field because this variable is available for the entire 2004-2019 period, whereas field relative employment is only available for 2007-2013.

Panels A and B show results for GDP by field using the narrow and broad definition of potential entrants, respectively. Column (1) shows the results for all SCPs and columns (2) and (3) show results separately for private and public institutions. Given

the greater turnover of SCPs than bachelor's programs, for comparison Column (4) shows estimates of the entry regression for bachelor's programs. To facilitate results' interpretation and comparison, the last row of each panel reports the elasticity of entry probability with respect to GDP by field and field relative employment, evaluated at the sample means.

Both panels show a significant correlation between SCP entry and local economic activity. Coefficients in panel B are much smaller than those in panel A and the corresponding elasticities are larger, consistent with the fact that, by definition, average entry probability is much lower under the broad than the narrow definition of potential entrants. Nevertheless, both panels tell a similar story: a 1%-increase in local labor demand in a field raises the probability of a new program being opened in that field by about 0.5-0.9% at local private HEIs, but only 0.1%-0.2% at public HEIs. Since these estimates control for field categories, they are not driven by different field specialization between public and private HEIs. Instead, they are likely driven by different funding, governance, and management regimes. Private HEIs do not receive public funding and only attract students if they offer relevant programs, whereas the public funding received by public HEIs is not necessarily related to enrollment or local labor market needs. Further, public HEIs may have less ability than private HEIs to respond to local labor market changes because they are larger, more bureaucratic, and have a more complex governance.

Importantly, bachelor's programs are less responsive to local economic activity than SCPs. In principle, it should be easier to set up new SCPs, which are short and eminently practical, than bachelor's programs. At the same time, the greater responsiveness of SCPs is driven by private HEIs, since the responsiveness of bachelor's programs is rather similar to that of public HEIs. In other words, the responsiveness of private SCP providers is not merely due to their programs being short but may be related to the funding and management factors cited above, all of which might lead them to interact more with local employers when selecting their offerings.

Panels C and D show estimates using relative employment by field as the measure of local labor demand for the narrow and broad definition of potential entrants, respectively. They tell a similar story as those from panels A and B even though relative employment by field is available for a shorter period than GDP by field. In what follows we focus on the narrow definition and leave results using the broad definition to the appendices; results are generally robust under both definitions. As an additional ro-

Table 3: Program Entry and Economic Activity

Dependent Variable : Indicator for Opening a New Program

| | All SCPs | Private SCPs | Public SCPs | Bachelor's |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Panel A: GDP (2004-2019); Narrow Entrant Definition | | | | |
| L.GDP by Field | 0.0018*** | 0.0020*** | 0.0007*** | 0.0008*** |
| | (0.0001) | (0.0001) | (0.0002) | (0.0001) |
| Constant | 0.0006 | -0.0073* | 0.0211* | 0.0189*** |
| | (0.0034) | (0.0037) | (0.0085) | (0.0033) |
| N. of Observations | 68,654 | 52,699 | 15,955 | 89,559 |
| Mean of Dep. Variable | 0.023 | 0.022 | 0.027 | 0.020 |
| Elasticities | 0.39 | 0.47 | 0.11 | 0.18 |
| Panel B: GDP (2004-2019); Broad Entrant Definition | | | | |
| L.GDP by Field | 0.0006*** | 0.0007*** | 0.0002*** | 0.0004*** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Constant | -0.0007 | -0.0021*** | 0.0040*** | 0.0026*** |
| | (0.0004) | (0.0004) | (0.0009) | (0.0004) |
| N. of Observations | 1,004,480 | 770,880 | 233,600 | 999,808 |
| Mean of Dep. Variable | 0.0016 | 0.0015 | 0.0018 | 0.0018 |
| Elasticities | 0.71 | 0.87 | 0.20 | 0.41 |
| Panel C: Employment (2007-2013); Narrow Entrant Definition | | | | |
| L.Field Relative Employment | 0.4095*** | 0.4473*** | 0.2844*** | 0.1629*** |
| | (0.0364) | (0.0426) | (0.0668) | (0.0320) |
| Constant | -0.0129 | -0.0203** | 0.0043 | 0.0108*** |
| | (0.0056) | (0.0057) | (0.0134) | (0.0054) |
| N. of Observations | 14,971 | 11,480 | 3,491 | 19,679 |
| Mean of Dep. Variable | 0.026 | 0.024 | 0.031 | 0.020 |
| Elasticities | 0.75 | 0.87 | 0.43 | 0.39 |
| Panel D: Employment (2007-2013); Broad Entrant Definition | | | | |
| L.Field Relative Employment | 0.0220*** | 0.0238*** | 0.0160*** | 0.0126*** |
| | (0.0017) | (0.0020) | (0.0031) | (0.0018) |
| Constant | 0.0010 | -0.0004 | 0.0054** | 0.0036*** |
| | (0.0006) | (0.0005) | (0.0019) | (0.0006) |
| N. of Observations | 323,575 | 248,325 | 75,250 | 322,070 |
| Mean of Dep. Variable | 0.0019 | 0.0017 | 0.0023 | 0.0019 |
| Elasticities | 0.61 | 0.71 | 0.36 | 0.34 |

Note: Each column presents the coefficients from an OLS regression where the dependent variable is an indicator for whether institution $j$ opens a new program in department $d$ and field $k$ in year $t$, for the 2004-2019 period. Elasticities of entry probability with respect to the corresponding economic activity variable, evaluated at the sample means, are reported at the bottom of each panel. GDP by field is measured in billions of COP and field relative employment is between zero and one; both variables are included with a one-year lag. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

bustness check (see Section 4), we repeat these entry regressions using a version of the GDP-by-field and relative employment variables that is exclusively based on "movers," namely students who work in a department but obtained their degree in a different one. Table A.4 shows these results, which are practically identical to the ones from panels A and B in Table 3.

We would expect changes in labor demand not only to motivate the opening of new SCPs but also the enrollment of new, additional students—either in existing or new programs. We examine aggregate enrollment effects (Table A.5) and find that, indeed, enrollment in a field and department rises in response to a local demand increase for graduates in the field, as in Grosz (2022). Consistent with entry responses, the enrollment elasticity with respect to labor demand changes is higher for private than public HEIs (1.2 v. 0.9, respectively). Enrollment elasticities are larger than entry elasticities because they account for additional students not only at new but also at existing programs. Nevertheless, the main message from these results is that not only do HEIs respond to economic activity changes; students respond as well.

We further explore heterogeneous responsiveness to local labor market demand by looking at the three HEI types that provide SCPs (Table A.6.) Both the estimates using GDP-by-field and field relative employment show that technological and technical institutes (which specialize in SCPs) as well as technological schools (offering SCPs as well as bachelor's programs) are more responsive than universities (which teach the full spectrum of degrees, ranging from SCPs to PhDs). Through greater specialization in SCPs, non-university HEIs have an institutional setup readily geared towards SCPs, which makes them nimble and fast. Anecdotal evidence indicates that these institutions are in closer contact with the private sector than universities and operate more flexibly. Because of their larger variety of products, universities lack this flexibility. Based on conversations with university leaders, universities that offer both SCPs and bachelor's programs struggle to manage the two very different sets of students and faculty. In addition, high fixed costs limit their ability to change their offerings.[15]

Overall, the main takeaway from this analysis is that SCP entry is indeed responsive to local labor market demand, particularly on the part of private and non-university HEIs.

[15]We observe similar patterns when looking separately at public and private institutions for each of the three HEI types. Results are available upon request.

## 5.2 Entry, costs, and competition

We now estimate specifications of Equation 5 which include cost proxies, $X_{jkdt}$, and show results in Table 4. As expected, lower costs are positively associated with entry for both public and private HEIs. Larger institutions (where size is measured by the institution's enrollment share in the department) are more likely to open new programs in any field, and institutions that are more specialized in a particular field (as measured by the fraction of their students enrolled in the field) are more likely to open programs in it. Comparing the entry elasticities with respect to these variables for private and public HEIs, we find that private HEIs are more sensitive to specialization than public HEIs, consistent with their lack of public funding—in the absence of public funding, they must avoid the fixed cost of opening programs outside their field of specialization. Meanwhile, public HEIs tend to be more responsive to size than private HEIs, consistent with their larger size.

Table 4: Program Entry and Proxies for Cost

Dependent Variable : Indicator for Opening a New Program (Narrow Entrant Definition)

| | All SCPs | Private SCPs | Public SCPs |
|---|---|---|---|
| | (1) | (2) | (3) |
| L.GDP by Field | 0.0012*** | 0.0014*** | 0.0004* |
| | (0.0001) | (0.0001) | (0.0002) |
| L.HEI share in Dept. | 0.1067*** | 0.1310*** | 0.0879** |
| | (0.0188) | (0.0236) | (0.0286) |
| L.Field share in HEI | 0.1456*** | 0.1397*** | 0.1571*** |
| | (0.0091) | (0.0098) | (0.0216) |
| Constant | -0.0090** | -0.0150*** | 0.0039 |
| | (0.0034) | (0.0037) | (0.0083) |
| N. of Observations | 62,822 | 48,527 | 14,295 |
| Mean of Dep. Variable | 0.0203 | 0.0194 | 0.0236 |
| Elasticities: | | | |
| HEI share in Dept. | 0.18 | 0.16 | 0.26 |
| Field share in HEI | 0.31 | 0.31 | 0.28 |

Note: Each column presents the coefficients from an OLS regression where the dependent variable is an indicator for whether institution $j$ opens a new program in department $d$ and field $k$ in year $t$ for 2004-2019. GDP-by-field is in billions of COP; HEI share in the department and field share within the HEI are enrollment shares and range between zero and one. All independent variables are lagged one year. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

Table 5 shows estimates of a specification of Equation 5 including market structure variables, $M_{kdt}$, to assess the relationship between SCP entry and the presence of competitors. These regressions control for entry cost proxies because an institution's

number of competitors is likely correlated with its size and specialization. For instance, an institution attracting a high share of local SCP students and highly specialized in a field might face low entry costs in that department and field, thereby deterring competitors' entry. Columns 1 and 3 present OLS estimates. We expect them to be upward-biased, as the number of competing programs is likely correlated with unobserved shocks in the error term and might lead to a positive correlation between entry decisions and number of competitors. Columns 2 and 4 present the corresponding 2SLS estimates, where we correct for endogeneity using the instruments described in Section 4 (Table A.7 shows the first-stage regressions). At the bottom of the table, we present the statistics for weak IV tests and over-identification tests for the 2SLS estimates. Since instruments are weak for public HEIs, we also include the Anderson-Rubin Wald test, which is robust to weak instruments and shows we can reject the null hypothesis that coefficients on all endogenous variables are not significantly different from zero.

As expected, the 2SLS coefficients on the number of private and public competitors are all negative and much larger, in absolute value, than the OLS estimates. Two main patterns stand out. First, both private and public HEIs respond mostly to the presence of same-type competitors. Based on the 2SLS coefficients, the probability of a private HEI opening a new SCP in a market falls by about 0.11 (or 11 percentage points) in response to ten additional programs taught by private HEIs in that market. Similarly, the entry probability of a new SCP on the part of a public HEI falls by about 0.1 (or 10 percentage points) in response to ten additional programs taught by other public HEIs. Second, neither public nor private HEIs seem to respond to SENA competition. Findings are robust to using the broad definition of potential entrants (Table A.8).

These estimates suggest that public and private HEIs compete in different segments of the market and differentiate their products. This is consistent with their different specialization patterns and the student sorting described in Section 2.1. For example, competition may be particularly fierce among private HEIs—all of which are seeking to attract the same pool of students by offering relatively similar programs—but not between public and private HEIs, which attract different types of students and offer different products. Private HEIs, for instance, tend to emphasize student services, private sector connections, and job search assistance more than public HEIs, but the latter offer subsidized tuition and a different portfolio of programs. SENA programs, in turn, may be altogether different from those offered by public or private institutions, explaining why they do not elicit any competitive response on the part of HEIs. Indeed,

Table 5: Entry Decisions and Market Structure

Dependent Variable: Indicator for Opening a New Program (Narrow Entrant Definition)

| | Private HEIs | | Public HEIs | |
|---|---|---|---|---|
| | OLS | 2SLS | OLS | 2SLS |
| | (1) | (2) | (3) | (4) |
| N. of SENA SCPs (lagged) | -0.0004 | 0.006 | 0.0018** | 0.010 |
| | (0.0002) | (0.003) | (0.0006) | (0.006) |
| N. of Private SCPs (lagged) | -0.0036*** | -0.112*** | 0.0029* | -0.056 |
| | (0.0006) | (0.011) | (0.0011) | (0.035) |
| N. of Public SCPs (lagged) | 0.0027** | -0.074 | -0.0221*** | -0.095** |
| | (0.0010) | (0.045) | (0.0038) | (0.037) |
| HEI share in Dept.(lagged) | 0.1138*** | -0.541*** | 0.0411 | -0.158 |
| | (0.0223) | (0.139) | (0.0247) | (0.109) |
| Field share in HEI (lagged) | 0.1610*** | 0.086*** | 0.1401*** | 0.093* |
| | (0.0099) | (0.012) | (0.0210) | (0.042) |
| Constant | 0.0055 | 1.811*** | 0.1413*** | 1.303*** |
| | (0.0090) | (0.408) | (0.0277) | (0.336) |
| N. of Observations | 49,848 | 45,581 | 14,688 | 13,405 |
| Mean of Dep. Variable | 0.0189 | | 0.0240 | |
| Weak identification tests: | | | | |
| Cragg-Donald Wald F stat | | 25.723 | | 5.492 |
| Kleibergen-Paap rk Wald F stat | | 140.835 | | 3.280 |
| Anderson-Rubin Wald test | | 100.61 | | 21.95 |
| Overidentification test: | | | | |
| Hansen J statistic | | 18.404 | | 4.495 |

Note: Each column presents coefficients from a regression where the dependent variable is an indicator for whether institution $j$ opens a new program in department $d$ and field $k$ in year $t$, for the 2004-2019 period. The independent variables are the market number of SCPs offered by private institutions, public institutions, and SENA, plus controls for proxies of the cost of opening a program: HEI's enrollment share of SCP students in the department (total over all fields) and the field's enrollment share within the HEI. Columns (1) and (3) show OLS estimates, and columns (2) and (4) show the respective 2SLS estimates. The endogenous variables are the number of SCPs offered by private HEIs, public HEIs, and SENA (first three independent variables). Instruments are the number of programs offered by each provider type in 2004 interacted with lagged GDP-by-field and SENA's budget for the department and year. All the variables indicating number of programs are measured in tens. All explanatory variables are included with a one-year lag. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

for decades SENA has provided vocational training programs (lasting a few weeks or months) and has only recently entered the SCP market. As a result, students might perceive SENA's SCPs as different from those provided by public or private institutions. Further, SENA provides different skills than those provided by the HEIs—more focused on occupational training than on socio-emotional competencies—and a different student experience.

To summarize, when deciding whether to open a program in a given market, institutions respond to local labor market demand, cost considerations, and the presence of same-type competitors. We now turn to discussing our exit estimates.

## 5.3 Exit

### 5.3.1 Exit at the individual program level

We start with the decision to close a specific, existing program. Table 6 shows estimates for equation 7. The decision to close an individual program does not appear related to local labor demand, either at private or public HEIs (columns 1, 2, 4, and 5). It is not related to the presence of competitors either (Table A.9, panel B). Based on conversations with HEI directors, we look at enrollment changes as a possible determinant of program closings (Table 6, columns 3 and 6). Holding local labor demand constant, in period $t$ private HEIs are more likely to close programs with lower enrollment growth between $t-2$ and $t-1$, consistent with their full dependence on tuition revenue. Program closings at public HEIs, in contrast, do not respond to enrollment growth, consistent with their weaker relationship between funding and enrollment.

To further explore the relationship between closings and enrollment changes, Table 7 regresses closing decisions on both one-lagged (between $t-2$ and $t-1$) as well as two-lagged (between $t-3$ and $t-2$) proportional enrollment changes. Once again, private HEIs respond to enrollment growth whereas public HEIs do not. Among private HEIs, more recent enrollment changes seem more impactful on program closing.

We also look at the relationship between program closing and cost proxies. As in the entry analysis, we expect that lower costs (as captured by larger size or greater specialization) would lower the probability of closing a program. Columns 2 and 4 show that greater specialization in a field lowers the probability of closing programs in it (the effect is more precisely estimated for private than public than public HEIs). And, among private HEIs, larger institutions are (marginally) less likely to close programs.

Table 6: Program Exit and Economic Activity

| Dependent Variable: Indicator for Closing a Specific Program | | | | | | |
|---|---|---|---|---|---|---|
| | Private HEIs | | | Public HEIs | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| L.GDP by Field | 0.0001 | | 0.0002 | -0.0004 | | -0.0000 |
| | (0.0001) | | (0.0002) | (0.0005) | | (0.0004) |
| L.Field Rel. Employment | | 0.0059 | | | 0.0728 | |
| | | (0.0521) | | | (0.0933) | |
| L.Enrollment Change | | | -0.0054*** | | | -0.0002 |
| | | | (0.0013) | | | (0.0002) |
| Constant | 0.0210 | 0.0573* | 0.0194 | 0.0532* | 0.0571 | 0.0406 |
| | (0.0173) | (0.0276) | (0.0181) | (0.0241) | (0.0308) | (0.0236) |
| N. of Observations | 13,423 | 3,389 | 10,069 | 4,463 | 1,174 | 3,286 |
| Mean of Dep. Variable | 0.112 | 0.093 | 0.094 | 0.090 | 0.069 | 0.062 |

Note: In this table, the unit of observation is an incumbent program. Each column presents the coefficients from an OLS regression of an indicator for whether incumbent program $i$ in department $d$ and field $k$ is closed in year $t$ and the independent variables on our GDP-by-field and relative employment-by-field measures, and the one-year proportional enrollment change, all lagged one year, for the 2004-2018 period. GDP by field is measured in billions of COP, field relative employment is between zero to one, and enrollment change is the proportional change between years $t-2$ and $t-1$. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

In other words, program closing at private HEIs appears driven by enrollment changes and cost of provision (particularly specialization), but no determinant is more than marginally significant to explain closings at public HEIs.

### 5.3.2 Exit at the market level

Motivated by the fact that many HEIs open and close programs simultaneously, we now turn to how HEIs decide whether to close any program at all in a market. Table 8 shows estimates for equation 8. We control for both contemporaneous and lead entry to capture the possibility that institutions might close a program in the current period to make room for a new one in the future.

Controlling for field-level local economic activity, we find a positive correlation between entry and exit decisions, both for private and public institutions (columns 2, 3, 5, and 6), at the market level. In other words, an institution's decision to close programs in a field and department is correlated with its own decision to open new programs in that market, both in the current and next period. We interpret this finding as evidence of capacity constraints—when seeking to open a new (perhaps more modern) program, given their limited resources HEIs may need to reallocate

Table 7: Program Exit and Cost Proxies

Dependent Variable: Indicator for Closing a Specific Program

| | Private HEIs | | Public HEIs | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Lagged Enrollment Change | -0.0108*** | -0.0105*** | -0.0001 | -0.0001 |
| | (0.0023) | (0.0023) | (0.0002) | (0.0002) |
| Two-Lagged Enrollment Change | -0.0039** | -0.0039** | -0.0001 | -0.0001 |
| | (0.0013) | (0.0013) | (0.0002) | (0.0002) |
| Lagged Field Share in HEI | | -0.0340** | | -0.0543* |
| | | (0.0125) | | (0.0216) |
| Lagged HEI Share in Dept | | -0.2058* | | -0.0918 |
| | | (0.0839) | | (0.0880) |
| Lagged GDP by Field | | 0.0004 | | -0.0000 |
| | | (0.0002) | | (0.0005) |
| Constant | 0.0295 | 0.0570* | 0.0417 | 0.0606* |
| | (0.0215) | (0.0231) | (0.0248) | (0.0268) |
| N. of Observations | 8,581 | 8,578 | 2,861 | 2,861 |
| Mean of Dep. Variable | 0.097 | 0.097 | 0.058 | 0.058 |

Note: In this table, the unit of observation is an incumbent program. Each column presents the coefficients from an OLS regression of an indicator for whether incumbent program $i$ in department $d$ and field $k$ is closed in year $t$, on lagged proportional enrollment change ($t-1$ minus $t-2$) and two-lagged proportional enrollment change ($t-2$ minus $t-3$), for the 2004-2018 period. Columns (2) and (4) also include cost proxies (the HEI's enrollment share in the department and the field's enrollment share in the HEI, both between zero and one) and GDP-by-field (in billions of COP), all lagged one year. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

Table 8: Program Exit and Entry

Dependent Variable: Indicator for Closing Any Program

| | Private HEIs | | | Public HEIs | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| L.GDP by Field | 0.0015*** | 0.0018*** | 0.0016*** | -0.0001 | -0.0006 | -0.0007 |
| | (0.0003) | (0.0003) | (0.0003) | (0.0008) | (0.0006) | (0.0006) |
| Open Program (year t+1) | | 0.1042*** | 0.0983*** | | 0.1751*** | 0.1565*** |
| | | (0.0213) | (0.0207) | | (0.0377) | (0.0367) |
| Open Program (year t) | | | 0.1001*** | | | 0.1364*** |
| | | | (0.0182) | | | (0.0291) |
| Constant | 0.0193 | -0.0008 | -0.0041 | 0.0586 | 0.0417 | 0.0297 |
| | (0.0277) | (0.0211) | (0.0212) | (0.0348) | (0.0261) | (0.0258) |
| N. of Observations | 6,703 | 6,087 | 6,087 | 2,339 | 2,170 | 2,170 |
| Mean of Dep. Variable | 0.175 | 0.122 | 0.122 | 0.139 | 0.098 | 0.098 |

Note: In this table, each column presents the coefficients from a regression of an indicator for whether institution $j$ closes any (at least one) program in field $k$ and department $d$ in year $t$, on indicators for whether institution $j$ opens any (at least one) program in field $k$ and department $d$ in year $t$ or $t+1$, as well as the lagged GDP-by-field (measured in billions of COP), for 2004-2018. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

infrastructure and faculty away from other programs onto the new one.[16]

Another important finding emerges from Table 8. Consistent with our entry estimates, public HEIs do not respond to local demand shocks when deciding to close programs in a market (column 4). Meanwhile, private HEIs respond to them but in a counter-intuitive manner, since they close more programs in markets with higher labor demand (column 1). In other words, in response to positive demand shocks private HEIs not only open some programs (Section 5.1) but also close others, thereby contributing to program turnover or "churn." This echoes well-know results from other industries (Dunne et al., 1988) where positive demand shocks leads not only to entry but also exit of firms and creates firm turnover.

To summarize, both public and private HEIs tend to open and close programs in a market simultaneously, likely due to capacity constraints. When choosing which program to close, private HEIs close those with lower enrollment growth and higher costs. Among private HEIs, positive local labor market shocks drive not only entry but also exit (and therefore turnover) of programs.

[16]For instance, in 2018 the LCI Technological Foundation in Bogota closed "Technologist in Fashion Design" and opened "Technologist in Photography and Digital Imaging," and in 2006 the Latin American University Corporation in Atlantico closed "Professional Technician in Executive Assistantship" and opened "Professional Technician in Human Resources Administration."

# 6. Conclusion

This paper studies entry and exit of SCPs in Colombia across markets defined as field of study-location combinations. We show that these programs exhibit high turnover rates—higher, in fact, than traditional bachelor's programs—providing evidence of a highly dynamic market that could respond to the changing skill needs of the economy. We find that, when opening new programs, institutions respond to changes in local economic activity. Private institutions are more responsive than public ones, presumably because they depend more on tuition revenues and operate more flexibly. Further, non-university institutions are more responsive than universities, likely because they are nimbler and more specialized in SCPs. Our results are robust to multiple specifications and definitions of potential entrants.

When opening new programs, HEIs also respond to competition from same-type HEIs and to costs, opening more programs in their fields of specialization or in locations where they are relatively large. They do not respond to competition from SENA. These patterns suggest that institutions compete in highly segmented markets, and that SENA programs are not viewed as close substitutes to those offered by public or private HEIs. An interesting finding is that when institutions open a program in a market they often close others in the same market, presumably to liberate resources. In choosing which program to close, private HEIs decide based on recent enrollment growth and costs. More importantly, private HEIs not only open but also close programs—generating program turnover or "churn"—in response to positive local labor demand shocks.

Overall, our results show that private HEIs are more responsive to market conditions than public HEIs when opening and closing programs. These findings are consistent with their funding and management and, in principle, bode well for their ability to respond to the changing skill needs of the economy. They are also consistent with evidence for SCPs in the U.S., where private for-profit institutions tend to show stronger and more flexible responses than community colleges. One important difference with that literature is our reliance on direct supply-side measures (program entry and exit) rather than equilibrium outcomes (student enrollment or graduation). Another difference is our study of exit, not explored in other papers, and our systematic investigation of entry and exit determinants.

All in all, our results indicate that, given their responsiveness to local labor market demand, SCPs seem well positioned for the skill provision currently needed by Colombia

and other countries alike. They also highlight the need to fund and regulate institutions and programs in order to maximize their responsiveness to changing local conditions without sacrificing, of course, their quality and value added to the students.

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# Online Appendix: Additional Tables and Figures

Table A.1: Distribution of Programs by Field

| Field | Number of SCPs | % of SCP Enrollment | % Public | % Private |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **Business and Social Sciences** | **1,657** | **43.9** | **37.17** | **51.1** |
| Business | 1,037 | 29.0 | 18.46 | 33.43 |
| Social Sciences | 252 | 6.3 | 10.16 | 6.40 |
| Economics | 176 | 4.9 | 3.84 | 5.46 |
| Accounting | 192 | 3.7 | 4.71 | 5.80 |
| **Arts and Architecture** | **454** | **10.4** | **5.95** | **15.29** |
| Arts | 423 | 9.6 | 4.46 | 14.57 |
| Architecture | 31 | 0.8 | 1.49 | 0.72 |
| **Sciences** | **163** | **5.7** | **8.80** | **3.46** |
| Health | 99 | 4.3 | 3.72 | 2.60 |
| Agronomy and Veterinary | 42 | 0.8 | 3.22 | 0.60 |
| Math and Natural Sciences | 22 | 0.6 | 1.86 | 0.26 |
| **Engineering** | **1,189** | **40.1** | **48.09** | **30.16** |
| Systems | 450 | 11.8 | 9.67 | 14.01 |
| Electronic and Telecommunications | 231 | 6.8 | 9.67 | 5.76 |
| Industrial | 173 | 8.1 | 6.32 | 4.59 |
| Mechanical | 106 | 4.8 | 6.20 | 2.11 |
| Electrical | 50 | 1.6 | 4.46 | 0.53 |
| Environmental and Sanitary | 45 | 2.4 | 1.98 | 1.09 |
| Civil | 30 | 1.5 | 2.60 | 0.34 |
| Biomedical | 10 | 0.5 | 0.62 | 0.19 |
| Agribusiness and Food | 19 | 0.2 | 0.99 | 0.41 |
| Chemical | 17 | 0.7 | 0.99 | 0.34 |
| Agronomic and Livestock | 9 | 0.1 | 0.50 | 0.19 |
| Agriculture and Forest | 6 | 0.1 | 0.62 | 0.04 |
| Administrative | 3 | 0.0 | 0.00 | 0.11 |
| Mining and Metallurgy | 2 | 0.2 | 0.25 | 0.00 |
| Other engineering | 38 | 1.3 | 3.22 | 0.45 |
| **Total Number of SCPs**: | **3,463** | | | |
| Public HEIs | 807 | | | |
| Private HEIs | 2,656 | | | |

Note: This table presents information at the field-of-study level. Column 1 shows number of short cycle programs per field; columns 2, 3 and 4 show percentage of SCP enrollment by field (overall, in public HEIs, and in private HEIs respectively). SENA programs are not included. Columns 2, 3, and 4 each sum up to 100. Fields are aggregated into four "field categories". Number of programs is the count of distinct programs that are offered during the sample period (2004-2019); percentages of students by field are computed based on sample period totals.

Table A.2: Entry and Exit

| | SCPs | Bachelor's Programs |
|---|---|---|
| Avg. Number of Programs Offered per Year | 1,208.7 | 2,239.3 |
| Avg. Number of New Programs per Year | 136.6 | 136.4 |
| Avg. Number of Closing Programs per Year | 127.0 | 90.6 |
| Avg. Number of HEIs Active per Year | 155.7 | 176.4 |
| Avg. Number of HEI-Field-Depts per Year Offering at least One Program | 606.3 | 1,314.6 |
| Avg. Number of HEI-Field-Depts with at least One New Program per Year | 123.6 | 144.1 |
| Avg. Number of HEI-Field-Depts with at least One Closing Program per Year | 112.8 | 107.1 |
| Avg. Number of Potential Entrants per Field-Dept under Narrow Definition per Year | 4,921.2 | 6,987.9 |
| Avg. Number of Potential Entrants per Field-Dept under Broad Definition per Year | 67,586.7 | 67,967.4 |

Note: This table presents the average, over all years from 2004 to 2019, for variables associated with entry and exit. SCPs and Bachelor's programs include those provided at public and private institutions. SENA programs are not included. "Dept" stands for "department".

Table A.3: Descriptive Statistics for the Variables Used in the Empirical Analysis

| Panel A: Entry Regressions | | |
|---|---|---|
| | Mean | Std. Dev. |
| Indicator for New SCP (Narrow Entrant Definition) | 0.023 | 0.148 |
| Indicator for New SCP (Broad Entrant Definition) | 0.003 | 0.052 |
| Indicator for New Bachelor's Program (Narrow Entrant Definition) | 0.020 | 0.140 |
| Indicator for New Bachelor's Program (Broad Entrant Definition) | 0.002 | 0.042 |
| GDP by field | 4.83 | 10.79 |
| Field Relative Employment | 0.047 | 0.075 |
| Number of SENA SCPs | 12.12 | 9.45 |
| Number of Private SCPs | 16.37 | 16.46 |
| Number of Public SCPs | 3.94 | 2.96 |
| HEI Enrollment Share in Department: | | |
| Public HEIs | 0.111 | 0.162 |
| Private HEIs | 0.035 | 0.050 |
| Field Enrollment Share in HEI: | | |
| Public HEIs | 0.291 | 0.278 |
| Private HEIs | 0.364 | 0.294 |

| Panel B: Exit Regressions | | |
|---|---|---|
| | Mean | Std. Dev. |
| Indicator for Closing an SCP | 0.106 | 0.308 |
| GDP by field | 17.345 | 24.417 |
| Field Relative Employment | 0.144 | 0.124 |
| Proportional Enrollment Change | 0.676 | 1.434 |

Note: This table presents the mean and standard deviation for the variables used in the main regressions in the empirical analysis. An observation is an HEI-field-department-year. Panel A shows the variables used in entry regressions (for 2004-2019) and panel B shows the variables used in exit regressions (for 2004-2018). In each panel, dependent and independent variables are in the top and bottom portion, respectively. In Panel A, independent variable means are shown for potential entrants according to the narrow definition (means are almost the same for entrants according to the broad definition). GDP by field is measured in billions of COP, and number of competing programs are expressed in tens of programs. (One-year) proportional enrollment change is between 0 and 1. Table shows overall sample means. Over all years, the number of SCP observations (potential entrants) is 1,073,280 (broad definition) and 70,632 (narrow definition); for bachelor's, number of observations (potential entrants) is 1,068,288 and 92,616 (broad and narrow definition, respectively). For SCP exits, total number of observations is 17,895.

Table A.4: Program Entry and Economic Activity using Only Movers

Dependent Variable : Indicator for Program Opening - GDP Measure with Only Movers

| | Panel A: Narrow Entrant Definition | | | |
|---|---|---|---|---|
| | All SCPs | Private SCPs | Public SCPs | Bachelors |
| | (1) | (2) | (3) | (4) |
| L.GDP by Field (using only movers) | 0.0016*** | 0.0019*** | 0.0004 | 0.0006 |
| | (0.0001) | (0.0002) | (0.0002) | (0.0001) |
| Constant | 0.0009 | -0.0065 | 0.0171 | 0.0192 |
| | (0.0032) | (0.0035) | (0.0080) | (0.0031) |
| N. of Observations | 62,822 | 48,527 | 14,295 | 83,733 |
| | Panel B: Broad Entrant Definition | | | |
| | All SCPs | Private SCPs | Public SCPs | Bachelors |
| | (1) | (2) | (3) | (4) |
| L.GDP by Field (using only movers) | 0.0005*** | 0.0007*** | 0.0002*** | 0.0004*** |
| | (0.0000) | (0.0001) | (0.0000) | (0.0000) |
| Constant | 0.0001 | -0.0012*** | 0.0043*** | 0.0031*** |
| | (0.0003) | (0.0003) | (0.0009) | (0.0004) |
| N. of Observations | 1,004,480 | 770,880 | 233,600 | 999,808 |

Note: This table presents the same regression shown in Panels A and B from Table 3 but using an alternative variable for GDP by field, in which the enrollment shares used as weights only include the "movers" (students who work in a given department but did not obtain their degree there). GDP by field is measured in billions of COP. All regressions include year, department, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

Table A.5: SCP Enrollment and Economic Activity

Dependent Variable: Total SCP Enrollment by Dept-Field-Year

| | All SCPs | Private | Public |
|---|---|---|---|
| L.GDP by Field | 766.4124*** | 262.2605*** | 40.5253*** |
| | (5.3091) | (2.5430) | (2.5092) |
| Constant | -543.6767*** | -1006.2352*** | 1109.9461*** |
| | (167.6649) | (80.3098) | (79.2408) |
| N. of Observations | 3,608 | 3,608 | 3,608 |
| Mean of Dep. Variable | 2,080.01 | 550.26 | 425.33 |

Note: In this table, each column presents the coefficients from a regression of aggregate SCP enrollment in department $d$ and field $k$ in year $t$ on GDP by field, for the 2004-2019 time period. Column (1) includes all SCP enrollment in private HEIs, public HEIs and SENA; column (2) includes only enrollment in private HEIs; and column (3) only enrollment in public HEIs. GDP by field is measured in billions of COP. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

Table A.6: Program Entry and Economic Activity: Responses by HEI Type

Dependent Variable : Indicator for Opening a New Program (All SCPs offered by HEIs)

| Panel A: Narrow Entrant Definition | | | | | | |
|---|---|---|---|---|---|---|
| | Technological and Technical Institutes | | Technological Schools | | Universities | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| L.GDP by Field | 0.0024*** | | 0.0017*** | | 0.0005*** | |
| | (0.0002) | | (0.0002) | | (0.0001) | |
| L.Field Relative Empl. | | 0.5741*** | | 0.4476*** | | 0.1820*** |
| | | (0.0691) | | (0.0631) | | (0.0492) |
| Constant | -0.0218*** | -0.0398*** | 0.0131* | -0.0052 | 0.0099 | 0.0018 |
| | (0.0056) | (0.0104) | (0.0057) | (0.0081) | (0.0061) | (0.0069) |
| N. of Observations | 25,476 | 5,468 | 26,086 | 5,550 | 17,092 | 3,953 |
| Mean of Dep. Variable | 0.030 | 0.036 | 0.022 | 0.023 | 0.015 | 0.014 |

| Panel B: Broad Entrant Definition | | | | | | |
|---|---|---|---|---|---|---|
| | Technological and Technical Institutes | | University Institutions | | Universities | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| L.GDP by Field | 0.0009*** | | 0.0006*** | | 0.0001*** | |
| | (0.0001) | | (0.0001) | | (0.0000) | |
| L.Field Relative Empl. | | 0.0278*** | | 0.0247*** | | 0.0105*** |
| | | (0.0031) | | (0.0030) | | (0.0023) |
| Constant | -0.0043*** | -0.0025*** | 0.0020*** | 0.0052*** | 0.0007 | 0.0005 |
| | (0.0006) | (0.0007) | (0.0007) | (0.0015) | (0.0005) | (0.0006) |
| N. of Observations | 374,636 | 122,537 | 349,816 | 111,952 | 280,028 | 89,086 |
| Mean of Dep. Variable | 0.0021 | 0.0023 | 0.0016 | 0.0021 | 0.0009 | 0.009 |

Note: In this table, each column presents the coefficients from an OLS regression where the dependent variable is an indicator for whether institution $j$ opens a new program in department $d$ and field $k$ in year $t$, for 2004-2019. Each column corresponds to a separate regression by institution type. GDP by field is measured in billions of COP and field relative employment is between zero and one; both variables are included with a one-year lag. Panel A shows the results using the narrow definition of potential entrants, while panel B uses the broad definition. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

Table A.7: Entry and Market Structure: First-Stage Regressions

Endogenous Market Structure Variables in Entry Regressions

| Dependent Variable : | N. of Private SCPs | N. of Public SCPs | N. of SENA SCPs |
|---|---|---|---|
| | (1) | (2) | (3) |
| Panel A: Regressions for Private HEIs | | | |
| N. of Private Progr. in 2004*L.GDP by Field | 0.0003*** | -0.0001*** | -0.0003*** |
| | (0.0000) | (0.0000) | (0.0001) |
| N. of Public Progr. in 2004*L.GDP by Field | 0.0017*** | -0.0011*** | -0.0021** |
| | (0.0004) | (0.0001) | (0.0007) |
| N. of SENA Progr. in 2004*L.GDP by Field | -0.0041*** | 0.0023*** | 0.0043*** |
| | (0.0007) | (0.0002) | (0.0012) |
| SENA Budget (in billions of COP) | 0.0032*** | 0.0013*** | 0.0258*** |
| | (0.0007) | (0.0003) | (0.0019) |
| Constant | 10.7128*** | 8.0969*** | 8.6058*** |
| | (0.1446) | (0.0656) | (0.3740) |
| N. of Observations | 45,195 | 45,195 | 45,195 |
| F-test for excluded instruments | 418.70 | 131.69 | 55.29 |
| Panel B: Regressions for Public HEIs | | | |
| N. of Private Progr. in 2004*L.GDP by Field | 0.0001*** | 0.0002*** | -0.0000 |
| | (0.0000) | (0.0000) | (0.0001) |
| N. of Public Progr. in 2004*L.GDP by Field | 0.0001 | 0.0018*** | 0.0005 |
| | (0.0006) | (0.0003) | (0.0012) |
| N. of SENA Progr. in 2004*L.GDP by Field | -0.0008* | -0.0034*** | -0.0002 |
| | (0.0009) | (0.0004) | (0.0019) |
| SENA Budget (lagged) (in billions of COP) | 0.0031*** | 0.0032*** | 0.0231*** |
| | (0.0004) | (0.0002) | (0.0009) |
| Constant | 10.5320*** | 7.9299*** | 8.9981*** |
| | (0.2692) | (0.1213) | (0.7321) |
| N. of Observations | 13,271 | 13,271 | 13,271 |
| F-test for excluded instruments | 25.29 | 45.63 | 14.69 |

Note: This table presents the coefficients from the first-stage regressions for the endogenous variables in Table 5: number of private SCPs, public SCPs, and SENA SCPs measured in tens, for the 2004-2019 period. The instruments are the number of these programs offered in 2004 interacted with the lagged GDP-by-field variable as well as SENA's budget for the department lagged one period. The regressions include department, year, and field-category fixed effects. Panel A shows the regressions corresponding to private HEIs (column 1 in Table 5) and panel B those for public HEIs (column 3 in Table 5). First-stage regressions for columns 2 and 4 in Table 5 are similar to those presented here (not shown). The bottom line presents the F-test statistic for excluded instruments. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

Table A.8: Entry Decisions and Market Structure

Dependent Variable: Indicator for Opening a New Program (Broad Entrant Definition)

| | Private HEIs | | Public HEIs | |
|---|---|---|---|---|
| | OLS | 2SLS | OLS | 2SLS |
| | (1) | (2) | (3) | (4) |
| N. of SENA SCPs (lagged) | 0.000 | 0.007*** | 0.000*** | 0.011*** |
| | (0.000) | (0.001) | (0.000) | (0.002) |
| N. of Private SCPs (lagged) | -0.001*** | -0.008*** | 0.001*** | 0.012** |
| | (0.000) | (0.002) | (0.000) | (0.004) |
| N. of Public SCPs (lagged) | 0.000*** | -0.042*** | -0.003*** | -0.070*** |
| | (0.000) | (0.008) | (0.001) | (0.011) |
| HEI share in Dept.(lagged) | 0.221*** | 0.213*** | 0.100*** | 0.037* |
| | (0.021) | (0.025) | (0.016) | (0.017) |
| Constant | 0.003** | 0.353*** | 0.020*** | 0.347*** |
| | (0.001) | (0.045) | (0.003) | (0.066) |
| N. of Observations | 823,680 | 770,880 | 249,600 | 233,600 |
| Mean of Dep. Variable | 0.0014 | | 0.0017 | |
| Weak identification tests: | | | | |
| Cragg-Donald Wald F stat | | 198.008 | | 56.672 |
| Kleibergen-Paap rk Wald F stat | | 666.312 | | 275.914 |
| Overidentification test: | | | | |
| Hansen J statistic | | 175.419 | | 38.666 |

Note: In this table, each column presents coefficients from a regression where the dependent variable is an indicator for whether institution $j$ opens a new program in department $d$ and field $k$ in year $t$, for the 2004-2019 period. The independent variables are the market number of SCPs offered by private institutions, public institutions, and SENA, plus controls for proxies of the cost of opening a program: HEI's enrollment share of SCP students in the department (total over all fields) and the field's enrollment share within the HEI. Columns (1) and (3) show OLS estimates, and columns (2) and (4) show the respective 2SLS estimates. The endogenous variables are the number of SCPs offered by private HEIs, public HEIs, and SENA (first three independent variables). Instruments are the number of programs offered by each provider type in 2004 interacted with lagged GDP-by-field and SENA's budget for the department and year. All the variables indicating number of programs are measured in tens. All explanatory variables are included with a one-year lag. All regressions include department, year, and field-category fixed effects. *,**, and *** denotes significance at the 10, 5 and 1% level. Standard errors are clustered at the institution-year level.

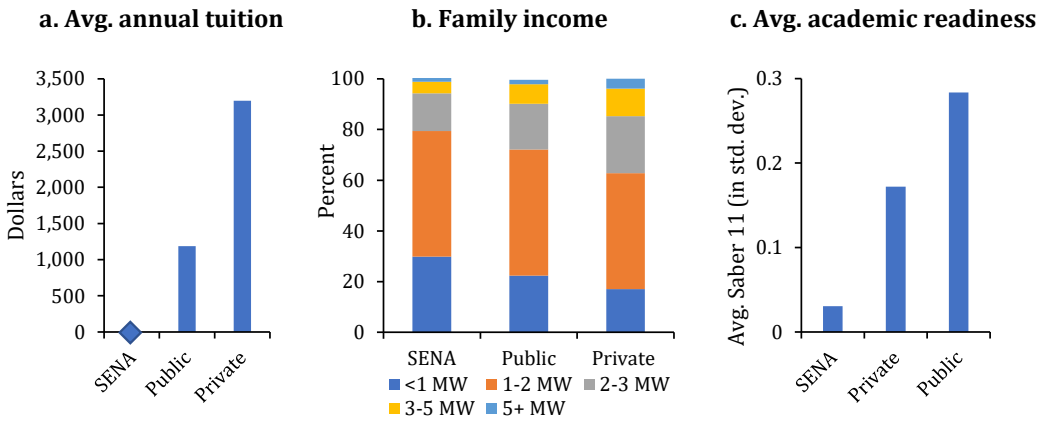
Table A.9: Exit Decisions and Market Structure

Dependent Variable: Indicator for Program Closing

| | Private HEIs | | Public HEIs | |
|---|---|---|---|---|
| | OLS | 2SLS | OLS | 2SLS |
| | (1) | (2) | (3) | (4) |
| N. of SENA SCPs (lagged) | 0.0036** | 0.0066 | 0.0029 | 0.0098 |
| | (0.0012) | (0.0041) | (0.0019) | (0.0093) |
| N. of Private SCPs (lagged) | -0.0017 | -0.0279 | 0.0021 | -0.0048 |
| | (0.0033) | (0.0182) | (0.0040) | (0.0651) |
| N. of Public SCPs (lagged) | 0.0075 | -0.1815 | -0.0007 | -0.0311 |
| | (0.0089) | (0.0930) | (0.0096) | (0.0392) |
| HEI share in Dept.(lagged) | -0.3370** | -0.7168* | -0.1795 | -0.2557 |
| | (0.1112) | (0.2837) | (0.1330) | (0.1817) |
| Field share in HEI (lagged) | -0.0157 | 0.0012 | -0.0359 | -0.0394 |
| | (0.0135) | (0.0214) | (0.0267) | (0.0442) |
| Constant | -0.0183 | 2.0229* | 0.0370 | 0.2141 |
| | (0.0894) | (1.0030) | (0.0836) | (0.8239) |
| N. of Observations | 11,496 | 10,069 | 3,786 | 3,286 |

Note: In this table, each column presents the coefficients from a regression of an indicator for whether institution $j$ closes a program in department $d$ and field $k$ in year $t$ on the market total number of SCPs offered by private institutions, public institutions, and SENA, for 2004-2018. In columns (2) and (4) we also control for our proxies for the cost of opening a program. HEI share in a department is the HEI's enrollment share of SCP students in the department (total over all fields), and field share in HEI is the enrollment share of the field within the HEI. All variables indicating number of programs are measured in tens. Panel A and B show OLS and 2SLS estimates, respectively. The endogenous variables are the number of SCPs offered by private institutions, public institutions, and SENA (first three independent variables). Instruments are the number of programs offered by provider type in 2004 interacted with lagged GDP-by-field variable as well as SENA's budget for the corresponding department and year (first-stage regressions are available upon request). All explanatory variables are included with a one-year lag. HEI share in the department and field share within the HEI are enrollment shares and range between zero and one. All regressions include department, year, and field-category fixed effects. Standard errors are clustered at the institution-year level.

Figure A.1: Tuition and Student Characteristics by SCP Provider Type




Note: Panel a shows average annual tuition by HEI provider type (in PPP dollars of 2019). Panel b shows, for each HEI provider type, the classification of students based on their family monthly income level. Panel c shows the average score in the national mandatory high school exit exam (*Saber 11*), which is a measure of academic readiness for higher education. MW = monthly minimum wage. Panels b and c show averages for the SCP graduates included in the Labor Observatory of Education (OLE) in 2013. Source: SNIES, OLE, and Saber 11.