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Life-Cycle Wage Premiums and STEM in Brazil *

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Abstract

This paper estimates the life-cycle wage premiums of STEM (*Science, Technology, Engineering and Math*) college graduates and STEM workers occupations in Brazil. Using data from the 2010 Brazilian Demographic Census, we find there is 12.2% premium associated to majoring in STEM fields. This premium is lower than the premium of traditional fields such as Medicine and Law as well as the premium associated with STEM degrees observed in developed economies such as Canada and the US. We provide evidence that this is not connected to the premium to working in STEM occupations but rather to a poor transition from college to jobs in STEM occupations. Breaking the analysis by gender, we find the premium associated to majoring in STEM fields is similar for women and men. However, women are less likely to survive in STEM throughout the life cycle.

Keywords: Brazil, STEM Majors, STEM Occupations, Demographic Census, Returns to STEM, Wages Gaps, Crosswalks

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1 Introduction

The STEM sector is widely regarded as a crucial pillar of productivity growth and innovation in advanced economies as these fields are central to the creation and diffusion of new knowledge and technology (Barth et al., 2018). For this reason, there are growing efforts being directed at understanding and expanding STEM (*Science, Technology, Engineering and Math*) education and career opportunities, in particular, for women and minorities. Nevertheless, there are few studies documenting the career dynamics of individuals with STEM degrees or working in STEM occupations, in particular in developing countries.

This paper explores data from the 2010 Demographic Census to create a unified picture of STEM education and careers in Brazil. We begin by adjusting international standards to create a classification of STEM majors in Brazil. We then document the wage premium of individuals who graduate in STEM fields and discuss the determinants of this wage premium. We end discussing the gender gaps in STEM fields and its relationship with major choices and career progression.

Using the methodology proposed by Deming & Noray (2020), we find that a wage premium of 12.2% to graduating in STEM fields in Brazil. This premium does not change throughout the life cycle. Furthermore, it is much more modest than the premium to degrees such as Medicine (75.5%) or Law (36.6%).

There is substantial heterogeneity in the wage premium across STEM sub-fields (“Engineering and Architecture”, “Computing and Mathematics”, “Physical and Life Sciences”). “Engineering and Architecture” graduates receive substantial wage premiums of 35% throughout the whole life cycle. However, “Computing and Mathematics” graduates obtain a low and imprecisely estimated wage premium of 4.8%, whereas “Physical and Life Sciences” graduates obtain a negative wage premium of -15.7%.

There are substantial differences in the STEM wage premiums in Brazil and in developed countries. First, the wage premium of STEM graduates is much lower in Brazil than in countries such as US and Canada. Second, the wage premiums documented in Brazil are flat for all STEM sub-fields. This contrasts with the changes over the life cycle observed in the US. On the one hand, the wage premium for “Engineering and Architecture” and “Computing and Mathematics” degrees are large at the beginning of the workers’ careers (as their up-to-date skills are highly valued) and decline over the life cycle (as their skills become obsolete). On the other hand, the wage premium for Physical and Life Sciences degrees are small at the beginning of the workers’ careers and rise over the life cycle.¹

While the premium to STEM degrees is modest, the premium to STEM occupations is

¹See Deming & Noray (2020).

quite high in Brazil. Workers in STEM jobs with college degrees receive a wage premium of 47.5% throughout the life-cycle. This finding indicates that low returns of STEM occupations does not seem to explain the low premium of STEM degrees.

Indeed, the modest wage premium of STEM degrees is explained by the transition from college to the labor market. 29% of the individuals with “Computer and Mathematics” degrees and 11.8% of the individuals with “Physical and Life Sciences” degrees work in STEM occupations.² More than one half of the individuals with “Computer and Mathematics” degrees are employed in Education (16.4%) or in low-level IT occupations (36.4%), whereas almost one half of the individuals with “Physical and Life Sciences” degrees are employed in Education and Health occupations (33.7%) or are not working (14.0%).

The low probability of STEM graduates being employed in STEM occupations ends up reflecting in the competitiveness of college seats in STEM fields. Competitiveness broadly matches wage premiums. Using data from cutoff score for entrance in public universities, we find that “Engineering and Architecture” seats rank in the top quartile of the distribution of cutoff scores while “Computer and Mathematics” and “Physical and Life Sciences” rank in the middle of this distribution. This results indicate it is likely that most of the college seats in STEM are catering individuals who do not cater to individuals looking to work in STEM occupations but rather in jobs in education, health, and low to medium-skill technical jobs.

The patterns of selection across different STEM sub-fields are different between women and men. Overall, 37.5% of the individuals with STEM degrees are women and 62.5% are men. However, women are 60% of the graduates of “Physical and Life Sciences” but only 26% of the graduates of “Engineering and Architecture”. This implies women concentrate in STEM degrees with the lowest premiums while men in the STEM degrees with highest premiums, increasing the gender gaps within STEM.

Turning to occupations, we find another barrier to women in STEM. In the beginning of the life cycle, the gender distribution of individuals with STEM degrees working in STEM occupations mimics the gender distribution of individuals with STEM degrees. However, throughout the life cycle, the participation gap increases a lot with women typically leaving these occupations. The wage gaps in STEM follow a different dynamic. Wage gaps in STEM start at the level of non-STEM occupations (17.4%) but decline slightly over time in STEM (14.4%) and increase in non-STEM occupations (31.1%). This is consistent with a selection effect in which the women who survive in STEM throughout the life cycle are highly productive and therefore receive on average a better compensation (relative to men) than women in other occupations.

Our work relates to different strands of literature. First, it contributes to the body of

²prime aged, 25-54 years old.

work that links STEM fields to productivity and growth (Autor et al., 2020; Shambaugh et al., 2017; Peri et al., 2015; Bianchi & Giorcelli, 2020; Zilberman & Ice, 2021; Deming & Noray, 2020). It contributes to this literature by providing insights on the relevance and returns to STEM degrees and careers in a developing country. Second, our main results provide contrast with some papers that emphasize the potential of STEM majors and training in raising expected earnings in the labor market (Altonji et al., 2012, 2016; Leighton & Speer, 2020; Black et al., 2021; Dahl et al., 2020; Ng & Riehl, 2020). Third and last, it adds to the debate on the gaps in participation and earnings that women and other minorities face in high-paying and technology sectors and the labor market as a whole (Card & Payne, 2021; Goldin, 2014; Hsieh et al., 2019; Kleven et al., 2019).

The rest of this paper is divided as follows. Section 2 describes the main data source and the taxonomy used to classify STEM educational and occupational fields. Section 3 presents the empirical strategy. Section 4 displays the main results for the life-cycle estimates of wage premiums of different majors and jobs. Section 5 interprets these results in the light of the Brazilian setting and also discusses the interaction of gender and STEM fields. Section 6 concludes.

2 Data and Classification

Our primary data source is the Brazilian Demographic Census, which is conducted on a regular basis by *IBGE*³. The census represents a cross-section of the entire Brazilian population, and thus weights are attributed to surveyed households to ensure an accurate depiction of Brazil. We focus on the latest version (2010), which contains *ISCED* codes that allow us to classify higher education degrees into fields of study and Household *CBO* occupational codes. According to the census, there were about 78 million active age individuals participating in the workforce in 2010, of which about 11 million held college degrees. The primary sample in this paper is restricted to economically-active individuals between 18 - 65 years – approximately 13 million observations representing 122 million individuals. For crosswalks between higher Education and the labor market and estimations of returns to STEM majors, the sample is further restricted to economically-active individuals between 25 and 54 years of age.

2.1 STEM Major Taxonomy

We divide college degrees into STEM and Non-STEM majors using a novel classification suited to the specificity of Brazilian data, but that builds on an international framework set

³*IBGE* stands for *Instituto Brasileiro de Geografia e Estatística*

by the SAGA - UNESCO project and the OECD.

ISCED codes

UNESCO officially accepted the International Standard Classification of Education (ISCED) as a standard for classifying educational fields in 1976. The ISCED rests on “internationally agreed concepts and definitions and ISCED mappings of education programmes and related qualifications in countries worldwide”. Its central function is to facilitate cross-national comparisons of educational statistics at all levels. In particular, ISCED - level 6 codes classify higher education fields of study. The fundamental criteria for separating degrees into college-major fields is subject content, including the distinction between practical and theoretical approaches. The 2010 Demographic Census provides ISCED degree codes for each individual that has graduated from college. We use these codes as inputs to build our classification of degree fields.

Prior to 2013, ISCED codes were comprised of 3 digits followed by an alphabet letter and another two digits (e.g., all Biology degrees were classified by the code “421C01”). The first digit represented the broad field of study, in this case “4” - “Sciences”, the first two digits combined represented the narrow field of study - e.g. “42” stands for “Life Sciences” - and the third digit combined with the first two provided the detailed field of study, the remaining characters (e.g. “C01”), consist of a letter and two subsequent digits, representing the labels that distinguish between degrees within a same detailed field of study (e.g. distinguish “pure” Biology from Biochemistry). From 1997 to 2013, UNESCO had nine separate broad fields of study, namely, 0 - General programmes, 1 - Education, 2 - Humanities and Arts, 3 - Social sciences, business and law, 4 - Sciences, 5 - Engineering, manufacturing and construction, 6 - Agriculture, 7 - Health and welfare, 8 - Services.

In 2013, UNESCO revised this classification to account for the changing landscape of higher education. It added two new broad fields while updating the names and descriptions of sub-fields at each subsequent level of aggregation and conducting a few inclusions and exclusions at the finest level. We do not concern ourselves with this revision since our data precedes the mentioned changes. Table A1 of Appendix A provides a breakdown of ISCED broad fields of study (before the revision), in bold, and the narrow fields contained within them.

SAGA’s STEM field classification

What makes ISCED codes worthwhile when classifying STEM fields is that SAGA (STEM and Gender Advancement), a global policy initiative created by UNESCO, has already developed an educational STEM field classification compatible with ISCED codes. It provides a starting point for identifying STEM majors in Brazil. SAGA’s classification is compatible with revised 2013 ISCED codes. Given that IBGE’s Census dataset contains

codes (up to 3 digits) with the previous division of ISCED fields, it requires some adjustments. SAGA considers all higher education degrees as STEM within three broad fields: 05 Natural sciences, mathematics and statistics, 06 Information and communication technologies and 07 Engineering, manufacturing and construction. This definition is available in the 2017 working paper entitled “Measuring gender equality in science and engineering: the SAGA toolkit”. Table A2 of Appendix A provides a finer breakdown of these fields, only up to the detailed field level.

Adaptations to Brazilian Context

Table 1: STEM Degree Fields in Brazilian Higher Education

	ISCED codes:	Narrow Field or Degree name:
Group 1: Computer & Mathematics	46	Mathematics and statistics
	48	Computing
Group 2: Engineering	52	Engineering and engineering trades
	54	Manufacturing and processing
Group 3: Architecture	581	Architecture and town planning
Group 4: Physical & Life Sciences	42	Life sciences
	44	Physical sciences

Note: This table reports the novel STEM degree classification used to subdivide fields of higher education in the 2010 Census. STEM degree fields are separated into four large groups: 1. Computer & Mathematics, 2. Engineering, 3. Architecture, 4. Physical & Life Sciences. The column on the left displays the ISCED codes (pre-2013 revision) and names of each of the corresponding fields within each group.

Here we adapt the classification proposed by SAGA (seen in Table A2) to the specificity of Brazilian college and labor markets. In particular, STEM fields are divided into four groups listed in Table 1, instead of three groups because it is prudent to split Engineering degrees from Architecture degrees. In Brazil, the content of Architecture degrees tends to be far less mathematical than traditional Engineering and attracts a much larger share of women. According to data from the 2010 Higher Education Census, at the time, over two-thirds of individuals enrolled in Architecture degrees were women, but less than one-quarter of the Engineering college majors were female. The ISCED codes for the fields that compose each group are different from those used by SAGA. Some hand matching between fields before and after the 2013 revision was necessary. Additionally, it is worth noting that Physical and Life Sciences degrees do not include Medicine, both in SAGA’s classification and in our own. As we shall see in subsequent sections, these degrees are much more selective and typically carry a very high premium in Brazil, so it is indeed convenient to keep them separate from traditional Physical and Life Sciences majors like Biology and Chemistry.

2.2 STEM Occupation Taxonomy

We follow the definition for strict-STEM occupations proposed by the Bureau of Labor Statistics (BLS) to classify workers in STEM and non-STEM occupations.⁴ The occupational classifications used in the Demographic Census (*Código Brasileiro de Ocupações* (CBO household)) are not directly comparable to standard occupation classification (SOC) from the United States. Thus, we generated a correspondence between these occupations to create a CBO-household-based STEM taxonomy analogous to the SOC taxonomy proposed by the BLS. We opted for a more restrictive classification, which left out the social sciences and brought the definition of the term STEM closer to the so-called hard sciences, particularly those of a technical-scientific nature. We consider occupations of the following areas: natural and life sciences, engineering (and some fields related to architecture), mathematics, information technology, researchers, and CEOs from related STEM industries or areas – such as research and development, construction, and information and communication technology.⁵ The complete list of 4-digit CBO occupations used to define STEM workers is presented in Appendix A, Table A3.

Finally, to report the premiums associated with working in different STEM occupations in Section 4, it is convenient to aggregate these occupations into a few fields as was done in the Degree Taxonomy in the previous subsection. This paper focuses on four aggregate sub-fields over which four-digit STEM occupation codes are distributed when breaking down STEM occupation premiums. Namely, 1. Engineering and Related, 2. Physical and Life Sciences, 3. Computer and Math, 4. STEM CEOs and Managers. Note once again that Medicine is not included in Physical and Life Sciences occupations. For more details see Appendix A, Table A4.

3 Empirical Methodology

Following Deming & Noray (2020), we estimate the evolution of life-cycle wage premiums of different college majors and occupations in Brazil, restricting the sample to the active age college-individuals educated workforce. We use only one cross-section (2010) to analyze and compare the earnings of different fields of study and professions to STEM. Our dependent variable is the real monthly wage (in log) in the main job of each individual i .

⁴See the BLS report “STEM 101: Intro to tomorrow’s jobs”. For a more detailed explanation, see the report [STEM Classification in the Formal Labor Market in Brazil](#).

⁵The main difference in relation to the BLS classification is that we do not include higher education professors because CBO-Dom does not enable us to distinguish the fields of specialization of these professionals. The corresponding CBO code aggregates them in a single occupation, regardless of the area of knowledge where they teach. Therefore, defining this category as a STEM occupation would imply that any college professor would be classified as a STEM worker despite their teaching and research physics or literature.

To extract the life-cycle wage patterns of different college majors fields at different ages, including STEM, We estimate the following econometric model:

$$\ln(wages)_i = \alpha_i + \sum_m^M \sum_a^A \gamma_a^m \times (a_i * MAJOR_i^m) + \xi X_i + \theta_{age} + \epsilon_{iam} \quad (1)$$

Where the dependent variable is the log of the real monthly wage for each individual i in 2010, a_i is an indicator variable that is equal to one if respondent i is either age in two-year bins going from ages 25–26 to ages 53–54. These bin indicators are interacted with $MAJOR_i^m$ indicators of whether individual i attended each selected majors m . Therefore, the γ_a^m coefficients of interest can be interpreted as the wage premium of having attended major m at age bin a in relation to all omitted majors, that is, those $\notin (m, M)$. The equation also includes age fixed effects θ_{age} and a set of individual covariates X_i for race, job formality⁶, graduate school education and interactions between sex and each age bin a . Standard errors are clustered at the major-by-age level.

Equation (2) represents a slight variation of the specification above, that replaces indicators of selected majors m with selected occupations o . In this case, the γ_a^o coefficients of interest can be interpreted as the wage premium of working in a specific occupational field o at age bin a in relation to all omitted occupational fields, that is, those $\notin (o, O)$.

$$\ln(wages)_i = \alpha_i + \sum_o^O \sum_a^A \gamma_a^o \times (a_i * OCCUPATION_i^o) + \xi X_i + \theta_{age} + \epsilon_{iao} \quad (2)$$

In the next section, using the two equations outlined above, we present estimates of premiums of STEM college majors and occupations and compare them to those of other fields such as Education and Medicine.

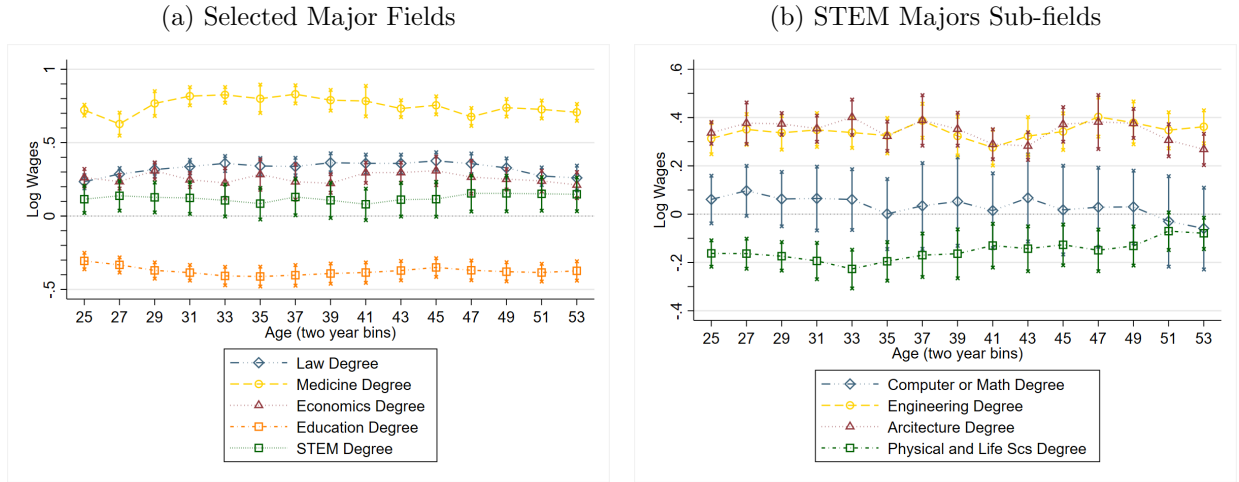
4 Life-Cycle Returns for STEM Majors and Careers

Figure 1 follows the specification seen in Equation 1. Panel (a) reports the life-cycle wage premium estimated at each two-year age bin for college-educated individuals in several degree fields, namely Law, Economics, Medicine, Education and STEM degrees (as defined in Table 1). These wage premiums are simultaneously calculated in relation to all other degrees. For instance, when interpreting the positive premium of a Law degree over the life-cycle,

⁶In Brazil, over 40% of employees are not in formal occupations; thus, it is important to include this additional control not considered by Deming & Noray (2020) for the US setting.

it is in relation to an average of all other degree fields for which coefficients were not estimated, such as Arts, Social Sciences (excluding Economics), Accounting and many more.⁷ By far, Medicine degrees have the highest associated premiums, preserved over the entire economically-active life cycle. When summarized into a single coefficient (see Appendix A, Table A3, Panel A) the average estimated premium of a Medical degree is 75.5 percent. Law and Economics degrees are also associated with high premiums, retained over the life-cycle of around 32.6 percent and 26.0 percent, respectively. In contrast, STEM degrees as a whole only carry a comparatively modest premium of 12.2 percent. Education degrees (e.g., teaching, education administration) present negative premiums of -37.6 percent in relation to the average omitted degree field.

Figure 1: Relative Wage Returns to Selected College Major Fields over the Life Cycle



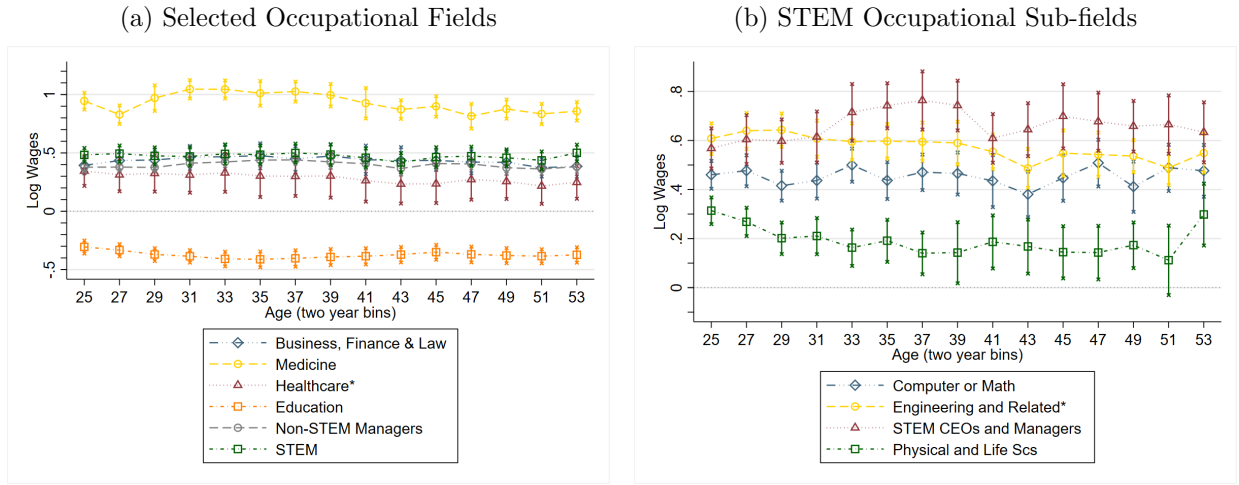
The figure plots coefficients and 95% confidence intervals from an estimate of equation (1), a regression of log monthly wages on interactions between two-year age bins and indicators for college major. The sample is composed of the college-educated workforce aged 25–54 in the 2010 Brazilian Demographic Census. Panel (a) compares the premiums for the fields of Law, Economics, Medicine, Education and STEM. The left-out category is all other majors. Panel (b) breaks down the premiums of each separate sub-field within STEM, as classified in Table 1. The regression also includes controls for sex-by-age indicators, age fixed effects, race and an indicator for having any graduate education. Standard errors are clustered at the major-by-age level.

To understand why the premiums of STEM college majors are low in comparison to more traditional fields such as Medicine, Economics and Law, we present the estimates of a regression analogous to that of Panel (a) but breaking down the STEM Degrees into the four sub-fields described in Table 1. We note that both Engineering and Architecture related majors carry a premium of around 35 percent, larger than Law and Economics. On the other hand, Computer and Math degrees display a modest premium (4.6 percent) that even

⁷The same logic applies, later, when interpreting the occupational premiums displayed in Figure 2

declines and turns negative for the last age bins included in the analysis. A similar pattern of gradual decline, albeit more evident, is also detected in the US by [Deming & Noray \(2020\)](#) where high early-career premiums are associated with a reward for holders of degrees in fields associated with fast-changing skill requirements such as Engineering and Computer Science. The premium declines as skill obsolescence sets in. The Physical and Life Sciences STEM major sub-field has a negative premium over the entire life-cycle and also weighs negatively on the average premium of STEM majors. As discussed in the next section, this may be related to the close association between this type of degree and careers in Education and health fields associated with lower earnings. The premiums in this field do rise slightly over the life-cycle, perhaps with tenure, but are still negative in the last-age bin.

Figure 2: Relative Wage Returns to Selected Occupational Fields over the Life Cycle



The figure plots coefficients and 95% confidence intervals from an estimate of equation (2), a regression of log monthly wages on interactions between two-year age bins and indicators for occupational fields. The sample is composed of the college-educated workforce aged 25–54 in the 2010 Brazilian Demographic Census. Panel (a) compares the premiums for the fields of Business, Finance and Law, Medicine, Healthcare (excluding Medicine), Education, Management (excluding STEM Managers) and STEM careers. The left-out category is all other occupations. Panel (b) breaks down the premiums of each separate sub-field within STEM, as classified in Table 2. The regression also includes controls for sex-by-age indicators, age fixed effects, race and an indicator for having any graduate education. Standard errors are clustered at the major-by-age level.

Beyond Physical and Life Sciences, one should expect that a large part of the life-cycle earnings trends of the different college majors is explained by the type of occupation linked to each major group. Figure 2 shifts the focus to the relationship between different occupations and wage premiums. Panel (a) showcases the estimated life-cycle premiums for college-educated workers in Business, Finance and Law (combined), Medicine, Healthcare (excluding Medicine), Education, Management (excluding STEM Managers) and STEM careers. The estimates are derived from a regression based on Equation 2.

Again, medical professions are associated with the highest premium, which is expected given that degrees in Medicine are the only path towards a career in the field, with some attrition. However, we note that, unlike STEM degrees, STEM careers carry a very significant premium of around 47.5 percent (see Appendix A, Table A5, Panel C), which is higher than Business, Finance and Law (43.8 percent) and Non-STEM Managers (40.2 percent). Again educational professions display a large negative premium of -25.5 percent.

In Figure 2b, we break STEM occupations into the sub-fields detailed in Appendix A, Table A4. Some interesting conclusions can be drawn. First, it is clear that Engineering and related occupational fields (including Architecture) have the highest wage premium throughout the entire life-cycle of individuals with STEM jobs. In contrast, Physical and Life Sciences are the lowest of all STEM occupational groups and decline with time. Part of this might be linked to the actual classification of Educational professions as STEM under the Household CBO. For example, a high-school teacher of Chemistry or Biology may sometimes be classified as a Biologist or Chemist. Even if this is not the case, it is true that for the US, again Deming & Noray (2020), notes that the Physical and Life Sciences area is associated with lower premiums than other applied STEM occupations. Lastly, Computer and Math occupational premiums (45.1 percent) are actually much higher than the premiums of holding a degree in the field (4.6 percent). This difference is likely explained, at least in part, by the relatively small share of individuals with Computer and Math college majors who eventually can work in the same field.

The degree composition of each the STEM occupational sub-fields is showcased in Appendix A Table A6. For each of the four STEM occupational sub-fields, we list the names of the top five degrees, the share of total employees represented by each of the top five degrees, the share of total employees represented by the sum of STEM degrees within the top five, and the share of total employees represented by the sum of STEM degrees overall.

Within Engineering and Related (Panel A) and Computer and Math (Panel B) – the top five degrees, mostly commonly associated with these two STEM occupational sub-fields, respectively represent 88 percent and 88.7 percent of the total workers. For Engineering and Related professions four out of the five main occupations are represented by STEM degrees in architecture, manufacturing and processing, civil or other types of engineering. Computer and Math professions also attract high share of STEM degree holders in the field of Computer Sciences (60.4%). Furthermore, when we add up all the STEM degrees in the Engineering and Related and Computer and Math jobs, they respectively account for 83.6 percent and 73.0 percent of college-educated workers in these sub-fields. This means that, indeed, a very high share of college-educated workers in applied STEM jobs did study STEM. However, as we shall see in the next section, the transition from an applied STEM degree to a STEM

jobs, where relative premiums are high, is far from straightforward.

Other STEM fields, on the other hand, do not see such a large share of their college-educated workers represented by STEM degree holders. Panel C of [A6](#) reveals that most Physical and Life Sciences workers are sourced from Health (excluding Medicine) degrees and Agriculture and Related degrees. Life and Physical Sciences degrees respectively are only the third and fourth most popular degrees and together account for only 23.3 percent of college-educated workers in this occupational sub-field. STEM degree are also not a majority among STEM CEOs and Managers (Panel D) representing less than half of all workers with degrees in this sub-field. An interesting observation is that degrees in Management, Retail and Marketing are quite popular among STEM jobs, in particular for STEM Executives (28.2%). It seems that there is significant demand for administrative workers in Brazilian STEM labor markets. We will discuss these issues in greater detail in the next section.

A limitation of our results in this section is that we cannot disentangle the effects of time and age on life-cycle wage premiums since we only have one cross-section – i.e., the 2010 Census – over which to analyze our returns. This means that each unique surveyed individual contributes only to estimating one age-bin coefficient; they are not tracked over time. With this caveat in mind, in the next section, we discuss some possible explanations for the trends observed in [Figures 1 and 2](#), in light of the academic literature of the field.

5 Discussion

5.1 From STEM Degrees to STEM Labor Markets

The literature on college-major choice often centers on the returns to STEM fields that are associated with innovation and productivity ([Autor et al., 2020](#); [Shambaugh et al., 2017](#); [Peri et al., 2015](#); [Bianchi & Giorcelli, 2020](#)). Some papers also emphasize the role of mathematical and technological skills acquired during school and college, particularly in STEM majors, in raising expected earnings in the labor market ([Altonji et al., 2012, 2016](#); [Leighton & Speer, 2020](#); [Black et al., 2021](#); [Dahl et al., 2020](#); [Ng & Riehl, 2020](#)). Adding to this literature, in the context of developing countries, we document a significant positive impact on earnings of studying STEM fields in college, but also that other traditional degree choices like Medicine and Law carry a higher premium than STEM.

A comparison with the US can help understand why. [Deming & Noray \(2020\)](#) find that the highest premiums paid for STEM degrees in the US are related to studying applied sciences (i.e., Engineering and Computer Science), which start high (over 40 percent) and decline over the life-cycle. They associate this decline with the fast pace of skill change in applied STEM sectors, which rewards young “up-to-date” employees and penalizes them as their skills become obsolete. The authors also show that individuals majoring in the non-

applied Physical and Life Sciences STEM field start with a negative premium that rises, converging with tenure to the levels of the applied STEM fields by the time they are 50 years old.

In contrast, our main findings indicate that the applied fields of Engineering and Architecture in Brazil indeed offer similar premiums to those in the US, of around 35 percent. Still, these premiums do not decline significantly with age, indicating that the requirement of updated skills in this sector is perhaps not as high. This logic applies to premium dynamics in all of the STEM sub-fields. The fact that Brazil is not at the forefront of developing new technologies might explain why the necessity for constant updates in the skill-sets of STEM workers seems less pressing than in the US and why there is even room for individuals with degrees in administrative and operational areas, as discussed previously.

Furthermore, at the start of one’s career Physical and Life Sciences degrees in Brazil are also negative and approximate levels seen in the US, but over the life cycle they remain negative. Another difference is that Computer and Math degrees in Brazil do not carry a large wage premium. Attrition may partially explain the lower premiums when moving into careers in this field. Perhaps demand for very high-skilled workers in Computer and Math is not as high in Brazil as in the US and other developed economies. Only around, 28.7 percent of workers in this field end up in the high premium STEM sector (see Appendix A, Table A7).

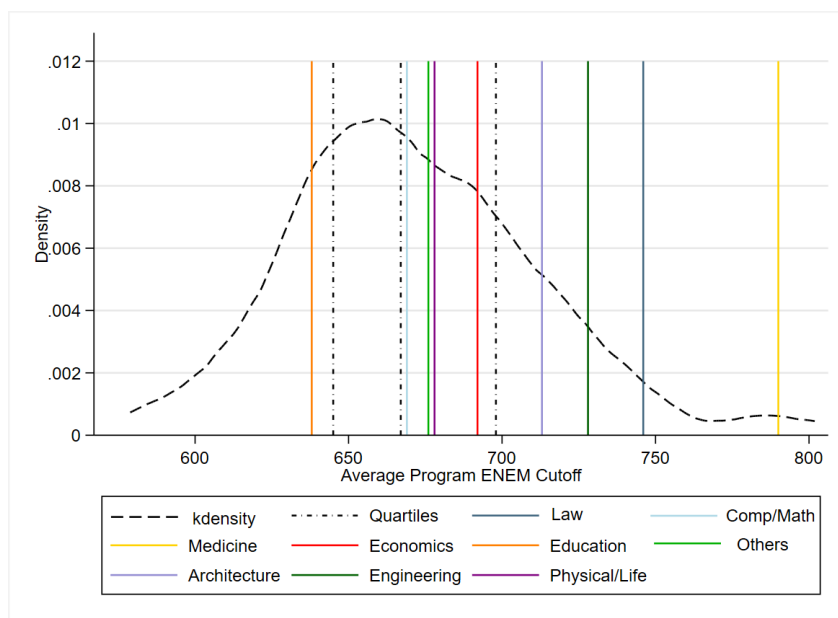
The goal and quality of students attending Computer and Math majors are also potential factors justifying the low degree premiums. There is evidence that vocational and technical specializations can raise the earnings of individuals, especially those of disfavoured backgrounds (Alon et al., 2018; Carnevale et al., 2020). The lack of short-term higher education options in Brazil creates an opening for traditional undergraduate programs to target less qualified individuals and those looking to exercise task-based careers. In this context, undergraduate computer and math courses may be seen as stepping stones for low-level teaching and technical support jobs rather than doors to careers in high-technology STEM sectors. We will further discuss how the selectivity and low-premium attached to this field of study are indicative of this.

The shortage of vocational higher education in Brazil is documented by Schwartzman (2018). The author points to the lack of supply of short-term tertiary-education courses catering to low-level technical tasks, such as IT-support careers. This is partly due to an outdated undergraduate model that prioritizes academic achievement. A clear picture of this is provided in our previous report “*Brazilian Higher Education and STEM*”. According to data from the Higher Education Census, in 2017, only 14 percent of college students in Brazil were pursuing short-term technological courses, while in the US, over half of the students

opted for associated degrees or other short-term certificates.

In 2010, Brazil's public higher education programs gradually began adopting a centralized system that assigned students to seats based on their scores in a standardized nationwide test called ENEM. Public universities in Brazil account for 20% of the college market and, unlike the US, are on average far more selective than private options. Thus, ENEM cutoff scores averaged over programs within each field of study at these institutions provide a good measure of the up-tier competition for college seats in each of these areas.

Figure 3: Distribution of ENEM Cutoffs for Fields of Study in Public Higher Education



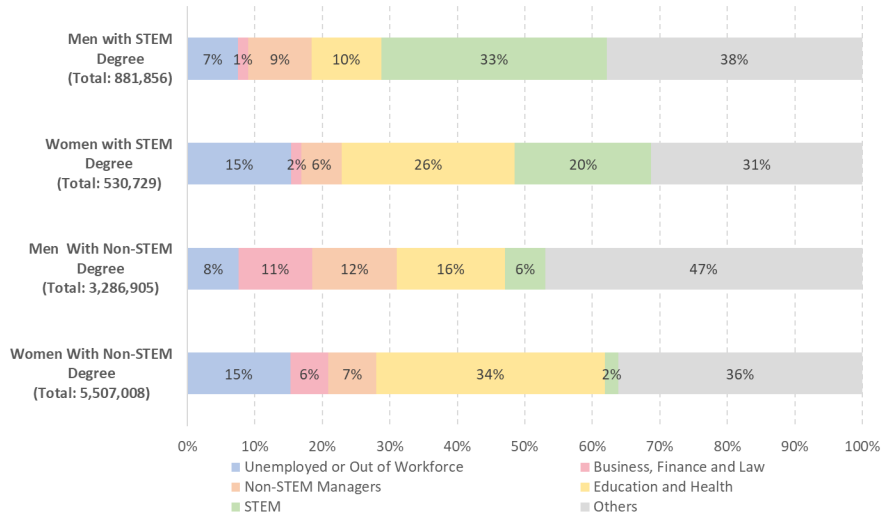
The figure plots distribution of ENEM cutoff scores to a degree in each 3-digit ISCED field of study. The sample consists of all public-higher-education programs that adopted a new centralized platform of admissions called SISU from 2011 to 2015. The platform uses standardized ENEM scores to allocate students to their preferred seats in programs. Since multiple institutions have programs in the field, each ISCED field's cutoff is calculated as an average of cutoffs for programs within it, weighted by the number of enrolled students. The colored vertical lines indicate where selected fields of study (e.g., Engineering) placed in the distribution.

Figure 3 displays the distribution of ENEM cutoffs in each separate ISCED detailed field of study. The sample comprises all Public Higher Education Programs that adopted the new centralized system between 2011 and 2015. Within each field of study, programs are weighted by the number of enrolled students. This histogram, therefore, provides suggestive evidence that selectivity at the college stage is correlated with the size of earnings premiums for the fields of study analyzed in Section 4.

As expected, Medicine has the highest cutoff score of all fields of study considered in our previous analysis of wage premiums (above the 98th percentile), not coincidentally and by a large margin; it also displays the largest estimated wage premiums in Figure 1. The

high-wage-premium fields of Law, Engineering, and Architecture are also quite selective, placing well above the 80th percentile of the distribution of cutoff scores, with Economics just below the third quartile. On the other hand, as expected, Education majors have the lowest competition for seats, falling below the 25th percentile of cutoff scores and matching their status as the lowest (negative) estimated premiums out of the selected fields analyzed in Figure 1. Physical and Life Sciences majors carry the lowest premiums among the four STEM degree fields, followed by Computer and Math. Although both fields are above the median ENEM score, the former is more competitive, which is perhaps unexpected given that Computer and Math wage premiums are positive (albeit small), while Physical and Life premiums are strikingly negative. As seen in Appendix A, Table A7, this may well be because only 11.8 percent of workers in Physical and Life Sciences find their way into STEM occupations, by far the lowest transfer into STEM jobs out of all four STEM degree fields.

Figure 4: Degree to Occupation Sectors Crosswalk - Brazilian Census 2010, Individuals Aged 25-54



This figure displays the occupational distribution of four subsets of college-educated individuals, namely Men with a STEM degree, Women with a STEM degree, Men with Non-STEM degree and Women With Non-STEM degree. The total number of individuals in each subset is displayed next each corresponding bar, under the labels.

Figure 4 represents the occupational distribution of individuals aged 25-54, with a college degree, split by gender and by type of degree (STEM vs non-STEM). Indeed, it seems that a relatively small share of workers – both male and female – with STEM degrees find their way into STEM occupations in Brazil. Nevertheless, Engineering and Related professions (including architecture) offer the highest premium among STEM and thus, graduates with degrees in Engineering and Architecture are more likely to follow into STEM, perhaps because

of the high premium (again, see Appendix A, Table A7).

Of course, a combination of the value-added of college in terms of STEM skills and the demands for these skills in the is likely to explain the apparent attrition in obtaining high-paying STEM related jobs after graduating from STEM. Even for applied STEM sub-fields we have detected that this is a problem. The flatness of the premium curves over the life cycle suggest certainly suggests that the demand for up-to-date skills is less relevant in Brazil for Engineers and even Computer Science jobs than in the US. Still, over 70 percent of Engineering and Related and Computer and Math college-educated workers graduated in STEM (see Appendix A, Table A6).

Overall the Applied STEM sectors do seem to hire a significant share of their college-educated workforce from the pool of STEM degree holders, it is the path from a degree to a job in STEM that is less direct, perhaps because of competition for few vacancies due to a lack of demand. The same is true for Physical and Life Sciences, with additional attrition coming from the labor-demand side. Less than one-quarter of college graduates working in the field of Physical and Life Sciences have majored in one of this specific area. Instead, this STEM occupational sub-field is focused on hiring individuals with Health and Agriculture related degrees while Physical and Life Science majors are disproportionately found lower paying Education sector jobs like teaching.

5.2 Female underrepresentation and STEM Gender-Wage Gaps

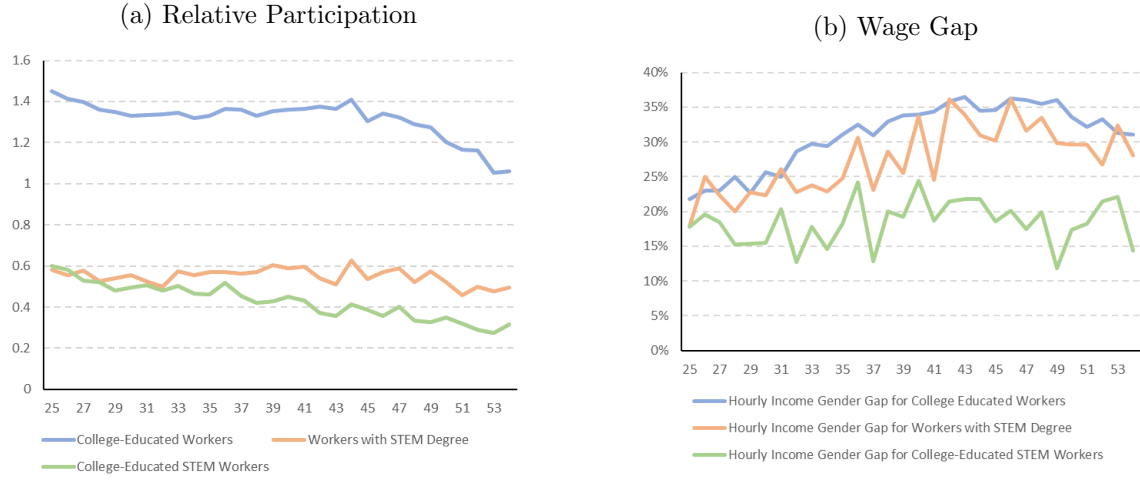
The crosswalks between majors and occupational fields, seen in Figure 4, can also help explain some of the gender differences in STEM education and careers. The underrepresentation of women in STEM is already reflected in their college degree choices. Women represent 63 percent of non-STEM college graduates in the 2010 Census, but only 38 percent of graduates majoring in STEM. Additionally, both women with and without STEM degrees are more likely to find themselves in Education- and Health-sector low-paying jobs and out of the workforce or unemployed.

Appendix A, Table A8 provides additional insight into why women with STEM degrees are less likely to specialize in STEM jobs and why they also lean towards less profitable jobs. We note that, while 50.2 percent of men with STEM degrees studied in the selective fields of Engineering and Architecture, only 23 percent of women completing STEM majors concentrate in these fields linked to the highest-paying STEM professions over the life-cycle. Instead, more women are awarded degrees in the low-paying, low-specialization area of Physical and Life Sciences. This effect is manifested in labor markets, in the form of low relative participation in STEM jobs and large gender gaps in wages, particularly for women with STEM degrees as opposed to college-educated women that in fact work in STEM, which aligns with what has been documented for the US Economy as well Beede et al. (2011).

A potential explanation for the gender differences in major choices and the subsequent divergent labor-market paths of men and women may be performance gaps in testing that lead women to choose less selective fields with lower returns, including within STEM. However, evidence from the literature suggests that actual test performance is only part of the issue. Using confidential data from admissions at the UNICAMP, a Brazilian public university in São Paulo and a discrete-choice model [Traferri \(2011\)](#) finds that in general women avoid applying for seats in certain fields (including STEM) due to subjective bias and preferences, but that differences in entrance probabilities explain a large part of the gender gap in application to the most competitive majors. [Lemos \(2019\)](#), builds on this conclusion with data for all ENEM applicants in Brazil. The author concludes that female applicants are 4.5 percentage points less likely to select STEM fields in Brazil’s centralized admissions platform and that only part of this effect is explained by actual admittance probabilities given women’s realized grades. These findings align with data from similar settings ([Bordón et al., 2017](#)). The empirical literature suggests that higher female risk aversion, self-perception, the lack of role models and responses to high-stakes settings can all impact the gender gaps in major-choices (see [Saygin, 2016](#); [Peri et al., 2015](#); [Ors et al., 2013](#); [Exley & Kessler, 2022](#); [Borges & Estevan, 2021](#)).

In Figure 5a, the relative female participation for three different snapshots of the labor market are depicted; namely, college-educated workers, workers with a STEM degree and college-educated workers in STEM occupations. For every man in the first age bin (25 – 26) with a college degree, there are about 1.45 young women, but there are only around 0.6 young women with a STEM degree for every man and the same is true for the college-educated STEM workers. Furthermore, the relative participation of college-educated women in the labor markets declines rapidly after reaching 45 years old. For 53- and 54-year-old individuals participation of college-educated men and women is almost equal although much more young women with college degrees initially entered the workforce. Perhaps this is partially because in previous generations, fewer women attended college. As noted, we cannot disentangle effects from the passing of time and generational changes.

Figure 5: Female Relative Participation and Gender Wage Gap



Panel (a) displays life-cycle relative-participation of women, for three distinct sub-samples. Namely, all college-educated workers, workers with a STEM degree, and college-educated workers in STEM jobs. Panel (b) displays the gender-wage gaps in each of these sub-samples.

Figure 5b compares life-cycle hourly-wage gaps for workers with college degrees, STEM degrees, and those with college degrees working in STEM jobs. Since women with a STEM degree are disproportionately found in lower premium careers, it is unsurprising that the gender wage gap for college-educated workers is only slightly higher than for workers with a STEM degree. The gender wage gap also increases with age in all three subsets of workers. However, among college-educated workers that find their way to STEM professions, the gender gap starts at the same level (just under 20 percent) but has a flat trend and is thus significantly lower than the wage gap for college-educated workers. Goldin (2014) notes that science and technology professions are more prone to flexibility, which can reduce gender-wage gaps generated by the excessive remuneration of long or specific hours in sectors such as finance and law.

Simply having a STEM degree does not seem to significantly reduce the gender differentials in wages, and certainly not as much as working in a STEM profession. It is hard to reconcile this with evidence from developed country settings. Card & Payne (2021) investigate what part of the gender wage gap for college-educated workers in Canada and the US is explained by majoring in STEM or controlling more broadly for fields of study explain part of the wage gap. In Appendix A, Table A9, Panel A, we compare our estimates of the gender wage gap and the returns of STEM degrees in the Brazilian Labor Market with their estimates for Canada (Panel B) and the US (Panel C). We use a similar sample of college-educated workers aged 25-34 and similar controls for an adequate comparison (see table footnotes). The first row of Column (1) for each panel depicts wage gaps without a

dummy for STEM degrees. In Column (2), by adding this control, the gender-wage gap falls by 26.2 percent in Canada and by 11.3 percent in the US, but only by 4.1 percent in Brazil.

In contrast, Brazil has a gender gap over three times higher than Canada and twice as high as the US, regardless of adding broader controls for fields of study (see Column (3)). The second row of Column (2), Panel A, indicates that returns to STEM degrees indeed seem low for Brazil (10.7%), when compared to the US and Canada (18.8%). The estimated return is also in line with the life-cycle premiums seen in Figure 1.

As previously discussed, these low STEM degree returns, at least in part, can be linked to a lack of specialization of individuals with STEM degrees in professions that reward these skills. The question then becomes: why is the allocation of STEM degree holders in the Brazilian labor market, particularly women, dissipated across sectors that have no apparent direct relation with these fields of study? In Brazil, both demand and supply-side factors may partially explain this. A recent Bureau of Labor Statistics report, [Zilberman & Ice \(2021\)](#) projects that the STEM sector in the US will grow 8.0 percent by 2029, pushed by Computer Occupations, in comparison to a 3.7 percent growth for all other occupations. The lack of selectivity of Computer and Math degrees and the low premiums in the field raises questions about whether a similar trend can be expected in Brazil in the near future.

6 Conclusion

This paper estimates the life-cycle wage premiums of STEM college graduates and STEM workers occupations in Brazil. We take advantage on the information on college degree and occupation status of individuals to estimate life-cycle wage premiums of individuals in STEM. We find there is 12.2% premium associated to majoring in STEM fields. This premium is lower than the premium of traditional fields such as Medicine and Law as well as the premium associated with STEM degrees observed in developed economies such as Canada and the US. While the premium to STEM degrees is modest, the premium to STEM occupations is quite high in Brazil. Workers in STEM jobs with college degrees receive a wage premium of 47.5% throughout the life-cycle.

Breaking the analysis by gender, we find the premium associated to majoring in STEM fields is similar for women and men. However, women are less likely to survive in STEM throughout the life cycle. We also present evidence that the probability of STEM graduates being employed in STEM occupations is low and that the patterns of selection across different STEM sub-fields are different between gender.

Additionally, we also find that women are less likely to survive in STEM occupations throughout the life cycle. In the beginning of the life cycle, the gender distribution of individuals with STEM degrees working in STEM occupations mimics the gender distribution

of individuals with STEM degrees. However, throughout the life cycle, the participation gap increases, with women typically leaving these occupations. The wage gaps in STEM follow a different dynamic. Wage gaps in STEM start at the level of non-STEM occupations (17.4%) but decline slightly over time in STEM (14.4%) and increase in non-STEM occupations (31.1%). This is consistent with a selection effect in which the women who survive in STEM throughout the life cycle are highly productive and therefore receive on average a better compensation (relative to men) than women in other occupations.

Taken together, these results suggest that a large share of individuals with degrees in STEM – in particular women – fail to progress to high-paying careers in the same field in Brazil. The particular degree field of Computer and Math is poised to play a crucial role in the automation and AI revolution in advanced economies. However, the lack of college selectivity and low returns indicates that Brazil is not at that stage. These results raise the question of which kind of policies should be implemented in order to increase return on STEM occupations on these particular areas.

Additionally, women disproportionately major in lower-paying STEM fields in Brazil. The under-representation of women in STEM majors and high-paying STEM jobs may be attributable to a variety of factors, including gender stereotypes and the lack of female STEM role models that might discourage women from pursuing STEM education and STEM jobs. [Carlana \(2019\)](#) raise different kind of policies that potentially may alleviate the impact of gender stereotypes. One set of potential policies may be aimed at informing people about own bias or training them in order to assure equal behavior toward all individuals, especially within the schooling context ([Carlana et al., 2022](#)). An alternative way to fight against the negative consequences of stereotypes is increasing self-confidence of girls in math or providing alternative role models – as done in the context of Indian elections, where exposure to female leaders weakens gender stereotypes in the home and public spheres ([Arkes & Tetlock, 2004](#)), or in French schools, by offering alternative STEM role models ([Breda et al., 2018](#)). Besides, the recruitment and professional training of women for nontraditional occupations⁸ can boost female employment. Though cultural and personal preferences do exert a certain influence, there are reasons to believe that some women are possibly unaware of the differences in employment opportunities and wages associated with different professions. In a study of secondary students in Mexico, girls that were provided with information on labor market returns tended to switch their study track to fields with a higher predominance of men and to STEM careers ([Szekely, Piras, and Bustelo, 2017](#)). Further research is needed to investigate the impact of these different types of policies.

⁸Nontraditional occupations are fields in which women have traditionally been underrepresented, as we observe in STEM.

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A Appendix

Table A1: ISCED Higher Education Fields of Study

ISCED 1997 (and 2011): Fields of Education	
0 General programmes	5 Engineering, manufacturing and construction
01 Basic programmes	52 Engineering and engineering trades
08 Literacy and numeracy	54 Manufacturing and processing
09 Personal development	58 Architecture and building
1 Education	6 Agriculture
14 Teacher training and education science	62 Agriculture, forestry and fishery
	64 Veterinary
2 Humanities and Arts	7 Health and welfare
21 Arts	72 Health
22 Humanities	76 Social services
3 Social sciences, business and law	8 Services
31 Social and behavioural science	81 Personal services
32 Journalism and information	85 Environmental protection
34 Business and administration	86 Security services
38 Law	84 Transport services

Table A2: SAGA / UNESCO - STEM Degrees

Broad Field	Narrow Field	Detailed Field
05 Natural sciences, mathematics and statistics	051 Biological and related sciences	0511 Biology 0512 Biochemistry
	052 Environment	0521 Environment sciences 0522 Natural environments and wildlife
	053 Physical sciences	0531 Chemistry 0532 Earth sciences 0533 Physics
	054 Mathematics and statistics	0541 Mathematics 0542 Statistics
06 Information and communication technologies	061 Information and communication technologies	0611 Computer use 0612 Database and network design and administration 0613 Software and applications development and analysis
07 Engineering, manufacturing and construction	071 Engineering and engineering trades	0711 Chemical engineering and processes 0712 Environmental protection technology 0713 Electricity and energy 0714 Electronics and automation 0715 Mechanics and metal trades 0716 Motor vehicles, ships and aircraft
	072 Manufacturing and processing	0721 Food processing 0722 Materials (glass, paper, plastic and wood) 0723 Textiles (clothes, footwear and leather) 0724 Mining and extraction
	073 Architecture and construction	0731 Architecture and town planning 0732 Building and civil engineering

Table A3: List of STEM (Household CBO)

Occupational Family	Code
Research and Development Director	1223
Managers of construction companies	1323
Managers of Information Technology and Communications Services	1330
Physicists and astronomers	2111
Meteorologists	2112
Chemicals	2113
Geologists and geophysicists	2114
Mathematicians, actuaries and statisticians	2120
Biologists, botanists, zoologists and the like	2131
Agronomists and the like	2132
Environmental protection professionals	2133
Industrial and production engineers	2141
Civil engineers	2142
Environmental engineers	2143
Mechanical engineers	2144
Chemical engineers	2145
Mining, metallurgical and related engineers	2146
Engineers not previously classified	2123
Electrical engineers	2151
Electronic engineers	2152
Telecommunications engineers	2153
Building Architects	2161
Landscape architects	2162
Urban planners and traffic engineers	2164
Cartographers and Surveyors	2165
Graphic and multimedia designers	2166
Pharmaceuticals	2262
Systems Analysts	2511
Program and application (software) developers	2512
Developers of web pages and multimedia	2513
Application developers	2514

Continued on next page

Table A3 – *Continued from previous page*

Occupational Family	Code
Developers and analysts of programs and applications (software) and multi-media not previously classified	2519
Database designers and administrators	2521
System Administrators	2522
Computer network professionals	2523
Database and computer network specialists not previously classified	2529

Table A4: STEM Occupational Fields in the Brazilian Labor Market

	Household CBO Codes
Group 1: Engineering & Related	2141; 2142; 2143; 2144; 2145; 2146; 2149; 2151; 2152; 2153; 2161; 2162; 2164; 2165; 2166
Group 2: Physical and Life Sciences	2111; 2112; 2113; 2114; 2131; 2132; 2133; 2262
Group 3: Computer and Math	2120; 2511; 2512; 2513; 2514; 2519; 2521; 2522; 2523; 2529
Group 4: STEM CEOs and Managers	1223; 1323; 1330

Table A5: Relative Wage Returns to Selected Degree and Occupational Fields (Summary)

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: College Degree Premiums						
	STEM Degrees	Law	Medicine	Economics	Education	-
<i>Coef.</i>	0.122***	0.326***	0.755***	0.260***	-0.376***	-
<i>SD</i>	0.0149	0.0105	0.0149	0.0117	0.00903	-
Panel B: STEM Degree Premiums						
	Computer and Math	Engineering	Architecture	Physical and Life Sciences	-	-
<i>Coef.</i>	0.0461*	0.343***	0.351***	-0.157***	-	-
<i>SD</i>	0.0202	0.00986	0.0117	0.0113	-	-
Panel C: Occupation Premiums						
	STEM Jobs	Business, Finance & Law	Non-STEM Managers	Health	Medicine	Education
<i>Coef.</i>	0.475***	0.438***	0.402***	0.296***	0.936***	-0.255***
<i>SD</i>	0.0107	0.0141	0.00557	0.0219	0.0173	0.00754
Panel D: STEM Occupation Premiums						
	Engineering and Related	Physical and Life Sciences	Computer and Math	STEM CEOs and Managers	-	-
<i>Coef.</i>	0.583***	0.205***	0.451***	0.666***	-	-
<i>SD</i>	0.0105	0.0125	0.0109	0.0149	-	-
Sample Size	8,963,191	8,963,191	8,963,191	8,963,191	8,963,191	8,963,191
Observations	763,327	763,327	763,327	763,327	763,327	763,327

Notes:

Table A6: Degree Composition of STEM Occupational Sub-fields

	(1)	(2)
<i>Top Five Degrees</i>	No. Of Employees	Share of Total
<i>Panel A: Engineering and Related</i>		
1. Engineering (excluding Civil)	133,441	42.2%
2. Civil Engineering	68,656	21.7%
3. Architecture and Urbanism	55,885	17.7%
4. Management, Retail and Marketing	14,666	4.6%
5. Manufacturing and Processing	5,666	1.8%
Top five degrees as Share of Total:		88.0%
STEM degrees (in top five) as Share of Total:		81.5%
STEM degrees (all) as a Share of Total:		83.6%
<i>Panel B: Computer and Math</i>		
1. Computer Sciences	114,876	60.4%
2. Management, Retail and Marketing	26,508	13.9%
3. Engineering (excluding Civil)	15,877	8.3%
4. Teaching and Education	6,681	3.5%
5. Math and Statistics	4,706	2.5%
Top five degrees as Share of Total:		88.7%
STEM degrees (in top five) as Share of Total:		71.2%
STEM degrees (all) as a Share of Total:		73.0%
<i>Panel C: Physical and Life Sciences</i>		
1. Health (excluding Medicine)	63,563	43.3%
2. Agriculture and Related	23,750	16.2%
3. Life Sciences	22,152	15.1%
4. Physical Sciences	12,009	8.2%
5. Teaching and Education	5,482	3.7%
Top five degrees as Share of Total:		86.5%
STEM degrees (in top five) as Share of Total:		23.3%
STEM degrees (all) as a Share of Total:		27.7%
<i>Panel D: STEM CEOs and Managers</i>		
1. Managment, Retail and Marketing	16,283	28.2%
2. Computer Sciences	14,026	24.3%
3. Engineering (excluding Civil)	7,363	12.8%
4. Civil Engineering	3,546	6.1%
5. Teaching and Education	2,458	4.3%
Top five degrees as Share of Total:		75.7%
STEM degrees (in top five) as Share of Total:		43.2%
STEM degrees (all) as a Share of Total:		48.4%

Table A7: STEM Degree to Occupations - Crosswalk

	Total STEM Field	in Each Field	Unemployed or Out of Workforce	Business, Finance and Law	Non-STEM Managers	Education and Health	STEM	Others
Computer & Math Degree		483,308	9.0%	1.8%	7.0%	16.4%	28.7%	36.6%
Engineering Degree		482,808	9.2%	1.6%	11.6%	4.2%	34.2%	38.7%
Architecture Degree		105,543	10.8%	1.6%	6.6%	3.6%	54.6%	22.3%
Physical & Life Scs Degree		340,926	14.0%	1.0%	5.4%	33.7%	11.8%	33.1%

Table A8: Distribution of STEM Degrees by sub-fields and Gender

	(1)	(2)	(3)	(4)
	Men with STEM		Women with STEM	
	Degree		Degree	
	Absolute	Share (%)	Absolute	Share (%)
Computer & Math Degree	311,530	35.3%	171,778	32.4%
Engineering Degree	394,091	44.7%	88,717	16.7%
Architecture Degree	40,118	4.5%	65,425	12.3%
Physical & Life Scs Degree	136,117	15.4%	204,809	38.6%
All STEM Degrees	881,856	100.0%	530,729	100.0%

Note: This table reports absolute and percent distributions of STEM degree held by the population of Brazil, according to the 2010 Brazilian Demographic Census, split by gender, in each STEM sub-field.

Table A9: Effect of Field of Study on Gender Wage Gap for University-Educated Workers Age 25–34

	Bachelor's Degree			Bachelor's Degree or Higher		
	(1)	(2)	(3)	(4)	(5)	(6)
A. Brazil - 2010 Census						
Female	-0.339 (0.0025)	-0.325 (0.0026)	-0.268 (0.0026)	-0.338 (0.0025)	-0.325 (0.0025)	-0.269 (0.0025)
STEM Major		0.107 (0.0036)			0.101 (0.0035)	
Field of study	No	No	Yes	No	No	Yes
Controls (9 fields)						
B. Canada - 2006 Census						
Female	-0.103 (0.011)	-0.076 (0.011)	-0.075 (0.0011)	-0.107 (0.010)	-0.087 (0.010)	-0.073 (0.010)
STEM Major		0.188 (0.012)			0.154 (0.011)	
Field of study	No	No	Yes	No	No	Yes
Controls (10 fields)						
C. United States - 2009 American Community Survey						
Female	-0.160 (0.006)	-0.142 (0.006)	-0.118 (0.007)	-0.158 (0.010)	-0.139 (0.010)	-0.117 (0.006)
STEM Major		0.188 (0.007)			0.187 (0.006)	
Field of study	No	No	Yes	No	No	Yes
Controls (10 fields)						

Notes: This Table displays the coefficients for the effects of degree field of study on the gender weekly-wage gap for university-educated workers. Standard errors in parentheses. Brazilian, Canadian and US Samples, respectively, include all occupied people age 25–34 in 2010 IBGE Census, the 2006 (Canadian) Census and the 2009 ACS (who were native born or immigrated before age 15 and were not attending school at the survey date). Sample in columns 1–3 includes people whose highest degree is a bachelor's degree. Sample in columns 4–6 includes people with a bachelor degree or more. The Dependent variable in all models is log of average weekly wage. Weekly income in Panel A was winnerized at 1%. Panels B and C exclude observations with weekly wage less than 15 or over 4,000. Brazilian sample size in columns 1–3 is 311,783 (results are weighted). Canadian sample size is 12,237; U.S. sample size is 534,419. Brazilian sample size in columns 4–6 is 324,532. Canadian sample size is 15,772; U.S. sample size is 750,035. All models control for part-time work, age (grouped variable in Canadian data), province/state. Panel A also controls for formality status and defines part time work as anything under 25 hours per week. Results for Panel B and C are taken directly from Card and Payne (2020).