Extended Abstract submitted under Theme. 1601 Education and labor force

A demographic projection of engineering workforce in Brazil through 2020.

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1. Objective

The booming of the Brazilian economy between 2004 and 2010 suggested that the B from the acronym BRIC would be finally taking off. Nonetheless, experts often raise concerns on a number of potential struggles to a sustained high economic growth in the country. One of the major hurdles relates to the availability of qualified and specialised workforce in key occupations demanded in fast-growing economies. This concern is compounded by rapid population aging in Brazil, where working-age population is estimated to peak around 2020.

Thus, one critical issue is the uncertainty over whether Brazil is going to have enough qualified labor force to meet market's demand if economic growth pace continues as observed in recent years. This paper aims to contribute to this debate by presenting a demographic projection of engineering workforce availability in Brazil up to 2020.

2. Methods

The projection method we have used is an adaptation of the cohort-component method to a simplified model of entries and exits in the labor market. The intuition behind the adapted balancing equation of population change is illustrated in Figure 1. Data from five different public databases available in Brazil were used to run the projections on yearly basis. The method is rather flexible and can be adapted to project almost any population group with higher education degree from different backgrounds, by sex and age.

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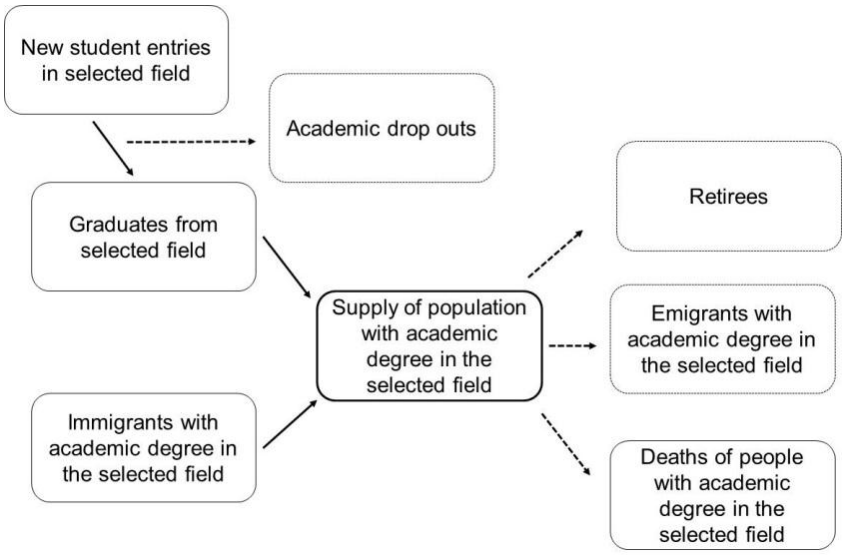

Figure 1. Illustration of the population projection method
Source: Adapted from Goic (1994; 1999), Bastías *et al*. (2000) and Rodrigues (2008).

The baseline population was drawn from the 2000 Brazilian Population Census. It covers the number people who declared having a degree in the broad engineering branch of engineering, manufacturing and construction, as specified by the Ministry of Education.

Based on the Brazilian Annual Higher Education Census, reported flows of new graduates between 2000 and 2009 are added annually to the baseline population. Future flows of new labor market entrants are projected as follows. First we calculate the average number of years (n) a student takes to complete his or her degree. Then we calculate, separately for men and women, an average graduation rate (AGR), which is the proportion of students who actually complete their degree in a length of time no longer than this estimated graduation average time (n)[1]. Finally we estimate the number of new engineering professionals that will entry the labor market in a future year "X" by multiplying AGR to the number of undergraduate intakes in year (X-n).

When "X" is year 2016 or earlier, student intakes in year (X-n) is already given by official figures. When "X" is 2017 or later (up to 2020), student intakes are projected. The major strength of this method lies in this step, because the number of graduates we project up to 2016 (half of the time horizon of our projection) is highly determined by the number of students currently enrolled in universities.

We draw four scenarios that differ in terms of possible growth rates to be observed in the number of student entries. The most pessimistic scenario considers a perspective of constant enrollment number (CEN), i.e. a growth rate of 0%. The most optimistic scenario predicts student intakes growing at the highest rate observed in recent years, which means an average 16.8% annual growth rate between 2011 and 2020. Two other scenarios lie between these two.

We have projected mortality rates using the same methodology used in official population projections in Brazil: A logistic interpolation between the logarithm of the

[1] Average graduation rates were estimated at 42% for men and 49% for women.

age-specific mortality rates observed in the period of 2000-2011 and a limit life table for United States in 2100, estimated by the U. S. Bureau of the Census (Oliveira, Albuquerque e Lins, 2004). Since educational level information is often misreported in death certificates in Brazil, our mortality projection is based on the mortality rates observed in the Federal District (FD), the state with the highest life expectancy in the country.[2] Individuals over 70 years old were considered retired and international migration was not taken into account [3].

3. Results/Findings

According to the national census, in the year 2000 there were around 525,000 people under 70 years old holding a diploma in the selected engineering fields in Brazil. The population pyramid shows a relatively old age structure with a clear male predominance among this engineering workforce in the year 2000. Around 51% of those engineers living in Brazil in this year were men between 35 and 55 years old.

If our hypotheses are confirmed, the engineering labor force in the country is likely to face two significant changes in the coming years: rejuvenation and feminization, as Figure 2 shows. These changes result mainly from a rapid education expansion observed in recent years (mostly in the private education sector) and a combination of increasing female enrolment in engineering courses at universities and lower dropout rates when compared to their male counterparts.

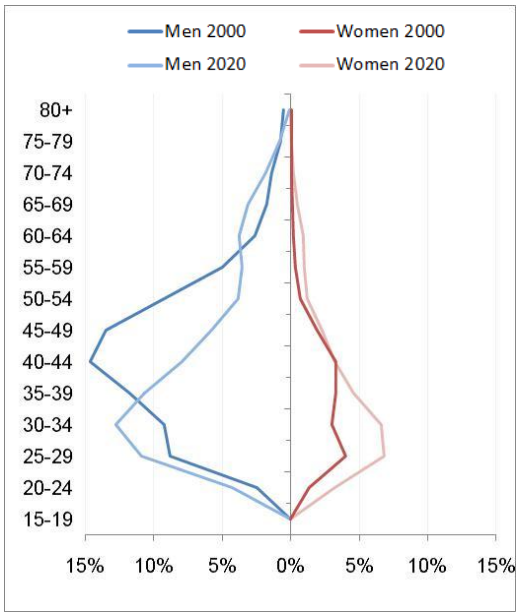

Figure 2. Distribution, by sex and age, of the Brazilian less than 70 years old population holding a degree in engineering or in engineering technology fields – Brazil, 2000 and 2020.

Sources: For year 2000: Brazilian Institute of Geography and Statistics (IBGE), Brazilian Ministry of Education (MEC) and Brazilian Ministry of Health (MS). For year 2020: author's own projections.

[2] In 2008, life expectancy at birth in FD was 75.8 years, a relatively high figure when compared to the country's average of 73 years (Brazil, 2009).

[3] Official household sample survey reported that 99.2% of Brazilian labor force was less than 70 years old in 2009. Available data produced by the Ministry of Labor suggests that foreign engineering professionals are still very few in the Brazilian labor market – they were less than 1% of the total labor force in these occupations in 2009.

Following our scenarios for future student enrolments and given the considered mortality and retirement prospectus, our projection results show that Brazilian labor market would have in 2020 between 1,6 and 2,3 million people holding a degree in engineering fields (see figure 3).

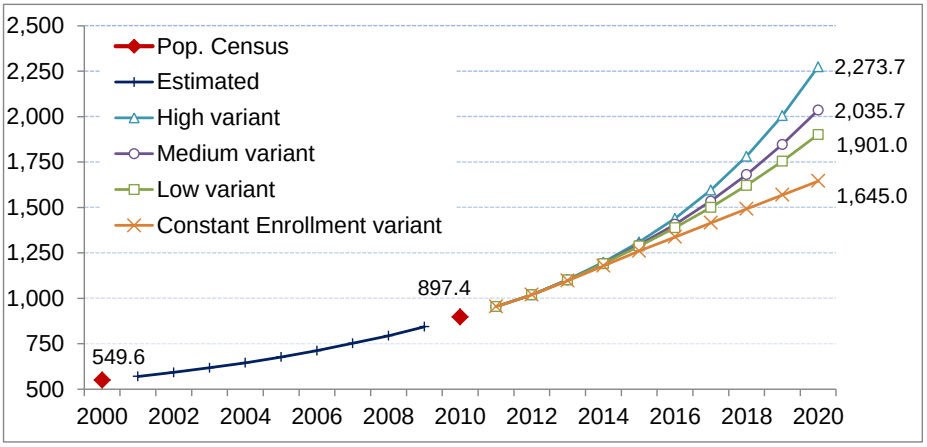

Figure 3. Scenarios for the number of engineering professionals in the Brazilian labor Market – 2000-2020 (in thousands)

Sources: For years 2000-2009: Brazilian Institute of Geography and Statistics (IBGE), Brazilian Ministry of Education (MEC) and Brazilian Ministry of Health (MS). For year 2020: author's own projections.

4. Implications for Policy

If Brazilian authorities are considering taking concrete initiatives to deal with an eventual shortage of engineers in the country, then they should be aware of the following points before choosing any particular policy:

1. There is a clear labor market matching problem: only three out of ten people with engineering degree actually work in a typical engineering occupation;
2. Academic drop-out rates are remarkably high among engineering students (51% for women and 59% for men). Besides, addressing this issue is the only way to ensure short-term results;
3. Possibly, the problem lies rather in education quality than in the quantity of students that the Brazilian education system is able to produce
4. Any rapid expansion in student intakes could compromise even further potential quality problems and yet, it would only yield results after six or seven years.
5. Easing immigration rules to attract foreign engineers might play an important role to alleviate some local bottlenecks. However, it falls far short of what is needed to properly deal with this issue nationally.
6. Finally, we draw attention that the claimed shortage of engineers in the country might not be a matter of purely quantitative supply, rather the spatial concentration of engineering schools and labor force play a rather important role in this debate.