

# Prospects for Egypt's Population and Labor Force: 2000 to 2050

Ragui Assaad

# **PROSPECTS FOR EGYPT'S POPULATION AND LABOR FORCE: 2000 TO 2050<sup>1</sup>**

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### **Abstract**

I argue in this paper that although recent developments had temporarily reduced demographic pressures on the Egyptian labor market, such pressures will return with a vengeance in the next decade. The sizable echo generation born between 2006 and 2014 is the reflection of the large youth bulge generation born in the early 1980s; a reflection that was further compounded by rising fertility rates in the late 2000s and early 2010s. As the echo generation reaches working age, the net annual increase to the labor force will rise from 575 thousand per year in 2020-25 to 800 thousand in 2030-35, which will pose a major job creation challenge. This upcoming wave of new entrants will also be substantially more educated, with 50-60% having secondary or post-secondary education, and another third having university education or higher. To accommodate this upcoming growth in labor supply and absorb the stock of existing unemployed and discouraged workers, I estimate that employment growth would have to reach 2.7% per year, something that would require sustained GDP growth rates in excess of 6% per year. The quality of jobs created by the Egyptian economy would also have to improve substantially to satisfy the higher aspirations of the increasingly educated new entrants and curtail the rising rates of discouragement among female new entrants.

**Keywords:** Population projections, labor force projection, Egypt.

**JEL Classifications:** J11, J21, J82.

## 1. Introduction

Until recently, Egypt had been experiencing a pronounced youth bulge a demographic phenomenon characterized by a substantial rise in the share of the youth population in total population, and that is associated with severe demographic pressure, first on the education system and then on the labor market (Assaad & Barsoum, 2009; Assaad & Roudi-Fahimi, 2007). Egypt's youth bulge resulted from large declines in early childhood mortality in the early 1980s without commensurate declines in fertility. By 2020, the youth bulge generation was in their mid to late 30s and had already transitioned into the labor market. The generation that followed was much smaller as fertility declines started to catch up with higher childhood survival, leading to reduced pressures on labor markets in the 2010s (Krafft, Assaad, & Keo, 2019). However, as the youth bulge generation reached its prime child-bearing ages in the 2010s, a dramatic increase in births—dubbed the echo of the youth bulge—materialized (Krafft & Assaad, 2014). In fact, the number of annual live births increased explosively from about 1.8 million in 2006 to 2.7 million in 2014, after a period of relative stability prior to 2006 (CAPMAS, 2019). The baby boom associated with the echo of the youth bulge was made even larger by an unexpected reversal in the long-running decline in fertility rates from 2008 to 2012, which exacerbated the large increase in the number of potential parents. After a long period of fairly steady decline, the total fertility rate increased from 3.0 in 2008 to 3.5 in 2014 (Ministry of Health and Population, El-Zanaty and Associates, The DHS Program, & ICF International, 2014).

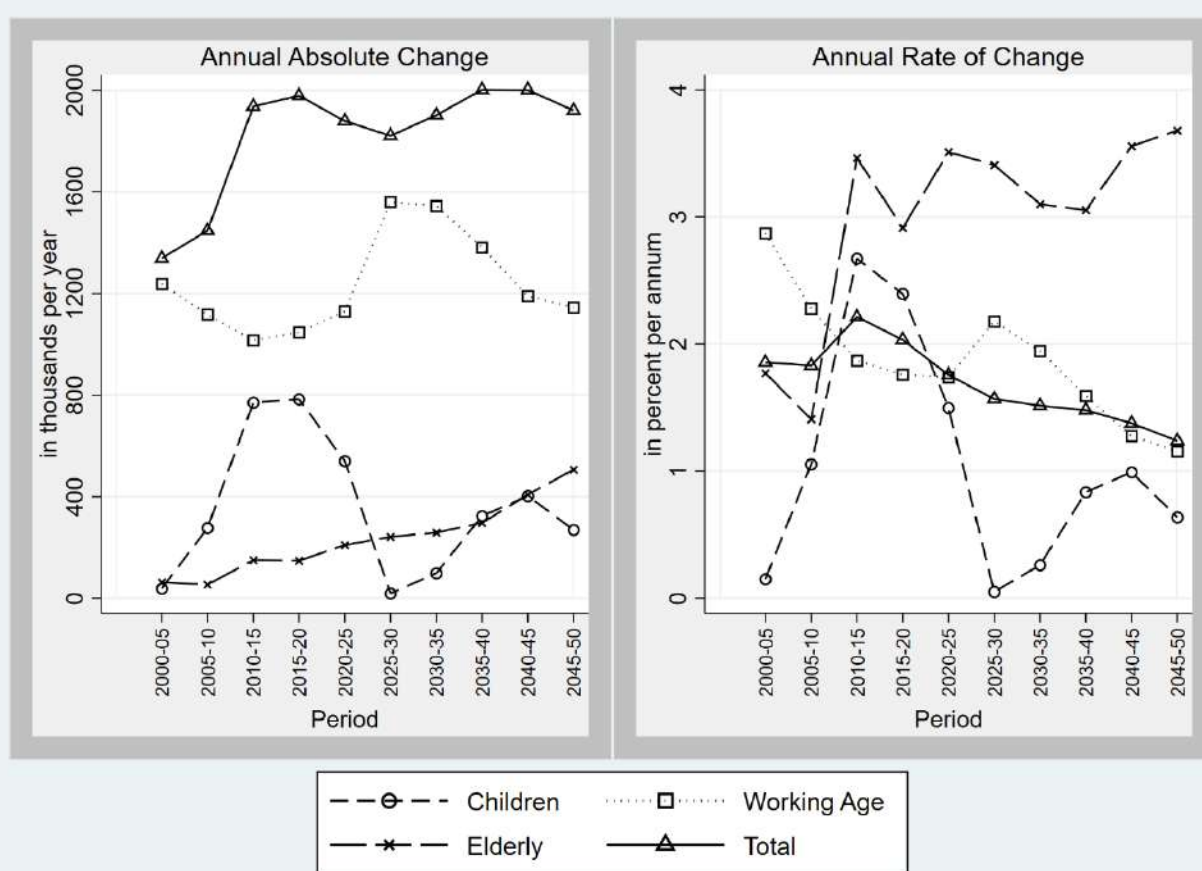
As shown in Figure 1, the baby boom of the late 2000s and early 2010s is manifested in the dramatic acceleration of the growth of the child population (0-14) from 0.2% per annum (p.a.) in 2000-05, to 1.1% p.a. in 2005-10, to a peak of 2.7% p.a. in 2010-15. This represents an increase in the annual increment in the child population from as low as 40 thousand per year in 2000-05 to as much as 785 thousand in 2015-20. This bulge in the child population is expected to subside to nearly zero by 2025-30, before starting to increase again as the echo generation reaches childbearing age.

The recent baby boom has had dramatic effects on population growth in Egypt in recent years. As shown in Figure 1, the annual increment in population went from 1.3 million p.a. in 2000-05, to nearly 2 million p.a. in 2015-20. During the same period, the average annual rate of growth increased from 1.9% p.a. to 2.2% p.a. The annual increment is projected to decline to 1.8 million p.a. in 2025-30 before rising again to nearly 2.0 million until 2050. A relatively constant projected absolute increase in a rising population means that the rate of population growth is projected to decline steadily from its peak in 2010-15 through 2045-50 when it will reach 1.2% p.a. It is readily apparent from these projections that Egypt is just coming out of a period of peak population growth, driven primarily by the sizable baby boom of the early 2010s.

By 2020, the echo generation had not yet reached working age and their parents' generation—the youth bulge generation—was already well into working age. With a relatively smaller generation in between, the rate of growth of the working age population actually declined from 2.9% p.a. in 2000-05 to 1.8% p.a. by 2015-20 (Figure 1). This represents a decline in the annual increment to

the working age population from 1.2 million p.a. in 2000-05 to 1 million p.a. in 2015-20. The rate of growth of the working age population is projected to decline further to 1.7% p.a. in 2020-2025, providing a continued respite from labor supply pressures for a few more years. However, it is projected to increase substantially to 2.2% p.a. by 2025-30 when the echo generation reaches working age. This acceleration in the size of the working age population means that its annual increment will rise dramatically from about a million persons per year in the 2010-2025 period to nearly 1.6 million p.a. in the 2025-35 period. This acceleration in the size of the working age population has enormous implications for labor force growth and thus the resumption of substantial demographic pressures on the labor market. While, this growth will gradually subside post-2035, it will still exceed a million persons per year by 2045-50.

**Figure 1. Estimated and Projected Average Annual Absolute Change (Thousands per Year) and Average Annual Rate of Change (Percent per Annum) of the Population (Percent per Annum) by Major Age Categories**



Source: Authors' calculations based on data from United Nations Department of Economic and Social Affairs Population Division (2019)

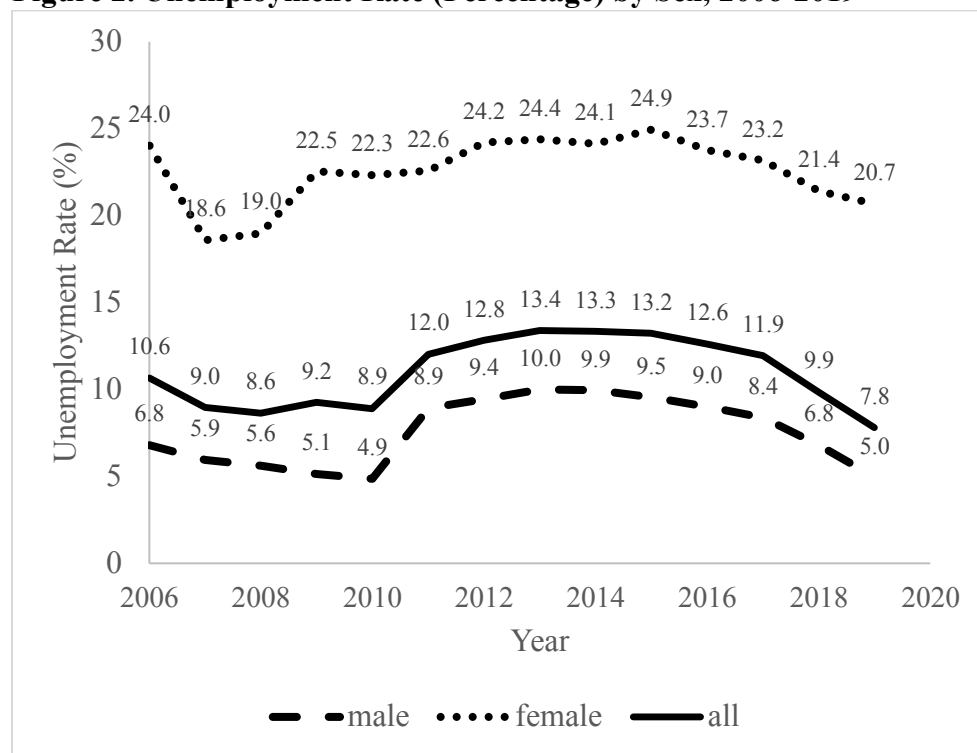
Note: Projections are based on the UN's Population Division's medium-variant projection. The major age categories are defined as follows: children are ages 0-14, working age are ages 15-64 and elderly are ages 65+

The recent demographic developments have served to substantially reduce labor supply pressures on the Egyptian labor market in the past decade. The diminution of these pressures has had important effects on some labor market indicators, such as the unemployment rate. After reaching a peak of 13.4% following the 2011 revolution and the period of political instability and economic crisis that followed it, unemployment began to slowly decline until 2017 and then rapidly from 11.9% in 2017 to 7.8% in 2019, according to official estimates (Figure 2). Although it is tempting to attribute the reduction in unemployment to the recovery in GDP growth rates, available evidence suggests that it was due the diminution of labor supply pressures. In fact, as GDP growth rates recovered from the lows they had reached right after the revolution, going from 1.8% per annum (p.a.) in 2011 to 5.5% p.a. in 2019, the employment-to-population ratio continued to decline steadily from a high of 47.8% in 2010 to 38.5% in 2019, its lowest level since 2000 (Figure 3).

The observed decline in the unemployment rate is arguably the result of developments on the supply side of the labor market rather than on the demand side. It is well established that unemployment in Egypt is primarily structural, and reflects the challenges to the labor market posed by the insertion of educated new entrants (Assaad, 2008). The changing age structure of the population as the youth bulge generation moved into prime working age resulted in the slowest growth of the youth and young adult populations in years. There is also substantial evidence that there are increasing rates of discouragement, i.e. individuals who want to work, are available for it, but are no longer actively searching for it, which are pushing participation rates downward. This is especially true among women with secondary education, whose participation rates have plummeted in recent years as their public sector employment prospects have dwindled.

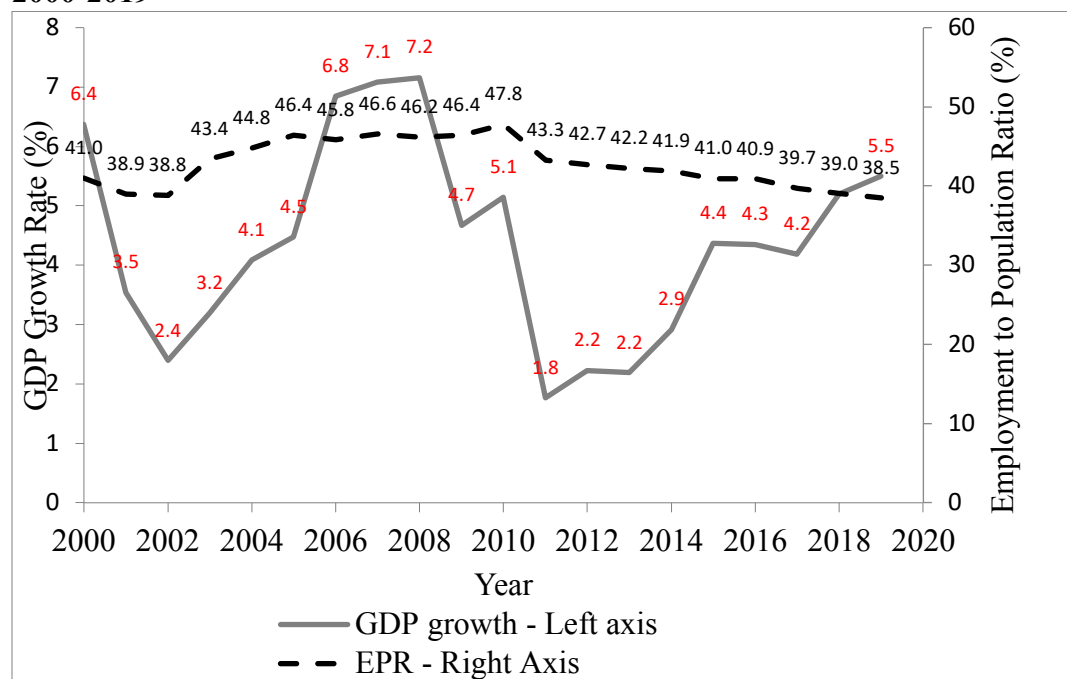
Both of these developments would show up as reduced labor supply and therefore lower unemployment. The reduction in demographic pressures are only temporary, however, and will reverse by the middle of this decade as discussed above. While I cannot forecast how employment and job creation will behave in the future, I am able to forecast with substantial confidence the trajectories of the population and labor force over the next thirty years. These trajectories point to the fact that substantially more job creation will be necessary in the near future to maintain the low levels of unemployment observed in recent years, let alone reduce them further.

**Figure 2. Unemployment Rate (Percentage) by Sex, 2006-2019**



Source: CAPMAS, Labor Force Survey.

**Figure 3. GDP Growth Rate and Employment to Population Ratio (EPR) (Percentage), 2000-2019**



Source: CAPMAS Labor Force Survey for employment-to-population ratio and World Bank, World Development Indicators for GDP growth.



In what follows, I use the United Nation's Population Division's 2019 version of the population projections for Egypt by age and sex up to the year 2050 together with the trajectory of educational attainment since 1988 to produce population projections that are also broken down by education. I also project age, sex and education-specific labor force participation rates to produce detailed labor force projections up to 2050 broken down along these three dimensions. The details of the projection methodology are laid out in the Appendix.

In section 2, I discuss the results of the population projections, including the sex, age and education breakdowns of the projected population from 2020 to 2050. In section 3, I examine the projection of participation rates by education and sex. I present the trajectory of the labor force and its sex, age, and education composition in Section 4. Section 5 examines the employment creation needs to meet the demands of Egypt's growing labor force, and Section 6 concludes.

## **2. Projections of Population Size and Composition**

As mentioned above, I use the United Nation's Population Division's 2019 version of the population projections for Egypt by 5-year age group through 2050, relying primarily on the medium-variant projection. The estimates and projections by age group and sex are shown in five-year intervals from 2000 to 2050 in Table 1. I further break down the projections of the working age population (15-64) into four educational categories ((i) no certificate, (ii) primary or preparatory (lower secondary), (iii) (upper) secondary or post-secondary, and (iv) university or above) based on my own projection of the share of these four categories in each age and sex group. The estimates from 2000 to 2015 and projections from 2020 to 2050 are shown Table 2. The details of the methods used are also described in the Methodological Appendix.

As shown in Table 1, total population in Egypt is projected to increase from 102 million in 2020 to just under 160 million by 2050 according to the UN's medium variant projection. It is estimated to have increased by 20 million in the last ten years alone.

### **2.1 Population Projection by Age Group**

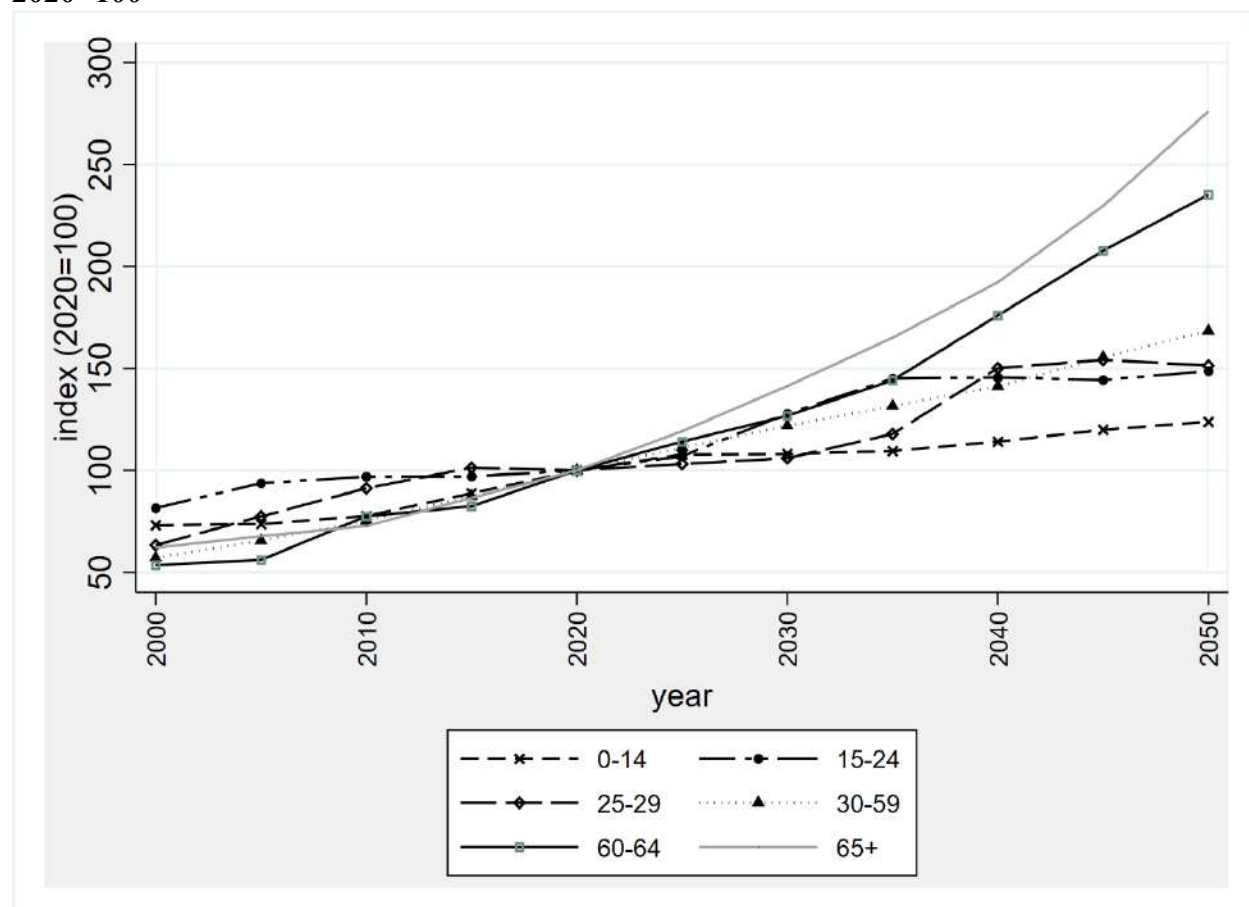
As seen in Figure 1, while the growth of the working age population decelerated in the past two decades, the growth of the child population increased explosively as a result of the substantial echo of the earlier youth bulge. The other component of the population whose growth will accelerate substantially is the elderly population, i.e., 65 and over. Its growth rate has more than doubled from 1.4% p.a. in 2005-10 to 3.5% p.a. in 2010-15 and will stay roughly at that elevated level through 2045-50. Again, this will translate into substantial pressure on the elderly care system and on both contributory and non-contributory pension schemes as the annual increment to the elderly population increases steadily to reach half a million per year in 2045-50.

Figure 4 shows the resulting population trends from these differential growth rates by age group. The two fastest growing age groups are the elderly (65+) and the near elderly (60-64), whose numbers will increase by 2.8 and 2.3 times, respectively, by 2050, relative to what they are in 2020. However, in terms of increased pressure on labor supply, it is the growth of the 15-24 and 25-29 age groups that matters the most. The 15-24 age group had the slowest growth from 2005

to 2020, while the growth of the 25-29 age group slowed appreciable in the 2010-2020 time period, underscoring the slowdown in demographic pressures on labor supply in the past decade. Both will grow slowly for another five years and then the growth of the 15-24 age groups will accelerate in the second half of the 2020 decade as the echo generation reaches working age. The acceleration of the 25-29 age group will follow in the early 2030s and will experience its largest growth spurt from 2035 to 2040.

The age structure of the population will change substantially between 2020 and 2050. As shown in the population pyramids depicted in Figure 5, the two youngest age groups were the largest in 2020, reflecting the echo generation and the increase in fertility post-2010. By 2050, this large base will have reached their late 30s, contributing to another, albeit smaller, echo of young children. There will also be a considerable expansion of the elderly population above the age of 65.

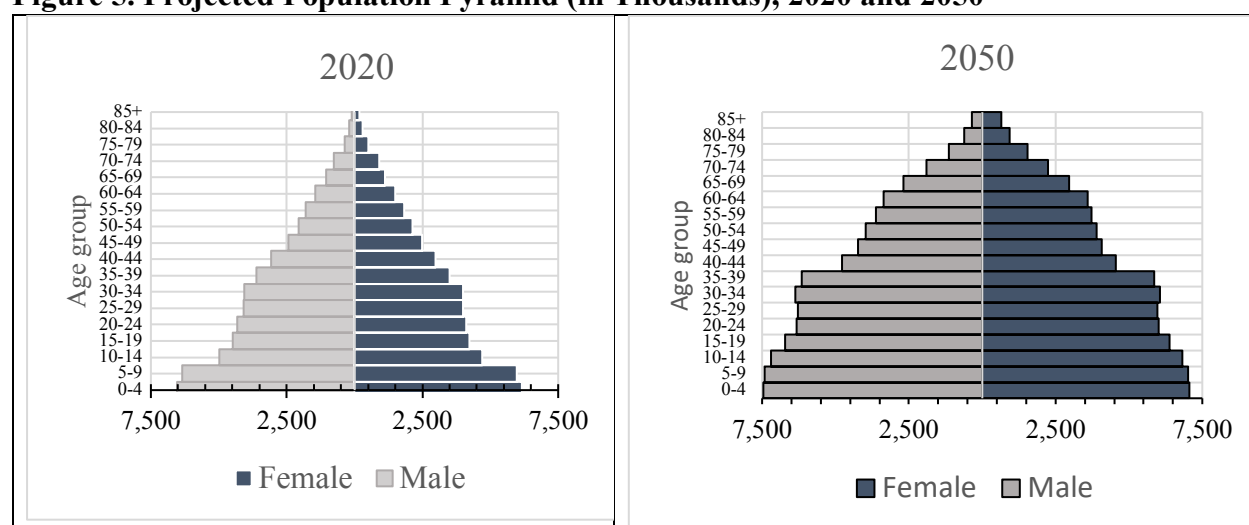
**Figure 4. Estimated and Projected Population Trends by Major Age Groups, Index 2020=100**



Source; Authors' calculations based on data from United Nations Department of Economic and Social Affairs Population Division (2019)

Note: Projections are based on the UN Population Division's medium-variant projection.

**Figure 5. Projected Population Pyramid (in Thousands), 2020 and 2050**



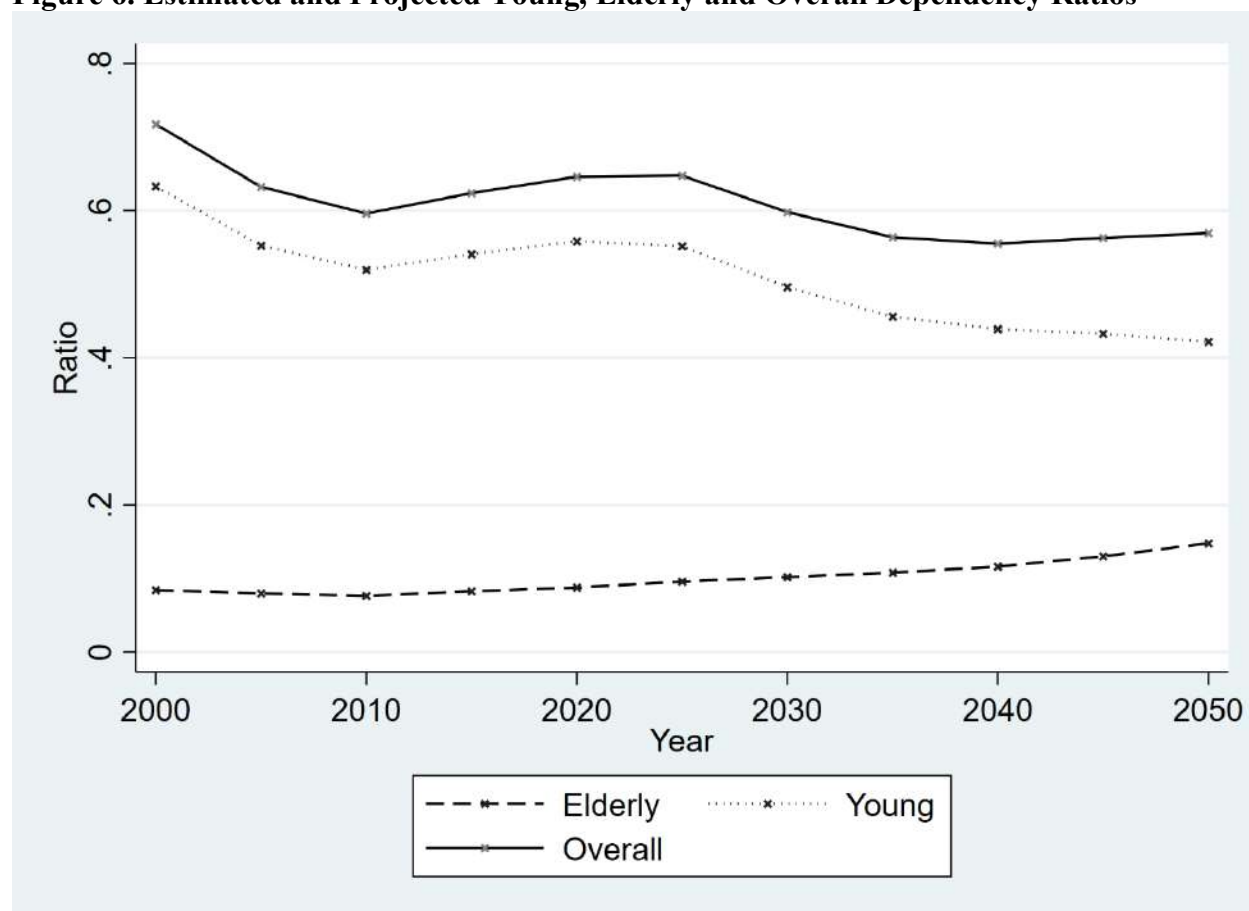
Source; Authors' calculations based on data from United Nations Department of Economic and Social Affairs Population Division (2019)

Note: Projections are based on the UN Population Division's medium-variant projection.

### Effects on dependency ratios

These changes have important implications for the trajectory of dependency ratios in Egypt shown in Figure 6. After declining substantially from 2000 to 2010, the overall dependency ratio, defined as the ratio of the child plus elderly population to the working age population, began increasing again from 2010 to 2020 and will continue rising slightly through 2025. This reflects big increases in the young dependency ratio and slower increases in the elderly dependency ratio during this period; a direct result of the large size of the echo generation. While the young dependency ratio will decline in 2025 and will continue declining steadily until 2050, the overall dependency ratio will reflect this decline only through 2040. After that, it will start rising; a reflection of the increase in the elderly dependency ratio. Thus, Egypt's demographic window of opportunity, which is marked by a decline in the dependency ratio was opening in the first decade of the century, has closed somewhat from 2010 to 2020 due to the large echo of the youth bulge. It will reopen again from 2025 to 2040, after which it will begin closing because of high elderly dependency.

**Figure 6. Estimated and Projected Young, Elderly and Overall Dependency Ratios**



Source; Authors' calculations based on data from United Nations Department of Economic and Social Affairs Population Division (2019)

Note: Projections are based on the UN's Population Division's medium-variant projection. Overall dependency ratio is defined as  $(\text{Pop Age 0-14} + \text{Pop Age 65+}) / \text{Pop Age 15-64}$ , Young dependency ratio is defined as  $(\text{Pop 0-14} / \text{Pop 15-64})$ , and elderly dependency ratio is defined as  $(\text{Pop Ages 65+} / \text{Pop. Ages 15-64})$ .

## 2.2 Population Projections by Educational Attainment

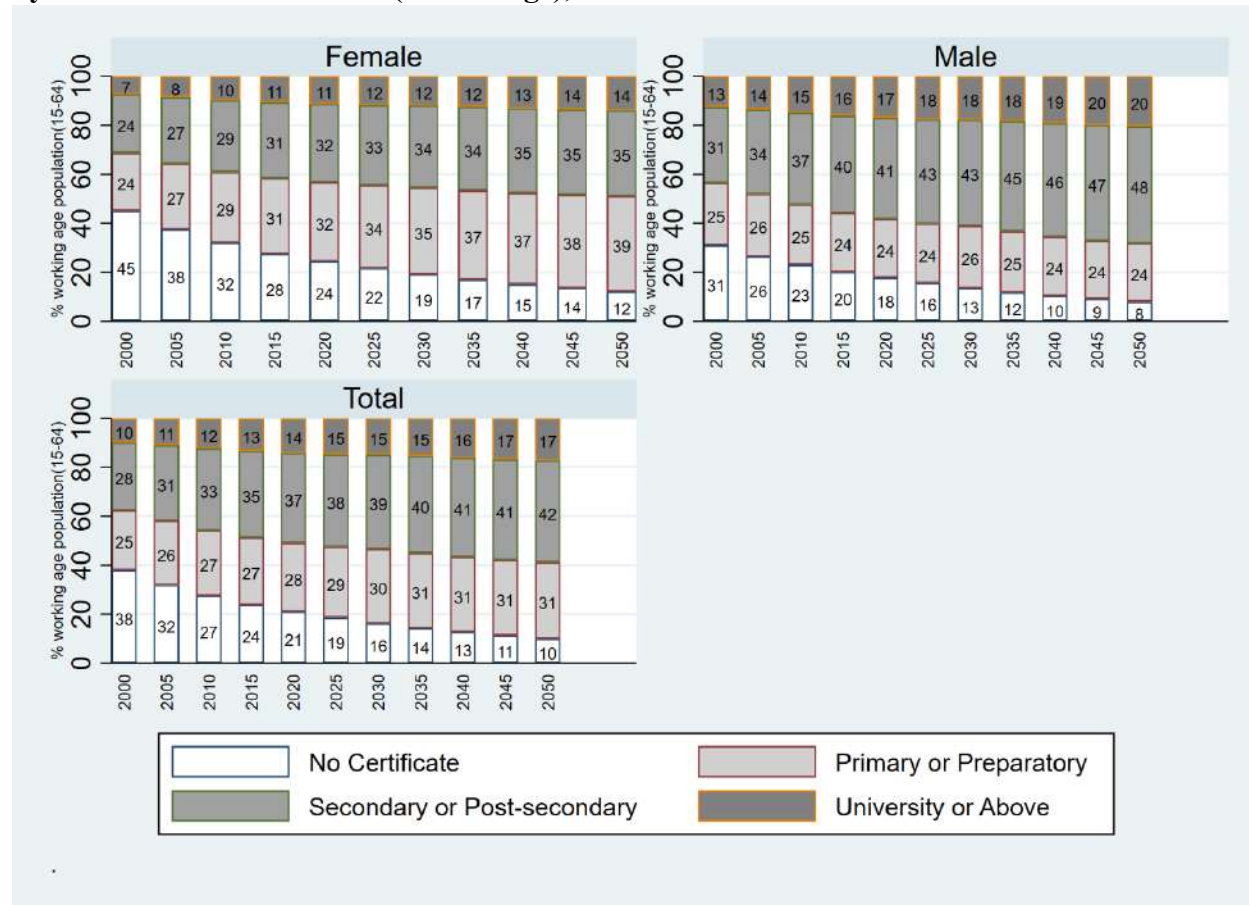
I extend the UN Population Division's population projections for Egypt by further breaking them down by educational attainment. Since my ultimate concern is about projecting the labor force, I do so only for the working age population, ages 15-64. I start by projecting the share of the working age population in four educational attainment groups, namely (i) no certificate, (ii) primary or preparatory, (iii) secondary or post-secondary, and (iv) university or above. The results of this exercise are shown in Figure 7. I then combine these projections with the projection of the size of the working age population by five-year age group and sex obtained from the UN's medium variant projection to produce the projected size of the working age population by educational attainment. This results are shown in Figure 8 and Table 2.<sup>3</sup>

<sup>3</sup> Note that the educational share projections are conducted for specific age and sex groups as discussed in the Methodological Appendix.

As shown in Figure 7, the rising educational attainment of the population is quite clear. While 38% of the working age population had no educational certificate in 2000, this share had already dropped by nearly half to 21% by 2020, and is projected to be further halved to 10% by 2050. The drop is more pronounced for women, whose educational attainment was lower to start with. At the other end of the education spectrum, the share of those with university degrees and higher increased from 10% in 2000 to 14% in 2020 and is projected to increase further to 17% by 2050. The component of the working age population that is expected to increase the most constitutes those with secondary and (2-year) post-secondary education, the vast majority of whom have technical (vocational) secondary degrees. This group has already grown from 28% of the working age population in 2000 to 37% in 2020 and is projected to reach 42% by 2050. In fact, by 2050, 73% of the working age population will have either basic (primary or preparatory degrees) or secondary or post-secondary education.

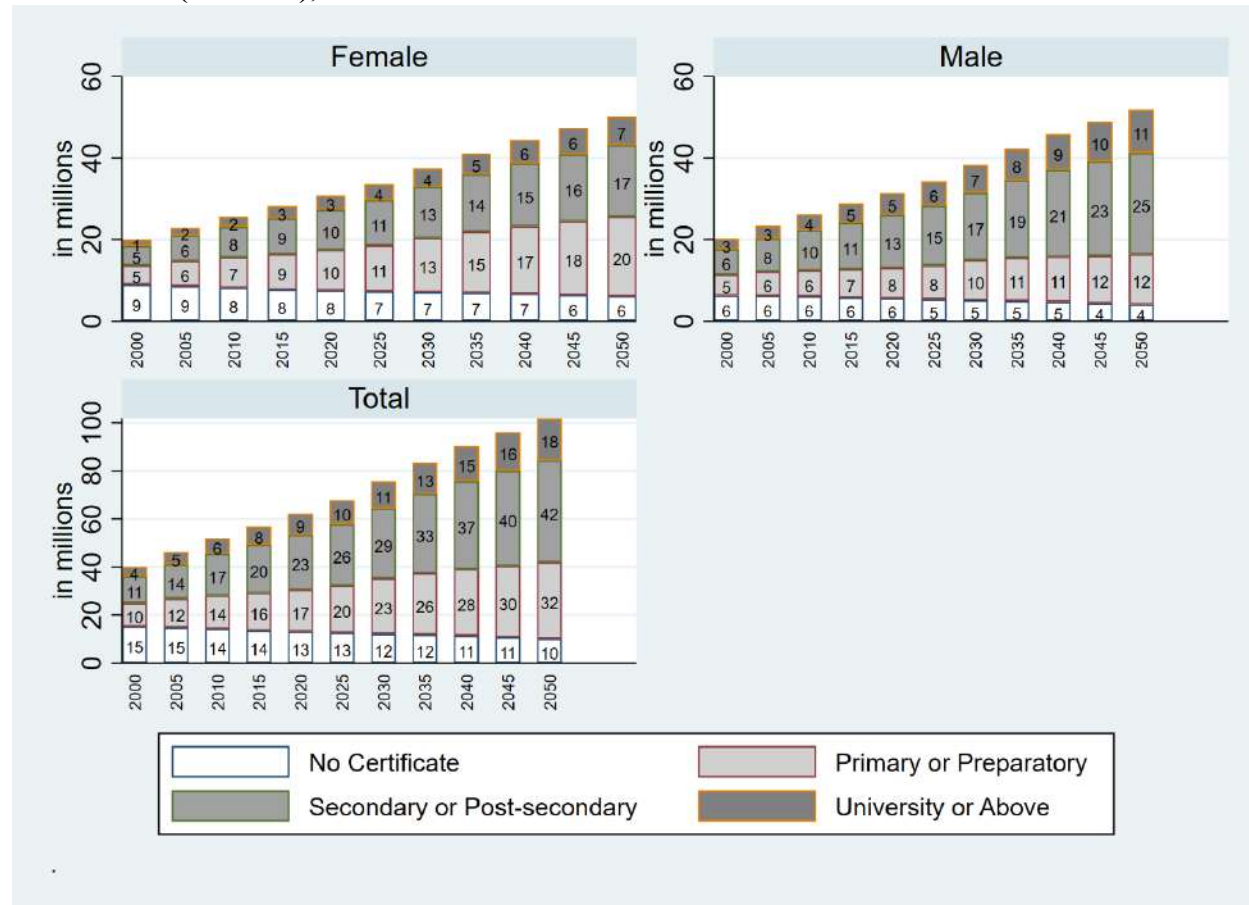
The overall size of the working age population in 2020 is estimated at 62 million individuals, of which 23 million have a secondary or post-secondary education and 9 million have university education or above (Figure 8 and Table 2). By 2050, the size of the working age population is projected to increase to 102 million, of whom 43 million will have secondary and post-secondary degrees and 18 million will have university degrees and above.

**Figure 7. Estimates and Projections of the Structure of the Working Age Population 15-64 by Educational Attainment (Percentage), 2000-2050**



Source: Author's calculations based on data from labor force surveys from 2000 to 2017 and projections based on these data using the methodology described in Appendix 1.

**Figure 8. Estimated and Projected Size of Working Age Population (15-64) by Educational Attainment (Millions), 2000-2050**



Source: Author's calculations based on data from labor force surveys from 2000 to 2017, United Nations Department of Economic and Social Affairs Population Division (2019), and projections based on these data using the methodology described in Appendix 1.

It is also instructive to examine the rate at which each educational group is changing relative to the overall growth of the population. Again, I do that in both absolute and relative terms. As shown in Figure 9, the average annual increment to the working age population will jump from 1.1 million in 2020-25 to 1.6 million in 2025-30. This jump is made up almost exclusively of individuals with basic education and above. Those with basic education will eventually receive secondary degrees so the permanent jump will be among those with secondary/post-secondary degrees. The annual increment of those with university degrees will also increase, but with a lag, going from 250,000 per year in 2025-30 to 350,000 in 2035-40.

In relative terms, the rate of growth of the working age population, which had been declining from 2000 to 2020 will rise substantially in 2025-30 as the echo generation makes it into working age. All educational groups except for those with no certificates are growing faster than the overall working age population; the fastest growth rate being among university graduates, followed by secondary/post-secondary graduates. As shown in the right panel of Figure 9, university and

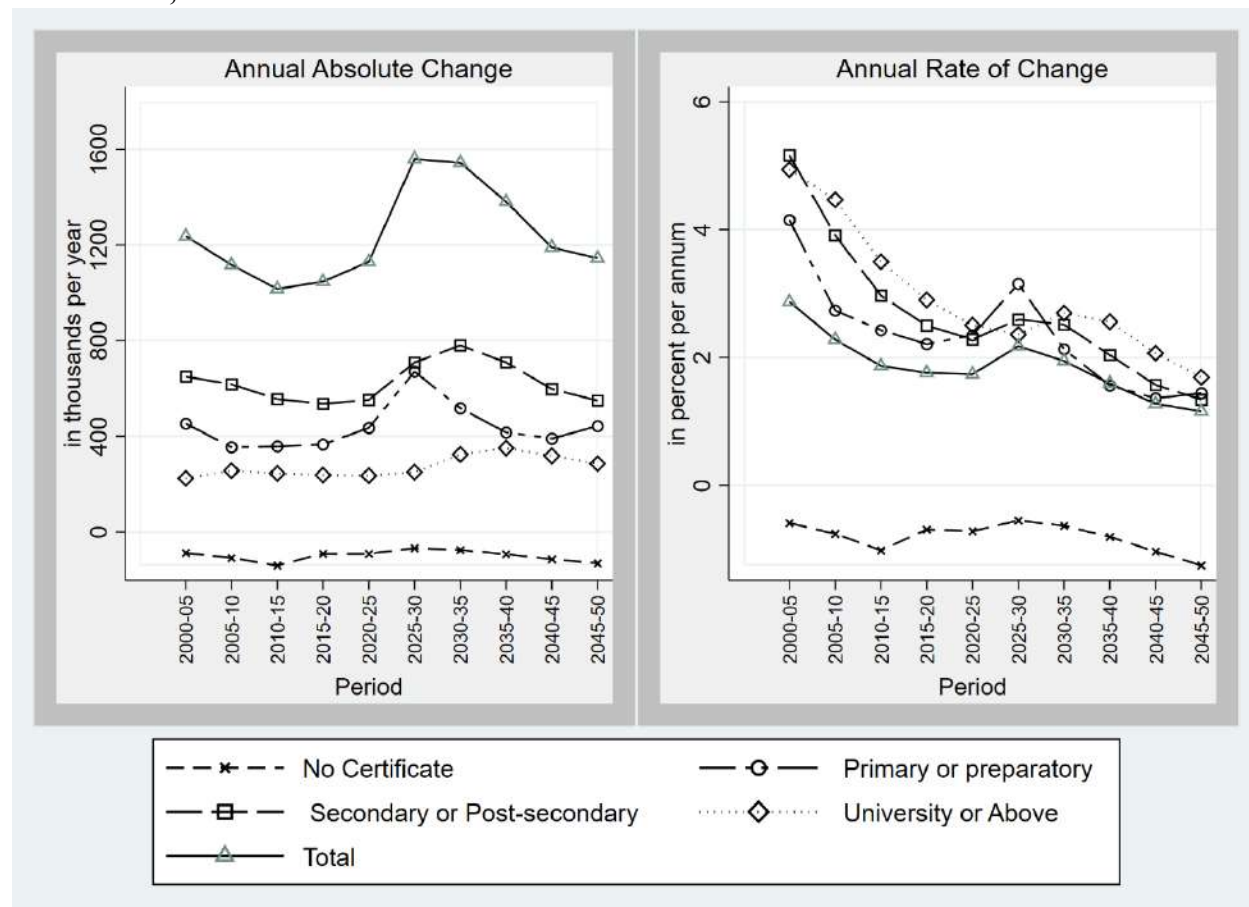
secondary/post-secondary graduates have each increased at the explosive rate of about 5% p.a. in the 2000-05 period. While this rate has slowed down in subsequent years, university graduates were still growing at 2.9% p.a. and secondary/post-secondary graduates at 2.5% p.a. in 2015-20. These rates are projected to decline further in 2020-25, but accelerate thereafter, first for secondary/post-secondary and then for university graduates through 2035-40.

In terms of absolute numbers, it is secondary/post-secondary graduates that have constituted the largest annual increment in the past 20 years and they will continue to do so through 2050. As shown in the left panel of Figure 9, secondary/post-secondary graduates were increasing by between 540,000 and 650,000 per year from 2000 to 2020. This increase is projected to rise substantially starting in 2025-30 to reach 780,000 per year. The annual number of university graduates added to the working age population will also rise gradually from about 240,000 in 2015-20 to 363,000 in 2035-40. The temporary spike in the number of basic education graduates from 365,000 per year in 2015-20 to a peak of 670,000 per year in 2025-30 indicates the echo generation reaching this level of education, but most of them will continue on to higher levels, leading to the rapid decline thereafter.

The second half of this decade will therefore see a large increase in the number of individuals with secondary/post-secondary and then university education who will no longer be satisfied with the casual, informal jobs that have been available so far to the less educated.



**Figure 9. Estimated and Projected Annual Absolute Change (Thousands per Year) and Annual Rate of Change (Percent per Annum) in the Working Age Population by Educational Attainment, 2000-2050**



Source: Author's calculations based on data from labor force surveys from 2000 to 2017, United Nations Department of Economic and Social Affairs Population Division (2019), and projections based on these data using the methodology described in Appendix 1.

### 3. Projecting Labor Force Participation Rates

To transform these projections of the working age population into labor force projections, I need to first project participation rates. Since participation is strongly shaped by sex, age and education, I use data from the official labor force surveys from 2000 to 2017 to project participation rates by sex, five-year age groups, and the four educational groups presented above.<sup>4</sup>

I use two projection methods to project the sex-age-education-specific participation rates to 2050. The first is a "trend projection" that essentially assumes that observed trends in participation in 2000-2017 will continue forward. Since trends were generally downward for both men and women, this assumption assumes that these downward trends in participation will continue. Overall participation trends may not reflect the same trends because of compositional shifts of the working age population toward more educated groups, which tend to have higher participation

<sup>4</sup> The details of the participation rate projections are discussed in the methodological appendix.

rates. The second projection method is a “moving average projection” that assumes group-specific participation rates will remain constant at the average level of the last five years of the data, thus eventually stabilizing.

Neither of the two methods projects rising sex-age-education specific participation, which could happen if labor market conditions improve sufficiently to pull people into the workforce. Thus, my labor force estimates derived from these participation rates will generally be on the conservative side. The projected participation rates by education and gender using both the trend and moving average methods are shown in Figure 10.

As shown in Figure 10, overall participation rates for women (of all education groups) were fluctuating but essentially flat from 2000 to 2015, averaging around 23%. Those for men were rising somewhat from 75% to 77-79% during the same period. The trend projection method projects a slight decline in overall participation for women, with female participation gradually falling to 21% by 2050. It projects male participation to be essentially flat, stabilizing at 77% by 2050. The moving average projection method projects that overall will rise by a mere one percentage point from 2020 to 2050 for women and will fluctuate but remain essentially flat for men in the range of 77-79%.

Given that Egypt has some of the lowest female participation rates in the world, it is a little surprising (and truly a bit disappointing) that on the present evidence female participation rates should probably be projected to remain flat, if not decline slightly through 2050. This is particularly noteworthy given the rising share of the educated among women of working age (shown in Figure 7) and the generally higher participation of educated women (shown in Figure 10).

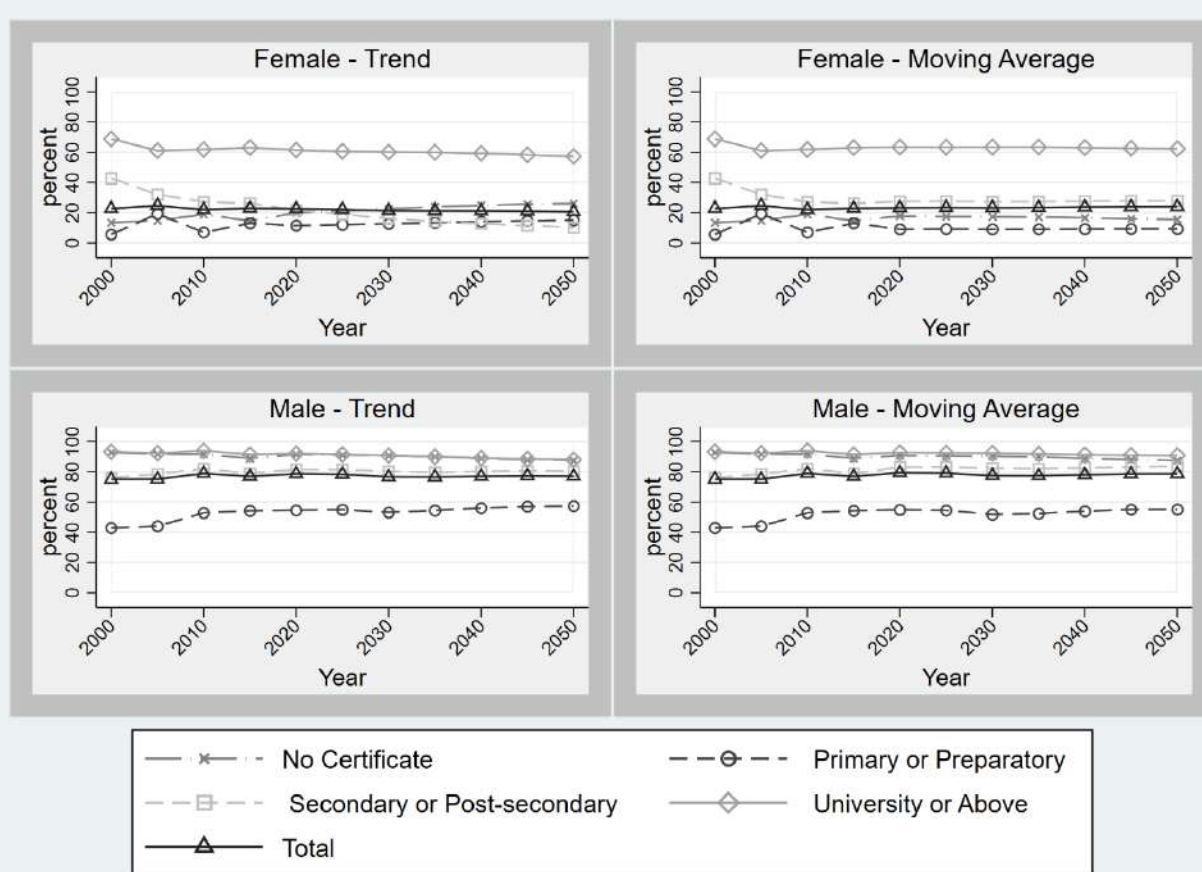
The seeming paradoxical stagnation, if not decline in female participation in Egypt, is part of a broader regional phenomenon that has come to be known as the “MENA paradox.” The main explanation of the paradoxical overall trend is that the participation of more educated women, such as those with university and secondary/post-secondary degrees has been declining as their share of the working age population has been rising. This decline has been attributed to the long-run reduction in public sector hiring and the relatively inhospitable environment in the private sector, particularly for married women (Assaad, Hendy, Lassassi, & Yassin, 2018). The trend projection indicate a continued decline of participation among educated women, and thus slightly declining overall female participation rates. The moving average projection assumes the decline will stop and education-specific participation rates will stabilize at the moving average of the latest five years in the data, producing a slightly rising overall female participation rate.

The participation of females with secondary/post-secondary degrees has been falling substantially from 2000 to 2015, going from 41% to 25%. This declining trend is essentially due to the suspension of hiring of workers with these credentials in the government, a sector that educated female workers are highly dependent on. In the absence of government jobs many women with these credentials simply prefer to stay out of the labor force rather than take up informal jobs in

the private sector like their male counterparts. The trend projection method, shown in Figure 10 assumes a continuation of the declining participation trend for secondary/post-secondary educated women, leading to projected participation rates among this large and growing segment of the female population of just 10% by 2050.

If this trend is interrupted, as assumed in the moving average projection method, the participation rates of this group would stabilize at 28% from 2020 to 2050, which is quite a large difference. Both projection methods project relatively stable participation rates among secondary/post-secondary educated males, the largest group in the working age population (as shown in Figure 8. The trend projection methods projects this group's participation to start out at 82% in 2020 and then decline to 80% by 2030 and remain at that level through 2050. The moving average method projects their participation to remain stable at about 83%.

**Figure 10. Estimates and Projection of Participation Rates (Percentage) by Gender and Educational Attainment and Projection Method, 2000-2050**



Source: Author's calculations based on data from labor force surveys from 2000 to 2017 and projections based on these data using the methodology described in Appendix 1.

Similarly, participation rates among university educated women fell from 69% in 2000 to 61% in 2005, only to rise slightly to 63% in 2015. An extension of this trend would result in a falling participation rate for this group as well to about 57% by 2050. The moving average method

projects stable participation rates for university educated women at 63% from 2015 to 2045 and then a slight decline to 62% by 2050. Male university graduates also had declining participation trends, although from very high levels. The trend method projects that their participation will continue declining from 92% in 2020 to 88% in 2050. The moving average method also projects a decline, but at a somewhat slower rate from 93% in 2020 to 91% in 2050.

Participation among males with no education is also declining over time under both projection scenarios. This suggests that the decline is not due to the decline of the underlying age-specific participation rates, but to the change in the age composition of this group to older ages as younger groups gradually attain higher education levels.

The two projection methods produce relatively similar overall participation rates, so the overall labor force projections they produce will also be similar. However, they produce different participation trends by educational level, so the educational composition of the projected labor force they result in may be slightly different. As mentioned above, neither of the methods considers a scenario where participation rates increase over time, since this has not been the recent trend and there is no evidence in past data for such a scenario. Nevertheless, improved labor market prospects could help pull more people, especially educated women, into the labor force.

#### **4. Projecting the Size and Composition of the Labor Force through 2050**

With projections of the size and composition of the working age population and of the age, sex and education-specific participation rates, I am now in a position to project the size and composition of the labor force through 2050.

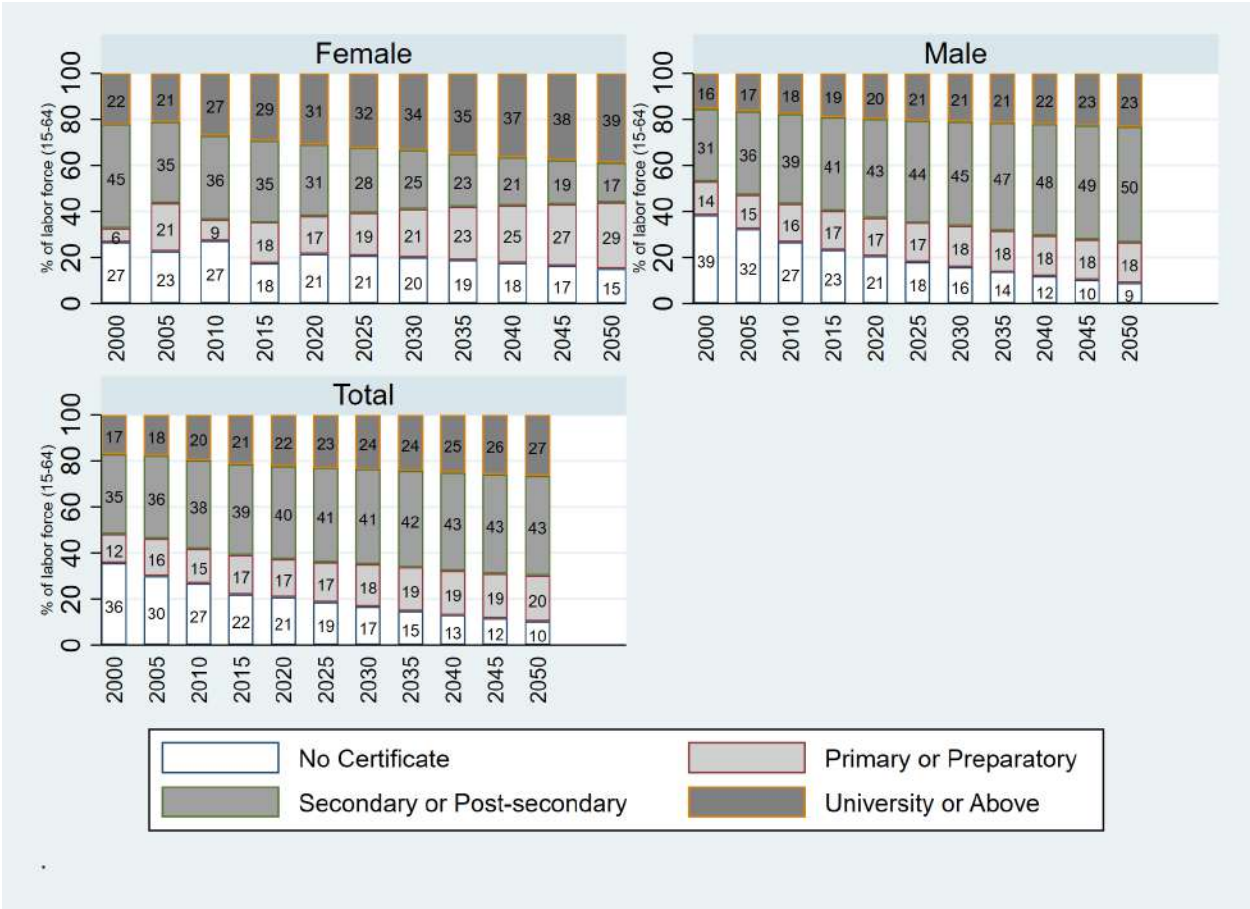
Since I have two alternative projections of participation rates, I will also have two alternative projections of the labor force. As shown in Table 3, these two alternatives are identical until 2015 and then diverge slightly from that point on. However, by 2050, the overall labor force projection differs only by 2.5 million individuals, or about 5%, with two thirds of the difference coming from the female labor force projection. Because the trend projection assumes that labor force participation of women with secondary/post-secondary education will continue to fall, it produces much lower estimates of women with these credentials in the labor force. This results in about 1.6 million fewer women in the labor force by 2050 compared to the moving average projection. In the results below, I show results from both alternatives on the same chart. In some cases, when the results get too crowded, I only show the results from the moving average projection.

As Figure 11 shows, the distribution of the labor force by education is very similar across the two projection methods for men. Both methods project the share of the male labor force with secondary/post-secondary degrees to be about 50% by 2050 and the share of those with university and higher degrees to be 23-24%. However, the distribution of the labor force by educational attainment for women is quite different across the two methods. The trend method projects the share of women with secondary/post-secondary degrees to be only 17% by 2050, compared to 41% with the moving average method. The proportion of the female labor force with university degrees and above is projected to be about the same in the two methods: 39% in the trend method

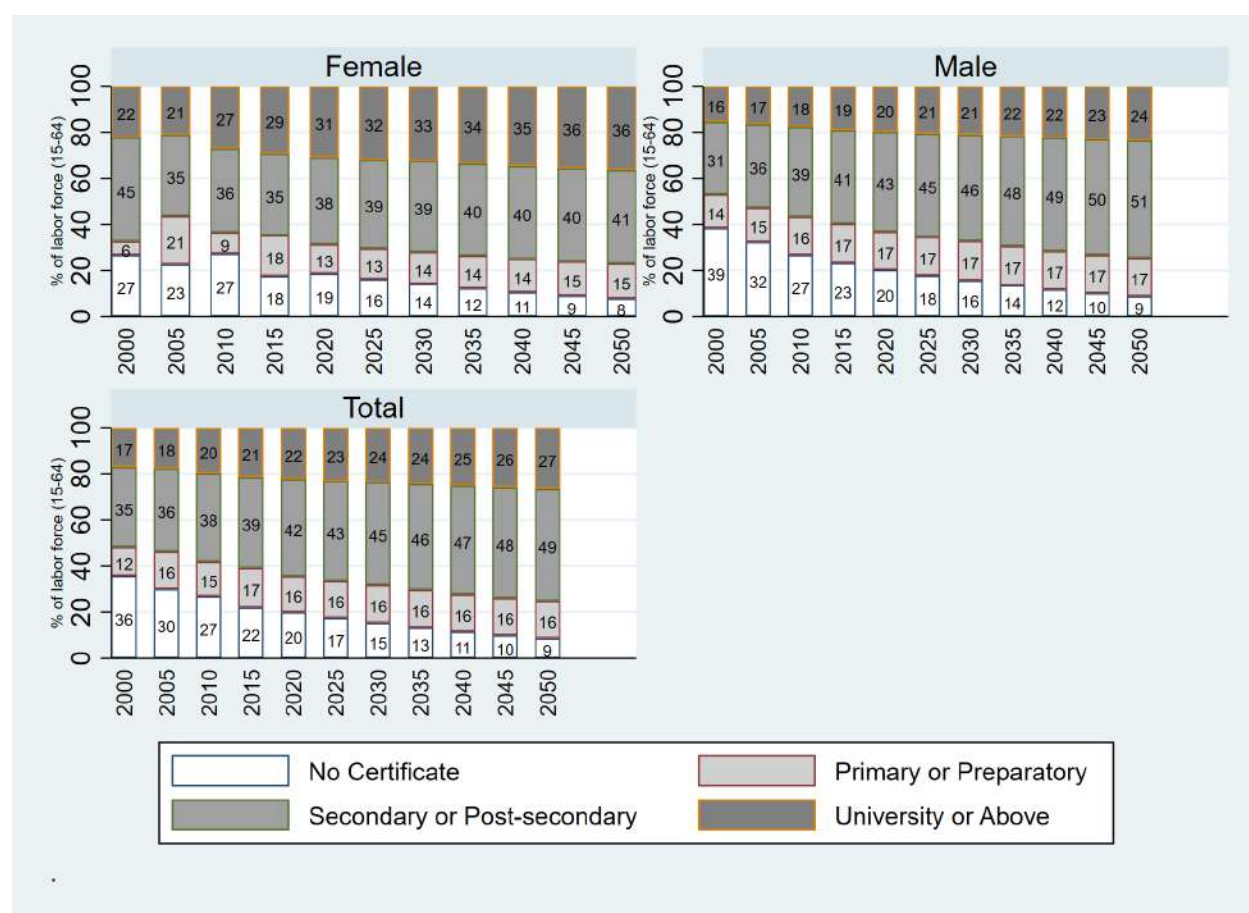
and 36% in the moving average method. Thus, it is primarily in the size of the female labor force with secondary/post-secondary degrees where the difference lies.

**Figure 11. Estimates and Projections of the Distribution of the Labor force by Educational Attainment and Gender (Percentage), 2020-2050, Trend and Moving Average Projection Methods**

A. Trend Projection Method



## B. Moving Average Projection Method



Source: Author's calculations based on data from labor force surveys from 2000 to 2017 and projections based on these data using the methodology described in Appendix 1.

I move next to the estimated and projected change in the labor force and its various components from 2000 to 2050. As before, I characterize the change in both absolute and relative terms. I show projections from both the trend and moving average methods, noting that the projection from the moving average method is almost always the higher one.

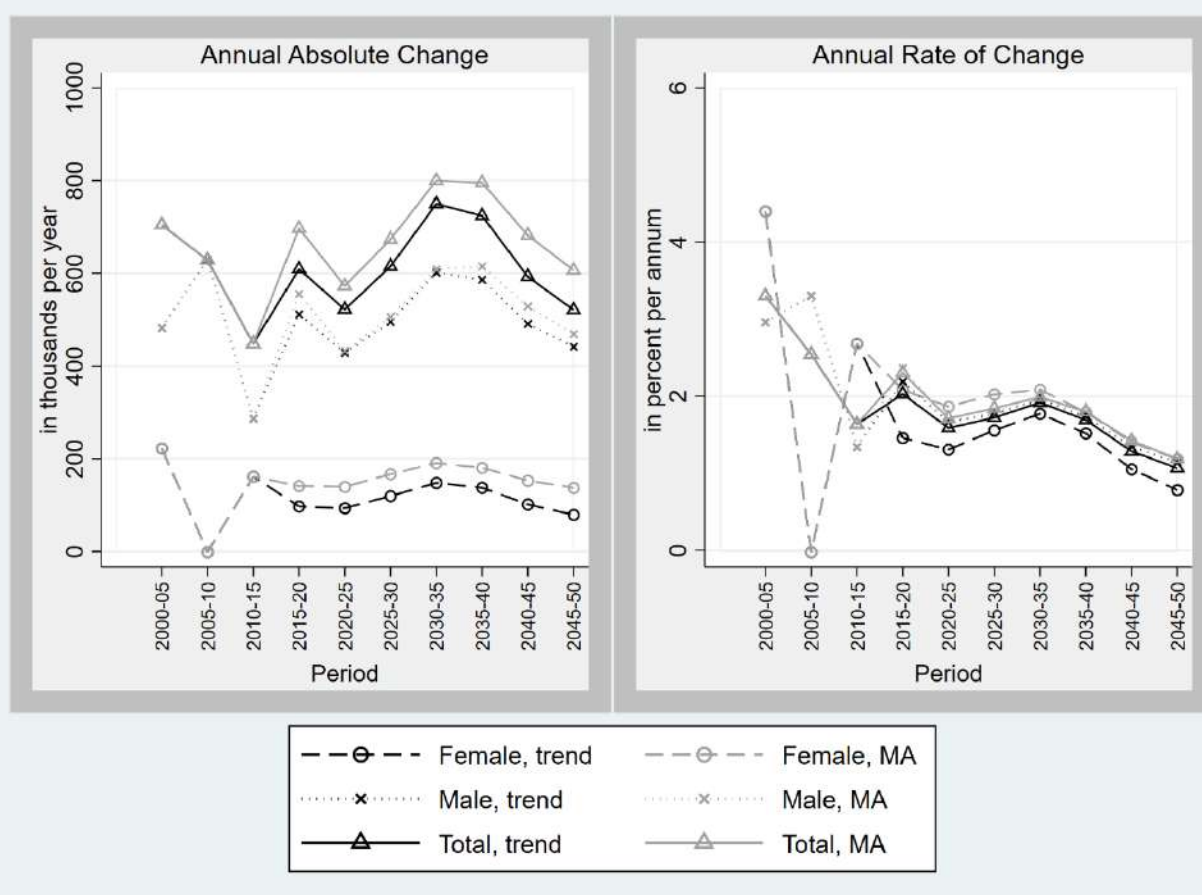
As shown in Figure 12, the annual increment to labor force fell steadily from 705,000 per year in 2000-05 to 450,000 in 2010-15. It is projected to have climbed back up to between 610 and 700 thousand per year from 2015 to 2020. After another 5 years of relative calm from 2020 to 2025, the annual increment to the labor is projected to increase substantially from 2025 to 2035. By the 2030-35 period, the annual increment to the labor force will have increased to between 750 and 800 thousand per year, depending on the projection method used.

The demographic pressures on labor supply during that period will exceed those experienced in the early 2000s, when the peak of the youth bulge was entering the labor force. The annual increment to the labor force will then stabilize and decline thereafter to reach somewhere from 520 and 600 thousand per year by the 2045-50 period. The bulk of the annual increment is made up of



males, whose projections are fairly similar according to the two projection methods. At the highest point (2030-40) women will only make up from 150,000 to 190,000 additional workers per year, compared to 615,000 for men.

**Figure 12. Estimated and Projected Annual Absolute Change (Thousands per Year) and Annual Rate of Change (Percent per Annum) in the Labor Force by Sex and Projection Method, 2000-2050**



Source: Author's calculations based on data from labor force surveys from 2000 to 2017, United Nations Department of Economic and Social Affairs Population Division (2019), and projections based on these data using the methodology described in Appendix 1.

#### 4.1. Labor force growth rates

In terms of relative rates of change, the growth of the labor force has generally been decelerating since 2000, falling from 3.3% p.a. in 2000-05 to 1.6% p.a. in 2010-15. After climbing briefly to about 2.2% p.a. in 2015-2020, it will stabilize at around 2% p.a. from 2020 to 2035 and then begin declining to 1.2% p.a. by 2045-50. The male and female components of the labor force are projected to increase at about the same rate, with the trend projection producing somewhat lower labor force growth rates for women compared to men and the moving average method producing somewhat higher rates.

## **4.2. Labor force growth by age group**

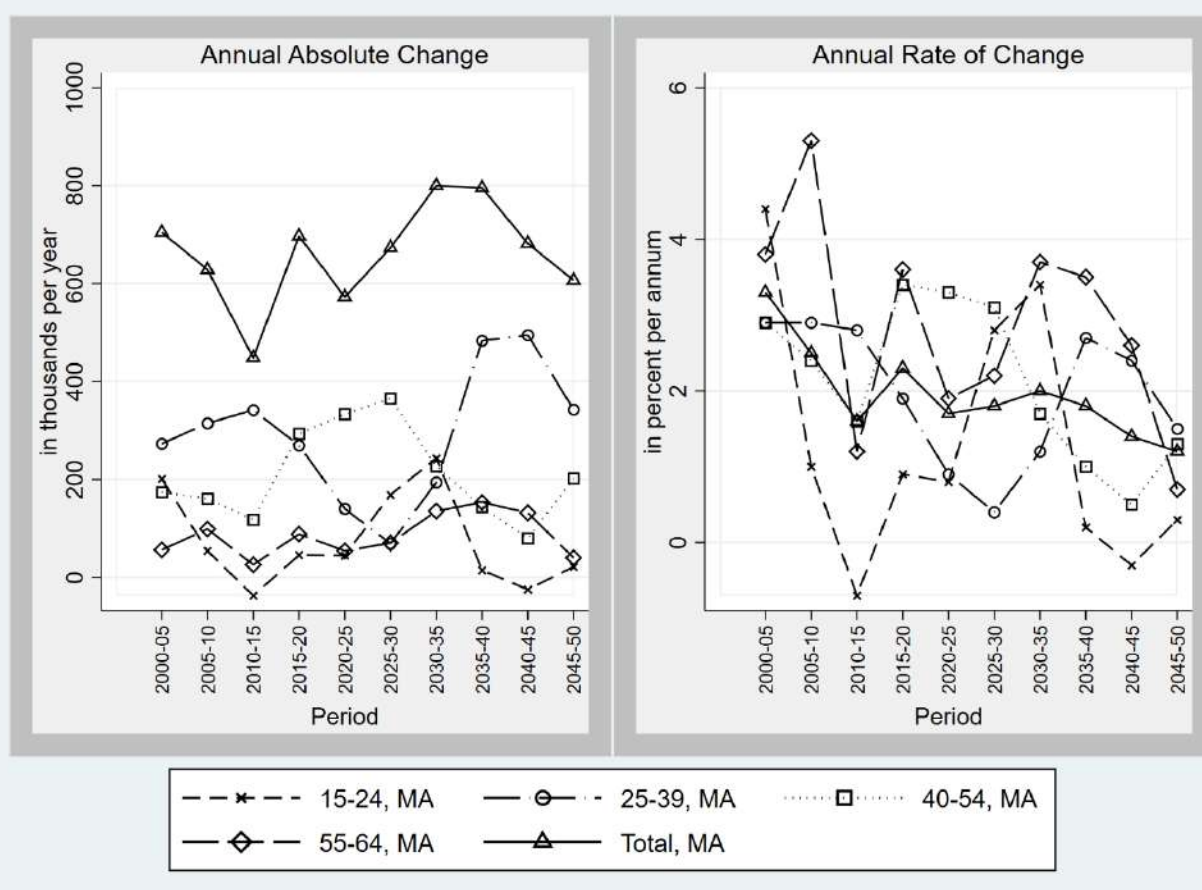
I move next to the change in the labor force by age group shown in Figure 13. I limit this analysis to the moving average projection method, noting that the age patterns are similar for the trend projection. The largest annual increment to the labor force in the period 2000 to 2015 was for young adults aged 25-39, whose annual increment increased from 273,000 in 2000-05 to 342,000 thousand in 2010-15. These constitute the youth bulge generation born in the early 1980s and who entered the workforce in the late 1990s and early 2000s (Assaad & Roudi-Fahimi, 2007; Krafft & Assaad, 2014). Conversely, the annual increment of 200,000 of youth aged 15-24 in 2000-05 turned into an annual decline of 37,000 in 2010-15. It is precisely this dramatic decline in the number of additional youths every year that accounted for the rapid decline in the unemployment rate in recent years (shown in Figure 2) despite falling employment to population ratios.

The net increase in youth every year is projected to have recovered somewhat in 2015-20, but only to 45,000 per year, out of an overall annual increment of 700,000. Starting in 2015-20, the number of young adults added annually will start falling sharply from 342,000 to 68,000 by 2025-30. During that period, the age group that will make up the largest increment to the labor force are prime age workers (40-54 year-olds). Nevertheless, starting in 2025-30, the net increment in youth aged 15-24 will start climbing substantially to reach 243 thousand per year in 2030-35. This increase will renew the demographic pressure on the labor market and on the demand for jobs. This future youth bulge will be then be reflected in a bulge in the number of young adults ten years later.

From a relative change point of view, the fastest rates of growth in the past two decades were recorded for older workers 55-64, followed by young adults. However, by 2025-30, the fastest growth rates will again be for youth and these rates will remain high into 2030-35. After that overall rates of labor force growth are projected to decline, led by rates of growth for youth. In short, a substantial youth bulge is expected in the labor force in the 2025-2035 period, as the echo generation makes its way to working age, mirroring the substantial pressures that their parents' generation—the original youth bulge generation—put on Egyptian labor markets in the early 2000s (Krafft & Assaad, 2014; Krafft, Assaad, & Keo, 2019).



**Figure 13. Estimated and Projected Average Annual Absolute Change (Thousands per Year) and Average Rate of Change (Percent per Annum) of the Labor Force by Age Group, 2000-2050 (Moving Average Projection Method)**



Source: Author's calculations based on data from labor force surveys from 2000 to 2017, United Nations Department of Economic and Social Affairs Population Division (2019), and projections based on these data using the methodology described in Appendix 1.

#### 4.3. Labor force Growth by Educational Attainment

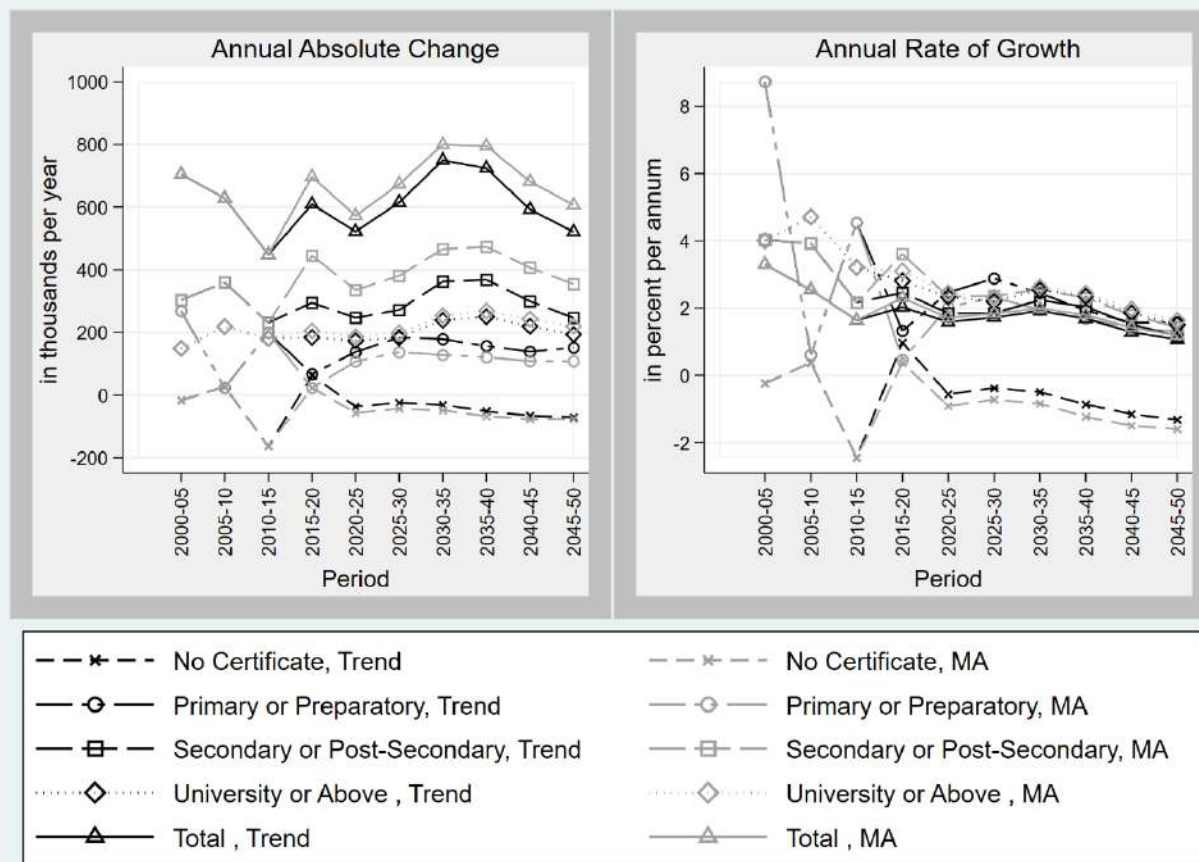
Finally, I turn to the change in the labor force by educational attainment, shown in Figure 14. From 2015-2020 onward, the dark colored lines reflect the trend projection method and the light-colored lines reflect the moving average projection method. The largest increment to the labor force is composed of secondary/post-secondary graduates, who added nearly 36,000 to the labor force every year in the 2005-10 period. They have continued to be the largest group in terms of absolute size, adding from 300 to 450 thousand in 2015-2020 depending on the projection used. At the peak in 2035-40, they will add between 370 and 475 thousand per year to the labor force, or between 47% and 60% of the annual increment. This is the component that has the greatest spread between the trend and moving average projections methods because it depends strongly on the assumption made about how the participation of women with secondary degrees will evolve. If their participation continues to drop, as the trend projection method assumes, the lower bound

numbers will be realized. If, on the other hand the decline in their participation stops, as the moving average projections method assumes, the upper bound numbers will be realized.

The second largest group in terms of annual increment to the labor force is university graduates. They added about 220,000 per year in 2005-2010 (about 34% of the total). That annual increment will continue at more or less that level through 2035-40. Primary and preparatory graduates will also add about 140,000 per year starting in 2020-25, but the annual increment of those without certificates added to the labor force every year will actually be negative and increasingly so through 2050.

In relative terms, the fastest rate of growth in 2015-20 was among secondary/post-secondary graduates (3.6% p.a.) according to the moving average method, and among university graduates (2.8% p.a.) if one believes the trend projection method. University graduates will be the fastest growing component in 2020-25 as well, but in 2025-30, the component comprising primary and preparatory graduates will grow faster, but only temporarily. University graduates will then resume being the fastest growing component through 2050, but not by much.

**Figure 14. Estimated and Projected Average Annual Absolute Change (Thousands per Year) and Average Rate of Change (Percent per Annum) of the Labor Force by Educational Attainment and Projection Method, 2000-2050**



Source: Author's calculations based on data from labor force surveys from 2000 to 2017, United Nations Department of Economic and Social Affairs Population Division (2019), and projections based on these data using the methodology described in Appendix 1.

## **5. Employment Requirements to Meet the Needs of a Growing Labor Force**

I will rely in the following discussion more heavily on the higher labor force projections produced by the moving average method, since as I will show below, the declining participation trends captured by the trend method were primarily due to discouragement rather than a lack of desire and availability to join the workforce. I consider the moving average projection, although higher, to still be a conservative estimate of the growth of the labor force in the next three decades. Improved employment prospects could pull even more people in the labor force, causing even these projections to be exceeded.

The moving average projection method projects the labor force as a whole to grow by 1.9% to 2% in the upcoming decade, which will translate into the need to create 575,000 jobs per year on average in the first half of the decade and 675,000 jobs per year in the second half just to keep pace with the growth of the labor force. This number will rise to 800,000 jobs per year in the 2030s. Even higher job creation numbers would be needed to reduce the current stock of unemployed, and discouraged workers.

Although published unemployment rates, which require “active search” for a person to be counted as unemployed, have been falling in recent years, I attribute this decline to the slow growth of the youth and young adult populations, as well as to increased discouragement. Many young people, and especially young women, are no longer actively searching and therefore no longer considered part of the standard labor force and standard unemployment, although they desire to work and are available for it.

Before I discuss the discouragement phenomenon in greater detail, it is useful to review official data on unemployment, which excludes discouraged job seekers. Table 4 shows the size of the labor force and unemployment, and the unemployment rate by sex and education from 2000 to 2018 based on official labor force survey data.<sup>5</sup> The overall unemployment rate has increased from 2000 to 2005, a period of substantial demographic pressure resulting from the insertion of the youth bulge generation into the labor market. It decreased from 2005 to 2010 due to improved economic performance and an attenuation of demographic pressures. It increased again from 2010 to 2015 in the aftermath of the January 25<sup>th</sup> revolution and the economic crisis that ensued and then decreased again from 2015 to 2018, but mostly due to subsiding labor supply pressures and increased discouragement, as I will discuss below.

As shown in Table 4, standard unemployment rates were three times higher among women than they were among men (21.4% vs 6.8% in 2018) and they did not decline as much since 2015.

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<sup>5</sup> Although some aggregated data are available for 2019, the detailed results for 2019 are not yet published. Also note that the labor force figures in the table may be slightly different from the estimates I presented earlier for the same year due to some smoothing over age and education groups that I undertook in my estimation approach.

Unemployment among women is particularly high among university-educated women, but this is only because women with secondary and post-secondary degrees appear to be leaving the labor force in droves or not entering in the first place out of discouragement. The size of this group in the labor force fell by 18% from 2015 to 2018, whereas the number of university-educated women in the labor force increased by 9%. This is the same phenomenon as the sharp decline in the labor force participation of women with secondary and post-secondary degrees I noted above. Interestingly discouragement is so great among this group that the number unemployed among them decreased at an even higher rate than the labor force (42% in 3 years), leading to a drop in the standard unemployment rate from 33.6% in 2015 to 23.5% in 2018.

While official data do not provide direct information about discouragement and the discouraged unemployed, there is considerable evidence from unofficial sources that discouragement has increased substantially, especially among women. While the standard rate of unemployment, which requires “active search,” declined from 8.7% in 2012 to 8.2% in 2018 according to the Egypt Labor Market Panel Survey, the broad rate of unemployment, which includes discouraged job seekers, increased from 9.6% to 11.1% (Krafft, Assaad, & Keo, 2019). This suggests that discouraged unemployment increased three-fold from 2012 to 2018 from 0.9% to 2.9% of the labor force. Almost all of the increase in discouragement during this period was among women. Discouraged unemployment went from 0.5% to 0.9% of the male labor force, whereas it increased from 2.1% to 8.3% of the female labor force.<sup>6</sup> Thus in the absence of discouragement, the female labor force would have been 8.3% larger than it was in 2018.

The moving average projections of the labor force have some built-in discouragement component because they build on actual participation in the last five years of data. However, they at least keep the level of discouragement constant going forward. A conservative estimate of employment growth that would keep both current unemployment and discouragement rates constant during the upcoming decade is the 1.9%-2% per year I discussed above. However, *to eliminate both unemployment and discouragement in Egypt by the end of the decade, I estimate that employment would have to grow at an average 2.7% per year.* In what follows I assess the likelihood of such employment growth rates.

Although the latest episode of economic recovery in Egypt has resulted in relatively weak employment growth, some studies suggest that the long run elasticity of employment to GDP growth in Egypt could be as high as about 0.9 (Assaad, AlSharawy, & Salemi, 2019). This means that if this long-run elasticity could be realized again, an average annual GDP growth rate of 3% p.a. would be needed to maintain the necessary rates of employment growth. Other estimates of the elasticity of employment to GDP growth for Egypt and the region are substantially lower—for example, IMF (2017)<sup>7</sup> estimates Egypt’s employment-growth elasticity at 0.58 between 1991 and 2017—and Kapsos (2017) puts the figure for North Africa at 0.5. At the latter elasticity, which would allow for some productivity growth, an employment growth rate of 2.7% p.a. would require

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<sup>6</sup> Calculated from data provided in Krafft, Assaad, & Keo (2019).

<sup>7</sup> IMF. (2017). Arab Republic of Egypt: Selected Issues.

a steady GDP growth rate of 5.4% p.a. The IMF suggests that an average GDP growth rate of about 6 percent a year would be consistent with absorbing new entrants and reducing unemployment by about 30 percent from the 12.2 percent unemployment rate of 2017. That would still leave unemployment at about 8 percent of the labor force; to bring it down to the 3–5 percent that would widely be considered “full employment” would require a higher rate of GDP growth. As matters have turned out, Egypt’s GDP growth has not reached 6 percent since that time, and of course Covid-19 has played havoc with all outcomes.

## **6. Conclusions**

I began this analysis with a seeming paradox, falling unemployment rates in recent years despite also falling overall employment to population ratios. I interpreted this seeming paradox as the result of a temporary stage in Egypt’s demographic development in the second half of the 2010s when the growth of the youth and young adult populations was at its lowest. The youth bulge generation, born in the early 1980s, had already reached adulthood by that time and had already been integrated into the labor market. With unemployment in Egypt being a phenomenon that primarily involves educated youth and young adults entering the labor force for the first time, the reduced demographic pressure translated into lower unemployment rates. On top of this, I also saw a trend of falling labor force participation rates among educated women, especially those with secondary and post-secondary educations, further reducing pressure on labor supply. In previous generations these women would have obtained work in the large public sector, but as the public sector drastically reduced hiring over the past three decades, many of these women simply drop out of the labor force after a period of unemployment prior marriage (Assaad, Hendy, Lassasi, & Yassin, 2018). A large fraction of these women with intermediate levels of education would like to work and are available for it but are no longer actively seeking it out of discouragement. Given the current measures of the labor force and unemployment used in Egypt, these discouraged workers are classified as out of the labor force. In fact, at current rates of discouragement, the female labor force in 2018 would have been 8.3% larger.

The diminution of demographic pressures on labor supply is only a temporary phenomenon. I project that the growth of the working age population will accelerate significantly in 2025-2030 as the echo generation, those born between 2006 and 2014, reaches working age. This echo was particularly large because rising fertility rates from 2008 to 2014 compounded the population momentum of the earlier youth bulge. Although the peak growth rate in the working age population will be reached in 2025-30, demographic pressures on the labor market will continue through 2035. In particular, the growth of youth (15-24) entering the labor force will accelerate substantially from 1.1% p.a. in 2020-25 to 3.1% p.a. in 2025-30 to 3.8% p.a. in 2030-35. If efforts to substantially increase job creation in the Egyptian economy are not successful by then, this new youth bulge will result in much higher rates of youth unemployment than we see today.

The bulk of new entrants among the echo generation will be educated. Nearly 50-60% of them will have secondary or post-secondary degrees and about a third will have university degrees or above. If current trends continue, they will be mostly male, with young men making up between

75% and 80% of labor market entrants. The number (and proportion) of women will crucially depend on what happens to the trend in labor force participation among women with secondary/post-secondary degrees, and to a lesser extent among those with university degrees. Participation among this large and growing group of women had been declining in recent years. If that trend continues, the proportion of women among new entrant will be under 20% at the peak in 2030-35. If the participation trend flattens out, their proportion could be as high as 25%. If the trend reverses and starts rising, a scenario I have not explicitly considered here, their proportion could be even higher. This will very much depend on the quality of opportunities provided in the Egyptian economy, because, in the case of women in Egypt, these opportunities not only determine the unemployment rate, but also the labor force participation rate through its effect on discouragement. Most crucially, it depends on the opportunity structure for educated married women. Currently these opportunities are almost exclusively in a shrinking public sector, with the private sector being particularly inhospitable to married women. If this changes, we can hope to stabilize the participation rates of educated women and maybe even reverse their decline. If current patterns continue, female participation rates will continue to decline and eventually, as the second youth bulge hits, both male and female unemployment rates are bound to rise again.

The problem with attempting to make definitive projections of labor force or GDP growth at the present time is that we remain ignorant of many key matters. We do not know whether the number of persons infected by the virus is actually larger than the announced number, because testing for the virus in Egypt is much more limited than in the developed countries. Even in the latter, the number of persons who are infected but are asymptomatic is not known; in fact, the head of the US Centers for Disease Control and Prevention has said that the number of Americans infected could be 10 times the reported number.<sup>8</sup> We do not know how long the virus will persist. We do not know whether there will be a “second wave” of the virus. We do not know whether persons who have been infected and recovered have acquired a degree of immunity. We do not know whether or when it will be possible to develop a vaccination that will be effective, safe, affordable, and produced in the huge numbers required to immunize most of the world’s population. We do not know whether and how the virus will mutate, so that it might require an annual vaccination, as happens with the influenza virus. This may sound like a depressingly large number of “don’t knows,” but it reflects the reality of the times. It also means that under the present circumstances policymakers would find the projections in this paper very helpful indicators of trends and direction of major structural changes, and essential roadmaps that would enable them to identify and focus on some key issues.

The key questions concerning the future outlook that policymakers must take into account would include: (i) the conservative nature of the assumptions that underpin my projections of the labor force (as I have pointed out earlier); (ii) the uncertainty surrounding the participation rates for women (one would hope that conditions for female employment would improve over the next three decades, but it is virtually impossible to judge by how much they will improve and how many

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<sup>8</sup> The Washington Post, June 25, 2020.

women will be induced by these improvements to join the labor force, thus raising the growth of the labor force and the GDP growth required for full employment (in other words, will achieving success in one area raise the challenges in another); and (iii) whether the pattern of growth will result in the higher quality jobs that our increasingly educated workforce is aspiring to. Perhaps one should also add the great imponderable, namely (iv) whether the effects of the Covid-19 pandemic on undermining the principal drivers of Egypt's GDP growth—tourism, expatriate remittances, Suez Canal revenues, and exports—will persist into the long-term and be sufficiently serious as to significantly reduce the country's potential GDP growth rate.

For these reasons, perhaps policymakers should regard a GDP growth rate of about 6 percent a year as the *minimum* to attain, and, to allow for slippages, should aim for a rate that is somewhat higher, say, 6.5–7.0 percent. This compares with a real GDP growth rate of about 4.5 percent a year that the country averaged between 1965 and 2019. The country will have to make an effort to achieve the required rate, but *prima facie* it does not appear unattainable. One might also recall that in the periods of their most rapid growth, several of the East Asian countries, such as South Korea, Taiwan, Malaysia, Singapore, and Hong Kong maintained average GDP growth rates of 8–9 percent for two decades or so, while that for China frequently remained between 9 and 10 percent.

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**Table 1. Population Estimates and Projection by Sex and Age Group, 2000-2050 (in thousands)**

Sex	Age group	Year										
		2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Female	0-14	12,348	12,426	13,082	14,932	16,843	18,168	18,233	18,476	19,264	20,242	20,894
	15-24	6,821	7,827	8,108	8,122	8,331	8,889	10,617	12,061	12,124	12,024	12,381
	25-29	2,583	3,078	3,632	4,042	3,998	4,076	4,174	4,639	5,907	6,081	5,972
	30-59	9,682	11,131	12,703	14,765	16,944	18,863	20,606	22,166	23,733	26,077	28,156
	60-64	823	871	1,182	1,234	1,510	1,732	1,970	2,243	2,681	3,160	3,600
	15-64	19,909	22,907	25,625	28,163	30,782	33,560	37,366	41,109	44,446	47,343	50,108
	65+	1,925	2,093	2,249	2,631	3,006	3,565	4,230	4,991	5,861	6,976	8,344
	All	34,182	37,426	40,956	45,726	50,631	55,293	59,829	64,576	69,571	74,561	79,346
Male	0-14	13,022	13,135	13,862	15,864	17,869	19,244	19,273	19,524	20,355	21,391	22,085
	15-24	7,133	8,212	8,480	8,481	8,787	9,412	11,255	12,757	12,788	12,679	13,055
	25-29	2,541	3,189	3,749	4,154	4,096	4,271	4,404	4,899	6,246	6,399	6,283
	30-59	9,736	11,170	12,884	14,926	17,048	18,924	20,805	22,547	24,233	26,780	29,105
	60-64	760	789	1,112	1,206	1,452	1,647	1,784	2,025	2,530	2,991	3,366
	15-64	20,169	23,359	26,226	28,768	31,383	34,253	38,248	42,228	45,798	48,850	51,809
	65+	1,459	1,604	1,718	2,086	2,451	2,938	3,481	4,013	4,627	5,554	6,716
	All	34,650	38,098	41,806	46,718	51,703	56,435	61,002	65,765	70,780	75,795	80,610
All	0-14	25,370	25,561	26,944	30,796	34,713	37,412	37,506	37,999	39,618	41,632	42,979
	15-24	13,954	16,038	16,589	16,603	17,118	18,300	21,871	24,818	24,913	24,704	25,436
	25-29	5,124	6,267	7,381	8,196	8,095	8,347	8,578	9,538	12,153	12,480	12,255
	30-59	19,418	22,301	25,587	29,691	33,992	37,787	41,411	44,713	47,967	52,858	57,261
	60-64	1,583	1,660	2,294	2,440	2,961	3,379	3,754	4,269	5,210	6,151	6,965
	15-64	40,078	46,266	51,851	56,930	62,165	67,813	75,614	83,337	90,243	96,193	101,918
	65+	3,384	3,697	3,967	4,717	5,456	6,503	7,711	9,004	10,489	12,530	15,060
	All	68,832	75,524	82,762	92,443	102,334	111,728	120,831	130,340	140,350	150,355	159,957

Source: UN (2019)

Note: Projections are based on UN Population Division's Medium Variant Projection.

**Table 2. Estimates and Projections of Working Age Population (15-64) by Sex and Educational Attainment, 2000-2050 (in thousands)**

Sex	Educational Attainment	Year										
		2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Female	No Certificate	8,967	8,609	8,195	7,762	7,517	7,287	7,126	6,936	6,708	6,425	6,074
	Primary or Preparatory	4,708	6,125	7,418	8,674	9,944	11,333	13,228	15,023	16,581	18,025	19,532
	Secondary or Post-secondary	4,768	6,230	7,534	8,739	9,844	10,991	12,558	14,033	15,349	16,455	17,496
	University or Above	1,466	1,942	2,477	2,987	3,477	3,950	4,454	5,117	5,809	6,439	7,007
	All	19,909	22,907	25,625	28,163	30,782	33,560	37,366	41,109	44,446	47,343	50,108
Male	No Certificate	6,271	6,187	6,051	5,779	5,565	5,336	5,154	4,963	4,722	4,429	4,121
	Primary or Preparatory	5,112	5,959	6,437	6,968	7,526	8,312	9,769	10,560	11,081	11,587	12,294
	Secondary or Post-secondary	6,261	8,047	9,828	11,401	12,975	14,587	16,563	18,989	21,218	23,099	24,802
	University or Above	2,526	3,166	3,910	4,620	5,317	6,019	6,762	7,717	8,777	9,735	10,592
	All	20,169	23,359	26,226	28,768	31,383	34,253	38,248	42,228	45,798	48,850	51,809
All	No Certificate	15,238	14,795	14,246	13,541	13,082	12,623	12,280	11,899	11,430	10,854	10,195
	Primary or Preparatory	9,820	12,084	13,855	15,642	17,470	19,644	22,997	25,583	27,661	29,612	31,826
	Secondary or Post-secondary	11,029	14,278	17,362	20,139	22,819	25,578	29,121	33,021	36,567	39,554	42,298
	University or Above	3,991	5,109	6,387	7,607	8,794	9,968	11,216	12,834	14,585	16,173	17,599
	All	40,078	46,266	51,851	56,930	62,165	67,813	75,614	83,337	90,243	96,193	101,918

Source: Author's calculations based on data from ELMPS 1998, 2006, 2012, 2018 (OAMDI 2019) and UN (2019)

Note: Projections are based on UN Population Division's Medium Variant Projection.

**Table 3. Estimates and Projections of Labor Force by Sex and Educational Attainment, 2000-2050 (in thousands)**

A. Trend Projection

Sex	Educational Attainment	Year										
		2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Female	No Certificate	1,212	1,276	1,540	1,134	1,488	1,537	1,603	1,657	1,670	1,643	1,581
	Primary or Preparatory	264	1,178	519	1,136	1,149	1,379	1,675	2,011	2,339	2,632	2,943
	Secondary or Post-secondary	2,039	1,995	2,040	2,283	2,149	2,080	2,035	1,995	1,968	1,898	1,789
	University or Above	1,008	1,187	1,531	1,884	2,137	2,395	2,677	3,067	3,442	3,754	4,010
	All	4,524	5,636	5,629	6,437	6,924	7,391	7,989	8,730	9,418	9,927	10,323
Male	No Certificate	5,821	5,674	5,544	5,132	5,091	4,860	4,673	4,465	4,194	3,893	3,602
	Primary or Preparatory	2,191	2,621	3,398	3,779	4,102	4,562	5,188	5,745	6,203	6,605	7,053
	Secondary or Post-secondary	4,752	6,312	8,066	8,978	10,587	11,888	13,291	15,145	17,013	18,580	19,921
	University or Above	2,355	2,923	3,671	4,223	4,891	5,502	6,137	6,941	7,818	8,603	9,315
	All	15,120	17,530	20,678	22,112	24,671	26,813	29,289	32,296	35,227	37,681	39,891
All	No Certificate	7,033	6,950	7,084	6,267	6,579	6,397	6,276	6,122	5,863	5,536	5,183
	Primary or Preparatory	2,455	3,799	3,916	4,915	5,252	5,942	6,863	7,757	8,542	9,237	9,995
	Secondary or Post-secondary	6,791	8,308	10,106	11,261	12,735	13,969	15,326	17,139	18,980	20,478	21,710
	University or Above	3,364	4,110	5,202	6,107	7,028	7,897	8,814	10,009	11,259	12,358	13,325
	All	19,643	23,166	26,308	28,549	31,594	34,204	37,279	41,026	44,645	47,608	50,213

## Moving Average Projection

Sex	Educational Attainment	Year										
		2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Female	No Certificate	1,212	1,276	1,540	1,134	1,336	1,273	1,233	1,184	1,112	1,028	944
	Primary or Preparatory	264	1,178	519	1,136	903	1,044	1,202	1,367	1,527	1,673	1,815
	Secondary or Post-secondary	2,039	1,995	2,040	2,283	2,701	3,024	3,420	3,832	4,231	4,563	4,857
	University or Above	1,008	1,187	1,531	1,884	2,204	2,500	2,821	3,245	3,662	4,032	4,367
	All	4,524	5,636	5,629	6,437	7,143	7,841	8,675	9,629	10,531	11,296	11,983
Male	No Certificate	5,821	5,674	5,544	5,132	5,048	4,827	4,651	4,458	4,193	3,895	3,601
	Primary or Preparatory	2,191	2,621	3,398	3,779	4,127	4,524	5,051	5,526	5,971	6,370	6,770
	Secondary or Post-secondary	4,752	6,312	8,066	8,978	10,787	12,141	13,650	15,566	17,536	19,237	20,715
	University or Above	2,355	2,923	3,671	4,223	4,929	5,564	6,235	7,081	8,005	8,847	9,610
	All	15,120	17,530	20,678	22,112	24,890	27,056	29,586	32,631	35,705	38,350	40,696
All	No Certificate	7,033	6,950	7,084	6,267	6,384	6,100	5,884	5,642	5,305	4,923	4,545
	Primary or Preparatory	2,455	3,799	3,916	4,915	5,030	5,568	6,253	6,893	7,498	8,043	8,585
	Secondary or Post-secondary	6,791	8,308	10,106	11,261	13,488	15,165	17,070	19,399	21,766	23,800	25,572
	University or Above	3,364	4,110	5,202	6,107	7,132	8,063	9,056	10,326	11,667	12,879	13,977
	All	19,643	23,166	26,308	28,549	32,034	34,896	38,262	42,260	46,237	49,645	52,678

Source: Author's calculations based on data from ELMPS 1998, 2006, 2012, 2018 (OAMDI 2019), CAPMAS Labor Force Surveys 2000-2017, and UN (2019)

Note: Projections are based on UN Population Division's Medium Variant Projection.

**Table 4. Labor Force, Unemployment (in thousands) and Unemployment Rate (%) by Sex and Educational Attainment, 2000-2018**

Sex	Educational Attainment		2000	2005	2010	2015	2018
Female	No Certificate	Labor Force ('000s)	1,472	1,701	1,961	1,463	1,337
		Unemployment ('000s)	3	7	25	59	18
		Unemployment Rate (%)	0.2%	0.4%	1.2%	4.0%	1.4%
	Primary or Preparatory	Labor Force ('000s)	81	102	214	708	416
		Unemployment ('000s)	4	11	31	59	26
		Unemployment Rate (%)	4.4%	11.0%	14.4%	8.3%	6.2%
	Secondary or Post-secondary	Labor Force ('000s)	1,801	2,106	2,165	2,558	2,107
		Unemployment ('000s)	745	912	736	860	496
		Unemployment Rate (%)	41.4%	43.3%	34.0%	33.6%	23.5%
	University or Above	Labor Force ('000s)	873	1,106	1,699	1,977	2,163
		Unemployment ('000s)	203	326	572	638	752
		Unemployment Rate (%)	23.2%	29.4%	33.7%	32.3%	34.8%
	All	Labor Force ('000s)	4,228	5,014	6,040	6,705	6,023
		Unemployment ('000s)	954	1,256	1,363	1,616	1,291
		Unemployment Rate (%)	22.6%	25.0%	22.6%	24.1%	21.4%
Male	No Certificate	Labor Force ('000s)	7,257	6,953	6,839	6,489	5,726
		Unemployment ('000s)	26	56	61	264	117
		Unemployment Rate (%)	0.4%	0.8%	0.9%	4.1%	2.0%
	Primary or Preparatory	Labor Force ('000s)	1,063	1,450	2,477	3,211	3,985
		Unemployment ('000s)	12	46	51	290	155
		Unemployment Rate (%)	1.1%	3.2%	2.1%	9.0%	3.9%
	Secondary or Post-secondary	Labor Force ('000s)	4,418	5,948	7,593	8,577	9,301
		Unemployment ('000s)	528	761	515	960	699
		Unemployment Rate (%)	11.9%	12.8%	6.8%	11.2%	7.5%
	University or Above	Labor Force ('000s)	2,118	2,528	3,232	3,450	3,832
		Unemployment ('000s)	179	331	360	522	582
		Unemployment Rate (%)	8.4%	13.1%	11.1%	15.1%	15.2%
	All	Labor Force ('000s)	14,856	16,879	20,140	21,726	22,843
		Unemployment ('000s)	743	1,194	987	2,036	1,554
		Unemployment Rate (%)	5.0%	7.1%	4.9%	9.4%	6.8%
All	No Certificate	Labor Force ('000s)	8,729	8,654	8,799	7,952	7,064
		Unemployment ('000s)	29	63	86	323	135
		Unemployment Rate (%)	0.3%	0.7%	1.0%	4.1%	1.9%
	Primary or Preparatory	Labor Force ('000s)	1,144	1,552	2,691	3,918	4,400
		Unemployment ('000s)	15	57	82	349	181
		Unemployment Rate (%)	1.3%	3.7%	3.0%	8.9%	4.1%
	Secondary or Post-secondary	Labor Force ('000s)	6,219	8,054	9,758	11,134	11,407
		Unemployment ('000s)	1,273	1,673	1,251	1,820	1,195
		Unemployment Rate (%)	20.5%	20.8%	12.8%	16.3%	10.5%
	University or Above	Labor Force ('000s)	2,991	3,633	4,931	5,426	5,995
		Unemployment ('000s)	382	657	932	1,160	1,334
		Unemployment Rate (%)	12.8%	18.1%	18.9%	21.4%	22.3%
	All	Labor Force ('000s)	19,083	21,893	26,180	28,431	28,866
		Unemployment ('000s)	1,698	2,450	2,351	3,652	2,845
		Unemployment Rate (%)	8.9%	11.2%	9.0%	12.8%	9.9%

Source: CAPMAS, Labor Force Survey.

Notes: In 2000 and 2005, labor force and unemployment are estimated for the populations 12-64. In 2010 to 2018, labor force is estimated for the population 15+ and unemployment is estimated for the population 15-64.

## **Methodological Appendix**

In order to conduct labor force projections broken down by age and sex, I started with the UN Population Divisions medium variant projection for Egypt population by sex and age group (United Nations Department of Economic and Social Affairs Population Division, 2019) and then undertook the following steps:

1. Breakdown UN population projection by age and sex through 2050 into four educational categories
2. Project labor force participation rates for each age, sex and education group through 2050
3. Apply projected participation rates to projected working age population (15-64) in each and sex group to obtain labor force projections by age and sex group through 2050

I now present the details of each of these steps at a time.

### **1. Breakdown of UN population projections into four educational categories**

I first obtain the breakdown of the population 15-64 classified by sex and five-year age groups into 4 educational attainment categories from the cross-sectional data of the Egypt Labor Market Panel Survey for the 1988, 1998, 2006, 2012 and 2018 rounds. The four educational categories are (i) no certificate, (ii) basic, which include primary and preparatory (lower secondary) certificates, (iii) upper secondary and 2-year post-secondary certificates, (iv) university degrees and above.

The next step was to smooth the proportion of population in each educational category across age groups since these proportions should vary smoothly with age. Since proportions have an upper bound of 100 and lower bound of 0, I use an exponential trend to smooth the proportions that decline with age and a modified exponential trend to smooth the proportion that rise with age. This smoothing method was applied separately across genders and for each year of data. I then adjusted the smoothened proportion so that for each year and sex, the sum of the proportions across education groups for a particular age group adds up to 100 percent.

The smoothed proportions were then projected forward for each age and sex group again using an exponential trendline for declining proportions and a modified exponential trendline for rising proportions. Using these trendlines I obtained estimates and projections of the proportion of each and sex group in each of the four education categories for five-year intervals from 2000 to 2050. The projected values were again adjusted so that proportion add up to 100 percent for each year. The projected population in each of four educational categories by age and sex group from 2000 to 2050 was then obtained by multiplying these projected proportions by the UN Population Division's, low, medium and high variant projections by age and sex group. While I use the medium variant projections for all the results presented in the paper, the data set contains the low and high variants as well.

## **2. Projecting labor force participation rates for each age, sex and education group through 2050**

First, I used microdata data from the official labor force survey for the period 2000 to 2017 to estimate a logit model of labor force participation as a function of age, sex and educational attainment. The model included the main effect of sex, age group, education (in the same four categories), and survey year, but also interactions of year\*sex, year\*sex\*education, year\*sex\*age category, and year\*sex\*education\*age $\geq$ 25 dummy. The latter is to allow the participation rates of those still in school to differ from those who completed their education. I then use this model to predict participation rates by sex, age group and education for every year from 2000 to 2017.

The sex-age-education specific participation rates were then projected forward to 2050 using two distinct methods. The first is a trend method that fits an exponential trendline for declining participation rates and a modified exponential trendline for rising participation rates. This method simply assumes that trends in participation from 2000 to 2017 will continue forward in time. The second method is a moving average method that assumes that sex-age-education specific participation rates will take on the moving average value of the past five years. In this method, participation rates post-2017 essentially stabilize at their average value for the period 2012-2015. Given that participation rates in Egypt has a tendency to decline over time after correcting for age, sex and education, the moving average method will generally given slightly higher projections of participation than the trend method.

## **3. Applying projected participation rates to projected working age population (15-64) in each sex, age, and education group to obtain labor force projections by sex, age and education through 2050**

The final step was to multiply the population projections for the working age population 15-64 by sex, age and education with the corresponding participation rates in each year to obtain the labor force estimates and projections from 2000 to 2050 that I present in the paper. Recall, there are also 3 variants of population projections and two methods to project population. The estimates and projections are therefore obtained for 2 sexes, 4 education groups, 10 age groups, 3 variants, and 2 projection methods from 2000 to 2050 (every five years, adding up to 11 time period). This results in a data set containing population, participation rates and labor force for the resulting 5280 cells. This data set is available from the author upon request.