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Heterogeneity in returns to investment in education in Egypt¹

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Abstract

The paper estimates the rates of return to investment in education in Egypt, allowing for multiple sources of heterogeneity across individuals. The paper finds that, in the period 1998-2006, returns to education increased for workers with higher education, but fell for workers with intermediate education levels; the relative wage of illiterate workers also fell in the period. This change can be explained by supply and demand factors. On the supply side, the number of workers with intermediate education, as well as illiterate ones, outpaced the growth of other categories joining the labor force during the decade. From the labor demand side, the Egyptian economy experienced a structural transformation by which sectors demanding higher-skilled labor expanded. In Egypt, individuals are sorted into different educational tracks, creating the first source of heterogeneity. Second, the paper finds that large-firm workers earn higher returns than small-firm workers. Third, females have larger returns to education. Formal workers earn higher rates of return to education than those in the informal sector, which did not happen a decade earlier. And finally, those individuals with access to technology (as proxied by personal computer ownership) have higher returns.

JEL Classification: J24, J30, J31

Keywords: Egypt, Returns to Education, Firm Size, Gender, Access to Technology, Formality

I. Introduction

Macroeconomists generally include proxies for human capital in their growth regressions or growth decomposition exercises. Initially they used years of schooling as a proxy, but given the limited success of this variable in explaining growth, economists began focusing on the quality of education. Hence, the returns to investment in education became a central element for growth analysis.

This paper measures the rate of return to investment in education in Egypt. While most studies use an average rate of return for a country (Psacharopoulos and Patrinos, 2004), it is possible that rates of return differ across groups of individuals. Although some studies (El Hamidi, 2006 & Said, 2007) estimate separate rates of return for males and females in Egypt, this one explores heterogeneity beyond the gender aspect in three dimensions. First, returns may vary depending on the specific educational path

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followed by the individual. In the Egyptian education system, individuals are sorted into different groups at different stages. Hence, returns to education may vary according to the specific educational path. Second, returns to education may differ according to the size of the firm where the individual works, given that large firms will have more capital, which in turn will imply different labor productivity and wage levels. And third, the paper explores the possibility that returns to education increase with the level of technology, as postulated by the Nelson-Phelps (1966) growth model. The productivity of schooling may be associated with the possibility of acquiring new technologies and new knowledge (Rosenzweig, 2010), and not all individuals have the same opportunities, creating unequal productivity of schooling outcomes.

The objective of this paper is to investigate why the productivity of education varies across individuals in Egypt, controlling for heterogeneity arising from several sources. Section II briefly describes the Egyptian education system and reviews previous studies on the topic. Section III describes the model; Section IV presents stylized facts of the data and discusses the methodology. Section V presents the econometric results, and Section VI discusses the policy implications and concludes.

II. Background and Literature Review for Egypt

The Egyptian education system is a maze through which students navigate toward the labor force. Along the way, students are sorted into groups at different stages. The first stage, basic education, is compulsory and takes 9 years to complete: 6 years of primary and 3 of preparatory level education. After finishing this stage, individuals who wish to pursue secondary education are sorted into three possible categories: general secondary education (3 years), 3-year vocational education (with specialization in agriculture, industry, or commerce), and 5-year vocational education. Those who graduate from general education and wish to continue into higher education are sorted again into university (4-year or 5-year programs) or into post-secondary technical institutes (with programs from 2 to 5 years). Graduates of 3-year vocational education can also pursue studies in post-secondary technical institutions. University graduates can further pursue post-graduate studies.

There are relatively few studies that examine the rate of return (RoR) to education in Egypt. Most studies calculate a rate of return for each level, allowing for gender heterogeneity. For instance, Tansel (1995) shows that the returns to education for males in Egypt were higher than for females, and increased with the level of education, while they decreased for females: the RoR for primary education was 0.9 percent, 2.7 percent for general secondary education, 3.1 percent for vocational education, 7.5 percent for university graduates, and 11.8 percent for those with post-graduate studies. Returns to education for females decreased with higher education levels: the RoR for primary education was 9.9 percent; for general secondary, 8.2 percent; for vocational education, 6.1 percent; and for higher education, 7.4 percent. The study shows that returns to education are higher in the government and public sectors only for early education levels (primary and preparatory), while the RoRs for vocational, university, and higher education levels were superior in the private sector (El Arabi, 2010).

Wahba (1996) studies the determinants of earnings in the Egyptian labor market using the Egyptian Labor Force Sample Survey (LFSS) undertaken in October 1988. She uses the classical Mincerian model.

Her study is consistent with earlier studies in showing an increase in returns to education with education level. She also reports variations among regions, and explains these discrepancies by differences in labor productivity characteristics.

Said (2007) uses the 1998 LFSS, 1998 ELMS, and 2006 ELMPS to study workers' earnings in Egypt. She ran 18 multivariate regressions of log hourly wage regressed on education levels for three rounds (1988, 1998, and 2006), males and females, sector of employment, and region. Said reports considerable improvement in female wages between 1998 and 2006, due to the concentration of female employment in the government sector, where wages increased by 40 percent between these two periods compared with a 17 percent increase in the private sector. Said reports a 4.7 percent return on vocational education, 7 percent for post-secondary education, and 8.5 percent for university education, without allowing for any heterogeneity.

El Arabi (2010) uses a sample of 862 observations of household heads between 15 and 64 years old who are wage employees distributed among five Egyptian governorates to study the economic and non-economic determinants of the demand for education. El Arabi also uses both the classical and extended Mincerian models. El Arabi finds that the return on education in Egypt is very low compared with other developing countries, which explains why school drop-out rates are high among the poor.

El-Hamidi (2006) used 1998 ELMS to study the determinants of an individual to choose a certain level of education and to estimate returns to each level of education. The sample used in the paper consists of 4,843 urban private sector non-agriculture workers. The paper found that children born to parents of lower level of education are more likely to be sorted in vocational education, while others join general education. The study further shows that the "sheepskin effect" is evident for males in vocational education compared to general education as the former received higher returns to education. The sheepskin effect is not evident in women, according to the study.

III. The Model

The starting point is the estimation of a human capital earnings function of the Mincer type, in which we control for experience, location, sector of employment, and other individual characteristics. The regression model is as follows:

$$\ln W = \alpha + \beta_1 DED_i + \beta_2 EXP_i + \beta_3 EXP_i^2 + \beta_4 Region_i + \beta_5 SEC_i + \beta_6 Activity_i + \beta_7 X_i + \varepsilon_i \quad (1)$$

Where; Ln W is Ln hourly wage. DED is a vector of educational level dummies (illiterate, read & write, primary, preparatory general secondary, 3-year vocational education (agriculture), 3-year vocational education (industry), 3-year vocational education (commerce and others), 5-year vocational education, post-secondary, 4-year university, 5-year university, and post-graduate). EXP_i is years of experience calculated as Age - years of education - 6. EXP_i^2 is Years of experience squared. $Region_i$ corresponds to four regional dummies (Greater Cairo, Alexandria and Canal cities, Upper Egypt, and Lower Egypt). SEC_i represents four sector of employment dummies (government, public enterprises, private, and others). $Activity_i$ stands for 16 economic activity dummies (agriculture / hunting / forestry / fishing, mining & quarrying, manufacturing, electricity, gas, and water supply, construction, wholesale and retail trade, hotels and restaurants, transportation, storage and communication, financial intermediaries, real estate, public administration and defense, education, health and social work, other communication, social, and personal activities, and private household). X_i represents five personal characteristics and work environment dummies: covered by medical insurance, formal labor contract, member of a trade union, received training, and married. ε_i is error term.

To estimate annual rates of return to education level, we follow Teal (2008) and calculate the RoR as follows:

$$ROR_i = e^{\frac{\beta_{i(\text{level})} - \beta_{i(\text{level}-1)}}{n_i}} - 1 \quad (2)$$

Where; ROR_i is the annual rate of return on education level i . $\beta_{i(\text{level})}$ is the coefficient corresponding to a certain level of education, while $\beta_{i(\text{level}-1)}$ is the coefficient corresponding to the preceding level. n_i is the number of years required to finish the level of education corresponding to β_i .⁴ e is a mathematical constant = 2.718.

⁴ Primary education requires 6 years for completion; preparatory and general secondary each require 3 years; vocational education, 5 years; post-secondary, 3 years (on average); 4-year university education, 4 years; 5-year university education, 5 years; and post-graduate studies, 3 years (on average).

IV. Method and Data

This section describes the method and data used in the paper.

A. The Method

Simple OLS estimates of equation 1 may be biased due to two problems: endogeneity of education, and sample selection bias. Endogeneity may arise due to the fact that the individual's schooling choice may reflect unobserved characteristics (i.e., ability), while sample selection bias may arise if those who were employed (and reported wage income) have systematic differences with respect to those who did not participate in the labor market. The first problem is generally tackled through instrumental variables estimation, which are hard to find, hence posing some limitations on the findings of the paper. The second problem is tackled through a Heckman two-step method of estimating a labor force participation equation, and then estimating the wage model.

To examine sample selection bias, first we estimate participation in the labor market equation,⁵ and then we estimate the earnings equation. The participation equation includes the individual's age, number of years of education, gender, marital status, a dummy if there is a family member living abroad, and regional dummies. The participation equation includes variables that are correlated with labor force participation. Being a female is associated with very low labor force participation in Egypt (22%) compared to a male participation rate that reached 74%. Therefore, we included "being a female" in the participation equation to overcome selection bias arising from low female participation in the labor force. Having a member living abroad and transferring remittances might discourage local family members from working and participating in the labor force, relying on the income received from abroad (proxy to non-labor income).

The inverse Mills coefficient is negative and significant in the wage equation. With the coefficients from both the OLS and the Heckman estimations, we calculated the returns to education, showing that OLS leads to overestimating the returns to education by 8 to 16 percent, depending on the level of education.

Hence, in the remainder of the paper, we proceed with the Heckman method and the full sample.

B. Data and Stylized Facts

The Egyptian Labor Market Panel Survey (ELMPS) has 23,995 observations for 1998, while the 2006 (ELMS) surveyed 37,000 individuals. We start by showing stylized facts of the labor force to provide some context for the econometric results presented in the next section. Individuals below 6 years of age

⁵ We used extended labor force participation, which includes those who were working or actively seeking work in the past 3 months previous to the survey. The extended definition also includes those involved in the production of primary goods that might be used in household consumption.

are excluded. Female labor force participation is low, but increased from 31 percent in 1998 to 38 percent in 2006. Male participation rates increased from 47 to 65 percent between the two years. The labor force is mostly composed of males: 63 percent are males, up from 61 percent in 1998.

Regarding the composition of the labor force by level of education, illiterates are the larger category for both genders. However, while 19 percent of all participants were illiterate, females reached 36 percent. Most of the illiterate population is composed of females. At other education levels, the distribution between females and males is more balanced, except in vocational education for agriculture and industry, and 5-year university (mostly engineering), where males are the majority. Almost 15 percent of males had primary education, and 11 percent of females.⁶

Males received higher median hourly wages than females in state-owned enterprises (“public”) and the private sector (“private”), but the reverse happened in the government. These sample statistics show that the median wage of the private sector is lower than in the government or the public sector. This result will change in a multivariate setting that adequately controls for the level of education, experience, and other individual characteristics.

Because we are interested in exploring the hypothesis of complementarity of education and technology, we report on whether the individual owns a computer. Personal computer (PC) ownership increases with educational attainment. Only 12 percent of workers report owning a computer, but the ownership rates are very different across education levels: less than 2 percent of workers with primary education owned a computer, 6 percent of those with preparatory level education, 10 percent with general secondary education, 17 percent with post-secondary education, 29 percent with university-4 education, and 53 percent with university-5 level education. The average rate of computer ownership, 12.4 percent, is similar to Colombia’s (13 percent), but significantly lower than in Chile (57 percent), Brazil (51 percent), and Mexico (32 percent) (World Bank, 2011); to name a few comparable countries.

C. Formal vs. Informal Workers

In 2006 the percentage of formal labor (i.e., having a work contract and contributing to social insurance) increased to almost 36 percent compared with only 11 percent in 1998. This trend toward formality is associated with a higher wage premium and higher returns to education for formal labor in 2006.

Most of the informal labor (79.5 percent in 1998 and 70 percent in 2006) works in micro enterprises (1 to 4 employees), while most of the formal labor works in the government sector. The majority of the informal workers are clustered in the private sector. Therefore, most of the informal labor is clustered in private micro enterprise, while most of the formal labor is in the government sector. The largest share of informal labor in 1998 and 2006 are illiterate, while the largest share of formal labor are 4-year university graduates.

⁶ These figures are significantly lower than those in China, a country witnessing similar structural transformation in its economy, where the numbers are 30 and 25 percent for males and females, respectively.

Two facts are worth noting: (a) informality decreases with education level; and (b) at each level of education, there was a shift toward formality between 1998 and 2006, with the exception of secondary and post-secondary education.

V. Results

A. General Regression with Full Sample, 1998-2006

Table 1 shows the results of the Heckman estimation for both periods. All the signs are the expected ones in both the participation equation and the earnings (wage) equation. The negative sign on the gender (female) variable in the participation equation is not surprising, given the observed differences in labor force participation rates. The existence of a migrant member in the household negatively affects participation, capturing the effect of non-earned income and the corresponding substitution effect on labor force participation. This result is also reported by Assad and Binzel (2009). The other variables in the participation equation have the expected signs: the likelihood of participating in the labor market increases with age, education level, and if the individual is married.⁷ The negative sign of the lambda coefficient means that there is a negative correlation between unobserved characteristics that affect labor force participation and wage earnings. Individuals who are less likely to participate in the labor market, but that effectively work, will earn lower wages.

The estimated coefficients on education levels from the earnings equation (Table 1) allow computing the rates of return as described in equation 2. Figure 1 summarizes the results. There are two general trends that are remarkable: (a) the rate of return increases with the level of education; and (b) the rate of return increased for higher levels of education, but decreased for lower levels of education between 1998 and 2006. Although in 1998 the RoRs have a U-shaped form, given the very high rate of return to general secondary education, in 2006 RoRs are more or less increasing monotonically. The RoR is not computed for illiterate workers, because it is the omitted category in the regressions, but the constant in the wage equations can be interpreted as the wage of an individual with no schooling, or the “base wage” of the country as postulated by Rosenzweig (2010), and shows a significant decline between 1998 and 2006. These results will be confirmed throughout the paper, disaggregating the sample by gender, firm size, and formal/informal wage contracts.

The evolution of the RoR to investment in education in Egypt in the period 1998-2006, in particular the observed relative changes in the return to skilled and unskilled labor, can be explained from both the supply and demand perspectives. From the supply side, the number of illiterate workers, as well as those with intermediate levels of education (Table 2) increased significantly during the period, precisely the workers whose RoRs experienced the largest declines. On the demand side, the Egyptian economy experienced a structural change during the decade, according to which activities that require skilled labor, such as financial intermediation and communications, increased their shares in GDP, while those

⁷ This result is driven by male characteristics and will change when gender heterogeneity is allowed for in the next section.

intensive in the use of unskilled labor, such as construction and agriculture, decreased in importance (Figure 2).

B. Different Paths Imply Different Rates of Return

The U-shaped form of returns to education in 1998 is due to the unusually high returns to general secondary education, 19 percent. The high value of the general secondary coefficient in Table 1 leads to the calculated high rate of return for general secondary education, and affects the returns to university education as well as to post-secondary.⁸ However, some post-secondary students graduate from vocational institutions. Hence the RoR for post-secondary education varies depending on the educational path followed by each student. Returns to post-secondary education increased significantly between 1998 and 2006 (where general secondary is the preceding level), but were still low, compared with university level education. Figure 3 summarizes the RoRs for different educational paths.

Summing up, the main results regarding the heterogeneity of RoRs arising from the sorting of individuals show that: (a) Vocational education has a higher return than general secondary education in the most recent period⁹, while in 1998 the reverse was true. However, most individuals sorted into the general secondary category continue into the university level, which has significantly higher rates of return. (b) The rate of return to post-secondary education oscillates from 5 to 6.4 percent per year, depending on the specific path of the individual. (c) The rate of return to university education is higher than that of post-secondary technical institutes, and the post-graduate rate of return is the highest of all.

Other remarkable results from the general regression (Table 1):

- a) On-the-job training has a premium of 11 percent, slightly lower than the 14 percent registered in the previous decade. Disaggregation by firm size will yield interesting results in the next section.
- b) The wage differences between the private sector and the government did not change between 1998 and 2006. In 2006, workers in the private sector earned 20 percent more than government employees, while in 1998 it was exactly the same premium. Similarly, workers in publicly owned companies earned 13 percent more than government workers, on average.
- c) Regional premiums have declined significantly or disappeared. In 1998, workers in Cairo earned more than workers in the rest of the country: 10 percent more than workers in Alexandria, and 17 percent more than workers in Upper or Lower Egypt. By 2006, the Cairo premium with respect to Alexandria was not significant, while the (negative) premium for workers in Upper and Lower Egypt had decreased to one-half its 1998 size.

⁸ This is given that returns to these levels are calculated as indicated in equation 2, and involve the difference between the coefficients of these variables and the coefficient of general secondary education.

⁹ In line with El Hamidi 2006 study.

- d) Finally, it is remarkable that while workers with formal wage contracts in 1998 earned less than workers with informal contracts, in 2006 the situation was reversed: workers with formal work contracts earned 13 percent more.

C. Do Returns to Education Vary by Firm Size?

Returns to education vary by firm size. Tables 3, 4, and 5 report estimations for three types of firms: micro firms (up to 4 employees), small firms (between 5 and 50 employees), and large firms (more than 50 employees). The returns to education increase with firm size, as shown in Tables 3, 4, and 5. This is the same result obtained by Teal (2008) for workers in Tanzania.

In general, all firms reward advanced levels of education more with the exception of firms with 50 or more employees or in vocational education.

Returns to on-the-job training vary inversely with firm size: workers who take training in micro firms receive an 18 percent premium, 11 percent in small firms, and 2 percent (not statistically different from zero) in large firms.

The other result that is worth highlighting when considering differences by firm size is the premium for workers' experience: in large firms, it is almost twice the size of the premium in small firms. In 2006 (see Tables 3, 4, and 5), larger firms compensated experience more than small firms did, as micro firm employees earned a 2.6 percent premium for each additional year of experience, while workers in large firms earned a premium of 4.1 percent.

Our results for returns to education increasing with firm size coincide with results from numerous other studies, finding that the wage premium increases with firm size (Lallmand et al, 2005). This might be explained by higher productivity in large firms, which has been documented for Egypt (World Bank, 2010).

D. Informality

Formal vs. informal labor

The regression results in Table 1 show that formal labor (i.e., having a contract and contributing to social insurance) enjoyed a higher wage premium (13.2 percent) in 2006 compared with their informal counterparts. In 1998, informal labor had a higher wage premium than formal labor. The increase in the wage premium of informal labor coincided with a similar shift toward formality between 1998 and 2006. The table shows the increasing trend of labor to shift from informality to formality; in 2006, formal labor enjoyed higher wages.

Formality and returns to education

We ran additional, separate OLS regressions for formal and informal labor for 1998 and 2006 (see Tables 6 and 7).

In 1998, informal labor experienced higher returns to education for preparatory, 4-year University, and 5-year university degrees compared with their formal counterparts.

In 2006, formal labor witnessed higher RoRs for all education levels except post-graduate studies. The gap in rates of return between formal and informal labor narrowed as education levels advanced. One possible explanation would be that the professions that graduates with higher education pursue might not entail signing a contract or contributing to social insurance (such as consultants, physicians, etc.). This is further confirmed by the higher wage premium received by informal workers (30 percent) who are trade union (or syndicate) members, compared with their formal counterparts (18 percent).

Although an additional year of experience yielded a very similar premium for formal and informal labor in 1998, it rewarded 1 percent more for formal workers compared with their informal counterparts in 2006.

In both 1998 and 2006, there was no wage premium among informal labor working in different sectors of employment; their formal counterparts working in the private sector received the highest wage premium, followed by those working in the public sector.

E. Are There Gender Differences in the Returns to Education?

There are gender differences in returns to education. To examine heterogeneity in returns to education due to gender differences, we ran separate models for males and females (Tables 8 and 9).¹⁰ The estimations show interesting results. In the labor force participation equation, being married enters with opposite signs: while married males are more likely to participate in the labor market, females are less likely. The education coefficient is three times as large for females as males, pointing to the importance of female education to increase the likelihood of labor force participation.

Rates of return for both males and females increase with level of education, and exhibit the same trend between 1998 and 2006: the returns increase for higher levels of education and decrease for lower levels. Returns to education are higher for females, consistent with previous studies of Egypt.

¹⁰ We ran four regressions: one for each year by gender. The constant term captures the regression's specific gender, i.e., if it is a regression for males, the constant term (the comparison group) measures the returns on illiterate males, not covered by medical insurance, workers in the informal market, not a trade union member, single, without training, living in Cairo, working for the government, and in the agriculture/hunting or forestry sector.

Three-year vocational education and post-secondary education exhibit low RoRs in 2006 for males, and lower than in 1998. But for females, the RoR is slightly increasing in vocational education and strongly increasing in post-secondary education.¹¹

In 1998 and 2006, males and females earned similar wage premiums on each additional year of experience: while in 1998 females were rewarded 4.2 percent and males 4.7 percent for each year of experience, in 2006 the compensation increased for females to 4.6 percent and decreased for males to 3 percent (see Tables 8 and 9).

One of the more striking contrasts in the wage equation is the premium paid by the private sector with respect to what an individual with identical characteristics would earn in the government: while the private sector pays a premium of about 25 percent for males, the premium is insignificant for females. This is true for both 1998 and 2006. This means that females working in the government earn wages similar to market determined levels, but males working in the government earn less than market rates. The male premium is also significant for public enterprise workers: they earn 20 percent more than government workers, while females in public enterprises receive no premium.

Formality of the wage contract implied higher wages for both males and females in 2006 and had the same rising pattern: while formality was not rewarded for females in 1998, in 2006 it was rewarded with a 25 percent premium. Male workers with a formal contract earned 10 percent less in 1998, and a 12 percent premium in 2006.

The premium for training has different levels and trends for males and females. While the premium declined from 13 to 9 percent for males, it increased from 6 to 17 percent for females.

In 1998, women residing in Greater Cairo received a wage premium, followed by Lower and Upper Egypt, while women living in Alexandria and Canal cities received the lowest wages. In 2006, wages for women living in Lower or Upper Egypt were not statistically different from those in Greater Cairo; however, women living in Alexandria received lower wages (see Tables 14 and 15).

The trend is reversed for men in both years, as wages received by men living in Alexandria and Canal cities were not statistically different from men residing in Greater Cairo, while wages in Upper Egypt were the lowest followed by Lower Egypt. In 2006, men residing in Alexandria and Canal cities continued to earn wages that were not statistically different from those living in Greater Cairo, while those living in Lower and Upper Egypt received lower wages.

F. Access to Technology

Up to this point, we have described how returns to education increase with education level. However, we have also seen that access to technology varied positively with education level. The Nelson-Phelps growth model postulates that returns to education depend on the degree of technological advancement. Hence, initially we introduce a dummy for PC ownership to control for access to

¹¹ The RoRs for post-secondary education are calculated assuming general secondary education is the previous stage.

technology. It is noteworthy to mention that the findings of this section indicate merely a correlation between owning a PC and returns to education and do not imply any causation, as there is a potential endogeneity problem. Table 10 shows that the coefficient is positive, significant, and implies that PC owners earn a 20 percent wage premium. But, more interestingly, the coefficients for all the education levels fell significantly, although the largest falls were for the higher education levels. This suggests that technology does not homogeneously affect all returns to education.

To allow a heterogeneous response, we interacted the PC ownership dummy variable with each level of education. Table 11 summarizes the results, and shows that the interacted term is mostly significant for higher levels of education. The activities of those with higher education will be less routinized and are more likely to use technology more intensively. In this fashion, the rate of return to education for those without access to a PC will be calculated without the interacted term, while for those with a computer it will be calculated as the sum of the coefficients of the interacted variable with the original one. This is shown for those coefficients that are statistically significant in Table 11. Table 12 summarizes the RoRs, depicting the wide variance in the RoR, depending on access to technology. On average, those with access to technology earn 3.3 times more than those without access.

These results point to the importance of technology in education. In principle, they suggest the relevance of building school computer labs, supplying computers, and connectivity in schools. This will necessarily imply developing and disseminating new curricula in electronic format. Distance learning programs will also become essential elements.

However, providing computers and technology is no guarantee that the quality of education will improve. Evaluations of these programs show mixed results, especially in developing economies. For instance, an impact evaluation of the use of computers in education in Colombia showed that teachers used the computers for class preparation and to teach students computer skills in the presentation and dissemination of information, rather than for the intended purpose of developing new knowledge in language and mathematics (Barrera and Linden, 2009). Hence, the introduction of technology will not affect education unless teachers are trained and develop new skills in the use of the new technology. Incorporating technology in the learning process requires more than computers in the classroom.

VI. Conclusions, Policy Implications, and Directions for Future Research

The rate of return to investment in education in Egypt varies significantly across individuals, and this paper sheds light on how education and labor policies can become factors perpetuating inequality. Regarding education policy, the first source of heterogeneity in returns to investment arises with the sorting of individuals into the general secondary-university path or the vocational training – post secondary track: individuals in the first track earn higher rates of return to education.

The paper also shows that returns to education are positively correlated with firm size and depend on the formality of the work contract. Hence labor or tax policies that discriminate or make more cumbersome employment by large firms are likely to push workers into earning lower returns to their investment in education. Similarly, setting minimum wages without consideration of market conditions

pushes workers into informality that might also have lower returns to education according to our results.

Female workers earn higher returns to education than males, but their labor participation rates are significantly lower. This paper confirmed that female participation in the labor market is negatively associated with marriage and having small children, pointing at the importance of having child care centers to promote female participation in the labor market. Another significant difference between male and female wages occurs in the government sector, which employs over 40% of wage earners. While males in the private sector earn a 25 percent premium with respect to government employees, females in the government sector earn the same as in the private sector. This is a clear incentive for females to wait in queue for a government job, as it sets a reservation wage. This might explain why female unemployment is higher than that for males.

Finally, access to technology produces the largest discrepancy in RoR across individuals, with the RoR being two to four times larger for individuals with access to computers. This result highlights the importance of modifying the curriculum to include more computer access in schools, with corresponding monitoring and evaluation of the use of computers in the classroom.

Regional wage premiums have declined significantly or disappeared: At the end of the 1990s, workers in Cairo earned a premium of 10 percent with respect to Alexandria and Canal cities, and 17 percent with respect to Upper and Lower Egypt; our estimates based on the most recent survey show the first one has been eliminated while the second one has halved in the decade.

The rates of return to education estimated here are gross rates of return. Further research on this topic could consider the cost of education, and two key elements of uncertainty: the probability of becoming unemployed and the wage risk associated with the level of education. In Egypt, unemployment increases with the level of educational attainment (Figure 7), while in many other countries the reverse occurs: unemployment decreases with education.

Wage dispersion, as measured by the coefficient of variation of wages for each level of education, decreases with the level of education (Table 13). This is a counterintuitive result, since higher returns should be associated with higher risk. In other countries, the wage risk increases with the level of education (Martins and Pereira, 2000). Exploring these two puzzling facts is essential for the research agenda on returns to education and the working of labor markets in Egypt.

Table 1 - General Regression

2006				1998			
VARIABLES	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR ¹	VARIABLES	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR ¹
Read & Write	-0.0276 (0.0393)			Read & Write	0.0740* (0.0396)		
Primary	0.0812** (0.0361)		1.83%	Primary	0.235*** (0.0407)		2.72%
Preparatory	0.176*** (0.0464)		3.21%	Preparatory	0.300*** (0.0530)		2.19%
General Secondary	0.308*** (0.0851)		4.50%	General Secondary	0.832*** (0.104)		19.40%
3-year Vocational - Agriculture	0.333*** (0.0530)		5.37%	3-year Vocational - Agriculture	0.436*** (0.0678)		4.64%
3-year Vocational - Industry	0.300*** (0.0391)		4.22%	3-year Vocational - Industry	0.572*** (0.0510)		9.49%
3-year Vocational - Commerce & Oth.	0.339*** (0.0368)		5.58%	3-year Vocational - Commerce & Oth.	0.512*** (0.0463)		7.32%
5-year Vocational Education	0.568*** (0.132)		8.16%	5-year Vocational Education	0.595*** (0.0638)		6.08%
Post Secondary	0.485*** (0.0477)		6.08%	Post Secondary	0.849*** (0.0643)		0.57%
4-year University	0.629*** (0.0431)		8.36%	4-year University	0.950*** (0.0540)		2.99%
5-year University	0.831*** (0.0751)		11.03%	5-year University	1.095*** (0.0791)		5.40%
Post Graduate	1.007*** (0.0970)		13.43%	Post Graduate	1.428*** (0.109)		17.27%
Experience	0.0376*** (0.00238)			Experience	0.0486*** (0.00283)		
Experience ²	-0.000465*** (4.28e-05)			Experience ²	-0.000509*** (4.88e-05)		
Medical Insurance	0.170*** (0.0382)			Medical Insurance	0.0471 (0.0461)		
Formal Labor	0.132*** (0.0350)			Formal Labor	-0.0848** (0.0422)		
Member of Trade Union	0.232*** (0.0226)			Member of Trade Union	0.137*** (0.0253)		
Married	0.0517** (0.0249)	0.637*** (0.0279)		Married	-0.0708** (0.0332)	0.923*** (0.0432)	
Training	0.108*** (0.0207)			Training	0.140*** (0.0277)		
Alex & Canal Cities	-0.0466 (0.0305)	0.00803 (0.0411)		Alex & Canal Cities	-0.105*** (0.0332)	-0.0196 (0.0554)	
Upper Egypt	-0.0800*** (0.0254)	0.106*** (0.0339)		Upper Egypt	-0.178*** (0.0289)	0.162*** (0.0464)	
Lower Egypt	-0.0745*** (0.0251)	0.129*** (0.0334)		Lower Egypt	-0.162*** (0.0285)	0.198*** (0.0459)	
Public Sector	0.134*** (0.0409)			Public Sector	0.137*** (0.0441)		
Private Sector	0.209*** (0.0378)			Private Sector	0.208*** (0.0464)		
Other Sec. of Employment	-0.00851 (0.134)			Other Sec. of Employment	-0.310* (0.159)		
Fishing	0.199 (0.126)			Fishing	0.261** (0.130)		
Mining & Quarrying	0.458*** (0.132)			Mining & Quarrying	0.141 (0.138)		
Manufacturing	0.0145 (0.0371)			Manufacturing	0.131*** (0.0434)		
Electricity Gas & Water	0.180** (0.0724)			Electricity Gas & Water	0.222*** (0.0834)		
Construction	0.308*** (0.0393)			Construction	0.270*** (0.0470)		
Wholesale & Retail Trade	-0.101** (0.0394)			Wholesale & Retail Trade	-0.0823* (0.0500)		
Hotels & Restaurants	0.0796 (0.0546)			Hotels & Restaurants	0.0805 (0.0770)		
Transp. Storage & Comm.	0.185*** (0.0409)			Transp. Storage & Comm.	0.202*** (0.0520)		
Financial Intermediaries	0.562*** (0.0716)			Financial Intermediaries	0.381*** (0.0786)		
Real Estate	0.0550 (0.0692)			Real Estate	-0.125 (0.118)		
Public Admin. & Defense	-0.0456 (0.0453)			Public Admin. & Defense	-0.00864 (0.0518)		
Education	0.00767 (0.0455)			Education	0.0689 (0.0531)		
Health & Soc. Work	-0.0153 (0.0542)			Health & Soc. Work	-0.0760 (0.0645)		
Other Communication	-0.281*** (0.0569)			Other Communication	0.0339 (0.0529)		
Private HH	-0.255** (0.101)			Private HH	0.578** (0.241)		
Age		0.0270*** (0.000968)		Age		0.00989*** (0.00127)	
Years of Education		0.0743*** (0.00200)		Years of Education		0.0936*** (0.00287)	
Female		-1.549*** (0.0238)		Female		-1.302*** (0.0339)	
Family Member Living Abroad		-0.346*** (0.0616)		Family Member Living Abroad			
lambda		-0.0532** (0.0247)		lambda		-0.0948*** (0.0330)	
Constant	-0.349*** (0.0771)	-1.419*** (0.0443)		Constant	3.663*** (0.0963)	-1.340*** (0.0580)	
Observations	19,444	19,444		Observations	9,624	9,624	

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

† Rates of return are calculated using equation 2.

Table 2 – Change in Flow of Participants to the Labor Market between 2001-2006

Illiterate	Read & Write	Less Than Intermediate	Intermediate	Above Intermediate	University & Above	Total
49%	-23%	16%	37%	3%	18%	100%

Source: Authors' calculations using the CAPMAS labor force survey.

Table 3 - Firm Size 1-4 2006

VARIABLES	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR [†]
Read & Write	-0.0196 (0.0547)		
Primary	-0.0235 (0.0504)		
Preparatory	0.0972 (0.0672)		
General Secondary	0.173 (0.129)		
3-year Vocational - Agriculture	0.130 (0.0829)		
3-year Vocational - Industry	0.114** (0.0578)		0.56%
3-year Vocational - Commerce & Oth	0.119** (0.0581)		0.73%
5-year Vocational Education	0.355 (0.284)		
Post Secondary	0.155* (0.0829)		-0.60%
4-year University	0.331*** (0.0748)		4.03%
5-year University	0.295 (0.208)		
Post Graduate	0.700*** (0.191)		13.09%
Experience	0.0268*** (0.00413)		
Experience ²	-0.000401*** (6.97e-05)		
Medical Insurance	0.236*** (0.0831)		
Formal Labor	0.161** (0.0798)		
Member of Trade Union	0.253*** (0.0475)		
Married	0.105*** (0.0372)	0.310*** (0.0555)	
Training	0.175*** (0.0324)		
Alex & Canal Cities	-0.0428 (0.0548)	-0.0378 (0.0843)	
Upper Egypt	-0.0666 (0.0454)	-0.0363 (0.0693)	
Lower Egypt	-0.0183 (0.0440)	-0.0194 (0.0676)	
Public Sector	0.105 (0.116)		
Private Sector	0.145 (0.0899)		
Other Sec. of Employment	-0.0727 (0.335)		
Fishing	0.390** (0.182)		
Mining & Quarrying	0.789** (0.391)		
Manufacturing	0.0737 (0.0574)		
Electricity Gas & Water	0.293 (0.180)		
Construction	0.307*** (0.0577)		
Wholesale & Retail Trade	-0.120** (0.0532)		
Hotels & Restaurants	0.0184 (0.0797)		
Transp. Storage & Comm.	0.149*** (0.0567)		
Financial Intermediaries	0.152 (0.213)		
Real Estate	0.153 (0.101)		
Public Admin. & Defense	-0.121 (0.0994)		
Education	0.0606 (0.0942)		
Health & Soc. Work	-0.00779 (0.0988)		
Other Communication	-0.366*** (0.0916)		
Private HH	-0.0483 (0.119)		
Age		0.0395*** (0.00216)	
Years of Education		0.0581*** (0.00392)	
Female		-1.936*** (0.0484)	
Family Member Living Abroad		-0.0711 (0.131)	
lambda		-0.178*** (0.0379)	
Constant	-0.0684 (0.131)	-0.895*** (0.0861)	
Observations	5,234	5,234	

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

† Rates of return are calculated using equation 2.

Table 4 -Firm Size 5-49 2006			
	Wage Equation	Labor Participation	ROR †
VARIABLES	lnwage_hr	in_laborf	
Read & Write	-0.0699 (0.0712)		ROR
Primary	0.149** (0.0624)		3.72%
Preparatory	0.209** (0.0849)		2.02%
General Secondary	0.0808 (0.164)		
3-year Vocational - Agriculture	0.144 (0.0957)		
3-year Vocational - Industry	0.232*** (0.0705)		0.77%
3-year Vocational - Commerce & Oth.	0.149** (0.0735)		-1.98%
5-year Vocational Education	-0.0193 (0.595)		-4.46%
Post Secondary	0.194** (0.0986)		3.85%
4-year University	0.531*** (0.0873)		11.91%
5-year University	0.717*** (0.188)		13.57%
Post Graduate	0.570* (0.293)		1.31%
Experience	0.0274*** (0.00503)		
Experience ²	-0.000354*** (8.40e-05)		
Medical Insurance	0.214*** (0.0712)		
Formal Labor	0.0888 (0.0612)		
Member of Trade Union	0.181** (0.0714)		
Married	0.0568 (0.0442)	0.150 (0.127)	
Training	0.112*** (0.0369)		
Alex & Canal Cities	-0.0436 (0.0619)	0.317 (0.205)	
Upper Egypt	-0.0292 (0.0519)	-0.153 (0.145)	
Lower Egypt	-0.0427 (0.0531)	-0.0122 (0.145)	
Public Sector	0.139 (0.345)		
Private Sector	-0.0471 (0.132)		
Fishing	-0.0671 (0.148)		
Mining & Quarrying	-0.481* (0.279)		
Manufacturing	-0.168*** (0.0554)		
Construction	0.185*** (0.0553)		
Wholesale & Retail Trade	-0.0802 (0.0666)		
Hotels & Restaurants	-0.0320 (0.0772)		
Transp. Storage & Comm.	0.412*** (0.0986)		
Financial Intermediaries	0.688*** (0.193)		
Real Estate	-0.0418 (0.120)		
Public Admin. & Defense	-0.214 (0.189)		
Education	-0.281** (0.109)		
Health & Soc. Work	-0.0721 (0.159)		
Other Communication	0.372*** (0.133)		
Private HH	-0.451 (0.276)		
Age		0.0359*** (0.00580)	
Years of Education		0.0320*** (0.00903)	
Female		-1.779*** (0.110)	
Family Member Living Abroad		6.725 (0)	
lambda		-0.302*** (0.0734)	
Constant	0.180 (0.174)	0.398** (0.197)	
Observations	1,402	1,402	

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

† Rates of return are calculated using equation 2 .

Table 5 - Firm Size 50+ 2006

	Wage Equation	Labor Participation	ROR †
VARIABLES	lnwage_hr	in_laborf	
Read & Write	0.0972 (0.199)		
Primary	0.285* (0.171)		3.18%
Preparatory	0.232 (0.189)		
General Secondary	0.466 (0.310)		
3-year Vocational - Agriculture	0.813*** (0.236)		21.37%
3-year Vocational - Industry	0.456*** (0.157)		7.75%
3-year Vocational - Commerce & Oth.	0.384** (0.165)		5.20%
Post Secondary	0.595*** (0.181)		4.39%
4-year University	0.975*** (0.166)		13.57%
5-year University	1.471*** (0.219)		22.26%
Post Graduate	3.212*** (0.525)		110.78%
Experience	0.0416*** (0.0104)		
Experience ²	-0.000654*** (0.000230)		
Medical Insurance	0.0755 (0.0821)		
Formal Labor	0.0379 (0.0832)		
Member of Trade Union	0.310*** (0.0821)		
Married	0.178** (0.0823)	-5.797 (7.222)	
Training	0.0230 (0.0708)		
Alex & Canal Cities	0.114 (0.0891)	4.943 (0)	
Upper Egypt	-0.0500 (0.0973)	-1.107 (1.136)	
Lower Egypt	-0.168* (0.0857)	4.695 (0)	
Mining & Quarrying	0.314 (0.297)		
Manufacturing	0.0550 (0.175)		
Electricity Gas & Water	0.316 (0.301)		
Construction	0.350* (0.211)		
Wholesale & Retail Trade	-0.0732 (0.196)		
Hotels & Restaurants	0.148 (0.210)		
Transp. Storage & Comm.	0.257 (0.206)		
Financial Intermediaries	0.826*** (0.266)		
Real Estate	-0.243 (0.254)		
Public Admin. & Defense	0.0119 (0.513)		
Education	-0.361 (0.249)		
Health & Soc. Work	-0.313 (0.307)		
Other Communication	0.184 (0.254)		
Private HH	-0.319 (0.383)		
Age		-0.0152 (0.0811)	
Years of Education		-0.436 (0.409)	
Female		-6.474 (0)	
Family Member Living Abroad		-0.263 (0)	
lambda		-0.108 (0.697)	
Constant	-0.406* (0.224)	20.94 (0)	
Observations	506	506	

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

† Rates of return are calculated using equation 2.

Table 6 - Formal vs Informal - 1998

VARIABLES	Informal		Formal	
Read & Write	0.183*** (0.0650)		0.0160 (0.0533)	
Primary	0.248*** (0.0591)	ROR 1%	0.281*** (0.0549)	ROR 5%
Preparatory	0.393*** (0.0843)	5%	0.340*** (0.0652)	2%
General Secondary	0.378 (0.309)		0.996*** (0.104)	24%
3-year Vocational - Agriculture	0.401*** (0.130)	0%	0.606*** (0.0757)	9%
3-year Vocational - Industry	0.560*** (0.0792)	6%	0.730*** (0.0575)	14%
3-year Vocational - Commerce & Oth.	0.323*** (0.0974)	-2%	0.679*** (0.0544)	12%
5-year Vocational Education	0.491*** (0.141)	2%	0.779*** (0.0673)	9%
Post Secondary	0.419 (0.319)		1.020*** (0.0655)	1%
4-year University	0.765*** (0.147)	10%	1.123*** (0.0561)	3%
5-year University	0.910*** (0.301)	11%	1.291*** (0.0770)	6%
Post Graduate			1.605*** (0.101)	17%
Experience	0.0412*** (0.00591)		0.0477*** (0.00335)	
Experience ²	-0.000424*** (9.32e-05)		-0.000414*** (6.22e-05)	
Medical Insurance	0.452 (0.358)		0.0177 (0.0440)	
Member of Trade Union	-0.0463 (0.126)		0.145*** (0.0240)	
Married	0.0192 (0.0566)		-0.00651 (0.0308)	
Training	0.0807* (0.0488)		0.171*** (0.0348)	
Alex & Canal Cities	0.0200 (0.0795)		-0.163*** (0.0346)	
Upper Egypt	-0.168** (0.0665)		-0.168*** (0.0302)	
Lower Egypt	0.0181 (0.0634)		-0.240*** (0.0301)	
Public Sector	-0.129 (0.325)		0.171*** (0.0442)	
Private Sector	0.0642 (0.248)		0.219*** (0.0465)	
Other Sec. of Employment	-0.0436 (0.503)		-0.301* (0.159)	
Fishing	0.322* (0.170)		0.0940 (0.260)	
Mining & Quarrying	-0.00252 (0.279)		0.328** (0.165)	
Manufacturing	0.174*** (0.0655)		0.0928 (0.0811)	
Electricity Gas & Water	0 (0)		0.197** (0.0989)	
Construction	0.354*** (0.0641)		0.109 (0.101)	
Wholesale & Retail Trade	-0.0865 (0.0740)		0.0138 (0.0934)	
Hotels & Restaurants	0.0662 (0.109)		0.168 (0.131)	
Transp. Storage & Comm.	0.257** (0.103)		0.198** (0.0820)	
Financial Intermediaries	0 (0)		0.343*** (0.0945)	
Real Estate	-0.00126 (0.215)		0.0679 (0.163)	
Public Adm. & Defense	-0.201 (0.399)		-0.0198 (0.0770)	
Education	0.256 (0.250)		0.0452 (0.0775)	
Health & Soc. Work	-0.922*** (0.240)		-0.0706 (0.0853)	
Other Communication	0.0669 (0.0782)		0.000264 (0.0921)	
Private HH	0.521* (0.282)		0 (0)	
Constant	3.677*** (0.270)		3.365*** (0.108)	
Observations	1,105		2,333	
R-squared	0.239		0.450	

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 7- Formal vs Informal - 2006

VARIABLES	Informal		Formal	
Read & Write	0.0184		-0.103	
	(0.0435)	ROR	(0.0743)	ROR
Primary	0.0779**	1.0%	0.148**	4.3%
	(0.0388)		(0.0684)	
Preparatory	0.185***	3.6%	0.270***	4.2%
	(0.0528)		(0.0788)	
General Secondary	0.215**	1.0%	0.500***	8.0%
	(0.106)		(0.131)	
3-year Vocational - Agriculture	0.268***	2.8%	0.541***	9.5%
	(0.0622)		(0.0862)	
3-year Vocational - Industry	0.225***	1.3%	0.500***	8.0%
	(0.0430)		(0.0635)	
3-year Vocational - Commerce & Oth.	0.143***	-1.4%	0.581***	10.9%
	(0.0469)		(0.0599)	
5-year Vocational Education	0.0621		0.755***	10.2%
	(0.642)		(0.145)	
Post Secondary	0.224***	0.3%	0.743***	8.4%
	(0.0720)		(0.0680)	
4-year University	0.455***	6.2%	0.890***	10.2%
	(0.0576)		(0.0621)	
5-year University	0.734***	10.9%	1.091***	12.5%
	(0.188)		(0.0923)	
Post Graduate	1.387***	36.4%	1.209***	11.2%
	(0.327)		(0.111)	
Experience	0.0259***		0.0343***	
	(0.00333)		(0.00375)	
Experience ²	-0.000343***		-0.000278***	
	(5.47e-05)		(7.49e-05)	
Medical Insurance	0.0676		0.204***	
	(0.0688)		(0.0478)	
Member of Trade Union	0.304***		0.188***	
	(0.0533)		(0.0263)	
Married	0.148***		0.0627*	
	(0.0284)		(0.0342)	
Training	0.166***		0.00758	
	(0.0241)		(0.0353)	
Alex & Canal Cities	-0.0636		-0.0670	
	(0.0446)		(0.0415)	
Upper Egypt	-0.0996***		-0.0887**	
	(0.0359)		(0.0352)	
Lower Egypt	-0.0531		-0.118***	
	(0.0352)		(0.0350)	
Public Sector	-0.115		0.170***	
	(0.124)		(0.0487)	
Private Sector	0.115		0.181***	
	(0.0772)		(0.0498)	
Other Sec. of Employment	0.160		-0.0599	
	(0.273)		(0.160)	
Fishing	0.207*		-0.0884	
	(0.119)		(0.528)	
Mining & Quarrying	-0.242		0.801***	
	(0.260)		(0.175)	
Manufacturing	-0.000574		0.160*	
	(0.0393)		(0.0917)	
Electricity Gas & Water	0.293		0.285***	
	(0.334)		(0.107)	
Construction	0.335***		0.175	
	(0.0388)		(0.114)	
Wholesale & Retail Trade	-0.117***		0.120	
	(0.0401)		(0.106)	
Hotels & Restaurants	0.0348		0.458***	
	(0.0571)		(0.128)	
Transp. Storage & Comm.	0.154***		0.340***	
	(0.0455)		(0.0940)	
Financial Intermediaries	0.889***		0.635***	
	(0.217)		(0.105)	
Real Estate	0.0213		0.299**	
	(0.0815)		(0.131)	
Public Adm. & Defense	-0.0280		0.0567	
	(0.110)		(0.0839)	
Education	-0.274***		0.127	
	(0.0876)		(0.0842)	
Health & Soc. Work	-0.261***		0.150	
	(0.0989)		(0.0925)	
Other Communication	-0.0655		-0.263**	
	(0.0752)		(0.102)	
Private HH	-0.213**		-0.0906	
	(0.0981)		(0.312)	
Constant	-0.171*		-0.583***	
	(0.102)		(0.118)	
Observations	3,470		4,075	
R-squared	0.187		0.221	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

† Rates of return are calculated using equation 2 .

2006				1998			
VARIABLES	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR [†]	VARIABLES	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR [†]
Read & Write	0.0222 (0.0372)		ROR	Read & Write	0.0773* (0.0412)		ROR
Primary	0.148*** (0.0395)		0.0212	Primary	0.274*** (0.0506)		0.0333
Preparatory	0.268*** (0.0532)		0.0408	Preparatory	0.369*** (0.0690)		0.0322
General Secondary	0.436*** (0.0928)		0.0576	General Secondary	0.926*** (0.129)		0.204
3-year Vocational - Agriculture	0.492*** (0.0648)		0.0775	3-year Vocational - Agriculture	0.526*** (0.0883)		0.0537
3-year Vocational - Industry	0.420*** (0.0549)		0.052	3-year Vocational - Industry	0.660*** (0.0754)		0.1019
3-year Vocational - Commerce & Oth.	0.398*** (0.0564)		0.0443	3-year Vocational - Commerce & Oth.	0.592*** (0.0774)		0.0772
5-year Vocational Education	0.738*** (0.174)		0.0986	5-year Vocational Education	0.711*** (0.0942)		0.0708
Post Secondary	0.594*** (0.0672)		0.0541	Post Secondary	0.954*** (0.0986)		0.0094
4-year University	0.840*** (0.0668)		0.1063	4-year University	1.079*** (0.0893)		0.039
5-year University	0.996*** (0.0930)		0.1185	5-year University	1.213*** (0.110)		0.0591
Post Graduate	1.292*** (0.121)		0.1626	Post Graduate	1.596*** (0.140)		0.1881
Experience	0.0330*** (0.00258)			Experience	0.0474*** (0.00358)		
Experience ²	-0.000352*** (4.46e-05)			Experience ²	-0.000476*** (5.76e-05)		
Medical Insurance	0.104*** (0.0404)			Medical Insurance	0.0317 (0.0530)		
Formal Labor	0.122*** (0.0362)			Formal Labor	-0.101** (0.0459)		
Member of Trade Union	0.236*** (0.0245)			Member of Trade Union	0.143*** (0.0298)		
Married	0.354*** (0.107)	1.494*** (0.0491)		Married	0.0698 (0.176)	1.710*** (0.0711)	
Training	0.0895*** (0.0200)			Training	0.130*** (0.0291)		
Alex & Canal Cities	-0.00978 (0.0339)	0.0116 (0.0596)		Alex & Canal Cities	-0.0351 (0.0391)	0.0355 (0.0753)	
Upper Egypt	-0.0950*** (0.0280)	0.0945** (0.0477)		Upper Egypt	-0.143*** (0.0342)	0.0840 (0.0615)	
Lower Egypt	-0.101*** (0.0275)	0.0521 (0.0474)		Lower Egypt	-0.117*** (0.0348)	0.151** (0.0611)	
Public Sector	0.205*** (0.0427)			Public Sector	0.202*** (0.0490)		
Private Sector	0.248*** (0.0415)			Private Sector	0.259*** (0.0541)		
Other Sec. of Employment	0.0409 (0.149)			Other Sec. of Employment	-0.291 (0.186)		
Fishing	0.161 (0.114)			Fishing	0.233* (0.131)		
Mining & quarrying	0.435*** (0.122)			Mining & quarrying	0.151 (0.140)		
Manufacturing	0.0304 (0.0358)			Manufacturing	0.146*** (0.0465)		
Electricity Gas & Water	0.168** (0.0721)			Electricity Gas & Water	0.214** (0.0923)		
Construction	0.285*** (0.0367)			Construction	0.266*** (0.0489)		
Whole Sale & Retail Trade	-0.0813** (0.0380)			Whole Sale & Retail Trade	-0.0293 (0.0541)		
Hotels & Restaurants	0.0519 (0.0509)			Hotels & Restaurants	0.118 (0.0799)		
Transp. Storage & Comm.	0.193*** (0.0392)			Transp. Storage & Comm.	0.238*** (0.0553)		
Financial Intermediaries	0.674*** (0.0786)			Financial Intermediaries	0.439*** (0.0964)		
Real Estate	0.0639 (0.0712)			Real Estate	-0.164 (0.141)		
Public Adm. & Defense	-0.0129 (0.0471)			Public Adm. & Defense	0.0371 (0.0579)		
Education	0.0427 (0.0496)			Education	0.101 (0.0619)		
Health & Soc. Work	-0.0264 (0.0665)			Health & Soc. Work	-0.0296 (0.0849)		
Other Communication	-0.303*** (0.0554)			Other Communication	0.0267 (0.0557)		
Private HH	-0.494*** (0.112)			Private HH			
age		0.0121*** (0.00162)		age		-0.00463** (0.00192)	
Years of Education		0.0466*** (0.00280)		Years of Education		0.0562*** (0.00384)	
Family Member living Abroad		-0.342*** (0.0817)					
lambda		0.397*** (0.136)		lambda		0.124 (0.189)	
Constant	-0.816*** (0.187)	-1.065*** (0.0591)		Constant	3.318*** (0.266)	-0.911*** (0.0738)	
Observations	9,891	9,891		Observations	4,970	4,970	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

† Rates of returns are calculated using equation 2

Table 9 Females							
2006				1998			
VARIABLES	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR ¹	VARIABLES	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR ¹
Read & Write	-0.492*** (0.171)			Read & Write	-0.0737 (0.166)		
Primary	0.384* (0.206)		15.72%	Primary	0.332** (0.143)		7.00%
Preparatory	0.606** (0.273)		7.68%	Preparatory	0.336** (0.158)		0.13%
General Secondary	0.722* (0.374)		3.94%	General Secondary	0.848*** (0.214)		18.61%
3-year Vocational - Agriculture	0.574* (0.319)		-1.06%	3-year Vocational - Agriculture	0.612*** (0.193)		9.64%
3-year Vocational - Industry	0.845*** (0.288)		8.29%	3-year Vocational - Industry	0.672*** (0.141)		11.85%
3-year Vocational - Commerce & Oth.	0.829*** (0.278)		7.72%	3-year Vocational - Commerce & Oth.	0.554*** (0.112)		7.54%
5-year Vocational Education	0.999*** (0.372)		8.18%	5-year Vocational Education	0.631*** (0.139)		6.08%
Post Secondary	1.033*** (0.318)		10.92%	Post Secondary	0.883*** (0.133)		1.17%
4-year University	1.113*** (0.347)		10.27%	4-year University	1.003*** (0.126)		3.95%
5-year University	1.352*** (0.405)		13.43%	5-year University	1.227*** (0.179)		7.87%
Post Graduate	1.516*** (0.436)		14.38%	Post Graduate	1.430*** (0.217)		15.30%
Experience	0.0465*** (0.00850)			Experience	0.0416*** (0.00664)		
Experience ²	-0.000364** (0.000153)			Experience ²	-0.000314** (0.000152)		
Medical Insurance	0.335*** (0.0962)			Medical Insurance	0.131 (0.0939)		
Formal Labor	0.251*** (0.0923)			Formal Labor	0.131 (0.111)		
Member of Trade Union	0.161*** (0.0541)			Member of Trade Union	0.0980** (0.0464)		
Married	0.165*** (0.0587)	-0.268*** (0.0496)		Married	0.0507 (0.0507)	-0.393*** (0.0703)	
Training	0.168** (0.0798)			Training	0.0576 (0.100)		
Alex & Canal Cities	-0.162** (0.0732)	0.0322 (0.0608)		Alex & Canal Cities	-0.340*** (0.0606)	-0.0958 (0.0973)	
Upper Egypt	0.0242 (0.0652)	0.0967* (0.0526)		Upper Egypt	-0.244*** (0.0531)	0.156* (0.0853)	
Lower Egypt	0.0608 (0.0675)	0.228*** (0.0508)		Lower Egypt	-0.237*** (0.0533)	0.173** (0.0831)	
Public Sector	-0.0599 (0.121)			Public Sector	-0.166 (0.107)		
Private Sector	0.0807 (0.0870)			Private Sector	-0.00622 (0.0892)		
Other Sec. of Employment	-0.364 (0.297)			Other Sec. of Employment	-0.215 (0.291)		
Manufacturing	0.0245 (0.140)			Manufacturing	0.157 (0.124)		
Electricity Gas & Water	0.563** (0.260)			Electricity Gas & Water	0.286 (0.194)		
Construction	0.613** (0.299)			Construction	-0.00333 (0.213)		
Whole Sale & Retail Trade	-0.204 (0.146)			Whole Sale & Retail Trade	-0.252* (0.137)		
Hotels & Restaurants	0.213 (0.337)			Hotels & Restaurants	-0.691** (0.301)		
Transp. Storage & Comm.	0.267 (0.177)			Transp. Storage & Comm.	-0.0399 (0.162)		
Financial Intermediaries	0.269 (0.184)			Financial Intermediaries	0.228 (0.150)		
Real Estate	0.0666 (0.192)			Real Estate	0.0913 (0.216)		
Public Admin. & Defense	-0.0592 (0.141)			Public Admin. & Defense	-0.201 (0.125)		
Education	-0.0453 (0.136)			Education	-0.134 (0.122)		
Health & Soc. Work	-0.0898 (0.138)			Health & Soc. Work	-0.313** (0.128)		
Other Communication	0.239 (0.220)			Other Communication	0.193 (0.183)		
Private HH	0.254 (0.229)			Private HH	0.758*** (0.248)		
age		0.0304*** (0.00153)		age		0.0239*** (0.00204)	
Years of Education		0.129*** (0.00365)		Years of Education		0.170*** (0.00639)	
Family Member living Abroad		-0.204** (0.0972)					
Children 5 years or Less		-0.164*** (0.0497)		Children 6 years or less		8.978 (0)	
Children between 6 & 14 years		0.399*** (0.0445)					
lambda		0.253 (0.164)		lambda		0.0163 (0.0351)	
Constant	-1.551*** (0.542)	-3.151*** (0.0805)		Constant	3.536*** (0.176)	-3.185*** (0.117)	
Observations	9,553	9,553		Observations	4,654	4,654	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

¹ Rates of returns are calculated using equation 2

Table 10 Access to Technology - PC ownership			
VARIABLES	2006		
	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR †
Read & Write	-0.0238 (0.0392)		
Primary	0.0768** (0.0360)		1.69%
Preparatory	0.163*** (0.0463)		2.92%
General Secondary	0.284*** (0.0849)		4.12%
3-year Vocational - Agriculture	0.320*** (0.0528)		5.37%
3-year Vocational - Industry	0.277*** (0.0391)		3.87%
3-year Vocational - Commerce & Oth.	0.315*** (0.0368)		5.20%
5-year Vocational Education	0.546*** (0.131)		7.96%
Post Secondary	0.449*** (0.0478)		5.65%
4-year University	0.567*** (0.0437)		7.33%
5-year University	0.728*** (0.0760)		9.29%
Post Graduate	0.912*** (0.0975)		12.19%
Experience	0.0360*** (0.00238)		
Experience ²	-0.000450*** (4.27e-05)		
Medical Insurance	0.177*** (0.0381)		
Formal Labor	0.123*** (0.0349)		
Member of Trade Union	0.216*** (0.0226)		
PC Ownership	0.205*** (0.0268)		
Married	0.0539** (0.0249)	0.637*** (0.0279)	
Training	0.109*** (0.0206)		
Alex & Canal Cities	-0.0481 (0.0304)	0.00803 (0.0411)	
Upper Egypt	-0.0690*** (0.0254)	0.106*** (0.0339)	
Lower Egypt	-0.0553** (0.0251)	0.129*** (0.0334)	
Public Sector	0.123*** (0.0408)		
Private Sector	0.202*** (0.0377)		
Other Sec. of Employment	-0.0316 (0.133)		
Fishing	0.206* (0.125)		
Mining & quarrying	0.445*** (0.132)		
Manufacturing	0.0106 (0.0369)		
Electricity Gas & Water	0.186** (0.0722)		
Construction	0.306*** (0.0391)		
Whole Sale & Retail Trade	-0.104*** (0.0393)		
Hotels & Restaurants	0.0825 (0.0544)		
Transp. Storage & Comm.	0.182*** (0.0408)		
Financial Intermediaries	0.529*** (0.0715)		
Real Estate	0.0362 (0.0690)		
Public Admin. & Defense	-0.0524 (0.0452)		
Education	0.0123 (0.0453)		
Health & Soc. Work	-0.0245 (0.0540)		
Other Communication	-0.277*** (0.0566)		
Private HH	-0.248** (0.100)		
age		0.0270*** (0.000968)	
Years of Education		0.0743*** (0.00200)	
Female		-1.549*** (0.0238)	
Family Member living Abroad		-0.346*** (0.0616)	
lambda		-0.0673*** (0.0247)	
Constant	-0.316*** (0.0769)	-1.419*** (0.0443)	
Observations	19,444	19,444	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

† Rates of returns are calculated using equation 2

Table 11 - Access to Technology - PC interactive dummies			
2006			
VARIABLES	Wage Equation lnwage_hr	Labor Participation in_laborf	ROR [†]
Read & Write	-0.0275 (0.0394)		
Primary	0.0724** (0.0361)		1.68%
Preparatory	0.176*** (0.0471)		3.51%
General Secondary	0.273*** (0.0889)		3.29%
3-year Vocational - Agriculture	0.314*** (0.0531)		4.71%
3-year Vocational - Industry	0.270*** (0.0395)		3.18%
3-year Vocational - Commerce & Oth.	0.297*** (0.0376)		4.12%
5-year Vocational Education	0.439*** (0.139)		5.40%
Post Secondary	0.482*** (0.0502)		7.22%
4-year University	0.560*** (0.0447)		7.44%
5-year University	0.736*** (0.101)		9.70%
Post Graduate	0.772*** (0.126)		7.32%
Read & Write - PC	0.00665 (0.234)		
Primary - PC	0.0206 (0.211)		
Preparatory - PC	-0.151 (0.156)		
General Secondary - PC	0.232 (0.259)		
3-year Vocational - Agriculture - PC	0.164 (0.349)		
3-year Vocational - Industry - PC	0.204** (0.0806)		10.44%
3-year Vocational - Commerce & Oth. - PC	0.275*** (0.0639)		14.11%
5-year Vocational Education - PC	0.905** (0.370)		26.31%
Post Secondary - PC	-0.0339 (0.0856)		
4-year University - PC	0.200*** (0.0395)		12.95%
5-year University - PC	0.168 (0.126)		
Post Graduate - PC	0.479*** (0.174)		25.90%
Experience	0.0361*** (0.00239)		
Experience ²	-0.000450*** (4.27e-05)		
Medical Insurance	0.174*** (0.0381)		
Formal Labor	0.128*** (0.0349)		
Member of Trade Union	0.219*** (0.0226)		
Married	0.0515** (0.0249)	0.637** (0.0279)	
Training	0.109*** (0.0206)		
Alex & Canal Cities	-0.0503* (0.0304)	0.00803 (0.0411)	
Upper Egypt	-0.0733*** (0.0254)	0.106*** (0.0339)	
Lower Egypt	-0.0598** (0.0252)	0.129*** (0.0334)	
Public Sector	0.118*** (0.0408)		
Private Sector	0.196*** (0.0377)		
Other Sec. of Employment	-0.0467 (0.134)		
Fishing	0.205 (0.125)		
Mining & quarrying	0.453*** (0.132)		
Manufacturing	0.0157 (0.0369)		
Electricity Gas & Water	0.187*** (0.0722)		
Construction	0.308*** (0.0391)		
Whole Sale & Retail Trade	-0.101** (0.0393)		
Hotels & Restaurants	0.0844 (0.0544)		
Transp. Storage & Comm.	0.183*** (0.0408)		
Financial Intermediaries	0.523*** (0.0716)		
Real Estate	0.0377 (0.0690)		
Public Admin. & Defense	-0.0547 (0.0452)		
Education	0.00718 (0.0453)		
Health & Soc. Work	-0.0159 (0.0540)		
Other Communication	-0.279*** (0.0566)		
Private HH	-0.249** (0.100)		
age		0.0270*** (0.000968)	
Years of Education		0.0743*** (0.00200)	
Female		-1.549*** (0.0238)	
Family Member living Abroad		-0.346*** (0.0616)	
lambda		-0.0669*** (0.0247)	
Constant	-0.304*** (0.0770)	-1.419*** (0.0443)	
Observations	19,444	19,444	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
† Rates of returns are calculated using equation 2

Table 12 – Access to Technology and Rates of Return

ROR (2006)	With PC	Without PC
Voc. Sec. Industrial(3-Yrs)	10%	3.18%
Voc. Sec. Commerce & Other(3-Yrs)	14%	4.12%
Vocational Sec. (5-Yrs)	26%	5.40%
University (4-Yrs)	13%	7.44%
Post Graduate	26%	7.32%

Table 13- Wage Variability by Level of Education

Log Hourly Wages 2006	Mean	Range	S.D.	C.V
Illiterate	0.574356	7.363491	0.698594	1.216308
Read & Write	0.605313	7.087198	0.700891	1.157898
Primary	0.600967	7.815974	0.717499	1.193908
Preparatory	0.68016	5.49931	0.674432	0.991578
General Secondary	0.719294	3.534729	0.726791	1.010423
Voc. Sec. Agr.	0.762449	7.060184	0.914658	1.199632
Voc. Sec. Ind.	0.713535	7.020302	0.707029	0.990882
Voc. Sec. Comm.	0.816916	8.064637	0.908271	1.111829
Vocational Sec. (5 Yr)	1.061099	4.237093	0.947272	0.892727
Post-Secondary	1.03215	6.560169	0.850148	0.823667
University (4-Yr)	1.110068	7.536291	0.818655	0.737482
University (5-Yr)	1.504037	6.340902	0.820116	0.545276
Post Graduate	1.536158	3.444239	0.909388	0.591989
Total	0.813368	9.3174	0.815371	1.002462

Figure 1 – Rates of Return, 1998 and 2006

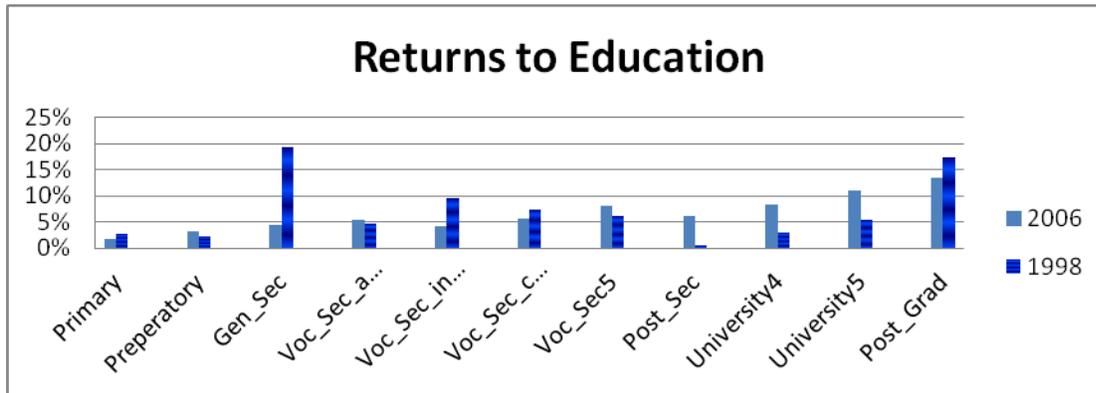
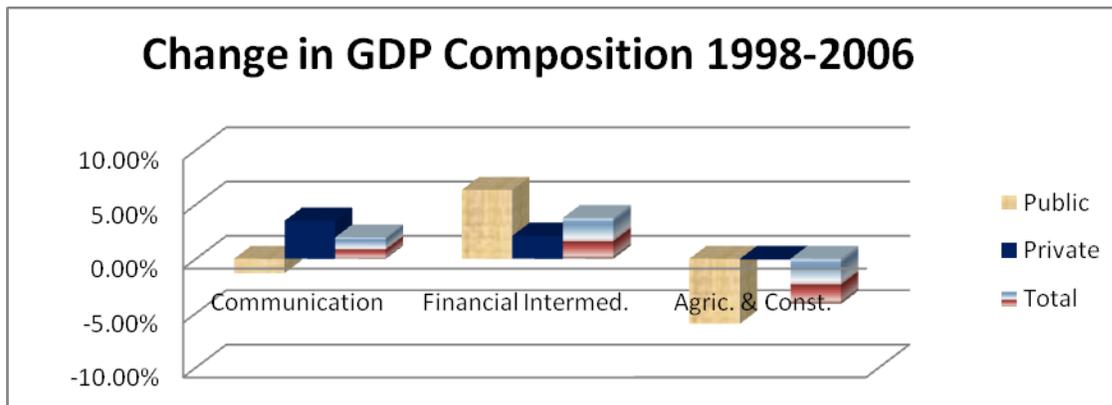
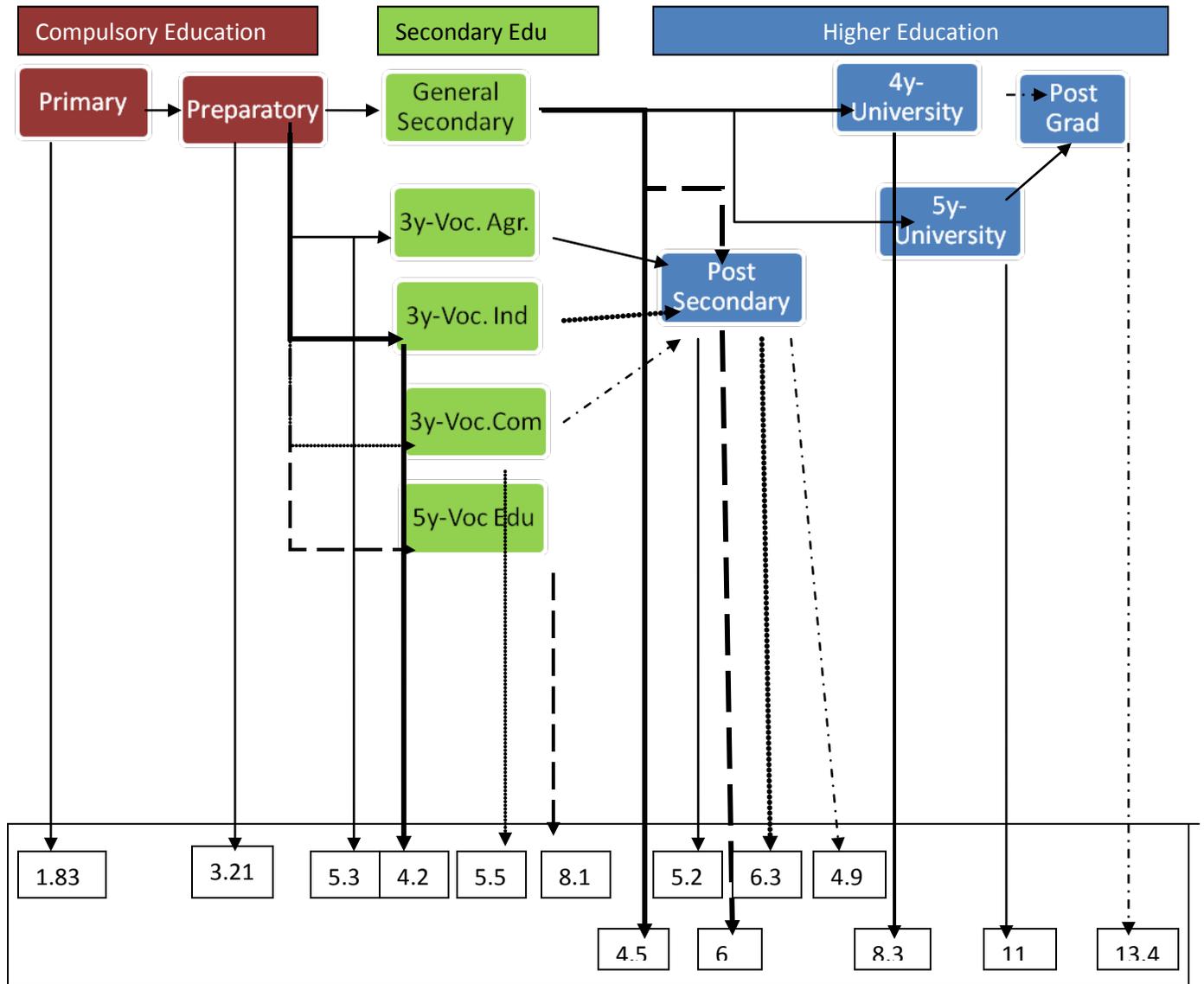


Figure 2 - Structural Changes in the Economy



Source: Authors' calculations.

Figure 3 – Educational Paths and Returns to Education



- The figures in the squared brackets are rates of return to education for the year 2006.
- Intermediate level corresponds to Secondary education, while above intermediate is above secondary and below university.

Figure 4 – Returns to Education for Males, 1998 and 2006

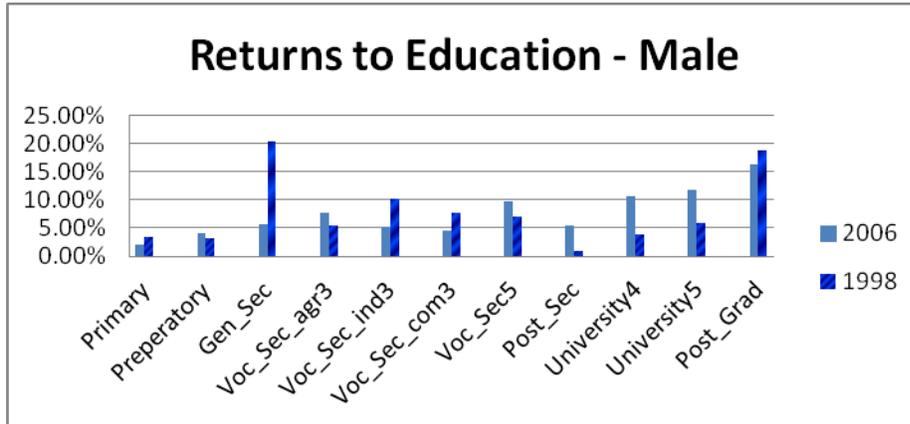


Figure 5 – Returns to Education for Females, 1998 and 2006

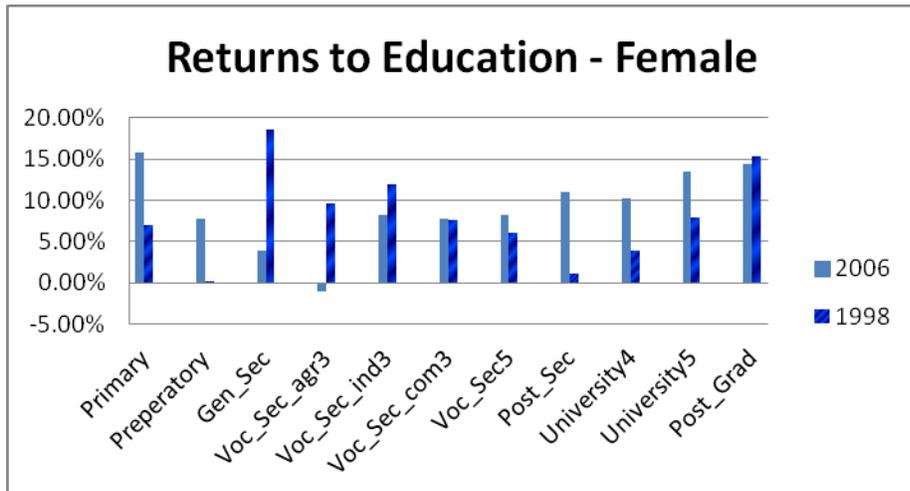


Figure 6 – Returns to Education by Gender, 2006

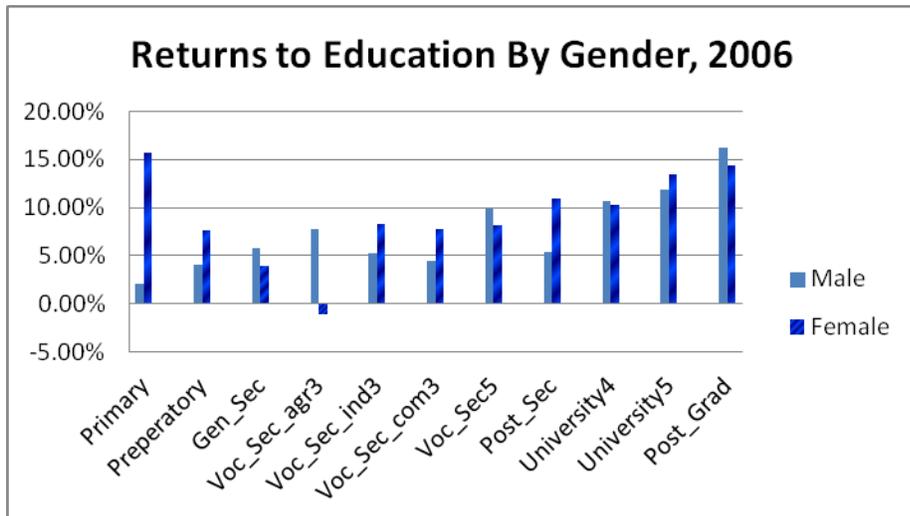
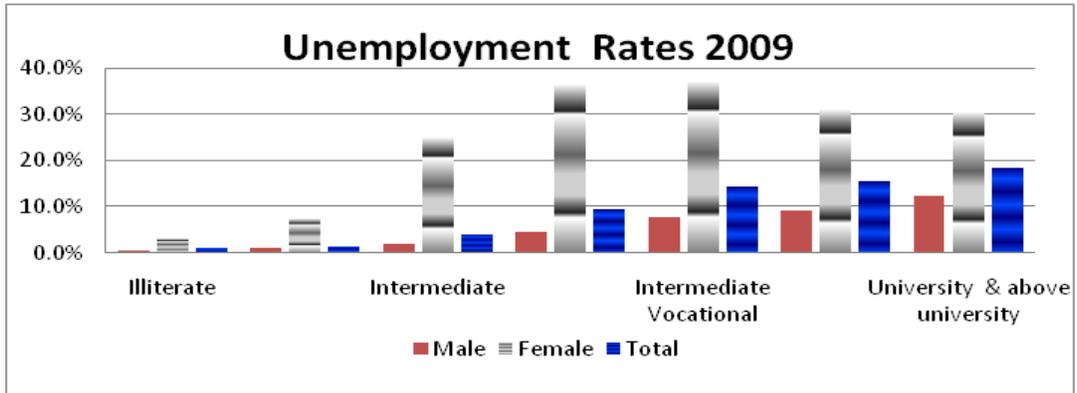


Figure 7 - Unemployment Rate by Level of Education and Gender



Source: CAPMAS.

References

- Assaad, R., and C. Binzel. 2009. The Impact of International Migration and Remittances on the Labor-Supply Behavior of Those Left behind: Evidence from Egypt. German Institute for Economic Research.
- Barrera-Osorio, F., and L. Linden. 2009. The use and misuse of computers in education: Evidence from a randomized experiment in Colombia, Policy Research Working Paper Series 4836, World Bank, Washington, D.C.
- El Arabi, A. 2010. Determinants of the demand on education in Egypt. Partners in Development Conference.
- El-Hamidi, F. 2006: General or Vocational Schooling? Evidence on School Choice, Returns, and 'Sheepskin' Effects from Egypt 1998, *The Journal of Policy Reform*, 9:2,157-176
- Labor Force Survey. Central Agency for Public Mobilization and Statistics. Republic of Egypt. Various surveys.
- Lallemand T., and F. Rycx. 2006. Establishment Size and the Dispersion of Wages: Evidence from European Countries. *Applied Economics Quarterly* 52(4): 309-36.
- Thierry Lallemand & François Rycx, 2005. "Establishment Size and the Dispersion of Wages: Evidence from European Countries," IZA Discussion Papers 1778, Institute for the Study of Labor (IZA).
- Martins and Pereira (2004). Does education reduce wage inequality? Quintile regression evidence from 16 countries", *Labor Economics* 11 355- 371
- Nelson, R., and E. Phelps. 1966. Investment in humans, technological diffusion, and economic growth. *American Economic Review: Papers and Proceedings* 51(2): 69-75.
- Patrinos, H. , C. Ridao-Cano, and C. Sakellariou. Estimating the returns to education: accounting for heterogeneity in ability. The World Bank. Working Paper Series WPS 4040. October.
- Psacharopoulos, G., and A. Patrinos. 2004. Returns to investment in education: A further update. *Education Economics*, Taylor and Francis Journals, 12(2): 111-34.
- Rosenzweig, M. 2010. "Microeconomic approaches to development: schooling, learning and growth." *Journal of Economic Perspectives*. (Summer): 81-96.
- Said, M. 2007. The fall and rise of earnings and inequality in Egypt: New evidence from ELMPS, 2006. Economic Research Forum. Working Paper # 0708.
- Tansel, A. 1995. Returns to investment in education in MENA region. Economic Research Forum. Volume 2.
- Teal, F., and G. Kahyarara. 2008. The returns to vocational training and academic education: Evidence from Tanzania. *World Development* 36(11).
- Wahba, Jackline. 1996. Earnings and Regional Inequality in Egypt. Economic Research Forum Working Paper Series No. 9613, Cairo.

- World Bank. 2010. Productivity and other performance measures in Egyptian firms. World Bank. June.
- World Bank. 2011. "Can computers help students learn?" From Evidence to Policy, Number 4, January.