Microeconomic Analysis of Private Returns to Education in Egypt: An Instrumental Variable Quantile Regression Approach

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This study provides updated estimates for the rate of return to an additional year of schooling in Egypt. Additionally, it addresses the major issues of heterogeneous returns and endogeneity of educational attainment. Instrumental Variable Quantile Regression along with other models are employed for that objective. The paper uses the most recent issues of the Harmonized Labor Force Survey (HLFS) and Egypt Labor Market Panel Survey (ELMPS) from 2008 to 2018. The findings can be summarized as follows; the returns increase over time up to 2015 then decreases to reach 5.67% in 2018, a number that falls below the global average. Moreover, females' returns to education are higher than males; the returns are also higher in urban areas compared to rural ones providing an evidence that there exists developmental bias towards urban regions in Egypt. In line with preceding studies, the instrumental variable two-stage least squares estimates are higher than the ordinary least squares' estimates. Additionally, a confirmation of heterogeneous returns across the wage distribution is presented. The instrumental variable quantile regression estimates exhibit an increasing pattern across the levels of wages. Thus, the less able individuals gain lower marginal profits of education than do the more gifted employees. Indicating complementarity between education and unobservable characteristics and that education may aggravate wage inequality in Egypt. Furthermore, it confirms the presence of the over education crisis. Moreover, the region-based results in terms of the ability explanation provide that education complements low ability in rural areas while it compensates it in urban ones.

Keywords: returns to education, endogeneity, heterogeneous returns, instrumental variable quantile regression, wage distribution, Egypt.

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Introduction

The education of the workforce of a country is regarded as an essential step towards economic growth, poverty alleviation and global competitiveness (Elsayed & Marie, 2021). Besides, at the microeconomic level, the outcomes of the individual's labour market are clearly linked to his or her education. Yet, a huge barrier to investment in education is chiefly driven by credit constraints

that are faced by poorer households (Elsayed & Marie, 2021). Consequently, it is very important to examine the relation between the educational sector and the labour market. Moreover, the question of whether education influences people differently across the wage distribution is considerably less understood (Balestra & Backes-Gellner, 2017).

On another horizon, Egypt has faced a huge rise in population by mid-1970, consequently, the number of students enrolling to school has grown by more than 50% (Elsayed & Marie, 2021). As a result, a fundamental policy implying the reduction of compulsory years of education –from six to five– was imposed in 1990. According to Elsayed and Marie (2021), this policy lessened educational costs and resulted in increasing the levels of investment in human capital as well as lowering gender inequalities.

The estimation of the Rate of Return to Education (RORE) has been an area of great interest for several decades. For the studies that have estimated the private RORE on a global level, there has been no consensus regarding whether returns are higher for primary, secondary or tertiary education. Concerning the estimates of the Middle East and North Africa (MENA) region, several papers found the return to tertiary education to be the highest (Pscaharapoulos, 1994; Pscharapoulos & Patrinos, 2004; Rizk, 2019). Colclough et al. (2010) also concluded the same for African countries. On the other hand, Tzannatos et al. (2016) found the RORE to be the highest at the primary level for Arab countries. Montenegro and Patrinos (2014) reached similar conclusion for the MENA region.

Further, regarding the RORE across the distribution of the wage, possible heterogeneous returns of schooling on wages were discovered. In addition, another issue concerning the endogeneity of educational attainment was revealed (Balestra & Backes- Gellner, 2017). Consequently, the two previously stated matters often complicate the estimation of the impacts of educational attainment on the earnings distribution.

As a result, the objective of this research is to estimate the private RORE in Egypt to understand how education affects the earnings and to address the two major issues of

heterogeneous returns to education and endogeneity of educational attainment. For that purpose, the most recent available issues of the Harmonized Labor Force Survey (HLFS) and Egypt Labour Market Panel Survey (ELMPS) from 2008 to 2018 are employed. Due to the relevance of the Quantile Regression (QR) to the analysis of the RORE across the different points of the wage distribution, one of the main contributions of this work is to examine the potential effects of education and various unobserved factors such as ability and social skills on earnings using QR. Not only this, but also the Instrumental Variable Two-Stage Least Squares (IV-TSLS) that addresses the endogeneity issue and the Instrumental Variable Quantile Regression (IVQR) that targets heterogeneity and endogeneity problems concurrently, will be applied. Afterwards, the results of the standard Ordinary Least Squares (OLS), IV-TSLS, QR and IVQR will be compared to determine whether taking heterogeneity and endogeneity into consideration changes the findings and conclusions. It is worth mentioning that this is the first Egyptian study to conduct an IVQR on this subject matter.

The paper is structured as follows. It starts with presenting the relevant literature followed by the employed methodology. Subsequently, the utilized datasets are listed. The following section provides some descriptive statistics. Afterwards, the results are presented and discussed. Finally, the conclusion and some policy recommendations are presented.

Literature Review

Estimating the RORE has been a prevalent topic of interest. Previous studies have employed different modelling techniques to estimate the Mincer earnings equation; OLS, IV-TSLS, QR and IVQR. So, the literature is classified as follows. Firstly, the findings of the studies that utilized OLS are presented, then the findings of the studies that have estimated RORE for Egypt specifically, then the studies that have performed QR analysis and finally IVQR methods.

Speaking of the OLS results of the simple Mincerian equation, Montenegro and Patrinos (2014) estimated the schooling returns for 139 economies. They reported an average RORE of

10% between 1970 and 2013 for the whole sample. Regarding males and females' estimates, the RORE was 9.6% and 11.7% respectively for the studied sample as a whole. Similarly, Tzannatos et al. (2016) estimated educational returns for 22 Arab countries. The estimates were between 5.8% and 6.3% for women and between 5.2% and 5.3% for men. In 2018, Psacharopoulos and Patrinos estimated the RORE over the years 1950 to 2014. They claimed that the returns have been increasing since 2000 to reach about 9.1% on average. It was found to range from 5.7% in the MENA region to 11% in Latin America. Further, the returns to male education were found to be 2% less than females'. Many studies concluded that females returns are higher such as Patrinos, Psacharopoulos & Tansel, 2019; Psacharopoulos & Patrinos, 2018; Barouni & Broecke, 2014 among others.

Moving on to the returns at the different levels of education using the extended Mincer model, Psacharopoulos (1994) have indicated that the private RORE was the highest for the tertiary level compared to the primary and secondary levels in the MENA region, estimated at 17.4%, 15.9% and 21.7% for the primary, secondary and tertiary levels respectively. Contradicting their global estimate, which indicated that returns to the primary level are the highest. In 2004, Psacharopoulos and Patrinos found the returns to primary education to be the highest on a global level with 26.6%. Colclough et al. (2010) reviewed the outcomes of previous literature spanning 1960 to the early 2000s for 31 countries. They calculated the RORE for African countries to be 8.9%, 9.7%, 14% and 22.7% for primary, lower secondary, upper secondary and tertiary levels respectively.

For the case of Egypt, in 2019, Rizk estimated a 5% RORE in Egypt in 2010/2011. It was detected that the average RORE was higher for females. The return to university education was 8.6%, which is the highest. The rate of increase in earnings was 2.3%, 4.1% and 5.3% for basic, secondary and post-secondary levels respectively. Using data of 2012, Assaad et al. (2016) estimated the RORE for males of ages 20 to 45 in Egypt after the policy reform of lessening compulsory years of schooling to 5 years instead of 6 years. The study disclosed that this

procedure affected males' completed years of schooling negatively whilst, the influence of it on females' educational attainment was insignificant. In addition, the IV-TSLS estimated the RORE of the studied sample of males to range between 2% to 5.7%.

In 2014, Barouni and Broecke concluded that, for 2006, the return to basic education was the lowest. In addition, the return was found higher for women. A similar effort was conducted by Krafft (2013) who focused on the returns to vocational education in Egypt in 2012. A 4.1% RORE was estimated for males. Further, the returns to vocational secondary and university education relative to no education were 10.5%.and 44.7% respectively. Likewise, Salehi-isfahani (2009) estimated a 5.3% RORE in Egypt for 2006 for men. The study showed that returns to basic education, upper secondary, vocational and tertiary levels relative to less than primary were 8.6%, 4.4%, 3% and 7.5% respectively. In their study, Salehi-Isfahani et al. (2009) conducted a comparison of private RORE of urban males in Egypt, Iran, and Turkey during the period 1987 - 2006 using the same methodology- a modified version of Mincer earnings function. The sample was limited to full time urban male-workers aged 20–54 who are salary earners. The RORE in Egypt was found to be about 5.3% in 2006 compared to 12.4% and 7.6% in Turkey and Iran respectively. In addition, regarding the returns at different levels of schooling, the study demonstrated low returns to vocational training as compared to general upper secondary in Iran and Egypt. The authors claimed that such a finding may be due to how students are being chosen at vocational and general upper secondary education. Moreover, the increasing competitiveness in the three countries across time may have increased earnings on university education and in rare cases to vocational education, but not to secondary school. An interesting finding was revealed by El-Hamidi (2006) using data for 1998 in Egypt. It was disclosed that male-returns to vocational education are higher than general secondary by 29%. While the respective difference for females was merely 4%. The study explained such outcome by the possible fact stating that academic secondary is not reviewed as a terminal degree. Moreover, male graduates of higher institutes

were found to earn more than their vocational secondary peers by 11%. Yet, the corresponding value of females was 3%.

If RORE is constant regardless of the wage distribution, OLS is adequate to estimate it. Otherwise, if the influence of education is heterogeneous across the wage distribution, the estimated RORE can be biased. Accordingly, QR is used to examine that heterogeneous impact at different points of the wage distribution. In addition, the wage distribution reflects education and unobservable factors such as ability and social skills. That is, individuals at the bottom of the wage distribution are susceptible to have lower education and lesser endowment of unobservable skills (Knight & Song, 2003). Recently, the applied literature is interested in investigating whether the effect of education is independent of these unobservable characteristics, compensates for them or complements them (Fiszbein, et al., 2007).

Using QR, most of the literature indicates that the RORE is different across quantiles of wage leading to three possible situations. First, education complements low skills, thus a larger effect is observed at the top of the wage distribution than at the bottom. Second, education compensates for these unobservable low skills, therefore larger effect should be found at the bottom of the wage distribution. Finally, the effect of education is independent of these unobservable skills, therefore, RORE is constant at the different points of wage distribution and the OLS estimates are enough (Walker & Zhu, 2001).

Regarding the first finding, in 2004, Martins and Pereira estimated the RORE for 15 European countries over the period (1980-1995) and indicated that the RORE is higher at the top of the wage distribution than at the bottom for 11 out of the 15 European countries. These results suggest a positive interaction between schooling and ability. Moreover, the QR estimates of South Africa (Mwabu & Schultz, 1996); deduced that among whites, returns to higher education increase from 9% to 18% with increasing percentiles of the earnings distribution. Likewise, Arabsheibani, et al. (2003) estimated the returns for men in Brazil in 1988, 1992 and 1998, and found that, RORE is very high, ranging from 7% to 26% depending on levels of experience and

education. Similar results are obtained for Argentina by Fiszbein, et al. (2007). The paper concluded that men in higher quantiles have higher returns.

Martins and Pereira (2004) reviewed the possible reasons for the positive relation between the RORE and percentiles of the wage distribution. The first is *over-education*, since highly educated workers take low-skilled jobs with low wage; therefore, low wage is related to low RORE. The second is ability, that is, if education enhances *ability*, the RORE may compound the effect of education and ability together. Therefore, higher wage could be due to higher education and more ability, and vice versa. Differences in school quality is the third possible cause. Mincer model only takes into consideration the differences in schooling quantity, ignoring the effect of quality.

The second finding exists when education compensates for the unobservable low ability and skills. Mwabu and Schultz (1996) indicating that in South Africa in 1993, schooling and ability are substitutes for African males at the primary level. For this group, returns are about 10% - 13% for the lower half of the deciles, and they diminish for the upper half. These quantile estimates indicate that there would be significant returns to extending primary education to the less educated and less able Africans (Knight & Song, 2003). Similar results are underlined for women in Argentina. Fiszbein, et al. (2007) asserted that returns are the highest at the lowest quantile, meaning that education is a substitute for ability in the case of Argentine women.

Among the leading works that utilized the QR in Egypt is (Jemmali & El Hamidi, 2018). The study investigated the schooling earnings differentials among college and non-college graduates who are wage earners aged 18-30 years in Egypt for the years 2006 and 2012. College graduates were detected to get higher hourly wages than their non-college peers. Specifically, the RORE was found to be around 8% and 14.2% for college degree holders in 2006 and 2012 respectively. Moreover, on average, university graduates' earnings are 27.7% and 19.8% higher than their non-college counterparts in 2006 and 2012 respectively demonstrating a declining average wage gap amongst the two groups over years. Yet, this wage gap is not uniform across

the earnings distribution. Such wage gap was attributed more to discrimination factors – represented by uneven returns to covariates– than endowment factors –measured through variances in productivity characteristics.

According to Balestra and Backes-Gellner (2017), QR application in researches of returns to education has been bounded for many years due to the dilemma of endogeneity. Yet, recent efforts by Chernozhukov and Hansen (2008, 2013) offered IVQR methodology that can handle endogeneity and heterogeneity issues at the same time. While the IVQR technique has been useful in many researches in economics, it is quite novel to educational returns literature.

Among the few scholars who applied the IVQR are Balestra and Backes-Gellner (2017). The RORE at different points of the distribution of wage in Switzerland was estimated. Beginning from the QR estimation, an increase in the estimates of returns in the quantile index was found, while once the endogeneity of education is introduced through IVQR, higher returns at the lower quantiles were detected. They picked the reform on obligatory education expansion as an instrument for years of schooling. The study claimed also that the scarce researches which have employed IVQR to study RORE, unveiled varied results.

Wang (2013) applied the IVQR method to estimate RORE over the entire wages' distribution in urban China. Spouse education was selected as an IV. The study disclosed that returns are higher for individuals in the lower part of the wages' distribution ranging from 5.1% at the lowest quartile to 3.1% at the highest quartile. Moreover, the results revealed that educational returns are greater for females than for males over the distribution. The results also claimed the presence of added impacts of education on earnings. In a like manner, Arabsheibani, et al. (2012) utilized IVQR to Russian data and realized that the IV estimates of the RORE are higher than the OLS ones. Increasing returns across the conditional earnings' distribution was found. For instance, they estimated 15% return at the highest decile and 5% at the lowest decile.

Likewise, Chletsos and Roupakias (2018) investigated the association between schooling and the variance of male earnings in 2006 and 2016 using the IVQR. Spouse educational

attainment was selected as the IV. They revealed higher returns at lower quantiles in the pre-crisis period, while the contrary holds true in the post-crisis time. The results advocate that the returns are underestimated when the endogeneity problem is not accounted for. Caluban (2016) spotted the returns across the several income distribution parts. The study made use of the Two-Stage QR to get more precise and unbiased estimates of educational effect on earnings in the Philippines in addition to OLS and QR models. The family size, parental education and wealth of the household were selected as the IVs. The outcomes provided that returns to education rise over deciles of wage, meaning that schooling aggravates wage inequality. Consequently, those at the lower deciles may choose to work instead of seeking higher education, as the short-term returns of work are bigger than the long-term ones.

Methodology

Over the years, returns to education have been estimated using two methods: the "full or discounting" and the "Mincerian earnings function" (Psacharopoulos & Patrinos, 2018). The first one is the most appropriate for estimating the RORE as it considers the most important part of employee's early earnings history, however, it is very data consumptive. Therefore, researchers have resorted to the less data-demanding method (Psacharopoulos, 1994) and adopted the Mincerian function method (Mincer, 1974). To achieve the goal of the paper, the RORE is estimated using the Mincerian earnings function using OLS regression, IV- TSLS, QR and IVQR. The OLS estimates will be employed for comparison, as concentrating on the OLS findings solely, possibly produce under- or overestimated results.

Ordinary Least Squares Regression

The study makes use of two versions of Mincer function; namely, the basic and the extended versions. The basic model is as follows:

$$\ln W_i = \beta_0 + \beta_1 S_i + \beta_2 E_i + \beta_3 E_i^2 + \varepsilon_i \quad (1)$$

where W_i is the hourly or monthly wage for the i^{th} individual; S_i is years of schooling; E_i is labor market experience (age - S_i - 6); E_i^2 is experience-squared; and ε_i is a random disturbance term. A semi-log form is used for our models, especially log linear form. Therefore, β_1 can be viewed as the average rate of return to schooling. Whilst, β_2 and β_3 represent on the job experience and training effect on earnings.

While, the extended version of the function follows the below equation:

$$\ln W_i = \beta_0 + \beta_{1j} D_{ij} + \beta_2 E_i + \beta_3 E_i^2 + \varepsilon_i \qquad (2)$$

The extended earnings function is used to estimate returns to different levels of schooling, by converting the continuous years of schooling variable S_i of equation (1) into a polytomous categorical variable D_{ij}. where D_{ij} is a categorical variable taking the values of 1 to 7 if the i^{th} individual is falling in one of eight categories: illiterate (omitted group), primary, preparatory, academic secondary, professional/vocational secondary, post-secondary, university and postgraduate. Consequently, β_{1j} denotes the cumulative return to each educational level as compared to being illiterate. Additionally, the marginal returns are calculated as the difference between return to one level of schooling and the preceding level. Moreover, annualized marginal returns are obtained by dividing the marginal returns for each level by the mean number of years of education for each level.

Throughout the paper, it is assumed that the opportunity cost (that is, the earnings foregone while studying) is the only cost of education. Although this assumption reduces the realism of the estimates to some extent, it is worth mentioning that: most studies do not include the direct costs of education (fees, the cost of books, uniforms and so on). Further, the opportunity cost is the highest cost invested in education. Therefore, we do not think this assumption to be a limitation of the work. Furthermore, a significant assumption of OLS is that the regressors are exogenous.

Yet, if this assumption is not met and the regressors are correlated with the error term then, the OLS estimates will be biased and inconsistent.

Two-Stage Least Squares

The 2-stage least squares that was established by Henri Theil and Robert Basmann can be used to tackle the endogeneity dilemma. In other words, it eliminates the potential correlation between the explained variable and the error term. This is accomplished by including two consecutive applications of OLS. The first stage encompasses regressing the endogenous independent variable on the instrument(s) and the independent variables. The second step implies regressing the dependent variable using the estimates of the first regression in which endogeneity has been accounted for and this is adequate to eradicate endogeneity bias.

Quantile Regression

Estimation of educational effects on wages is usually constrained by two potential issues. One is heterogeneity in returns to education. The QR enables to examine the impact of schooling at different parts of the wage distribution, conditional on particular values of the other utilized covariates. Hence, the within-group heterogeneity in returns can be estimated. Further, the estimated returns can be compared to deduce the magnitude of schooling effect on wage inequality because of other unobservable factors (Walker & Zhu, 2001).

The QR method was introduced by Koenker and Basset (1978). In a wage equation, the QR model can be written as:

$$\ln W_i = X_i\alpha_\theta + \beta_{1\theta}S_i + u_{\theta i} \quad (3)$$

$$with \quad Quant_\theta(\ln W_i | S_i, X_i) = X_i\alpha_\theta + \beta_{1\theta}S_i \quad (4)$$

where X_i is the vector of explanatory variables other than years of schooling; (1, E_i and E_i^2), α_θ is the return to X at the θ^{th} quantile and $\beta_{1\theta}$ is the RORE at the θ^{th} quantile. $Quant_\theta(\ln W_i | x_i)$

denotes the θ^{th} conditional quantile of $\ln W_i$ given x_i. The θ^{th} regression quantile, $0 < \theta < 1$, is defined as a solution to the problem:

$$\min_{\beta \in R^k} \left\{ \sum_{i:ln\, W_{i \geq x_i \beta}} \theta |\ln W_i - x_i \beta_\theta| + \sum_{i:ln\, W_{i < x_i \beta}} (1-\theta) |\ln W_i - x_i \beta_\theta| \right\} \quad (5)$$

The θ^{th} quantile is derived by solving the above problem using linear programming methods (Martins & Pereira, 2004). Assuming independence between the schooling variable and disturbance term may be too strict due to the unobserved earnings' determinants. Hence, to consider the probable dependence between education and the error term, the IVQR approach developed by Chernozhukov and Hansen (2008, 2013) can be applied.

Instrumental Variable Quantile Regression

Since the true effect of schooling on earnings cannot be assessed without handling the bias caused by the endogeneity issue, IVQR must be applied to estimate the causal impact of education across the conditional earnings' distribution, thus allowing for quantile-specific intercepts and slopes (Balestra and Backes-Gellner, 2017). However, addressing heterogeneity and endogeneity issues simultaneously constitutes larger challenge than dealing with each problem distinctly. Speaking of potential sources of endogeneity, it is argued that there are two possible causes; measurement error in education variable S and the omitted ability variable (Trostel, Walker and Woolley, 2002).

IVQR can resolve the heterogeneity and endogeneity biases simultaneously. The identification of the IVQR relies on the presence of a vector Z of instrumental variables that are statistically linked to S nonetheless independent of the error term. So, an assumption must be made that given the information (X, Z); the distribution of the disturbance term does not differ across the endogenous S. It is commonly known as rank similarity implying restriction on the variation in ranks among potential outcomes. It enforces the subsequent restriction:

$$Conditional\ on\ (X, Z),\quad \{U_s\}\ are\ identically\ distributed\ across\ \ s \in S \quad (6)$$

where U_s is the rank or error term accountable for the possible outcomes' heterogeneity between folks with the same observed characteristics. Rank similarity assumption implies a moment restriction as follows:

$$P\ [\ln(W_i)\ \leq\ Q_{\ln(W_i)}\ (\theta|X,S)\ |X,Z]=\ \theta \tag{7}$$

$$P\ [\ln(W_i)-X_i\alpha_\theta-\ \beta_{1\theta}S_i\ \leq 0|X,Z]=\ \theta \tag{8}$$

The moment condition given in (8) presents a statistical restriction for estimating the parameters α_θ and $\beta_{1\theta}$. Chernozhukov and Hansen expressed the problem as finding α_θ and $\beta_{1\theta}$ so that zero is the solution to the standard quantile regression of $[\ln(W_i)-X_i\alpha_\theta-\ \beta_{1\theta}S_i]$ on (X,Z) such that:

$$0=\ argmin_{f\in F}\ E\left[\rho_\theta\ \left(ln(W_i)-X_i\alpha_\theta-\ \beta_{1\theta}S_i-f(X,Z)\right)\right] \tag{9}$$

where F is the class of measurable functions of (X, Z). In practical application, F can be restricted to the values of Z_i such that $f\ (X,\ Z)\ =Z'_{\hat{\gamma}}$ (Balestra and Backes-Gellner, 2017).

The estimation includes a two-step procedure. For a given value of β_θ^j , the ordinary QR of $ln(W_i)-\beta_\theta^j$ on X and Z is run firstly to obtain the estimates $[\hat{\alpha}(\beta_{(\theta)}^j,\ \theta),\ \hat{\gamma}(\beta_{(\theta)}^j,\ \theta)]$. Second, we test $\hat{\gamma}(\beta_{(\theta)}^j,\ \theta)=0$ and save the corresponding F-statistic, Fj. Next, these two steps are repeated for all values in a pre-specified support for $\beta_{(\theta)}^j$ and the value that minimizes the F-statistic is the IVQR estimator $\hat{\beta}_\theta^{IVQR}$. After obtaining the $\hat{\beta}_\theta^{IVQR}$, the corresponding $\hat{\alpha}_\theta$ is retrieved. The resulting $\hat{\beta}_\theta^{IVQR}$ can be interpreted as the actual impacts on persons having fixed their level of unobserved heterogeneity at a given quantile. Once the IVQR estimates are obtained, they will be compared with the QR to determine whether addressing endogeneity alters the results and findings.

Validity Tests for Using Instrumental Variables

Prior to using IVs, endogeneity existence in the model must be checked. This can be done through

the Durbin and Wu-Hausman endogeneity tests (Caluban, 2016). In case of endogeneity, IV estimation is a possible solution. Given the broadly recognized endogeneity of educational attainment in the earnings' equation, selecting valid instruments to control for this problem is critical. Thus, finding proper instruments stays a subject of incredible discussion in the literature of returns to schooling. Mostly, an idealistic instrument ought to be correlated with schooling variable, yet be exogenous to the wage unobservable determinants (Balestra and Backes-Gellner, 2017).

The validity of the selected instrument can be tested by the Sargan-Basmann test. Additionally, applying the partial F-test of the joint significance of instruments and calculating its partial R^2 provides evidence about strength or weakness of an instrument. An F-statistic higher than10 indicates that the model contains a strong instrument and vice versa.

Data

In our analysis, we utilized two datasets, the HLFS and the ELMPS. The first is conducted by the Central Agency for Public Mobilization and Statistics (CAPMAS) and harmonized, cleansed and provided by Economic Research Forum (ERF). While, the latter is carried out by ERF in cooperation with CAPMAS. For the HLFS, the returns are calculated for the 2008, 2010, 2012, 2013, 2015, 2016 and 2017 and 2018 rounds. As for the ELMPS, 2012 and 2018 are utilized. It is worth mentioning that the IV-TSLS and IVQR will be applied together with the OLS and QR for 2012 and 2018 of the ELMPS because of data availability about the potential instruments. From each round, the sample is limited to individuals aged 15 to 65 years old, who are employees or wage workers including; full-time/regular, part-time/temporary and seasonal/irregular workers. This sample choice was due to the fact that their average working hours per week is almost identical (45 hours/ week). The returns to education are calculated using the hourly wage, which have been generated from the datasets using monthly wage and total working hours per week.

Descriptive Statistics

In this section, descriptive analysis for wage earners is presented. To start, as revealed by Table A-2 (online Appendix), wage earners (employees) account for almost 64% on average of the sample of working group aged 15-65 years for the studied years from 2008-2018. Besides, the corresponding percentages of employers, self-employed and family workers are 13%, 12% and 10%. Hence, it can be concluded that wage earners constitute the highest proportion of the labor market in Egypt overtime.

As seen in Table A-3 of the online Appendix A, the gender composition of employees reveals that male-workers represent 80% of the waged workers sample while females account for 20% on average. In addition, 54% of wage workers are rural area residents compared to 46% who live in urban areas (online Appendix A, Table A-3). Further, it can be seen from the sample of wage earners aged 15-65 that, on average 35% are public sector workers as compared to 59% private sector workers (See Table A-4, online Appendix A). Moreover, it can be noted that the percentage of public sector workers kept on decreasing from 40% in 2008 to reach 33% in 2018. On the other side, the proportion of private sector workers had increased from 54% in 2008 to 63% in 2018.

Moreover, it was detected that employees acquire about 9.9 years of schooling on average which is the highest compared to the average of 5.8, 7 and 5.4 years of education of employers, self-employed and family workers respectively (Table A-5, online Appendix A). Speaking of waged workers, full time and part time workers get about 11 years of schooling on average for the studied years of analysis (Table A-6, online Appendix A).

The analysis reveal that the mean of monthly nominal wage kept rising by 13.7% annually from 662 EGP in 2008 to 2,710 EGP in 2018. For the real wage, it seems that inflation is responsible for much of the increase in nominal wage, while the real wage increases by only 3%

annually from 823 EGP in 2008 to 1,142 EGP in 2018[1]. Speaking about hourly wage, it was found that its average is almost similar for males and females. Yet, males' mean monthly wage was found to be higher than females. This difference can be attributed to the variation in weekly working hours between males and females. The data indicate that males tend to work on average 4.5 hours/week more.

Regarding years of schooling, the mean value is 10.75, which is higher than the world average of 8.8 stated in Psacharopoulos and Patrinos (2018). It increased form 9.3 in 2008 to reach a maximum of 11.4 in 2015 then decreased to 9.9 in 2018. Further, females' average years of education found to be always higher than males. For levels of education, the highest proportion of individuals in the total sample hold a vocational secondary degree, with a share of 35% on average, followed by 21% with university degree. Further, the prevalent level of education among males was vocational secondary while the highest percentage of females had university education as depicted in Figure 1. It is shown that the proportion of females pursuing their studies at each level of education after secondary education is higher than males.

[Figure 1 here]

Results

Ordinary Least Squares Regression Results

Standard Mincer Model

The estimated RORE for the total sample, males and females across years of analysis are presented in Table 1. The results demonstrate that the marginal RORE is 5.1% on average for the studied years. Moreover, the estimated coefficients are lower than the private average global rate of 8.8% reported by Psacharopoulos and Patrinos (2018). Whereas, they fall around the presented

[1] Real wage is calculated using 2010 consumer price index as base year.

estimate of the MENA region of 5.7% (Ibid, 2018). Except for year 2012 which is considered an outlier[2], it is shown that the average RORE kept on increasing from 2.6% to 6.2% in 2015, then began to decrease continuously up to the end of the period to reach 3.30% in 2018. It is worth mentioning that the authors had estimated the RORE for the sample of full-time workers aged 15-65. The difference in the estimated RORE between the sample of all employees and that of full-time workers was solely 0.2% on average for the studied years.

Table 1: Rate of Return to Schooling (2008-2018)

This decreasing trend since 2015 can be attributed to the change in average years of schooling as mentioned earlier as the mean of the years of schooling has the same trend of the RORE.

In addition, the same trend is observed for both genders. Regarding gender differentials in returns, for males, one additional year of schooling increases RORE from 2.6% in 2008 to 5.8% in 2015. Then, the rate decreased gradually over time up to 3.1% in 2018. By way of contrast, for females, returns kept on increasing from 5.4% in 2008 to 9.4% in 2015, followed by a decrease to reach 6.3% in 2018. Importantly, the average RORE is almost 2.5% higher for females over the period of the study. Different returns between females and males may reflect different selection into labour market. It was found that they are not equally represented in the global labor force. Despite representing more than half of the adult population worldwide, females are underrepresented in the global workforce. Notably, in Egypt, a much higher fraction of females' labour force participants is university degree holders. Moreover, Psacharopoulos and Patrinos (2018) also found the same results – RORE for females is higher. They suggested that this does not mean that females earn more; rather female education is a better investment and should be a development priority when pursuing poverty alleviation. Besides, Harmon, Oosterbeek & Walker (2003) recognised that for the UK, Germany, Ireland, Italy and Greece the returns to women education are considerably higher.

[2] The first survey conducted after the 2011 revolution.

Regarding the different governorates, wide discrepancies exist from one city to another. The RORE for the Egyptian governorates in 2018, ranged from 1.3% to 5.7%. The highest belonged to Cairo, the Egyptian capital. While, Upper Egypt cities possess the lowest RORE. Therefore, more attention to these cities is needed to reduce such inequality.

The earnings functions are then estimated separately for the different economic sectors. Theoretically speaking, in sectors where productivity is dependent upon knowledge and qualification, education is highly appreciated. It was shown that returns are the lowest for those who work in the agricultural, construction, retail and transportation sectors where a large body of the less educated labor is employed, and higher education is not required. While, returns are the highest for those who work in the financial, ICT and health sectors where educational qualifications are highly important for employment.

The earnings function using the simple Mincer model in 2018 is as follows:

$$\widehat{lnW_i} = 1.544 + 0.035S_i + 0.024E_i - 0.00024E_i^2 \qquad (10)$$

As expected, the results indicate non-monotonic effect of experience on wage; it is positive at the beginning up to 49 years[3] of experience, and then it turns negative. This can be explained by the fact that workers after specific age might not comprehend technological changes in work and they might do not have the required skills to cope with the new changes in their jobs.

Extended Mincer Model

For the extended earnings function, as depicted in Table 2, the RORE for an extra year of schooling tends to increase with higher educational levels.

Table 2: Annualized Marginal Returns by Educational Level (2018, 2017, 2013, 2012)

[3] Taking the first derivative of lnW relative to experience and equalizing the results by zero, the optimal years of experience are 45 years, after that the effect of experience on wage turns negative.

The annual RORE rises from 1.4% at the primary to 2.2% at the preparatory and further to 5.3% at the academic secondary, reaching 8.2% at the university for 2012. All other years display almost the same pattern. As far as gender is concerned, at all levels of education, returns are higher for females as illustrated in Table 3. In 2018, females with a university degree had 49% higher returns. The absolute number of females in different levels of education in general is less than the number of males, which may be one reason for females higher RORE. For example: although the number of males and females almost the same in the ELMPS 2018 sample (30,542 and 30,688 for males and females respectively), the used sample - including only waged workers within 15 - 65 years old workers - has much more males than females. The numbers of males and females in the used sample are 10,294 and 1,927 respectively.

Table 3: Returns to Education by Level of Education and Gender (2018)

Instrumental Variable Quantile Regression

One of the study's objectives is targeting heterogeneity and endogeneity problems of estimating the RORE. Hence, QR is utilized to deal with the first problem, while the IV-TSLS targets the second. Moreover, the mentioned problems have been considered simultaneously using the IVQR. Yet, to apply the IV-TSLS and IVQR, endogeneity and the validity of the utilized instruments should be examined first. Table 4 presents the selected Instruments.

Table 4: Models' Instruments, 2018

Validity Tests for Using Instrumental Variables Results

For the IV estimates to be acceptable, the chosen instruments should pass some tests. The outcomes of first stage regression for 2018 are presented in Table 5. Moreover, the reduced form estimates are also presented in Table B-1, online Appendix B.

Table 5: First Stage Regression 2018 (Years of schooling is the dependent variable)

In addition, for validation of the instruments, three tests had been conducted. For instance,

endogeneity tests, tests of over-identifying restrictions as well as first-stage regression summary statistics. These tests are presented in Table 6.

Table 6: Tests of Validity, 2018

As expected from the literature and supported by the test of endogeneity, years of schooling variable is correlated with the error term of the estimated equation, thus it is considered as endogenous variable in all the models, with one exception of the rural model. Therefore, for this model, it is expected that the RORE would be more similar than other models. Otherwise, the IVQR avoids the problem of endogeneity and yields higher RORE than its QR counterparts.

Using two different test statistics, the null hypothesis of valid instruments and correctly specified models was not rejected at the 5% level of significance in all cases.

As illustrated from the employed first stage regression tests, the eigenvalue statistics is very big (much more than its critical values), therefore, the null hypothesis of the weak instruments are rejected in all the models at the 1% level of significance, indicating that the used instruments are strong. Moreover, the adjusted R^2 is good enough and significant in all models reflecting that the instruments have explanatory power for years of schooling variable.

Finally, the validity of instruments for IVQR is also examined by applying the first stage quantile regression at different deciles for all models as illustrated in Table B-2, Table B-3, and Table B-4, online Appendix B.

Aggregate Estimation Results

With the endogeneity issue and instrumental variables checked, the results from the employed models can be compared. Table 7 demonstrates the estimates of OLS, IV-TSLS, QR and IVQR for all models in 2018. All the models provide that education has a positive effect on earnings. After considering solely the problem of endogeneity through IV-TSLS, the estimated returns of the aggregate model are 2.13% higher than OLS estimates. Hence, the OLS regression fails to account for endogeneity and as a result, it underestimates the RORE. Balestra and Backes-Gellner (2017)

claimed that measurement errors in the schooling variables and the identification of local marginal treatment impacts are possible causes.

Table 7: Educational ROR (%) for all models (OLS, IV-TSLS, QR IVQR) in 2018

As mentioned earlier, the QR informs about the RORE across the wage distribution. By comparing OLS and QR models, the similarity or dissimilarity between the average effects of schooling with the ones at various quantiles can be assessed. After accounting for heterogeneous effects of schooling through QR, the estimates uncover non-similarity of RORE across the quantiles of the wage distribution. In 2018, there is a considerable increase in returns from 3.12% at the 0.1 decile to the highest returns of 3.75% at the upper decile. Markedly, the lowest RORE is present at the bottom decile. That is, the least earners have lower gains from pursuing an extra year of education. To put it differently, wealthier persons are more probable to get higher reward as a result of their investment in education. According to Balestra and Backes-Gellner (2017), the previous results provide that marginal effects may conceal useful information on the rest of the distribution. Notably, the results of 2018 are similar to the results of the Philippines (Caluban, 2016).

As seen from Table 7, QR underestimates the returns across the wage distribution as it considers education exogenous. Yet, the results of the IVQR reveal a similar picture as the QR that educational returns are not homogeneous across the earnings distribution. Moreover, the estimated returns increase over the different quantiles according to the IVQR. That is causal impact of schooling is less significant in the lower parts of the wage distribution becoming more significant at the top. In 2018, the RORE estimated by the IVQR is 5.37% at the 0.1 decile, increasing to 5.5% at the 0.25 one, rising to 5.6% at the median reaching 5.72% and 5.84% at the 0.75 and 0.9 quantiles respectively. Compared to QR estimates, the IVQR returns are 2.25%, 1.89%, 2.40%, 2.57% and 2.09% higher over the wage distribution in 2018.

These results are consistent with Caluban (2016) and Arabsheibani, et al. (2012) who discovered increasing returns across wage deciles according to the QR and IVQR in Philippine and Russia respectively. This literature provides that poorer persons portray and demonstrate lower returns to investments in education compared to their wealthier counterparts.

One possible conclusion is that education aggravates wage inequality. Hence, persons at the lower wage deciles may choose working instead of continuing higher education as the impact of education takes a longer time to be cultivated. This may be intuitive in a country where poverty is relatively high as Egypt. If individuals opt to join the labour market immediately, they will earn salaries, though lower, as soon as possible, which allows to obtain the basic necessities of life. Interpreting quantiles as the level of individual ability, if a larger effect is observed at the top of the wage distribution it is argued that education complements low skills. Thus, according to the previous results, education complements ability in Egypt.

Gender-Based Results

Table 7 presents the estimates of OLS, IV-TSLS, QR and IVQR for males and females in 2018 in different deciles.

In general, females' RORE is higher according to all regressions. Such a result would be explained by the heavier presence of females in the public sector. Further, it can be explained in terms of the double effect mentioned by Dougherty (2005) stating that education enhances both men's and women's productivity at the same time, yet it reduces factors contributing to the gender gap such as discrimination and preferences, such an effect pertaining to women only.

For males, yet, due to endogeneity, the estimates of the IV-TSLS are 75% higher than those of the OLS. For the results of the QR and IVQR, the same trend of monotonically increasing returns across the earnings distribution holds. The impact of employing the IVQR is the highest at the top end of the wage distribution, where the return reaches 6.53%. Similar to the general

findings in Egypt, male earnings are more pronounced for employees at the upper tail of the wage distribution.

Speaking about the female results, in the presence of endogeneity, the IV-TSLS coefficient is almost 57% higher than its OLS counterpart. Such findings uncover the magnitude of the effect of endogeneity existence in the model and the importance of addressing such problem to accurately estimate the RORE.

Regarding the QR and IVQR results, it is observed that the estimates of the IVQR are higher. Nevertheless, the returns to education exhibit the same trend based on both models. For instance, the RORE is decreasing over the wage distribution unlike the prevailing trend of the two previous models of Egypt and males. That is, the highest return of 12.49% is found at the lowest decile while the least return is 5.75% at the top decile.

Such results reveal that in terms of the ability interpretation, education is complementing little ability for male workers while it compensates it for females. Moreover, it indicates that education increases wages inequality for male employees, yet it lessens it among employed females. Hence, endeavours should be targeted to enhance the quality of education and invest more in those with lower ability - that is, compensatory education - could converse this trend. Further, female education is an essential step towards welfare and poverty alleviation. These outcomes are similar to the findings of Fiszbein, et al. (2007) in Argentina.

Region-Based Results

In 1977, Michael Lipton studied urban bias theory arguing that there exists developmental bias towards urban regions in the third world countries. Consequently, rural regions turn out to be economically poorer. According to Lipton, the most vital battle that the government in less developed countries should care for is the one prevailing between the rural and urban areas. So, if persons residing in urban region have greater returns to schooling, then urban bias is present. As a result, we divided the studied data further into sub-samples of rural and urban classes to

check if urban bias occurs in Egypt. The results of OLS, TSLS, QR and IVQR for urban and rural areas in 2018 across different deciles are demonstrated in Table 7.

Based on the results of the four models, employees who live in urban areas have higher returns. In terms of the OLS, for individuals living in a rural area the wage will increase by 1.9% lower rate than their urban counterparts. This is in line with the theory of urban bias, as more resources such as higher paying jobs and better schools can be found in urban regions, as mentioned earlier.

For the rural area models, the estimates of the QR and IVQR are so close due to the absence of endogeinty problem. Besides, the results of the QR in rural areas show an upward trend. It is 2.27% at the lowest decile, increasing to 2.42% at the median and reaches 3.4% at the top decile. Meaning that education can raise wage inequality in the rural regions. Such finding may be ascribed to the low-skilled type of occupations such as agriculture, fishing and construction that are prevailing in the rural areas. As these are skill-oriented jobs where education has minor effect on wages.

On the other hand, the estimates of RORE of urban residents in 2018 are 4.75% and 9.68% based on the OLS and IV-TSLS respectively. Hence, the effect of endogeneity is obvious. In addition, the IVQR estimates are higher than the QR across all wage deciles. However, their results show a monotonically downward trend over the wage distribution. That is, estimated values of RORE are greater in the lower tail of the wage distribution. Hence, the least earners are rewarded by larger gains from pursuing an extra year of schooling: therefore, they should invest in their education to increase their wages in the long run. That is, education decreases wage inequality in urban areas unlike the case in rural regions.

This difference in returns may be due to the fact that large companies are usually located in urban areas, so highly educated individuals have better chances of finding good jobs that provide suitable returns to their education, whereas good opportunities are harder to find in rural areas. Moreover, quality of education is higher in urban areas.

Conclusion

The aim of this study is providing updated estimates for the RORE in Egypt across genders, regions, and in different wage deciles and to address the major issues of heterogeneous returns to education and endogeneity of educational attainment. This is achieved through the utilization of the latest available issues of the HLFS and ELMPS from 2008 to 2018, as well as the application of OLS, IV-TSLS, QR and IVQR models to several different model specifications.

Our findings reveal that the average RORE in Egypt in the last decade ranged between 3.5% and 8.5%, falling below the global average of 8.8%. This could be related to the quality of the Egyptian educational system. Employers do not consider academic attainment to be a sufficient indicator for a prospective employee's skill and talent and may resort to personal screening and interviewing as an alternative. Another possibility is a mismatch between the supply and demand of graduates in the Egyptian labour market at tertiary level. The results also indicated that the highest return is associated with tertiary level. Education at the basic levels generally provides a range of social and nonmarket benefits while at the higher levels, most of the benefit is private and market-related. These results can also point to increasing emphasis being placed by employers on higher qualifications, with the best candidates being the ones to pursue education up to the tertiary levels where admission is competitive. Upon accounting for endogeneity through IV-TSLS, in accordance with the literature, the study's estimates of RORE found to be higher than the OLS by 76% in 2018. Reviewing the literature, Card (1999) revealed that the IV coefficients are 20-40% larger than their OLS counterparts. Such conclusion was also confirmed by Trostel et al. (2002).

Further, the results add significant evidence to the literature that the causal effect of education is not similar and that for each person, the effect may differ from the estimates broadly reported from the OLS or the IV-TSLS. That is, the returns vary according to the individuals' position along the earnings distribution and their unobservable wage determinants.

The paper employed an IVQR technique that addresses the prevailing problems of heterogeneous returns to schooling and endogeneity of educational attainment at the same time along with the QR. The results of both models showed that returns exhibit an increasing pattern across the wage levels. In 2018 the RORE estimated by the IVQR is 5.37% at the bottom decile rising to 5.84% at the top quantile. The IVQR returns are higher than their QR counterparts across the wage distribution. Providing an affirmation that endogeneity presence biases the estimates of the RORE even over the levels of earnings distribution.

According to the literature, the quantiles can be interpreted as the standard of individual's ability. Hence, the study's results may be interpreted as the positive association between the returns and ability. In particular, the less able employees obtain lower marginal profits of education. In addition, as returns are higher towards the top deciles, this indicates complementarity between education and unobservable traits such as ability and skills.

One conclusion is that education exacerbates wage inequality. Thus, persons at the lower wage deciles choose working not continuing higher education as its impact takes a longer time to be cultivated. This may be intuitive in a country where poverty is relatively high as Egypt. Another conclusion is the support of the existence of *over-education*, which is a crisis of higher education in Egypt according to Habibi and El Hamidi (2016). So, an enormous number of university graduates are whether unemployed or overeducated working in jobs that do not require their high education and skills. This catastrophe is not merely a labour market issue due to weak economic growth as even if Egypt experiences powerful economic progress and a big number of occupations is provided, only a fraction will demand university graduates.

For gender, the RORE is always higher for females, meaning that female education is an essential step towards welfare. One possible explanation of the latter result as indicated by Dougherty (2005) is that the better educated a female is, the more likely she is to be able to resist discrimination. Besides, it was claimed that the better education of a female may encourage her to seek employment outside the low-paying traditionally female occupations. Additionally, it is

possible that the better educated she is and the larger her potential earnings, the more capable she is of paying for childcare and other services that allow her to seek a wage offer that fully values her characteristics. Moreover, females usually choose to work in sectors where education is relatively highly valued.

In terms of the ability explanation, education is complementary to ability for males while it compensates it for females. Thus, investment in female education, is a very beneficial investment in Egypt that should be set as a developmental priority with several policies encouraging female school enrolment, whether through social security programs or societal awareness campaigns improving access to education. This result may be due to females' low labour market participation. If wages are less than expected, women prefer to take care of their family, as it is their main role according to the norms and values of the Egyptian society. However, men are responsible for spending on their families.

The RORE was found to be higher in urban areas providing an evidence that there exists developmental bias towards urban regions in Egypt. The results of the QR and IVQR in terms of the ability explanation provide that education complements low ability in rural areas while it compensates it in urban areas. This undermines the value of education in areas where little benefit would come from schooling, leading to inefficiency, as well as encourages migration to urban cities, which further exacerbates the problem of centralization and over populous cities. When faced with this issue, policy makers have the choice to provide incentives for employers to base their investments in rural areas, through tax cuts as an example as a step towards achieving equality of opportunity and nation-wide development.

Some areas have not been addressed and would be considered in future work. The comparison between RORE in Egypt and other countries in the MENA region or other regions can be examined. Once good data are available, the quality of education is an important factor to be included.

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List of Tables

Table 1: Rate of Return to Schooling (2008-2018)

Years	**RORE (%)**			**Source of data**
	Total	Male	Female	
2008	2.65	2.64	5.41	HLFS
2010	4.31	4.35	6.96	HLFS
2012	10.8	11.17	12.22	HLFS
2013	5.50	5.44	8.59	HLFS
2015	6.16	5.84	9.41	HLFS
2016	4.16	3.94	6.06	HLFS
2017	3.78	3.62	5.35	HLFS
2018	3.30	3.10	6.27	HLFS

Table 2: Annualized Marginal Returns by Educational Level (2018, 2017, 2013, 2012)

Level of Schooling	**2018**	**2017**	**2013**	**2012**
Primary Vs. Read & Write	0.04	0.74	1.27	1.40
Preparatory Vs. Primary	2.26	4.44	3.67	2.20

Academic Secondary Vs. Preparatory	4.41	2.21	5.20	5.33
Vocational Secondary Vs. Preparatory	3.14	2.89	5.70	4.23
Post-Secondary Vs. Secondary	7.30	6.07	8.08	5.58
University Vs. Academic Secondary	5.80	6.36	8.08	8.15

Table 3: Returns to Education by Level of Education and Gender (2018)

Educational Level	**RORE (%)**	
	Male	Female
Reads & Writes	6.84	4.15*
Primary	4.81*	37.69
Preparatory	12.78	31.12
General secondary	26.18	59.38
Vocational secondary	21.12	61.20
Post-secondary institute	38.59	86.53
University	50.32	99.34

*Insignificant coefficients.

Table 4: Models' Instruments, 2018

Model	**Instruments**
Total	Mother education and father education
Female	Father education and household size
Male	Mother education and father education
Urban	Mother employment, mother education and household size
Rural	Mother education and father education

Table 5: First Stage Regression, 2018 (Years of schooling is the dependent variable)

Total		**Male**		**Female**		**Urban**		**Rural**	
T	0.050 (0.000)	T	0.020 (0.089)	T	0.183 (0.000)	T	0.116 (0.000)	T	-0.014 (0.332)
T^2	-0.004 (0.000)	T^2	-0.004 (0.000)	T^2	-0.007 (0.000)	T^2	-0.005 (0.000)	T^2	-0.003 (0.000)
Mother Education	0.218 (0.000)	Mother Education	0.207 (0.000)	Household Size	-0.480 (0.000)	Mother Employment	0.248 (0.000)	Mother Education	0.135 (0.074)
Father Education	1.003 (0.000)	Father Education	0.953 (0.000)	Father Education	0.865 (0.000)	Mother Education	0.990 (0.000)	Father Education	0.893 (0.000)
						Household Size	-0.081 (0.045)		
Constant	8.690 (0.000)	Constant	8.842 (0.000)	Constant	12.257 (0.000)	Constant	8.708 (0.000)	Constant	9.421 (0.000)

Table 6: Tests of Validity, 2018

Model	Tests of Endogeneity		Tests of Over-identifying Restrictions		Test of First-Stage Regression Summary Statistics	
	Durbin $\chi^2(1)$	Wu-Hausman	Sargan $\chi^2(1)$	Basmann $\chi^2(1)$	Adjusted R^2	F-statistics
Total	27.066 (0.000)	F (1,1066) = 7.1 (0.000)	1.836 (0.176)	1.835 (0.176)	0.32 (0.000)	F (2,1066) =741.3 (0.000)
Male	101.187 (0.000)	F (1,8375) = 2.4 (0.000)	3.008 (0.083)	3.007 (0.083)	0.308 (0.000)	F (2,9074) =518.5 (0.000)
Female	12.582 (0.000)	F (1,1583) = 12.6 (0.000)	0.039 (0.844)	0.039 (0.844)	0.366 (0.000)	F (2,1583) =139.3 (0.000)
Urban	33.437 (0.000)	F (1,4115) =33.7 (0.000)	4.165 (0.1246)	4.164 (0.1247)	0.248 (0.000)	F (3,4114) = 132.5 (0.000)
Rural	0.2558 (0.613)	F (1,6541) =0.256 (0.613)	0.264 (0.607)	0.264 (0.608)	0.305 (0.000)	F (2,6541) =222.2 (0.000)

P-value is in parentheses.

Table 7: Educational ROR (%) for all models (OLS, IV-TSLS, QR IVQR), 2018

Model	**OLS**	**IV-TSLS**	**QR**					**IVQR**				
			0.1 decile	**0.25 decile**	**0.5 decile**	**0.75 decile**	**0.90 decile**	**0.1 decile**	**0.25 decile**	**0.5 decile**	**0.75 decile**	**0.90 decile**
Total	3.54	5.67	3.12	3.61	3.21	3.15	3.75	5.37	5.50	5.61	5.72	5.84

Male	3.24	5.67	2.49	2.72	2.91	2.98	3.85	3.93	4.60	5.24	5.85	6.53
Female	6.99	10.94	11.95	9.44	7.23	5.05	4.42	12.49	10.26	8.78	7.31	5.75
Urban	4.75	9.68	5.33	5.63	4.69	4.19	4.14	13.47	12.02	10.63	9.26	7.82
Rural	2.82	3.20	2.27	2.39	2.42	2.67	3.40	0.73	1.86	2.86	3.76	4.73

Source: ELMPS data. All the coefficients are significant at the 5% level of significance.

List of Figures

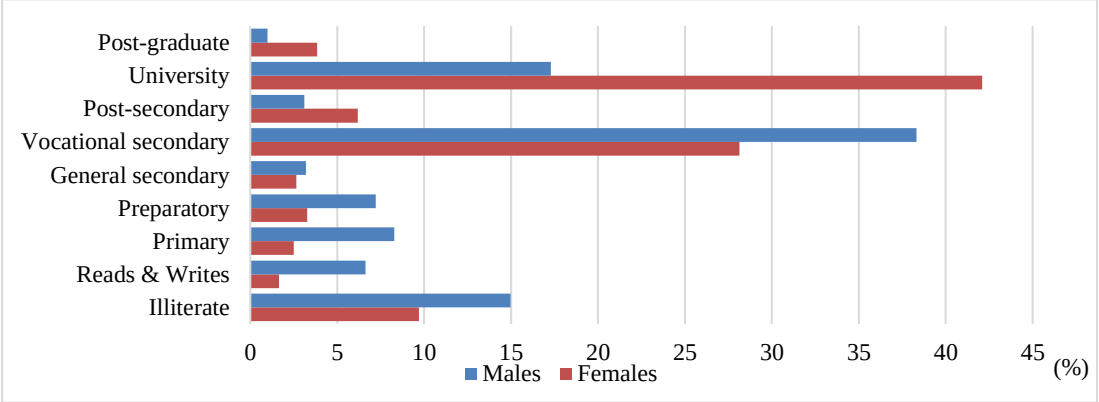

Figure 1: Proportion of Persons by Education Levels by Gender for Wage Earners (2018)