



# Übung zur Empirischen Wirtschaftsforschung

## IX. Einkommensfunktion II

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### Literatur

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## 6.1 Overview of Egypt Labor Force Sample Surveys

The Central Agency for Public Mobilization and Statistics (CAPMAS) is the only governmental body responsible for conducting national wide surveys in Egypt. CAPMAS has conducted Labor Force Sample Surveys (LFSS) since the 1960s. The goal of these surveys was to gather in depth data on Egypt's labor market situation. They first conducted them annually, and then started to conduct them quarterly to follow up changes in employment over a shorter time scale. However, the survey methodology was not constant throughout the years. To allow researchers to make reliable research across time, two surveys were performed after the October LFSS 1988 survey, which replicated the LFSS 1988 methodology:

1. The Egyptian Labor Market Survey (ELMS) 1998.
2. The Egyptian Labor Market Panel Survey (ELMPS) 2006.

These surveys were conducted in cooperation with the Economic Research Forum (ERF). Many researchers use the three surveys to make comparative studies across time given that they adopt similar methodology and definitions. All the surveys contain an individual survey and a household survey. We will use the ELMPS 2006 for our analysis. The ELMPS 2006 consists of households visited in 1998, households that split from 1998 and a refresher sample of 2,500 new households. The categories covered by the survey include:

- Basic Characteristics
- Housing, Service & Durables
- Parents and Siblings Characteristics
- Education
- Employment and Unemployment
- Job Characteristics of Primary and Secondary jobs
- Formality of job
- Earnings
- Household Enterprises
- Migration, Transfers and Non-labor income

We will use some variables from the ELMPS 2006 to estimate earning functions for Egyptian wage workers. The variables are found in the work file Übung9.wfi. All variables are calculated for a reference period of the last three months prior to the survey. But first we will compare ELMPS 2006 with SOEP 2012 in the next section.

## 6.2 Comparison between ELMPS 2006 & SOEP 2012

SOEP is a socio-economic survey while ELMPS is a labor market survey. Therefore SOEP covers many social dimensions such as the level of happiness and satisfaction with various life aspects, opinions about social and economic matters, and future prospects of respondents that is not covered in ELMPS.

- The breadth of the survey depends on the level of economic development of a country. Germany is more developed in various economic, social, and institutional measures relative to Egypt. Therefore issues such as the level of happiness, personal wellbeing inside and outside work, and opinions in political and social matters is also measured, in addition to labor market measures.
- Egypt suffers from illiteracy rates of 34% among women and 17.5% among men. In addition, the majority of females work in agricultural farms with their families in order to survive (i.e. unpaid family workers). In terms of employment, many small firms in the private sector of Egypt do not provide their employees with job contracts or social security. Consequently, ELMPS targets to collect more 'basic' information relative to SOEP. For example, ELMPS collects information about illiteracy, school interruptions, subsistence work of women and unpaid family work, and the formality of the job (whether an employee has a work contract or social security), among others.

The SOEP covers a reference period of one year and adopts the calendar method, while the ELMPS covers a reference period of 3 months.

- The SOEP adopts the calendar method in its questions about employment status and earnings. In the calendar method, respondents should record their monthly employment status and earning source for the past twelve months. This provides a lot of in-depth information about each respondent.
- In ELMPS, employment status for the past three months and the information about the respondent's first job are only available. Furthermore, earnings for the past three months are only inquired about.

The SOEP has a whole questionnaire about immigrants living in Germany, while ELMPS includes a questionnaire about Egyptian migrants. This is again due to country specific needs.

- For Germany, immigrants represent an important human resource given that Germany suffers from the lowest fertility rate in Europe (1.45 births per mother). In turn, it is important to collect in-depth information about immigrants' characteristics, opinions and degree of integration in the German society.
- Egypt has a fertility rate of 2.9 and suffers from high population concentration in its three largest cities of Cairo, Alexandria and Suez due to the concentration of economic activities there. Therefore, many people migrate from rural to urban regions, or outside Egypt, to find better work opportunities. These persons represent a major source of income for the rest of the household, as they provide them with money transfers. The questionnaire thus inquires about household members who migrated, the location of their migration and the amount of money they send to the household.

What is the replacement fertility rate (i.e. fertility rate that keeps a country's population stable)?

- In developed countries the replacement rate is 2.1, in developing countries it is 2.3 or more due to worse health care leading to a higher probability of death before the age of 15. In turn Germany's fertility rate means that the population size will shrink over time.

What is the total population size of Egypt as compared to Germany?

Rank ⇅	Country (or dependent territory) ⇅	Population ⇅	Date ⇅	% of world population ⇅
1	 China <sup>[8]</sup>	1,365,480,000	July 9, 2014	19%
2	 India	1,246,420,000	July 9, 2014	17.4%
3	 United States	318,355,000	July 9, 2014	4.44%
4	 Indonesia	252,164,800	July 1, 2014	3.51%
5	 Brazil	202,823,000	July 9, 2014	2.83%
6	 Pakistan	188,020,000	July 1, 2014	2.62%
7	 Nigeria	178,517,000	July 1, 2014	2.49%
8	 Bangladesh	156,591,000	July 9, 2014	2.18%
9	 Russia <sup>[9]</sup>	146,048,500	May 1, 2014	2.04%
10	 Japan	127,090,000	June 1, 2014	1.77%
11	 Mexico	119,713,203	July 1, 2014	1.67%
12	 Philippines	99,833,600	July 9, 2014	1.39%
13	 Vietnam	89,708,900	July 1, 2013	1.25%
14	 Ethiopia	87,952,991	July 1, 2014	1.23%
15	 Egypt	86,770,500	July 9, 2014	1.21%
16	 Germany	80,716,000	September	1.13%

However the relevant measure here is the population growth rate. It is quite different between Germany and Egypt!

- In 2013, it was 0.2% for Germany and 1.6% for Egypt.

## 6.3 Data in Workfile Übung9.wf1

*Y* Net basic income per 3 months in EGP

*XYR* Years of experience in the labor market  
(2006 - year of entry into the labor  
market for a continuous period of 6 months)

*HRS* Average number of work hours per day

*F* 1 if respondent is female, 0 if male

*ILLITERATE* 1 if cannot read or write, 0 otherwise

*READ&WRITE* 1 if can read and write but without any certificate, 0  
otherwise

*PRIMARY* 1 if has primary certificate, 0 otherwise

*PREPARATORY* 1 if has preparatory certificate, 0 otherwise

*VOCATIONALSECONDARY* 1 if has vocational secondary certificate, 0 otherwise

*GENERALSECONDARY* 1 if has general secondary certificate, 0 otherwise

*DIPLOMA* 1 if has diploma, 0 otherwise

*UNIVERSITY* 1 if has university certificate, 0 otherwise

*PRIVATE* 1 if respondent works in private sector, 0 if works in the  
government

*URBAN* 1 if respondent living in Urban area, 0 if lives in Rural  
area

- Primary is finishing Grade 1 to 6, Preparatory is finishing Grades 7 to 9 and Secondary is finishing Grades 9 to 12. General Secondary is similar to 'Abitur' while Vocational Secondary is studying more technical fields like 'Fachschule'. Diploma is similar to 'Fachhochschulabschluss'

## 6.4 The Earnings Function

The man behind the modern earnings function theory is Jacob Mincer. In 1958, he presented his theory about measuring earnings which was an innovation in the labor economic field. Mincer and other authors explained that the neoclassical assumption of homogeneous human input in the production function is not accurate. Indeed, individuals differ in their abilities, which means that the productivity of each individual is not identical. This means that the influence of individuals on total output and income will also not be constant. Mincer's innovation was to treat schooling and training as investment opportunities which individuals invest in to maximize their future returns. The basic model was written as:

$$\ln(y_t) = \beta_0 + \beta_1 \text{Schooling} + \beta_2 \text{Experience} + \beta_3 \text{Experience}^2 + \varepsilon_t \quad (1)$$

The coefficients from the OLS regression of figure (1) are treated as showing the individual's private returns to schooling and experience. For example, we expect that an increase in years of schooling will have a positive effect on the individual's earnings. If the estimated value for  $\beta_1$  is 0.2, what does this mean economically?

- It means that having an additional year of schooling allows the individual to earn 20% ( $\beta_1 * 100$ ) more wage than the wage he would earn without this additional year. If we assume that the forgone wages are his only current cost, then by giving up 100% of his wages now, he can earn 20% more in all subsequent years. If our schooling variable was a set of dummies, then a similar interpretation can be made.

Social returns of schooling (as opposed to private returns) allow us to estimate how much society gains from an individual's schooling. As previously mentioned higher educated persons can contribute more to output and growth. However, this requires us to also calculate the cost of tuition and anything else paid by the government. We focus on estimating only private returns in this class.

The experience squared term in equation (1) is also estimated to capture the phenomenon that returns to experience are not stable over time. For example, having one year of experience provides a different return to having five years of experience, and so on. In order to give this flexibility in our estimations, we need to also model the squared term for experience, as the linear experience term does not change with respect to experience. Usually we will get a positive value for the linear term ( $\beta_2$ ) and a negative value for the polynomial term ( $\beta_3$ ), which shows that returns first increase with years of experience, but then the rate of increase decreases, and can become negative. To analyze the effect of a change of experience on output:

$$\Delta \ln(y) = (\beta_2 + 2\beta_3 \text{Experience}) \quad (2)$$

We usually show the estimation results for the experience in a graphical plot to allow for visualization.

Reasons for falling returns to experience is that earnings usually rise as workers grow older and more experienced, until reaching a certain prime age where returns reach a peak. After that, additional years of experiences do not lead to higher income as people become older and less productive.

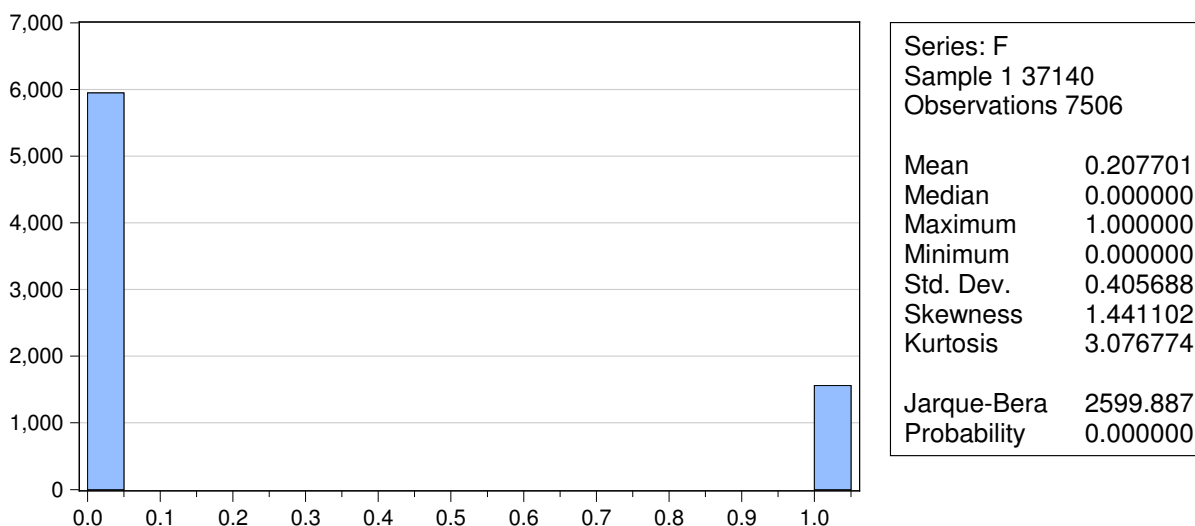
Labor economists have since used the Mincer equation and included other variables to explain earnings such as gender, region of residence, sector of work, ethnic differences..etc.

## 6.5 The Econometric Model

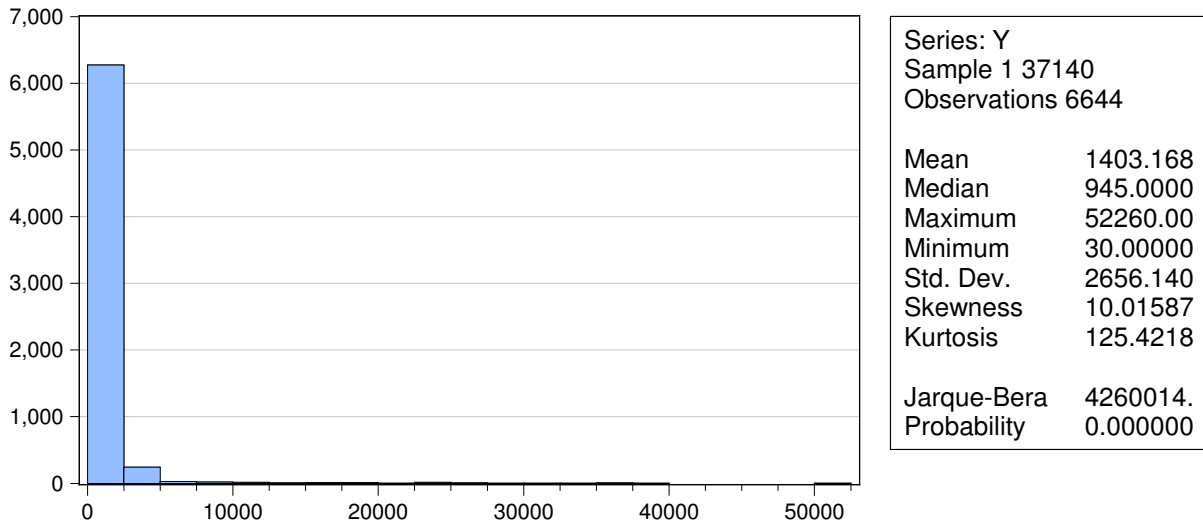
We will estimate a function that includes the basic Mincerian components of schooling, which are dummies in our case, HRS, XYR polynomial, the female dummy F, in addition to URBAN dummy and PRIVATE dummy. Our reference group for the educational dummies is ILLITERATE.

$$\ln(y_t) = (\beta_0 + \beta_1 \ln(Hrs) + \beta_2 Xyr + \beta_3 Xyr^2 + \beta_4 Read\&Write + \beta_5 Primary + \beta_6 Preparatory + \beta_7 VocationalSecondary + \beta_8 GeneralSecondary + \beta_9 Diploma + \beta_{10} Uni + \beta_{11} F + \beta_{12} Urb + \beta_{13} Private + \varepsilon_t)$$

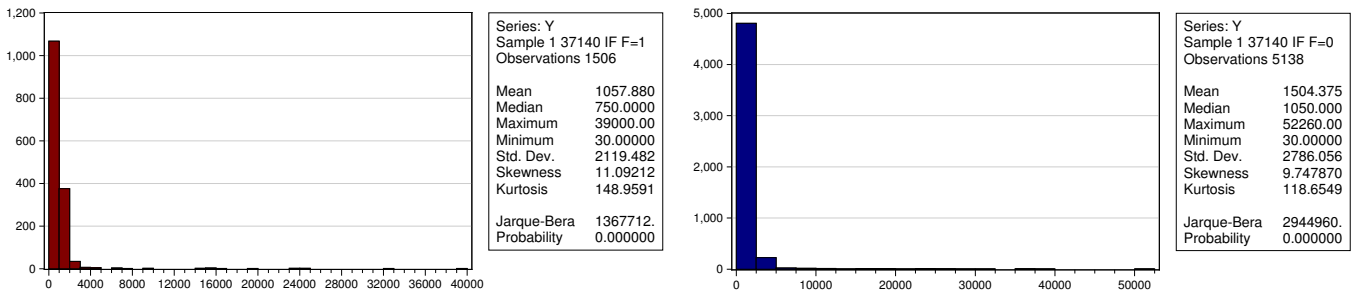
Let us first examine some descriptive statistics of the data.



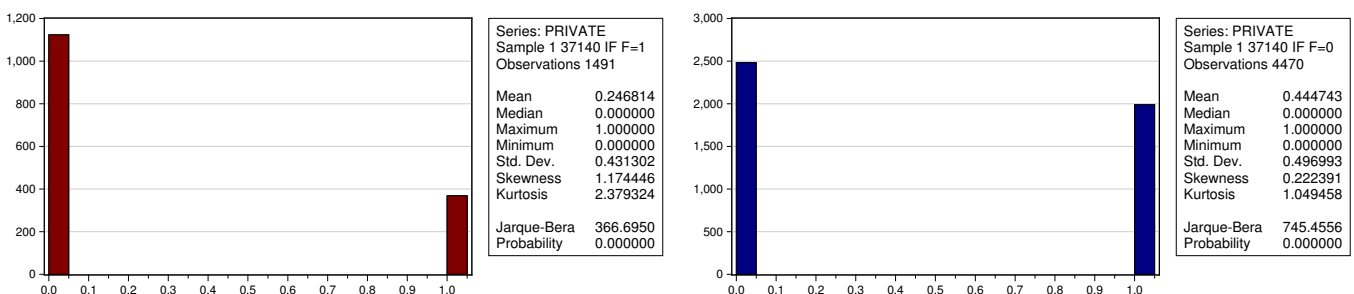
The figure shows that 20.7% of the total sample of wage workers is females, while 80% are males. This shows that wage work is not the primary work type for the majority of females. Actually, the majority of females work as unpaid family workers.



The mean earnings for all sample is 1.403 EGP per 3 months. The number of observations is 6.644. There is a very big difference between the minimum and maximum wage value. The standard deviation from the mean is 2.656 EGP.



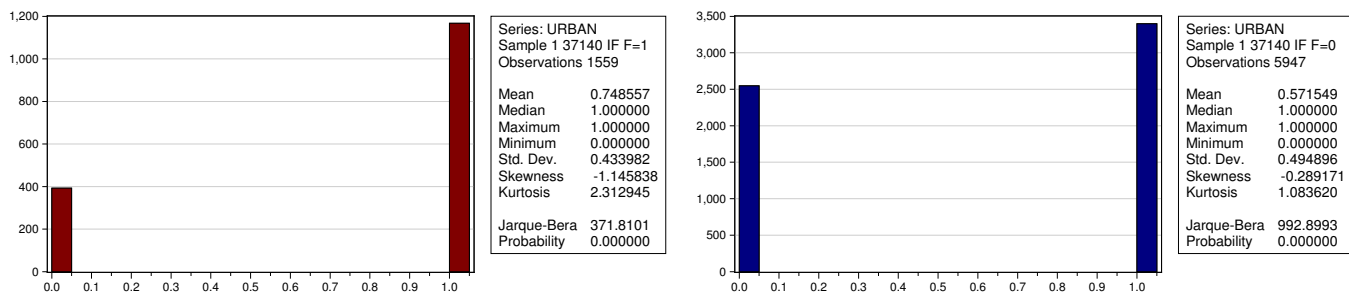
Looking at earnings per gender, the average wages of females are much lower than those of males, with a difference of 447 EGP per 3 months. The maximum value for female wage workers are also lower than the corresponding value for males, at 39.000 relative to 52.260, respectively.



Examining sector of employment by gender shows that males are more concentrated in the private sector relative to females. More specifically, 44.4% of total male wage workers are employed in the private sector,



relative to 24.6% of females. In turn, 75.4% of female wage workers are employed in the government sector.



57% of males wage workers live in urban regions, relative to 74.8% of females wage workers. Hence, the majority of females wage workers live in urban regions relative to male wage workers, who are more evenly distributed across both regions.

We now show the estimation results from equation 1 (modell1):

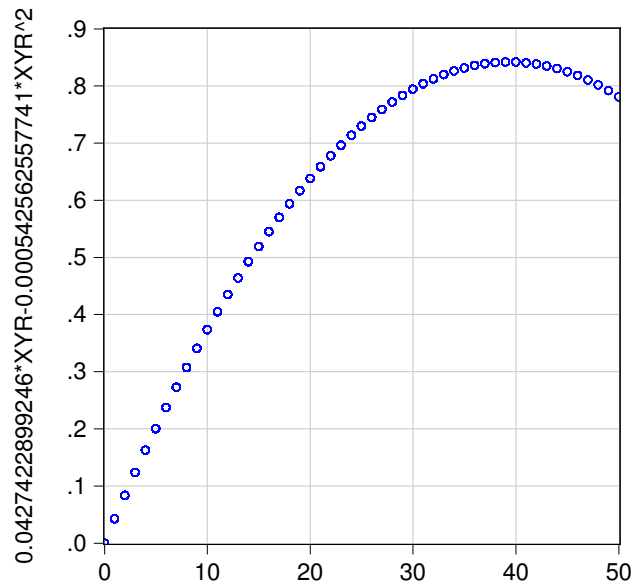
Dependent Variable: LOG(Y)				
Method: Least Squares				
Date: 07/08/14 Time: 17:21				
Sample (adjusted): 1 37134				
Included observations: 5847 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.374453	0.088903	60.45299	0.0000
LOG(HRS)	0.308689	0.038787	7.958663	0.0000
XYR	0.042742	0.002305	18.54400	0.0000
XYR^2	-0.000543	5.29E-05	-10.25562	0.0000
READWRITE	-0.037016	0.043853	-0.844099	0.3986
PRIMARY	-0.018130	0.038337	-0.472924	0.6363
PREPARATORY	0.081626	0.046069	1.771836	0.0765
VOCATIONALSECONDARY	0.169994	0.030577	5.559458	0.0000
GENERALSECONDARY	0.204381	0.078501	2.603533	0.0093
DIPLOMA	0.264363	0.040284	6.562476	0.0000
UNI	0.442535	0.032334	13.68648	0.0000
URBAN	0.125329	0.017092	7.332674	0.0000
PRIVATE	0.306169	0.019865	15.41269	0.0000
F	-0.229281	0.019262	-11.90324	0.0000
R-squared	0.195910	Mean dependent var	6.872547	
Adjusted R-squared	0.194118	S.D. dependent var	0.666805	
S.E. of regression	0.598597	Akaike info criterion	1.813934	
Sum squared resid	2090.069	Schwarz criterion	1.829913	
Log likelihood	-5289.036	Hannan-Quinn criter.	1.819490	
F-statistic	109.3202	Durbin-Watson stat	1.185515	
Prob(F-statistic)	0.000000			

With cross sectional analysis,  $R^2$  is usually lower relative to time series analysis. However, the significance of the coefficients given by their t-statistic and p-value are analyzed in the same manner as we did in time series data.

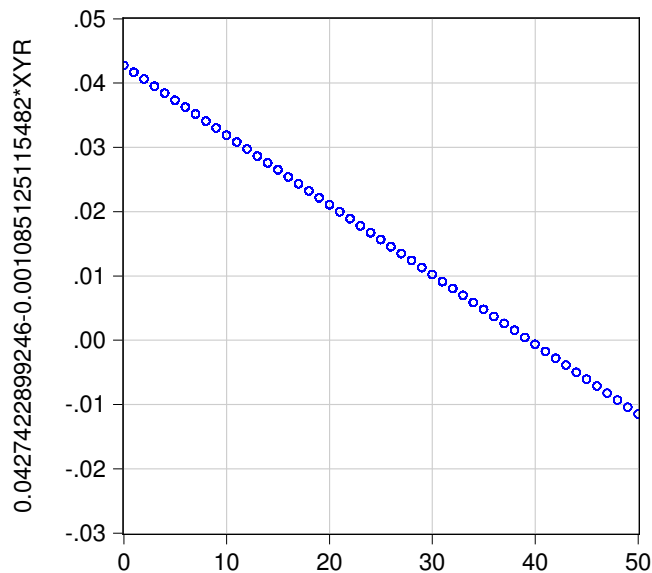
Analyzing the HRS coefficient shows that a one percent higher work hour leads to 0.30% higher earnings.

The experience and experience squared coefficients are significant and have the expected signs. This shows that experience profiles of wage workers are inversely U-shaped, as explained by human capital theory. We

can plot the *total effect* of experience on income to allow for graphical visualization:



Returns to experience are 38% for a person having ten years of experience, but then the rate of increase falls as the years of experience increase. For example, with twenty years of experience, returns to experience increase by 26% . With thirty years, the increase is 16%, and with forty years it is only 4%. Finally with fifty years of experience, returns decline by 10%.



In the above plot, we show the *marginal effect* of experience on earnings. With this plot we can see how earnings change for each additional year of experience (i.e. what we showed in equation 2). The plot shows

that marginal returns to experience per year increase between 3-4% for the first ten years. For the next ten years, marginal returns increase between 2-3%, and for the next ten years they increase between 1-2%. Finally, having more than forty years of experience reduces marginal earnings between 0-1% per year.

Before analyzing a model with categorical dummies, always keep in mind what the reference group is. Clearly the reference group is the group which is not shown in our model. In this case it is the ILLITERATE group. Consequently all analysis for the rest of the educational dummies will be made relative to this group

Looking at the educational dummy results in model 1, the coefficients starting from READ&WRITE up to PRIMARY are not statistically significant. What does this mean?

- This means that the returns to education for individuals in these groups are not significantly different from the returns of the illiterate group (reference group). In other words, having any of these educational categories does not provide a higher returns than that taken by someone who is illiterate.

Starting from PREPARATORY certificate, earnings are significantly higher than the illiterate group by 8.1%. Returns to education then increase with higher education levels. The highest increase in earnings comes from having UNI, where earnings are 44.2% higher than the illiterate group. This is followed by having a DIPLOMA, with 26.4% higher earnings than the illiterate group. Next comes GENERALSECONDARY and VOCATIONALSECONDARY, with 20.4% and 16.9% higher earnings relative to the illiterate group, respectively.

- The analysis of educational dummies thus highlights that having a university education provides the highest returns to education relative to the illiterate group, and that educational certificates below PREPARATORY do not pay off.

Living in an URBAN regions provides 12.5% higher earnings relative to living in rural regions. This is because urban regions have much better development, infrastructure, and job opportunities due to the large concentration of economic activity in these regions.

Working in the private sector provides 30.6% higher earnings relative to working in the government sector.

Females earn around 23% less than what is earned by males. This shows a possible discrimination effect by gender.

Given that the dummy F is statistically significant and has a high value, it makes sense to estimate separate earning functions for males and females. We do this in the next step.

We now estimate equation 1 for males and females separately. We start by estimating model 2 for females (i.e.  $f=1$ ).

Dependent Variable: LOG(Y) Method: Least Squares Date: 07/08/14 Time: 17:41 Sample: 1 37140 IF F=1 Included observations: 1479				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.941947	0.153279	32.24147	0.0000
LOG(HRS)	0.492574	0.069915	7.045302	0.0000
XYR	0.040014	0.004883	8.194217	0.0000
XYR^2	-0.000191	0.000137	-1.387091	0.1656
READWRITE	-0.577250	0.127461	-4.528830	0.0000
PRIMARY	-0.190413	0.110151	-1.728648	0.0841
PREPARATORY	0.029055	0.122960	0.236294	0.8132
VOCATIONALSECONDARY	0.043339	0.063353	0.684090	0.4940
GENERALSECONDARY	0.066054	0.169919	0.388738	0.6975
DIPLOMA	0.033991	0.075499	0.450213	0.6526
UNI	0.234083	0.064012	3.656887	0.0003
URBAN	0.101270	0.033971	2.981109	0.0029
PRIVATE	0.107349	0.039452	2.721005	0.0066
R-squared	0.319359	Mean dependent var	6.640438	
Adjusted R-squared	0.313787	S.D. dependent var	0.635030	
S.E. of regression	0.526046	Akaike info criterion	1.561895	
Sum squared resid	405.6780	Schwarz criterion	1.608473	
Log likelihood	-1142.021	Hannan-Quinn criter.	1.579259	
F-statistic	57.32096	Durbin-Watson stat	1.098802	
Prob(F-statistic)	0.000000			

Comparing the results to the first estimation, we note that the second estimation provides a better fit given by  $R^2$ . Additionally the values of the coefficients and their statistical significance has also changed relative to model 1.

The HRS coefficient shows that one percent higher work hour leads to 0.49% higher earnings.

The experience polynomial is significant and has the expected signs of a positive linear term and a negative polynomial term. This shows that females face an inverse U-shape earnings experience profile.

What do the educational dummies show?

- Female wage workers with READWRITE and PRIMARY are estimated to have significantly lower earnings relative to the illiterate group. More specifically READWRITE have 57.7% less earnings than the illiterate group, while having a PRIMARY certificate provides 19% less earnings relative to the illiterate group.
- Education only pays off for the university level. All other levels do not provide significantly higher returns relative to the illiterate group. Specifically, having UNI certificate provides 23.4% higher earnings relative to the reference group.

Living in an URBAN region provides 10% higher earnings relative to living in a rural region, while working in the PRIVATE sector provides 10.7% higher earnings relative to working for the government.

Let us now show the results of model 3 for males:

Dependent Variable: LOG(Y) Method: Least Squares Date: 07/08/14 Time: 17:42 Sample: 1 37140 IF F=0 Included observations: 4368				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.565194	0.105632	52.68478	0.0000
LOG(HRS)	0.245460	0.045593	5.383756	0.0000
XYR	0.035460	0.002746	12.91338	0.0000
XYR^2	-0.000434	6.04E-05	-7.178346	0.0000
READWRITE	0.025772	0.047332	0.544489	0.5861
PRIMARY	0.007138	0.041700	0.171167	0.8641
PREPARATORY	0.087299	0.050327	1.734642	0.0829
VOCATIONALSECONDARY	0.150486	0.035093	4.288148	0.0000
GENERALSECONDARY	0.197531	0.088226	2.238918	0.0252
DIPLOMA	0.280461	0.047885	5.856989	0.0000
UNI	0.471395	0.037604	12.53575	0.0000
URBAN	0.118321	0.019585	6.041311	0.0000
PRIVATE	0.351619	0.022821	15.40751	0.0000
R-squared	0.137765	Mean dependent var	6.951139	
Adjusted R-squared	0.135389	S.D. dependent var	0.659019	
S.E. of regression	0.612785	Akaike info criterion	1.861367	
Sum squared resid	1635.327	Schwarz criterion	1.880361	
Log likelihood	-4052.225	Hannan-Quinn criter.	1.868070	
F-statistic	57.98548	Durbin-Watson stat	1.609689	
Prob(F-statistic)	0.000000			

The HRS coefficient shows that one percent higher work hour provides 0.24% higher earnings.

The experience polynomial is significant and with the expected signs. Comparing the polynomial to that of females shows that females have higher returns to experience than males.

The education dummies show that education levels starting from PREPARATORY provide significantly higher returns relative to the illiterate group, with earnings increasing by education level. The highest earnings are for UNI, with 47% higher wage relative to the illiterate group, followed by DIPLOMA with 28% higher wage relative to the illiterate group. SECONDARY certificates follow with 19.7% higher earnings for GENERAL and 15% higher earnings for VOCATIONAL, relative to the illiterate group.

What do the educational dummy results show us compared to those of females?

- Compared to females, males are able to benefit from their education starting from a relatively early stage (i.e. preparatory level). A possible reason for this is the high concentration of males in the private sector, which seem to offer males better pay per level of education than females. Another reason is that the government sector which employs almost 80% of female wage workers does not employ persons who have less than secondary certificate. The second reason could also explain why females have higher returns to experience than males.
- Males with university education earn almost a double more than females with the same education. This shows a possible discrimination effect, where males are paid more than females with the same educational attainment.