THE RETURNS TO EDUCATION IN UKRAINE

by

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Abstract

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Chairperson of the Supervisory Committee:

In this paper the main attention is given to theoretical and empirical analysis of wage determinants and private rates of return to education in Ukraine. We test the null hypothesis of zero private returns to education in Ukraine versus the alternative hypothesis of positive returns using the Mincer's extended earnings function. We find that the private returns to virtually all educational levels are positive in Ukraine, though rising with the level of education, the latter finding contradicting the world evidence. We propose a possible explanation for this anomaly and suggest the issue as the area for further research.

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GLOSSARY

The private rate of return (PRR) to education is the discount rate that equalizes the net present value of the stream of benefits from education and the net present value of the stream of costs of education (Psacharopoulos 1988, p. 100)

Chapter 1

INTRODUCTION

Nowadays, economists have come to an agreement about the role human capital accumulation plays in economic dynamics and growth. Following Nesterova and Sabirianova (1999, p.5), educational level, skills and professional experience of people in the labor force constitute one of the major sources of technological improvements, efficiency and productivity growth. Investment in human capital, in particular in education, is, therefore, a crucial determinant of the "opportunities and frontiers of economic change". (Nesterova and Sabirianova 1999, p.5)

The centralized system of wage setting in the Soviet Union virtually established a one-to-one correspondence of personal income and a set of characteristics like industry, occupation, position of a worker. The correlation between quality of education acquired, professional skills, other personal characteristics of an employee on the one side and his or her wage on the other proved to be weak and even insignificant. As a result, workers were less mobile and tied to an industry and occupation chosen once when entering the labor force. (Nesterova and Sabirianova 1999, p.5)

The situation has changed dramatically during the years of transition. Despite the high general educational level (Nesterova and Sabirianova 1999, p.5), Ukrainian labor market found it hard to satisfy the ever-growing demand for highly qualified labor, mainly due to inappropriate structure of the labor force. Technical and engineering workers that constituted its large portion became less demanded, while the demand for qualified employees in social sciences, business, etc. is not

met. This resulted in high levels of structural unemployment, though mainly hidden one (wage arrears, unpaid leaves).

As it is widely accepted in the economic literature, investment in human capital contributes substantially in economic growth and development. And it is also indisputable that private return is the primary consideration of an individual when deciding upon acquiring his/her education and training, and that private rate of return has no less, and even more, significance than policy measures aimed to stimulate human capital accumulation. As Cheidvasser and Benitez-Silva (2000, p.1) have put it, "[r]eturns to education affect the overall educational level of the population, which in turn has been suggested as one of the key determinants of a country's economic growth (Barro 1991)."

In this paper the main attention will be given to theoretical and empirical analysis of returns to education in Ukraine. This includes econometric estimation of the extended earnings function and testing the null hypothesis of zero private returns to education in Ukraine versus the alternative hypothesis that the rates of return to education are positive.

The rest of the work proceeds as follows. The next chapter provides a survey of literature on returns to human capital, with greater emphasis on the debates across the earnings function developed by Mincer (1974) and critical evaluation of various specifications of the model based on empirical evidence.

Next, the theoretical part describes features of educational system and labor market peculiar to Ukraine and justifies the choice of the earnings function for econometric estimation that best captures those peculiarities.

Finally, the empirical part describes data and methods used to conduct the research, presents the major results of econometric analysis, their interpretation,

points out the major weaknesses of the investigation and gives suggestions for future research.

Chapter 2

LITERATURE SURVEY

2.1. Evolution of the Human Capital Concept

As in Nesterova and Sabirianova (1999, p.6), the idea of how important it is for the national economy to invest in human capital, in particular in education, first appeared in the work of A. Smith, where he stressed that the costs of acquisition and development of professional skills may and should be treated as a kind of investment with its own return. As cited in Psacharopoulos (1988, p.99):

> "A man educated at the expense of much labor and time… may be compared to one… expensive machine… The work which he learns to perform… over and above the usual wages of common labor will replace the whole expense of his education." (Smith 1776, p.101).

Literature on education as a form of investment appeared in the 1920s-1930s. (Strumilin 1929; Walsh 1935, referred to in Psacharopoulos 1988, p.99). Following the work of Adam Smith, Walsh (1935) pointed out:

> "…[I]n any calculation of the national wealth… it is altogether legitimate to include… professional capacities as capital. In fact it would be illegitimate not to include them. They have involved an expense. The expense has been incurred for profit. The returns tend to cover that expense and the necessary margin of profit." (Walsh 1935, pp.284-285)

He questions, however, the application of Smith's doctrine unless the "acquired and useful abilities" (Smith 1776 as in Walsh 1935, p.285) are those that result from vocational training rather than from general education. Putting it in his words, it must be important to distinguish between "schooling alone (not all

education), and schooling of a particular kind – that which trains a man for a professional career" (Walsh 1935, p.256):

> "The training children receive up to and including that in secondary school is not primarily intended to develop vocational skills. Rather it is the intent of the parents and the state to promote the education of citizens. The purpose is to provide political and cultural education in the widest sense. … Education beyond the secondary school is more apt to be undertaken for definitely economic reasons. … When deciding whether to contribute to still further schooling of children, parents are surely guided above all the expectation that the training could be turned to profitable account." (Walsh 1935, p.256)

Using several sets of micro data, which contain information on age, annual earnings, and education received, Walsh compares discounted values of life-time earnings of average men with different levels of schooling to costs of acquiring the corresponding educational levels in order to test the hypothesis that the expenditures on such training are in fact "capital investment made in a profit-seeking, equalizing market" (Walsh 1935, p.256). His finding is that labor market is not in fact competitive for "*in every case the value of the abilities trained in college exceeds the cost of their acquisition*" (Walsh 1935, p.275), which suggests that the inputs (labor) are not homogeneous, "differing in their abilities and training" (Walsh 1935, p.275).

"[Nonetheless,] it was not until the late 1950s that the [concept of human capital] became a separate field of study – the economics of education." (Psacharopoulos 1998, p.99) The impulse was the tendency for real incomes of workers in developed countries, in particular in the United States, to grow ever faster than the amounts of land, reproducible capital, and labor force. (Psacharopoulos 1998, p.99).

Theodore W. Schultz, among the first economists, who solved this perplexity, addressed the issue:

> "Can this be a windfall? Or a quasirent pending the adjustment in the supply of labor? Or, a pure rent reflecting the fixed amount of labor? It seems far more reasonable that it represents rather a return to the investment that has been made in human beings. The observed growth in productivity per unit of labor is simply a consequence of holding the unit of labor constant over time although in fact this unit of labor has been increasing as a result of a steadily growing amount of human capital per worker. As I read our record, the human capital component has become very large as a consequence of human investment." (Schultz 1961, p.6)

Going further than his predecessors in treating education and training as a kind of capital, Schultz stresses that human capital possesses much the same features with physical capital (it is subject to depreciation and entails maintenance, it deteriorates when idle, the low return on it is often a result of underinvestment), and inasmuch as it does, the same policy measures that ensure accumulation of physical capital should be undertaken in order to speed the accumulation of human capital and steady economic growth. (Shultz, 1961, pp. 13-15)

In the early 1960s, a wide variety of empirical works in the area of human capital in general and education in particular appeared in economic literature. A number of researchers (e.g. Houthakker, 1959; Miller, 1960; Renshaw, 1960 referred to in Weisbrod 1962, p.108) tried to investigate the connections between a worker's earnings and his educational attainment. The results showed "an [incontestable] positive correlation" (Weisbrod 1962, p.108), though the effects of other factors, such as work experience, mental ability and other personal characteristics of a worker, both observable and not, were mostly neglected. These early attempts were based mainly on empirical evidence and did not have any theoretical ground. (Weisbrod 1962)

Gary Becker (1962) was the first who made an attempt to place a theoretical ground under "a wide range of empirical phenomena which had either been given *ad hoc* interpretations or had baffled investigators" (Becker 1962, p. 10).

The contribution of human capital to economic growth has, however, been questioned in recent years. Following Gary Becker in his Nobel Lecture (Becker 1993, p.395),

> "Schultz and others… early on emphasized that investments in human capital are a major contributor to economic growth. But after a while the relation of human capital to growth was neglected, as economists became discouraged about whether the available growth theory gave many insights into the progress of different countries."

Lant Pritchett (1997) investigated the impact of educational expanding on economic growth. Using two cross-sectional datasets, he finds that "… the estimated impact of educational capital accumulation on a widely accepted, growth accounting, definition of [total factor productivity] growth is large, negative, and statistically significant." (Pritchett 1997, p. 53) Acknowledging the broad evidence of a positive effect of education on individual earnings, he assesses the following possibilities to explain this "micro-macro paradox" (Pritchett 1997, p. 2, 54):

- "…schooling may not raise cognitive skills or productivity but may nevertheless raise private wages because it serves as a signal to employers of some positive characteristics like ambition or innate ability."

- "… expanding the supply of educated labor in the presence of stagnant demand could cause the rate of return to education to fall rapidly."

- "…schooling has created cognitive skills but the typical institutional environment was sufficiently bad that these skills were devoted to privately remunerative but socially wasteful, or even counter-productive, activities."

He finds little evidence supporting the first two explanations and comes to conclusion that "the payoff to education is conditional on the economic policy environment, not an absolute given." (Pritchett 1997, p.55) For this reason we should not infer from the above results that social investment in education is useless or even undesirable, and not only because "evidence suggests schooling has a large number of beneficial effects beyond raising economic output… [for example,] infant mortality falls significantly with the education of mothers" (Pritchett 1997, p.55). Probably "returns to investment in human capital are only realized over a lifetime" (Shultz XXXX) and over the long time horizons educational attainment does translate into economic development and growth.

2.2. Empirical Studies on Returns to Human Capital

A very important study that provided an empirical tool for research in the area of human capital was developed by Mincer (1974). As in Dougherty and Jimenez (1987), the so-called "Mincerian earnings function" has been used by researchers in numerous studies and became a classical empirical tool for estimating the private rates of returns to education, experience, and tenure. One of the popular specifications of the earnings function (Y) is parabolic with schooling (SCH), experience (EXP), and experience squared (EXP^2) as explanatory variables (Dougherty and Jimenez 1987, p.7):

$$LnY_i = \alpha + \beta SCHi + \gamma EXPi + \delta EXP^2_i + \varepsilon_i \qquad (1).$$

Mincer (as in Dougherty and Jimenez 1987, p.7) showed that the coefficient β of the schooling variable could be interpreted as a "crude estimate of private rate of return to schooling" (ι):

$$\iota = \frac{\partial LnY}{\partial SCHi} \qquad (2).$$

The contribution of Mincer cannot be understated. Specifically, the inclusion of quadratic terms for the experience variable explains the diminishing marginal returns to experience. However, this specification has a number of drawbacks. In particular, the schooling variable is calculated simply as a number of years spent for education, while it must be important to distinguish among different educational levels. The reason is that the quality of education provided by, say, universities is likely to be higher than that provided by vocational schools or colleges due to better facilities (computer, library, etc.), higher proficiency and higher educational level of faculty, and more possibilities for students to acquire practical skills through internships. Another point is the so-called 'certification effect' considered by Dougherty and Jimenez (1987, p.7): the perception of an employer may be such that he might value a worker with a certificate more than a worker without one. For these reasons, as well as for the reasons of simpler interpretation of coefficients, "most of the analysis is done on variants of [another] equation" (3) that "allows the estimated rate of return to vary by level of schooling" (Dougherty and Jimenez 1987, p.7):

$$LnY_i = \alpha + \Sigma\beta_k ED_{ik} + \gamma EXP_i + \delta EXP_i^2 + \varepsilon_i \qquad (3).$$

Here, D_{ik} is a dummy standing for the k-th level of education acquired by the i-th individual. Following Dougherty and Jimenez (1987, p.7), in this case, the rate of private return to the k-th educational level can be shown to equal:

$$i = \frac{b_k - b_{k-1}}{T_k - T_{k-1}} \qquad (4).$$

Some specifications (e.g. Nesterova and Sabirianova, 1999) also include the tenure variable and its quadratic term in the model.

Despite obvious convenience of coefficients interpretation in the standard specifications of the Mincerian earnings function, they have been subject to a number of criticisms. C.R.S. Dougherty and E. Jimenez point out:

> "The theoretical foundation for the semi-logarithmic specification is so widely accepted that it has seldom been subjected to empirical tests. However, the link between theory and the estimating equation rests on a set of ingenious but empirically debatable assumptions." (Dougherty, Jimenez, 1987)

Blinder (1976) cited in Dougherty and Jimenez (1987, p.8) highlights the following of them:

1. For an individual not making post-school investment, "age-earnings profile would be flat and the present discounted value of lifetime earnings is the same for all the individuals, regardless of [years of schooling]".
2. "…[t]he number of years at work is independent of the number of years spent in school". (The only type of correlation assumed here is expressed by the formula for calculating years of experience: EXP = age – 6 – SCH, and neglects other kinds of relationship. Though it seems reasonable to assume that people with higher education stay at work longer than uneducated people whose job requires physical powers. [Dougherty and Jimenez 1987])
3. "[t]he return to all post-school investment in human capital is a constant" and not changing over the lifetime.
4. There is no overlapping of schooling and working: no one works during the years of schooling, and no one devotes time to education during the time spent in the labor force.

There are some other debatable points in the basic earnings functions, as mentioned by Dougherty and Jimenez (1987), namely:

> "The appropriate definition of the dependent variable is the logarithm of earnings, as opposed to earnings as such or any other functional form. …A single function can be used to model lifetime earnings, making no

> distinction between early and mature labor market experience." (Dougherty and Jimenez 1987, p.2)

Another point, which is worth mentioning, is deterioration of human capital during the years (if any) out of the labor force.

The experiment conducted by Dougherty and Jimenez in the same paper, however, shows that among other simple transformations of the standard earnings equations, the log-linear form is the most appropriate one from the econometric point of view, for it largely eliminates the problems of heteroscedasticity in explanatory variables and non-normality of residuals that are severe in the linear specification.

Such basic specifications of the Mincerian earnings function described above allowed economists to conduct numerous studies on this topic. As in Nesterova and Sabirianova (1999, pp. 6-7), for the former Soviet Union, the lack of accessible micro data did not allow to use this tool for investigation of returns to education and experience during the Soviet period. The researches in the area of human capital were conducted using aggregate national and regional data. The surge of immigration to the United States in the late 1970s gave rise to the studies based on the data obtained from interviews with the immigrants. The work of Gregory and Kohlhase (1988 referred to in Nesterova and Sabirianova 1999, p.7) found large returns to factors external to a firm, such as political issues. (Nesterova and Sabirianova 1999, p. 7)

The data collected in the Russian Longitudinal Monitoring Survey after the break-up of the Soviet Union allowed to analyze the wage and employment patterns in Russia during the transition period. The last work by D. Nesterova and K. Sabirianova (1999) uses the updated data. Their major finding with respect to returns to education is that the most significant factor that determines wages is

industry (workers in fuel sector earn substantially more than those in agricultural sector) and occupation.

However, the standard specification of the earnings function led to severe consequences, as suggested by the work of Dougherty and Jimenez (1987). Their major findings are as follows.

First of all, interaction of the effects of schooling and experience on earnings should not be neglected. The life-time patterns of unskilled and educated workers' earnings differ by nature: the marginal effects of experience on education for an unskilled worker are likely to be sharply increasing during the first years at work and diminishing but still positive afterwards. An educated worker, on the contrary, faces increasing marginal returns to experience, with the rate of the increase positively correlated to the educational level received during the years of schooling. Omission of the interaction variable, therefore, leads to the omitted variable bias in the coefficients estimates, with overestimation.

Second, the traditional definition of years of experience (experience = age – 6 – years of schooling) largely neglects the distinction between "work experience" acquired when a child and adult work experience, which is especially important for developing countries like Brazil. As a result, the rate of return to primary education is overestimated.

One of the crucial assumptions behind the standard specifications of the earnings function is that the only cost of one additional year of schooling is foregone earnings that a person would get if he worked instead of studying. Direct costs (tuition fees, expenditures on books, difference between living expenditures in the place of studying and home area if the person studies in a region other than his native city/town) are neglected. Meanwhile, Chiswick (1997, pp. 2-6) argues that in many cases such a simplification results in incorrect interpretation of the

schooling coefficient as an estimate of private rate of return to education. He shows that if we let

E_0 = earnings of a person without education
E_t = earnings of a person who completed the t^{th} year of schooling
Ct = direct costs of the t^{th} year of schooling
r_t = private rate of return to the t^{th} year of schooling
S = total number of years of schooling completed
K_t = investment in year of schooling t relative to earnings forgone
($K_t = C_t / E_{t-1}$), then

$$\ln E_s = \ln E_0 + (r_0 K_0)S \qquad (5)$$

Next, Chiswick points out that the equation (5) is estimated, the coefficient of schooling ($b=r_0K_0$) is interpreted as the rate of return to education while the correct estimate would be (assuming that r_t and K_t are the same for all t)

$$r_0 = b / K_0 \qquad (6)$$

Hence, depending on the value K_0 takes, neglecting the direct cost of schooling results in either under- or over- estimation of rate of return to schooling. If the value of K_0 is more than unity (implying the direct costs exceed the benefits) then the rate of return is overestimated. If the value of K_0 is less than unity (implying the direct costs are smaller than the benefits), the rate of return is underestimated. (Chiswick 1997, pp.3-6).

A wide variety of literature is written on returns to education. Many studies provide empirical results of estimating returns to education. As summarized by Psacharopoulos (1988), the findings common to over sixty countries are the following:

1. The social returns to education may be compared to a "reasonable return" on any other kind of capital, and even exceeds it. That is, investment in human capital generally contributes to economic growth more than investment in physical capital.

2. Rates of return (both social and private) to different educational levels have a diminishing nature. Primary education yields the highest return, while higher education – the lowest, though at all levels the returns are positive. This is attributed to that the opportunity cost of acquiring university degree is higher than that of getting a primary education.

3. Social returns to education are negatively correlated with a country's per capita income. This must be due to relative scarcity of human capital in low-income countries and its abundance in high-income countries.

4. Private rates of return are higher than social ones for all educational levels, the issue resulting from subsidization of education in most countries.

5. Private returns to education are higher for women than for men, which is due to lower opportunity cost of study for women.

The question, however, arises regarding the effect of education on earnings: would the estimates of returns to schooling be statistically and, more importantly, economically significant if we were able to control for a variety of unobservable or difficult-to-measure characteristics like innate ability, cognitive skills, ambition of a worker? Or, probably, the effects attributed to education attainment are in fact largely those of personal characteristics?

Orley Ashanfelter and Alan Krueger (1994) investigated the effects of education on wage rates in a sample of identical twins that have same background, are

considered genetically identical, and thus are likely to have similar abilities and other personal characteristics. The major result of the study was that inability to control for these unobservables does not bias the estimated rate of return to schooling upwards, but rather the returns are significantly underestimated.

Chapter 3

ESTIMATING THE EDUCATION – WAGE RELATIONSHIP: THEORETICAL AND EMPIRICAL ISSUES

3.1 The Specific Educational Environment in Ukraine during Transition

The educational system Ukraine has inherited from the former USSR was represented, from the supply side, exclusively by state-owned scholastic institutions. During the years of transition, new institutions other than of state property emerged. Although the expenses on higher education were defrayed by the state, over the course of transition government spending on education fell dramatically. This, from the one side, led to a decrease in quality of teaching and, from the other side, made higher education less available for many people. Those willing to get higher education are induced to pay at least a part of the expenses on it. For this reasoning, a number of surveys suggest that the average years of schooling in Ukraine, as well as in the other FSU states, tend to decline.

Additionally, the transition to the market wage-setting system (as opposed to the previously functioning centralized one) broke down a one-to-one correspondence of an employee's wage and industry the worker is employed in, his/her occupation, and position. The characteristics such as quality of education acquired, professional skills, other personal characteristics of an employee are becoming more and more important in the wage determination mechanism. Nesterova and Sabirianova 1999, p.5)

Nonetheless, the years of central planning created deep structural inconsistencies in the labor market and, as a consequence, educational one. The inappropriate

structure of the labor force resulted in high levels of structural unemployment, with private returns to technical and engineering education having fallen sharply, while returns to economic, business administration having risen dramatically.

The basic model chosen here for analyzing private rates of return to education in Ukraine is one developed by Mincer (1974), particularly its variation with dummies standing for educational levels. It regresses the logarithm of earnings on educational levels, experience, and experience squared. The primary and unfinished general secondary educational levels (9 grades), being obligatory, are omitted (the latter serving as the base category), so that there are four variables (dummies for junior specialist – a degree offered by vocational schools, bachelor, specialist, and master) taking the value of one if a person has the degree and zero otherwise.

There is, however, a number of features peculiar to Ukrainian educational system and labor market, which should be captured by the model for analyzing the returns to education.

3.2 Mismatching of Education and Skills

The first one, which has already been mentioned above, is structural inconsistencies in the labor market. High demand for experts in engineering in the Soviet Union during the 1970s, for example, resulted in 'epidemic' demand for the corresponding education, while after the opening of the Soviet economy to international markets and transition to market economy the demand for humanities and social sciences, especially for economic and business, increased rapidly. The system for higher education responded to the changes in the labor market rather quickly by shifting the supply of educational services to the most

demanded sciences and areas. Young people newly coming into the labor force, therefore, are expected to have higher rates of return to education and experience. People that had already been participating in the labor force at the moment these changes occurred are, conversely, likely to find their private returns to education lower. Additionally, young people are likely to make larger post-school investment in human capital, taking the form of self-instruction.

That has two important implications. First, when estimating returns to education we need to distinguish among fields an individual received his/her education. For this purpose, Dougherty and Jimenez (1987) used different variables for higher social, higher technical, etc. levels of education. Such a method, however, does not allow us to separate the effect of acquiring a particular degree from the effects of demand of the labor market for employees with specific knowledge in a particular field.

A way to do this here is to include two sets of variables into the regression: dummies for the field education was acquired in and interactions between the field and the educational level, the latter serving to separate the effect of education itself and the effect of acquiring a particular certificate in a particular field. In this case, we will be able to compare the contributions of acquiring education in a particular area within various educational levels. For example, the difference between the coefficients of university*economic and university*engineering variables would yield an estimate of what percentage of income was foregone by an average individual who decided to get a university degree in engineering rather than in economics. It is worth mentioning that we are not able to draw a line between two actually different fields of study – economics and business. The reason is that in Ukraine, like in all of the post Soviet countries, economics is understood in a wider context and teaching of it also includes business administration.

Second, to control for the shocks external to the individual in question, specifically shifts in the market demand for labor, an age variable should be introduced. Nesterova and Sabirianova (1999, p.20) make a point that "the new market economy rewards younger people". Their explanation is very similar to that made above: during the Soviet era, education was aimed at developing narrow skills that could hardly be applied in changing conditions. Another possible explanation of this phenomena would be that younger people are more mobile and devote more time and effort to job search.

3.3 Unemployment and Wage Arrears

The second feature is widespread unemployment, both 'explicit' (an individual looses his job) and 'implicit' – unpaid leaves, wage arrears, and part-time work. This notion is important for two reasons.

First, if individuals with different levels of education are subject to wage arrears to different extent or have different probability of becoming unemployed, the analysis that neglects these facts will be distorted. The reason is that we are primarily interested in the rate of return to education **actually** offered by the Ukrainian labor market during the transition period. If a person with a complete higher education is not only offered a higher wage **if** he will be able to find a job, but also the **probability** of finding the job is higher for him than for a person with basic higher education, then the 'unconditional return' to his education is higher than the rate of return to his education conditional upon that he is employed. However, Nesterova and Sabirianova (1999, p.10) restrict their sample to employees only, and leave out the unemployed. In our opinion, this may lead to underestimation of rates of return to education, especially taking into account

their finding that more educated people "are less likely to become unemployed" or drop out of the labor force Nesterova and Sabirianova (1999, p.32).

Second, prolonged unemployment, especially one taking the form of unpaid leaves, results in deterioration of human capital (though wage arrears may have largely the same effect through decreased incentives to make efforts doing the job). Unfortunately, the data available do not contain information on these issues, so that we are not able to incorporate them into the present research. Nesterova and Sabirianova (1999, p.9) also note that the account of wage arrears and non-regularity of wage payments could be taken by using contractual wages rather than actually paid earnings on the left-hand side of the regression equation. Although Lehmann et al. (1999) do not find that education has a significant impact on probability to become subject to wage arrears in the Russian Federation, our opinion is that the actual earnings rather than contractual wages should be used in estimating the earnings function for Ukraine.

3.4 Regional Effects

Ukraine has 25 regions (24 oblasts and the Crimean Republic) plus Kiev and Sevastopol. Some of the regions are industrial, and some of them agricultural. Dnepropetrovsk oblast, for example, is far more industrially developed than Kirovograd oblast, the fact that is to be expected to influence the incomes of their inhabitants. The point that "the estimation of the standard earnings equation … may be distorted owing to considerable regional differences in … income levels" is made in Nesterova, Sabirianova (1999, p.10). For that reason they controlled for regions when estimating the returns to human capital. It is also straightforward to suggest that individual's earnings are, on average, likely to be higher in Kiev than in any regional center, earnings in the latter are expected

to be higher than in rural areas. To eliminate the disturbing effects of regions' level of industrial development on the coefficients of schooling dummies, we need to control for two things: first, whether the income is earned in a regional (oblast) center (or in a large city), in a small town or in a rural area; and second, we need to specify the region.

3.5 The Effect of Establishment Type

It is widely accepted in the literature that ownership type of an enterprise employing a worker has a significant influence on the worker's earnings (e.g. Psacharopoulos 1988, p.105). Public sector tends to underrate the importance of human capital compared to the private sector. Thus, an average employee working at a private-owned firm receives higher wage than that working at a state-owned enterprise. To eliminate the disturbing effect of the sector of employment, we need to control for the ownership type of an enterprise. Nesterova and Sabirianova (1999, p.19) ran four separate regressions for different types of firms: de novo firms, state-owned firms, privatized firms, and former collective and state farms. In the context of the present research, we also need to control for ownership type in the estimated equation that tests the hypothesis of positive returns to education.

Chapter 4

EMPIRICAL EVIDENCE

4.1 The Data

The micro data used in the research are obtained from "The Survey of Households' Standards of Living" (micro files on members of households) that has been conducted by Derzhkomstat starting the year 1999.

The data set was collected for over 12,000 households from all the regions of Ukraine and contain information on individuals' age, state of health, family and socio-economic status, educational background, region the individual in currently living in, place of living (large city, small town, or rural area), years of working experience as stated at the workbook, industry the individual is employed in, type of enterprise ownership, and earnings.

4.2 The Sample

For our purposes, only 5,430 observations are useful. We exclude observations without information on key subjects, specifically on educational level, years of working experience, industry individual is employed in, form of enterprise ownership, and age.

The absence of information on working experience, however, may be due to the simple fact that the given individual has not ever worked. For that reason, we

examine the column containing information on whether the person has ever worked, and set working experience equal to zero if the individual has not spent any time in the labor force. Otherwise, the observation is excluded from our sample.

There are certain groups of people, however, who stated that they don't have any labor market experience while their socio-economic status and information on earnings suggest that this statement is unreliable. Specifically, these are retirees, as well as students, unemployed and housewives who reported positive earnings at principal and secondary jobs. These observations are also left out.

We would also like to exclude pupils because these are children currently involved in schooling, and housewives because these are voluntary unemployed. Whether to exclude students from the sample is a debatable point. The reason that we might want to keep them is that many of them report they earn wages. However, we may not rely on educational levels reported by students: some of them may report the previously obtained degree, and some the degree they expect to acquire. Additionally, the wages may be summer earnings or those students earned at part-time jobs. Thus, the inclusion of this group of individuals may lead to measurement errors in educational level variable (due to uncertainty as to which level, actual or expected, is reported) leading to biased estimates of rates of return. For that reason, we exclude students from the sample.

We also exclude retirees who do not currently work, i.e. do not receive salaries and wages.

As to unemployed, we keep them in the sample for the reason that follows. If it is true for Ukraine that more education lowers the probability of becoming unemployed (as found by Nesterova and Sabirianova, 1999, for the Russian Federation) then dropping observations on unemployed is likely to result in

excluding the subsample, which presumably consists of less educated individuals with the lowest (virtually zero, except for the unemployment benefits) income. The share of individuals with, for example, basic higher education in this subsample is thus expected to be larger than the share of individuals with complete higher education. Hence, the exclusion of unemployed essentially leads to exclusion of proportionally larger lowest-income group of people with basic higher education than the lowest-income group of people with complete higher education, and as a result, the average income of less educated people in the whole sample increases proportionally more than that of more educated individuals. As the earnings of people with the basic higher education are the opportunity cost of acquiring the complete higher education, dropping observations on unemployed results in overestimation of the opportunity cost and, consequently, in underestimation of the private rate of return to a given educational level (complete higher in the present example).

4.3 The Dependent Variable

The dependent variable is the natural logarithm of individual's annual earnings (lnearn). These are actual earnings received during the year 1999 and are comprised of 12 types of income. Of those, we include:

- wages and salaries in monetary form at primary place of employment;
- wages and salaries in non-monetary form at primary place of employment;
- wages and salaries in monetary and non-monetary form at other places of employment;

- entrepreneurial income;
- income from individual labor activity;
- earnings at other part-time jobs;
- unemployment benefits;
- lump sum payments in connection with job quit.

4.4 The Explanatory Variables

1. Educational level. Six dummies are taken to represent educational levels taking the value of one if it is the highest education level the individual has acquired. The variable has 10 categories:

- Complete higher education (C_HIGHER) offered by universities and institutes, and lasting normally for 5 years;
- Basic higher education (B_HIGHER) corresponding to the bachelors degree and lasting normally for 4 years;
- Incomplete higher education (I_HIGHER) – this is not an educational level but rather a way to say that an individual has terminated his/her studies or has not completed the higher education for some reason. Thus, we may not speak about the rate of return to it because we don't know how many years it took before termination;

- Secondary special education (SPEC_SEC) offered by technical schools and lasting for 4 years;

- Vocational (VOCATION) offered by vocational schools and lasting for 3 years;

- Complete general secondary (C_SEC_G) offered by schools and lasting for 2 years;

- Incomplete general secondary – obligatory (base category) lasting for 9 years.

We also have two illiterate people in the sample as well as people who have only completed the primary educational level and those without primary education. To account for those, we introduce three additional dummies: ILLITER for illiterate, PRIM for primary education and NO_PRIM for those without primary education.

2. Age (age).

3. Experience (exp) – years of individuals' working experience as stated in the workbook.

4. Experience squared (exp2).

5. Gender – dummy (GENDER), 2 categories: value of 1 if male, 0 if female.

6. Branch – dummies, 8 categories: manufacturing (MANUF), agriculture and forestry (AG_FORES), construction (CONSTRUC), transport and communications (COMMUN), trade and services

(SERVICES), social sector (SOCIAL), finance, crediting and insurance (FINANCE), governmental organizations (base category).

7. Form of property of the enterprise – dummies, 7 categories: collective enterprises and cooperatives (COL_COOP), joint-stock companies (JOINT), leasing enterprises (LEASE), foreign enterprises (FOREIGN), private (PRIV), other (OTHER), state-owned enterprises (base category).

8. Region. The data are collected for 15 representative regions of Ukraine (excluding Kiev). These are grouped into 3 categories (economic regions) according to Syrotenko, Chernov and Platukha (1994, p. 182): Donetsk-Pridnieprovsky region (DON_PRID), Southern region (SOUTH), and South-Western region (base category).

9. Place of living – dummies, 3 categories: large city (CITY), small town (TOWN), and rural area (base category)

We are not able to control for the field of study due to the fact that the data set contains only few observations this information if available for.

4.5 The Regression Equation and Expected Results

To test the hypothesis of positive returns to education, we need to estimate the following equation:

$$lnearn_i = \alpha_0 + \sum \beta_k ED_{ik} + \alpha_1 exp_i + \alpha_2 exp2_i + \sum \gamma_k EDik*exp_i + \sum \eta_k ED_{ik}*exp2_i + age_i + \sum \nu_m PLACE_m + \sum \omega_l REGION_l + \sum \tau_n FORMPROP_n + \sum \theta_p BRANCH_p + \varphi GENDER + \varepsilon_I$$

Where : ED – education dummies,

exp – working experience,

exp2 – working experience squared,

age – age,

GENDER – gender dummy,

BRANCH – branch dummies,

FORMPROP – form of property dummies,

REGION – economic regions dummies,

PLACE – place of living dummies (large city, small town, or rural area).

exp*ED – interactions of educational dummies and working experience variable

exp2*ED – interactions of educational dummies and working experience variable squared

The coefficients of educational variables are expected to be positive, and their magnitudes increase through post general school levels as follows (in ascending order): vocational school, secondary specialized, basic higher, and complete higher education. The reason of why we expect such ordering is that, first, we suppose that private earnings increase with years of schooling (that is why the increment of complete higher education is larger than that of basic higher or secondary general, which in turn is higher than that of vocational school or incomplete higher). Second, if two educational levels require equal periods of studying, then we would expect that basic higher education offered normally by

universities, institutes and colleges raises the wages compared to specialized secondary education offered by technical schools due to better trained faculty and/or better facilities (like computers, library), etc.

We also expect a positive sign of the experience variable for the reason that working experience is likely to contribute to enhancement of individual's human capital (develop his vocational skills), and negative coefficient of experience square as marginal returns from experience tend to decline over the lifetime.

On the contrary, the coefficient of the age variable is expected to be negative for we expect that the vocational skills of elder people who acquired their education and working experience in the planned economy are less demanded by the market in the transition period than those of younger people.

We also expect that we will find wage discrimination by gender: males are expected to have higher earnings than females, the result of a vast majority of empirical studies on wage determination.

4.6 The Estimation Technique

When evaluating the specifications of the earnings functions, Dougherty and Jimenez (1987) find that the earnings equations are subject to heteroscedasticity, although this problem is largely reduced when the log of earnings, rather than earnings themselves, enter the RHS of the equation.

For that reason we suspect that in our sample, the coefficients' variances may be heteroscedastic. To test the hypothesis of homoscedasticity, we run the OLS regression and apply the Cook-Weisberg test for heteroscedasticity using fitted values of the regressand. On the basis of the test results (Appendix A), we reject

the null hypothesis of constant variance of the coefficients. Thus, we use the robust OLS estimation technique with Huber/White/sandwich variance estimates.

4.7 The Discussion of the Results

The Stata output for OLS estimation with robust standard errors is provided in Appendix B. Note that the interactions of educational dummies and the experience and experience squared variables are highly statistically insignificant.

We suggest the following explanation of why we find the interactive effects insignificant for our sample. The rationale for inclusion of the interactive effects of education and experience on earnings was the argument of Dougherty and Jimenez (1987) that the age-earnings profiles of individuals with different educational levels have not only different intercepts, but also different slopes and curvature. To account for these differences, the interactions of educational dummies and experience and experience squared should be introduced into the earnings equation.

During the Soviet period, however, wages were determined by the wage grids, which put earnings into dependence on occupation, industry, and position of a worker. The so-called experience allowances (increases in wages after a certain number of years spent in the labor force) differed across industries, enterprises and authorities but did not typically differ across professional groups inside a specific authority or enterprise, and thus were not correlated with an individual's educational level. As a large part of our sample is comprised of employees of state-owned enterprises and governmental organizations and authorities where the centralized wage setting system still exists, we find that for Ukraine the

interactions of the effects of education and experience on earnings are insignificant.

Hence we exclude the interactive terms from the earnings equation. The summary statistics of the regression results for the model without interactions are provided in table 4.1, a more detailed information is given in Appendix C. For all the dummy variables except educational levels we present the marginal effects rather than estimated coefficients. We keep the regression coefficients of educational dummies rather than calculate the marginal effects of educational levels on earnings because what we are primarily interested in are the private rates of return to education, the computation of which involves the use of regression coefficients estimates.

The experience variable has a positive and statistically significant coefficient. Its magnitude suggests that one additional year of experience contributes to an increase in earnings of on average 4.95%, while the coefficient of the experience squared suggests that the marginal effect of experience on earnings is diminishing with more experience accumulated (negative sign), but the rate of its change is quite low (0.8%).

In contrast, the effect of age on earnings is negative, as expected: one additional year of age corresponds to a 1.5% decrease in annual earnings. This result supports our assumption as to the skills mismatch: elder people who acquired their education and skills in the planned economy receive lower wages, though

Table 4.1 Summary Statistics for the Model without Interactions

Number of obs = 5430 F(29,5399) = 454.05 Prob > F = 0.0000 R-squared = 0.2921 Root MSE = .86144			
Variable	Coefficient/Marginal Effect	Robust Standard Error	P-value
constant	6.48198	.1129004	0.000
CITY	.405731	.0363552	0.000
TOWN	.247838	.0348947	0.000
DON_PRID	.117126	.0275283	0.000
SOUTH	.010413	.0374322	0.782
age	-.0150411	.003414	0.000
GENDER	.311519	.0259551	0.000
C_HIGHER	.5579705	.0576312	0.000
I_HIGHER	.3885593	.1236733	0.002
B_HIGHER	.276116	.1128632	0.014
VOCATION	.1439714	.0591398	0.015
SPEC_SEC	.265075	.054967	0.000
C_SEC_G	.0955925	.0571022	0.094
PRIM	-.0318384	.1152901	0.782
NO_PRIM	.3233468	.0857146	0.000
ILLITER	-.5685662	.1870346	0.002
exp	.0494726	.0053213	0.000
exp2	-.0008119	.0000938	0.000
COL_COOP	-.271304	.0432303	0.000
JOINT	-.092259	.0380393	0.011
LEASE	.362065	.1252693	0.014
FOREIGN	.234393	.203706	0.301
PRIV	.185949	.0461919	0.000
OTHER	-0.878074	.076423	0.000
MANUF	-.080646	.0512719	0.101
AG_FORES	-.578008	.0707158	0.000
CONSTRUC	-.143666	.0715481	0.030
COMMUN	-.007389	.0575752	0.898
SERVICES	-.142493	.0527187	0.004
SOCIAL	-.176969	.0463181	0.000
FINANCE	.190123	.0823787	0.035

the experience accumulated during the Soviet period is still rewarded for the marginal increase in earnings due to experience more than offsets the negative marginal effect of age.

The marginal effect of gender suggests that males receive on average 31% higher earnings than females. This result is fully consistent with the world empirical evidence on wage discrimination. We should note, however, that the differences in male and females earnings might be lower if we were able to control for occupation and position of workers.

The place of living also has a considerable impact on earnings. As expected, the highest wages are earned, on average, in large cities followed by small towns, and the lowest-income are the rural areas. In large cities, the average earnings are 40.6% higher than in rural areas. This is attributed to more opportunities in the labor market that can be realized in large cities.

To compute the rates of return to the k-th educational level, we use the formula presented in Chapter 2 (p. 9):

$$\rho = \frac{\beta_k - \beta_{k-1}}{T_k - T_{k-1}} \qquad (4).$$

As in Ukraine some educational levels require the same number of years of studying, we calculate the rates of return to complete higher education both relative to basic higher and specialized secondary. Also, we may compute the rates of return to vocational education both relative to complete and incomplete general secondary. We do not compute the rate of return to incomplete higher education because it is ambiguous how many years it takes every individual to obtain it. The results are represented below (Table 4.2):

Table 4.2 The Private Rates of Return to Education

Educational level (k)	Coefficient (k)	Educational level (k-1)	Coefficient (k-1)	Rate of Return
complete higher	0,557971	basic higher	0,276116	0,281855
complete higher	0,557971	specialized secondary	0,265075	0,292896
basic higher	0,276116	vocational	0,143971	0,132145
specialized secondary	0,265075	vocational	0,143971	0,121104
vocational	0,143971	complete secondary general	0,265075	-0,040368
vocational	0,143971	incomplete secondary general		0,047990
complete secondary general	0,265075	incomplete secondary general		0,1325375

To insure that the obtained rates of return are statistically significant, we applied the tests of restrictions that the coefficients of the k-th and (k-1)-th levels of education are equal to each other. The results are reported in Appendix C. Note that in the case of rates of return to vocational relative to incomplete secondary general and the return to complete secondary general relative to incomplete secondary general educational levels, the t-tests for individual significance of the coefficients of vocational and complete secondary general dummies are the tests for statistical significance of the rates of return, because the (k-1)-th level of education in these cases is the base category.

We find that the differences in coefficients are significant with the exception of basic higher education relative to vocational one and of vocational relative to complete secondary general. We also find that the rates of return are positive except for the return to vocational relative to complete secondary general education, which is also statistically insignificant.

However, we also obtain a result, which is inconsistent with the world evidence. The rates of return to educational levels in our sample rise rather than fall as the

education level gets higher. The returns should fall as the educational level gets higher because the opportunity cost of education increases with educational level.

Our discussion on inclusion of unemployed individuals in the sample suggests one possible explanation for this anomaly.

If, in fact, the probability of becoming unemployed decreases as the level of education gets higher, we would expect that dropping the observations on unemployed would reduce the gap between the rates of return to different educational levels. And if the marginal change of the probability to become unemployed is increasing, the rates of return in our sample may even start diminishing as the educational level gets higher.

To see whether this might be the case, we restrict our sample to individuals who have not reported themselves as unemployed and estimate the rates of return to different levels of education. The regression results along with the tests for significance of the rates of return are reported in Appendix D. The test suggest that the rates of return to all educational levels are significant at 5% level. Table 4.3 provides the calculated private rates of return for the restricted sample.

Table 4.3 The Private Rates of Return to Education: The Sample Without Unemployed

Educational Level (k)	Coefficient	Educational level (k-1)	Coefficient	Rate of Return
complete higher	0,561148	basic higher	0,37866	0,1824878
complete higher	0,561148	specialized secondary	0,275358	0,2857899
basic higher	0,37866	vocational	0,171718	0,2069428
specialized secondary	0,275358	vocational	0,171718	0,1036407
vocational	0,171718	complete secondary general	0,087862	0,083856
vocational	0,171718	incomplete secondary general		0,05723916
complete secondary general	0,087862	incomplete secondary general		0,04393075

As the result of exclusion of unemployed individuals from the sample, the rate of return to complete higher education relative to basic higher fell by almost 10 percentage points and became slightly lower than the return to basic higher relative to vocational education. The difference between these returns now constitutes 2 percentage points as opposed to 15 points in the sample including unemployed. We should also take into account that in the unrestricted sample we were not able to reject the hypothesis of zero returns to basic higher education relative to vocational education at significance levels below 20%. If for the whole population the returns to basic higher relative to vocational education are zero, the difference between the two rates of return reduces even more.

The difference between rates of return to complete higher relative to specialized secondary and to specialized secondary relative to vocational education remained virtually unchanged.

These results suggest that one possible explanation of why we got the returns to education rising as the level of education increases may be that the probability of becoming unemployed in Ukraine decreases as the level of education gets higher. However, to conclude with sufficient level of confidence that this is the real reason, a separate research investigating the determinants of probability to become unemployed in Ukraine is needed.

4.8 Weaknesses of the research and suggestions for future research

The present research was conducted using the cross sectional data. Thus, it does not allow us to track the major trends in returns to human capital over the course of transition to market economy in Ukraine. We are not able to test the hypothesis of declining returns during the period of transition.

The data used to conduct the present research was collected for the purposes of investigating the conditions of living of Ukrainian households rather than returns to human capital. Thus, some important information is missed. The absence of information on tenure (employment period at the current working place) may distort the analysis if tenure has a significant impact on wage determination. Also, we would be interested in information on the year education was acquired in by each individual. That would allow us to control for whether the quality and content of education is likely to be demanded by the economy more properly than using just age variable.

The estimation technique is simple OLS, so the possible endogeneity in the education variable is not captured. A way to tackle this problem is to use the instrumental variable approach with parents' education as an instrument (Verbeek 2000, p.131). The lack of data does not allow us to do this.

Another problem with the present research is the quality of data set itself. A lot of the observations are missed, which substantially reduces the sample size.

Our finding that the rates of return rise as the level of education gets higher is inconsistent with the world evidence. This issue requires additional research in the area.

Finally, we acknowledge the fact that the private rates of return to education estimated on the basis of our sample is to a large extent the return given by the planned economy rather than the return offered by the market. The large portion of the sample is comprised of people who acquired their education and enhanced their skills during the Soviet period. For that reason, we would be more interested in estimating the returns to education for younger people who made their decision on investment to education during the transition period.

CONCLUSIONS

The present research concentrated on estimating the private rate of return to education in Ukraine during the transition period.

We used the extended Mincer's earnings function accommodated for the Ukraine's contemporary situation as the empirical tool in order to investigate the education-wage relationship and test the hypothesis of positive returns to education.

Our findings suggest that the private rates of return to education in Ukraine are positive at virtually all educational levels. We also find that the rates of return to education are higher the higher the educational level, the result inconsistent with the findings of other researchers in this area. We suggest a possible explanation for this phenomenon: if the probability of becoming unemployed decreases the more education is acquired by an individual, then the inclusion of unemployed into the sample might lead to the rates of return rising with the educational level. Although our results provide some support for this argument, we view this issue as the one of the areas for further research.

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APPENDIX A

The OLS Regression with Interactions of the Effects of Education and Experience on Earnings

lnearn	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
city	.3387856	.0374256	9.052	0.000	.2654163	.4121549
town	.2230441	.0351446	6.346	0.000	.1541465	.2919416
don_prid	.1124853	.027535	4.085	0.000	.0585055	.1664651
south	.012425	.0354415	0.351	0.726	-.0570546	.0819047
age	-.0159076	.0032608	-4.878	0.000	-.0223001	-.0095151
gender	.2709133	.0254454	10.647	0.000	.22103	.3207966
c_higher	.7976786	.1516279	5.261	0.000	.5004265	1.094931
c_h_exp	-.0143077	.0149722	-0.956	0.339	-.0436593	.0150438
c_h_exp2	.0001088	.0003275	0.332	0.740	-.0005332	.0007507
i_higher	.1724596	.2632624	0.655	0.512	-.3436412	.6885603
i_h_exp	.0510876	.0384902	1.327	0.184	-.0243688	.126544
i_h_exp2	-.0014287	.0010679	-1.338	0.181	-.0035222	.0006649
b_higher	.1270068	.2851088	0.445	0.656	-.4319218	.6859354
b_h_exp	.020293	.0308064	0.659	0.510	-.0401	.080686
b_h_exp2	-.0004584	.0007412	-0.619	0.536	-.0019115	.0009946
vocation	.2880132	.1415289	2.035	0.042	.0105592	.5654671
voc_exp	-.0086582	.0150137	-0.577	0.564	-.0380912	.0207749
voc_exp2	.0000556	.00035	0.159	0.874	-.0006305	.0007417
spec_sec	.3997023	.1339764	2.983	0.003	.1370543	.6623503
s_s_exp	-.0117474	.0137052	-0.857	0.391	-.0386152	.0151204
s_s_exp2	.0002015	.0003082	0.654	0.513	-.0004028	.0008057
c_sec_g	.3845388	.1404716	2.737	0.006	.1091576	.6599201
s_g_exp	-.0243359	.0145177	-1.676	0.094	-.0527965	.0041247
s_g_exp2	.0003933	.0003297	1.193	0.233	-.0002532	.0010397
prim	-.1524223	.2887131	-0.528	0.598	-.7184169	.4135723
pr_exp	.0196079	.0267148	0.734	0.463	-.0327638	.0719797
pr_exp2	-.0004621	.0005397	-0.856	0.392	-.0015202	.0005959
no_prim	-1.054632	11.60115	-0.091	0.928	-23.79758	21.68832
n_p_exp	.0645026	.5945595	0.108	0.914	-1.101075	1.23008
n_p_exp2	-.0007688	.0074012	-0.104	0.917	-.0152782	.0137406
illiter	(dropped)					
ill_exp	-.1847273	.2831594	-0.652	0.514	-.7398344	.3703798
ill_exp2	.0109358	.0207187	0.528	0.598	-.0296812	.0515528
exp	.0608628	.0124378	4.893	0.000	.0364798	.0852459
exp2	-.0009302	.0002641	-3.523	0.000	-.0014479	-.0004125
col_coop	-.3173446	.0411199	-7.718	0.000	-.3979563	-.2367329
joint	-.0964459	.0375108	-2.571	0.010	-.1699823	-.0229096
lease	.3190039	.1269127	2.514	0.012	.0702036	.5678042
foreign	.1884048	.1500193	1.256	0.209	-.1056937	.4825033
priv	.1712418	.0500053	3.424	0.001	.0732112	.2692724
other	-1.983723	.8676269	-2.286	0.022	-3.684623	-.2828231
manuf	-.0813082	.0535842	-1.517	0.129	-.1863549	.0237386
ag_fores	-.8589359	.066244	-12.966	0.000	-.988801	-.7290707
construc	-.1516584	.0718713	-2.110	0.035	-.2925552	-.0107616
commun	-.0041579	.0602235	-0.069	0.945	-.1222204	.1139045
services	-.1524645	.056437	-2.701	0.007	-.2631038	-.0418251
social	-.1919747	.0524779	-3.658	0.000	-.2948526	-.0890969
finance	.1696575	.1293762	1.311	0.190	-.0839721	.4232872
_cons	6.344907	.1425441	44.512	0.000	6.065463	6.624352

```
Number of obs =    5430
F( 47,  5382) =   47.75
Prob > F      =  0.0000
R-squared     =  0.2943
Adj R-squared =  0.2881
Root MSE      =  .86146
```

The Cook-Weisberg test for heteroscedasticity using fitted values of lnearn

```
Ho: Constant variance
         chi2(1) = 474.78
         Prob > chi2 = 0.0000
```

APPENDIX B

Regression with Interactions of the Effects of Education and Experience on Earnings with Robust Standard Errors

lnearn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
city	.3387856	.036661	9.241	0.000	.2669153	.4106559
town	.2230441	.0351234	6.350	0.000	.154188	.2919001
don_prid	.1124853	.0276465	4.069	0.000	.0582869	.1666837
south	.012425	.0375377	0.331	0.741	-.061164	.086014
age	-.0159076	.0034423	-4.621	0.000	-.022656	-.0091593
gender	.2709133	.0260399	10.404	0.000	.2198646	.321962
c_higher	.7976786	.1687435	4.727	0.000	.466873	1.128484
c_h_exp	-.0143077	.0170679	-0.838	0.402	-.0477677	.0191523
c_h_exp2	.0001088	.0003875	0.281	0.779	-.0006509	.0008685
i_higher	.1724596	.307612	0.561	0.575	-.4305844	.7755035
i_h_exp	.0510876	.0324962	1.572	0.116	-.0126181	.1147933
i_h_exp2	-.0014287	.0008255	-1.731	0.084	-.0030469	.0001896
b_higher	.1270068	.578066	0.220	0.826	-1.006236	1.26025
b_h_exp	.020293	.055728	0.364	0.716	-.0889565	.1295425
b_h_exp2	-.0004584	.0011695	-0.392	0.695	-.0027512	.0018343
vocation	.2880132	.1756452	1.640	0.101	-.0563226	.6323489
voc_exp	-.0086582	.0180283	-0.480	0.631	-.0440009	.0266846
voc_exp2	.0000556	.0004147	0.134	0.893	-.0007574	.0008686
spec_sec	.3997023	.1641992	2.434	0.015	.0778054	.7215992
s_s_exp	-.0117474	.0164437	-0.714	0.475	-.0439836	.0204889
s_s_exp2	.0002015	.0003696	0.545	0.586	-.0005231	.0009261
c_sec_g	.3845388	.1770695	2.172	0.030	.0374109	.7316667
s_g_exp	-.0243359	.0177981	-1.367	0.172	-.0592274	.0105557
s_g_exp2	.0003933	.0004024	0.977	0.328	-.0003955	.001182
prim	-.1524223	.2964392	-0.514	0.607	-.7335631	.4287185
pr_exp	.0196079	.0275861	0.711	0.477	-.0344719	.0736878
pr_exp2	-.0004621	.0005582	-0.828	0.408	-.0015564	.0006321
no_prim	-1.054632	2.23306	-0.472	0.637	-5.432332	3.323069
n_p_exp	.0645026	.1124303	0.574	0.566	-.1559063	.2849115
n_p_exp2	-.0007688	.0013925	-0.552	0.581	-.0034987	.0019611
illiter	(dropped)					
ill_exp	-.1847273	.017035	-10.844	0.000	-.2181229	-.1513317
ill_exp2	.0109358	.0008728	12.529	0.000	.0092247	.0126469
exp	.0608628	.015369	3.960	0.000	.0307334	.0909922
exp2	-.0009302	.0003363	-2.766	0.006	-.0015895	-.0002709
col_coop	-.3173446	.0433352	-7.323	0.000	-.402299	-.2323901
joint	-.0964459	.038156	-2.528	0.012	-.1712472	-.0216447
lease	.3190039	.1258544	2.535	0.011	.0722783	.5657295
foreign	.1884048	.204643	0.921	0.357	-.2127783	.5895879
priv	.1712418	.0461844	3.708	0.000	.0807016	.261782
other	-1.983723	.1251897	-15.846	0.000	-2.229145	-1.738301
manuf	-.0813082	.0506409	-1.606	0.108	-.1805849	.0179686
ag_fores	-.8589359	.0701799	-12.239	0.000	-.9965168	-.7213549
construc	-.1516584	.0710997	-2.133	0.033	-.2910426	-.0122741
commun	-.0041579	.0567786	-0.073	0.942	-.1154669	.1071511
services	-.1524645	.0523842	-2.911	0.004	-.2551588	-.0497702
social	-.1919747	.0460472	-4.169	0.000	-.2822459	-.1017036
finance	.1696575	.0823776	2.060	0.039	.0081641	.331151
_cons	6.344907	.1734009	36.591	0.000	6.004971	6.684843

```
Number of obs =    5430
F( 44,  5382) =  960.32
Prob > F      =  0.0000
R-squared     =  0.2943
Root MSE      =  .86146
```

APPENDIX C

Regression with Robust Standard Errors without Interactions

lnearn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
CITY	.405731	.0363552	9.367	0.000	.2692863	.4118281
TOWN	.247838	.0348947	6.345	0.000	.1530047	.28982
DON_PRID	.117126	.0275283	4.023	0.000	.0567924	.1647254
SOUTH	.010413	.0374322	0.277	0.782	-.0630234	.0837409
age	-.0150411	.003414	-4.406	0.000	-.0217339	-.0083482
GENDER	.311519	.0259551	10.448	0.000	.2203036	.3220685
c_higher	.5579705	.0576312	9.682	0.000	.4449901	.6709509
i_higher	.3885593	.1236733	3.142	0.002	.1461097	.6310089
b_higher	.276116	.1128632	2.446	0.014	.0548586	.4973734
vocation	.1439714	.0591398	2.434	0.015	.0280335	.2599093
spec_sec	.265075	.054967	4.822	0.000	.1573176	.3728324
c_sec_g	.0955925	.0571022	1.674	0.094	-.0163509	.2075359
prim	-.0318384	.1152901	-0.276	0.782	-.2578534	.1941766
no_prim	.3233468	.0857146	3.772	0.000	.1553115	.491382
illiter	-.5685662	.1870346	-3.040	0.002	-.9352294	-.201903
exp	.0494726	.0053213	9.297	0.000	.0390407	.0599045
exp2	-.0008119	.0000938	-8.652	0.000	-.0009958	-.0006279
COL_COOP	-.271304	.0432303	-7.321	0.000	-.4012477	-.2317502
JOINT	-.092259	.0380393	-2.545	0.011	-.1713685	-.0222237
LEASE	.362065	.1252693	2.467	0.014	.0634232	.55458
FOREIGN	.234393	.203706	1.034	0.301	-.1887669	.6099251
PRIV	.185949	.0461919	3.692	0.000	.0799889	.2610984
OTHER	-0.878074	.076423	-27.535	0.000	-2.254159	-1.954519
MANUF	-.080646	.0512719	-1.640	0.101	-.1845972	.0164301
AG_FORES	-.578008	.0707158	-12.201	0.000	-1.001401	-.7241379
CONSTRUC	-.143666	.0715481	-2.168	0.030	-.2953579	-.0148318
COMMUN	-.007389	.0575752	-0.129	0.898	-.1202871	.105454
SERVICES	-.142493	.0527187	-2.916	0.004	-.2570763	-.0503764
SOCIAL	-.176969	.0463181	-4.205	0.000	-.2855636	-.1039594
FINANCE	.190123	.0823787	2.113	0.035	.012561	.335552
_cons	6.48198	.1129004	57.413	0.000	6.260649	6.70331

Note: for all the dummy variables except for the educational levels, we provide the marginal effects rather than the estimated regression coefficients

Number of obs = 5430
F(29, 5399) = 454.05

Prob > F = 0.0000
R-squared = 0.2921
Root MSE = .86144

The tests for equality of coefficients of educational dummies

```
 H0: - c_higher + b_higher = 0.0

       F(  1,  5399) = 7.52
       Prob > F = 0.0061


H0: - c_higher + spec_sec = 0.0

       F(  1,  5399) =  82.22
       Prob > F = 0.0000


H0: - b_higher + vocation = 0.0

       F(  1,  5399) = 1.58
       Prob > F = 0.2084


H0: vocation - spec_sec = 0.0

       F(  1,  5399) = 10.64
       Prob > F = 0.0011


H0: - vocation + c_sec_g = 0.0

       F(  1,  5399) = 1.44
       Prob > F = 0.2295
```

APPENDIX D

Regression with Robust Standard Errors without Interactions: the subsamle without unemployed

lnearn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
CITY	.389396	.0362638	9.069	0.000	.257776	.3999624
TOWN	.25657	.03512	6.503	0.000	.1595345	.2972363
DON_PRID	.125213	.0279329	4.223	0.000	.0632111	.1727331
SOUTH	.029654	.0380475	0.768	0.442	-.0453673	.1038127
age	-.0151175	.0035466	-4.263	0.000	-.0220704	-.0081646
GENDER	.286943	.0262829	9.598	0.000	.2007434	.3037959
c_higher	.5611481	.0594853	9.433	0.000	.4445304	.6777658
i_higher	.3438918	.1329671	2.586	0.010	.0832169	.6045668
b_higher	.3786603	.0906172	4.179	0.000	.2010101	.5563105
vocation	.1717175	.0611671	2.807	0.005	.0518027	.2916323
spec_sec	.2753582	.0572222	4.812	0.000	.1631771	.3875393
c_sec_g	.0878615	.0590916	1.487	0.137	-.0279844	.2037075
prim	-.0236895	.1184135	-0.200	0.841	-.2558328	.2084537
no_prim	.2923457	.0886047	3.299	0.001	.1186409	.4660505
illiter	-.6179204	.1968819	-3.139	0.002	-1.003897	-.231944
exp	.0397496	.0053057	7.492	0.000	.0293481	.0501511
exp2	-.0006385	.0000917	-6.962	0.000	-.0008183	-.0004587
COL_COOP	-.28753	.0453044	-7.483	0.000	-.4278368	-.2502033
JOINT	-.0992	.0383899	-2.721	0.007	-.1797367	-.0292141
LEASE	.313474	.1191274	2.289	0.022	.0391327	.5062184
FOREIGN	.382037	.1163328	2.781	0.005	.0954939	.5516224
PRIV	.238949	.0490684	4.367	0.000	.1180676	.3104594
other	(dropped)					
MANUF	-.05031	.0526727	-0.980	0.327	-.1548849	.0516392
AG_FORES	-.56179	.0741629	-11.125	0.000	-.9704391	-.6796542
CONSTRUC	-.11651	.0728685	-1.700	0.089	-.2667267	.0189828
COMMUN	.043315	.0576332	0.736	0.462	-.0705838	.1553898
SERVICES	-.11078	.054989	-2.135	0.033	-.2252159	-.00961
SOCIAL	-.16014	.0475702	-3.669	0.000	-.2677805	-.081263
FINANCE	.231217	.0843007	2.467	0.014	.0427358	.3732699
_cons	6.597226	.1181566	55.835	0.000	6.365586	6.828866

Note: for all the dummy variables except for the educational levels, we provide the marginal effects rather than the estimated regression coefficients

Number of obs	= 4950
F(29, 4920)	= 58.65
Prob > F	= 0.0000
R-squared	= 0.3040
Root MSE	= .82637

The tests for equality of coefficients of educational dummies

```
H0: - c_higher + b_higher = 0.0

       F(  1,  4920) = 5.64
       Prob > F = 0.0176


H0: - c_higher + spec_sec = 0.0

       F(  1,  4920) = 78.17
       Prob > F = 0.0000


H0: - b_higher + vocation = 0.0

       F(  1,  4920) = 6.68
       Prob > F = 0.0098


H0: vocation - spec_sec = 0.0

       F(  1,  4920) = 7.60
       Prob > F = 0.0059


H0: - vocation + c_sec_g = 0.0

       F(  1,  4920) = 4.23
       Prob > F = 0.0397
```