PRIVATE INVESTMENT IN HUMAN CAPITAL: EFFECT ON EARNINGS IN UKRAINE

by

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Abstract

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This paper explores private returns to human capital in Ukraine before and during the transition from centrally-planned to market economy. One hypothesis tested is that decentralized labor market leads to wider wage dispersion through higher returns to education. We use the data from Ukrainian Longitudinal Monitoring Survey (2003) to estimate extended Mincer earnings equations and investigate the differences in returns to human capital by gender, age, sector of employment and type of ownership of the firm. The evidence shows that the increase in the private returns to education over 13 years of economic transformation is really moderate in Ukraine, as compared to other countries in transition. Although women in 1986 enjoyed significantly higher returns to schooling than men, gender difference is found to be less profound in 2003. The new private firms tend to value education more and experience less, as compared to the state-owned companies. We also find a strong impact of industry-specific characteristics on earnings in Ukraine in both periods.

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GLOSSARY

Human capital. All acquired characteristics of workers (stock of abilities, knowledge, and skills) that make them more productive.

Internal rate of return. The discount rate that equates the present value of benefits with the investment costs.

Private rate of return to education. The yield on the investment in schooling received by the person making the investment.

Chapter 1

INTRODUCTION

The most valuable of all capital
is that invested in human beings

Alfred Marshall
Principle of Economics

It is now customary among economists to refer to the human capital concept when analyzing the differences in earnings capacities of people. Wages vary not only because the jobs are different but also because the people who fulfill these jobs differ in their characteristics. All the characteristics (knowledge, skills and abilities) acquired by people through the lifetime that contribute to higher productivity constitute the concept of human capital. The investment in human capital, thus, includes education, on-the-job training and expenditure on activities improving health, job search and migration. Education and training have received the most attention by labor economists since they are viewed as clear types of investment that bring interest in the form of increased earnings in the future. As Benjamin Franklin stated, "An investment in knowledge pays the best interest".

While there is no doubt that private investment in education and training yields advantages to individuals in the form of higher earnings in the future and lower probability to become unemployed, accumulation of human capital is also beneficial through its positive externality on society. People with more education are more likely to be better-informed voters, less likely to commit crime, and have a positive impact on the productivity of other workers. "The main engine of growth is the accumulation of human capital – of knowledge – and the main

source of difference in living standards among nations is difference in human capital"(Lucas, 1993). Therefore, to ensure sustained economic growth one must promote the accumulation of human capital among other things.

Since its origin in 1950s, the concept of investment in human capital and its effects on earnings have been extensively studied by labor economists. The most important theoretical results derived are that higher levels of education are generally associated with higher earnings (see e.g. the rates of return estimates review for 98 countries since the late 1950s by Psacharopoulos and Patrinos (2002)), the economic incentives for human capital accumulation are largest at younger ages, the monetary gains from each additional year of schooling decline as much schooling is acquired (Psacharopoulos and Patrinos (2002)), and individual's aptitude and ability influence the decisions on human capital investment (Card (1994), Card (1999), Blackburn and Neumark (1993)).

During the last decade special attention in labor research world has been paid to analyzing the rates of return to education in the Central and Eastern European countries, as well as the former Soviet Union countries, as they launched the transition towards the market economies. Several studies (Flanagan (1994), Chase (1997), Orazem amd Vodopivec (1997)) compare the evolving returns during transition with the returns in pre-transition period. The administratively command economies were generally characterized by centralized price and wage setting, output plans targeting, promoting full employment and the equality among the workers. As a consequence, the contributions of low-skilled workers were often overvalued, whereas the contributions of highly educated intellectuals were devalued leading to a very compressed distribution of income and comparatively low returns to education. Earnings benefits obtained in a command economy didn't actually reflect the workers productivity and/or firm's performance.

With the beginning of enterprise restructuring, privatization, trade liberalization, and enhanced technological progress, new requirements were set in the labor market. The newly established environment demanded more skilled and more productive workers, free "unconstrained" price and wage setting led to the increased wage inequality. Thus, the main hypothesis tested by numerous recent studies (see e.g. the survey of studies on transitional labor markets by Svejnar (1999)) is that in such conditions the private returns to education are likely to shift in favor of more educated people and differences in wages are expected to become more dispersed. On the contrary, an alternative hypothesis exists suggesting that knowledge and experience gained in the pre-transition period might appear not be useful and applicable during the transition. If this is true, the rates of return to schooling and experience should fall.

There is also another possibility. In Soviet times, the returns to education may have been considerable, but these returns were measured not in earnings but in total remuneration including fringe benefits. Thus, educated workers may have received payment-in-kind in the form of holiday subsidies, health care and a housing subsidy, better access to consumer goods, provision of child care facilities, food subsidies, and other privileges. Since there are opportunity and effort costs to schooling (even if it is free), there had to be some incentive to ensure the required number of high-skilled workers. With transition and privatization, these non-wage payments were no longer possible. Estrin et al. (1997) find that fringe benefits were paid much more in state-owned and privatized Polish firms in the 1991-1993 period than in newly established private firms. Since *de novo* firms provide significantly fewer benefits, the general belief is that the exploitation of the incentive aspects of additional benefits would decrease during the transition. The required differentials had to be made up through higher earnings, what may serve as another plausible explanation for the higher estimates for returns to education during the transition period.

The purpose of this study is to evaluate the returns to human capital components (education, labor market experience and specific human capital component approximated by tenure) in Ukraine 13 years after independence, and to determine how these returns changed between the pre-transition period and during the transition. I also explore how the returns differ among groups identified by gender, age, region, sector of economy and firm characteristics. The micro data examined in this study is taken from the Ukrainian Longitudinal Monitoring Survey (ULMS) performed in 2003.

In estimating the returns to education we employ the standard Mincer (1974) earnings function, augmented by dummy variables capturing gender, sector, region, and firm ownership effects. The available data allows defining the schooling variable in Mincer's equation in a twofold manner: either by actual number of years spent on schooling or by the level of diploma obtained. However, the latter specification is more desirable since it incorporates more realistic interpretation of the effects of educational levels on individual's earnings.

Our research extends the earlier studies on the returns to education in Ukraine (see Leschenko, 2001; Shyshkina, 2001) in several ways. First, it makes use of a more current and richer source of data. Second, we make an attempt to account for possible schooling endogeneity and sample selection problem. Third, we calculate private rates of return to human capital (education, labor market experience and specific human capital (tenure)) for 1986 and 2003 years to test the hypothesis of increased returns to human capital under transition.

The remainder of the paper is organized as follows. In Chapter 2 we provide an overview of several fundamental studies that contributed to the formation and further evolution of human capital framework. The overview also focuses on studies that explore the changing returns to education in the transition economies of Eastern Europe and the former Soviet states. Chapter 3 presents the

theoretical framework for the concept of investment in human capital. In Chapter 4 we introduce the econometric model used to estimate the relationship between education and earnings. In Chapter 5 we discuss data, estimation techniques and present major estimates. Finally, we summarize the main findings and draw some conclusions in Chapter 6.

Chapter 2

LITERATURE REVIEW

There is, at present, a consensus among economists that investment (both public and private) in human capital is overwhelmingly important for ensuring economic development and growth. People are the primary source of the wealth of nations. Notwithstanding the fact that scientists began to treat the acquisition and development of skills and knowledge by the individuals as a profitable investment in human capital only in the late 1950s, research in this field of labor economics proceeded progressively during the second half of the 20th century. The successive section of the paper is an attempt to overview the evolution of the major theoretical and empirical findings on the returns to investment in human resources with particular attention paid to research outcomes focusing on the economies in transition.

To begin with, it is worth pointing out that the first economist who viewed human beings as capital and the investment in them similar to that in the machinery was Adam Smith in his *"Wealth of Nations"* (1776) (as cited in Kaufman, 1986). The author distinguished two categories of labor input, "common" and "skilled", the latter constituted the workers that decided to go through an apprenticeship program (to invest in training). The investment undertaken was considered good whenever "… the increased benefits both pay back the initial costs and yield a rate of return at least as high as alternative investments of one's time and money". Fisher, Petty, and Marshall (Nesterova and Sabirianova, 1999) also stressed the importance for society to invest in education. However, these economists failed to inherit Smith's idea of human

resources as a form of capital and the object of investment and continued to treat labor as a homogeneous input that had no need to acquire specific knowledge and skills.

The next important attempt in reviving the human capital concept was made by Friedman and Kuznets (1945). They measured net present values of earnings streams for five professional occupations using a 4 percent discount rate to evaluate the profitability of investments in human capital.

In the early 1960's the framework of human capital investment was given new emphasis in the works by Mincer (1957, 1958, 1962), Becker (1962, 1964) and Schultz (1961, 1962). Mincer (1957, 1958) was the pioneer in deriving theoretically and empirically the link between education, labor market experience and differences in earnings across individuals. His main findings suggest that the inequality in earnings increases with age, schooling level and occupational rank. Furthermore, he was the first to include concave experience-earnings profiles in his study and present the schooling-earnings function approach to estimating the profitability of investments in human capital in contrast to the previously used net present value approach. The Mincer study served thereafter as a benchmark for numerous empirical studies conducted by economists working in this area.

Schultz (1961) suggested that much of what was called consumption constitutes investment in human capital. He named direct expenditures on education, health, and internal migration to take advantage of better job opportunities as clear examples of investments that enhance human capabilities and productivity, leading to a positive rate of return.

Becker (1962, 1964) summarized all the preceding findings on human capital into a coherent theoretical framework, and even went further, applying human capital methods in areas such as "the economics" of marriage, family relations, and

discrimination. His study is based on the assumption that individuals make their choices on education and training as to maximize the expected present value of the stream of future incomes up to the retirement date net of the costs of the investments into the human capital. Therefore, "most investments in human capital both raise observed earnings at older ages, because returns are added to earnings then, and lower them at younger ages, because costs are deducted from earnings then." (Becker, 1964, p.48). Moreover, Becker raises the question of relationship between the unequal distribution of income and individual's ability. He argues that "… "abler" persons tend to invest [in themselves] more than others" and "…the distribution of earnings could be very unequal and even skewed, even though "ability" were symmetrically and not too unequally distributed" [1964, p.49].

The availability of large micro data sets on individuals and households in 1960s and 1970s fostered the empirical analysis of the differences in wages by education and age based on human capital theory in a large number of countries. Psacharopoulos and Patrinos (2002) survey the latest estimates of the returns to investment in education in 98 countries based on new econometric techniques. This survey supplements preceding reviews of the empirical results by Psacharopoulos (1985, 1994). The latest patterns derived by Psacharopoulos and Patrinos (2002) constitute that 1) the private returns to higher education are increasing; 2) private returns are higher than "social"; 3) the average rate of return to another year of schooling is 10 percent; 4) the highest returns are recorded for low and middle-income countries (the Latin America, the Caribbean region, and the Sub-Saharan Africa region), the returns are lower in the high-income countries of the OECD; 5) women, overall, receive higher returns to their schooling investments.

Much attention in recent studies has been paid to the causal effect of education on earnings. The empirical results suggest that the rates of return to education are understated by standard estimation techniques (simple cross-sectional OLS applied to the traditional Mincerian earnings-education equation). These findings are interpreted in the survey by Card (1994). He stresses the fact that education is not randomly assigned to individuals; rather decisions on training made by individuals are influenced by their unobserved innate ability. Moreover, it is commonly assumed that ability influences an individual's earnings. If there are unobserved ability differences in the population (heterogeneity), the estimated rates of returns to schooling do not reflect the true causal effect of education on earnings (*ability bias).* More sophisticated estimates of the returns to education designed to control for the endogeneity of schooling are generally higher than simple OLS.

Card summarizes studies that attempted to cope with the problem of ability bias. He concludes that traditionally researchers use the following strategies to deal with the problem: either find an instrument that is highly correlated with the schooling variable but not correlated with the residual term in Mincer's equation (IV technique), or use proxies for ability and include them as regressors. The institutional features of the educational system, family background information (mother's and/or father's education) or parental income are often used as proxies in the empirical works. An alternative approach is to use the fixed-effect method: compare education-earnings relationships for siblings, genetic twins, or father-son\mother-daughter pairs assuming that they have similar or identical ability. The failure to account for ability effect in estimation of the rates of return to education is generally treated as the omitted variable bias. The main conclusions drawn from the literature overview by Card are as follows: "… [1] the return to education is related to some observable covariates, such as race, school quality, family background measures, and perhaps measured ability…[2] individual

returns to education are declining with the level of education…[3] IV estimates of the returns to education based on family background are systematically higher than corresponding OLS estimates … [4] IV estimates of the return to education based on interventions in the school system tend to be 20% or more above the corresponding OLS estimates."

Heckman and Vytlacil (2000) complicated the problem of ability bias arguing that "if the dependence between ability and education becomes too strong, it is impossible to isolate the effect of education from ability even if the latter is perfectly observable". Thus, ability bias isn't the problem of omitted variables, as it is frequently mentioned in the literature, but rather the problem of inseparability of schooling from ability. This view gave rise to the employment of econometric models of self-selection rather than IV techniques in estimating the returns to schooling.

Heckman (2001) and Heckman and Li (2003) show that in the presence of unobserved heterogeneity and selection in general, conventional methods like OLS or IV do not allow arriving at the "true" rates of return to education. . Heckman states that even observationally identical people make different choices and the rates of return are likely to vary across schooling levels and across individuals of the same schooling level. This suggests that the return to schooling is a heterogeneous, random variable. Conventional methods foresee finding the average treatment effect (ATE) estimators – the unique parameter within separate schooling level. Heckman, on the contrary, suggests that the better methodology is to estimate marginal treatment effects (MTE) using the nonparametric method of local instrumental variables. MTE is the marginal gain to schooling of a person with some observable characteristics just indifferent between taking schooling or not at the controlled level of unobservables. Heckman and Li (2003) show, what had already been established by Heckman and Vytlacil (1999, 2000, 2001), that all

the other treatment variables (average treatment effect, treatment on the treated and treatment on the untreated) can be unified using MTE. Parental income is used as a proxy for ability in their study since they believe that better family resources are usually associated with better environments that raise ability.

During the last decade a number of economists have focused on the changes in the returns to education in Central and East European (CEE) and former Soviet Union (FSU) countries as they launched their transition towards market economies. The main issue put into question by the researchers is how the earnings relate to workers characteristics, particularly education and experience, under the new conditions, and whether returns to education during the transition period differ from returns under the communism wage grid.

Svejnar (1999) surveys a number of important econometric studies on transitional labor markets in Central and Eastern Europe. A separate section of his paper is devoted to wage inequality and human capital analysis in the pre-transition period and during economic transition. He concludes that, in almost all the CEE countries studied, returns to education increased significantly during transition. For example, returns in the Czech Republic increased from 4.4% in the pre-transition period to 4.9% during transition. In the Slovak Republic returns for males increased from 2.8% to 4.9% during the transition period and for females from 4.4% to 5.4%. In Poland the rates of return to education amounted to 5% in the pre-transition period both for men and women and increased to 7-8% during transition. The exception is East Germany, where the returns to education both for men and women declined after its unification with the Western part (from 7.7% to 6.2%). This may be due to the poor suitability of education gained in the command economy to the new economic environment. Another finding indicates that "… women enjoyed a higher rate of return on education than men under communism and that the gap narrowed as the transition started…"

(Svejnar, 1999, p.2839). Most studies applied the traditional Mincer's human capital earnings functions with a Tobit or Heckman correction for possible selection biases.

The findings of some interesting studies on changing returns to education in CEE countries during their transition towards the market economies are summarized in Table 1. The conclusion is the only: rates of return to education increase substantially during transition both for men and women in all the countries under consideration.

Table 1

Rates of Return to Schooling in Transition Economies
(Selected Studies)

Authors	Country	**Pre-transition**			**During transition**			Data
		Males	*Females*	*M and F*	*Males*	*Females*	*M and F*	
Flanagan (1994) (as cited in Svejnar, 1999)	Czech R.	0.034	0.054	0.044	0.044	0.053	0.049	1988 and 1991 surveys
Orazem and Vodopivec (1994)	Slovenia	*Vocat School* *Middle School* *University*		0.163 0.319 0.715	*Vocat School* *Middle School* *University*		0.201 0.406 0.943	1987 and 1991 data
Chase (1997) (from Svejnar, 1999)	Czech R. Slovak R.	0.024 0.028	0.042 0.044		0.052 0.049	0.058 0.054		1984 and 1993 micro data
Rutkowski (1997) (from Svejnar, 1999)	Poland			0.05			0.07-0.078	1987, 1992 and 1995-96 micro data
Campos and Jolliffe (2004)	Hungary			0.064			0.112	1986 and 1998 micro data

In the former Soviet Union countries, most of the empirical studies on the labor market and earnings determinants were carried out for Russia due to availability of data. The first rounds of the Russian Longitudinal Monitoring Survey (RLMS) were conducted in 1992-1993 and this dataset was subsequently extended to include the 1994-1998 period.

Nesterova and Sabirianova (1998) analyze how returns to schooling were changing over the transition period in Russia (particularly in 1992-1996) using OLS and firm fixed-effect estimations of earnings function. They show that at the beginning of the transition (1992-1994) a shift towards "unconstrained" wage setting led to the increased returns to more educated individuals. However, these returns subsequently fell. They argue that the latter finding may be explained by the structural changes in the labor market, especially in its demand side, as well as possible inadequacy in the new conditions of the general and firm specific human capital acquired under the old regime. The returns to experience are also found to have declined substantially. In terms of firm ownership, workers of new private firms have much higher returns to schooling and smaller returns to experience in comparison with those of state-owned and privatized companies. The analysis of education and unemployment reveals that individuals with higher education tend to have lower probabilities of moving from employment to unemployment.

Clark (2000), utilizing data from the RLMS rounds between 1994-1998, finds returns to education of between 6-13 % depending on the definition of wages[1], but most estimates obtained are within the lower bounds of this range. He admits that, "These represent significant returns and suggest a certain amount of

[1] Clark categorizes wages into three groups in order to capture the remuneration from other sources: 1) wages from primary source of work net of taxes; 2) wages including secondary jobs, and goods received in terms of roubles per month; 3) total monthly income including wage bonuses, profits, pensions and 1) and 2)

transformation of the labor markets to a more flexible and less rigid wage structure". Consistent with Nesterova and Sabirianova (1999), Clark estimates significantly higher returns in the non-state sector as opposed to the state sector. The main contribution of the paper, however, is the detailed examination of the returns to different categories of education in compliance with the screening hypothesis of schooling. This hypothesis stipulates that the diploma obtained rather than years of schooling serves as a signal to the employer about the worker's productivity and ability. Clark finds significant increasing marginal returns to each additional level of post-compulsory education. The only exception is the returns to post-graduate education, where negative augmented returns as an increment to a university degree are exhibited.

Brainerd (1998) focuses on answering the question of who are the "winners" and "losers" of economic transition in Russia. She finds that the "winners", at least in the short period under study (1991-1994) are "…young well-educated men whose skills have enabled them to exploit new profit-making opportunities in the private sector of the economy". The losers are "…older workers, men in particular, whose human capital has been devalued and who have few incentives to acquire new skills relevant to the emerging economy". Women also appear to be "hurt" much in terms of decreased earnings.

As opposed to other countries in transition, very little research on returns to education has been accomplished for Ukraine. In the research that exists, it is difficult to give much credence to the findings. The main reason, of course, is the unavailability until recently of appropriate individual and household survey data. There are also some drawbacks of the methodologies applied. Leschenko (2001) uses Ukrainian Household Survey from Kiev International Institute of Sociology for 1996 and estimates extended Mincer earnings function by OLS. The model specification includes dummy variables that control for region, ownership of the

firm, sector of activity and type of a city differentials as well as traditional age, gender, education and tenure characteristics. The results obtained are corrected for possible downward bias due to the self-selection problems by Heckman correction procedure with the marital status and number of children used as selection variables. However, she fails to correct the estimates of the returns to education for possible ability bias due to data limitations. Therefore, we can expect that there may be correlation of residuals with education variable in Mincer equation (Card, 1998). Leschenko produces some unexpected results: the private returns to the higher education in 1996 were lower than the returns to specialized secondary education. The returns to incomplete higher education were the highest, about 16%. The returns to the vocational education were the lowest, estimated at 2.8%. Shyshkina (2001), in contrast, concludes that the private rates of return to education in Ukraine in 1999 were positive and increasing at virtually all-educational levels. This finding is inconsistent with the findings available in the large literature on the returns to education. The above-mentioned studies conducted the research using the cross-sectional data and, therefore, couldn't track the major trends in returns to human capital over the period of economic transformation in Ukraine. The estimation technique in both studies is simple OLS and the schooling endogeneity is not captured. That's why the research in this exactly field should be expanded and improved.

Chapter 3

HUMAN CAPITAL INVESTMENT: BASIC THEORETICAL MODEL

The theory of human capital investment is based on the assumption that individual decides on the continuation of his studies so as to maximize the net present value of his lifetime earnings (cost-benefit analysis with discounting). Education and the other forms of training that enhance worker's productivity are valuable in the sense that they increase individual's earnings. The theory, thus, considers only monetary rewards to the individual, although the non-monetary benefits are also present. Let's consider the situation, in which an individual, after finishing complete secondary school at the age of 18, makes a decision on whether to enter the university and spent 4-5 years more on education, or start working. The income streams over the life cycle associated with each alternative are depicted at figure 1. Wu denotes the stream of the costs associated with the additional investment into the higher education and future earnings received after graduation. Ws denotes the earnings stream for the individual if he decides to start working right after finishing the general school. Continuation of studies is associated with the direct cost of the schooling (area a) and the opportunity cost of the income foregone (area b). The Wu profile lies above the Ws profile and is steeper in later years of the life cycle reflecting the main prediction of human capital theory: more educated people should earn higher wages in their peak work years for investment in education to be worthwhile. The higher earnings in later years must compensate for the costs associated with additional schooling as well as for fewer working years in which the individual can recoup the investment in schooling. Besides, since these higher earnings are received relatively later in life, the individual discounts them more heavily in terms of their present value (see the explanation of human capital theory predictions in Kaufman, 1986).

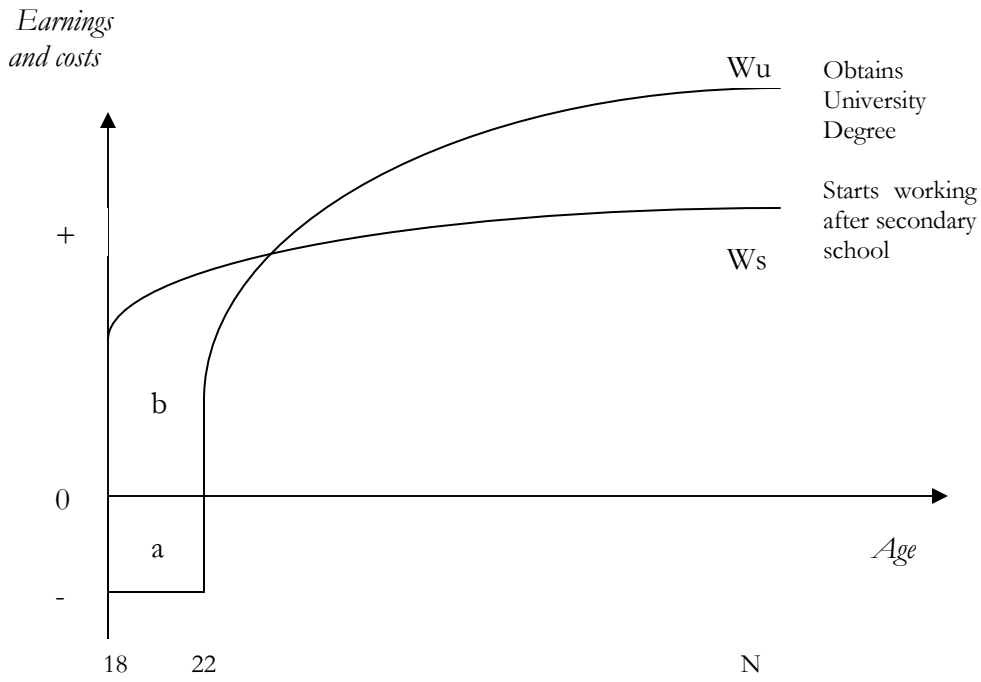


Figure 1. Earnings streams faced by University graduate and individual who starts working after finishing school (source: Kaufman, 1986)

The individual will decide to enter the university if the net present value of the lifetime earnings up to the retirement date N in the case he graduates from the university (NPV (university)) exceeds the NPV of his earnings if he starts working after general school (NPV (work)). The NPV's for both alternatives are as follows:

$$\text{NPV (work)} = W_{s1} + \frac{W_{s2}}{(1+r)} + \frac{W_{s3}}{(1+r)^2} + \ldots + \frac{W_{sn}}{(1+r)^{n-1}};$$

$$\text{NPV (university)} = -C_1 - \frac{C_2}{(1+r)} - \frac{C_3}{(1+r)^2} - \frac{C_4}{(1+r)^3} - \frac{C_5}{(1+r)^4} + + \frac{W_{u6}}{(1+r)^5} + \ldots. + \frac{W_{un}}{(1+r)^{n-1}};$$

where C_i is the cost associated with i additional year of schooling;

the parameter r is the individual's discount rate which relates a dollar received this year to a dollar received a year from now.

Clearly, individual will choose the investment alternative that provides positive and higher NPV of its earnings streams. An alternative approach to decide whether university is a good investment is to calculate the internal rate of return and compare it with the market interest rate. The internal rate of return (IRR) is the interest rate at which the NPV of investment is zero, i.e. discounted costs and returns are equal. The investment is profitable and will be undertaken if the internal rate of return is greater than the market interest rate. However, comparing investment projects with the IRRs both exceeding the market interest rate may lead to incorrect decision if you choose the project with higher IRR: the higher IRR doesn't imply a higher NPV. Another problem arises if the investment into schooling isn't characterized by the unique internal rate of return, rather several IRRs are calculated. Therefore, investment rule on the NPV approach is often considered superior to the IRR approach.

The general investment rule treated by the rational individuals can be summarized as follows: an investment into additional year of schooling makes sense if the NPV of the project "Invest into education" is greater than zero or the IRR is greater than the market interest rate.

Let's extend our discussion of the optimal schooling decision to the situation when two individuals with different levels of abilities make their choice (we follow Borjas (1996) in this discussion). For the ease of exposition let's assume that individuals face the same discount rate r that is constant, i.e. independent of how much schooling the individual gets. In this case, every individual has his/her own Earnings-Schooling profile as depicted in part (a) of figure 2; those with higher productivity have a higher earnings-schooling locus. Individuals with the same level of schooling are still rewarded differently due to productivity

differential ($W_u^h > W_u^l$). The locus of the high-ability person is steeper, so that he gains more from additional year of schooling than the low-ability individual, but at the same time he looses more in terms of higher foregone income. Therefore, the marginal rate of return (MRR) schedule of the high-ability person can be located either to the right from that of the low-ability person or to the left. It is often assumed that it lies to the right, i.e the gains associated with the additional year of schooling outweigh the income foregone and direct costs.

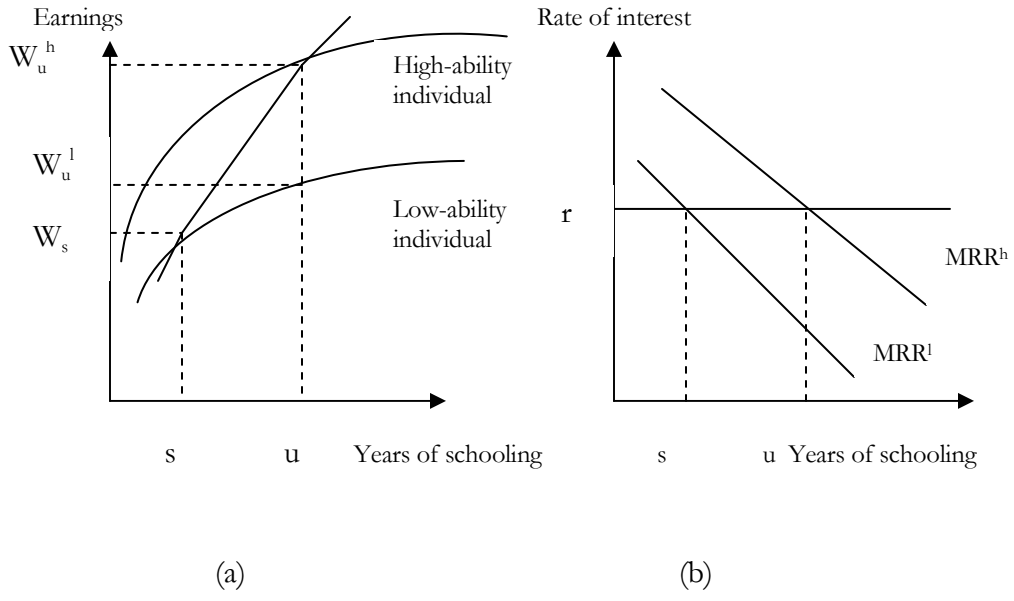


Figure 2. Optimal schooling decisions faced by individuals with different levels of ability (source: Borjas, 1996)

Optimal decisions for each individual are s years of schooling for the low-ability person and u years – for the high-ability individual (part (b) at figure 2). The line that intersects the two earnings-schooling locuses at (a) represents the relationship between the different levels of schooling and the corresponding levels of income actually observed. It has nothing to do with the "true" earnings-schooling locuses. Therefore, as long as the ability levels remain unobservable

and unknown, estimates of the rates of return to education based on observable characteristics will not reflect the true causal effect of schooling on earnings.

C h a p t e r 4

ECONOMETRIC MODELING OF SCHOOLING-EARNINGS RELATIONSHIP

The econometric estimation of wage determinants is based on the relationship of the form:

$$\ln Y_i = f(X_i, Z_i) + U_i, \quad i = 1,\ldots,n \tag{1}$$

where lnYi is the natural logarithm of individual i's earnings;

X_i indexes the set of observable human capital characteristics that are likely to influence individual's wage (i.e., a measure of schooling or educational attainment, experience, tenure and other human capital components);

Z_i are other factors affecting earnings, both observable and unobservable, such as innate cognitive ability, race, gender and other static/dynamic non-human capital characteristics;

U_i is a random disturbance term that is usually assumed to be normally distributed with zero mean and constant variance.

The earliest attempts to derive the functional form of the equation (1) were based on the earnings streams concept and the net present value approach. Friedman and Kuznets(1945) computed the net present value of earnings streams using a 4 percent discount rate. Mincer (1962, p.64) converted the net present value formula into a ratio:

$$Y_1/Y_0 = (1+r), \tag{2}$$

where Y_1 is the increment in earnings due to one additional year of schooling undertaken;

Y_0 is the cost of the investment in the additional year of education (it is assumed in the model that the only cost of the investment is that of foregone earnings);

r represents the rate of return from the investment.

It follows that after s years of schooling, the above formulated ratio (2) becomes:

$$Y_s / Y_0 = (1+r_1)(1+r_2) \ldots (1+r_s) \qquad (3)$$

If we assume that the rate of return to schooling is the same for all levels of education ($r_1 = r_2 = \ldots = r_s = r$) and if we approximate $(1+r)^s$ by e^{rs}, then (3) becomes:

$$Y_s / Y_0 = e^{rs} \qquad (4)$$

Taking natural logarithms of both sides of equation (4) and appending the disturbance term *U* we get the most basic human capital earnings equation that is used as a benchmark for constructing more complex earnings functions:

$$\ln Y_s = \ln Y_0 + r*S + U \qquad (5)$$

This simplest specification of earnings function was further extended by Mincer(1974) to account for the effects of work experience:

$$\ln Y_i = \ln Y_0 + \beta_1 * S_i + \beta_2 * X_i + \beta_3 * X^2_i + U_i, \qquad (6)$$

where $\ln Y_0$ represents the log of earnings of an individual with no schooling and no experience;

S_i represents a measure of schooling or educational attainment;

X_i is worker's experience (the number of years an individual has worked since completing schooling);

U_i is a statistical residual that captures unobserved innate and other characteristics that are not included into the equation but influence earnings differentials.

X^2 is present in the regression to assure the concave shape of experience (age)-earnings profiles that is generally suggested by the human capital theory and extensively justified by the empirics.

The appropriate econometric technique to apply to the estimation of the rates of return to human capital (education, experience, specific human capital, etc.) will depend, first of all, on the assumption of the relationship between these human capital components and the earnings variable. According to Blundell et all.(2001), we can distinguish 2 broad characterizations of the specification of this relationship. The first relates to the *measurement of education*. There exist two alternatives in the scope of the measurement of educational attainment: 1) one-factor model, where schooling variable is represented by the total number of years spent on education and 2) multiple factor model, where education enters the human capital earnings function as a set of variables describing different levels of schooling. The first approach is rather restrictive since it assumes that changes in the rates of return to education associated with an extra year of schooling are independent of the level of educational attainment. That is, whether you are at the vocational school and decide to continue your studies at the higher level of schooling (technical, for example) will have the same impact on your earnings as if you decide to study at the post-graduate level after having obtained a master's degree. In other words, there are no differential trends in the rates of

return for different educational levels and each additional unit of human capital acquired has the same return. This is clearly unrealistic assumption, though convenient for estimation since it provides us with a single estimate of the rate of return to schooling.

The alternative is to use the multiple factor model with several variables that represent different levels of education and have separate effects on individual's earnings. This would seem to be a more attractive framework and will be, thus, applied to our research along with the schooling variable measured as the total number of years spent on education.

Another characterization relates to the possible heterogeneity across individuals both in observable and unobservable characteristics. By including a set of dummy variables that describe individual's observed covariates as well as demographic variables and aspects of the local labor market, we allow differential earnings for individuals with heterogeneous characteristics.

Another issue of great concern among labor economists has been the possible parameter bias in the estimation of the earnings function due to omitting from the regression equation variables that measure individual's abilities. The ability differences of individuals can encompass genetic differences as well as the differences produced in the course of experience acquisition. If there are such unobserved ability differences across individuals in the population, then earnings differentials across workers with different levels of schooling do not estimate the real rates of return to education. This is explained by the fact that innate abilities, on the one hand, are likely to have an impact on the individual's decisions on schooling since education is not randomly assigned to individuals, and, on the other hand, they are likely to influence an individual's earnings as well. As a result, the explanatory variable that describes schooling is correlated with the error term in the Mincer earnings function, and conventional OLS estimators produce

biased rates of return. This problem is called *ability bias* in the estimation of the rates of return to human capital.

Ideally the researchers would like to answer the question of how the earnings of a particular individual with a particular level of education differ from earnings of the same individual if he does not decide to obtain that level of education. However, by definition, the two outcomes can't be observed simultaneously. In this respect, the estimation problem in the returns to human capital is synonymous with the construction of counterfactuals in evaluation studies (as, for example, the evaluation of certain policies implementation). Therefore, estimates of the rates of return to human capital are usually derived by comparing the earnings of those who obtained the specific degree of education with earnings of a *different* group of people who decided not to continue studies for that specific degree.

To allow the education variable in the earnings function to be endogenous and characteristics of individuals to be heterogeneous, the following two specifications are traditionally applied:

1) include controls for ability and individual characteristics in the Mincer earnings function and estimate it by OLS;

2) include controls for individual characteristics in the regression equation and instrument the variable that describes the individual's ability for the variable that describes the individual's decision on education (i.e. Schooling variable) and estimate the regression equation by instrumental variable technique.

Taking into consideration the points discussed above on the potential specification of the extended Mincer earnings equation, the determination of

the rates of return to education, experience and specific human capital in our study will be based on the estimation of the following regression equation:

$$\ln W = \beta_0 + \Sigma^J_j \beta_{1j} S_j + \beta_2 \text{Exp} + \beta_3 \text{Exp}^2 + \beta_4 \text{Ten} + \sum^L_l \delta_l \text{Sector}_l +$$

$$+ \sum^M_m \mu_m \text{Ownership}_m + \sum^N_n \pi_n \text{Region}_n + U_1, \quad (7)$$

where

ln W is the natural logarithm of the monthly wage (net of taxes);

S 5 dummies for specific levels of education: *secondary* for compulsory general secondary education and complete general secondary, *vocational* for vocational training, *specialized secondary* education, *basic higher* education, and *complete higher* - combines complete higher and post-graduate studies (aspirantura) (see Appendix A for description of educational system in Ukraine).

The categories were designed in such a way as to make the information on education reported by individuals comparable as of 1986 and 2003.

The specific educational dummy equals 1 if the level of education it stands for is the highest obtained by the individual and 0 otherwise. The coefficients of educational dummies are expected to be positive and their magnitudes are expected to increase through every higher level of education, indicating that those better educated normally earn higher wages. The reasons for the higher earnings of people with more education are explained by the human capital theory. Firstly, higher earnings are necessary to compensate for the costs associated with additional schooling. Secondly, people with more education have fewer years in the labor force in which to recoup their investment in schooling. Therefore, higher future earnings reflect remuneration for fewer working years and additional costs incurred during the years of schooling; higher earnings are necessary to encourage investing in human capital. Thirdly, these higher earnings

are not obtained until later in life and are heavily discounted in terms of their present value (Kaufman, 1986).

Exp is the actual working experience of an individual represented by the total number of years since he/she first started to work till today.

Exp^2 is introduced into the regression equation to capture the concavity of the experience-earnings profiles. We expect, therefore, the sign of the coefficient for *Exp* to be positive and the sign for Exp^2 to be negative.

Ten is individual's tenure, which is the number of years that an individual has worked for the current employer. It represents specific human capital, that is, skills and knowledge that are of value only to that employer. We expect the sign of the coefficient for *Ten* to be positive and for Ten^2 be negative.

Sector is the group of dummies representing the following sectors of the economy: 1) agriculture and forestry, 2)manufacturing, 3)electricity, gas and water supply, 4)construction, 5)motor vehicles building, 6)transport, post and telecommunication services, 7)finance, 8)public administration and defense, 9)education, health and social protection, 10)other services, 11) other industries.

Ownership is type of the ownership of the enterprise the individual is currently working for. We define the following types of the ownership: 1) state, 2) collective cooperatives, 3) private, 4) privatized. By inclusion of types of ownership controls, we distinguish between the human capital evaluation by private and public sector, in particular. It is expected that public sector tends to underevaluate the human capital characteristics. Therefore, returns to education are expected to be higher in private sector and in new firms, whereas the rates of

return to experience are expected to be negligible in new private firms since the experience gained may be inappropriate in new environment.

Region includes residence dummies: *rural, urban* and a dummy for *Kyiv*.

Chapter 5

INVESTMENT IN HUMAN CAPITAL IN UKRAINE: EMPIRICAL ANALYSIS

5.1 Data and Samples

The data used in this study are taken from the Ukrainian Longitudinal Monitoring Survey 2003[2] that contains information on the representative sample of 8641 individuals drawn out of the working-age population between 15 and 72 years old. The individual ULMS questionnaire contains information on individual's employment, income, time allocation, level of education, family characteristics and others and, therefore, is suitable for our research.

The data used in this research was restricted to the sample consisting of 3041 employees that reported their earnings and the highest educational attainment in section E "Primary and Secondary Jobs during the Control Week", and was used for the estimation of the rates of return to human capital in 2003. We also make use of the retrospective section of the Survey and construct a sample of 2404 individuals that reported information on their employment characteristics and income as of 1986. To determine the level of education possessed by these respondents in 1986, the table on individual history of education from section G "Education and Skills" was used. The employees, whose employment and educational information was incomplete or inconsistent, as well as unemployed people, pupils and pensioners were restricted from the sample.

[2] ULMS 2003 was carried out by the Kiev International Institute of Sociology at the request of IZA, Centre for Economic Reform and Transformation (CERT), Economics Education and Research Consortium (EERC)-Ukraine, Leuven Institute for Transition Economics (LICOS), Rheinland_Westfaelisches Institut fuer Wirtschaftsforschung (RWI) – Essen, and the William Davidson Institute (WDI).

For the purposes of our research, namely for the possibility to compare the rates of return to education over time (in pre-transition period and 13 years thereafter), the original data on the highest individual educational attainment in 1986 and 2003 was cleaned in such a way as to make it consistent in two periods. We were left with the 5 categories (levels of education): secondary school, vocational school, specialized secondary education, basic higher education, and complete higher education. The description of each category is presented in Appendix A. Table 5.1.1 presents the distribution in both samples by the level of educational attainment.

Table 5.1.1

Sample Description: Distribution by Educational Level, %		
	1986	**2003**
Total	100.00	100.00
Secondary School	31.6	28.09
Vocational School	25.72	24.72
Specialized secondary education	27.29	23.71
Basic higher education	14.31	3.79
Complete higher education	1.08	19.69

What is new and valuable in the Survey that can be used for this kind of research for Ukraine is the information on parental level of education (the highest educational attainment) that can be used for corrections of possible 'ability biases' in estimating the returns to education. Although we can give some credence to the reliability of information on parent's level of education possessed in 2003, we can't assign the same certainty to the information on parent's education in 1986 since there is a probability that parents could have obtained the reported degree between 1986 and 2003. Since the Survey doesn't provide us with the history of parent's education, we should be very cautious in correcting 'ability bias' with the 1986 sample, as possible measurement errors in variables employed may lead to even larger biases in 'corrected' IV estimates than in 'uncorrected' OLS ones.

The original ULMS individual data also contains information on firm-specific characteristics that are important and will be included to the Mincer earnings equation; in particular, information on firm's type of ownership, firm's industry (see Table 5.1.2), and firm's location (see Table 5.1.3).

Table 5.1.2

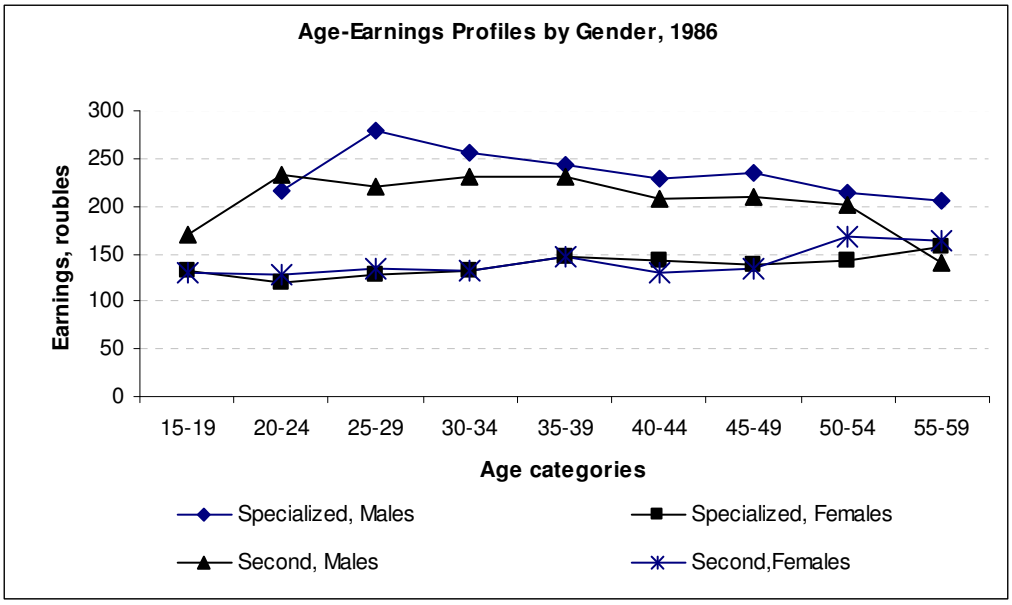
Employment distribution by sectors of economy: ULMS, %		
	1986	**2003**
Total	100.00	100.00
Agriculture and Forestry	13.08	10.48
Manufacturing	35.47	24.11
Electricity, Gas and Water Supply	1.48	3.37
Construction	5.93	4.68
Motor Vehicles Building	8.92	12.78
Transport, Post and Telecommunications	7.76	7.85
Finance	1.70	1.70
Public Administration and Finance	5.32	4.48
Education, Health and Social Protection	13.96	22.39
Other services	6.03	7.25
Other industries	0.35	0.91

Table 5.1.3

Distribution by region of employment: ULMS, %		
	1986	**2003**
urban area	57.95	64.8
rural area	42.05	35.2
Kyiv city	5.47	7.44

Descriptive statistics of basic variables is presented in Appendix B.

Figures 3 and 4 illustrate age-earnings profiles for the sub samples that will be used for the empirical analysis. It is clear from the graphs that the average earnings of those who are more educated are higher in both periods (age-earnings profiles of better educated people lie above the others). Men constantly earn higher earnings than women possessing the



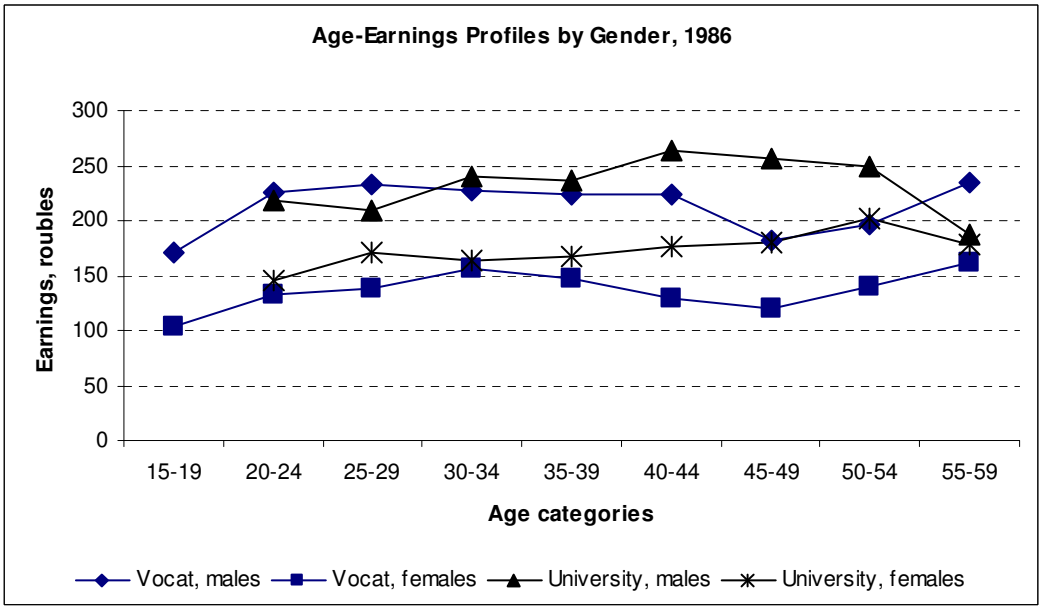


Figure 3. Age-Earnings Profiles by Gender and Educational Attainment, 1986

same educational degree. Moreover, in 1986, men who have completed only secondary school earned higher wages than women having completed specialized secondary education. In the same way, men with vocational education on average earned higher earnings than women with university degree. The 2003 data tells the same story about the differences in earnings, except that these differences have become even more dispersed. The profiles describing the information on individual's education and earnings for 2003 sub sample are steeper for the younger age categories. This may indicate the tendency by the employers to reward with higher wages workers who are younger. As Nesterova and Sabirianova (1999) state, in the new environment employers are likely to reward "… younger, more mobile, more active and more adaptive people".

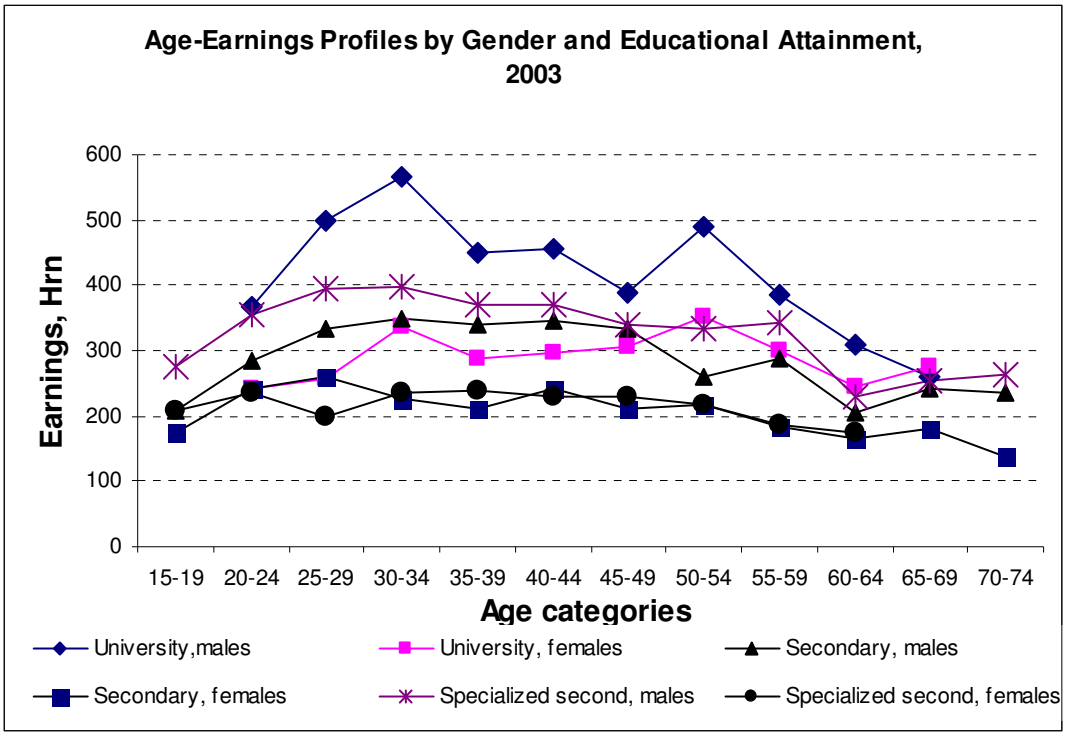


Figure 4. Age-Earnings Profiles by Gender and Educational Attainment, 2003

5.2 Estimation Results

Estimation of Extended Earnings Equations by OLS

The basic endogenous schooling model is usually represented by the system of two equations:

$$\begin{cases} \ln W_i = \alpha S_i + \beta X_i + \varepsilon_i & (1) \\ S_i = \gamma Y_i + \nu_i & (2) \end{cases}$$

The model predicts that the logarithm of individual's wage ($\ln W_i$) is determined by the schooling variable (S) that can be measured by the total number of years spent on education or the vector of dummy variables denoting the highest individual's educational attainment (degree), and a set of exogenous variables (X) that reflect all possible characteristics influencing individual's earnings. The coefficient α, thus, is the return to education, which in this specification is assumed to be constant.

The reduced form of the schooling equation includes all the exogenous variables (Y), both observable and unobservable, that may influence the schooling decision by the individual. Therefore, if there exist such covariates that influence both schooling and earnings they will be included both in X and in Y.

OLS estimation of equation (1) is likely to lead to downward and/or upward biases due to the following possible sources:

Firstly, OLS estimation of (1) will result in an unbiased estimate of the return to education only if schooling is exogenous, that is ε_I and ν_I are uncorrelated. Otherwise OLS estimates would be biased upward as a result of individual's optimal choice (see Card (1999) for the explanation of the direction of this bias).

Secondly, if there exist individual unobservable characteristics ("innate ability") that influence both schooling decisions and the wage obtained by the individual, the OLS estimates of the rates of return to education will be biased upward since the "pure" contribution of education to individual's productivity will not be separated from that made by unobserved ability and will be, thus, overstated (Card (1999)).

Thirdly, OLS estimates of the relationship between schooling and earnings will still be biased if our schooling variable is measured with errors. According to Card (1999), individuals with very high levels of schooling cannot report positive errors in schooling, whereas individuals with very low levels of schooling cannot report negative errors in schooling. If the errors in observed schooling measures are negatively correlated with true schooling, the actual reliability of reported schooling measure may be higher than the estimated reliability. The direction of bias of OLS estimates is expected, therefore, to be downward.

Since the primary interest of our research is the returns to human capital before and during the transition to the market economy, we start our analysis with the estimation of the rates of return to schooling, types of education, experience and specific human capital by OLS for the samples of 1986 and 2003 years. The hypothesis tested is the increased rates of return to an additional year of schooling and types of education with the liberalized labor market, which could have contributed to wider wage discrepancy that is observed in modern Ukraine. We also explore the differences in the rates of return to human capital by gender, age, industry of employment and type of ownership of the firm.

We start the analysis of the rates of return to human capital with the estimation of the so called "raw" returns to human capital simply by regressing the log of

monthly wages (net of taxes) on a continuous years of schooling variable (or types of education dummies), actual experience and its square, tenure, and region of residence dummies (we distinguish between urban and rural areas and introduce separate dummy for the city of Kyiv). We expect that rural inhabitants have lower opportunities for obtaining education than residents of towns and cities. Such specification allows the returns to education reflect the pure effect of schooling in allocating workers into low- or high-paying occupations or industries among other things (Brainerd, 1998). The results reveal that the returns to an additional year of education increased over the transition period: from 3.4% to 4.4% for men and from 4.0% to 4.6% for women (see columns 1a-3a in Tables 5.2.1, 5.2.2). The fact that women enjoyed higher rates of return to education compared to those of men in the centrally planned economy isn't surprising. The planners propagandized egalitarian distribution of income that led to "high relative wages and high female labor force participation rates compared to western economies" (Orazem and Vodopivec, 1994). Another possible explanation may be the availability of far larger opportunities for men in the Soviet period to earn higher earnings compared to women without necessarily investing in education.

The regressions in columns 2 and 4 (full specification) add 11 industry dummies and a dummy for the state-owned firms to specification 1 ("raw" return). This contributes much to the explanatory power of our model as well as raises the estimated returns to education holding their overall tendencies the same. The returns to an additional year of schooling increased from 4.5% in 1986 to 5% in 2003 for men and from 5.4% to 5.7% - for women in compliance with the hypothesis of the increased rates of return to education during the period of economic transformation as well as the results of the extended studies on the returns to education in other transition economies. However, the magnitude if

this change in the returns to education in Ukraine from 1986 to 2003 is rather moderate, in contrast to the empirical findings in CEE countries and Russia.

Table 5.2.1

OLS Estimates of the Returns to Human Capital: Males

Variables	**1986**				**2003**			
	"Raw" return		Full		"Raw" return		Full	
	1a	1b	2a	2b	3a	3b	4a	4b
Constant	4.764	5.109	4.408	4.875	5.259	5.639	5.270	5.732
	(39.670)	(103.660)	(26.830)	(41.070)	(49.320)	(99.160)	(33.610)	(49.170)
Educational levels*:								
Vocational		0.032		0.028		0.103		0.038
		(0.800)		(0.740)		(2.410)		(0.950)
Specialized secondary		0.141		0.145		0.177		0.130
		(3.240)		(3.550)		(3.510)		(2.790)
Basic higher		0.156		0.222		0.372		0.374
		(3.160)		(4.570)		(3.560)		(3.490)
Complete higher		0.118		0.201		0.275		0.319
		(0.640)		(1.190)		(4.730)		(5.520)
Years of education	0.034		0.045		0.044		0.050	
	(3.620)		(4.940)		(5.120)		(5.820)	
Experience	0.021	0.021	0.022	0.021	0.012	0.013	0.012	0.013
	(3.950)	(3.810)	(4.210)	(3.980)	(2.480)	(2.660)	(2.650)	(2.870)
Experience^2	-0.001	-0.001	-0.001	-0.001	0.000	0.000	0.000	0.000
	-(4.280)	-(4.130)	-(4.270)	-(4.020)	-(4.390)	-(4.530)	-(4.100)	-(4.380)
Tenure	0.002	0.002	0.001	0.001	0.004	0.004	0.002	0.002
	(0.980)	(1.020)	(0.530)	(0.590)	(1.780)	(1.790)	(0.810)	(0.940)
City of Kyiv	0.074	0.076	0.078	0.080	0.209	0.212	0.176	0.178
	(1.400)	(1.430)	(1.520)	(1.530)	(3.620)	(3.640)	(3.030)	(3.030)
State ownership			0.126	0.127			0.043	0.046
			(2.160)	(2.170)			(1.050)	(1.120)
Regional dummies**	0.000	0.000	0.948	0.964	0.000	0.000	0.000	0.000
Sector dummies**			0.000	0.000			0.000	0.000
R^2	0.045	0.048	0.155	0.159	0.121	0.123	0.230	0.232
Sample size	1077	1077	1077	1077	1448	1448	1448	1448

Notes: t-statistics are reported in parentheses

* - Omitted variable is secondary education

** - p-values on joint significance are reported

Table 5.2.2

OLS Estimates of the Returns to Human Capital: Females

Variables	1986				2003			
	"Raw" return		Full		"Raw" return		Full	
	1a	1b	2a	2b	3a	3b	4a	4b
Constant	4.285	4.717	4.230	4.800	4.769	5.227	4.658	5.223
	(49.400)	(125.180)	(27.400)	(36.400)	(55.530)	(105.370)	(20.800)	(26.580)
Educational levels*:								
Vocational		0.058		0.049		0.050		0.032
		(1.720)		(1.520)		(1.170)		(0.780)
Specialized secondary		0.019		0.065		0.079		0.116
		(0.640)		(2.240)		(2.240)		(3.310)
Basic higher		0.255		0.325		0.156		0.181
		(7.230)		(8.770)		(2.280)		(2.760)
Higher		0.385		0.434		0.294		0.358
		(4.300)		(4.650)		(7.110)		(8.050)
Years of education	0.040		0.054		0.046		0.057	
	(6.020)		(7.920)		(7.560)		(8.450)	
Experience	0.011	0.010	0.008	0.006	0.012	0.013	0.012	0.013
	(2.680)	(2.350)	(1.920)	(1.570)	(2.970)	(3.120)	(3.040)	(3.240)
Experience^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	-(1.830)	-(1.570)	-(1.130)	-(0.870)	-(3.350)	-(3.520)	-(3.390)	-(3.630)
Tenure	0.001	0.002	0.001	0.001	0.002	0.002	0.003	0.003
	(0.780)	(0.920)	(0.550)	(0.650)	(1.090)	(1.020)	(1.920)	(1.790)
City of Kyiv	0.021	0.014	0.042	0.039	0.210	0.209	0.222	0.220
	(0.500)	(0.330)	(0.970)	(0.890)	(4.120)	(4.090)	(4.610)	(4.550)
State ownership			0.032	0.038			-0.133	-0.134
			(0.590)	0.710			-(3.010)	-3.030
Regional dummies**	0.000	0.001	0.361	0.543	0.000	0.000	0.000	0.000
Sector dummies**			0.000	0.000			0.000	0.000
R^2	0.052	0.068	0.149	0.165	0.118	0.119	0.177	0.179
Sample size	1327	1327	1327	1327	1593	1593	1593	1593

Notes: t-statistics are reported in parentheses

* - Omitted variable is secondary education

** - p-values are reported

With the liberalization of wages and prices, men gain relative to women, whose rates of return to education rise more moderately (by 0.3% compared to 0.5% for

men). But still we observe significantly higher rates of return to schooling for females both in pre-transition period and nowadays.

It is much more informative to look at changes in the rates of return to specific levels of education rather than the rates to an additional year of schooling (see columns b of Tables 5.2.1, 5.2.2). In 1986 men who spent 4 years at university (corresponding to basic higher education) were rewarded the most: they earned, on average, 22.2% more than men with the general secondary education (column 2b of Table 5.2.1). Men possessing vocational qualifications didn't receive significantly higher wages compared to those, who started their careers right after finishing the secondary school (2.8% difference). Women, in turn, did enjoy higher rates of return to each higher level of education: those with the basic higher educational degree received 32.5% more than those with the secondary education, and 5-6 years spent at university were rewarded with almost 43% difference in earnings compared to wages of women with no degree. In 2003 the situation changes: highly-educated men are the "winners" earning almost 32-37% more compared to low-educated (column 4b in Table 5.2.1). For females, in contrast, the returns to separate levels of education decreased over the course of transition, except for the returns to specialized secondary education that exceed the returns to general secondary education by 11.6% in 2003. In general, wage differentials for men across educational groups became more dispersed in 2003, whereas for women - more compressed as compared with the 1986 year.

The rate of return to experience estimated for men in 1986 is highly significant and amounts to 2.2% (this is much less compared to data from other countries), whereas for women it is even less both in magnitude (0.8%) and significance (according to Brainerd (1998) lower returns to experience for women is the standard outcome in most countries). In 2003 more-experienced workers earn 1.2% more than workers with the experience of 1 year less. Lower returns to experience in 2003 for men (compared to 1986) may indicate that younger

workers and their skills are more valuable in new environment and that knowledge and skills possessed by the most experienced people and highly demanded in the Soviet times are of less importance nowadays, when priorities have reoriented towards entrepreneurial, managerial skills, knowledge in marketing and finance. The effect of tenure is negligible and insignificant in all the specifications and in both periods.

The positive and significant coefficient near the state ownership dummy for men in 1986 (columns 2a, 2b in Table 5.2.1) indicates that those employed in the state-owned firms earned at those times almost 13% more, on average, than other workers. This is not surprising and overlaps with the Soviet evidence, when the majority of enterprises were under state ownership. As of 2003 this coefficient decreases to 4.3% and becomes insignificant. We can judge about the differences in earnings between the state-employed workers and the workers of the other firms in 2003 on the basis of the regression for women, which produced negative and highly significant coefficient near state-ownership dummy. This indicates that women employed in the state sector earn somewhat 13% less than women employed at private, privatized or other type of ownership enterprises. The detailed examination of the differences in individual earnings by the type of ownership of the firm is provided in Table 5.2.3.

Table 5.2.3

Regression Coefficients on Human Capital Components, by Type of Ownership

1986	State	Non-state firms		
Experience	0.014***			
Exp^2	-0.0003***			
Tenure	0.001			
Years of schooling	0.042***			
2003	**State**	**Collective farms**	**Privatized**	**Private**
Experience	0.013***	0.025	0.005	0.010
Exp^2	-0.0003***	-0.001	-0.0002	-0.0003
Tenure	0.002	0.011	0.015	-0.002
Years of schooling	0.031***	0.036	0.028**	0.056***

*- significance at 10%, ** - significance at 5%, *** - significance at 1%

The results come from 6 separate earnings regressions that include human capital variables, regional dummies, industry dummies, gender dummy, and for which the samples were restricted to the number of firms in different type of ownership groups. As of 1986 we fail to differentiate enterprises by the non-state type of ownership due to very limited number of firms represented in each group. The overall feature observed is that private firms tend to value education more in 2003, compared to the state-owned firms. In contrast, the rates of return to experience are insignificant for the non-state enterprises and much lower in magnitude (0.5%-1% vs 1.3% as of 2003), indicating that skills and experience accumulated in the Soviet times may not be applicable and highly demanded in the period of economic transformation. This implies that younger workers should perform better in transition, when new opportunities and requirements to realize these opportunities emerge, compared to the elder people. The same results were obtained by other researchers in this field (Nesterova and Sabirianova (1999), Brainerd (1998)).

Another interesting result concerns differences in earnings in the Soviet times and in transition period across sectors of employment (Tables 2 and 3 in appendix C). Most of the sector dummies included into the extended earnings equations are highly significant indicating their importance. We have chosen agriculture and forestry sector as the base category for comparison. The coefficients near industry dummies reveal that in 1986 the earnings of workers in manufacturing, electricity, gas and water supply sector and construction were the highest and differed approximately by 25-35% from the wages of those employed in agriculture and forestry (holding other variables constant). The workers in finance, education, health and social protection and other services sectors earned the least and their wages didn't significantly differ from those employed in agriculture and forestry. In 2003 the importance of service sector increases and, *ceteris paribus*, those employed in service industries earn almost 20% more than workers in agriculture and forestry. The result is justified by the reality: the highly developed service sector is what makes the market economy different from the centrally-planned economy among other things. The sharp distinction concerns the financial sector: while insignificant and small in magnitude in 1986, the coefficient near finance dummy becomes highly significant in 2003 and yields the conclusion that financial specialists earn 33% more than agricultural workers, holding other variables fixed. This may reflect the increased demand at modern Ukrainian labor market for bank workers, audit and accounting specialists, financial analysts and the like.

The region of residence seems to be insignificant determinant of individual earnings in pre-transition period (Tables 2 and 3 in appendix C) but highly significant in 2003. Moreover, the negative coefficient near rural area dummy reveals that its inhabitants earn, on average, lower wages than residents of cities and towns, holding other variables constant.

To test the possibility of upward bias of the OLS estimates of the rates of return to education due to the presence of unobservable innate ability, we control for family background, in particular for mother's and father's total years of education by simply introducing these characteristics into the regression (Table 5.2.4).

Table 5.2.4

Extended Earnings Regressions with Parental Education Controls

Variables	**Men**				**Women**			
	1986		**2003**		**1986**		**2003**	
Constant	4.395	4.835	5.163	5.586	4.201	4.739	4.416	5.142
	(26.530)	(39.110)	(29.410)	(38.520)	(27.310)	(35.460)	(19.590)	(25.740)
Educational levels *:								
Vocational		0.030		0.040		0.053		0.033
		(0.780)		(0.990)		(1.640)		(0.790)
Specialized secondary		0.139		0.123		0.060		0.108
		(3.380)		(2.600)		(2.070)		(3.110)
Basic higher		0.207		0.365		0.305		0.162
		(4.180)		(3.440)		(8.140)		(2.440)
Complete higher		0.189		0.293		0.397		0.336
		(1.160)		(5.090)		(4.230)		(7.770)
Years of education	0.041		0.046		0.049		0.053	
	(4.520)		(5.400)		(7.130)		(8.000)	
Experience	0.023	0.022	0.014	0.015	0.009	0.007	0.013	0.014
	(4.370)	(4.130)	(3.020)	(3.210)	(2.140)	(1.760)	(3.320)	(3.470)
Experience^2	-0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000
	-(4.430)	-(4.190)	-(4.140)	-(4.390)	-(1.070)	-(0.830)	-(3.370)	-(3.560)
Tenure	0.001	0.001	0.002	0.002	0.001	0.001	0.003	0.003
	(0.500)	(0.550)	(0.870)	(0.980)	(0.660)	(0.730)	(2.010)	(1.880)
City of Kyiv	0.071	0.074	0.163	0.166	0.029	0.029	0.221	0.219
	(1.380)	(1.410)	(2.770)	(2.780)	(0.660)	(0.640)	(4.570)	(4.520)
State ownership	0.125	0.126	0.049	0.051	0.030	0.035	-0.133	-0.134
	(2.130)	(2.140)	(1.190)	(1.250)	(0.560)	(0.650)	-(3.030)	-(3.050)
Regional dummies**	0.942	0.952	0.000	0.000	0.512	0.659	0.000	0.000
Sector dummies**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Parental education**	0.058	0.096	0.204	0.226	0.015	0.098	0.281	0.309
R^2	0.159	0.162	0.231	0.234	0.155	0.168	0.179	0.180
Sample size	1077	1077	1448	1448	1327	1327	1593	1593

Notes: t-statistics are reported in parentheses

* - Omitted variable is secondary education
** - p-values are reported

It should be noted that the inclusion of parental education as a set of controls lowers the measured rates of return to education by approximately 5% for the two periods, for males and females sub samples as compared with the full specification of earnings functions in Tables 5.2.1 and 5.2.2. Thus, ability may be an important determinant of the level of individual wages and conventional OLS estimates of the rates of return to schooling will overstate the "true" causal effect of education on earnings since they will incorporate the contribution of unobservable individual characteristics (ability) as well.

Instrumental Variable Estimation of the Returns to Education

IV estimation is the most general and frequently used method to handle the problem of schooling endogeneity and possible measurement errors; it is also the alternative approach to the inclusion of direct controls for the ability effects into the earnings regression if, of course, the legitimate instrumental variables for completed education are found (see Card (1999) for theoretical presentation of "cleaned" IV estimates). Because of data limitations, the main problem with IV estimation is finding a set of strong instrumental variables that would be highly correlated with the variable of interest (endogenous variable) and at the same time orthogonal to the regressand. That is why before running the regression it is important to test the validity and relevance of the potential instruments since their low quality may only lead to even larger biases in IV estimates than those produced by OLS method. I apply the set of diagnostic tests to the potential instrumental variables (mother's and father's total years of full-time education)

suggested by Baum, Schaffer and Stillman (2003) and present the results in Table 5.2.5.

Table 5.2.5

Testing Endogeneity of Schooling and the Quality of Instruments

Tests	**Men**		**Women**	
	1986	**2003**	**1986**	**2003**
Tests of endogeneity of schooling *H0: Regressor is exogenous* Wu-Hausman F test:	3.00103 F(1,1058) P-value = 0.08350	3.55646 F(1,1429) P-value = 0.05952	7.83378 F(1,1308) P-value = 0.00520	2.81940 F(1,1574) P-value = 0.09333
Durbin-Wu-Hausman chi-sq test:	3.04629 Chi-sq(1) P-value = 0.08092	3.59480 Chi-sq(1) P-value = 0.05796	7.90026 Chi-sq(1) P-value = 0.00494	2.84833 Chi-sq(1) P-value = 0.09147
Testing the relevance of instruments: F-test on excluded variables	F(2,1058) = 23.42 Prob > F = 0.0000	F(2, 1436) =65.70 Prob > F = 0.0000	F(2,1308) = 44.11 Prob > F = 0.0000	F(2, 1580)=120.73 Prob > F = 0.0000
Partial R^2	0.0513		0.1068	
Sargan's statistic	1.766 Chi-sq(1) P-val = 0.18393	0.085 Chi-sq(1) P-val = 0.77125	0.498 Chi-sq(1) P-val = 0.48059	0.392 Chi-sq(1) P-val = 0.53136

First, even though economic theory asserts that schooling is endogenous, this assumption should be checked. The two tests for endogeneity of schooling variable are performed, which test simultaneously the appropriateness of OLS estimation. In the case the endogeneity assumption isn't justified, resort to IV estimation will only result in the loss of efficiency. As Wooldridge states, "…an important cost of performing IV estimation when x and u are uncorrelated: the asymptotic variance of the IV estimator is always larger, and sometimes much larger, than the asymptotic variance of the OLS estimator." (as cited in Baum et al. (2003)). The Wu-Hausman F-statistic and the Durbin-Wu-Hausman Chi-squared statistic test the null hypothesis that the regressor (years of schooling) is exogenous, that is, that the OLS is an appropriate estimation technique in the sense that it is more efficient. We reject Ho at the 10% significance level for all the cases except for the women sub sample in 2003, for which Ho can be rejected at 5%. Thus, schooling may be endogenous.

To test the relevance and validity of the potential instruments, we first examine whether the instrumental variables are correlated with the included endogenous variable, and then see whether they are orthogonal to the error term. As suggested by Baum et al. (2003), the former condition can be tested by examining the fit of the first stage regression, in which the endogeneous variable is regressed on the full set of instruments. 2 measures are discussed by Baum et al. (2003): F-test of the joint significance of the instruments in the first-stage regression and the partial R^2 (the R^2 of the first-stage regression with the included instruments "partialled-out"). We report the partial R^2 obtained from regressing years of schooling against only our potential identifying variables and do not restrict our sample by gender. Since the R^2 in the full specification of the earnings functions isn't as large and changes within 15-20%, the reported partial R^2 (5.13% for the sample of 1986, and 10.68% - 2003) speaks in favor of the potential instruments. It is somewhat less for 1986 sample, but the possibility for reporting errors in parental education variables as of 1986 should be kept in mind, since individuals that were interviewed reported the information on education of their parents as of 2003. Although it is normal that parents finish their education before bearing children or at least before their children decide on continuation of their education after finishing school, there still exist some probability that parents could have obtained the degree between 1986 and 2003.

F-tests on the excluded variables justify the correlation assumption between the instruments and the schooling variable (the null hypothesis that the parental education variables are jointly insignificant can be rejected at the 1% significance level) (see Table 5.2.5).

The second assumption of instrument validity (orthogonality to the error term) is tested by the Sargan misspecification test[3]. The null hypothesis of valid instruments can not be rejected across all the subsamples as the p-values of Sargan's statistics are not significant.

The IV estimates of the returns to human capital, reported in Table 5.2.6, are substantially above the corresponding OLS estimates (11.8% vs 4.5% for men in 1986, 9.7% vs 5.0% for men in 2003, 12.6% vs 5.4% for women in 1986, and 8.2% vs 5.7% for women in 2003). But the magnitudes and signs of other coefficients do not significantly differ from those generated by the OLS earnings regressions (Tables 5.2.1 and 5.2.2).

[3] Sargan's statistic is N times the uncentered R^2 in the regression of the IV's residuals on all the exogenous variables and instruments, distributed asymptotically as chi-squared with the number of overidentifying assumptions as degrees of freedom

Table 5.2.6

IV Estimates of the Returns to Human Capital

Variables	Men		Women	
	1986	**2003**	**1986**	**2003**
Constant	3.470	4.115	2.970	4.349
	(6.110)	(12.160)	(6.310)	(16.720)
Years of education	0.118	0.097	0.126	0.082
	(2.640)	(3.690)	(4.520)	(5.120)
Experience	0.019	0.011	0.006	0.011
	(3.300)	(2.380)	(1.260)	(2.800)
Experience^2	-0.001	0.000	0.000	0.000
	-(3.680)	-(3.650)	-(0.330)	-(3.020)
Tenure	0.002	0.001	0.000	0.003
	(0.850)	(0.620)	-(0.130)	(1.640)
City of Kyiv	0.087	0.161	0.046	0.226
	(1.250)	(2.420)	(0.890)	(4.600)
State ownership	0.143	0.043	0.028	-0.126
	(2.330)	(1.060)	(0.550)	-(3.340)
Regional dummies**	0.704	0.000	0.446	0.000
Sector dummies**	0.000	0.000	0.000	0.000
R^2	0.101	0.208	0.074	0.168
Sample size	1077	1077	1327	1448

Notes: t-statistics are reported in parentheses
** - p-values are reported

The direction of bias is consistent with the numerous researches of this kind that are surveyed in Card (1999). He concludes that "…IV estimates of the return to education based on family background are systematically higher than corresponding OLS estimates and probably contain a bigger upward ability bias than the OLS estimates".

To choose between the OLS and IV estimates of the rates of return to human capital, we perform Hausman specification test (see Table 5.2.7).

Table 5.2.7

Hausman Specification Test

Ho: (schooling is exogenous): both IV and OLS estimates are consistent and OLS is efficient;

H1: (schooling is endogenous): OLS is inconsistent, IV is consistent

Test	**Men**		**Women**	
	1986	**2003**	**1986**	**2003**
Hausman specification test	chi2 = 3.08 Prob>chi2 = 0.9995	chi2 = 3.55 Prob>chi2 = 0.3143	chi2 = 8.12 Prob>chi2 = 0.9187	Chi2 = 2.78 Prob>chi2= 0.9999

Hausman specification test tests the null hypothesis that requires that assumption on the consistency of both OLS and IV estimates holds. Under Ho OLS is an appropriate estimation technique in the sense that it is more efficient. Turning to IV will only result in an efficiency loss if Ho is accepted. The results in Table 5.2.7 reveal that we can not reject the null hypothesis that OLS estimates are consistent and more efficient.

To conclude, it should be mentioned that IV estimates are highly sensitive to the choice of legitimate instruments. If the instruments are not sufficiently correlated with the endogenous variable, the rates of return to human capital will be estimated without preserving accuracy. At the same time, if the family background variables contain reporting errors, "it could induce a positive bias in the schooling coefficient that may partially reduce the direct attenuation effect of measurement error in the schooling variable" (see Pons and Gonzalo (2001) for this discussion). This may explain why the IV estimates are much higher than the OLS coefficients and might be, thus, higher than the "true" effect of schooling on individual's earnings. Lastly, Pons and Gonzalo (2001) admit that if the

returns to schooling are heterogeneous across individuals, the IV estimates will tend to estimate average return from among those with a higher propensity to go on studying. This is so called "local average effect", which isn't equal to the average effect of schooling on individual earnings observed in the population. If this is the case, Heckman (2001) suggests applying nonparametric method (so called "local IV") for estimation of the heterogeneous rates of return to schooling. Hence, the further research in the field under discussion should be expanded to finding another potential instruments and exploring the possible heterogeneity in the returns to education.

Correcting the Rates of Return to Human Capital for Selection Bias

Microeconometric studies often have to contend with selection problems. Selection biases arise when a sample used for estimation isn't randomly drawn from the population; rather the way in which the data was collected or the behavior of the individuals determine the available information. For instance, the individuals for whom earnings are observed (or reported) are not likely to form a representative, randomly-selected sample from the population. In the same way, earnings of graduate students can only be observed for those who have graduated from the university and it is unknown what the earnings for these individuals would be had they decided not to complete the university education.

According to labor economics theory, rational individuals decide to work if the market wage exceeds their reservation wage. In this case, the individuals with relatively higher wages and relatively longer time spent on education may be overrepresented in the sample for which wages are actually observed. The estimated relationship between education and wages will, thus, underestimate the true relationship between the level of education and wages. Similar biases can arise for the women sub sample. On average, women face somewhat decreased

opportunities in completing education and working due to maternity leave. To correct the estimated coefficients under interest for selection biases, Heckman suggested a two-stage least squares correction method (the Heckit model). The first stage of the Heckman model estimates the participation equation, in which the likelihood of working (and observing a wage) depends on the set of variables influencing labor market participation. In the second stage, the predicted individual probabilities are incorporated into the main equation along with the other determinants of wages (as education, experience, tenure, region, industry and type of ownership in our model).

In our study we assume that the probability of working and, thus, observing a wage, is a function of marital status, age, number of children (expect much higher significance for women), as well as education, and region of residence, which influence the probability to be employed and determine wage. Because of high unemployment in the country, especially among women and those with little education, we expect that OLS estimates of the rates of return to human capital are underestimated, and the corrected coefficients should be higher. The estimated Heckman models are presented at tables 4-7 in appendix C. All the coefficients in the participation equation are highly significant, except for the coefficient near number of children for men in 1986. The reported Heckman results also present the coefficients, standard errors, and confidence intervals on lambda (the inverse Mills ratio) and rho (measure of correlation between the errors in main and participation equations). If the coefficient on Heckman's lambda is statistically significant, there is a selection bias. Our results reveal that the null hypothesis of no selection bias can be rejected only for the women model in 1986 (table 5 in appendix C): the ratio of the estimated coefficient on lambda in this model to its standard error (0.21245/0.03977=5.342) is a number that exceeds the critical values for the normal distribution at reasonable levels of significance. The likelihood-ratio test reported at the bottom of the output is an

equivalent test for rho=0 as well as for lambda significance, and clearly justifies the Heckman correction for the 1986 women subsample. The corrected coefficient for the rate of return to schooling is estimated at 7.5%, which is higher than the correspondent OLS estimate (5.4%) according to our expectations. Relying on the valid correction leads us to the conclusion that the returns to education for women in pre-transition period were much higher than the returns for men, but this difference in earnings between gender groups has become less profound during transition.

Chapter 5

CONCLUSIONS

The goal of this study is to evaluate the private rates of return to human capital in Ukraine in pre-transition period and in the period of economic transformation. For this purpose we use data from the Ukrainian Longitudinal Monitoring Survey that was conducted in 2003 and included the retrospective section with the individual information going back to 1986. We estimate the extended Mincer earnings equations for 1986 and 2003, separately for men and women, with the schooling variable defined in a twofold manner: actual number of years spent on education and the level of diploma obtained. We also explore the possible inconsistency of OLS estimates of the returns to human capital due to schooling endogeneity, and apply IV estimation of the earnings functions with parental education instrumented for the schooling variable. However, we cannot reject the viability of OLS estimates on the basis of Hausman specification test. Finally, we correct the estimated rates of return to human capital for sample selection bias applying the Heckman method.

We find that the rate of return to an additional year of schooling in 1986 amounted to 4.5% for men, and 5.4% for women (the latter coefficient if corrected for sample selection is even higher – 7.5%). Significantly higher rates of return to education for women in pre-transition period, in contrast to those of men, is the evidence consistent with the findings in other former centrally-planned economies. For the year 2003, the rate of return to education was estimated at 5.0% for men, and 5.7% for women. The magnitude of the increase of the returns to schooling over the course of transition is really moderate in our country, as compared to the findings in CEE countries and Russia. This may probably be related to comparatively sluggish implementation of labor market

reforms, slow adjustment of the educational system to the needs of a market-based economy and skill mismatch that is likely to prevail in modern Ukraine.

We also examine the returns to specific levels of human capital investment in the two time periods by including dummies for educational attainment into the earnings functions. What we observe is significant and positive returns for undertaking additional levels of education after compulsory secondary school both in Soviet times and in transition. However, the distribution of the returns to education across separate categories of educational attainment has become more dispersed for men, and more contracted for women in 2003, as compared to 1986. The largest increase in the returns to education over transition is observed for men who graduated from the university, in particular who completed basic higher education (more than 150% increase). This finding is consistent with the highest returns to incomplete higher education in 1996 in Ukraine reported by Leschenko (2001). Therefore, young highly-educated men gain the most in the period of economic transformation, whereas elder and less-educated people are worse-off. Vocational education and specialized secondary education show the smallest changes in returns from 1986 to 2003. Gender difference in the returns to schooling is becoming less and less profound during the transition.

The downward trends in the rates of return to experience indicate that the skills and experience that were valuable in the Soviet times are of lower importance and applicability in a decentralized labor market. The new, private firms tend to value education more and experience less, in contrast to the state-owned companies.

We also find a strong impact of industry-specific and type of ownership characteristics on earnings in Ukraine in both periods. The differences between wages obtained in pre-transition period and wages during transition are

particularly strong in the financial and public services sectors, which now offer comparably higher earnings for intra-industry employees than they did in Soviet times. This finding is consistent with our expectations, since the developed service and financial sectors is what makes the market economy different from the centrally-planned economy among other things.

Region of residence is found to be insignificant determinant of individual earnings under an administrative-command economy, but becomes highly significant over the course of transition with higher average earnings to those who inhabit urban areas.

Concluding, we would like to remark that the decentralized wage-setting is generally associated with higher returns to educational and training investment, and further reforming of the Ukrainian labor market should clearly provide more incentives for individuals to accumulate "new" human capital that will meet the needs of a market-based economy.

BIBLIOGRAPHY

Baum, Christopher F., Mark E. Schaffer and Steven Stillman *Instrumental Variables and GMM: Estimation and Testing*. The Stata Journal 3, No 1, 2003.

Becker, Gary S. *Investment in Human Capital: A Theoretical Analysis*. Journal of Political Economy, 70(5) Part 2: Investment in Human Beings, 1962.

Becker, Gary S. *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. New York: National Bureau of Economic Research, 1964.

Blackburn, M.L. and D. Neumark. *Omitted Ability Bias and the Increase in the Return to Schooling*. Journal of Labor Economics, vol.11, 1993.

Blundell, Richard, Lorraine Dearden and Barbara Sianesi. *Estimating the Returns to Education: Models, Methods and Results*. University College London and Institute for Fiscal Studies, 2001.

Borjas, George J. *Labor Economics*. 1996.

Brainerd, Elizabeth. *Winners and Losers in Russia's Economic Transformation*. The American Economic Review, Vol. 88, No.5, 1998.

Campos, Nauro F. and Dean Jolliffe. *After, Before and During: Returns to Education in Hungary (1986-1998)*. CEPR Discussion Paper No.4215., 2004.

Card, David. *Earnings, Schooling, And Ability Revisited*. Working Paper, New York: National Bureau of Economic Research, 1994.

Card, David. *The Causal Effect of Education on Earnings* in *Handbook of Labor Economics,* Volume 3, edited by O. Ashenfelter and D.Card, 1999.

Chase, Robert S. *Markets for Communist Human Capital: Returns to Education and Experience in Post-communist Czech Republic and Slovakia*. Economic Growth Center Discussion Paper No.770, Yale University, 1997.

Clark, Andrew. *The Returns and Implications of Human Capital Investment in a Transition Economy: An Empirical Analysis for Russia, 1994-1998*. Discussion Paper, Edinburgh: Centre for Economic Reform and Transformation, 2000.

Estrin, Saul, Mark Schaffer and Inderjit Singth. *The provision of social benefits in state-owned, privatized and private firms in Poland* in M. Rein, B.L. Friedman and A. Worgotter, eds. Enterprise and social benefits after communism (Cambridge University Press, Cambridge, UK), 1997.

Friedman, Milton and Simon Kuznets *Income from Independent Professional Practice*. New York: National Bureau of Economic Research, 1945.

Heckman, James J. *Micro Data, Heterogeneity and Econometric Policy Evaluation*. Nobel Memorial Lecture in Economic Sciences, *Journal of Political Economy,* 109(4), 2001.

Heckman, James J. and Xuesong Li *Selection Bias, Comparative Advantage and Heterogeneous Returns to Education: Evidence from China in 2000*. Working Paper, National Bureau of Economic Research, 2003.

Heckman, James J. and Edward Vytlacil. *Identifying The Role Of Cognitive Ability In Explaining The Level Of And Change In The Return To Schooling*. Working Paper, National Bureau of Economic Research, 2000.

Kaufman, Bruce E. *The Economics of Labor Markets and Labor Relations*, 1986.

Leschenko, Natalie. *Returns to Education in Ukraine*. EERC MA Thesis Paper, 2001.

Mincer, Jacob. *A Study of Personal Income Distribution,* Ph.D. dissertation, Columbia University, 1957.

Mincer, Jacob. *Investment in Human Capital and Personal Income Distribution*. Journal of Political Economy, 66(4), 1958.

Mincer, Jacob. *On-the-Job Training: Costs, Returns and Some Implications*. Journal of Political Economy, 70(5) Part 2, 1962.

Nesterova, Daria V. and Klara Z. Sabirianova. *Investment in Human Capital under Economic Transformation in Russia*. EERC Working Paper No 99/04 (Russia), 1999.

Orazem, Peter E. and Milan Vodopivec. *Winners and Losers in Transition. Returns to Education, Experience, and Gender in Slovenia.* World Bank Policy Research Working Paper No 1342, August 1994.

Pons, Empar and Maria Teresa Gonzalo. *Returns to Schooling in Spain. How Reliable are IV Estimates?* Queen Mary,

University of London, Working Paper No.446, 2001.

Psacharopoulos, George. *Returns to Education: A Further International Update and Implications*. Journal of Human Resources 20 (4), 1985.

Psacharopoulos, George. *Returns to Investment in Education: A Global Update*. World Development 22 (9), 1994.

Psacharopoulos, George and Harry A. Patrinos. *Returns to Investment in Education: A Further Update*. World Bank Policy Research Working Paper, 2002.

Schultz, Theodore W. *Investment In Human Capital*. American Economic Review, 51(1) March, 1961.

Schultz, Theodore W. *Investment In Human Beings*. Special Supplement to the *Journal of Political Economy,* 60(5) Part 2, 1962.

Shyshkina, Anastasiya. *The Returns to Education in Ukraine*. EERC MA Thesis Paper, 2001.

Svejnar, Jan. *Labor Markets In The Transitional Central And East European Economies* in *Handbook of Labor Economics*, Volume 3, edited by O. Ashenfelter and D. Card, 1999.

Appendix A

Educational System in Ukraine

Educational system of Ukraine provides 3-5 years of pre-school education, 3-4 years of primary school, and 5 years of basic (fundamental) secondary education, which is mandatory and free of charge. Thereafter, students are faced with the choice: either continue attending secondary school for 2 more years to complete full secondary education or enter vocational school (3 years after basic secondary education and 1 year after complete secondary education) or specialized secondary school (3-4 years after basic secondary school). The tertiary education in Ukraine includes 4 years at higher educational establishment (university, institute, academy) to obtain bachelor's degree and 1-2 years – to obtain specialist's or master's degree. Ukrainian candidate of science degree lies between the western pattern master's degree and a doctorate of science.

Some facts from *Ukraine: Human Development Report 2003*
prepared by UNDP

- Since 1990 the enrollment rate into vocational schools, which were so popular in Soviet Ukraine, has seen drastic drop by 20% in 1-2 year programmes, and by 40% in 3-4 year programmes.
- Total enrollment in universities has risen from 0.8 mln to nearly 1.6 mln students since 1990.

- The adult literacy rate is traditionally very high in Ukraine – 99%.

Appendix B

Table 1. **Descriptive Statistics of Basic Variables**

1986						
Variables	**Total**		**Males**		**Females**	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Years of Schooling	12.13	1.73	12.13	1.71	12.13	1.75
Wage	180.43	144.01	228.90	188.53	141.09	72.69
Ln wage	5.04	0.52	5.28	0.52	4.85	0.44
Age	35.13	9.97	35.20	9.80	35.08	10.11
Experience	16.34	10.11	16.42	10.13	16.28	10.10
Father's years of schooling	7.96	3.69	7.95	3.65	7.97	3.72
Mother's years of schooling	7.33	3.82	7.30	3.81	7.36	3.82
N (%)	2404	100.00%	1077	44.80%	1327	55.20%
2003						
Variables	**Total**		**Males**		**Females**	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Years of Schooling	12.05	2.35	11.77	2.33	12.31	2.34
Wage	304.57	239.59	366.17	290.03	248.53	162.91
Ln wage	5.52	0.65	5.68	0.71	5.37	0.56
Age	41.17	11.80	40.98	12.52	41.34	11.10
Experience	22.13	12.30	21.96	13.11	22.27	11.52
Father's years of schooling	9.46	3.47	9.46	3.52	9.46	3.42
Mother's years of schooling	9.12	3.58	9.14	3.60	9.11	3.57
N (%)	3041	100.00%	1448	47.62%	1593	52.38%

Appendix C

Regression Results

Table 2. **Extended Earnings Regressions for the Whole Sample: 1986**

```
      Source |       SS       df       MS              Number of obs =    2404
-------------+------------------------------           F( 18,  2385) =   53.88
       Model |  188.221376    18  10.4567431           Prob > F      =  0.0000
    Residual |  462.846285  2385  .194065528           R-squared     =  0.2891
-------------+------------------------------           Adj R-squared =  0.2837
       Total |  651.067661  2403  .270939518           Root MSE      =  .44053

------------------------------------------------------------------------------
 log(wage)   |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Years of sch |   .0488015   .0054125     9.02   0.000     .0381879    .0594152
         exp |   .0141283   .0033127     4.26   0.000     .0076323    .0206243
      exp_sq |  -.0003401   .0000882    -3.85   0.000    -.0005131   -.0001671
         ten |   .0013506    .001338     1.01   0.313    -.0012732    .0039744
      gender |   .3754376   .0190279    19.73   0.000     .3381247    .4127504
       urban |   .0131247   .0203907     0.64   0.520    -.0268608    .0531101
       rural |  (dropped)
        kyiv |   .0564868   .0406719     1.39   0.165    -.0232691    .1362427
State_own    |   .0792415   .0374462     2.12   0.034     .0058111    .1526719
Manufacturin |   .2920242   .0380291     7.68   0.000     .2174507    .3665977
Electricity  |   .2386801   .0796076     3.00   0.003     .0825728    .3947874
Construction |   .3410308   .0505554     6.75   0.000     .2418937    .4401678
Motor_vehicl |   .0257341   .0440645     0.58   0.559    -.0606747    .1121428
Transport    |   .1438776   .0469553     3.06   0.002     .0518002    .2359551
     Finance |    .087428   .0800404     1.09   0.275    -.0695279    .2443839
Administrat  |   .2434685   .0534206     4.56   0.000      .138713    .3482241
Education    |  -.0808827   .0429025    -1.89   0.060    -.1650128    .0032473
Other_servic |   .0212102   .0483282     0.44   0.661    -.0735594    .1159798
Other_indust |   .0462012   .1512355     0.31   0.760    -.2503655    .3427679
       _cons |   3.935853    .073718    53.39   0.000     3.791295    4.080411
------------------------------------------------------------------------------
Omitted category: Agriculture and forestry
```

Table 3. **Extended Earnings Regressions for the Whole Sample: 2003**

Source	SS	df	MS		
Model	307.367656	18	17.0759809	Number of obs	3041
Residual	986.573919	3022	.326463904	F(18, 3022)	52.31
Total	1293.94158	3040	.425638676	Prob > F	0.0000
				R-squared	0.2375
				Adj R-squared	0.2330
				Root MSE	.57137

lnwage_2003	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Years_of_s~g	.0533586	.004651	11.47	0.000	.0442391	.0624782
exp	.0120391	.0028819	4.18	0.000	.0063884	.0176898
exp_sq	-.00035	.0000598	-5.85	0.000	-.0004672	-.0002327
ten	.0024316	.0012056	2.02	0.044	.0000677	.0047956
gender	.2686097	.0225249	11.93	0.000	.224444	.3127755
rural	-.1868965	.0244084	-7.66	0.000	-.2347552	-.1390377
urban	(dropped)					
kiev	.2061741	.0402101	5.13	0.000	.1273322	.2850159
State_owne~p	-.0302882	.0273689	-1.11	0.269	-.0839518	.0233753
Manufactur~g	.4421624	.0424941	10.41	0.000	.358842	.5254827
Electricit~r	.5106775	.0677244	7.54	0.000	.377887	.643468
Construction	.4539079	.0609359	7.45	0.000	.3344278	.573388
Motor_vehi~s	.2950656	.046911	6.29	0.000	.203085	.3870462
Transport_~t	.4884952	.0538014	9.08	0.000	.3830041	.5939862
Finance	.3293831	.0885227	3.72	0.000	.1558123	.5029539
Administra~e	.4040915	.0660668	6.12	0.000	.2745511	.5336318
Education_~h	.0578494	.0482499	1.20	0.231	-.0367566	.1524553
Other_serv~s	.1777703	.0543743	3.27	0.001	.0711559	.2843847
Other_indu~s	.0074783	.1178984	0.06	0.949	-.2236909	.2386476
_cons	4.474561	.0739223	60.53	0.000	4.329618	4.619504

Omitted category: Agriculture and forestry

Table 4. **Heckman Selection Model: Men (1986)**

```
Heckman selection model                         Number of obs      =      2153
(regression model with sample selection)        Censored obs       =      1076
                                                Uncensored obs     =      1077

                                                Wald chi2(17)      =    195.29
Log likelihood = -1145.467                      Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnwage_1986  |
   schooling |   .0396002   .0098171     4.03   0.000      .020359    .0588414
         exp |   .0190439   .0058564     3.25   0.001     .0075657    .0305222
      exp_sq |  -.0005185   .0001458    -3.56   0.000    -.0008043   -.0002328
       urban |   .0253062   .0390651     0.65   0.517      -.05126    .1018724
        kyiv |   .0823186   .0665758     1.24   0.216    -.0481676    .2128047
         ten |    .001074   .0021644     0.50   0.620    -.0031681    .0053162
agriculture  |  -.0448674   .2009949    -0.22   0.823    -.4388102    .3490755
manufactur   |   .2735985   .1956315     1.40   0.162    -.1098323    .6570293
electricity  |   .1487911   .2229508     0.67   0.505    -.2881845    .5857667
construction |   .2788514   .2009189     1.39   0.165    -.1149424    .6726451
motor_vehi~s |  -.0461254   .2063609    -0.22   0.823    -.4505853    .3583345
transport    |   .1292429   .1994757     0.65   0.517    -.2617223    .5202081
     finance |   .0861268   .2350092     0.37   0.714    -.3744827    .5467363
administrat  |   .2577258   .2022029     1.27   0.202    -.1385847    .6540362
education    |  -.2244794    .203592    -1.10   0.270    -.6235124    .1745536
other_servic |  -.0534249   .2054146    -0.26   0.795    -.4560301    .3491803
state_ownersh|   .1268264   .0580278     2.19   0.029      .013094    .2405588
       _cons |   4.412476   .2391901    18.45   0.000     3.943672     4.88128
-------------+----------------------------------------------------------------
select       |
   schooling |    .300534   .0389828     7.71   0.000     .2241291     .376939
         age |   .0541539   .0058522     9.25   0.000     .0426837     .065624
       rural |   2.065171   .2074786     9.95   0.000      1.65852    2.471821
   marstatus |   1.175535   .1391851     8.45   0.000     .9027371    1.448333
    children |   .0948866   .0848503     1.12   0.263    -.0714169    .2611902
       _cons |  -5.336364   .4043918   -13.20   0.000    -6.128958   -4.543771
-------------+----------------------------------------------------------------
     /athrho |  -.1508719   .1291547    -1.17   0.243    -.4040105    .1022666
    /lnsigma |  -.7424005   .0217816   -34.08   0.000    -.7850916   -.6997094
-------------+----------------------------------------------------------------
         rho |  -.1497375   .1262589                     -.3833753    .1019116
       sigma |     .47597   .0103674                      .4560779    .4967296
      lambda |  -.0712706   .0603456                     -.1895457    .0470045
------------------------------------------------------------------------------
LR test of indep. eqns. (rho = 0):   chi2(1) =     1.23   Prob > chi2 = 0.2680
------------------------------------------------------------------------------
```

Table 5. **Heckman Selection Model: Women (1986)**

```
Heckman selection model                         Number of obs      =      2734
(regression model with sample selection)        Censored obs       =      1407
                                                Uncensored obs     =      1327

                                                Wald chi2(17)      =    262.07
Log likelihood = -1389.603                      Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnwage_1986  |
   schooling |   .0749945   .0079011     9.49   0.000     .0595086    .0904804
         exp |   .0151052     .00437     3.46   0.001     .0065401    .0236702
      exp_sq |  -.0002317   .0001139    -2.03   0.042     -.000455   -8.49e-06
       urban |  -.0774331   .0317566    -2.44   0.015     -.139675   -.0151912
        kyiv |   .0404396   .0479106     0.84   0.399    -.0534634    .1343425
         ten |   .0010386    .001667     0.62   0.533    -.0022287    .0043059
agriculture  |  -.0486081   .2363252    -0.21   0.837    -.5117971    .4145808
manufactur   |   .1990324   .2316288     0.86   0.390    -.2549518    .6530166
electricity  |   .2312188   .2492838     0.93   0.354    -.2573685    .7198062
construction |   .2919806   .2369031     1.23   0.218     -.172341    .7563022
motor_vehi~s |  -.0465552   .2328706    -0.20   0.842    -.5029733    .4098628
transport    |   .0333731    .235526     0.14   0.887    -.4282493    .4949956
     finance |  -.0072268   .2442234    -0.03   0.976     -.485896    .4714423
administrat  |   .0639706    .239311     0.27   0.789    -.4050704    .5330116
education    |  -.1420593   .2318501    -0.61   0.540    -.5964771    .3123585
other_servic |  -.0380242   .2345731    -0.16   0.871     -.497779    .4217306
state_ownersh|   .0365075   .0482511     0.76   0.449     -.058063     .131078
       _cons |   3.671499   .2645485    13.88   0.000     3.152993    4.190004
-------------+----------------------------------------------------------------
select       |
   schooling |   .3345611   .0272332    12.29   0.000      .281185    .3879372
         age |   .0678445   .0042497    15.96   0.000     .0595153    .0761737
       rural |   2.058595    .165971    12.40   0.000     1.733298    2.383892
   marstatus |   .3886008   .0951508     4.08   0.000     .2021087     .575093
    children |  -.1281917   .0527563    -2.43   0.015    -.2315921   -.0247913
       _cons |  -5.778346   .2952153   -19.57   0.000    -6.356957   -5.199734
-------------+----------------------------------------------------------------
     /athrho |   .5652687   .1202003     4.70   0.000     .3296805    .8008569
    /lnsigma |  -.8793756   .0232811   -37.77   0.000    -.9250056   -.8337455
-------------+----------------------------------------------------------------
         rho |   .5118761   .0887057                      .3182337    .6645155
       sigma |    .415042   .0096626                      .3965292    .4344191
      lambda |   .2124501   .0397672                      .1345077    .2903925
------------------------------------------------------------------------------
LR test of indep. eqns. (rho = 0):   chi2(1) =    16.34   Prob > chi2 = 0.0001
------------------------------------------------------------------------------
```

Table 6. **Heckman Selection Model: Men (2003)**

```
Heckman selection model                         Number of obs      =      3199
(regression model with sample selection)        Censored obs       =      1751
                                                Uncensored obs     =      1448

                                                Wald chi2(17)      =    286.27
Log likelihood = -2503.853                      Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnwage_2003  |
   schooling |   .0489701   .0076535     6.40   0.000     .0339695    .0639707
         exp |   .0120419   .0043386     2.78   0.006     .0035384    .0205454
      exp_sq |  -.0003653   .0000888    -4.11   0.000    -.0005394   -.0001913
       rural |  -.1259332   .0832032    -1.51   0.130    -.2890085    .0371422
        kiev |   .1757523   .0646546     2.72   0.007     .0490317     .302473
         ten |   .0015083   .0018896     0.80   0.425    -.0021953     .005212
agriculture  |  -.6152263   .1438254    -4.28   0.000     -.897119   -.3333337
manufacturin |  -.0114893   .1370628    -0.08   0.933    -.2801275    .2571488
electricity  |  -.0104224    .154014    -0.07   0.946    -.3122843    .2914396
construction |   -.034533   .1467352    -0.24   0.814    -.3221287    .2530628
motor_vehi~s |   -.174671   .1434873    -1.22   0.223     -.455901     .106559
transport    |    .026186   .1438468     0.18   0.856    -.2557486    .3081206
administrat  |  -.0342736   .1536532    -0.22   0.823    -.3354284    .2668811
education    |  -.5844675   .1452362    -4.02   0.000    -.8691251   -.2998098
other_servic |  -.3644672    .148523    -2.45   0.014    -.6555668   -.0733675
other_indust |  -.6266804   .2049731    -3.06   0.002     -1.02842   -.2249404
state_ownersh|   .0425535   .0395796     1.08   0.282     -.035021    .1201281
       _cons |   5.283134   .1738209    30.39   0.000     4.942452    5.623817
-------------+----------------------------------------------------------------
select       |
   schooling |   .1064627   .0131513     8.10   0.000     .0806866    .1322389
         age |  -.0263546   .0024878   -10.59   0.000    -.0312306   -.0214787
       urban |   2.872241   .1122503    25.59   0.000     2.652234    3.092247
   marstatus |   .8126858   .0858803     9.46   0.000     .6443635    .9810081
    children |    .145792   .0385849     3.78   0.000     .0701669     .221417
       _cons |  -1.500388   .1577486    -9.51   0.000     -1.80957   -1.191207
-------------+----------------------------------------------------------------
     /athrho |  -.0554356   .1080314    -0.51   0.608    -.2671732    .1563019
    /lnsigma |  -.4782226   .0186682   -25.62   0.000    -.5148117   -.4416335
-------------+----------------------------------------------------------------
         rho |  -.0553789      .1077                     -.2609925    .1550414
       sigma |   .6198842   .0115722                      .5976131    .6429852
      lambda |  -.0343285   .0668263                     -.1653057    .0966486
------------------------------------------------------------------------------
LR test of indep. eqns. (rho = 0):   chi2(1) =     0.27   Prob > chi2 = 0.6045
------------------------------------------------------------------------------
```

Table 7. **Heckman Selection Model: Women (2003)**

```
Heckman selection model                         Number of obs      =      4525
(regression model with sample selection)        Censored obs       =      2932
                                                Uncensored obs     =      1593

                                                Wald chi2(17)      =    197.93
Log likelihood =  -2643.67                      Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnwage_2003  |
   schooling |   .0526917   .0074292     7.09   0.000     .0381308    .0672526
         exp |   .0114035   .0037503     3.04   0.002     .0040531     .018754
      exp_sq |  -.0002749   .0000808    -3.40   0.001    -.0004332   -.0001166
       urban |   .0660076   .1581546     0.42   0.676    -.2439696    .3759849
        kiev |   .2220123    .048682     4.56   0.000     .1265974    .3174273
         ten |   .0029334   .0014985     1.96   0.050    -3.62e-06    .0058705
agriculture  |  -.0666056   .1676004    -0.40   0.691    -.3950963    .2618851
manufacturin |   .1316144   .1635697     0.80   0.421    -.1889764    .4522051
electricity  |   .2923105   .1819985     1.61   0.108    -.0644001     .649021
construction |   .2188986   .1847532     1.18   0.236     -.143211    .5810082
motor_vehi~s |   .0380052   .1643115     0.23   0.817    -.2840395    .3600499
transport    |   .1867296   .1699679     1.10   0.272    -.1464015    .5198606
     finance |  -.0158412   .1856225    -0.09   0.932    -.3796545    .3479721
administrat  |   .1086944   .1735485     0.63   0.531    -.2314545    .4488432
education    |  -.0877282   .1625722    -0.54   0.589    -.4063638    .2309074
other_servic |  -.0049973   .1666496    -0.03   0.976    -.3316245    .3216299
state_ownersh|  -.1336201   .0371194    -3.60   0.000    -.2063728   -.0608675
       _cons |   4.655607   .2903382    16.04   0.000     4.086555     5.22466
-------------+----------------------------------------------------------------
select       |
   schooling |   .1414837   .0112374    12.59   0.000     .1194589    .1635086
         age |  -.0136384   .0019288    -7.07   0.000    -.0174188   -.0098579
       urban |   3.009886   .0972894    30.94   0.000     2.819202    3.200569
   marstatus |   .2670122    .056975     4.69   0.000     .1553433    .3786811
    children |     .14611   .0303636     4.81   0.000     .0865985    .2056215
       _cons |  -2.375063   .1446208   -16.42   0.000    -2.658514   -2.091611
-------------+----------------------------------------------------------------
     /athrho |  -.2035663   .2379356    -0.86   0.392    -.6699116     .262779
    /lnsigma |  -.6733848   .0229496   -29.34   0.000    -.7183652   -.6284043
-------------+----------------------------------------------------------------
         rho |  -.2008002   .2283419                     -.5849217     .256893
       sigma |   .5099795   .0117038                      .4875487    .5334423
      lambda |   -.102404   .1179575                     -.3335965    .1287885
------------------------------------------------------------------------------
LR test of indep. eqns. (rho = 0):   chi2(1) =     0.42   Prob > chi2 = 0.5152
------------------------------------------------------------------------------
```