External Return to Education in Poland

Strawinski, Pawel

University of Warsaw

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Paweł Strawiński
University of Warsaw, Faculty of Economic Sciences
pstrawinski@wne.uw.edu.pl

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ABSTRACT

In the article social rate of return to education is considered. As is pointed out in various research papers social return rate exceeds the pure technical rate of return by considerable margin. However, it is hard to calculate adequate figure due to methodological and data problems. The model used in the article is based on a comparative advantage theory. It contains two equations: one for technical and social rate of return to education, second deals with non-random selection for different education regimes. We find that private rate of return is over 7% yearly and therefore is still among the highest in Europe and there exists additional 1.5% social return to higher education.

Keywords: return to education, private returns, social return.
JEL classification: I21, O15

Introduction

The recent survey of educational determinants and educational career choices has shown that education is perceived by young persons as an investment. People that have decided to undertake such an investment consider not only pure financial gains but also other aspects. They expect that it pays off in the near future with satisfactory income level, and also better career perspectives, higher prestige, and last but not least, to lower the risk of unemployment spell. Those elements are part of so-called social return to education.

Investment in human capital creates a great opportunity for people, families, firms and a society as a whole. This is the simplest way to achieve higher level of social welfare. Human capital accumulation fastens technological and economic growth. Nowadays, in the era of globalisation, common markets and expansion of knowledge based economy investment in human capital are becomes necessity. Education improves workers' productivity and therefore has an influence on earnings. However, the total gains from investments in education are higher than economic rate of return. In addition, one has to take into consideration other aspects of such investments. They create many positive externalities for the society, for instance better hygiene and health standards. Educated people are presumed to be innovative, and others not so well educated often follow their new habits and style of life.

Despite that, they are hardly measurable and quantifiable, such as self-development, social interactions, they are all vital part of social return to education, i.e. public benefits that are received by society from increased amount of knowledge by its participants. Another important aspect is a possible spilover effect.

Many studies find that an additional year of schooling increases individual wages by 5-10%. However, the economic consequences of a change in average schooling may differ from this private return. Change in average education level raise individual wages, increase skilled-work supply, and also could have an influence on the labour demand. The wage rise is an effect of increased productivity, however is less than private rate of return to education if schooling has also a signalling effect, or other production factors are inelastically supplied. Similarly, the value of education to the society may exceed the private return rate, because of positive social returns due to changes in relative wages, or human capital externalities from more educated labour force. Despite the potential importance of this question for economic policy, much less is known about the social return to education than the private returns.

The concept of social capital has recently acquired acceptance among economists. It is used in wide rage of analysis from economics growth to institutional design. This concept is also used in economics analysis of education. Social return to education may be defined as a share of return than may be attributed to social capital. Following Coleman (1988), we distinguish social capital from human capital, such as education and ability, that workers brings to the labour market and distinguish each of these from financial capital. The sharing of knowledge and skills through formal and informal interaction may generate positive externalities across workers. This social effects increases return from education, but cannot be captured in standard human-capital based framework.

The private return to investment in education can be viewed as a discount rate. In such a case return is defined as a value that equalise the stream of incomes and the stream of expenditures in a given point of time. The private rate of return measures additional financial incomes earned, which can be attributed to higher qualifications. To estimate this value one has to take private born cost and expected increase of future incomes only, without considering taxes and social benefits. Government social policy influences the profitability of educational investment. The argument is raised that transfers and fee reductions for young students increase the total rate of return, lowering the private rate of return. But on the other hand, the private rate of return is lowered due to social security system and progressive tax system. As it is shown by de la Fuente (2003), in Europe investment in education seems to be more attractive than financial investment, because the former is supported by the government.

Such investments are supported by covering a large share or whole investment cost. The common policy instruments are subsidies or tax reductions. Public support of educational investment makes even in countries with progressive tax system real negative tax on human capital (Harmon et al. 2002).

Analogously, the social return to schooling is also often defined as the discount rate that equalizes the present value of social costs and social benefits of increased schooling. The key difference with the calculation of the private return to schooling is that the social return depends on the effect of schooling on output, not wages, and that the social return ignores redistribution. Standard supply and demand considerations suggest that wages of low-educated benefit from imperfect substitution between skilled and unskilled work, and the spillover effect. Furthermore, spillovers from education may arise though search externalities or endogenous skill-biased technical change (Acemoglu & Angrist 1999).

There is no straightforward measure that captures the social return to education. The usual proxy suggested in the literature is an effect of an increase in the share of educated workers. Such grow may increase total wages and private return to education for two separate reasons. First, the standard neoclassical model suggests that, if educated and uneducated workers are imperfect substitutes, an increase in share of educated workers will raise wages for both groups. Second, there may be human capital spillover effects. For above reasons, private and social return should be estimated simultaneously.

The article analyses social and private rate of return to higher education evolution during 1998-2005 period. The model for educational gains is based on a comparative advantage theory and uses Mincerian wage equation. The economic cost and benefits of obtaining a higher education degree are compared and return is calculated. Our aim is to unambiguously ascertain that positive spillover effect is present.

The article is divided into four main parts. In the first, methods and results for rate of return to education models in European countries are presented. The second part raises methodological issues. The empirical model is described with implications for analytical form. In the third datasets are presented and empirical results from conducted analysis. The article ends with a summary and results discussion.

The return to education

Many economist studies human capital returns to education. Several economic surveys find a positive relationship between an educational degree and received salary. Labour market researches for United States indicate that each additional year of education pays with an average wage increase by 7.5% (Acemoglu and Angrist 1999). In neighbouring Canada Bar-Or with co-authors estimated the rate of return to 4-year university diploma on 30% (1995). In a recent survey Caponi and Plesca (2007) showed that individuals with a university degree earn 30-40% more than secondary school graduates. In similar article Blundell et al. (2005) showed, using various econometric techniques that having a university diploma raises the average salary by 25% in United Kingdom. In another survey for that country Card (1999) estimated the annual rate of return to education at 6-11% depending on a field of study.

Similar results are obtained in studies concerning European Union members. Brunello, Coni and Lucifora (2001) examined the Italian labour market data, and showed that the average yearly rate of return to university education is about 6.2% for males, and 7.5% for females. This result has been confirmed by Mendolichcio (2005). She showed, that rate of return to education for women are in interval 7-12% and for men's in 6.5%-11%. Comparable results for UE15 were obtained by Harmon, Oosterbeek and Walker (2002). They estimated the average annual rate of return on 6.5%. De la Fuente (2003) in report prepared for European Commission estimated the yearly rate of return to education on 6.2%, while he stressed that in the long horizon there is an additional 3.1% premium form quicker technological development.

As it was pointed by Psacharopoulos (1993) return to investment in education decreases with growth of the national income per person. As a result it is expected that in Central and Eastern European countries, so also in Poland, the human capital rate of return to education is higher than the average for European Union members. However, many conducted empirical researches indicate a picture very different form one expected. Newell and Reilly (1999) have analysed distribution of wages in several transition countries and found that return to education is on remarkably low level. They estimated the rate of return to education on 2% only. Pastore and Verashchagina (2006) in Belarus' education survey arrived at similar conclusions. The economic transformation and decentralisation processes lead to an increase in rates of return to education. The rate reached the level of 4-5% depending on country specifity. Contrary to those finings, Strawinski (2006,2007) showed that technical rate of return to education for Poland ranged from 6% to 9.5% for 1998-2006 period. If one compare those results with Psacharopoulos (2003), which for developed countries estimated the rate of return to 7-12% yearly, it is obvious that in Central and Eastern Europe economies higher education was undervalued during transformation period. It was rewarded in term of prestige, but not in earnings. Hence, the social rate of return should be considerably higher for that period.

The empirical literature concerning social returns to education is rather limited. The evidence comes from a few studies. The micro studies refer to individual log wage explained by individual years of schooling, average years of schooling in relevant geographical area, and additional control variables. The social returns equal the sum of the two schooling coefficients: one for human capital return and the other for external return. Among few works it is worth to emphasise, that Rauch (1993) found an evidence for 8.1% social rate of return with 3.3% external rate by comparing wage rise with the average education attained in the area. Acemoglu and Angrist (1999) estimate of social return is around 7.5% (external 4.6%) using OLS methodology and 9.1% with 1.8% external rate for IV method. Moretti (2004) estimated spillovers from college education by comparing wages for otherwise similar individuals who work in the cities with different shares of college graduates in the labour force, and found a positive and significant relationship between increased supply of college graduates and average wages. Results indicate large positive relationship between individual wages and a share of college graduates, even when controlling for direct effect of individuals' education on wages. Also spillover effect is present. Better educated workers on the labour market decrease the supply of unskilled work and therefore causes an increase of their wages.

Macroeconomic approach to return to education uses cross-country regressions and takes the log of GDP per capita explained by average schooling and additional control variables. Heckman and Klenow (1997) estimate the size of the externality by comparing the schooling coefficient from human capital model with one from macroeconomic model. Their estimate of social return is 10.6%. Bils and Klenow (1998) use similar approach. When they take into account differences in technology, social returns become similar to private returns. In similar study Topel (1999) also use cross-country regressions and estimate external return to education on 6.2%. Acemoglu and Angrist (1999) looked at the effect of average education on workers' wages and finds significant externalities. Nevertheless, average and own education may be highly correlated. In addition, Psacharopoulos and Patrinos (2002) warn that the overall results are inconclusive.

Methodology

Measurement the level of social capital is ambiguous tasks. There is no widely held consensus on how to measure social capital, which is one of its weaknesses. The underlying problem is that factors that are potentially responsible for social capital creation are not easy to quantify. Some methods, proposed in literature, suggest that the level of education of the population, and its geographical concentration, are good proxies for associative behaviour, and therefore can be thought as measures for social capital.

There are several ways to estimate the rate of return to education. In this research we employ the Mincer human capital model (1974). This is most frequently used model in empirical economics. The Mincerian wage equations are commonly used in several labour economy fields, such as return to education, wage inequalities, or pay-gender discrimination gap. In this method empirical data are fitted to logarithm of actual wage by a linear regression model. Characteristics such as level of education, age as a measure of work experience and socio-demographic characteristics are used as explanatory variables. Human capital may be viewed as embodied in personal characteristics (Pracel and Dufur 2001). This basic model is extended by inclusion of the mechanism that allows for controlling non-random selection into education.

Analysis of social return to education beside pure technical rate of return to education has to take into consideration educational spillover effects. Education may affect national income in ways that are not fully measured by wages, for instance, is positively related with labour force participation. Several aspects of everyday life, as for instance, health or safety standards, election participation and voting behaviour are influenced by society education level. For example, in developing countries education is negatively associated with women's fertility and positively with infants' health (Kreuger and Lindahl 2001). The more educated societies the better understands interdependencies among different features, and are said to undertake better decision. Those indirect effects are vital part of social return. Moretti (2004) formulated a theoretical framework that allow for social return. In his general equilibrium model an increase in the number of educated workers in the local labour market may raise the average wage above the private return to schooling even in the absence of any spillovers. This is the case in the market with high intensity of high-skilled workers. The concern is that individuals in regions with high human capital are inherently better workers than individuals with the same observable characteristics who live in the low human capital intensity. This situation leads to self-selection problem, as predicted by a Roy model of self-selection.

Our empirical approach is similar to Acemoglu & Angrist (1999). We define social return to education as a sum of human capital return to education and the indirect effect measure by an increase in the share of educated workers on wages. The latter is called external wage effect in the literature. It equals to the effect of an increase in the share of educated workers minus the effect owed to private returns to education. The model itself is based on a comparative advantage theory. Each individual chooses their preferred education level. In order to do that, she compares streams of future incomes with alternative education levels. At every moment they can withdraw from the education system. Continuation of education is considered as an investment, because there is a necessity to choose between current costs and future incomes. Studies postpone the entrance to the labour market and lessens working activity time. Analogously to the standard cost benefit analysis of investment project, it is possible to calculate the internal rate of return. This return rate is defined as interest level that equals present value of cost stream with present value of future expected incomes stream.

To reduce the complexity of the analysis the rate of return to education is treated as the parameter characteristic of an individual. It is assumed, that undertaking investment at an individual level has no impact on general equilibrium of the economy. Henceforth, the marginal return rate is not affected by the decision of other society members. The next simplifying assumption is that the study costs are uniformly distributed over a study period. In reality, they are usually higher at the beginning and then decline.

Let Y_{ij} be lifetime labour income of person i with education level j. Let X_i be a vector of observable abilities and socio-demographic characteristics and ε_i a vector of unobservable terms that have an influence on the labour income. Then the lifetime income is defined by

$$Y_{ij} = f(X_i, \varepsilon_i) \tag{1}$$

Let's assume that the cost of achieving education level j for an individual i is equal C_{ij}. It varies among individuals due to specific abilities and predispositions heterogeneity. Let V_{ij} be a value of utility function derived for person i from of education level j. The mechanism of choosing the desired education level can be presented as:

$$V_{ij} = \max_j \left(Y_{ij} - C_{ij}\right) \tag{2}$$

It is presumed that people are behaving according to maximum utility theory. Therefore, one chooses such education level j, that maximises the difference between stream of future incomes attached to this level and the cost required to achieve it.

The analytic formula is an extension of Willis and Rosen (1979) model combined with Moretti (2004) approach. In our model beside human capital return we also consider social return to education. We distinct between the high skilled workers H and low-skilled ones L. We put emphasis on return to secondary level of education (high school or adequate) and tertiary level (university or adequate). First stage of education, the primary schools are compulsory and therefore, a lack of proper comparison group makes impossible return calculation for that education level. We assume that wages are increasing functions of the time. The rate of growth depends on skills achieved during education process and is g_h for person with higher skill level (university or equivalent education in case of return to tertiary education, or high school or equivalent in case of secondary education) and g_l for low-skilled workers. Schooling process is time-consuming. To reach a higher degree, a person has to dedicate some of his potential labour activity time. The amount of time necessary to achieve a degree is marked with T years. If one's chooses higher level of education their future stream of incomes is given by:

$$y_{Hi}(t) = \begin{cases} 0 & 0 \le t \le T \\ \overline{y_{ho}} \exp(g_h(t-T)) & T < t < \infty \end{cases} \tag{3}$$

The variable t represents working time and *(t-T)* is a measure of working experience. We can denote income equation for a low educated person in a similar way:

$$y_{li}(t) = \overline{y_{l0}} \exp(g_h t) \quad 0 \le t < \infty \tag{4}$$

The income stream is determined by two parameters: the starting salary for each education level $y_{.0}$ and the growth rate $g_.$ The person, while making decision about desired education level compares discounted future values of potential income.

$$PV_{hi} = \int_T^{\infty} y_{hi}(t) \exp(-r_i t) dt = \frac{\overline{y_{h0}}}{(r_i - g_h)} \exp(-r_i T) \tag{5}$$

$$PV_{li} = \int_0^{\infty} y_{li}(t) \exp(-r_i t) dt = \frac{\overline{y_{l0}}}{(r_i - g_l)} \tag{6}$$

The discounted value of education cost is equal PV(C). The person *i* chooses university education if PV(H)-PV(C)>PV(L), so the net benefit from achieving higher degree are greater than the benefits form lower level of education.

The discounted values of education level equation given by (5) and (6) are not earnings equations. They reflect an economic mechanism of choosing between two different education levels. The salary level is a function of education, experience measured by age and social and demographic characteristics. It is commonly assumed in the labour economy that the distribution of earnings is well approximated by the log normal distribution. The wage equation for each education level could be represented by the classical linear regression model. Following Acemoglu&Angrist (2000) and Moretti (2004), we also allow for human capital spillovers by letting worker's productivity depend on share of educated workers in the local labour market. We add human capital quality measure to wage equation

$$\ln(w) = X_i\beta + Y_{edu\,i}\gamma + \left(\frac{H}{H+L}\right)\delta + \varepsilon \qquad (7)$$

where X_i is a matrix of socio-demographic characteristics, Y_{edui} is a number of years spend in education system (education level proxy), H is a number of high skilled workers in local labour market and L is a size of low-skilled labour force. The γ coefficient is an estimate of average yearly return to schooling and δ is a proxy of external effect.

As it pointed out by Moretti (2004) the wage of uneducated workers w_L, benefits for two reasons from an increase of share of educated workers. First, an increase in the number of educated workers raises uneducated workers' productivity because of imperfect substitution. Second, the spillover further raises their productivity.

The principal challenge in estimating a causal effect of education on wages is identification. Individual education and average schooling levels are both correlated with wages for various reasons, so the observed relationship between variables is not necessarily casual (Acemoglu and Angrist 1999). The education level is up to some point pre-determined by the social background of the person (Becker 1976). Also as it shown in many studies individual wages are related to observed characteristic. There is an endogeneity problem and a potential sample selection problem. As a result the standard estimators would be inconsistent. Being aware of those problems, as is pointed out in the contemporary economic literature (Blundell et al. 2005; Harmon et al. 2002) to alleviate the endogeneity problem one has to use instrumental variable approach, and in the case of sample selection bias it is necessary to include a selection equation in the model. It describes the mechanism of selecting the observations to the estimation sample. The complete model can be written as

$$\begin{cases} w_0 = Z_i\delta + \xi_i \\ \ln(w) = X_i\beta + Y_{edu\,i}\gamma + \left(\frac{H}{H+L}\right)\delta + \varepsilon \end{cases} \qquad (8)$$

where w_0 is a selection indicator, Z_i is a selection variable matrix, D_i is a university degree indicator variable. The model can be consistently estimated by two-step procedure or the maximum likelihood method (Heckman 1979).

Sample characteristics

The main data source is Households Budget Survey (HBS). It is yearly, representative study that collects information about households with a special attention paid to income sources and expenditure structure. Each year over 30,000 households are surveyed. The household are drawn with rotation method, that, means that after a year the half of the sample is replaced by new households. Every four years the complete new sample is drawn. The reason for periodical replacement of household in the sample is to keep representative.

Each household during one month fills a record about its demographic structure, personal characteristics and also reports inflows and outflows. This way of collecting the information causes some difficulties with usage of the data. To overcome the problem we omit the data from households for which farming was the only or main income source. This way of handling the problem is justified in economic theory. The farming income is highly correlated with land productivity, and very weakly related to human capital productivity. As a consequence, farmer's income is only partly determined by its education and abilities.

TABLE 1. About here

The empirical sample is restricted to the individuals of working age (16-65 years for men's, 16-60 for women's), who receive incomes form work or self-employment. In addition, we excluded information about part-time employees and persons who combine incomes from employment and social assistance or those who declare that work is not their main source of income. This step is necessary because data does not provide information about exact number of hours worked, so it is not possible to calculate hypothetical full time earnings. In addition, all previously mentioned group of workers decide to work on non-economical basis, so their wage may not reflect the true value of their working abilities. In order to correct for a selection process some information about non-working persons is also included.

Before the return rate to university is calculated, basic sample characteristics are analysed. After all data correction operations about 35,000 observations are left in the sample. Characteristics in Table 1 are presented for full sample (left column) and working sample (right column). Working population between 1998 and 2005 do not differ greatly in terms of average education and labour market experience, however level of diversification has risen. It is noticeable that differentiation of education period measured by standard deviation almost doubled. Diversification in terms of working experience also has risen but slightly. This could be assigned to workers replacement process. Older, not so well educated generations slowly leaving labour market, and young people enter the market. Men's have a larger share in the sample (55-57%). This is attributed to fact that it is more usual for women's to be out of the labour force. Large percent of women's population do childbearing instead of regular work at the market. The characteristic that is extraordinareous and distinctive for polish labour market is a large share of self-employment (10 %). It is important to remark that employment structure has changed dramatically during those years as an effect of transition. As it is shown by Newell and Socha (2007) between 1998-2002 private sector employment rose by 50% and exceeded public sector employment. The traditional production sectors (farming, mining, industry) lost their importance. On the other hand, there was a great expansion of service sector. The share of public sector workers fall from 49% of working population in 1998 to just over 35% in 2005. The structure of employees in terms of town size seems to be stable over time. One has to take into consideration the fact, that overall rate of employment has raised.

TABLE 2. About here.

As it can be easily noticed by examining Table 2., there was a tremendous change in education structure in both population and working population. The progress is observed in share of people with university or equivalent degree evidently. The number of people with tertiary education rose dramatically during that period, and at the same time decrease in the number of very low qualified labour force was perceived.

Moreover, those changes were not equally spaced. There still exist observable gap between centres (Dolnoslaskie, Mazowieckie, Slaskie) which benefit from economic expansion and educational boom and peripheries (Kujawsko-Pomorskie, Lubelskie, Podkarpackie, Podlaskie, Swietokrzyskie) where is a sharp increase in secondary education share is noticeable, but slower in tertiary. The low-industrialized regions surely tries to catch-up commercial and industrial centres (major cities and it's suburbs), but one has to have in mind that new technologies are adopted in the centres not peripheries. The educational disparity fall from 13% to 10% percent for secondary education level, and from 7,5% to 7% for university education. However, the divergence in human capital between regions is still wide.

Results

In this section we present results from estimation of the social returns to education models based on cross–sectional data from the HBS. To provide robustness of the results we conducted the analysis with use of different estimation methods. Having in mind reasons enumerated in methodological section we use an instrumental variable approach (IV). This method is a standard estimation technique used in cases where endogenous variable is present in estimated equation. In our context, it is evident that personal education level can be correlated with the average education level in the neighbouring area.

Many standard estimators, including OLS and IV could be thought as special cases of GMM estimators. The latter estimator has a clear advantage over IV estimator. If heteroscedasticity is present in the model GMM is more efficient whereas heteroscedasticity is not present, the GMM is no worse asymptotically than IV (Baum et al. 2000). In our research we use cross-sectional data, and for that reason we could expect that model error is heteroscedastic. Moreover, we poses large sample, so usage of GMM is methodologically justified.

Social returns to education are not well recognised in the literature. We stipulate that they are heterogeneous, what means that they could vary for different kinds and levels of education. Nowadays, vast majority of pupils successfully attain to finish secondary level of education. To certain extent this is requested by law, because schooling is compulsory until age of 18. The different story is for university education. During communist era and at early stage of transition there were a few students, and only around 7% of population had a university degree.

The transition process changes the situation dramatically. Just after the transition educational boom mushroomed and nowadays, around 50% of young people continue their education at tertiary level. This figure is probably the highest in Europe. We assume that effect of education is not constant and changes with introduction of new technologies. Technological development has to be accompanied by increase in the number of highly qualified workers. Therefore, we suppose that both returns technical and social rate of return from secondary education decreased, and that for tertiary education increased. To explore this possibility, we estimated separate model and disjointedly report results for a social influence of secondary and tertiary level of education.

Estimates for external effect of secondary education are presented in Table 3. Columns (2)-(4) contains results for year 1998 and (5)-(7) for 2005, respectively. Results in each column are obtained by different method. Result in column (2) and (5) are obtained by two stage least square instrumental variable. Column (3) and (6) contains GMM estimates for instrumental method. In (4) and (7) two stage selection model results are presented. The instrumental variable estimates treat average schooling as endogenous, while selection model treats achieved level of education as a result of economic decision. In the former model gender, experience and its square, years of education, type of the family and also town size and regional dummies serve as an instruments. In the latter these variables and additionally non labour income are used in construction of selection equation. The sizes and magnitudes for coefficients beside variables included in the wage equation are in accord with labour market theory. Positive sign for *gender* variable show that employers tend to pay higher wages to the men than women, even if both have similar qualifications and working experience. This might be an indication of gender related wage discrimination. The coefficients of Mincerian wage equation are similar to those founded in other studies and those for experience and experience squared may be interpreted as diminishing marginal returns from working experience. The premium from additional year of education is positive and ranges form 6% to 7%.

To capture eventual education's spillover effect we use a share of secondary and tertiary school graduates. However, the average education in the region may be correlated with individual education, therefore there is a need for an instrument to rule out correlation. In general, in the dataset good instrument for educational share is not available. We desperately need to find a variable that is related to average education but not individual.

TABLE 3. About here.

The first candidate for instrument is a set of regional dummies. As long as Poland is ethnically homogeneous, there is no reason to think that some regions are advantaged or disadvantaged in terms of education. We assume that educational aspirations are there same in all regions. However, there is a problem with educational gap between cities in rural areas (Jakubowski & Sakowski 2006). Fortunately, the percent of population living in cities is not directly related to educational aspirations and abilities, and therefore town size dummies could serve as instruments for educational share. To check validity of used instruments we conducted the Shea test and found that they significantly explain endogenous regressor volatility. We ascertain that instruments are independent from unobservable error process by using Sargan test. To alleviate possible heteroscedasticity problem apart 2SLS IV estimates we employ GMM based IV estimates. The differences between two methods are negligible. This assured us that obtained results are robust.

Important observation is that selection process is significant only in equations for 2005. In 1998 unemployment rate was relatively high and part of that unemployment should be considered as involuntary. In 2005 after EU accession economy is growing at relatively high rate and everyone that want to work is capable of finding a job especially low skilled in service sector.

TABLE 4. About here

The similar results and interpretation can be derived from estimation of tertiary education models. All sign, sizes and coefficients magnitudes are in accord with expectations and support underneath economic theory. The estimate of human capital return rate to education estimation at 7% for tertiary level agrees with expectations. Similar result was achieved by Strawiński in earlier works (Strawiński 2006,2007). There is observed slight decrease in pure return to years of education and years of experience. Selection process is stronger for tertiary level of education, indicating that the role of unobserved skills and abilities is important and should not be neglected.

The external rate of return doubled in the 1998-2005 period. The coefficient for secondary education is around 0.7% in 1998 and 1.3% in 2005 (Table 3), for tertiary figures are 1.6% and 2.8% respectively. This means that the social rate of return to tertiary education is around 9.2% yearly. It is interesting to observe, that social rate of return does not changed over time. There was a shift, human capital part rate have decreased while external have increased. The different story is with social rate of return to secondary education. During 1998-2005 external rate have increased while overall social rate decreased.

This difference between return rate to secondary and tertiary education is consistent with Kreuger and Lindahl (1998) findings, who argues that expansion of human capital at lower level reduces crime and welfare participation rate, while expansion at tertiary education creates spillover effect in the form of increased productivity and technological progress. Therefore, larger social return in terms of wages should be observed for university level of education.

Unfortunately, our empirical approach has potential and quite obvious shortcomings. The econometric model deals with individual data and, for that reason, ignores some additional and potentially important external effects. The major concern is devoted to interregional and village-town mobility. Secondary schools, universities and also commercial and industrial areas are located mostly in towns. Therefore, towns accumulate human capital stock and observed spillover effect might be to some extent a town effect. This should not be a problem in our research due to specific construction of educational share variable. It poses a constant value for whole voivodship. However, a part of the measured return might reflect regional differences. Secondly, due to cross-sectional nature of data it was not possible to eliminate those regional differences.

Conclusions

Evidence on the returns to education has an implication for both economic theory and policy. A large literature report estimates of private return to education on the order of 6-10 percent. However, private returns may be only part of the story. If there is a positive social return to education, then private return underestimate the economic value of schooling. The economic literature stresses the role of external effect of education. A large body of research using individual level data provides evidence on positive social return to education that offset pure human capital return by considerable margin. On the other hand, the macro-evidence of human capital externalities is ambiguous. The most promising result concerns work of Lochner and Moretti (2004) about causal relationship between school enrolment, education and crime rate reduction.

Model presented in the article do not account for unobserved heterogeneity in ability. Individuals that are live in regions with high level of human capital may be better workers than those who live in regions with low human capital. As is pointed out by Rauch (1993) higher quality workers may move to areas with higher levels of educational share. This is straight consequence of Roy model, where the skills moves to job at which are better valued. Regions that have industrial structure that requires more educated workers are also likely to refer better price for unobserved ability (Moretti 2004).

Identification of social return requires exogenous variation in both individual and average schooling. In this paper, we use a geographical and demographic structure of population to mimic this variation. This strategy works because, there is an observable shift in demand for education, especially at the university level.

The aim of our research is to measure social return to education in Poland. To achieve this goal we used methodology proposed by Moretti (2004). In the first part economic model is briefly described. We used a Household Budget Survey as a source of empirical data. In the second part we reported estimation result for different specifications of the model. This step provided that obtained results are robust. We found that the social return to secondary education was 8.2% in 1998 and it fell down to 7.4% in 2005, while the return to tertiary education have risen from 9,1% in 1998 to 9,2% in 2005.

Our findings are in line with existing empirical literature. We have found positive external effect of education. The coefficient on share of educated people in the region is considerably larger for university level of education. But, also an increase in percentage of secondary school graduates increase wages, suggesting that still exist positive spillover effect.

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Table 1. Summary statistics

Variable	1998 population	1998 Working population	2005 population	2005 Working population
Log income	6.75 (0.47)	6.76 (0.47)	6.99 (0.51)	7.01 (0.51)
Years of education	11.55(2.15)	11.99 (2.11)	10.99 (4.55)	11.95 (3.80)
Years of experience	21.28(12.08)	18.86 (9.57)	21.84(12.89)	19.72 (10.86)
Age	39.84 (11.65)	37.95 (9.45)	39.84 (11.31)	38.67 (9.94)
Male	0.56 (0.50)	0.57 (0.50)	0.55 (0.50)	0.57 (0.49)
Self-employment	0.09 (0.28)	0.10 (0.31)	0.10 (0.29)	0.11 (0.31)
Public sector	0.37 (0.48)	0.49 (0.50)	0.27 (0.44)	0.35 (0.48)
Family	0.80 (0.39)	0.82 (0.38)	0.78 (0.41)	0.79 (0.41)
Tertiary education	9.45 %	12.25 %	15.33 %	19.66 %
Secondary education	33.20 %	38.66 %	35.42 %	39.17 %
Vocational education	38.44 %	39.13 %	36.34 %	34.78 %
Primary education	18.18 %	9.94 %	12.77 %	6.33 %
Town 500+	11.15 %	14.25 %	10.89 %	13.47 %
Town 200-500	9.89 %	12.57 %	8.91 %	10.78 %
Town 100-200	6.39 %	8.01 %	6.60 %	8.24 %
Town 20-100	17.36 %	21.33 %	18.09 %	22.03 %
Town –20	11.25 %	13.38 %	10.96 %	12.65 %
Village	43.96 %	30.47 %	44.55 %	32.83 %

Source: Own computation based on HBS data.

Table 2. Educational structure

Voivodship	1998 Secondary education and above	1998 Tertiary education and above	2005 Secondary education and above	2005 Tertiary education and above
Dolnoslaskie	48.98 %	10.75 %	53.12 %	15.95 %
Kujawsko-Pomorskie	38.18 %	7.68 %	45.35 %	10.48 %
Lubelskie	37.74 %	8.52 %	46.92 %	12.02 %
Lubuskie	42.71 %	9.05 %	52.63 %	14.14 %
Lodzkie	44.39 %	9.43 %	49.10 %	13.09 %
Malopolskie	43.13 %	11.28 %	48.00 %	15.83 %
Mazowieckie	50.96 %	13.19 %	57.72 %	19.69 %
Opolskie	40.92 %	7.18 %	51.52 %	16.75 %
Podkarpackie	38.20 %	7.91 %	47.26 %	14.00 %
Podlaskie	37.72 %	6.82 %	48.85 %	13.66 %
Pomorskie	42.38 %	10.72 %	49.35 %	17.58 %
Slaskie	44.36 %	9.45 %	55.40 %	16.78 %
Swietokrzyskie	35.40 %	7.92 %	46.51 %	12.44 %
Warminsko-Mazurskie	38.22 %	5.77 %	49.09 %	14.46 %
Wielkopolskie	37.06 %	7.37 %	47.39 %	14.20 %
Zachodnio-Pomorskie	49.00 %	10.34 %	52.12 %	15.74 %

Source: Own computation based on HBS data.

Table 3. Estimates of return to secondary education.

Variable	1998				2005			
	OLS	IV 2SLS	IV GMM	Selection	OLS	IV 2SLS	IV GMM	Selection
Log wage								
Secondary education	**0.0046 (0.0002)**	**0.0060 (0.0002)**	**0.0054 (0.0002)**	**0.0055 (0.0002)**	**0.0045 (0.0002)**	**0.0060 (0.0002)**	**0.0052 (0.0002)**	**0.0052 (0.0002)**
Male	0.2907 (0.0050)	0.3082 (0.0052)	0.2960 (0.0054)	0.2987 (0.0053)	0.2354 (0.0057)	0.2495 (0.0058)	0.2465 (0.0060)	0.2333 (0.0058)
Experience	0.0302 (0.0009)	0.0351 (0.0010)	0.0343 (0.0011)	0.0322 (0.0010)	0.0217 (0.0009)	0.0250 (0.0009)	0.0243 (0.0009)	0.0223 (0.0009)
Experience2	-0.0006 (0.0000)	-0.0007 (0.0000)	-0.0007 (0.0000)	-0.0006 (0.0000)	-0.0003 (0.0000)	-0.0004 (0.0000)	-0.0003 (0.0000)	-0.0003 (0.0000)
Years of education	0.0767 (0.0012)	0.0826 (0.0014)	0.0792 (0.0016)	0.0838 (0.0014)	0.0467 (0.0008)	0.0525 (0.0010)	0.0490 (0.0011)	0.0531 (0.0010)
Public employment	0.0238 (0.0053)	0.0250 (0.0053)	0.0217 (0.0053)	0.0214 (0.0054)	0.0837 (0.0062)	0.0805 (0.0062)	0.0921 (0.0063)	0.0712 (0.0063)
Self employment	0.3009 (0.0084)	0.3006 (0.0084)	0.3086 (0.0116)	0.2941 (0.0087)	0.2193 (0.0092)	0.2177 (0.0091)	0.2181 (0.0122)	0.2014 (0.0092)
Selection/lambda		0.0769 (0.0614)	0.4805 (0.0739)	0.1621 (0.0155)		0.8081 (0.0570)	0.6072 (0.0655)	0.1608 (0.0129)
Constant	5.0985 (0.0176)	4.6656 (0.0400)	4.8279 (0.0494)	4.9221 (0.0252)	5.7357 (0.0159)	5.2722 (0.0354)	5.4190 (0.0419)	5.5940 (0.0205)
Selection/instrument								
Male				0.3799 (0.0210)				0.1845 (0.0195)
Experience				0.0790 (0.0034)				0.0341 (0.0028)
Experience2				-0.0017 (0.0001)				-0.0006 (0.0001)
Years of education				0.2289 (0.0072)				0.0823 (0.0026)
Non-labour income				-0.0027 (0.0001)				-0.0028 (0.0000)
Family				0.2645 (0.0264)				0.3727 (0.0242)
Regional dummy				sig.				sig.
Town size dummy				sig.				sig.

Standard errors in parentheses
Source: Own computation based on HBS data.

Table 4. Estimates of return to tertiary education

Variable	1998				2005			
	OLS	IV 2SLS	IV GMM	Selection	OLS	IV 2SLS	IV GMM	Selection
Log wage								
Tertiary education	**0.0099** **(0.0004)**	**0.0127** **(0.0004)**	**0.0116** **(0.0004)**	**0.0108** **(0.0004)**	**0.0081** **(0.0003)**	**0.0095** **(0.0003)**	**0.0086** **(0.0003)**	**0.0092** **(0.0003)**
Male	0.2987 (0.0050)	0.3028 (0.0051)	0.2900 (0.0054)	0.2931 (0.0052)	0.2351 (0.0057)	0.2471 (0.0057)	0.2434 (0.0059)	0.2333 (0.0058)
Experience	0.0306 (0.0009)	0.0343 (0.0010)	0.0330 (0.0010)	0.0315 (0.0010)	0.0220 (0.0009)	0.0251 (0.0009)	0.0244 (0.0009)	0.0229 (0.0009)
Experience2	-0.0006 (0.0000)	-0.0007 (0.0000)	-0.0006 (0.0000)	-0.0006 (0.0000)	-0.0003 (0.0000)	-0.0004 (0.0000)	-0.0003 (0.0000)	-0.0003 (0.0000)
Years of education	0.0763 (0.0012)	0.0800 (0.0014)	0.0764 (0.0016)	0.0818 (0.0014)	0.0457 (0.0009)	0.0516 (0.0010)	0.0483 (0.0011)	0.0521 (0.0010)
Public employment	0.0280 (0.0053)	0.0300 (0.0053)	0.0256 (0.0053)	0.0253 (0.0054)	0.0843 (0.0062)	0.0814 (0.0062)	0.0904 (0.0063)	0.0720 (0.0062)
Self employment	0.3017 (0.0084)	0.3010 (0.0084)	0.3079 (0.0116)	0.2950 (0.0087)	0.2164 (0.0091)	0.2154 (0.0091)	0.2170 (0.0122)	0.1980 (0.0092)
Selection/lambda		0.5397 (0.0587)	0.2605 (0.0708)	0.1144 (0.0151)		0.7621 (0.0558)	0.5654 (0.0645)	0.1673 (0.0128)
Constant	5.2113 (0.0172)	4.9156 (0.0365)	5.0759 (0.0450)	5.1088 (0.0231)	5.8488 (0.0142)	5.4586 (0.0319)	5.5796 (0.0378)	5.7204 (0.0182)
Selection/instrument								
Male				0.3799 (0.0210)				0.1845 (0.0195)
Experience				0.0790 (0.0034)				0.0341 (0.0028)
Experience2				-0.0017 (0.0001)				-0.0006 (0.0001)
Years of education				0.2289 (0.0072)				0.0823 (0.0026)
Non-labour income				-0.0027 (0.0001)				-0.0028 (0.0000)
Family				0.2645 (0.0264)				0.3727 (0.0242)
Regional dummy				sig				sig
Town size dummy				sig				sig

Standard errors in parentheses
Source: Own computation based on HBS data.