# EDUCATION AND LABOR MARKET: HOW LONG IS IT WORTH STUDYING?

by

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# Abstract

The economic worth of education is estimated by earnings equations in a series of research work and earnings equations are also used in the decisions of continuing studies at certain stages of the educational system. However, previous research did not break down the examination of schooling coefficients of the earnings equation to the most detailed available data on educational stages. This thesis seeks answer to the question of how long it is worth studying by estimating marginal benefits of educational levels with the help of the detailed examination of a series of separate earnings equations estimated between two subsequent levels of education. Data used for the estimations is taken from the US Decennial Census of 2000 and 2010. Findings show that the increment in incomes between subsequent stages of education is high in the case of a high school diploma, therefore people should be highly motivated to obtain secondary school qualification. However, incomes increase at a much slower and continuously diminishing rate at the different stages of tertiary education, which together with increased costs and non measured factors may indicate a steep drop in motivation for acquiring higher degrees in spite of earlier conclusions supportive to tertiary education, which were drawn on more general calculations. Data also show that professional degrees are worth much more than following the academic path of studies through Master's and doctoral degrees.

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## Introduction

An important characteristic of education as a long term activity is that its beneficial impact on incomes can be observed only long after the education period itself is over. It is therefore increasingly difficult to measure the efficiency of education. However, similarly to other activities such measures are important if the goal is to maintain and improve the standard of quality. Under the above conditions one way of grasping the impact of education on economic performance and welfare is the earnings equation, where earnings, as the remuneration of work, is regressed on an independent variable of interest representing education as years spent in education or the reached qualification level.

The aim of this thesis is to answer the questions of how far it is worth studying and find those educational levels which are most worth achieving through the application of earnings equations. In order to find answer to the above questions the economic value of detailed educational levels is estimated by the coefficient of schooling years and reached qualifications in the earnings equation. Motivation for further studying is anticipated to be higher in the cases where the increase in returns or benefits is higher compared to another level of study. Therefore finding the most motivated educational stages also needs to answer the question of how the different detailed levels of qualifications are remunerated compared to each other. It is found that at higher educational stages motivation expressed in the increase of income paid for a qualification has a decreasing tendency.

Earnings equations have been used for the evaluation of educational activity in labor economic research for a long period of time *(Heckman, Lochner, Todd, 2008)*. Answers to the question of how long it is worth studying have been based on earnings equations applying the coefficient of length of education for the evaluation of years spent with studying. The underlying theory of these estimations is that the economic value of education can be expressed by the increment in later income generated by it. Higher generated income is also assumed to give motivation for the individuals to decide on further studying.

However, in spite of their widespread application, earnings equations mostly calculate general average evaluations of education and are rarely broken down into existing detailed educational levels, especially within tertiary education. Although it is emphasized in a series of works that higher education after a secondary school diploma is worthwhile both for the individuals and for society *(Ashenfelter, 1994; Card 1994)*, the question of exactly how far it is worth extending the studying time period for different individuals, remains unanswered. As studying circumstances and the decision for further studying are getting very varied at the different levels of tertiary education *(Bousquet, 2008)*, calculations made generally for this stage of study do not seem to be sufficient to answer the above question.

Returns to education at different educational stages also have been calculated in previous research *(Heckman, Lochner, Todd, 2008)*. However, calculations were not broken down into the most detailed levels of education available. This means that the marginal value of educational levels within a stage with wider range of levels or studying time was not addressed and the calculated values were averaged throughout the measured educational stage. In this thesis research is extended to more detailed levels with the estimation of marginal benefits facing individuals at points where they decide on further studying, therefore their sequential decision making situations may be better traced. Marginal benefits may be useful also from the point of view of policy makers, whose objective is to motivate further studies. From this aspect it is important to see the exact situation of those who decide on studying further in order to help and motivate them into the desired directions efficiently.

For the estimation of marginal benefits of further studies the schooling year coefficients of earnings equations are applied, using data only from those detailed educational levels which are particularly measured by the equation. Using a dummy variable it is also possible to compare the returns of two educational levels with the same length of studying period (for example, 12 years of study without and with a high school diploma). In this way earnings equation calculations are broken down into the most detailed available educational levels and it is possible to examine the impact of achieving different levels of education on the earnings of individuals. Data applied for the estimations were taken from the U.S. Census of 2000 and 2010.

Chapter 1 summarizes the theoretical background and the development of approach to the question of economic evaluation of education through earnings equations. The chapter starts from the human capital model, then summarizes the findings of the 1990s. It finally includes recent research based on the application of earnings equations.

Chapter 2 defines the research problem of evaluating the worth of studies in detail and puts the research questions into context. Methodology applied in the thesis also explained in the chapter.

Chapter 3 describes the educational structure of the United States of America. This short description is necessary for the understanding of the educational steps taken by individual students at different points in the system.

Chapter 4 exhibits the detailed estimations and calculations made for the coefficient of schooling in order to answer the question of what educational levels are the most worth achieving. A hypothesis on the form of the function of earnings growth on schooling years is tested and discussed.

Chapter 5 explains the evaluation of findings of Chapter 4 putting them into context with variables and issues not measured.

# 1. Theoretical background

Research on the measurement of worth of education and the formation of the concept of returns on educational investments started with the creation of the human capital model. Explicit answers to the question of how long it is worth studying were provided in the 1990s. In the 21st century more research found that conclusions of the 1990s were in fact more limited than previously thought.

The human capital model regards education and the resulting skills and knowledge of individuals as a special type of capital, sharing some basic characteristics of physical capital. This means that knowledge and competence can be accumulated for an individual, similarly to other properties, which are material in nature. Accumulated knowledge then is used for creating economic and non-economic value, generating income for the individual and the overall economy, as well. In principle, the higher the prior accumulated knowledge, the higher the created value per time period *(Mincer, 1994).*

The analogy implied between physical capital and human capital also provides an interpretation for the studying period before the start of working as being the investment period, when economic value is gathered and accumulated, though not created, yet. The useful lifetime of this investment starts at the end of the studying period, when accumulated knowledge produces new economic value through the work of using it. According to the economic model of production, the owner of human capital resource, that is the educated individual will earn the bulk of the income signifying the created new value. Variations of the model can be developed for cases, when education is financed by an organization, therefore the organization will require the ownership rights and income connected to the accumulated human capital, still the basic concept works: the owner of the resource should be entitled to get value produced by the resource as income.

The human capital model has a series of implications on the concept of studying. First, it is important that the investment or studying activity is clearly distinguished from the useful value creating or working activity in the human capital model. In the basic model these activities are separated also in time, as it defines the studying and the working period of an individual's lifetime excluding each other within a given year. Although in principle it is also possible to practice these activities parallel to each other (studying beside working) as it is often mentioned in research work *(Card, 1994),* these possibilities add vagueness to the human capital model, therefore are rarely examined in-depth. From the point of view of further conclusions drawn on the basis of the model, it is important that in most of the cases studying and creating value through working are considered to be different activities, which are not done simultaneously. This is justifiable taking into consideration that few individuals undertake studying beside working. Both activities are time and energy consuming, therefore parallel studies and work either exploit the individuals' resources beyond acceptable limits or reduce quality or amount of value creation and accumulation through the respective activity. As a consequence, studying reduces the time available for working and working full time hinders the further accumulation of knowledge through studying in the model.

The above distinction also implies that studying activity or the investment period means a financial outflow or non-financial costs for the owner of human capital, which stands for the amount invested in this resource. These costs comprise of educational fees and the opportunity cost of time spent by studies together with other, financially non measurable issues, such as the psychological and mental efforts *(Mincer, 1994).* Working or the useful lifetime of human capital on the other hand means income for the owner, which is regarded to be the return of investment.

On the basis of the above concepts it is possible to outline net present value and internal rate of return calculations for the assessment of human capital and according to the human capital model, this is exactly, what is done by individuals and societies, alike. Individuals assess the costs necessary for the achievement of a certain stage of education against the discounted value of a lifetime income expected for the holders of certificates of the above educational stage, and optimize the amount, which should be invested into studying in order to get the highest possible gain out of it *(Mincer, 1994).* Policymakers on the other hand use this model to calculate the value created by higher accumulated amounts of knowledge, as it is expressed in the remuneration of human capital and the optimal level of costs, which should be invested into this resource by the government in order to push up economic performance.

These calculations, however, do not get into an in-depth analysis of the value of studying, they target only to help in decision making in specific situations. To the question of how long it is worth studying, the human capital model gives the framework of decision making in the following way: if the return to education is positive, it is worth studying as far as one can, and the specific further studying decision is always based on non-observed individual factors and the actual financial opportunities of the decision maker. Though this basic decision making rule remains valid as has been observed by a number of studies *(Mincer, 1994; Neumark, Taubman, 1994)*, it is still a question, what level of education will finally be chosen by the majority of people and what level of education they are motivated to reach under the existing circumstances?

In the 1990s labor economists drew the main conclusion on the issue of the impact and value of studying based on previous research of the human capital model. According to this, schooling has an inevitably positive and relatively strong effect on earnings. This view seems to be universal in the studies of the era in spite of admitted measurement problems *(Mincer, 1994; Ashenfelter, 1994; Card, 1994).* The proof of positive effect of education on the individuals' and the nations' incomes are based on wage equations first applied by Becker and later refined by Mincer *(Mincer, 1994).* Wage equations are regressions, where the increase in wages as the income of working human capital is primarily explained by the amount of studying time invested in, controlling for the duration of work experience, which logically also can increase incomes. With the help of a squared item work experience is accounted for as having a diminishing positive impact on earnings, which has been empirically proven.

Weaknesses of wage equation calculations have also been detected, the self-selection problem and the correlation of the explaining variables being the most important of these. The self-selection problem means that observed wage increases may not be due to higher level education as those people are more likely to choose further studies, whose better abilities would ensure higher wages even without undertaking a higher education level. As omitted variables causing self-selection such as abilities are very difficult to assess, this problem often remains untreated.

Correlation between the time period spent in school and the length and amount of working experience is also detected. The longer time one spends studying, the less working experience can be gathered, so the negative relationship between the two explaining factors is inevitable, which may distort the results *(Bosworth, Dawkins, Stromback, 1996; Berndt, 1991).* It has to be remarked here that working after retirement and parallel studying and working may have an impact on the above variables to move them towards independence of each other, however, empirical research found the assumption of their correlation as valid.

Despite the above econometric problems, the results of wage equations research supported a certain optimism about the future demand for more educated workforce and individual decisions made for further studying. The positive estimated figure of the coefficient of the studying time was not questionable and this indicated the positive value of studying. It was therefore taken as a puzzle that in some studies entrance to higher education and even acquisition of high school diplomas lagged behind expectations *(Heckman, Lochner, Todd, 2008).*

In summary, the response to the question of the optimal length of the studying period has been refined and more specific answers were given regarding the desirable stages of education reached. It seemed that it was definitely worth studying at least until getting a secondary school diploma, though in most of the cases it was worth continuing studies until graduation and getting a college degree for a large proportion of the population. According to economic theory it was encouraged to study further by the higher wages offered and there was a perceived increasing demand even for PhD qualifications *(Bousquet, 2008; Ashenfelter, 1994).*

In the 21st century the human capital model has been further elaborated. New econometric models have been introduced in wage equations, such as different instrumental variables *(Yao, Zhang, 2015).* More sophisticated mathematical tools have been applied like structural dynamic programming models and the Markov process *(Heckman, Raut, 2016).*

These further insights show that uncertainty and distortions are in fact bigger than perceived in the 1990-ies in the question of the impact of education on earnings. It cannot be taken as granted any more, that the effect of education on wages is significantly positive at all stages and in all cases of education. As more and more quantitative ambiguities considered as minor earlier, are cleared, the magnitude of the basic positive effect is questioned even on the quantitative basis for some of the educational stages *(Heckman, Lochner, Todd, 2008).* It is also observed that ability based differences in individual wages may be determining over the effect of schooling *(Cesarini, Johannesson, Sandewall, 2013).* However, the positive effect of education on incomes is generally accepted and tested in a series of countries for the average educational rate of return.

As the value of education is not merely an economic question, a challenge of the economic interpretation of results is pronounced from non-economics fields of studies, as well. According to these, not only economics and pecuniary factors matter in the evaluation of the true returns and costs of education both in the decisions of individuals and the society, which may explain the economically puzzling choice of many individuals. Taking into consideration of non-pecuniary factors, the current situation of tertiary education is very disheartening *(Bousquet, 2008).* Even if returns are increasing with higher level qualifications, ex-post psychological costs may be much higher than anticipated at the time of the study decision making. The quality of education is assumed to be in line with later remuneration paid for the educated work, which also may be questioned from a purely academic point of view, even if no other alternative measurement has been invented so far to assess this factor quantitatively.

In summary, it is getting more and more uncertain, that the length of education in itself has any kind of effect at all on later returns. However, research done so far has not been a waste of time and energy. Since pecuniary factors do influence people’s life, it is well worth researching their schooling decisions from a quantifiable economic point of view as well, even if it is very difficult to find adequate quantifiable variables to grasp the essence of the education process.

# 2. The research problem and applied methodology

The aim of this thesis is to give an answer to the question of how long it is worth studying from an economic point of view. According to this general aim more specific estimations are made on the marginal benefits of different detailed educational levels in order to find out differences in the perceived value of educational stages compared to each other. These differences may explain the choice of individuals regarding the length of their study. Earnings equations can help in the estimations, though some aspects of their interpretation have to be considered first.

Earnings equations can be interpreted as the measurement of the worth of education in two ways according to the functions of education within societies. Education as an important service activity contributes to the well-being of people in an indirect way through two basic functions. At first it helps to increase the overall level of knowledge and better understanding thereby facilitating the invention of ever improving solutions for the emerging problems of the society. Secondly, it is to prepare individuals for doing quality job in their tasks received under the division of labor within the society. The operational efficiency of these functions can be approached from an overall economic and an individual, microeconomic point of view, respectively.

Education provides the knowledge and skills to individuals necessary for a high standard work performance. In principle, the higher level the qualification of an employee, the higher the value of contribution to welfare through work. If earnings paid to a worker represent the value created by that worker, the above underlying assumption can be tested through the earnings equations from the point of view of economic performance. In this case the coefficient of schooling years or qualifications represent the increment in created economic value between educational stages.

The other important aspect of interpreting earnings equations as measurements of worth of education is microeconomic, which focuses on the issue, how people are motivated to reach higher level qualifications in material terms, if they are motivated for this at all. Individual earnings represented by the dependent variable of the earnings equation are the means of increasing living standard for the observed individual, therefore serve as premium and motivation for achieving or maintaining a certain level of qualification. Therefore, individuals can be motivated to reach a higher qualification level if the coefficient of qualification levels or schooling years in the regression is significantly positive.

When earnings equations are used for the evaluation of education, an important aspect of interpretation is solving the decision dilemma of further studies. In this case the microeconomic approach is taken to earnings equations. As many researchers have pointed out *(Bosworth, Dawkins, Stromback, 1996)*, decisions on studying further are made by considering the marginal costs and benefits of studies *ex ante*. These characteristics of the decision making point highlight some issues concerning the usability of earnings equations for such situations, though it is hardly arguable that earnings equations are necessary for the numerical estimation of returns to studies.

Proper evaluation of the returns to education requires the examination of costs and marginal costs. The process of education involves a wide range of costs, which significantly differ from the aspect of measurability. Educational fees are the easiest to grasp from these, as directly measurable economic cost. Opportunity costs are also regarded as economic costs, though it is more difficult to estimate them. However, it seems that the highest cost factors are non-economic in nature and rather difficult to measure. Among these the psychological costs of studying should be mentioned at first place, which form part of the effort made during the studies. A good example of psychological costs may be that increasing measurable risks of getting higher earnings after graduating from a certain level of education may contribute to the immeasurable frustration of the graduated as part of their *ex post* psychological costs.

The related literature pays much more attention to the effect of hardly measurable non-pecuniary factors in the case of costs than in the case of benefits *(Heckman, Lochner, Todd, 2008)*. The reason for this is understandable if we consider that studying is always a very time consuming activity, which requires hard and regular non-pecuniary efforts for a long period of time. Only few can afford to invest in such activities purely for non-pecuniary returns, therefore it may be justifiable to assume that most of the people will put a high weight on pecuniary benefits while considering non-pecuniary costs also with high weights. This mechanism in fact is identical with making money through efforts, where financial profits reflect those non-pecuniary costs, which cannot be expressed in money terms.

Based on these assumptions, costs and marginal costs of study are even more difficult to assess than benefits. Although measurable and explicitly material costs like education fees do exist, psychological costs are taken often more seriously when decision is made on studying further. In case of benefits consideration of factors goes into the opposite direction. Higher earnings paid for a higher qualification are very good arguments to undertake further studies, while the enjoyment of studying in itself is not likely to offset costs. On the basis of the above arguments measurable pecuniary benefits like earnings may be decisive when making a decision of further studies over the undoubtedly existing cost factors. Therefore the examination of benefits of education in the form of earnings may be informative even without the examination of costs.

Economic common sense would suggest that for maximization of return marginal benefits should be calculated at the point of decision instead of overall benefits. In the decision made on studying further it does make a difference, how much more the overall return would be in exchange for an additional school year compared to the similarly calculated values at previous educational stages. Ultimately this is the meaning of marginal benefits, regressed on schooling years in order to find out the profitability of additional schooling for the individuals.

Classical wage equations, however, take the overall economic value approach and by including all observations in the regression throughout the different stages of education, calculate a coefficient of schooling, which refers to the whole of the education system and gives an average figure of remuneration for an additional schooling year at any stage of the system. This schooling coefficient is therefore universal for all the educational stages, where further studying decision may be taken. This implies that even if the calculated coefficient is taken as a marginal figure, it is the same amount for all stages. Classical wage equations therefore assume a linear relationship between schooling years and the increase in returns to schooling *(Card, 1994, Heckman, Lochner, Todd, 2008)*. Consequently, this linearity assumption can hinder the explanations of quitting education at a certain point, because it purposefully renders the same average value to every educational stage.

Later studies partially dismissed the overall linearity assumption, because empirical findings did not support it *(Heckman, Lochner, Todd, 2008).* Instead of assuming overall linearity, returns to education were examined between educational stages such as secondary or tertiary education. The educational stages were regarded as one unit and marginal returns were calculated between these units. In this case the calculated coefficient averages out marginal returns within a main educational stage and assumes linearity within the stage.

This methodology of handling the problem by separating main educational stages as larger units can be justifiable when simply income gaps are measured between two qualification levels consisting of more studying years each. Examination of larger educational stages as separate units also puts aside sheepskin effects. The sheepskin effect causes the last year or level of an educational stage to be more remunerated in itself than the previous years spent on the same course of study. This may be due to that the labor market also regards the main educational stages as distinctive units and does not distinguish the studying efforts markedly within the stages.

However, from the point of view of subsequent decision makings on continuing studies, especially in case of choosing higher level degrees, it can be informative to calculate marginal figures for the smallest educational steps possible to take on the basis of available data, as well. The reason for this is twofold. First, decisions regarding further studies are made roughly annually. Even if it is perceived that continuing studies until the next qualification is substantially worthwhile, short run cost factors may cause quitting studies in an earlier year. Secondly, if the linearity assumption does not hold within the larger educational stages, more detailed investigations of the marginal benefits may shed more light on the reasons of educational decisions made.

What is the functional form of the earnings equation regarding schooling at detailed levels? This question investigates in fact the change of marginal benefits induced by additional schooling years at different levels, which can determine the schooling decisions. Based on the calculations of Heckman, Lochner and Todd, partially releasing the linearity assumption, the coefficient of schooling years between different education stages does not seem to be constant. According to their results, marginal returns to education increase faster until the end of the secondary school, though figures are getting lower after the 12th year of education *(Heckman, Lochner, Todd, 2008)*. This implies that the functional form of the earnings equation on the schooling variable is a curve containing an inflexion point and concave in the region of longer studying periods. If this is the case, then continuing studies after the inflexion point may be less worthy depending on the actual costs of studies.

The aforementioned concavity of the function of earnings equation in the region of longer studying time periods can be verified by estimating schooling coefficients for separated earnings equations. The schooling coefficients also can stand for marginal benefits between two detailed levels of education. In both forms they provide information on the value of acquiring a certain qualification level.

If different educational levels are measured separately, it is possible to detect local changes in the steepness of the functional form. In this case only those observations are included in one regression, which represent two neighboring levels of studies, therefore it is possible to calculate the increment in earnings between those specific levels. The higher the coefficient of schooling in these equations with smaller number of observations, the better the examined level of education is remunerated compared to other levels.

Estimated schooling coefficients as marginal benefits compared to each other sequentially may reflect on the additional worth of studying for one more year or for one higher qualification at the point of decision. Since more general estimations done so far have calculated with data included from a wider range of educational levels resulted in average coefficients, they cannot be regarded as true estimations of marginal benefits and do not reflect the situation of a potential further studying individual at the decision making point properly. Due to the above discrepancy it is possible that more general estimations show higher values of further studying than that perceived by decision makers.

Due to that a longer studying period means a shorter active working period for getting the lifetime return holding the assumption of proven correlation between schooling years and working experience, the marginal benefits of an additional schooling year have always been supposed to be lower than the coefficient of schooling years *(Bosworth, Dawkins, Stromback, 1996; Heckman, Lochner, Todd, 2008)*. However, values calculated for educational stages prior to 12 years of study are not likely to be overestimated, because people normally do not start working before achieving this stage and their working period with returns to education will not be shorter by taking an additional school year at these points. This characteristic therefore may have an impact only on the comparison of coefficients estimated below 12 years of study and above 12 years of study, as shortening working period can be anticipated to start after this stage is achieved. However, the above issue affects the values of subsequent coefficients and the steepness of the functional form between tertiary educational levels in the same proportion, therefore comparison of different levels at this stage is not affected.

From the point of view of decisions made for studying further, conclusions can be different for the stages with different steepness of functional form of the earnings equation. If the increase in benefits measured by the estimated parameter of schooling years in the earnings equation is high between two levels of education, then the increase in earnings may compensate the shorter period of return in a way that encourages the bulk of the population to finish the referred stage of education. When the coefficient of schooling years in earnings equations starts to decrease, a drop can be expected in the number of students, who decide to continue studies further.

As it was pointed out, in spite of that the overall economic value and microeconomic approaches may examine technically identical earnings equations, their implications and insight often include differences. When measuring the economic value of education, data from a wide range of educational stages are used to estimate average values as coefficients of schooling years. In case of supporting individual decisions, however, marginal returns to education are more appropriate to calculate which need data from a more narrow range of educational stages. Due to these differences conclusions drawn on the worth of education may also differ from the points of view of the two approaches.

Average schooling coefficients and the overall economic value approach may conclude that education is worthwhile at every stage and level, while marginal returns to education show that certain steps within the educational structure are not worth taking. When the increment in costs is high between two stages, the deviation of marginal benefits from average benefits may cause negative returns locally. In these cases individual decision makers can decide on quitting further studies even if it seems worthwhile to hold on for subsequent years when returns to education turn into positive again.

It also has to be remarked that the coefficient of the schooling variable in a cross-section earnings equation estimates the average increase in incomes measured between two educational levels, not the discounted value of a life time income flow. This distortion in the estimation, however, is not likely to significantly influence the result of the comparison of two subsequent educational stages, as higher values remain still higher after discounting. Comparison of cross section average increase rates instead of discounted income flows increments results in more accentuated differences in earnings increase rates than exists in reality, though this does not alter the validity of conclusions drawn on the basis of simpler average calculations.

In this thesis the classical Mincerian equation is used for the estimation of schooling coefficients for the reason of simplicity, the data reflect only the benefit side and costs of education are taken into consideration only in the interpretation of results. Extensions of research are made by including newer data of 2010 and calculating the slope of the earnings function between more detailed stages of education compared to the previous studies (e.g. between Bachelor's and Master's degrees). The analysis is more detailed for the levels of tertiary education, which is done in order to find out the extent of consistency between the actual functional roles these qualifications play in society and their traditionally conceived or intended functions.

In the earnings equations applied in this thesis total income observed for an individual is logarithmized, which is the dependent variable. Independent variables are schooling years calculated on the basis of a detailed observation scheme of accomplished levels of education and working experience calculated from the observed individual’s age. The square of the working experience variable is also included in the regression equation, which stands for the empirically proved concave form of the earnings function on working experience.

Regression estimations are made on 2000 and 2010 micro data of the US male population. For the data used for the above mentioned detailed earnings equations I rely on samples of micro data obtained from the US decennial census of 2000 and 2010 *(US Decennial Census by IPUMS, 2010)*, where information is available on the level of acquired qualification and wages for the surveyed individuals. Acquired qualification levels are described in a detailed way in the database, they are broken down to years and qualifications separately, therefore both schooling years and qualification levels variables are possible to generate from them.

The basic question of how long it is worth studying can be answered by finding those detailed educational levels which are remunerated with the highest marginal benefits in the form of the increase in earnings compared to the previous qualification levels. In the determination of returns to education pecuniary benefits play an important role, which are analyzed in this thesis. The method of estimation of marginal benefits is through the schooling year coefficient of earnings equations, which are regressed on microdata obtained from the 2000 and 2010 Census of the United States.

## 3. Education structure in the United States

Detailed analysis of the relationship between obtained qualifications and incomes requires information on the structure of education in the United States. The structural chart presented here gives the framework of the detailed calculations following in the next chapter.

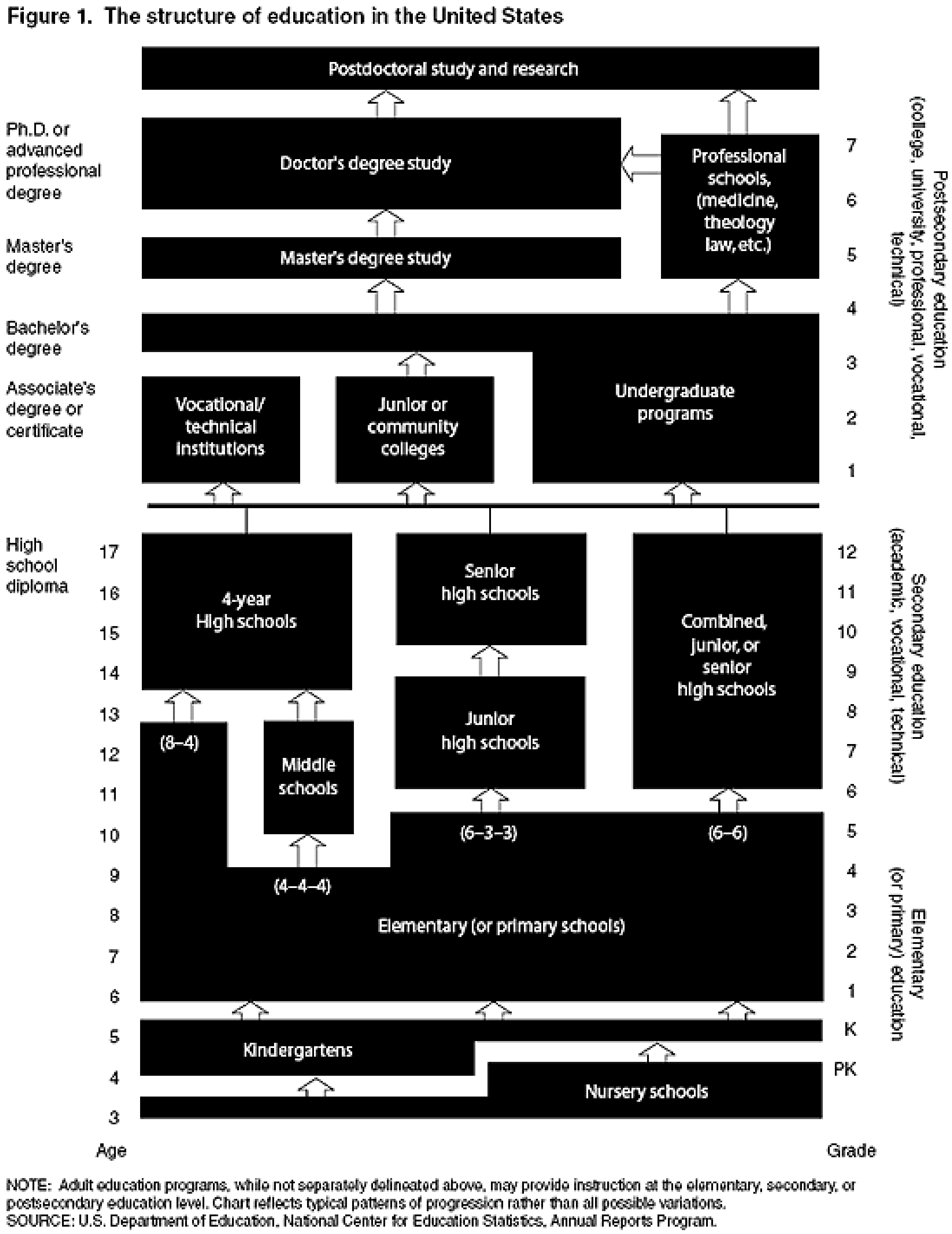


**Figure 1: The structure of education in the United States**

Source: U.S. Department of education. National Center for Education Statistics

Similarly to many other education structures, the education structure of the United States includes three main horizons which can be regarded as milestones in the educational development of all individuals.

The first horizon is the entry point of the education system, where formal school education begins usually at the age of 6. Although some variations in the starting age can be present as many children start school only at the age of 7, this difference is not likely to introduce serious distortions into the following analysis. Individuals, who leave nursery schools and kindergartens and do not enter schools can be regarded as completing zero years of education, while counting the number of years spent in education starts here for those, who enter elementary schools.

The second horizon is after 12 years of education along with the attainment of the high school diploma associated in many aspects with reaching maturity. The stages between the first and second horizons are called elementary and secondary education. Earlier years at these stages are part of elementary education, however the transition into secondary education can take place at various points. The first four years in elementary education are normally spent in primary schools having similar functions within the system. From Grade 5 or Grade 6 individuals can choose from four different paths to acquire a high school diploma. It is possible to start high school after Grade 6, in these cases high schools guide their students through Grade 7 to Grade 12 and provide a high school diploma. This encompasses six schooling years in the high school, which may be divided into twice three years. Another path means four years in the high school, while the years through Grade 5 to Grade 8 can be accomplished either in the elementary school or in a separate middle school.

Organizational principles of institutions within these stages are similar, as education for these cohorts is provided free by public schools. Although private institutions (in non-profit, parochial or for-profit forms) also exist, most of the students are educated in public schools.

They normally do not work, learning is their main social occupation and task. If tuition costs occur, it is paid by their adult family members along with their living costs.

After the attainment of the high school diploma, post-secondary or tertiary education, often simply called higher education starts. From this point on, characteristics of education change as students are regarded as adult individuals with full responsibility for their financial, working and educational decisions. Above this horizon education is normally not free, even public institutions require tuition fees. This is well in line with that individuals mostly start an independent life and found their own household after high school, therefore seek for own income sources and bear the financial burden of their own education. One aspect of this change, however, does not seem to be properly approached in the system at this point, namely that young adults cannot make sufficient effort to acquire financial means and educational achievement at the same time. If they consider further studies at all, they have to take into consideration the new element of education costs in their decision. These costs also include living costs and opportunity costs, not only the tuition costs, all of which emerge as new factors to consider compared to the decision situations before the high school diploma stage.

It cannot be surprising therefore, that many young adults decide to skip some years before entering tertiary education in order to collect financial funds or try working and studying simultaneously, doing each part time. In spite of finance opportunities by student loans, most of the young adults find alternative career paths to continuous studying at least temporarily, therefore they can not be regarded as traditional students *(Choy, 2002).*

Once decision on continuing studies in tertiary education has been made, students have different opportunities to proceed. Although all the stages within the category of tertiary education can be grouped together because of their similarities in organization, peculiarities of different types of programs, the existence of a further horizon still makes it possible to detail the education structure within higher education.

The third horizon of the education structure lies within tertiary education and signifies the attainment of a Bachelor's degree. It is possible to opt for a Bachelor's degree directly or pursuing an Associate's degree first, perhaps obtaining vocational qualification certificates. However, if studies are to be continued at even higher stages, the stage of Bachelor's degree is indispensable. The flexibility of the system with built-in opportunities of vocational training is remarkable and it is also important to mention at this point that Associate's degrees or vocational certificates may have the advantage of providing practical knowledge, which is in high demand among employers. Though these training opportunities require additional efforts from students, the possible value attached to them by employers may well worth the troubles.

After acquiring a Bachelor's degree many graduates choose to enter the workforce and finishes studies. Those, who still continue studying have different opportunities again to obtain higher level degrees. The most important paths are the academic path and the professional degree path. Academic path means a further two year studying period for a Master's degree then it is possible to take another step and pursue a doctoral degree. Professional degree programs provide first professional degrees and it is possible to start them after the Bachelor's level has been reached or with a Master's degree. Professional degrees regarded to be specialized in certain fields of study and mostly attached to professional communities organized by occupations, therefore they include practical elements, as well. The highest stages of education are doctoral and post-doctoral programs. Doctoral studies can be started with Master's degrees or professional degrees.

The three main horizons in the educational system of the United States help in distinguishing main educational stages. Detailed educational levels can be examined within these stages. Educational levels are formed according to years spent with studies.

# 4. Interpretation of calculation results

## 4.1 The coefficient of schooling years between different stages of study

According to the methodology followed in this thesis, in order to investigate the exact form of the earnings function on years of education, the simple Mincerian wage equation was calculated between various stages of education, as data availability allowed it. The applied earnings equation was the following:

$$ln\ y = \beta_0 + \beta_1 S + \beta_2 X + \beta_3 X^2 + \upsilon$$

where *ln y* is the logarithm of personal income, S is the number of completed schooling years calculated from the reported finished grades of the individuals, X is the years of working experience calculated from the individuals' age by deducting schooling years and another six years allowing for pre-school period, $X^2$ is the square of the number of years of working experience, $\beta_0$ is the estimated constant parameter, $\beta_1$, is the estimated coefficient of interest, $\beta_2$ and $\beta_3$ are estimated coefficients of control variables and $\upsilon$ is an error term.

The regression was estimated on large cross-section type samples taken from the US Census of 2000 and 2010. Due to the large size of the samples only the data of male individuals were examined, all the following calculations refer to the characteristics of males only. Micro data used in the regression were weighted back by personal weights in the calculation in order to represent the respective portion of individuals within the population. Obtained data went through the following adjustments to make them suitable for the regression:

1. Individuals with zero or negative total income were dropped. This adjustment was necessary because of the logarithm form of the dependent variable derived from total income. Zero or negative incomes cannot be transformed to make them suitable for

logarithmization without serious distortions of the results, therefore the smaller scale distortion of the sample was chosen.

2. The variable of interest, the number of schooling years (S) was calculated from the detailed information of school grades completed and qualifications obtained by individuals.
3. The control variable, the length of working experience (X) was calculated basically through the following formula:

$$X = Age - S - 6$$

The principle behind this calculation is that individuals start working after their studies have been completed. It is generally assumed that the entry to the education system takes place at the age of six, therefore years spent working equals the person's age minus schooling and pre-school years. Two further adjustments were necessary to this basic calculation, one for those, who leave school before starting work and another for those, who finish their schools at a younger age than it is generally assumed. Individuals with a low number of schooling years may quit studies before their age of 15. Since work-age is generally considered to be above 15, I assumed that these individuals had not started to gather working experience earlier than this age and modified the calculation of their working experience as

$$X = Age - 15$$

In case of those individuals, who finish their schools at an earlier age than assumed by the basic calculation, the length of working experience may result in a negative number. This usually can happen with young individuals and the absolute value of the negative number is usually not higher than 1. However, as negative working experience cannot be interpreted, in this cases X was changed to zero.

First, the earnings equation was estimated for all the education stages which gives the well-known average earnings increase for one additional schooling year irrespective of the completed length of education. The estimation of this rate does not distinguish the different educational stages, therefore it allows only a very superficial evaluation of the worth of study in general. Second, the earnings equation was estimated for the different stages of education separately, which highlights the differences in the schooling year coefficient and shows those figures, which the average consists of.

Since the classification of reported completed education was slightly different in 2000 and 2010, not all of the detailed stages are possible to compare directly. In order to find out the form of the function, first I examine the 2000 and 2001 data separately, then I make a comparison at those levels, where it is possible.

### *4.1.1 In year 2000*

#### *4.1.1.1 General comparison between the main stages of study in 2000*

The overall average calculated for the male population of the US in an earnings equation in 2000 shows that an additional school year resulted in a 15% increase in total incomes controlled for work experience, which is in line with previous research *(Heckman, Lochner, Todd, 2008).* Breakdown of this figure according to schooling years and educational stages, however, show substantial differences.



| | $\beta_1$ | St. err. | t | $R^2$ | Sample size |
|---|---|---|---|---|---|
| All stages | 0.1506 | (0.0001) | 1021.83 | 0.2462 | 7,313,840 |
| At least Grade 1 completed | 0.167 | (0.0002) | 1045.02 | 0.2527 | 7,259,295 |
| At least Grade 9 completed | 0.1776 | (0.0002) | 997.18 | 0.2455 | 6,898,340 |
| Entered tertiary education | 0.1495 | (0.0002) | 634.18 | 0.1975 | 3,892,081 |

**Table 1**

**Schooling year coefficients calculated with different ranges of education stages, 2000**

Excluding those individuals from the regression, who did not participate in formal education, the estimated increase of wages for an additional school year throughout the education system rises to 17 %. Further restricting the range of examination to secondary and tertiary education, the coefficient rises to almost 18%. Considering only tertiary education wage increase given for an additional school year sets back slightly below the overall average increase of 15%. These results roughly show that studying is remunerated with faster growing wages in the secondary education than within tertiary education.

#### *4.1.1.2 Detailed comparison of earnings increases for one additional studying year at different stages in 2000*

Results of regressions made at the most detailed stages of education possible on the basis of the database show the wage increases awarded for small additional studying steps made by individuals in the education system. In these calculations only the observations of two neighboring educational levels are included in one regression, where the educational levels are represented by the number of schooling years completed. However, between 12 years completed and high school diploma acquired there is not additional effort put into the next level expressed in schooling years, therefore in this regression a dummy variable was used instead of schooling years. Regression made for the entry to tertiary education also uses a dummy variable as variable of interest, because the difference between the acquisition of the high school diploma and the completion of some college time under one year is less than one year of studies. Regression calculating the coefficient of schooling between 12 and 13 years of study estimates the average increase in earnings between finishing of 12 years without a high school diploma and the completion of the first year in tertiary education.

The coefficients of schooling years for detailed stages of education are shown in Table 2.

| | $\beta_1$ | St. err. | t | $R^2$ | Sample size |
|---|---|---|---|---|---|
| Between 0 years and Grade 5 | 0.0166 | (0.0014) | 11.69 | 0.0172 | 91,549 |
| Between Grade 5 and Grade 7 | 0.0592 | (0.0031) | 19.42 | 0.0776 | 195,434 |
| Between Grade 7 Grade 9 | - 0.0058 | (0.0021) | -2.73 | 0.2483 | 323,951 |
| Between Grade 7 through Grade 10 | 0.0342 | (0.0013) | 26.2 | 0.2936 | 599,897 |
| Between Grade 9 and Grade 10 | 0.1342 | (0.0037) | 36.47 | 0.3293 | 441,467 |
| Between Grade 10 and Grade 11 | 0.1289 | (0.0031) | 42.11 | 0.3082 | 565,817 |
| Between Grade 11 and Grade 12 | 0.2548 | (0.0032) | 79.07 | 0.2532 | 520,273 |
| Between Grade 12 and high school diploma | 0.2629 | (0.0022) | 120.61 | 0.0885 | 2,440,442 |
| Entry to tertiary education | 0.0964 | (0.0014) | 66.59 | 0.0981 | 2,807,691 |
| Finishing the year 1 in tertiary education | 0.0818 | (0.0016) | 50.52 | 0.1939 | 1,751,450 |
| Between 12 and 13 years of study | 0.1748 | (0.0011) | 158.56 | 0.1312 | 4,191,892 |

**Table 2**

**Schooling year coefficients calculated for detailed education stages until Grade 12 in 2000**

Completed stages of education were not reported by every schooling year under Grade 8 in 2000, therefore only three stages were distinguishable in this range: the completion of the first four elementary grades, the completion of 6 years of elementary school and the completion of 8 years of elementary school. The coefficients of schooling years between these stages are statistically significant, however their absolute value is small and the correlation of the data is also weak. There were very few individuals surveyed in these categories of schooling and the change in incomes is very small, as well. The only relatively strong estimation at this detailed level shows that between Grades 7 or 8 and Grade 9, that is between the elementary and secondary level of education there is virtually no increase in later wages. It is therefore all the same from the point of view of incomes, whether an individual starts high school or not after the completion of elementary education.

Secondary education on the other hand produced much more substantial results. Here every additional school year resulted in a high wage increase, all of the estimates were statistically significant and the explaining power of the applied model was also fairly high. It is visible from the data that the highest increase in incomes, 25% was provided for the completion of the last year, that is for the step between 11 years and 12 years of education with a further increase for actually getting secondary qualification.

This latter effect is often called the sheepskin effect in the literature *(Heckman, Lochner, Todd, 2008; Wood, 2009),* and signifies the importance of a certificate of studies in line with or as opposed to the amount of time invested in studying. According to this effect the certificates themselves often can yield substantially higher wages and salaries than the same achievement in studying years which is not certified by an official document. Similarly, the last educational year of a studying program is empirically found to be more productive in terms of later incomes than the previous years. Taking into account the sheepskin effect it is not surprising that the increase in incomes becomes lower between two detailed levels of study when entry to the next main stage takes place compared to the previous step between the last but one and last year of studies of the preceding stage.

The wage increase associated with the entry into tertiary education can be characterized generally by the estimation of the wage increase between the 12 and 13 years of study through the different stages of the process using detailed information available from the applied data base. The first level of these is the accomplishment of Grade 12 in secondary education, which is an additional year of study and effort, though does not necessarily provide a certificate. The second step is receiving the secondary qualification certificate, which does not add to the acquired knowledge if the latter is measured in time, still needs effort and is remunerated in later incomes. The third stage is the actual entry to tertiary education by starting college or university. However, the number of studying years does not increase only with admission to higher education. Finally, the true start of tertiary education is if a freshman accomplishes the first year in college and therefore years spent by studying increases to 13.

Measuring the coefficients of the schooling years variables in wage equations restricted to the schooling years of 12 and 13 in 2000 the following can be concluded:

- The average wage increase taking into account all of those, who completed 12 years and those, who completed 13 years of study is 17%. This figure implies that it was worth indeed starting higher education in 2000, since the associated wage increase was quite probably higher than the overall average increase calculated for all stages of education.
- However, the number of those, who finished 12 years of education contains those individuals, who did not get their certificate of secondary qualification at that time. Since their wages would be probably lower than that of others in this group, the increase between the two years of study is certainly not surprising. Measuring the wage difference between those who finished Grade 12 without a certificate and those obtained the certificate, it is visible that individuals with a secondary education certificate would earn 26% more than similar individuals without a certificate.
- The wage difference between those, who start a college or university and those, who finish studying with a secondary qualification shows that entry to tertiary education in itself is remunerated by only a roughly 10% wage increase.
- Finally finishing the first year of higher education compared to starting it yielded an estimated wage increase of 8% in 2000.
- Summarizing the above figures it can be concluded that the most considerable part of wage increase between secondary and tertiary education was paid for getting the high

school diploma and not the additional studying effort in time in 2000, as it is also described in the literature *(Wood, 2009).*

Within tertiary education studying years are mostly not reported separately from the level of degrees obtained, therefore sheepskin effects cannot be traced. The only exception is the first year in tertiary education, where high attrition rates makes reporting the accomplishment of the first year statistically meaningful. In the proceeding years the difference between subsequent levels of degrees is generally only two years and within this period completed stages are not reported. Taking into consideration the above characteristics comparison of schooling years coefficients can be interpreted as income differentials provided for the accomplishment of an additional level of education and distinction between the studying effort in time and obtaining the degrees is not necessary. On the basis of the above features the following levels can be distinguished within tertiary education:

1. Individuals, who enter tertiary education, but do not finish the first year accomplish 12 years of study.
2. Completion of the first college year means 13 years of study overall.
3. Obtaining an Associate's degree takes normally two years at a college, therefore this certificate is associated with 14 years of study.
4. Bachelor's degree is mostly programmed to last four years, therefore it is best described with 16 years of study.
5. Master's degrees mean an additional two years to the Bachelor's level, therefore are obtainable with 18 years of study.
6. Professional degrees are possible to acquire after Bachelor's level has been completed and require a longer period of studying than academic Master's, therefore this type of qualification is associated with 19 years of study.

7. The highest educational level reported in the data base is the doctoral or PhD degree, which is set at three years after Master's degree, therefore constituting 21 years of study altogether.

In addition to the definition of studying stages it is a unique feature of tertiary education within the education system that in some cases different degrees can be substitutes to each other, as one level is not always required for starting another one. Allowing this, different stages can be compared not only sequentially, but also directly, omitting not required stages between them. According to these opportunities the following comparisons were made:

a) Between Stage 1 and Stage 2 it is measured how well it is remunerated if at least the first year of studies had been finished at college. In this case a degree had not been obtained at the end.
b) Between Stage 2 and Stage 3 the increase of incomes is estimated which was given for an Associate's degree compared to only one year of study in higher education.
c) Between stages 3 and 4 the value of Bachelor's degree is measured compared to the Associate's degree expressed as an average increase in incomes. In this step two years of study is involved.
d) Between Stages 4 and 5 earnings paid for a Master's degree is compared to earnings paid for a Bachelor's degree. Here the difference in studying period is also two years.
e) Professional degrees are possible to pursue after the accomplishment of the Bachelor's level, therefore Stage 4 and Stage 6 can be directly compared. The result of this regression, omitting the stage of the Master's degree shows, how much it is worth continuing studies after a Bachelor's degree for a professional degree.
f) Between Stage 5 and Stage 6 Master's degrees and professional degrees are compared. These degrees are not necessarily follow each other, many students with a Bachelor's

degree have to decide, which path to follow. Respective coefficients of schooling years in the earnings equation can provide information on the attainable remuneration.

g) Between Stage 5 and Stage 7 the earnings increase between Master's and doctoral levels is measured. This regression shows how well it is worth continuing studies on a PhD path from Master's level.

h) Finally a comparison is made between Stage 6 and Stage 7, where professional degrees and doctoral degrees are compared from the point of view of incomes.

| | $\beta_1$ | St. err. | t | $R^2$ | Sample size |
|---|---|---|---|---|---|
| Finishing the year 1 in tertiary education | 0.0818 | (0.0016) | 50.52 | 0.1939 | 1,751,450 |
| Between 13 years and Associate's degree | 0.1534 | (0.0017) | 88.34 | 0.1719 | 1,634,376 |
| Between Associate's and Bachelor's degree | 0.1777 | (0.0009) | 201.95 | 0.0761 | 1,562,960 |
| Between Bachelor's and Master's degree | 0.097 | (0.0009) | 102.83 | 0.0607 | 1,480,518 |
| Between Bachelor's and Professional degree | 0.2221 | (0.0010) | 211.67 | 0.0827 | 1,206,352 |
| Between Master's and Professional degree | 0.4746 | (0.0033) | 143.28 | 0.0595 | 522,104 |
| Between Master's and Doctoral degree | 0.0869 | (0.0014) | 61.76 | 0.0414 | 453,702 |
| Between Professional and Doctoral degree | - 0.1305 | (0.0029) | - 45.69 | 0.0559 | 179,536 |

**Table 3**

**Schooling year coefficients calculated for detailed education stages in tertiary education in 2000**

In 2000 the remuneration of a Bachelor's degree was high from the part of employers. The 15% increase in earnings between one completed year and the Associate's degree is slightly higher in itself than the overall average coefficient, though in this case sheepskin effect may push the figure up compared to the value in reality. Between the Associate's degree and the Bachelor's degree, however, sheepskin effect is not present, therefore the full 18% increase in incomes can be attributed to the difference in the appreciation of the two types of degrees. This implies that acquiring a Bachelor's degree was well worth on the basis of 2000 cross-sectional data.

At higher stages of education the explaining power of the conventional earnings function is low while the statistical significance of the estimated coefficients of schooling years is very high. From these it is possible to conclude that income differences according to the resulted values do exist, even if the variations in incomes can be high within the group of people with a specific degree level.

At the Bachelor's level students who want to continue studies may choose between pursuing a Master's degree or trying to get a professional degree. Since Master's is not required for starting a professional degree program, the earnings equation can be applied here to compare the worth of the professional degree path to the Master's path. Individuals with a Master's degree earned almost 10% more than those with Bachelor's degrees in 2000, while professional degree holders earned 22% higher incomes compared to Bachelor's. Direct comparison between the Master's stage (Stage 5) and the professional degree stage (Stage 6) shows that a professional degree holder earned 47% higher salaries in average than a Master's degree holder similar in age and working experience. Comparison to the doctoral stage (Stage 7) also reinforces the high value placed on professional degrees by employers, as further studying at the doctoral level yielded a lower than 9% increase in earnings, while direct comparison of professional degree holders and PhD qualifications shows that incomes for a PhD were substantially lower than incomes for professional degrees. Considering the longer studying time needed for acquiring a PhD compared to a professional degree, it is clear that PhD courses did not worth to take in pecuniary terms if individuals had the opportunity to pursue a professional degree instead in 2000.

### *4.1.2 In year 2010*

*4.1.2.1 General comparison between the main stages of study in 2010*

2010 data consist of a smaller sample compared to the 2000 data, still the number of individuals included may be high enough to draw similarly relevant conclusions that in the case of 2000.

The overall average increase in wages for an additional finished school year was approximately 17% in 2010, a 2% points increase from the previous decade. This can be interpreted that generally the worth of studying measured by the increase in incomes provided for higher qualifications further increased in the beginning of the 21st century.

| | $\beta_1$ | St. err. | t | $R^2$ | Sample size |
|---|---|---|---|---|---|
| All stages | 0.1666 | (0.0003) | 495.81 | 0.2628 | 1,595,177 |
| At least Grade 1 completed | 0.1844 | (0.0004) | 510.76 | 0.2707 | 1,585,720 |
| At least Grade 9 completed | 0.194 | (0.0004) | 499.44 | 0.2695 | 1,544,028 |
| Entered tertiary education | 0.1737 | (0.0005) | 344.3 | 0.2289 | 982,341 |

**Table 4**

**Schooling year coefficients calculated with different ranges of education stages, 2010**



The break down of regressions according to the main stages of education shows a similar pattern to that of 2000, though the coefficients are higher. Without the number of individuals with zero schooling years the worth of an additional year was up to 18% and further increased to 19% if elementary education was disregarded. However, between educational levels within tertiary education, the value of the coefficient sets back to the average 17%, while the value for tertiary education as one unit is above the overall average.

*4.1.2.2 Detailed comparison of earnings increases for one additional studying year at different stages in 2010*

| | $\beta_1$ | St. err. | t | $R^2$ | Sample size |
|---|---|---|---|---|---|
| Between 0 years and Grade 5 | 0.002 | (0.0052) | 0.4 | 0.0234 | 12,434 |
| Between Grade 5 and Grade 7 | - 0.0178 | (0.0145) | -1.23 | 0.0184 | 7,459 |
| Between Grade 7 Grade 9 | - 0.009 | (0.0090) | -1.00 | 0.2070 | 36,118 |
| Between Grade 7 through Grade 10 | 0.0000 | (0.0049) | 0 | 0.2997 | 73,430 |
| Between Grade 9 and Grade 10 | 0.0157 | (0.0108) | 1.46 | 0.329 | 56,238 |
| Between Grade 10 and Grade 11 | 0.1134 | (0.0083) | 13.7 | 0.3505 | 85,733 |
| Between Grade 11 and Grade 12 | 0.2498 | (0.0098) | 25.55 | 0.331 | 70,829 |
| Between Grade 12 and high school diploma | 0.2805 | (0.0073) | 38.33 | 0.1282 | 475,954 |
| Entry to tertiary education | 0.0856 | (0.0034) | 25.18 | 0.1481 | 580,159 |
| Finishing the year 1 in tertiary education | 0.1038 | (0.0038) | 27.23 | 0.2333 | 390,863 |
| Between 12 and 13 years of study | 0.1787 | (0.0025) | 72.3 | 0.1776 | 866,817 |

**Table 5**

**Schooling year coefficients calculated for detailed education stages until Grade 12 in 2010**

Results of regressions calculated for detailed educational levels are shown in Table 5. The stages within the main stages discussed earlier do not necessarily mean here a change in schools or studying programs, they can merely represent a further year of studying.

In the 2010 data stages of elementary and secondary education was much more detailed than in 2000 and the applied categories were also different. Due to these differences comparison opportunities between the two years are very limited. Another problem is here, that especially at the elementary level, the number of individuals included in the sample is very low, therefore some of the estimated regressions did not produce statistically significant results.

The only conclusion, which may be drawn upon the results is that there were not significant differences in the wages of those individuals who dropped out of school at the various stages of elementary education. The regression estimating wage increase on a relatively large sample between Grade 7 and Grade 10, including the switch from elementary education to secondary education effectively produced a very near to zero coefficient with a 0.3 $R^2$ value reinforcing the above conclusion up to Grade 10.

At the secondary level of education the pattern of wage increases between educational stages was similar again to that of 2000. Significant increase in later wage returns occur from Grade 10, a year later than in 2000. The estimated wage increase between Grades 10 and 11 is 11% jumping to 25 % for the completion of the last year of secondary education. These figures are slightly lower than the figures of 2000, though mainly can be interpreted as unchanged.

Coefficients estimating wage increases between the stages of transition into tertiary education show similar tendencies in 2010 as in 2000. The estimated average increase in earnings was 28% for the attainment of the secondary qualification certificate alone, while remuneration of the enter to tertiary education was a much lower wage increase of less than 9%. For the completion of the first year of tertiary education in addition to starting it the increase in incomes estimated to be 10%, a little higher than that for admission only. In 2010 it was visible that far the highest increase in incomes was paid for the high school diploma rather than long lasting studying effort. The emphasis on this stage of the process was even more accentuated than ten years before as the wage increase given for it was by 2 % points higher, while almost in all the other cases the values of the coefficient were slightly lower than in 2000. Apart from obtaining the high school diploma or its equivalent only the completion of the first year at college paid better in 2010 than in 2000 among the achievements of this period of learning. In summary the average increase in earnings between the completion of 12 and 13 years of study was 18% in 2010, only a slight increase compared to 2000.

As seen before at the general comparison of the increase in earnings of the main stages of the educational system in 2010, payments for highly educated individuals increased more in 2010 than in 2000. This signifies that the esteem of higher education in the eye of employers has increased. The average value of the schooling coefficient considering all kinds of tertiary education achievements became higher than the average value calculated for the overall educational system which also indicates that the acquisition of a degree is getting more worthwhile. Within tertiary education rates of return calculated by the coefficients of the earnings equation between educational levels were usually higher in 2010 than ten years before and the figures showed again a similar pattern to the values of 2000.

| | $\beta_1$ | St. err. | t | $R^2$ | Sample size |
|---|---|---|---|---|---|
| Finishing the year 1 in tertiary education | 0.1038 | (0.0038) | 27.23 | 0.2333 | 390,863 |
| Between 13 years and Associate's degree | 0.2121 | (0.0037) | 57.49 | 0.2064 | 395,415 |
| Between Associate's and Bachelor's degree | 0.1754 | (0.0018) | 98.74 | 0.0876 | 422,139 |
| Between Bachelor's and Master's degree | 0.1292 | (0.0019) | 69.75 | 0.0781 | 412,587 |
| Between Bachelor's and Professional degree | 0.2801 | (0.0023) | 122.34 | 0.1034 | 321,690 |
| Between Master's and Professional degree | 0.5682 | (0.0067) | 85.3 | 0.0691 | 152,329 |
| Between Master's and Doctoral degree | 0.1036 | (0.0027) | 38.81 | 0.0473 | 138,623 |
| Between Professional and Doctoral degree | - 0.1345 | (0.0054) | - 25.08 | 0.0452 | 47,726 |

**Table 6**

**Schooling year coefficients calculated for detailed education stages in tertiary education in 2010**

Increase in earnings for an Associate's degree compared to one finished academic year in 2010 was 21%, a statistically significant result with a relatively high explaining power. This figure means a 6% points increase compared to the 2000 value and probably is one of the main reasons of higher income increases detected among participants in tertiary education in 2010. The earnings premium paid for a Bachelor's degree compared to the Associate's degree was below 18%, virtually unchanged from the figure of 2000. Regarding that Associate's degrees were much higher valued in 2010 than in 2000, Bachelor's degrees also paid much better compared to secondary qualifications in 2010 than in 2000.

Appreciation of tertiary education in 2010 is also visible at the highest levels of education. A Master's degree meant an average of 13% increase in income compared to the Bachelor's level in that year, up by 3% points from 2000. PhD qualifications also paid better than Master's by 10%, which is approximately a 1% point increase compared to 2000. However, professional degrees compared to the academic path provided an even more significant increase in earnings in 2010 than in 2000. The income increase given for a professional degree compared to Bachelor's level was 28%, 6% points higher than in 2000. The comparison of the worth of the professional degree path and the Master's path also resulted 57% in favor of the professional degrees, a 10% points increase to 2000. In line with these estimations the comparison of the worth of a professional degree and a PhD gave the result of still 13% lower average payments in the case of PhDs.



Summarizing the above figures the main conclusions of the 2010 analysis are the following:

- Remuneration of higher education generally increased compared to 2000.
- Within higher education primarily Associate's and professional degrees were appreciated, while academic paths of study lagged behind the growth in esteem of professional degrees despite providing increasing earnings.

## 4.2 Concavity of earnings in schooling years

Based on previous research and the above calculations it does not seem to be justifiable to assume that schooling years have a linear relationship with the increase in earnings in the earnings equation. It is more likely that marginal benefits are lower when the studying period is longer, therefore the functional form of increase in earnings plotted on schooling years would show concavity. This concavity of the increase of earnings in schooling years can be investigated through a regression, which does not assume linearity between the increase in incomes and the variable of interest that is the schooling years. The hypothesis in this case is that increase in incomes shows a concave quadratic function of schooling years instead of linearity. This hypothesis may be tested if conventional earnings equations estimating a linear coefficient for schooling years are compared to regressions containing a quadratic variable of schooling years in addition to the linear variable of interest. The specification of the hypothetical equation is the following :

$$ln\, y = \beta_0 + \beta_1 S + \beta_2 S^2 + \beta_3 X + \beta_4 X^2 + \upsilon$$

If the explaining power of the equation containing the quadratic term is higher than that of the conventional equation and the estimated parameter of the quadratic term of schooling years is negative, than concavity in the functional form can be reinforced. However, concavity may be true only for certain periods of study and may be not the case at other stages. It is therefore useful to test the hypothesis on different ranges of the database, which can provide a more detailed picture of the relationship.

In order to test this hypothesis of concavity through the above method I made calculations for different ranges of educational stages both for the years of 2000 and 2010. The investigated ranges of educational levels were the following:

1. overall average calculations for all individuals in the sample ranging from those without any formal education to doctoral degree holders
2. calculation of coefficients only for those individuals, who entered the education system and completed at least one year of study there
3. calculation of coefficients for secondary and tertiary education only
4. calculation of coefficients within tertiary education

The results of calculations are summarized in Table 7 for the year of 2000 and Table 8 for the year of 2010.

| | **$\beta_{1,2}$** | **St. err.** | **t** | **$R^2$** | **Sample size** |
|---|---|---|---|---|---|
| **All stages** | | | | | |
| Linear coefficient | 0.1506 | (0.0001) | 1021.83 | 0.2462 | 7,313,840 |
| Linear component in quadratic assumption | 0.0264 | (0.0006) | 44.08 | 0.2509 | |
| Quadratic coefficient | 0.005 | (0.0000) | 214.33 | | |
| **At least Grade 1 completed** | | | | | |
| Linear coefficient | 0.167 | (0.0002) | 1045.02 | 0.2527 | 7,259,295 |
| Linear component in quadratic assumption | 0.1618 | (0.0011) | 151.78 | 0.2527 | |
| Quadratic coefficient | 0.0002 | (0.0000) | 4.99 | | |
| **At least Grade 9 completed** | | | | | |
| Linear coefficient | 0.1776 | (0.0002) | 997.18 | 0.2455 | 6,898,340 |
| Linear component in quadratic assumption | 0.5874 | (0.0018) | 322.39 | 0.2511 | |
| Quadratic coefficient | -0.0144 | (0.0001) | -225.98 | | |
| **Entered tertiary education** | | | | | |
| Linear coefficient | 0.1495 | (0.0002) | 634.18 | 0.1975 | 3,892,081 |
| Linear component in quadratic assumption | 0.4163 | (0.0023) | 181.41 | 0.2003 | |
| Quadratic coefficient | -0.009 | (0.0001) | -116.88 | | |

**Table 7**

**Comparison of schooling year coefficients between linear and quadratic assumed function form calculated with different ranges of education stages, 2000**

According to the result of calculations, quadratic terms were positive in 2000 when all observations were included in the estimation and became negative if only those individuals were included, who studied at least 9 years. Although the coefficients of the quadratic term are low, they are statistically significant. The explaining power is acceptable in all estimations and is slightly higher with the quadratic term than that of the respective traditional earnings equation in three cases out of the four.

| | $\beta_{1,2}$ | St. err. | t | $R^2$ | Sample size |
|---|---|---|---|---|---|
| **All stages** | | | | | |
| Linear coefficient | 0.1666 | (0.0003) | 495.81 | 0.2628 | 1,595,177 |
| Linear component in quadratic assumption | 0.0207 | (0.0015) | 14.28 | 0.2677 | |
| Quadratic coefficient | 0.0057 | (0.0001) | 103.21 | | |
| **At least Grade 1 completed** | | | | | |
| Linear coefficient | 0.1844 | (0.0004) | 510.76 | 0.2707 | 1,585,720 |
| Linear component in quadratic assumption | 0.1977 | (0.0026) | 76.18 | 0.2707 | |
| Quadratic coefficient | -0.0005 | (0.0001) | -5.18 | | |
| **At least Grade 9 completed** | | | | | |
| Linear coefficient | 0.194 | (0.0004) | 499.44 | 0.2695 | 1,544,028 |
| Linear component in quadratic assumption | 0.5961 | (0.0040) | 148.18 | 0.2742 | |
| Quadratic coefficient | -0.0139 | (0.0001) | -100.42 | | |
| **Entered tertiary education** | | | | | |
| Linear coefficient | 0.1737 | (0.0005) | 344.3 | 0.2289 | 982,341 |
| Linear component in quadratic assumption | 0.4844 | (0.0049) | 98.47 | 0.2321 | |
| Quadratic coefficient | -0.0104 | (0.0002) | -63.5 | | |

**Table 8**

**Comparison of schooling year coefficients between linear and quadratic assumed function form calculated with different ranges of education stages, 2010**

In 2010 the coefficients of the quadratic term were again positive including all observations, while became negative excluding those individuals from the examination who did not have any formal education. Results were statistically significant, the explaining power was better than in 2000 and the regressions with the quadratic term fitted slightly better the data than the linear estimation.

Summarizing the findings of data from the two census years it can be concluded that the explaining power of regressions was almost always higher in cases of including the quadratic term of schooling years compared to conventional earnings equations. The exceptions were in the 2nd range in both years. A slightly unexpected result was that the estimated coefficient of the quadratic term of schooling years was positive considering the overall average of individuals. This means that empirical data show an increasing rise in incomes as the studying period lengthens in these cases. In the data range of the 3rd and 4th cases, however, concavity was reinforced and gave a better explanation of the dataset.

The interpretation of these results can be that the increase in earnings is normally very low at the lower stages of education and starts increasing only at a relatively later stage. After this stage however, the increase in incomes slows down again, forming a functional curve, which is convex in the beginning, then becomes concave after an inflexion point. Assumption of linearity, however, can be accepted and give equally good estimations if the inflexion point is near to the arithmetic middle of the data range investigated.

These findings are in line with those derived from the calculations of the coefficients of detailed educational levels. Inflexion points are around the 12 years of study, where the increase in remuneration of one additional schooling year is the highest due to the highly respected high school diplomas. Wage increases are getting steeper below this point in length of studying time, as there was virtually no difference between the wages of school dropouts from the different levels at the elementary stage. Above the inflexion point the growth rate of earnings starts to decrease, as tertiary degrees mostly mean a lower increase in earnings than high school diplomas.

In summary, the estimation of a linear relationship between the marginal benefits and schooling years is justifiable if the whole range of educational stages is observed, however, concavity and a decrease in the income growth rate is inevitable with longer studying time.

## 5. Evaluation of results

This thesis calculated the coefficients of schooling years in earnings equations estimated between neighboring detailed educational levels. The aim is to shed light on the true functional form of income growth regressed on schooling years representing efforts put into studying as an investment into human capital. With the help of this detailed information I hope to contribute to answering the question of how long it is worth studying under the remuneration patterns documented by the microdata applied.

Limitations of the research include that only the benefit side of the return to study was analyzed in detail, though costs also play an important role in the decision question put forward. For a more clear answer to the research question cost analysis would also be desirable, even if relevant conclusions can be drawn on the basis of the analysis of the benefit side, as well. Data used for calculations consist of samples drawn from the male population of the United States due to size limitations. Further research could be done on female samples and other countries if data is available. Conclusions drawn on the basis of regressions have to be regarded together with the limitations common with this type of calculations. The self-selection problem is associated with omitted variables, which may be numerous in the case of a simple regression such as applied here. Correlation between the independent variables of schooling years and working experience also may be an issue, though results probably would be worse without the inclusion of working experience into the regression. Functional forms are still far from being sufficiently detected. Working experience can be applied as quartic variable in order to obtain better resulted *(Card, 1994).* The variable of schooling years was examined in this thesis assuming either a linear or quadratic relationship between schooling years and the growth in earnings. Other functional forms also may be detected in future research.

Under the limitations described above and according to the detailed calculations of schooling coefficients of earnings equations at different educational levels, it can be concluded that the high school diploma has the highest value of marginal benefits among all levels. Professional degrees also have high values of marginal benefits, similarly to high school diplomas. Other levels of education have lower figures of marginal benefits showing a decreasing tendency towards higher education.

However, from the aspect of evaluating higher education, it is generally true that the increase in incomes paid for tertiary education degrees is less than in the case of the high school diploma. The high school diploma in fact has the highest coefficient among all levels of education. This figure is even more accentuated taking into consideration that the highest increment in wages was calculated for getting the high school diploma itself without any additional studying time effort. This means to a certain extent that it still may be worth getting a secondary school diploma for the majority of the people and the labor market does have a demand and expectation for reaching this level of qualification.

Apart from the high motivation for acquiring secondary qualification, data also show that the remuneration of a Bachelor's degree is also fairly high. Considering that the percentage increase of income calculated by the earnings equations will be slightly diminishing with longer studying periods due to the fact that the increase starts from a higher value, the calculated marginal benefits for a Bachelor's degree could be regarded just as motivating as the remuneration of high school diplomas regarding benefits only. However, it has to be mentioned here that shortened return periods start to occur at this stage and costs of study can be assumed to jump steeply compared to the previous educational stage. If it is considered at this level that tertiary education does involve a considerable element of pecuniary costs while secondary education is mostly subsidized and targeted to reach everyone as a kind of public service, the concavity of real returns between these two stages may be huge. Therefore, coefficients nearly as high as in the case of high school diplomas may indicate a considerable drop in the marginal returns between Bachelor's degrees and high school diplomas compared to the value between high school diplomas and previous levels.

Despite that the earnings paid for the graduate workforce are higher than those paid to individuals with high school diplomas, this increment is probably sufficient to motivate only the more determined individuals for further studies. Increased costs as a consequence of the cease in subsidies creates a motivation system at this stage which may seriously reduce the number of students studying further. This may be intentional if policy makers do not want to raise the general qualification level of the population into the realms of tertiary education.

It has to be remarked here that counter selection problems, when present, may overrun the anticipated effect of self-selection in completing degree studies. Self-selection distorts estimations on the one hand, while still may have positive implications on value creating on the other hand by selecting those individuals for higher qualifications and longer studying periods who are most able to do the job. Counter selection, however, means similar distortions to estimations due to the non-random nature of selecting students for further studies meanwhile having a negative effect on value creation by providing further studying opportunities on the basis of financial or family background rather than that of abilities.

In the case of higher level degrees the coefficient of the Master's degree is even lower than the coefficient of the Bachelor's degree. This shows a serious decrease in motivation for acquiring the Master's level of qualification. Even if a remarkable improvement is visible in the 2010 data compared to 2000, the acquisition of a Master's degree is not motivated well, to say the least.

However, this does not mean that further studies are generally getting discouraged at the higher stages of education. Professional degrees are getting more and more encouraged as alternatives to Master's degrees, since incomes paid to an individual holding a professional degree are substantially higher than the incomes of Master's degree holders. It is likely indeed that previous estimates proving the positive worth of continuing studies in tertiary education generally derived their optimistic conclusion due to the inclusion of professional degree holders into the calculation. On the professional degree path the rise in income can be high enough to compensate the varied and considerable amount of costs associated with these programs. In fact, students are economically motivated to continue studies until a professional degree is obtained once they started higher education, which also indicates a marked increase in demand for professional degree holders in the labor market.

The evaluation of the results of estimations made for the doctoral stage of studies is difficult because the low number of occurrence compared to other stages makes the overall explaining power of regressions rather low. However, in spite of the uncertainty in these calculations, the values of resulted schooling coefficients are informative to a certain extent. Increase in incomes between a Master's degree and a PhD is positive, though the value of growth is the lowest measured within tertiary education. This indicates that continuing studies to this high level is not motivated on pecuniary grounds and this opportunity is provided for those who do have devotion towards their profession.

The relative underpayment of doctoral degrees is more clearly revealed when doctoral studies are compared to professional degrees. Although PhD degrees are considered higher level qualifications than professional degrees, the income of professional degree holders is higher in average than the income of PhD holders. This surprising outcome may be caused by the fact that professional degrees are available only in better paid professional fields, still it implies that professional degrees and the studying path towards professional degrees are more respected in the labor market than the so called academic path of studies through Master's and PhD degrees.

On the basis of Heckman, Lochner and Todd's 2008 paper, the coefficient of schooling years measured in higher education is expected to be lower than the same coefficient measured in secondary education on an average basis throughout the more detailed levels of education *(Heckman-Lochner-Todd, 2008).* Although costs, which may be the main reason for the decreasing rate of increase in returns, were not analyzed in this thesis, it is important to examine whether the concavity of returns graphed on schooling may be seen on the benefit side of returns alone.

Data used in this research show that the assumption of the concavity of earnings on education stages can be reinforced on the basis of calculations, although it is true only for the comparison of the higher main stages of education. Analyzing the earnings schooling year by schooling year, the pattern is varying and a universally concave form cannot be traced. One of the main reasons behind this is that the highest increase in earnings mostly occur at the end of the different studying programs. This characteristic is most visible in the case of high school diplomas, where the last year of studies and simply the attainment of the certificate independently from studied years earn much higher incomes than previous levels. Considering this finding, it is uncertain whether a university year of study or a secondary school year raises incomes more.

The functional form of the remuneration of work graphed as a function of schooling years is shown in Figures 2 and 3. Figure 2 shows data for 2000 with 2a panel for the academic path and 2b panel for the professional degree path, while Figure 3 shows data for 2010 with 3a panel for the academic path and 3b panel for the professional degree path.

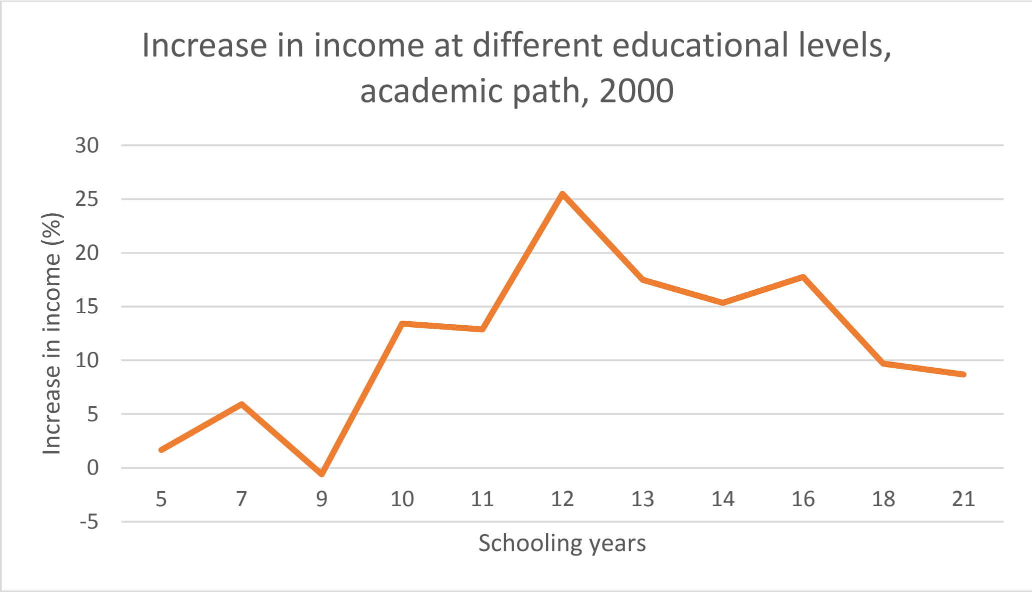


**Figure 2a**

**Increase in income at different educational levels, academic path, 2000**

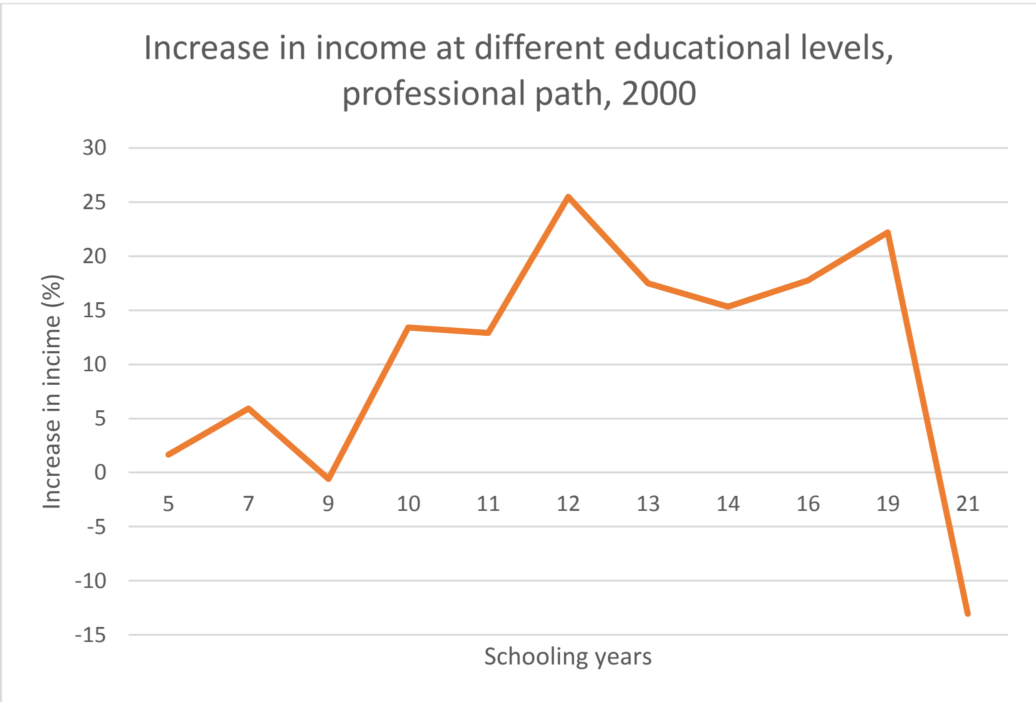


**Figure 2b**

**Increase in income at different educational levels, professional path, 2000**

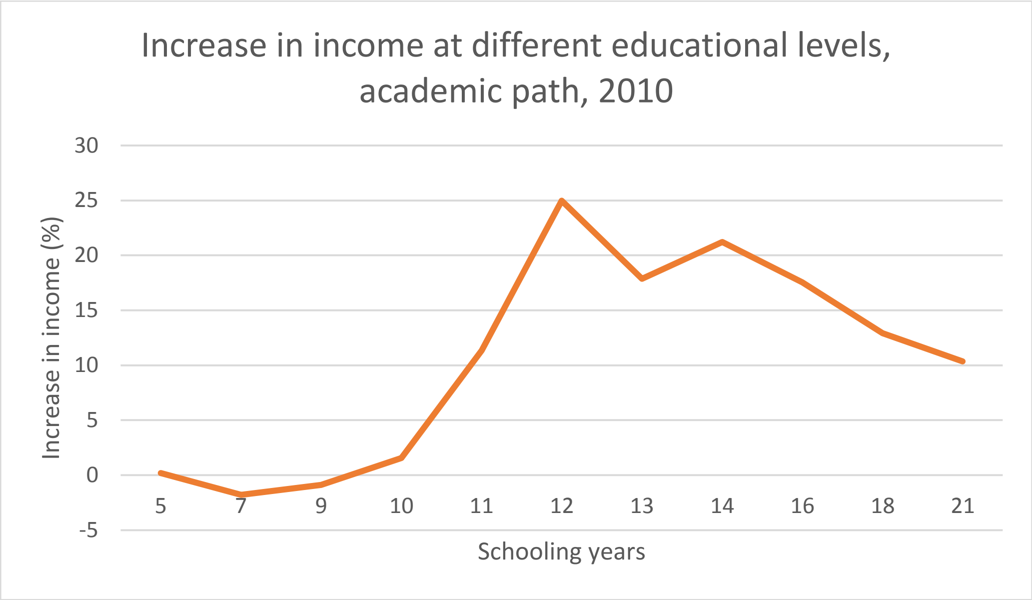


**Figure 3a**

**Increase in income at different educational levels, academic path, 2010**

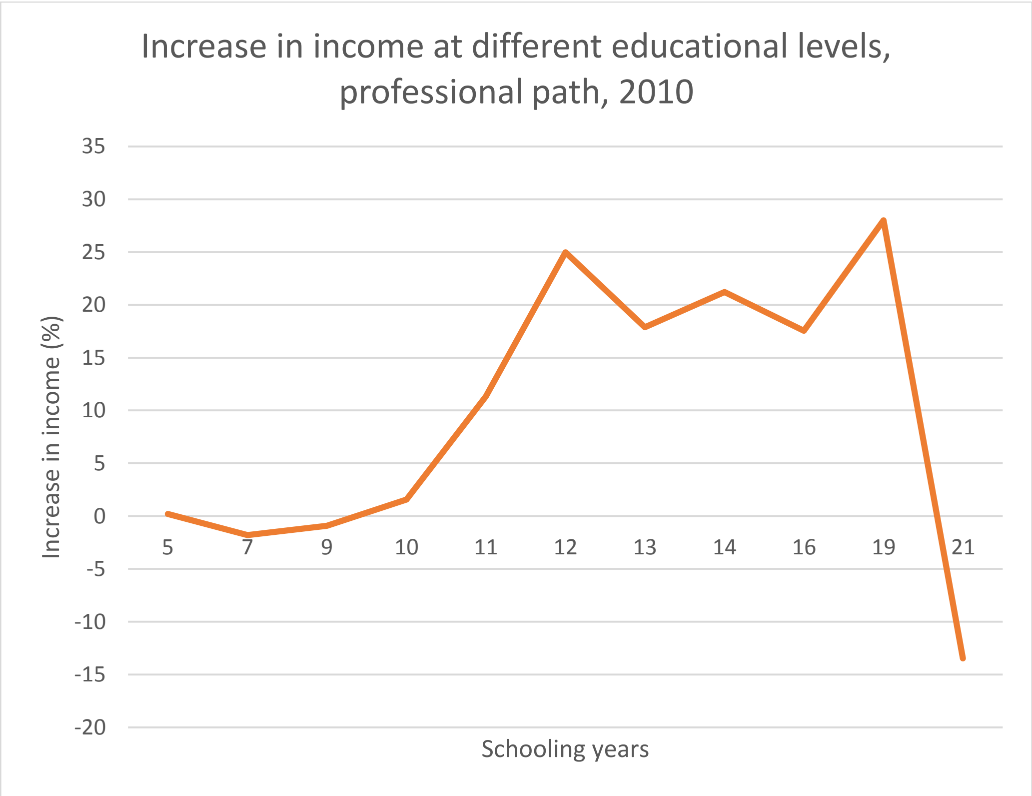


**Figure 3b**

**Increase in income at different educational levels, professional path, 2010**

The functions of Figures 2 and 3 represent the first differential functions of the earnings function calculated on schooling years. Their form means that increase in earnings is the steepest where the graphed functions have a maximum point. If the graphed function goes to the negative quarter, it means that the earnings function slopes downwards. The average linear figure calculated by classical wage equations would be a horizontal line in each of the above graphs. The form of these functions reinforces that earnings functions have a marked inflexion point at the schooling period of 12 years and become concave afterwards.

This result can be interesting from the point of view that educational decision making situations just like education itself profoundly change between the secondary and the tertiary stage, right at the point where remuneration trends change, too. This is the point in life when students reach adulthood, often start a life independent from their parents and take full responsibility of their financial issues. The function of education changes at this period of life, as a lot of the young people start working for making a living and continuing studies becomes much more an option, too often not a feasible option, rather than a requirement, as it was before.

The evaluation of education by the labor market in accordance with the form of the earnings function reflects a social attitude towards education, which not only motivates, but almost requires individuals to acquire a high school diploma. Within tertiary education, however, motivation for further education weakens except for those who can continue studies with relatively less effort compared to the average. This attitude is well in line with the changes in the life of individuals, however, it makes necessary for research and motivation systems to apply a different approach at this stage. Models and tools developed for the evaluation of education from an economic point of view can be applied, while more detailed calculations and the inclusion of new variables may be needed.

The basic human capital model, which was created in the 1950s and went through a number of interpretations and different applications throughout the years, can still be regarded as valid. Uncertainties pinpointed in the last fifteen years may help in better fitting the model to the realities, but it remains a useful framework for further research. Although most of the inquiries done so far investigated pecuniary factors only, the human capital model itself does not exclude non-pecuniary factors from research, even though it is difficult to find proper variables to grasp them. More elaborate insights into earnings equations and the human capital model can provide a better understanding of the nature and motivating force of labor demand, being either increasing or decreasing for the different levels of qualifications. However, earnings equations and calculations based upon them do not tell everything about the evaluation of education from the point of view of individual decisions and economic value creation.

Education does have a considerable and increasing economic value generally, if this value is measured by the increase in income paid for more educated individuals compared to those holding lower level qualifications. However, data on the amount of marginal benefits between the detailed educational levels show that there are big differences between the remuneration of these levels and the dynamics of increase in earnings is far from being linear. The most worthwhile qualification is the high school diploma, but professional degrees and to a certain extent Bachelor's degrees are also well paid by the labor market of the United States. Taking into consideration, however, that educational costs are likely to jump after the high school it is likely that for the big majority of people the optimal educational level to obtain is the high school diploma. Tertiary education is worthwhile only for those individuals, who have special commitments towards a profession or have abilities above the average.

## Conclusion

When answering the question of how long it is worth studying for individuals the human capital model and earnings equations are still valuable tools. Costs of education can be regarded as long term investments both by the decision making individuals and the society, as well. Returns to education is determined in a great part by the benefits paid in the forms of income received for later work.

Based on the calculations of marginal benefits of detailed educational levels, it seems very likely that the high school diploma and 12 years of study is the option which is most worth of efforts for the great majority of the population in the United States. Continuing studies for a degree in tertiary education is far less motivated, though it is definitely lucrative to go for a professional degree once an individual entered university. However, professional degrees are not issued in every professional field, therefore this high profitability may be the sign of the respect of these professions rather than the remuneration of higher level studies.

The above conclusions were drawn under a series of limitations. First of all, conclusions were made on marginal benefits only, the consideration of marginal costs require different methods and data. Although conclusions are valid even on the basis of the examination of marginal benefits only, the analysis of costs would make information gained more punctual. Eliminating uncertainties requires further expansion of research onto different samples and also on costs of education. Different non quantitative cost factors can play very important roles in this type of calculations, which problems were only mentioned, but not addressed in this thesis.

People may put the stronger emphasis on non-economical issues in their decisions concerning education, which is apparent when those studying paths are chosen which do not yield a satisfactory pecuniary return. In this case earnings equations in themselves do not have much to tell without incorporating non-observed factors properly in the model. As decisions and value creating in higher education are widely based on non-pecuniary factors, strictly interpreted economic management of universities or individual studies may not be reasonable without limits. However, throwing away all the findings based on the human capital model just because certain important factors were omitted from research would not lead to efficient management either. The most important task in the research of the human capital model and the earnings equations may therefore be the incorporation of non-pecuniary factors into the equations.

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